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Grindstone River Dam Removal

Draft Environmental Impact Statement

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Cover Image

Grindstone Dam

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ACRONYMS

AMA	Aquatic Management Area
BMP	Best Management Practice
CPE	Cumulative potential effects
CSW	Construction stormwater
DNR	(Minnesota) Department of Natural Resources
DSDD	Draft Scoping Decision Document
EAW	Environmental Assessment Worksheet
EIS	Environmental Impact Statement
EQB	Environmental Quality Board
FEMA	Federal Emergency Management Association
FSDD	Final Scoping Decision Document
H&H	Hydrology and Hydraulics
HEC-RAS	Hydrologic Engineering Center River Analysis System
LIDAR	Light Detection and Ranging
MEPA	Minnesota Environmental Policy Act
MPCA	Minnesota Pollution Control Agency
MWI	Minnesota Well Index
NPDES/SDS	National Pollution Discharge Elimination System/State Disposal System
OHWL	Ordinary high water level
RGU	Responsible Governmental Unit
SEIS	Supplemental Environmental Impact Statement
SEAW	Scoping Environmental Assessment Worksheet
SRV	Soil Reference Value
SQT	Sediment Quality Target
TEP	Technical Evaluation Panel
TMDL	Total Maximum Daily Load
USACE	U.S. Army Corps of Engineers

USGS	United States Geological Survey
WCA	Wetland Conservation Act
WOTUS	Water of the United States
WRAPS	Watershed Restoration and Protection Strategies

DEFINITIONS FOR TERMS AS USED IN THIS ENVIRONMENTAL IMPACT STATEMENT

Abutment: Concrete walls constructed on each side of the dam spillway that hold back the soil of the dam embankment.

Aquatic management area (AMA): AMAs are established to protect, develop, and manage lakes, rivers, streams, and adjacent wetlands and lands that are critical for fish and other aquatic life, for water quality, and for their intrinsic biological value, public fishing, or other compatible outdoor recreational uses. Parcels designated as 'general use' allow for angling, hunting, trapping, non-motorized travel and wildlife observation.

Bankfull stage: The flow at which the channel fills the banks and just begins to overflow onto the floodplain.

Dewater: To drain water from a waterbody or watercourse.

Drawdown: The lowering of the surface elevation of a water body.

Embankment: A mound or earthen material, typically created from placement and compaction of soil, sand, clay and/or rock, that from a barrier to water seepage and act as a containment berm.

Floodplain: Any land area susceptible to being inundated by flood waters from any source.

Flowage easement: An area of private property where the government or other entity has the right to overflow, flood, or submerge the land.

Headcutting: The process of a stream to create an erosional feature where an abrupt vertical drop occurs, which typically resembles a very short cliff or bluff. If left to natural processes, the headcut would likely migrate upstream.

Hydraulic roller: A hydraulic phenomenon known as the "drowning machine" that creates a recirculating current of rolling water capable of trapping a person at the downstream face of a dam. A hydraulic roller repeatedly takes a person to the bottom of the stream, releases them to the surface, sucks them back toward the dam, and pushes them back to the bottom.

Karst: A type of landscape where the dissolving of the bedrock has created sinkholes, sinking streams, caves, springs, and other characteristic features.

Ordinary High Water Level (OHWL): The highest water level that has been maintained for a sufficient period of time to leave evidence on the landscape, commonly the point where natural vegetation changes from predominantly aquatic to predominantly terrestrial**.**

Overburden: Overburden is any unconsolidated material above bedrock. In the area of the Grindstone River Dam, the overburden is primarily glacial sediment.

Prestressed beam bridge: A bridge constructed from concrete beams that have tension applied prior to construction.

Public Waters: The lakes, wetlands, rivers and streams that meet the criteria set forth in Minnesota Statutes 2021, Section 103G.005.

Riparian rights: Property rights related to owning shoreland. They include the right to wharf out to a navigable depth; to take water for domestic and agricultural purposes; to use land added by accretion or exposed by reliction; to take ice; to fish, boat, hunt, swim; to such other uses as water bodies are normally put. The riparian owner has the right to make use of the lake over its entire surface.

Sheetpiling: A sheet of interlocking steel driven into the ground to reduce seepage through the soil.

Sluicegate: A structure used to control water flow from a dam that consists of a valve or gate.

Toe wood-sod mat: A stream restoration practice for repair of cutbanks or construction of a bankfull bench. The upper bank is excavated or filled in depending on site conditions to create the bankfull bench. The bench consists of a bottom layer of logs, root wads, branches, brush, roots, and soil as fill. The fill is covered with a layer of live cuttings then with a top layer of sod mats and transplants set at bankfull stage.

Unionid: Freshwater mussels in the family Unionidae common to lakes, streams, and rivers. Unionids are bivalved mussels, meaning they have two shells attached at the hinge by an elastic ligament.

Spillway: A structure that provides safe release of surplus waters from a dam to a downstream area.

Thalweg: The line defining the lowest elevation within a watercourse.

Voided slab: A precast and prestressed concrete slab typically used for bridge, building, marine, and fish passage replacement applications.

EXECUTIVE SUMMARY

Introduction

The Minnesota Department of Natural Resources (DNR) section of Fisheries is proposing to remove the dam on the Grindstone River within the city of Hinckley, in Pine County, Minnesota. This would restore connectivity of the river channel and permanently remove the Grindstone Reservoir, a 26.6-acre public water basin within the state-owned Hinckley Aquatic Management Area (AMA). The proposed project is needed to address public safety concerns from the dam due to instability issues and inability to pass floods. The proposed project is also needed to allow for passage of fish and other aquatic wildlife and restore natural stream features, natural sediment transport, and habitat diversity within this section of the Grindstone River.

The purpose of the proposed project is to:

1. Address public safety concerns around dam instability, inability to pass floods, and the threat of dam failure.
2. Address public safety concerns by eliminating the hydraulic roller and reducing the threat of drowning.
3. Minimize impacts from flooding by providing a larger floodplain (i.e. restore the reservoir to a naturally functioning stream with a connected floodplain).
4. Restore fish and aquatic life connectivity to the Grindstone River system.
5. Increase pool and riffle habitat.
6. Improve hydrologic function of the Grindstone River by restoring more natural sediment and nutrient transport.

An Environmental Impact Statement (EIS) is mandatory for this project pursuant to Minnesota Rules 4410.2000, subpart 2. The Grindstone Reservoir has been identified as a public waters basin. Once the dam is removed, the public water basin will no longer exist as a basin. Minnesota Rules 4410.4400, subpart 20, identifies that projects that will eliminate a public water or public waters wetland require preparation of an EIS.

The scope of the EIS was developed from March through December 2020 and included a scoping environmental assessment worksheet (SEAW), a draft scoping decision document (DSDD), a public meeting and comment period, and a final scoping decision document (FSDD). The FSDD identified topics which would be assessed in the EIS including project alternatives, topics with potential effects, and studies required to assess effects.

Alternatives included in the EIS scope consisted of the no action alternative (leave the dam in place) and one modified design consisting of a partially engineered restoration. Seven topics with potential effects were identified to be assessed within the EIS and include:

- Wetland impacts
- Hydrological effects
- Sediment and contaminants
- Plant communities, wildlife, fish, and sensitive ecological resources
- Geology – karst
- Groundwater – private wells
- Public waters and riparian rights

Proposed Project and Alternatives Description

The proposed project includes the removal of the Grindstone River Dam (Grindstone Dam) along with floodplain grading and construction of a series of riffles with associated erosion control methods such as toe wood-sod mat for bank protection and reestablishment of the riparian zone. The area of impact includes the 26.6-acre Grindstone Reservoir, which would be permanently eliminated, the area immediately surrounding the dam, access routes for construction equipment, and downstream areas that may receive sediment.

Implementation of the proposed project would include (in sequential order): 1) drawdown of the reservoir, 2) consolidation of sediments, 3) dam removal and 4) floodplain grading and construction of riffles and associated erosion control methods. As the reservoir nears the end of drawdown and the floodplain establishes from exposed sediment, the river channel would reconfigure with pattern, dimension, and profile based on the underlying substrate and historic meander patterns. Typically, the thalweg (deepest portion of the channel) would end up in the deepest part of the reservoir, most likely the historic channel itself. The new channel may laterally migrate small distances during this time as the channel stabilizes and vegetation establishes. Once the drawdown is complete and the spillway removed, the remaining components of the dam would be demolished and removed from the site. Water would continue to run through the site and work would occur during low flow conditions. The earthen embankments would be excavated and graded using heavy equipment. The riffles would be installed following site preparation to stabilize sediments, allow for passage of flood flows, and to maintain continuity with the floodplain.

The alternatives included in the draft EIS are the no action alternative (leave the dam in place) and one modified design consisting of a partially engineered restoration. The no action alternative includes keeping the dam in place with ongoing maintenance, possible major repairs due to its poor condition, and the possibility of dam failure. The public safety risk from drowning and falls would remain. The biological and hydrological impacts of the dam would also still exist.

The partially engineered alternative includes all aspects of the proposed project with the addition of excavating a meander at a targeted location. Demolition of the dam, drawdown of the reservoir and installation of the riffles would be done in the same manner as described above for the proposed project. Staging areas for the partially engineered alternative would be the same as the proposed project with an additional staging area located within the old reservoir bed; the exact site location would be determined during contract design. Additional access routes would typically run along the shore of the former reservoir edge as it is likely rock and would need less time for sediments to consolidate.

Affected Environment: Wetland Impacts

Wetlands are located adjacent to much of the Grindstone Reservoir and the Grindstone River upstream of the reservoir. A total of 13 wetlands were delineated, totaling 51.2 acres and comprising a mix of Type 1 (Floodplain Forest), Type 2 (Fresh Wet Meadow/Sedge Meadow), and Type 6 (Alder Thicket) wetlands.

Affected Environment: Hydrological Effects

The Grindstone River is within the St. Croix River Basin and is a tributary of the Kettle River. The Grindstone Dam is located downstream of the junction of the North Branch and South Branch Grindstone Rivers. The watershed area that drains to the Grindstone Dam is approximately 76.7 square miles, and consists of primarily agricultural and rural land uses. The Grindstone Reservoir is located immediately upstream of the Grindstone Dam and is impounded at the dam elevation of approximately 1,019 feet above mean sea level. Upstream of the reservoir, the North and South Branch Grindstone Rivers are widened due to the slow flow caused by the impoundment. Downstream of the dam are multiple bridge crossings and a steeper river slope with some sinuosity that results in a faster moving river at a lower elevation.

Removal of the Grindstone Dam would open approximately 25.7 miles of public watercourse upstream of the dam as free-flowing (including the North Branch, South Branch, and an unnamed tributary to the South Branch). The Grindstone Dam is located within a Federal Emergency Management Association (FEMA) Zone A floodplain area.

Affected Environment: Sediment and Contaminants

The area affected by the proposed project includes not only the approximately 26 acres where sediment has accumulated behind the Grindstone dam, but also the receiving waters downstream that would receive legacy sediment mobilized as a consequence of the dam removal. Sediment cores were sampled to investigate the composition of the legacy sediment that will potentially mobilize. Six cores were taken from the thalweg of the north branch and main body of the reservoir, and one core was taken from the smaller south branch. The seven sediment samples were analyzed for a host of possible toxins: metals and metalloids (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc, chromium III, and chromium VI), organics (PAHs and PCBs), and biotically active components (phosphorus, nitrogen species, and total organic carbon). All concentrations were below level 1 Soil Reference Values (SRVs), where SRVs have been established, except for arsenic.

Arsenic exceeded all SRVs in the uppermost sediment in four of the seven cores, placing these sediments in the level 3 SRV category. These concentrations suggest that if channel material is excavated from (or exposed at) these sites, then the resulting dredged material is not acceptable for deposition in either residential/recreational or commercial/industrial settings. However, such arsenic concentrations may be natural in aquatic sediments. Statewide data suggests that most aquatic sediment in Minnesota exceeds level 2 SRVs and would be unsuitable for human exposure. In contrast, the risk to aquatic life is modest.

Affected Environment: Plant Communities, Wildlife, Fish, and Sensitive Ecological Resources

Currently, three plant communities are present at the AMA and include upland hardwood forest, wooded wetlands, and shallow lake. Numerous wildlife species are adapted to the plant communities of the AMA, including several species of greatest conservation need.

Although the forest is relatively narrow in width and contains a significant amount of edge habitat, it likely provides habitat structure that benefits a wide variety of wildlife. The forest is contiguous along the narrow corridor adjacent to much of the Grindstone River, both upstream and downstream of the dam. This corridor provides local connectivity within a landscape fragmented by the City of Hinckley, roads, and agricultural land use. Shallow lakes are considered important habitat for many wildlife species, particularly as breeding areas for waterfowl, shorebirds, and herpetofauna. The abundant aquatic vegetation within the impoundment serves as food and habitat for zooplankton, insects, fish, waterfowl, and other wildlife.

The fish assemblage of the Grindstone River consists of warm water and cool water species. The lowest diversity of fish species occurred within the reservoir and upstream in the north and south forks of the Grindstone River. In contrast, the fish community near the mouth had more species, a greater number of species intolerant of pollution, and a higher percentage of species that require clean, coarse substrates to spawn, indicating high quality habitat. Species diversity near the mouth of the river is likely enhanced due to the proximity and connectivity to the Kettle River, which has a high number of fish species. There have been 45 native fish species documented in the Grindstone River system; 34 species documented in the river downstream of the dam, 15 species documented in the reservoir, and 25 species documented in the north and/or south forks of the river upstream of the reservoir.

A query of the Minnesota Natural Heritage Information System was completed and found several rare animal species near the proposed project including mussels, Blanding’s turtle, and mudpuppy. Lake sturgeon, a state-listed species of special concern have also been reported in the Grindstone River.

A freshwater mussel survey was conducted by the DNR, Center for Mollusk Programs in September 2020 to determine the distribution and species composition of mussels within the reservoir and downstream of the dam. Only common species were collected in the reservoir. Downstream of the dam, unionids were absent within approximately 70 meters of the dam. Seven species were collected from 70 meters down of the dam to Old Highway 61, including four species state-listed as threatened in Minnesota. A previous study also identified two state-listed special concern species downstream of the Grindstone Dam.

According to the DNR Natural Heritage Information System (NHIS) review letter, Blanding’s turtles (*Emydoidea blandingii*), a state-listed threatened species, have been reported in the vicinity of the proposed project, but outside of a one-mile radius around the dam. In Minnesota, Blanding's turtles primarily inhabit marsh and pond habitats, but use many other wetland types and nest in sandy uplands.

According to the NHIS review letter, the mudpuppy (*Necturus maculosus*), a state-listed species of special concern, has been found in the Grindstone River both upstream and downstream of the dam. The mudpuppy is entirely aquatic and remains active year-round. Throughout its range, the mudpuppy inhabits rivers, lakes, reservoirs, and sluggish streams. In eastern Minnesota, mudpuppies prefer rivers with rocky or gravelly substrates and rely on several different types of microhabitat. Potential mudpuppy habitat is likely present within the Grindstone River and Grindstone Reservoir.

Lake sturgeon (*Acipenser fulvescens*), a state-listed species of special concern, are present in the Kettle River system. A 1956 fish survey found sturgeon in the section of the Grindstone River downstream of the dam. Sturgeon have not been found in any recent surveys; however, sturgeon are not specifically sampled for by DNR Fisheries and the type of sampling equipment used would rarely detect sturgeon. No physical barriers are present that would prevent movement of the Kettle River population into the Grindstone River downstream of the Grindstone dam. The Grindstone River contains suitable lake sturgeon habitat, and it is possible that lake sturgeon use the river during certain times of the year.

Affected Environment: Geology (Karst)

The uppermost bedrock in the area of the Grindstone Dam is the Precambrian Hinckley Sandstone. The Hinckley Sandstone is reported to be up to 500 meters thick at the Hinckley Fault, which is a line that runs from Askov through Hinckley and down to Pine City. Well logs in the project area identify the surface of the sandstone at depths of 42 to 46 feet below the existing surface.

Karst areas are characterized by sinkholes, caves, springs, and blind valleys. Approximately 15 miles northeast of the Grindstone Dam, hundreds of sinkholes have been mapped in the Hinckley Sandstone near Sandstone and Askov, Minnesota. Most sinkholes in Minnesota appear where there is less than about 50 feet of overburden over carbonate over sandstone bedrock. Since the overburden is 42 to 46 feet thick in the area of the Grindstone Dam, the development of sinkholes and other karst features is possible.

To better understand potential impacts from the proposed project, DNR geologists conducted a study to collect site-specific information regarding the electrical resistivity of subsurface geological materials near the dam and in nearby cleared terrestrial areas within a 250-meter zone. Under favorable conditions, the resistivity method can show karst fractures, especially if the resistivity survey lines are oriented approximately perpendicular to fracture and karst trends. One resistivity survey line was completed and did not identify any shallow karst features. The consensus of the DNR geoscientists involved was that the risk was low to negligible for land subsidence in the area from reservoir drainage and associated water table effects.

Affected Environment: Groundwater (Private Wells)

The primary bedrock aquifer is the Hinckley Sandstone. Most of the Hinckley Sandstone is a fine- to medium-grained sandstone composed of about 96 percent quartz. Quartz sandstones tend to retain good primary porosity characteristics, which are typical of productive aquifers. The Hinckley Sandstone aquifer is widely used throughout Pine County for both municipal and residential water supply. The glacial deposits above the Hinckley Sandstone include layers of clay, sand, and gravel of variable thickness and depth. In the area of the Grindstone Dam, the glacial deposits vary in thickness from 16 to 50 feet, as indicated by well logs in the Minnesota Well Index (MWI). The sand and gravel layers are aquifers that could be used for residential water supply. However, all of the wells in the study area (2,000-ft radius around the Grindstone dam) that are listed in the MWI extend to the deeper Hinckley Sandstone aquifer. Staff from the DNR Groundwater Technical Analysis Workgroup conducted a mail-in survey of residences within 2,000 feet of the dam asking if there were wells on the property. Some wells were identified in the mail-in survey (that are not found in the MWI) that may be completed in the shallower sand and gravel layers. If present, the clay layers could act as confining layers that could lessen the impacts of changing surface water and shallow groundwater elevations on deeper bedrock wells.

The Grindstone River generally serves as a groundwater discharge zone for the water table aquifer, which means that groundwater typically flows from the water table aquifer into the Grindstone River. In the area surrounding the Grindstone Reservoir, the opposite is true (water flows from the reservoir into the water table aquifer). This is because the water level in the reservoir has been artificially increased to approximately 1,019 feet above mean sea level. The water level of the river immediately downstream of the dam is considerably lower than that in the reservoir (approximately 7 feet). This elevation difference creates a “mound” in the water table aquifer, where the high reservoir elevation locally maintains a higher water table elevation.

Affected Environment: Public Waters and Riparian Rights

The Grindstone Reservoir is a 26.6 -acre public water basin with Public Waters ID number 5801210. The existence of the Grindstone Reservoir was created by construction of the Grindstone Dam in 1931 and the impoundment of water from the North and South Forks of the Grindstone River, both of which are public watercourses. The Grindstone Reservoir is nearly entirely surrounded by the Hinckley Aquatic Management Area (AMA), with the exception of a corner of one property that abuts the shoreline of the Grindstone Reservoir that is in in private ownership. In its current state, the private landowner has riparian rights.

Riparian rights are property rights arising from owning land abutting water. These rights include private access to the public water resource and reasonable use of water. Uses that have been found to be reasonable include the right to access, the right to construct a dock, the right to boat, and the right to swim. Removal of the Grindstone Dam would result in removal of the Grindstone Reservoir. With the Grindstone Reservoir diminished the private property referenced above would no longer be an abutting owner and, therefore, would no longer have riparian waters. In essence, if the Grindstone Dam is removed by the state, the state will have taken a property interest associated with the private property. The Minnesota Constitution requires that “[p]rivate property shall not be taken, destroyed or damaged for public use without just compensation therefore, first paid or secured.” Minnesota Constitution, Art. I, § 13. Thus if the state or another public entity wishes to remove the Grindstone Dam it must first institute a condemnation suit, pursuant to Minn. Stat. Ch. 117, to compensate the landowner for the taking of the riparian rights associated with the property.

Environmental Consequences: Comparison of Proposed Project and Alternatives

Environmental consequences for each of the topics assessed within the draft EIS are summarized in ES Table 1.

ES Table 1. Comparison of alternatives.

Topic	Proposed Project	No Action Alternative	Partially Engineered Alternative
Wetland Impacts	• Wetlands would be created within the restored floodplain/existing reservoir. • Existing floodplain wetlands would be fully or partially drained, with strongest effects immediately upstream of the dam. • Existing wetlands and a portion of the restored floodplain may be permanently filled from the temporary construction access/permanent angler foot path. Design options would consider permanent angler access that does not impact wetlands (e.g. boardwalk).	• No effect unless the dam fails. • If the dam failed, uncontrolled release could drain existing wetlands or alter and degrade hydrology. Without active restoration of exposed sediments, invasive plant species could establish.	• Similar impacts to the proposed project. • Some additional temporary impacts could occur if access through wetlands is needed for construction of the meander.

Topic	Proposed Project	No Action Alternative	Partially Engineered Alternative
Hydrological Effects	• The modeled water surface elevations show a decrease upstream of the existing dam in all recurrence intervals up to 1 mile upstream of the dam on South Branch of the Grindstone River and up to 0.6 mile upstream of the dam on the North Branch of the Grindstone River. • The maximum decrease in the 100-year storm recurrence interval would occur at the dam location, and would decrease by ~7.6 feet in the short term proposed project (surveyed thalweg) and ~7.7 feet in the long term proposed project (predicted thalweg). • The hydraulic modeling indicates there would be no change to the flood hydraulics of the bridges and other river stations of the Grindstone River downstream of the existing dam.	• No effect unless the dam fails. • A dam failure would cause an immediate and major safety concern for people utilizing the Grindstone Reservoir and at the downstream bridge crossings. In the short term, the sudden change in velocity and water elevation of the river would increase risks for injury to people and river biota as well as present hazards associated with erosion and debris transport downstream. In the long-term, once the H&H conditions equilibrate following a dam failure, the resulting conditions may be similar to the proposed project. • Specific H&H changes under dam failure are difficult to predict without conducting a dam failure analysis model.	• Similar impacts to the proposed project.

Topic	Proposed Project	No Action Alternative	Partially Engineered Alternative
Sediment and Contaminants	• The new stream channel would mobilize existing legacy sediment downstream as it cuts its new path. • Mobilization of fine sediment would cause short-term increases in turbidity. • Fine-grained sediment enriched in likely naturally occurring arsenic would be transported downstream. The sediment will likely be deposited in slack water environments or floodplains where arsenic concentrations might be similar. • Mobilization of coarse sediment (sands) may migrate and aggrade downstream, raising the streambed elevation in discrete, transitory locations.	• The dam will continue trapping sediment and nutrients, but with decreasing efficiencies as it gradually fills with accumulated sediment. • If the dam fails, sediment release would be a large, uncontrolled event.	• Similar impacts to the proposed project.
Plant Communities, Wildlife and Sensitive Ecological Resources	• Upland forest and wetland plant communities could permanently transition to communities with drier hydrologic regimes long-term. • Plant community shifts could facilitate colonization or expansion of invasive species like common buckthorn, permanently impacting plant communities in the absence of	• No effect unless the dam fails, though negative impacts associated with the dam such as migration barriers and altered hydrology and sediment transport would persist. • If the dam fails, uncontrolled release could dewater plant communities to a similar extent	• Similar impacts to the proposed project.

Topic	Proposed Project	No Action Alternative	Partially Engineered Alternative
	management. • The shallow lake community would be eliminated and permanently replaced by riverine, riparian shoreline, floodplain, and upland plant communities. • Some wildlife individuals would be temporarily or permanently displaced, and immobile invertebrates may perish due to dewatering of the reservoir and loss of shallow lake community. Long-term, positive impacts to habitat quality and connectivity would provide net benefit to wildlife. • Fish communities, including lake sturgeon, would benefit greatly from the dam removal via increased habitat connectivity and quality. • Although long-term dam removal should be beneficial to unionid mussels, individual unionids could be temporarily or permanently impacted by the dam removal process through changes in water quality, sedimentation, and local hydraulics.	as the proposed project. Without active restoration, invasive species could become established in areas of exposed sediment. • If the dam fails, uncontrolled release could cause direct mortality of less mobile and fully aquatic organisms via rapid dewatering of the impoundment. Examples include mussels or overwintering Blanding's turtles. Uncontrolled release could also displace aquatic organisms to downstream locations and bury downstream organisms in sediment.	

Topic	Proposed Project	No Action Alternative	Partially Engineered Alternative
	• Impacts to the Blanding's turtle could include permanent habitat loss from eliminating deep water overwintering habitat. Individuals could experience direct mortality from project construction. • Although long-term dam removal should be beneficial to mudpuppy populations, individuals could be temporarily or permanently impacted by the dam removal process through changes in water quality, sedimentation, and local hydraulics.		
Geology (Karst)	• The risk of land subsidence from reservoir drainage and associated water table affects is low to negligible.	• No effect. In the event of dam failure, the risk of land subsidence would be low to negligible.	• Similar to the proposed project, the risk of land subsidence from reservoir drainage and associated water table affects is low to negligible.

Topic	Proposed Project	No Action Alternative	Partially Engineered Alternative
Groundwater (Private Wells)	• Private wells are not likely to experience problems due to dam removal, though there may be a decrease in groundwater levels in wells close to the dam.	• No effect unless the dam fails. • If the dam fails, the risks to wells upstream of the dam would be similar to the risks associated with the proposed project. • For wells downstream of the dam, the risks would be limited to wells that could be temporarily flooded due to the dam break. Flooded wells would be at risk of contamination by surface water.	• Similar impacts to the proposed project, though the decrease in groundwater levels may be less in some areas.

Topic	Proposed Project	No Action Alternative	Partially Engineered Alternative
Public Waters and Riparian Rights	• Based on bathymetry data, it is expected that the river would reform within the old riverbed, which is approximately within the center of the current reservoir and would result in a loss of direct access to the shoreland of a public water by the existing private riparian landowner. This would remove the riparian rights from the parcel and result in diminishment of the land rights held by the parcel owner.	• No effect unless the dam fails. • Sudden release of water due to dam failure would likely result in loss of access to the shoreland by the neighboring landowner.	• The proposed meander location would abut the neighboring landowner's property, and would provide access from the property to the shoreland of the newly formed Grindstone River. • This alternative would maintain riparian rights, however, the type of waterbody present would change from a reservoir to a watercourse. Use of the underlying land may change to the benefit or detriment of the landowner. riparian rights.

Proposed and Recommended Mitigation and Monitoring

Mitigation and monitoring measures were developed throughout the scoping process and in draft EIS development and are summarized in ES Table 2. Further recommended measures may be developed based on public comment. Mitigation and monitoring measures discussed within this EIS are not formal commitments for implementation. Rather, the measures are a list of actions that could mitigate impacts, improve mitigation implementation and effectiveness, and inform the permitting process.

Mitigation and monitoring measures are listed in Table 6-1 as either "proposed" or "recommended". Proposed measures are anticipated to be required by permits or necessary for implementation of the proposed project. Recommended measures are monitoring or mitigation actions suggested during technical review of potential impacts and may be included as permit conditions by individual permit authorities, dependent on their review of the project and determination of mitigation requirements.

ES Table 2. Proposed mitigation, monitoring, and required permits and government approvals for each EIS topic. Each potential impact is for the proposed project only.

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
Wetland Impacts	• Wetlands would be created within the restored floodplain/existing reservoir. • Existing floodplain wetlands would be fully or partially drained, with strongest effects immediately upstream of the dam. • Existing wetlands and a portion of the restored floodplain may be temporarily or permanently impacted from the temporary construction access/permanent angler access route. Design options would consider permanent angler access that does not impact wetlands (e.g. boardwalk).	**Proposed Mitigation and Monitoring** • Mitigation and monitoring would be completed, at a minimum, according to state and federal regulatory requirements if determined necessary. • Drainage or wetland type conversion may be considered as "no-loss" due to the project purpose of fish and wildlife habitat restoration, meaning that WCA would not consider these impacts to result in permanent loss or impact to wetlands. • Temporary construction access impacts would be restored post-construction. A proposed permanent	• USACE Section 10 permit • USACE Section 404 permit • Wetland Conservation Act decision • MPCA 401 water quality certification

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
		angler access route may be considered a permanent impact depending on design, and could require a wetland replacement plan under WCA and MPCA rules. • Federal regulations may require compensatory wetland mitigation similar to the WCA replacement plan depending on qualification for general permits, final project design, and agency review. **Recommended Mitigation and Monitoring** • None	
H&H Effects	• The modeled water surface elevations show a decrease upstream of the existing dam in all recurrence intervals up to 1 mile upstream of the dam on South Branch of the Grindstone River and up to	• **Proposed Mitigation and Monitoring** • To be determined based on final design, permitting, and recommended mitigation and monitoring measures described below. • **Recommended**	• FEMA Letter of Map Revision (if needed)

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
	0.6 mile upstream of the dam on the North Branch of the Grindstone River. • The maximum decrease in in the 100-year storm recurrence interval would occur at the dam location, and would decrease by ~7.6 feet in the short term proposed project (surveyed thalweg) and ~7.7 feet in the long term proposed project (predicted thalweg). • The hydraulic modeling indicates there would be no change to the flood hydraulics of the bridges and other river stations of the Grindstone River downstream of the existing dam.	**Mitigation and Monitoring** • A post-construction bathymetric survey to confirm pre-project assumptions of sediment mobilization should be completed one year after project completion. • Inspection of the constructed riffles should be completed one year after project completion to confirm they are constructed and operating as designed. The operation and maintenance plan for the project should include inspections of the constructed riffle. • Monitoring of the downstream DNR-owned bridge should be conducted after the removal of the dam to confirm the	

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
		proposed project is operating as expected. • Monitoring of tributaries upstream of the existing dam should be completed routinely after the completion of the project. Bank erosion assessments should be completed if there appears to be any head cutting in tributaries or near the junction of tributaries with the Grindstone River as a result of the water levels changes that occurred from the project.	
Sediment and Contaminants	• The new stream channel would mobilize existing legacy sediment in the reservoir downstream as it cuts its new path. • Mobilization of fine sediment would cause short-term increases in	**Proposed Mitigation and Monitoring** • To be determined based on final design, permitting, and recommended mitigation and monitoring measures described below. • A slow drawdown of the	• National Pollution Discharge Elimination System/State Disposal System (NPDES/SDS) construction stormwater (CSW) permit

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
	turbidity. • Fine-grained sediment enriched in likely naturally occurring arsenic would be transported downstream. The sediment will likely be deposited in slack water environments or floodplains where arsenic concentrations might be similar. • Mobilization of coarse sediment (sands) may migrate and aggrade downstream, raising the streambed elevation in discrete, transitory locations.	reservoir water levels is critical to meter the downstream transport of fine sediment into small temporary pulses of turbidity that do not overwhelm or bury the aquatic biota (notably mussels). **Recommended Mitigation and Monitoring** • Both the water and biota should be monitored downstream of the dam during its dismantling to document the timing and magnitude of the turbidity pulse, plus its effective reach downstream. • The plan to minimize sediment mobilization includes removing the dam gradually during low-flow conditions, allowing sediment consolidation,	

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
		installing in-stream riffles as grade-control structures, installing bank stabilization structures, seeding with native plant mixtures, and planting floodplain-tolerant tree saplings. Full establishment of vegetation on the newly exposed substrate is expected to take two to five years.	
Plant Communities, Wildlife and Sensitive Ecological Resources	• Upland forest and wetland plant communities could transition to communities with drier hydrologic regimes long-term. • Plant community shifts could facilitate colonization or expansion of invasive species like common buckthorn. • The shallow lake community would be eliminated and replaced by riverine, riparian shoreline,	**Proposed Mitigation and Monitoring** • Mitigation of plant community impacts would focus on restoration of exposed shallow lake sediments to a floodplain plant community. • A slow drawdown of the reservoir water levels is critical to meter the downstream transport of fine sediment into small temporary pulses of	If an avoidance plan cannot be prepared or demonstrates unavoidable impacts to mussels, a permit to take state-threatened mussels would be required from DNR.

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
	floodplain, and upland plant communities. • Some wildlife species would be displaced and immobile invertebrates may perish due to dewatering of the reservoir and loss of shallow lake community. Long-term, positive impacts to habitat quality and connectivity would provide net benefit to wildlife. • Fish communities, including lake sturgeon, would benefit greatly from the dam removal via increased habitat connectivity and quality. • Although long-term dam removal should be beneficial to unionid mussels, unionids could be impacted by the dam removal process through changes in water quality, sedimentation, and local	turbidity that do not overwhelm or bury the aquatic biota – see monitoring and mitigation measure proposed for Sediment and Contaminants. • Erosion control BMPs would be used on newly exposed soils to address potential impacts to wildlife and fish, including sensitive species. These may include the use of wildlife friendly natural fiber, erosion control blankets, silt fencing, synthetic fiber-free hydro-mulch, and rock checks; specifications for BMPs and allowed materials would be included in construction documents. • A permit to take state-listed threatened mussels will be required due to potential sedimentation and	

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
	hydraulics. • Impacts to the Blanding's turtle could include habitat loss from eliminating deep water overwintering habitat and direct mortality from project construction. • Although long-term dam removal should be beneficial to the mudpuppy, individuals could be impacted by the dam removal process through changes in water quality, sedimentation, and local hydraulics.	local changes in hydraulic conditions. Monitoring of impacts to state-protected species will be required in the permit to take. The specifics of the monitoring will be developed during the permit to take process. • Actions to avoid or minimize disturbance to Blanding's turtles may include timing work to avoid stranding and disturbing turtles based on their phenology; use of BMPs described above; and educating contractors. **Recommended Mitigation and Monitoring** • A mussel avoidance plan could be prepared to demonstrate impacts to mussels would be avoided. Avoidance measures would include slow reservoir	

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
		drawdown, grade control, and erosion control BMPs. • Additional monitoring for turbidity, sediment accumulation, and sediment pollutants could be conducted for the purpose of monitoring potential impacts to mussel species downstream of the dam.	

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
Geology (Karst)	The risk of land subsidence from reservoir drainage and associated water table affects is low to negligible.	**Proposed Mitigation and Monitoring** • To be determined based on final design, permitting, and recommended mitigation and monitoring measures described below. **Recommended Mitigation and Monitoring** • Construction oversight could provide instruction regarding signs of potential land subsidence. A knowledgeable geotechnical engineer/geologist with karst experience could be on-call if signs of land subsidence related to karst appear. If water begins channelizing into a potential sinkhole, the location should be documented and a mitigation plan developed.	None.

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
Groundwater (Private Wells)	Private wells are not likely to experience problems due to dam removal.	**Proposed Mitigation and Monitoring** • To be determined based on final design, permitting, and recommended mitigation and monitoring measures described below. **Recommended Mitigation and Monitoring** • In a worst-case scenario, there is potential for supply wells to be impacted if the Grindstone Dam is removed. The mitigation of adverse impacts to water supply wells as a result of the Proposer's action would be the responsibility of the Proposer. • If a well is impacted, lowering the pump in the well is the most cost effective mitigation method. • Two mitigation approaches for well impacts	None.

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
		are proposed. The project Proposer would need to select and implement a mitigation approach prior to beginning work on the proposed project. ○ Conduct well inspections on 25 of the 37 wells within 2,000 feet of the dam that were not sealed to identify which wells are likely to require mitigation. ○ Notify owners of possible impacts prior to dam removal and develop a contingency plan to immediately mitigate the water supplies of any well owners that might be impacted.	

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
Public Waters and Riparian Rights	Loss of direct access to the shoreland of a public water by the existing private riparian landowner. This would remove the riparian rights from the parcel and result in diminishment of the land rights held by the parcel owner.	**Proposed Mitigation and Monitoring** • To be determined based on conversations with the landowner. **Recommended Mitigation and Monitoring** Action to avoid or mitigate impacts include: • Maintain riparian rights through selection of the partially engineered alternative. • Offer an easement to the landowner on DNR land extending from the existing parcel, across DNR land to the restored river • Provide a corridor to edge of new river to landowner by transferring property from DNR to the land owner that would extend	DNR Public Waters Work Permit

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
		the existing parcel to the restored river. • Enter into an agreement with the parcel owner to pay damages (for loss of property value, for example) or commence a condemnation action pursuant to Minn. Stat. Ch. 117.	

Cumulative Potential Effects

Cumulative potential effects (CPE) are environmental effects that result from the proposed project in conjunction with other projects in a given area. The effects from any one project may be small; however, the aggregated effects from all the projects together may be significant (Minnesota Rules 4410.0200, subpart 11a.)

Topics analyzed for the EIS and included in the CPE analysis are listed below. Analyses of public waters impacts and riparian rights impacts are not included because the scope of CPE analysis is limited to environmental effects per Minnesota Rules 4410.0200, subpart 11a.

- Wetlands
- Hydrological Effects
- Sediment and Contaminants
- Plant Communities, Wildlife, Fish, and Sensitive Ecological Resources
- Geology
- Groundwater

The inclusion of future projects in the CPE analysis is determined by assessing geographic scale and timeline of the proposed project and potential future projects. Potential future projects include those that are reasonably likely to occur and for which sufficient information is available to contribute to understanding of CPE. The geographic scale of the proposed project includes the 26.6-acre Grindstone Reservoir, which would be permanently eliminated, the area immediately surrounding the dam, access routes for construction equipment, and downstream areas that may receive sediment. The timeline of the proposed project would include (in sequential order): 1) drawdown of the reservoir, 2) consolidation of sediments, 3) dam removal and 4) floodplain grading and construction of riffles and associated erosion control methods. Drawdown, consolidation, and dam removal is expected to occur over 4-6 weeks during summer months. Floodplain grading and construction are anticipated to take place one year following dam removal once the main channel is established and soils are consolidated.

Each topic for the proposed project was assessed individually for geographic scale, timeline, and specific impacts. Further, several agencies and units of government were contacted to inquire about projects in the environmentally relevant area that are reasonably likely to occur and that may interact with environmental effects from the proposed project within similar geographic scales and timelines identified for the proposed project. Three reasonably foreseeable projects were identified by the inquiry. Most impacts were determined to be none, minimal, or temporary. Two of the three projects may likely require a mussel survey due to potential presence of state-listed mussel species and potential impacts.

1. INTRODUCTION

1.1. Project Background

The Minnesota Department of Natural Resources (DNR) section of Fisheries is proposing to remove the dam on the Grindstone River within the city of Hinckley, in Pine County, Minnesota. The dam is owned and maintained by the DNR and impounds the Grindstone Reservoir, a 26.6-acre public water basin within the state-owned Hinckley Aquatic Management Area (AMA).

There has been a history of dams at this location for various uses (logging, hydropower, water storage) since the late 1800s. In 1931, the former Minnesota Department of Game and Fish constructed the current reinforced concrete dam to provide a water supply for fish-rearing ponds that are located on an adjacent unit of the Hinckley AMA. The main feature of the dam is the concrete spillway over which water flows from the reservoir and falls into the river downstream of the dam (Figure 1). On each side of the spillway are concrete walls called abutments. The abutments hold back the soil of the embankment that act as containment berms. A sluicegate on the north side of the spillway is intended to be opened to drain the reservoir but it is likely inoperable.

Figure 1-1. Grindstone Dam located on the Grindstone River in Hinckley, Minnesota. The Grindstone River is in the foreground of the picture, the Grindstone Reservoir is located behind the dam. Labels: A. Concrete spillway; B. Left & Right Abutments; C. Sluice gate. ; D. Embankment, and E. Sheetpiling.

Due to the age and design of the structure there has been a history of repairs since the dam was constructed. In 1944, high water overtopped the south embankment, causing the embankment to erode and wash away, draining the reservoir. Repairs were completed later this same year. In 1954, the south embankment again failed due to high water and erosion. The dam was repaired and the abutment walls and earthen embankment were raised two feet to prevent the embankments from overtopping by flood waters. In 1974, a dam safety inspection indicated that the two feet added to the abutment wall had fallen off; additional repair needs were also reported and repairs were completed in 1976 (Department of the Army, Corps of Engineers, 1979). Additional extensive repairs occurred in 1985 and 2014. The 2014 repairs were required as an emergency after it was noticed that the concrete abutment wall had moved. The repairs temporarily stabilized the wall but did not address the long-term issue of instability. Due to the poor condition of the dam, the DNR obtained funds to address the aging dam long-term. Subsequent dam safety inspections by the DNR Dam Safety Unit have reported on the continued deterioration of the dam. A 2017 dam safety inspection report identified the dam to be stable but in poor condition and noted several deficiencies to the integrity of the dam, including: major cracks and displacement of concrete on both abutments with areas of exposed rebar; significant tilt to the south abutment; cracks in both of the embankments; and overgrowth of vegetation (Zwilling, 2017). The 2017 dam safety report also provided a list of items to monitor for further degradation, and a list of recommended repairs.

In addition to the poor condition of the dam, at least two drownings have occurred at the site due to the hydraulic roller of the dam. Due to the poor condition of the dam and the safety hazard the aging dam imposes, it became clear that the dam has reached the end of its lifecycle and must be addressed. In 2017, the DNR hosted its first public information meeting regarding the condition of the dam and the options being explored to address its poor condition. Ultimately, the DNR decided upon the proposed project, which is to remove the at-risk dam, drain the reservoir, and restore the free-flowing river channel of the Grindstone River in that area.

1.2. Project Purpose and Need

1.2.1. Project Need

The Grindstone River Dam (Grindstone Dam), built in 1931, has reached the end of its expected life cycle, already having required multiple expensive repairs to keep it in service. The dam is a safety hazard due to the hydraulic roller effect downstream of the dam, with at least two documented drownings at the site. The dam is a barrier to fish passage, and fewer species occur upstream from the dam than downstream. The proposed project is needed to address public safety concerns from the dam due to instability issues and inability to pass floods. The proposed project is also needed to allow for passage of fish and other aquatic wildlife and restore natural stream features, natural sediment transport, and habitat diversity within this section of the Grindstone River.

1.2.2. Project Purpose

The purpose of the proposed project is to:

1. Address public safety concerns around dam instability, inability to pass floods, and the threat of dam failure.

2. Address public safety concerns by eliminating the hydraulic roller and reducing the threat of drowning.
3. Minimize impacts from flooding by providing a larger floodplain (i.e. restore the reservoir to a naturally functioning stream with a connected floodplain).
4. Restore fish and aquatic life connectivity to the Grindstone River system.
5. Increase pool and riffle habitat.
6. Improve hydrologic function of the Grindstone River by restoring more natural sediment and nutrient transport.

1.3. Need for a State of Minnesota Environmental Impact Statement

An Environmental Impact Statement (EIS) is mandatory for this project pursuant to Minnesota Rules (Minn. R) 4410.2000, subpart 2. The rule directs that an EIS shall be prepared if the project meets or exceeds the thresholds of any of the EIS categories listed in part 4410.4400. Minnesota Rules 4410.4400, subpart 20, identifies that projects that will eliminate a public water or public waters wetland requires preparation of an EIS. The reservoir created by the dam (Grindstone Reservoir) has been identified as a public waters basin (#58012100 or 58-121P). Once the dam is removed, the public water basin will no longer exist as a basin. This activity is considered the elimination of a public water; therefore Minn. R. 4410.4400, subpart 20, applies.

The DNR is the Responsible Governmental Unit (RGU) for environmental review of the proposed project.

1.4. EIS Process and Scope

1.4.1. Process

Key elements of the EIS process include scoping, draft EIS development, final EIS development, adequacy determination, and supplementing EIS process (if necessary).

1.4.1.1. Scoping Process

The purpose of the scoping process per Minnesota Rules 4410.2100, subpart 1, is “to reduce the scope and bulk of an EIS, identify only those potentially significant issues relevant to the proposed project, define the form, level of detail, content, alternatives, timetable for preparation, and preparers of the EIS, and to determine the permits for which information will be developed concurrently with the EIS." The scoping process is further described within Minnesota Rules 4410.2100. To determine scope, the RGU is required to prepare a scoping environmental assessment worksheet (SEAW), draft scoping decision document (DSDD), and final scoping decision document (FSDD). The SEAW uses the standard EAW form to disclose sufficient information to identify potentially significant environmental impacts. Concurrent with SEAW development and distribution, the DSDD provides the public a preliminary view of the EIS scope. The purpose of the draft scoping decision document is to facilitate the delineation of issues and analyses to be contained in the EIS. The information in a draft scoping decision document is considered as preliminary and subject to revision based on the entire record of the scoping process. A 30-day scoping comment period begins following notice of availability of the SEAW and DSDD as published in the Environmental Quality Board (EQB) Monitor. During the scoping comment period, at least one public meeting is provided and held not less than 15 days after publication of the notice of availability of the SEAW and DSDD.

The FSDD is prepared after the comment period ends and serves as the "blueprint" of the EIS. At a minimum, the FSDD must include the items listed at Minnesota Rules 4410.2100, subpart 6, items A-G. Response to public comments is not required for the FSDD but is typically completed. The FSDD is issued within 15 days after the close of the 30-day scoping period. Specific information on the Grindstone scoping process is discussed in 1.3.2.

1.4.1.2. Draft EIS

An EIS preparation notice is published within 45 days after the RGU receives the proposer's cash payment pursuant to Minnesota Rules 4410.2100 and 4410.6500. Draft EIS development and distribution incorporates Minnesota Rules 4410.2300-2600 and is a process during which the RGU, consultants, and project proposer conduct studies and prepare the draft EIS document. Key content of the EIS includes: a project description, required government approvals, alternatives, mitigation measures, and analysis of environmental, economic, employment, and sociological impacts. When the draft EIS is completed, the RGU makes the draft EIS available for public review and holds an informational meeting in the County where the project is proposed per Minnesota Rules 4410.2600. Availability of the draft EIS is published in the EQB Monitor and via press release and also contains the date, time, and place of the informational meeting. The meeting takes place not less than

15 days after publication of the notice of availability in the EQB Monitor. The record remains open for public comment not less than ten days after the last date of the informational meeting. The RGU responds to timely substantive comments received on the draft EIS and proceeds to prepare the final EIS.

1.4.1.3. Final EIS

The final EIS will incorporate content and be distributed according to Minnesota Rules 4410.2700. The final EIS will respond to substantive comments on the draft EIS, obtain additional information if needed, and discuss at appropriate points in the final EIS responsible opposing views related to scoped issues which were not adequately discussed in the draft EIS. Availability of the final EIS is published in the EQB Monitor and via press release.

1.4.1.4. Adequacy Determination

The RGU generally determines adequacy of the final EIS pursuant to Minnesota Rules 4410.2800. Interested persons may submit written comments on the adequacy of the final EIS to the RGU for a period of not less than ten days following publication in the EQB Monitor of the notice of availability of the final EIS. The adequacy determination is made at least 10 days after publication in the *EQB Monitor* of the notice of availability. The adequacy determination should be made within 280 days after the EIS preparation notice (see Section 1.3.1.2) was published in the EQB Monitor or at a date agreed upon by the Proposer. The final EIS is determined adequate according to conditions outlined in Minnesota Rules 4410.2800, subpart 4, items A-C:

A. addresses the potentially significant issues and alternatives raised in scoping so that all significant issues for which information can be reasonably obtained have been analyzed in conformance with Minnesota Rules 4410.2300, items g and h;
B. provides responses to the substantive comments received during the draft EIS review concerning issues raised in scoping; and
C. was prepared in compliance with the procedures of the act and Minnesota Rules 4410.0200 and 4410.6500.

Public notice of the decision is published in the EQB monitor.

1.4.1.5. Supplementing EIS

If necessary, a supplemental EIS is prepared pursuant to Minnesota Rules 4410.3000. A supplemental EIS is required according to circumstances outlined in Minnesota Rules 4410.3000. subpart 3, items A-C:

A. whenever after a final EIS has been determined adequate, but before the project becomes exempt under part 4410.4600, subpart 2, item B or D, the RGU determines that either:
    a. substantial changes have been made in the proposed project that affect the potential significant adverse environmental effects of the project; or
    b. there is substantial new information or new circumstances that significantly affect the potential environmental effects from the proposed project that have not been considered in the final EIS or that significantly affect the availability of prudent and feasible alternatives with lesser environmental effects;
B. whenever an EIS has been prepared for an ongoing governmental action and the RGU determines that the conditions of item A, subitem (1) or (2), are met with respect to the action; or
C. whenever an EIS has been prepared for one or more phases of a phased action or one or more components of a connected action and a later phase or another component is proposed for approval or implementation that was not evaluated in the initial EIS.

The procedure for preparing a supplementing EIS is described in Minnesota Rules 4410.3000, subpart 5.

1.4.2. Scope

The SEAW and DSDD scoping documents were prepared in March 2020. The onset of the Covid-19 pandemic at this time resulted in delays to the public meeting and comment process. Therefore, the scoping documents were not noticed until a public meeting could be accommodated according to Covid-19 safety guidelines from the Minnesota Department of Health and Centers for Disease Control.

The SEAW and DSDD were noticed on October 12, 2020 in the *EQB Monitor*. A 30-day public review and comment period was open October 12 through November 12. An online public information meeting was held on November 5, 2020 to provide information on the project and EIS scoping process. The public meeting included a question-and-answer session along with a formal, verbal public input session. Written and verbal comments were received from a total of 16 entities during the 30-day review period and considered during development of the FSDD.

The scope of the EIS was described in the FSDD and approved on December 7, 2020. The purpose of the FSDD was to identify project alternatives and topics with potential effects to be assessed in the EIS. The FSDD also identified studies that will be required to assess effects. Also included with the FSDD is a Response to Comment document, which responds to substantive comments received during public review of the draft scoping documents.

On May 25, 2021, the DNR published the EIS Preparation Notice in the EQB Monitor. The EIS preparation notice identified the alternatives that will be addressed in the draft EIS and topics that will be analyzed. A press release was also issued at this time.

1.4.2.1. Alternatives

Per Minnesota Rules 4410. 2300, item G, the EIS must include the no action alternative and at least one alternative of each of the following types or provide a concise explanation of why no alternative is included in the EIS: 1) sites; 2) technologies; 3) modified designs or layouts; 4) modified scale or magnitude; or 5) an alternative incorporating reasonable mitigation measures identified through comments on the scope or the draft EIS. Alternatives may be excluded only if they meet one (or more) of the following criteria:

a) underlying need for or purpose of the project is not met;
b) significant environmental benefit over the proposed project is not provided; or
c) another alternative is likely to be similar in environmental benefits but will have less socioeconomic impact.

Alternatives included in the EIS consist of the no action alternative (leave the dam in place) and one modified design consisting of a partially engineered restoration. Descriptions of these two scoped alternatives are provided in Section 2.

Alternatives not included in the scope are described below.

1.4.2.1.1. Site Alternatives

No site alternatives were evaluated for the proposed project because the project purpose is reliant on a specific dam in a specific location being removed due to instability and safety issues.

1.4.2.1.2. Technology Alternatives

In consultation with the DNR Dam Safety Unit regarding availability of other technology alternatives, DNR engineers were not aware of other technologies that could be employed as an alternative to the proposed project. Therefore, no technology alternatives were evaluated.

1.4.2.1.3. Modified Design

1.4.2.1.3.1. Rock Arch Rapids

Modification of the dam with rock arch rapids to maintain existing pool elevation was not evaluated for the proposed project because this alternative would not satisfy all purposes of the proposed project. Construction of a rock arch rapids would maintain the current full pool reservoir, remove the drowning hazards associated with the current dam, and allow for fish and wildlife passage; however, instability issues would remain near the earthen berm, normal sediment transport would still be disrupted and natural stream features and habitat diversity would not be allowed to establish with this design.

1.4.2.1.3.2. Fully Engineered Alternative

The fully engineered restoration alternative was conceptualized during the scoping process as part of environmental review for the Grindstone Dam Removal Project and was described in the Final Scoping Decision Document for the project. The fully engineered restoration alternative would include the same dam removal as the proposed project, but rather than letting the river channel naturally restore, this alternative would restore the resultant river channel with full engineering. Implementation of the fully engineered restoration alternative would include: drawdown of the reservoir; consolidation of sediments; excavation of the river channels; and dam removal. In this alternative, the resultant stream would be manipulated along much of its distance within the AMA to design specifications that would ensure channel stability.

A screening analysis was completed in March 2022 to evaluate whether the fully engineered restoration alternative meets the needs of the proposed project and whether it would provide any significant environmental benefits in comparison to the proposed project or another alternative being considered (Appendix A). An alternative may be excluded from analysis in the EIS if it is determined that the alternative would not meet the underlying purpose of the project or offer significantly less environmental or social impacts (Minnesota Rules 4410.2300 item G). The screening analysis determined that the fully engineered restoration would likely meet the project purpose, but that this alternative would not offer significantly less environmental or social impacts compared to the alternatives discussed within the EIS. Therefore, the fully engineered alternative is not included in the analysis of impacts within the EIS.

1.4.2.1.4. Scale or Magnitude Alternatives

Reconstruction of the dam as a scale or magnitude alternative was not evaluated for the proposed project. Rebuilding the dam would address the aging infrastructure and safety concerns related to needed repairs and the inability to pass floods of the current dam and therefore satisfy one purpose of the proposed project. However, over the long-term the infrastructure and safety concerns would remain. The continuous need for maintenance and repairs would still exist and the risk of dam failure would continue. Rebuilding the dam would not satisfy additional purposes of the proposed project. The purposes of restoration of connectivity for fish and aquatic life, natural stream features, and natural sediment and nutrient transport within this section of the Grindstone River would not be achieved. Additionally, the purpose of addressing public safety concern for drownings caused by the hydraulic roller of the dam would not be accomplished.

1.4.2.1.5. EIS Topics

The FSDD described potentially significant and relevant issues to be included in the EIS based on the content of the SEAW. A purpose of the scoping process is to identify only those potentially significant issues relevant to the proposed project according to Minn. R. 4410.2100, subpart 1. The FSDD listed topics that were adequately analyzed by the SEAW and where additional analysis is not warranted; topics where significant impacts are not expected but additional analysis is required; and topics where potentially significant impacts may result and additional analysis is required.

1.4.2.1.6. Topics Determined to be Adequately Analyzed in Scoping EAW

The SEAW identified and described several topics that are not relevant or minor issues and will not be further analyzed in the EIS. The topics not included in the EIS are listed below:

- Cover types and plans
- Wastewater and stormwater
- Hazardous materials/wastes
- Historic properties
- Visual
- Air (stationary source emissions, vehicle emissions, dust and odor)
- Noise
- Traffic

Socioeconomic effects were also determined to be adequately analyzed by the SEAW. The proposed project would not be expected to have negative socioeconomic effects on the community. Social effects consider the ways in which the proposed project would have an effect on the community, such as how residents and visitors connect to the community historically and in the future. Economic effects considers ways in which the proposed project would have effects on the local economy.

Existing socioeconomic benefits of the Grindstone Reservoir include provision of public access to water resources, fishing, recreation, education, and outreach. All of these benefits would be expected to be maintained or improved following the proposed project. The existing boat launch and fishing pier provide access to the reservoir. Both the launch and the pier would be removed by the proposed project. Public access to the Grindstone River would be maintained following the proposed project by an anticipated public carry-in access for kayaks, canoes, and tubes at or near the location of the existing boat launch. Access for anglers would persist along the restored riverbank and the improved fish passage as a result of dam removal would be expected to a provide a similar or improved angling experience. Areas for outreach and education would still exist following the dam removal. An interpretive sign related to the history of the area would also be installed The Willard Munger State Trail crosses the Grindstone River just downstream of the dam and would potentially be rerouted during the demolition period of the dam. The trail reroute would be temporary in nature and recreational use of the trail for the community and visitors would continue to exist over the long-term. No commercial boat traffic occurs within or near the proposed project. The proposed project would not be expected to have economic effects on employment or the local economy.

1.4.2.1.7. Significant Impacts are not Expected and Further Analysis Needed

The FSDD identified four topics that require further analyses beyond the SEAW, but that are not expected to have significant impacts. These topics and corresponding EIS sections are listed below:

- Wetland (Section 3.1)
- Hydrological effects (Section 3.2)
- Sediment and contaminants (Section 3.3)
- Plant communities, wildlife, fish, and sensitive ecological resources (Section 3.4)

1.4.2.1.8. Potentially Significant Impacts May Result and Further Analysis Needed

The FSDD identified three topics that require further analyses beyond the SEAW, and that may result in potentially significant impacts. These topics and corresponding EIS sections are listed below:

- Geology – karst (Section 3.5)
- Groundwater – private wells (Section 3.6)
- Public waters and riparian rights (Section 3.7)

1.5. Government Approvals and Federal Regulatory Program and Law Requirements

The EIS provides information and evaluation on potential environmental impacts resulting from the proposed project and scoped alternatives, as well as identifies the possible need for additional mitigation measures. The EIS is not a decision-making document but is to be used by governmental units as information and a guide for the permitting process (Minnesota Rules, 4410.0300: Authority, Scope, Purpose, and Objectives). All Minnesota local and state government bodies identified in an EIS with permitting authority shall consider the report in making any decision to authorize the project according to Minnesota Rules, 4410.7055. Also, if an EIS is required for a governmental action (defined by Minnesota Rules, part 4410.0200, subpart 33); no permits or approvals may be granted, nor can a project begin until environmental review is completed, including an EIS Determination of Adequacy by the DNR, according to Minnesota Rules, 4410.3100.

Although the EIS provides information for use in permit issuance or denial, it is not required to gather or present all necessary permit-related information. Additional information may be required as part of the various permitting processes depending on the permit and the permitting authority. A Determination of Adequacy does not mean a permit will be granted.

The permits and approvals required or potentially required for the proposed project are listed in Table 1-1.

Table 1-1. Summary of Federal, State and Local Permits, Approvals, and Federal Regulatory Programs and Laws Related to the Proposed project.

Unit of Government	Type of Application	Status
U.S. Army Corps of Engineers (USACE)	Section 10 permit	To be obtained
USACE	Section 404 permit	To be obtained
DNR	Public waters work permit (depending on permitting process and timing, multiple permits may be needed)	To be obtained
DNR	Wetland Conservation Act (WCA)	To be obtained
DNR	Dam safety permit	To be obtained
DNR	Endangered species taking Permit	To be obtained if necessary
Minnesota Pollution Control Agency (MPCA)	National Pollution Discharge Elimination System/State Disposal System (NPDES/SDS) construction stormwater (CSW) permit	To be obtained
MPCA	401 water quality certification antidegradation assessment	To be obtained
MPCA	Notification to manage dredged material without a permit	To be obtained if necessary

Unit of Government	Type of Application	Status
City of Hinckley and/or Pine County	Permit to move fill within shoreland management zone	To be obtained if necessary
Pine County	WCA review (wetland impacts outside of state owned land)	To be obtained if necessary

2. PROPOSED PROJECT AND ALTERNATIVES

2.1. Proposed Project Overview

The proposed project includes the removal of the Grindstone Dam along with floodplain grading and construction of a series of riffles with associated erosion control methods such as toe wood-sod mat for bank protection and reestablishment of the riparian zone. The area of impact of the proposed project includes the 26.6-acre Grindstone Reservoir, which would be permanently eliminated, the area immediately surrounding the dam, access routes for construction equipment, and downstream areas that may receive sediment.

Implementation of the proposed project would include (in sequential order): 1) drawdown of the reservoir, 2) consolidation of sediments, 3) dam removal and 4) floodplain grading and construction of riffles and associated erosion control methods. As the reservoir nears the end of drawdown and the floodplain establishes from exposed sediment, the river channel would reconfigure with pattern, dimension, and profile based on the underlying substrate and historic meander patterns (Figure 2-1). Typically, the thalweg (deepest portion of the channel) would end up in the deepest part of the reservoir, most likely the historic channel itself. The new channel may laterally migrate small distances during this time as the channel stabilizes and vegetation establishes. Once the drawdown is complete and the spillway removed, the remaining components of the dam would be demolished and removed from the site. Water would continue to run through the site and work would occur during low flow conditions. The earthen embankments would be excavated and graded using heavy equipment. The riffles would be installed following site preparation to stabilize sediments, allow for passage of flood flows, and to maintain continuity with the floodplain.

2.1.1. Drawdown

Implementation of the proposed project would be initiated with a slow drawdown. The drawdown would allow for controlled release of reservoir waters, sediment consolidation, and facilitate subsequent implementation activities. Specifically, the proposed project includes demolition and removal of the main spillway structure and its abutments, the sluicegate, sheet piling and concrete reinforcements on the embankments. Proper erosion control and bank protections would be implemented with removal of the concrete reinforcements. All waste materials resulting from the demolition and removal of the dam would be disposed of at an approved offsite facility. Staging areas for heavy equipment would be located in the current parking area near the dam. Once the reservoir is drawn down and soils become dry, additional staging areas may be located within the newly created floodplain, if additional work is needed to shape the river channel.

Drawdown of the reservoir is planned to utilize one of two methods: 1) The sluice gate would be opened allowing for monitored release of flow, or 2) A series of notches would be created in the spillway to initiate a slight increase in the rate of water release. Demolition would proceed in a slow, precise manner to allow for a gradual, controlled release of water, which would minimize excess flow and deposition of sediment downstream. Length of drawdown would depend on river flow and precipitation; stabilization of sediments forming the floodplain in the emerging reservoir bed; and would occur in accordance with Public Waters Work Permit and other permit conditions. With either method, as the river incises in the sediments within the middle reach of the reservoir, it would generate fine sediment. The deeper and wider pool directly upstream of the dam, coupled with riffle construction, would function as a sediment trap as the river rebuilds its floodplain. Any issues that may occur during drawdown would be evaluated for any corrective actions that may be necessary.

2.1.2. Consolidation of Sediments

Following drawdown, loose, fine sediment would naturally consolidate and stabilize within the reservoir bed. Reservoir bed soil stabilization would begin immediately and be stabilized in accordance with permits as it becomes dewatered and revegetated.

2.1.3. Dam Removal

The proposed project includes demolition and removal of the main spillway structure and its abutments, the sluicegate, sheet piling and concrete reinforcements on the embankments. Demolition of the dam would be done preferably during low flow conditions (which typically occur late summer through fall) but could begin in normal mid-summer flows. Flow monitoring may be conducted before the proposed project begins to determine the exact timing and drawdown strategy. Equipment used in the demolition of the dam would likely be a hydraulic jackhammer or grinder attached to an excavator. Staging areas for heavy equipment would be located in the current parking area near the dam. Once the reservoir is drawn down and soils become dry, additional staging areas may be located within the newly created floodplain, if additional work is needed to shape the river channel. All waste materials resulting from the demolition and removal of the dam would be disposed of at an approved offsite facility.

After the dam is removed, the project proposes to allow the river channel to reform naturally for a period of months to one year, as determined by reservoir sediment, rainfall frequency and intensity and channel-forming flows (flows that occur when the river reaches the top of its banks). Once the main channel would be considered to be established (expected to be within one-year post-dam removal), grading and riffles would be installed. Allowing time for soils to consolidate before grading and construction of riffles is necessary, otherwise the soil would likely be too saturated to handle construction equipment.

2.1.4. Grading and Structures

After the sediment consolidation and dam removal, it is expected that a form of grade control would need to be installed in the channel in the area of the removed dam to slow flows and prevent excess incision of the channel and to assure a connected floodplain. This would likely take the form of a series of in-stream riffles. Additionally, toe wood-sod mat would be needed to protect the bank in the proximity of the riffles. The riffles are proposed in an area that is currently overwide, and the riffles need to tie into banks that do not currently exist. Bank protection measures such as coir wrap or toe wood-sod mat would protect the rebuilt banks from erosion, and allow time for the riffles and associated banks to stabilize and establish vegetation. Materials for the toe wood-sod mat can be utilized if any tree removal is occurring in the area; otherwise, the contractor would be required to source additional trees for the project. Floodplain grading may occur post-dam removal if determined to be necessary for connectivity. Grading, any necessary stream channel modification/excavation, and installation of in-stream grade control would require the use of heavy equipment. Natural excavated materials (soil and rock) from the dam removal and any bank shaping/grading necessary would be used on-site to ensure design elevations are met. Continuous intervention to the channel is not expected after the restoration (natural or engineered) is completed.

The access road to the upstream riffle would be graded using heavy equipment. If site conditions arise and additional fill is needed for the access road, the sediment accumulating in the dam pool could be used; ultimately this decision would be made by the contractor. If the area is still saturated from the drawdown, timber mats or similar may be needed to run machines over to prevent them from getting stuck. The placement of traction items would be temporary. In addition to the bulldozer, an excavator would be used to place baserock and boulders for the riffle; flat fishing stones for angler and other recreational access may also be placed along the shoreline. Any trees that are removed would then be used for the toe wood-sod mat structures. Once the project is finished, the access road may be converted to a boardwalk or covered with gravel to retain it as a walking and recreation path to the riffle. Gravel and any other materials (i.e. timber mats) to make the site accessible during construction would be sourced from offsite and located by the contractor.

Grading and structures would include: grading at the dam site, installation of riffles (at the dam site and upstream), toe wood-sod mat installation, and grading of the dam embankment. The upstream riffle would require access paths that would be built at the floodplain elevation, facilitating reforming of the floodplain and double as an initial access for anglers. The project area would be changing as sediment deposits. The exact sequencing of these construction activities would be at the discretion of the engineer and contractor. Any concerns related to downstream bridge stability would be addressed by appropriate professional engineers.

Once the grading and structures phase is complete, the exposed soils of the floodplain would be seeded with a native plant mixture; trees may be selectively planted in the following year. Newly-exposed reservoir sediments typically experience significant vegetation the first growing season; however, it would take two to five growing seasons for the native planting to fully establish. The site would be monitored for invasive species and vegetation best management practices (BMP) would be used to control invasive species.

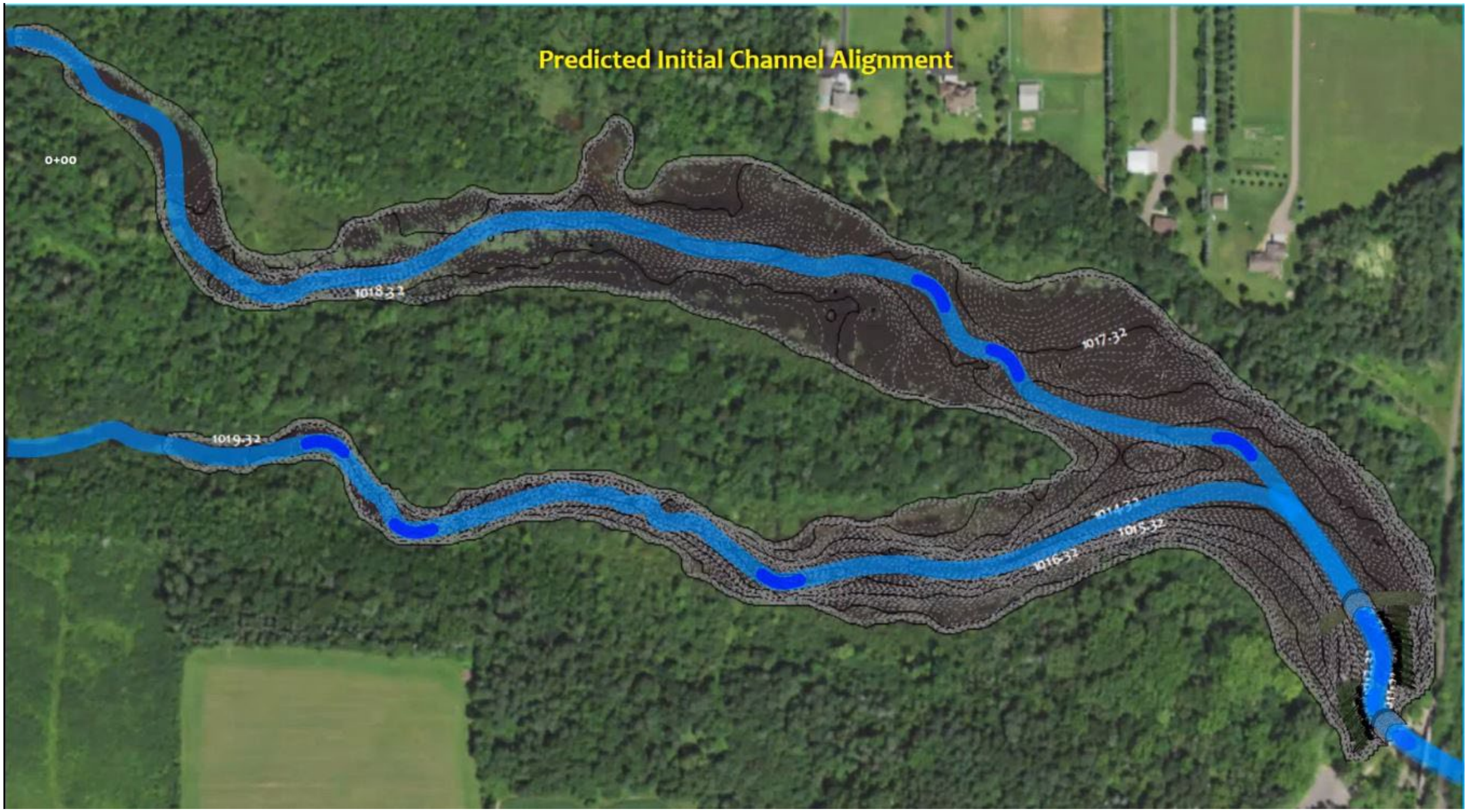

Figure 2-1. Predicted initial channel alignment following proposed project implementation. Dark blue areas indicate areas of pool formation. The two constructed riffles are depicted at the dam location and just upstream.

2.2. Alternatives

Two alternatives were identified for analysis in the EIS and include the no action alternative and one modified design. Alternatives not selected for further analysis during the scoping process are described in section 1.3.2.

2.2.1. No Action Alternative

The no action alternative provides the context for the potential environmental and socioeconomic effects that would occur if the project is not developed. The no action alternative includes keeping the dam in place with ongoing maintenance and possible major repairs.

Existing conditions of the dam and recommendations for ongoing maintenance were provided by the DNR Dam Safety Unit based on inspections in 2016 and 2020 (Dostert, 2020; Zwilling, 2017). Both inspections determined the dam to be in poor condition and failing. Major cracks were identified on both abutments. The south abutment had a significant tilt in 2016 that was partially stabilized in 2014 but continues to deteriorate. A 1-foot diameter sinkhole was identified above the base of the crack on the south abutment. The concrete cap on the north embankment is severely cracked and is in a deteriorated state, and the south embankment also has a significant crack. Erosion and soil loss were noted along both the upstream and downstream face of the south abutment. Formation of deep holes were noted within shotcrete on the north embankment.

Risks to public safety by leaving the dam in place include dam failure and risks of death and injury due to drowning or falls. Dam failure would result in an uncontrolled release of the reservoir down to the bottom elevation of the breach (failure). The dam is a drowning risk due to the hydraulic roller created by the dam. Two documented drownings have occurred at the site due to the hydraulic roller. The deterioration of the dam also presents an injury risk from trips and falls due to the holes in the north embankment.

The no action alternative would also maintain the existing biological and hydrological impacts of the dam. The dam is currently a barrier to fish and other aquatic life, prevents natural sediment and nutrient transport, and does not provide natural pool and riffle habitat.

2.2.2. Modified Designs or Layouts

One design modification is considered in the EIS and is described below.

2.2.2.1. Partially Engineered Restoration (Meander Excavation)

The partially engineered alternative includes all aspects of the proposed project with the addition of excavating a meander near station 19+00 to 21+00 as shown in Figure 2-2. The area of impact of the partially engineered alternative includes the 26.6-acre Grindstone Reservoir, which would be permanently eliminated, the area immediately surrounding the dam, access routes for construction equipment, and downstream areas that may receive sediment.

Demolition of the dam, drawdown of the reservoir and installation of the riffles would be done in the same manner as described above. Staging areas for the partially engineered alternative would be the same as the proposed project with an additional staging area located within the old reservoir bed; the exact site location would be determined during contract design. Additional access routes would typically run along the shore of the former reservoir edge as it is likely rock and would need less time for sediments to consolidate.

Excavating a meander near station 19+00 to 21+00 would provide increased sinuosity and habitat. Based on a 1939 aerial photo it appears that the channel may have taken this alignment (MHAPO 2021). Toe wood- sod mat bank stabilization would be used. The dimension parameters of the surveyed South Branch reference reach was used as a template for design and assumed footprint of both reaches upstream of the confluence. An elliptical riffle design that matched reference cross-sectional area would be used to shape the channel. Elliptical cross-sections have advantages when excavating new channels as they reduce near bank shear stress and allow vegetation to become established on the side-slopes and stabilize banks.

The excavated meander would likely be dug prior to the removal of the dam but after the sediments have had time to consolidate following drawdown. An excavator would be used to first dig the channel to the proper dimensions; this excavation would be done offline to minimize sediment release. After the meander is dug, the toe wood-sod mat would be installed. Timing of completion of channel excavation and toe wood-sodmat installation would be dependent on weather. Preferably, the excavated meander would be given a growing season for vegetation to establish before it is reconnected to the flowing river. Floating silt curtains would be used downstream when adding flow back to the meander. If the generated sediment from the meander can be used onsite, it would be stored either near the meander or near the upstream riffle within the floodplain for a limited amount of time as dictated by the permit. If the generated sediment is not needed, it would be disposed of offsite; the location of disposal and/or storage would be determined by the contractor.

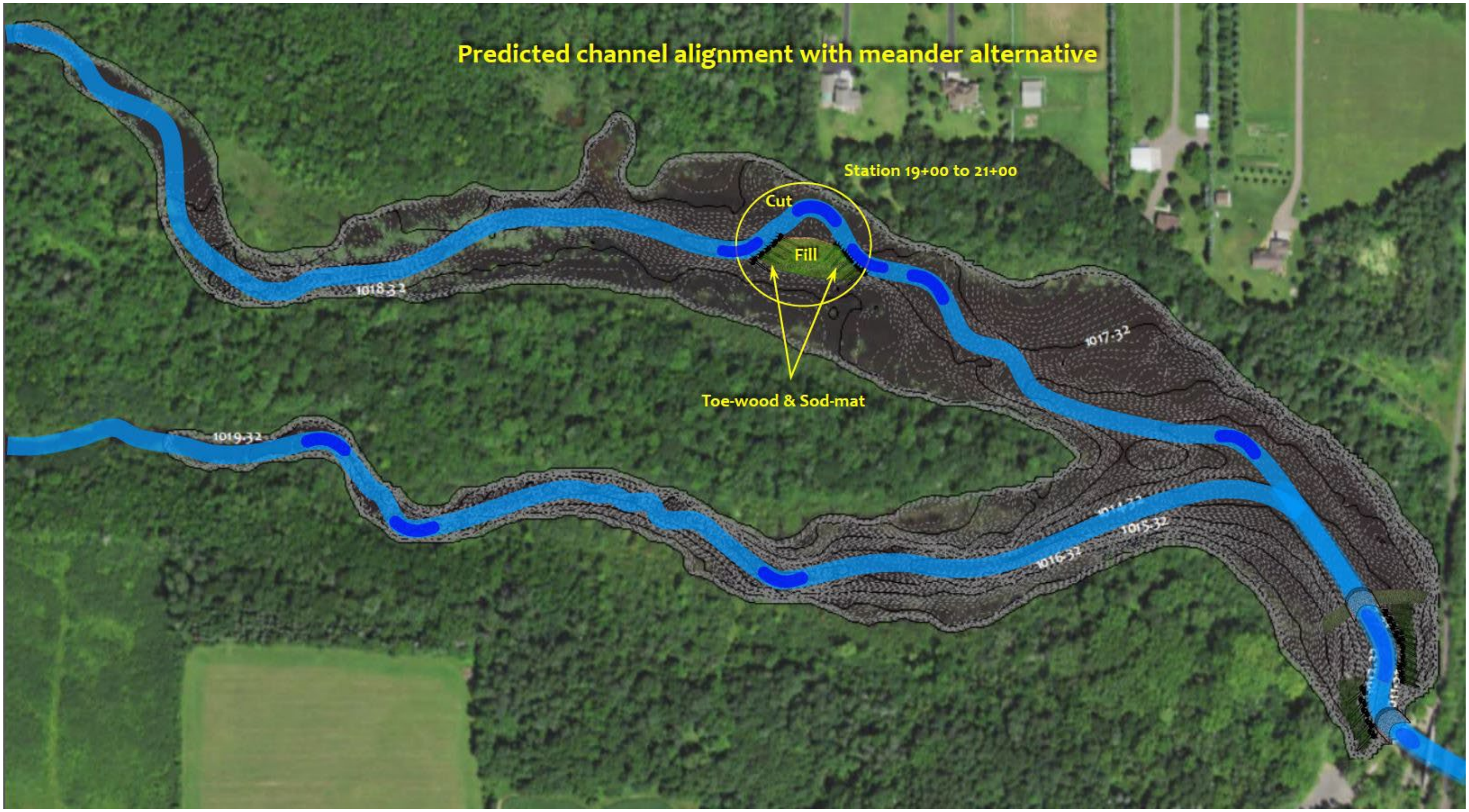

Figure 2-2. Partially engineered excavation with excavated meander at Station 19+00 to 21+00.

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1. Wetland Impacts

This section describes the wetland resources potentially affected by the proposed project, potential wetland impacts related to project implementation, and measures proposed to avoid, minimize, or mitigate impacts.

3.1.1. Affected Environment

Wetlands are located adjacent to much of the Grindstone Reservoir and the Grindstone River upstream of the reservoir. Some of these wetlands likely exist in their current locations due to the surface water elevation maintained by the dam. The historical extent and types of wetlands prior to dam construction are unknown.

The Final Scoping Decision Document (FSDD) identified the need for a wetland delineation to document existing wetland boundaries and types. A Level 1 wetland delineation dated April 27, 2021 determined the boundaries and types of wetlands potentially impacted by the proposed project (Appendix B).

The Level 1 delineation consisted of an examination of available mapping resources (soils, topography, National Wetlands Inventory, aerial photographs, historic aerials) to determine potential presence of wetlands. Boundaries were digitized based on topographic relief (2-foot Light Detection and Ranging (LIDAR) derived contours) and wetland signatures identified on aerial photographs. The boundaries were field-verified to confirm accuracy and document wetland plant community types.

A total of 13 wetlands were delineated along with two riverine aquatic resources (Table 3-1; Figure 3-1). The two riverine aquatic resources correspond to the Grindstone Reservoir and Grindstone River. Delineated wetland acreage totals 51.2 acres not including the two riverine aquatic resources. The delineated wetlands generally comprise a mix of Type 1 (Floodplain Forest), Type 2 (Fresh Wet Meadow/Sedge Meadow), and Type 6 (Alder Thicket) wetlands. Field observations described these wetland areas as a mosaic of both upland and wetland ranging from 15 to 100 percent wetland depending on microtopography. Although the wetland-upland mosaic contains some portion of upland over small microtopographic scales, the entire area is considered wetland. A portion of a fisheries pond downstream of the dam was delineated and identified as a Type 80 (Freshwater Pond).

The Wetland Conservation Act (WCA) Technical Evaluation Panel (TEP) conducted an on-site pre-application review of the Level 1 wetland delineation on July 21, 2021. The TEP noted several mineral flats that were not identified by the Level 1 wetland delineation. The mineral flats were disconnected from the reservoir and appeared to be receiving water primarily from surficial hydrology. Mineral flats are flat, precipitation-fed wetlands that are frequently present on former river terraces that have been disconnected from the main channel.

Table 3-1 Wetland and riverine resources identified by the Level 1 wetland delineation. Additional mineral flat wetlands were noted during the TEP field review.

Resource ID	Resource Type	Circular 39 Classification	Cowardin Classification	Eggers & Reed Classification	Resource Area
1	Tributary	Type 90	R2UBG	Riverine	1.02
2	Wetland	Type 1/2	PEM1B/FO1A	Floodplain Forest/Fresh Wet	1.91
3	Wetland	Type 2/6	PSS/EM1B	Sedge Meadow/Alder Thicket	0.40
4	Wetland	Type 1/6	PSS1B/FO1A	Floodplain Forest/Alder Thicket	15.72
5	Wetland	Type 1/6	PSS1B/FO1A	Floodplain Forest/Alder Thicket	13.44
6	Wetland	Type 1/6	PSS1B/FO1A	Floodplain Forest/Alder Thicket	0.31
7	Wetland	Type 1/6	PSS1B/FO1A	Floodplain Forest/Alder Thicket	1.51
8	Wetland	Type 1/6	PSS1B/FO1A	Floodplain Forest/Alder Thicket	0.79
9	Wetland	Type 1/6	PSS1B/FO1A	Floodplain Forest/Alder Thicket	12.68
10	Wetland	Type 1/6	PSS1B/FO1A	Floodplain Forest/Alder Thicket	0.12
11	Wetland	Type 1/6	PSS1B/FO1A	Floodplain Forest/Alder Thicket	0.87
12	Wetland	Type 2/6	PSS/EM1B	Sedge Meadow/Alder Thicket	0.05
13	Tributary	Type 90	R2UBG	Riverine	29.03
14	Wetland	Type 1/2/6	PSS/EM1B/FO1A	Floodplain Forest/Fresh Wet Meadow/Alder Thicket	3.26
15	Wetland	Type 80	PUBK	Freshwater Pond	0.11

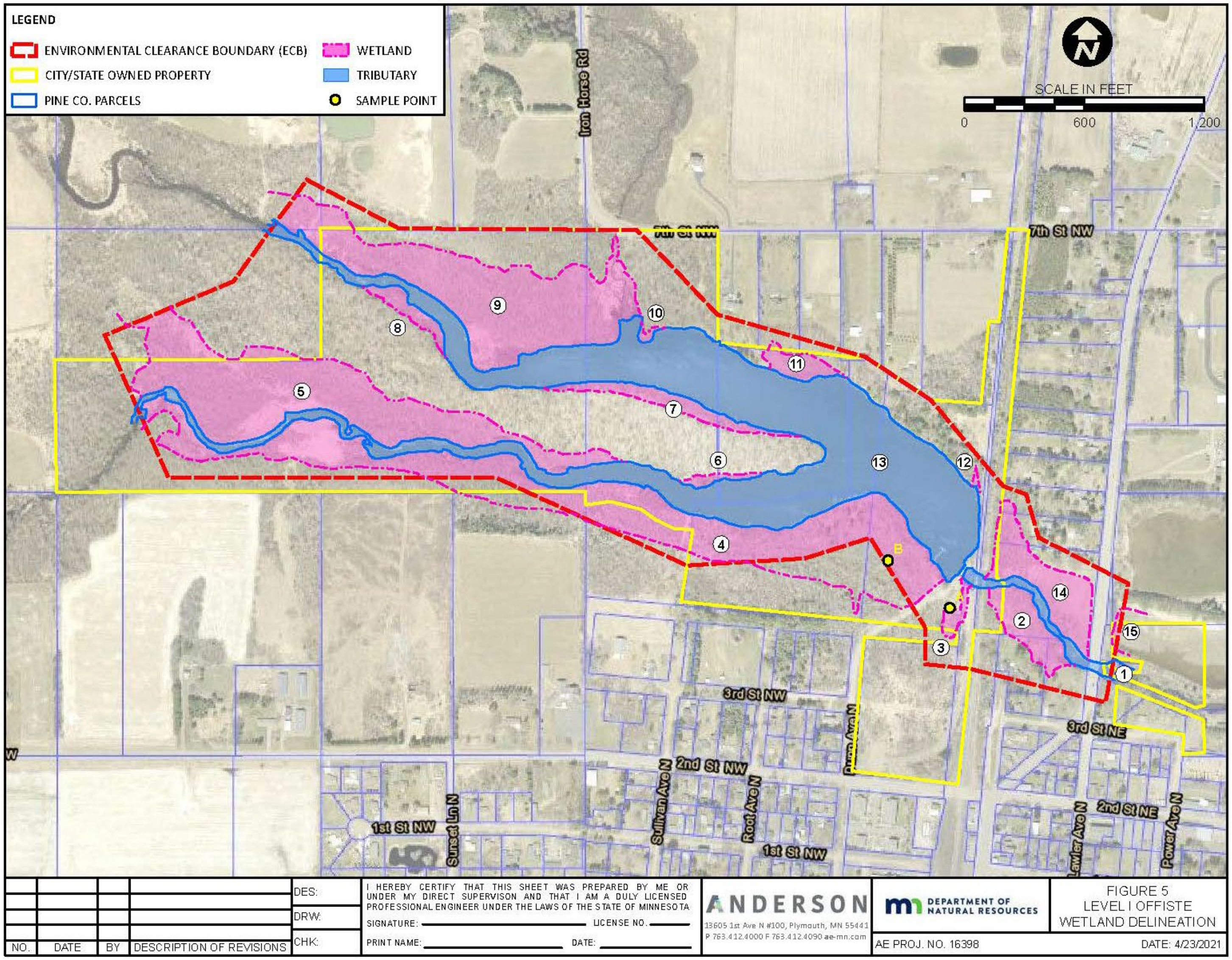

Figure 3-1. Delineated wetland boundaries labeled by Resource ID. The "Environmental Clearance Boundary" indicates the spatial extent of the study limits.

3.1.2. Environmental Consequences

This section describes both temporary and permanent impacts that are anticipated to occur to the existing wetlands present within the project vicinity for the proposed project and project alternatives. The term "impact" has a specific regulatory definition for state and federal wetland regulations. Wetland impacts within the EIS are considered under these specific regulatory definitions.

3.1.2.1. Proposed Project

Dam removal and subsequent changes in surface water elevation would create new wetlands within the restored floodplain, while also fully and partially draining some existing wetlands. Permanent angler access is proposed along the access route for riffle construction and may include a boardwalk or foot path that would minimize or avoid wetland fill. No other wetland impacts are expected.

The proposed project would likely create new wetlands and may result in net gain of floodplain wetlands. Wetland creation within the restored floodplain is inherent to project design and independent of potential regulatory wetland mitigation requirements (see Section 3.1.3). The channel of the Grindstone River within the existing area of the Grindstone Reservoir would be restored by allowing the new channel to naturally form following dam removal. Adjacent sediments to the restored channel would be exposed and a new floodplain would form adjacent to the restored channel. Bathymetry data indicates the reservoir bottom to be generally representative of the historical floodplain. Much of the exposed sediment would be expected to function as floodplain and maintain hydrologic connection to the Grindstone River such that wetland hydrology would establish. The TEP also noted a likely net gain of wetlands during the pre-application field review. The precise area, location, and type of new wetlands is unknown and is dependent on river channel evolution. The wetlands would likely occupy a significant portion of the restored floodplain and comprise mostly Type 1 or Type 2 emergent wetlands, with some succession of emergent wetlands to wooded wetlands in future decades. Exposed sediments would be seeded with a native plant mix and planted with trees to aid native plant community succession. Lower surface water elevations following dam removal would permanently impact the existing wetlands to some degree. Drainage may occur to the extent that wetland hydrology could be altered. Partial drainage would also likely occur to some remaining wetlands and cause change in the wetland boundary or type.

The specific wetlands and acreage lost or altered via drainage would depend primarily on floodplain response following dam removal. The EIS assesses hydrological effects of the dam removal, including changes to the floodplain, in Section 3.2 via a steady state Hydrologic Engineering Center River Analysis System (HEC-RAS) model. The modeled floodplain provides useful information for identifying locations and relative scales of hydrologic changes that would affect wetlands. The existing 100-year floodplain aligns approximately with the Level 1 wetland boundaries. Though not an indicator of wetland hydrology, results from the model combined with the Level 1 delineation are useful to generalize locations where changes to floodplain and wetland hydrology might be greatest.

Wetlands most affected by dam removal are likely those immediately upstream of the dam where the impoundment is largest (e.g. Resource IDs 4, 11, 12). New channel and floodplain formation in these currently impounded areas would likely occur at greater elevation differences from existing wetlands compared to existing wetlands located farther upstream. Model results also suggest the wetlands immediately upstream of the dam would be most affected by changes in floodplain location. Wetlands farther upstream would be less affected by dam removal (e.g. Resource IDs 5, 8). The Grindstone Reservoir already functions as a river in these areas and receives flow from the north and south branches of the Grindstone River. However, model results indicate that the floodplain in these areas would still be affected and could result in partial drainage.

Modeling results indicate very little change downstream of the dam and wetlands at these locations would not likely be significantly impacted (e.g. Resource IDs 2, 3, and 14). The mineral flats identified by the TEP would also likely not be significantly impacted as they are disconnected from the reservoir and hydrology is driven primarily by precipitation and surface flow from adjacent upland.

Completely and partially drained wetlands would experience shifts in hydrology following dam removal that could impact ecological condition. The wetlands are primarily dominated by trees and shrubs that are likely to persist as dominant cover, with small areas of sedge meadow that would be more sensitive to hydrologic change. However, the changes to hydrology could facilitate colonization of invasive species like common buckthorn (*Rhamnus cathartica*). Buckthorn is abundant within the AMA, including in delineated wetland areas (DNR 2013). Many other invasive species are present including reed canary grass, birdsfoot trefoil, Kentucky bluegrass, exotic honeysuckle, spotted knapweed, and

Canada thistle. Areas of sedge meadow would be more sensitive to shifts in hydrology and invasion than forested areas.

Drainage of wetlands due to the proposed project may be considered an impact under the Minnesota WCA pursuant to Minnesota Rules 8420.0111, subpart 32. Determination of impact would be subject to regulatory review of historic wetland condition prior to dam construction, existing conditions, and proposed conditions. Wetland impacts may also be regulated by Section 404(a) of the federal Clean Water Act.

Construction of the upstream riffle feature would require an access route that is proposed to be retained as permanent angler access to the restored channel. The access route may be converted to a boardwalk or foot path with a smaller footprint than the proposed access. The access route would likely transect both existing wetland and the exposed basin. A boardwalk would likely minimize or avoid wetland impacts. If proposed fill is included for a foot path, the portion of the foot path within existing wetland would likely be considered permanent impact under WCA and the Clean Water Act. The portion of the proposed access route within the existing reservoir is likely under DNR and USACE jurisdiction.

3.1.2.2. No Action Alternative

The no action alternative would not affect the existing wetlands unless the dam failed. Uncontrolled releases could drain existing wetlands or alter and degrade hydrology. Without active restoration of exposed sediments, invasive plant species could become established in these areas.

3.1.2.3. Partially Engineered Restoration

A partially engineered restoration would likely result in similar wetland impacts as described for the proposed project. The change in surface water elevation would be the same and the resulting floodplain would be very similar. Additional temporary impacts could occur if access through wetlands is needed for construction of the meander.

3.1.3. Proposed Mitigation and Monitoring Measures

Mitigation and monitoring would be completed, at a minimum, according to state and federal regulatory requirements if determined necessary. State regulations may or may not require mitigation under WCA and MPCA rules, and mitigation is dependent on review by applicable regulatory agencies. WCA regulates wetlands in Minnesota that are not public waters. The purpose of WCA according to Minnesota Rules 8420.0100 is to:

A. Achieve no net loss in the quantity, quality, and biological diversity of Minnesota's existing wetlands;
B. Increase the quantity, quality, and biological diversity of Minnesota's wetlands by restoring or enhancing diminished or drained wetlands;
C. Avoid direct or indirect impacts from activities that destroy or diminish the quantity, quality, and biological diversity of wetlands; and
D. Replace wetland values where avoidance of activity is not feasible and prudent.

Minnesota Rules 7050 also set forth water quality standards and mitigation principles for the protection of wetlands and are administered by MPCA. Minnesota Rules 7050.0186 state:

> Subpart 1. It is the policy of the state to protect wetlands and prevent significant adverse impacts on wetland beneficial uses caused by chemical, physical, biological, or radiological changes. The quality of wetlands must be maintained to permit propagation and maintenance of a healthy community of aquatic and terrestrial species indigenous to wetlands; preserve wildlife habitat; support biological diversity of the landscape; and be suitable for erosion control, groundwater recharge, low flow augmentation, storm water retention, and stream sedimentation. In addition, these waters must be suitable for boating and other forms of aquatic recreation as specified in part 7050.0222, subpart 6; general industrial use as specified in part 7050.0223, subpart 2; irrigation and use by wildlife and livestock as specified in part 7050.0224, subparts 2 and 3; and aesthetic enjoyment as specified in part 7050.0225, subpart 2.

If the proposed permanent angler access route is not able to avoid wetland fill via a boardwalk or other design alternative, fill would likely be considered a permanent impact and require a wetland replacement plan under WCA and MPCA rules. Drainage or wetland type conversion may be considered as "no-loss" due to the project purpose of fish and wildlife habitat restoration, meaning that WCA would not consider these impacts to result in permanent loss or impact to wetlands. Per Minnesota Rules 8420.0415, part D, fish and wildlife habitat restoration projects conducted by public agencies qualify under no-loss criteria. No-loss determination would require documentation and comparison of historic, existing, and proposed conditions. If a no-loss determination does not apply, the drainage or wetland type change impacts would likely require a wetland replacement plan. The replacement plan would also require a similar comparison of historic, existing, and proposed conditions, including demonstration of proposed impacts. The replacement plan would require approval by WCA authorities and would either achieve replacement by purchasing credits from a wetland mitigation bank or through approved project-specific restoration within the Hinckley AMA. If necessary, a replacement plan must be approved prior to construction of the proposed project.

Federal regulations may require compensatory wetland mitigation similar to the WCA replacement plan depending on final project design and agency review. The Grindstone River is a federal navigable water under Section 10 of the River and Harbors Act and a water of the United States (WOTUS) under Section 404 of the Clean Water Act. Section 10 regulates work in navigable waters and Section 404 regulates discharges of dredge and fill material into WOTUS. Wetlands adjacent to the Grindstone River are likely considered WOTUS. Compensatory mitigation may not be required should the proposed project qualify for a USACE general permit (for example, Nationwide Permit 53 – removal of low-head dams).

Permits issued by the federal government such as Section 10 and Section 404 permits also require certification under Section 401 of the Clean Water Act. Section 401 certification ensures that a permit is not issued that would result in a violation of state water quality standards set under the Clean Water Act. In Minnesota, the MPCA either reviews and certifies federal permits under Section 401 or waives the review. The MPCA issues a general certification for activities covered under federal nationwide and general permits. Activities not covered by a nationwide permit require an individual certification from the MPCA.

Specific regulatory requirements related to wetland impacts are strongly dependent on final project design and subsequent findings of the wetland regulatory review process. Interagency coordination among the project proposer and regulatory agencies is ongoing. Should the proposed project advance, interagency coordination would be critical to determine final mitigation measures.

Mitigation and monitoring would also consider the impacts to existing wetlands that may be potentially impacted beyond regulatory requirements. Drained wetlands would experience shifts in hydrology and vegetation and would require management to aid in natural succession to upland plant communities. Mitigation and monitoring measures for wetland plant communities are described further in Section 3.4.3.1, which also addresses upland plant communities affected by the proposed project.

3.2. Hydrological and Hydraulic (H&H) Effects

This section describes the hydrology and hydraulic (H&H) study in the vicinity of the Grindstone Dam. The purpose of the study is to examine how the existing floodplain and the Grindstone River water levels in the area may potentially be affected by the proposed project. This section also includes measures proposed to avoid, minimize, or mitigate impacts. The focus for this section is primarily on the flooding events within the project area, including recurrence intervals for the 2-, 10-, 50-, 100-, and 500-year storm events.

3.2.1. Affected Environment

The Grindstone River is within the St. Croix River Basin and is a tributary of the Kettle River. The Grindstone Dam is located downstream of the junction of the North Branch and South Branch Grindstone Rivers. The watershed area that drains to the Grindstone Dam is approximately 76.7 square miles (USGS, 2021), and consists of primarily agricultural and rural land uses. The Grindstone Reservoir is located immediately upstream of the Grindstone Dam and is impounded at the dam elevation of approximately 1,019 feet above mean sea level. Upstream of the reservoir, the North and South Branch Grindstone Rivers are widened due to the slow flow caused by the impoundment. Downstream of the dam are multiple bridge crossings and a steeper river slope with some sinuosity that results in a faster moving river at a lower elevation.

Removal of the Grindstone Dam would open approximately 25.7 miles of public watercourse upstream of the dam as free-flowing (including the North Branch, South Branch, and an unnamed tributary to the South Branch). The only upstream dam is located at the outlet of Grindstone Lake. The Grindstone Dam is located within a Federal Emergency Management Association (FEMA) Zone A floodplain area. There are FEMA Hydraulic Models from 2010 in the project area that are available from the DNR Floodplain Unit. Those models are the best available data at this time. The existing floodplain boundary can be seen in Figure 3-2.

3.2.2. Environmental Consequences

An H&H technical analysis was prepared to evaluate the potential impacts of the dam removal on flood levels within the Grindstone River (Appendix C). The H&H analysis used a steady state HEC-RAS model to estimate water surface elevations, depths, velocity, and other hydraulic computations at cross section locations along the river reach. The HEC-RAS model included the North and South Branch Grindstone Rivers approximately 1.4 miles upstream of the Grindstone Dam, and the Grindstone River approximately 6.4 miles downstream of the Grindstone Dam. The downstream extent of the model is just upstream of the junction of the Grindstone River and the Kettle River. The extent of the model is based on the existing model that is the best available from the DNR. The HEC-RAS model was refined for the project area by incorporating bathymetry data of the Grindstone Reservoir collected by the DNR and extending model boundaries to capture the floodplain areas for all storm events evaluated. The HEC-RAS model was not updated downstream of the Grindstone Dam as a part of this analysis, however the results for existing and proposed were compared for the entire HEC-RAS model extents. Data used in the model included peak flow data from United States Geological Survey (USGS) Stream Stats, and the best available data provided by the DNR from the FEMA effective model for the area.

3.2.2.1. Proposed Project

Hydraulic impacts from the proposed project were assessed in both a short-term and long-term condition. These two scenarios were selected for analysis based on field observations by DNR and assumptions about sediment processes. Based on DNR field review, the North Branch of the Grindstone River contains fine mobile sediment within the existing streambed, consisting of organics, silt, and sand, with a hard bottom underneath. It is predicted that after the removal of the dam and placement of the rock riffles, the river thalweg would shift down to the hard bottom, resulting in the sediment mobilizing, and leaving increased depths in areas of the North Branch Grindstone River. The two scenarios reviewed for the proposed project were:

1. Short term proposed project: This scenario simulated the river thalweg as it was surveyed.
2. Long term proposed project: This scenario simulated a new thalweg as a result of the fine sediment mobilizing and creating a deeper cross-sectional area in some locations.

The modeled results for the proposed project indicated that there would be a decrease in water surface elevations upstream of the existing dam in all recurrence intervals as compared to the existing conditions up to 0.6 miles upstream of the dam on the North Branch Grindstone River, and up to 1 mile upstream of the dam on the South Branch Grindstone River. The maximum decrease in the 100-year storm recurrence interval would occur at the location of the existing dam and would decrease by approximately 7.6 feet in the short term proposed project and approximately 7.7 feet in the long term proposed project. Figure 3-2 shows the comparison of the existing 100-year floodplain boundary and the proposed project 100-year floodplain boundary.

The proposed project hydraulic modeling indicates there would be no change to the flood hydraulics of the bridges and other river stations of the Grindstone River that are downstream of the existing dam.

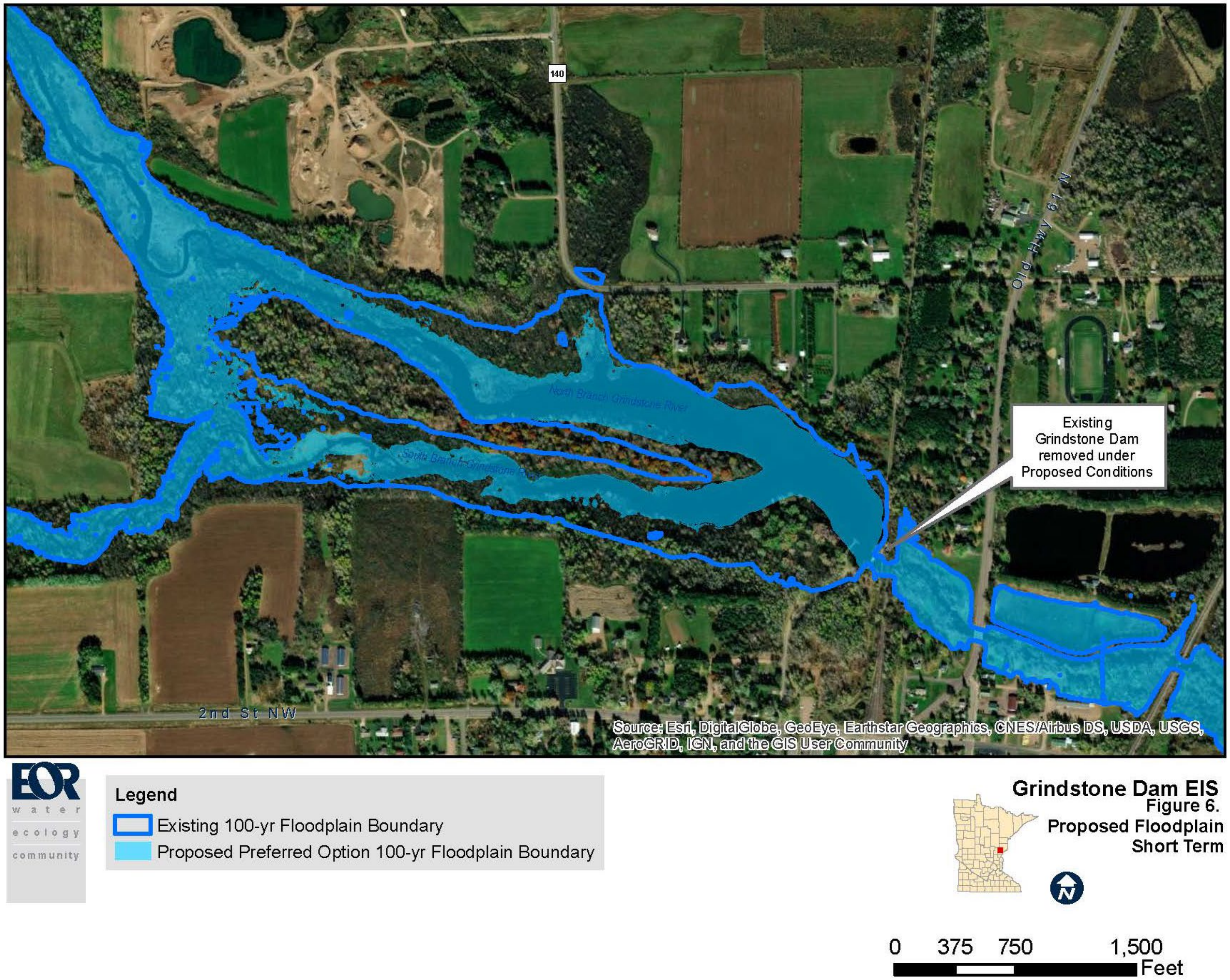

Figure 3-2 Existing and proposed floodplain boundary shown on an aerial map.

3.2.2.2. No Action Alternative

The no action alternative of leaving the dam in place would not change the H&H conditions unless the dam failed. If the dam failed, there would be a significant and abrupt change in H&H conditions. A dam failure would cause an immediate and major safety concern for people utilizing the Grindstone Reservoir and at the downstream bridge crossings. In the short term, the sudden change in velocity and water elevation of the river would increase risks for injury to people and river biota as well as present hazards associated with erosion and debris transport downstream. In the long-term, once the H&H conditions equilibrate following a dam failure, the resulting conditions may be similar to the proposed project. However, impacts from erosion and debris may permanently alter these conditions and are difficult to predict without a conducting a dam failure analysis model. A dam failure analysis model was not completed as a part of the H&H modeling.

3.2.2.3. Partially Engineered Restoration

A partially engineered restoration would have similar impacts as the proposed project. The physical location of the river would change in the partially engineered restoration with the addition of the meander, but does not significantly change the H&H water surface elevation recurrence interval results. The hydraulic analysis of the partially engineered restoration indicated there would be no impact on bridge structures downstream of the existing dam.

3.2.3. Proposed Mitigation and Monitoring

The steady state HEC-RAS model used to assess the proposed project and partially engineered restoration showed there is no impact to bridges or structures as a result of the project, and shows that flood levels will decrease as a result of the project. However, conditions that may affect the results include:

- Sediment in the river mobilizes and migrates more than expected, causing a change in hydraulics.
- One or both of the constructed riffles fails, causing a change in hydraulics.

The likelihood of greater than expected sediment mobilization or riffle failure is low and neither scenario was explored in the H&H analysis. Higher than expected sediment mobilization could change the predicted impacts if the sediment is deposited in a downstream location that would have an adverse impact on that specific location's hydraulic capacity. For example, if sediment were to be deposited at an existing bridge opening, there may be less area for water to pass through the existing bridge, resulting in higher water levels or flooding that could occur upstream of the bridge opening.

Riffle failure could affect downstream velocities and water surface elevations, and could have an adverse impact on downstream hydraulic conditions. The constructed riffles would be controlling the water elevation and velocities of the Grindstone River. If the riffles fail, there could be resulting flooding downstream or higher velocities that may result in erosion. Riffle failure was not considered as a scenario in the hydraulic modeling analysis.

Post-construction monitoring and inspection of the project is warranted to assess potential for impacts. A post-construction bathymetric survey should be completed to confirm pre-project assumptions of sediment mobilization should be completed one year after project completion to confirm pre-project assumptions of sediment mobilization. Inspection of the constructed riffles should also be completed one year after project completion to confirm they are constructed and operating as designed. The operation and maintenance plan for the project should include inspections of the constructed riffle.

Monitoring of nearby DNR-owned bridges and structures would be conducted by trained hydrology and erosion specialists after the removal of the dam to confirm the proposed project is operating as expected. It is possible that the existing Grindstone Dam catches and holds debris during storm events. With the removal of the dam, there may be increased likelihood of debris jams around downstream bridges, which would impact scour and increase the frequency for maintenance and removal of debris at bridges.

Monitoring of tributaries upstream of the existing dam would be completed after the completion of the project. Specifically, the tributary that joins the North Branch Grindstone River within the Grindstone Reservoir is of concern since it is located within the area predicted to have decreased flood elevations. Therefore, it may be susceptible to erosion as a result of the changing flood elevations within the Grindstone River. Bank erosion assessments would be completed if there appears to be any head cutting in tributaries or near the junction of tributaries with the Grindstone River as a result of the water levels changes that occurred from the project.

A Letter of Map Revision (LOMR) submittal may be necessary and would be submitted to DNR and FEMA following project completion.

3.3. Sediment and Contaminants

Because reservoirs create slack-water conditions that trap sediment behind dams, any dam removal project must consider the potential transport of this accumulated “legacy” sediment downstream. Riverine transport of legacy sediment in unnaturally large rates can change the shape of a stream channel and the grain size of the streambed sediment, potentially degrading the habitat of benthic organisms, i.e., those plants and animals that live on or near the stream bed. Transport of fine-grained legacy sediment can make the water turbid and harm both fish and filter-feeders such as mussels. This section characterizes the existing legacy sediment in the Grindstone reservoir, describes the environmental consequences of disturbing this sediment, and suggests ways to minimize these consequences.

3.3.1. Affected Environment

The area affected by the proposed project includes not only the approximately 26 acres where sediment has accumulated behind the Grindstone dam, but also the receiving waters downstream that would receive legacy sediment mobilized as a consequence of the dam removal. These waters include the Grindstone River below the dam, the Kettle River below its confluence with the Grindstone, and the St. Croix River below its confluence with the Kettle. The Kettle River is a state-designated wild and scenic river (DNR n.d.), and the St. Croix River is a federally designated scenic and recreational river (Waters 1977). These designations indicate that these rivers deserve extra scrutiny for possible environmental impacts from projects in their watersheds.

In recognition of the potential mobilization of legacy sediment, the DNR contracted with the engineering consulting firm WSB to collect and analyze sediment cores from the reservoir (Appendix D; WSB 2021). Based on the sample locations described in the FSDD, WSB collected seven sediment cores, ranging in depth from four to nine feet below grade (the sediment/water interface). Six cores were taken from the thalweg of the north branch and main body of the reservoir, and one core was taken from the smaller south branch (See Figure 3-3). The upper segment in each core was subsampled, as well as an underlying segment in three of the cores where a stratigraphic change was evident in the field. All samples were composed of greater than 7% fines (silts and clay) and thus analyzed further for chemical content (MPCA 2014), which was compared with Soil Reference Values (SRVs) of possible contaminants. An SRV is a concentration of a pollutant in soil or sediment that could impact human health and is calculated based on exposure parameters, toxicity, and chemical risk parameters (Brooks 2021b). When an SRV is impractical to apply because of being lower than ambient background concentrations, then an alternate SRV is determined based on an upper percentile (e.g., 95th percentile) of ambient concentrations. Arsenic is one such pollutant. A level 1 SRV is low enough to be safe for residential/recreational settings, where exposure may occur to people of all ages as they walk or recreate on lawns, parks, playing fields, and gardens. A level 2 SRV is higher but acceptable for commercial/industrial settings, where children are infrequently present and exposure to adults on vegetated areas is intermittent and less prolonged. A level 3 SRV (i.e., concentrations exceeding level 2) indicates that repeated human exposure is unacceptable, and that the sediment could be landfilled to minimize contact (Brooks 2021).

WSB analyzed the fine fraction of Grindstone sediment samples for a host of possible toxins: metals and metalloids (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc, chromium III, and chromium VI), organics (PAHs and PCBs), and biotically active components (phosphorus, nitrogen species, and total organic carbon). All concentrations were below level 1 SRVs (where SRVs have been established) except for arsenic (WSB 2021).

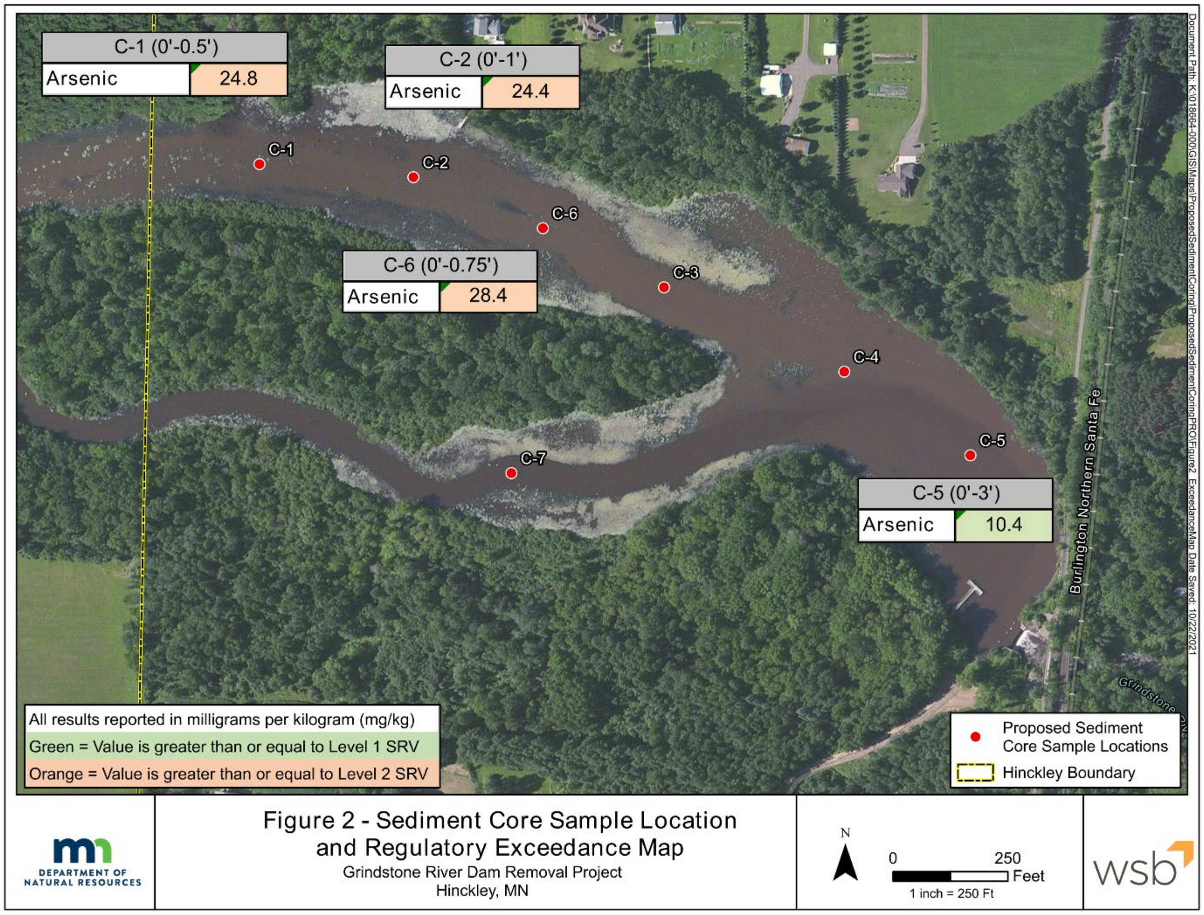

Figure 3-3. Sediment core sample location map and arsenic exceedance concentrations

Arsenic is a naturally occurring element that is commonly found in soils and groundwater, yet it is also considered “highly toxic in its inorganic form” (WHO n.d.). Human exposure is mostly through ingestion of contaminated groundwater and foods; children could ingest dust and dirt in some settings. Breathing of contaminated dust could provide further exposure. Contact with skin is inconsequential (ATSDR n.d.). Chronic exposure can cause cancer, skin lesions, and in utero damage (WHO n.d.).

Arsenic exceeded all SRVs in the uppermost sediment in four of the seven cores (Figure 3-3), placing these sediments in the level 3 SRV category. Arsenic SRVs for Minnesota were determined based on the 95th percentile of concentrations in 137 soil samples from across Minnesota collected to avoid human-caused contamination, i.e., “natural” samples to the degree possible (Brooks 2021a). Both the level 1 and 2 SRVs for arsenic have recently (fall 2021) been set at 9 mg/kg (MPCA 2021), whereas the concentrations in the uppermost sediment samples from cores C1, C2, C5, and C6 were 24.8, 24.4, 10.4, and 28.4 mg/kg, respectively (WSB 2021). These concentrations suggest that if channel material is excavated from (or exposed at) these sites, then the resulting dredged material is not acceptable for deposition in either residential/recreational or commercial/industrial settings (MPCA 2014).

However, such arsenic concentrations may be natural in aquatic sediments. Crane and Hennes (2016) analyzed surface (0-15 cm) sediment from 54 lakes across Minnesota and found an average of 10.5 mg/kg arsenic, with substantial variability (standard deviation of 12.6 mg/kg). These data suggest that most aquatic sediment exceeds level 2 SRVs and would be unsuitable for human exposure. In contrast, the risk to aquatic life is modest. In an earlier study Crane and Hennes (2007) determined sediment quality targets (SQTs) for a large number of toxins. A level I SQT provides "a high level of protection for benthic invertebrates," and a level II SQT provides "a moderate level of protection for benthic invertebrates" (Crane and Hennes 2007, p. xi). All concentrations of arsenic in the sediment from the Grindstone reservoir lie between the level I and level II SQT concentrations of 9.8 mg/kg and 33 mg/kg, respectively, indicating a moderate level of protection for aquatic organisms.

The chemistry of arsenic makes these data unsurprising. Arsenic is commonly bound to iron and manganese oxy-hydroxides in environmental settings (Ferguson and Gavis 1972, Aggett and O'Brien 2002, Fendorf et al. 2010). In organic-rich aquatic sediments, porewaters become reduced and thus dissolve oxy-hydroxides, thereby releasing iron, manganese, and their bound components (arsenic and phosphorus among them) into solution where they can diffuse through porewaters. Where the uppermost sediment is in contact with oxygenated water, iron and manganese once again become oxygenated and immobilized, which in turn traps adsorbed components such as arsenic. In short, natural porewater dynamics create a situation where soluble arsenic in the deeper sediment column diffuses upward and becomes trapped in the near-surface sediment, which thus becomes enriched in arsenic. If groundwater pressures additionally create groundwater flow upwards through aquatic sediment (as could happen in the headwaters of a reservoir), then the enrichment process could be enhanced.

3.3.2. Environmental Consequences

3.3.2.1. Proposed Project

The proposed project would result in a new stream channel being cut into the existing legacy sediment behind the dam. Because the reservoir level would be lowered gradually, the stream cut would begin first in the upper reaches of the reservoir, redistributing the mobilized sediment into the remaining (diminishing) pool below as well as to the downstream channel below the dam. Transported sediment should be confined to the existing downstream channel if the reservoir is lowered gradually enough to avoid flows greater than bankfull. Transported fine sediment (silt and smaller) will result in increases in turbidity and potentially impact the downstream streambed, with negative consequences for fish and benthic biota. However, such impacts will be short-lived, and because streamflows will remain as they currently are, there should be no substantial net deposition of fine sediment in the downstream channel. Transported coarse sediment (sands) may have a longer-lived impact as a pulse of mobilized sand works its way down the channel by saltation. This migrating and aggrading wedge of sand could raise the downstream streambed elevation (Pizzuto 2002) and potentially bury invertebrates, notably mussel beds (see section 3.4.4.1. Mussels below). The hydraulic effect of changed bed conditions are discussed above in section 3.2. H&H Effects.

Fine-grained sediment enriched in arsenic will also be transported downstream. However, as noted above, arsenic concentrations appear to be the consequence of natural processes and lower than the level II SQTs for moderate protection of benthic invertebrates. These fines will not linger in the downstream channel and will eventually be deposited in slack-water environments or floodplains, where arsenic concentrations might be similar. However, a better understanding is needed of where arsenic is likely to be found and why it is so common in aquatic sediment (Crane and Hennes 2016). Upstream of the dam location, stabilized banks composed of former reservoir sediment may immobilize existing arsenic, to the degree that these dewatered sediments are exposed to oxygen and the arsenic becomes tightly bound to metal (iron and manganese) oxy-hydroxides. Such sediment would eventually be moved downstream as a consequence of natural meander migration over time.

The proposed project will increase the downstream loads of not only sediment but nutrients as well, to the degree that the existing reservoir traps these sediments and nutrients. These loads then can contribute to the siltation and eutrophication of downstream receiving waters (Stanley and Doyle 2003). Sediment trapping efficiencies for reservoirs can easily reach over 90% (Brune 1953, Heinemann 1981). Phosphorus trapping efficiencies have been estimated at 12% globally for 1970-2000 (Maavara et al. 2015) but can range annually from zero to over 90% for selected reservoirs (Panuska and Robertson 1999). It seems likely that the existing trapping efficiency of the Grindstone Reservoir is relatively low, given its age and shallowness. While the current reservoir traps bedload, much of the fine sediment and phosphorus continue downstream, and consequently removal of the dam will increase downstream loads only slightly. Nonetheless, it is important to consider the eutrophication impact on receiving waters when sediment and nutrient traps are removed from the channelized system. Far downstream (greater than 90 miles) of the Grindstone Reservoir, Lake St. Croix has been declared impaired by eutrophication caused by excess phosphorus loads.

3.3.2.2. No Action Alternative

If the proposed project does not move forward, then the present reservoir will retain its legacy sediment behind the dam, until such time that the dam fails again. When this occurs, the sediment release will be a large, uncontrolled event that could decimate downstream habitat for an unknown (but temporary) period. Up until dam failure (if it occurs), the reservoir will continue its sediment and nutrient trapping function but with decreasing efficiencies as it gradually fills with accumulated sands and fines.

3.3.2.3. Partially Engineered Restoration

The partially engineered alternative involves directing the new channel formation toward a meander along the north valley wall of the upper part of the north branch of the reservoir footprint (see Figure 2-2). This proposed channel location is approximately where the arsenic concentrations in the upper sediment exceed the level 2 SRV (see Figure 3-3). However, the proposed channel excavation would be toward the valley wall, where sediments are likely coarser and thus with lower arsenic concentrations than in the fine sediment near the middle of the channel (the thalweg). Overall, we do not expect any significant difference in sediment mobilization and downstream impacts compared to the proposed project.

3.3.3. Proposed Mitigation and Monitoring

A slow drawdown of the reservoir water levels is critical to meter the downstream transport of fine sediment into small temporary pulses of turbidity that do not overwhelm or bury the aquatic biota (notably mussels). Both the water and biota should be monitored downstream of the dam during its dismantling to document the timing and magnitude of the turbidity pulse, plus its effective reach downstream (see section 3.4.4.1.3 for suggested mussel monitoring methods; specific monitoring requirements would be identified during permitting). A turbidity meter could be installed downstream to monitor the expected pulses of mobilized fine sediment created as the reservoir is gradually lowered. Migration of an aggrading sand layer downstream, if any, should be observed carefully for its potential to bury benthic biota. The plan to minimize sediment mobilization is discussed more fully in sections 2.1.3. Dam Removal and 2.1.4. Grading and Structures, but includes removing the dam gradually during low-flow conditions, allowing sediment consolidation, installing in-stream riffles as grade-control structures, installing bank stabilization structures, seeding with native plant mixtures, and planting floodplain-tolerant tree saplings. Full establishment of vegetation on the newly exposed substrate is expected to take two to five years.

The arsenic-enriched sediment in the north arm of the reservoir presents a challenge should the partially engineered alternative be selected. This alternative design is discussed more fully in section 2.2.2.1 above, partially engineered restoration (meander excavation). If possible, channel excavation should take place while there is still a residual pool remaining behind the dam to temporarily capture eroded sediment in stormwater runoff during construction. As noted above, the material excavated to create the meander channel may be coarse enough to have lower arsenic concentrations than those measured in the fine sediment in the middle of the channel. This material could be then used as fill on the inside of the constructed meander, thus burying the fine sediment enriched in arsenic. Otherwise, if the excavated material still exceeds the level 2 SRV for arsenic (9 mg/kg), then the sediment is technically unsuitable for land application where repeated human exposure is expected. It may still be suitable for filling the inside of the meander, if one can argue that the restored floodplain will not receive significant human contact. Perhaps in addition, cleaner fill could be placed over the dredged sediment placed inside the meander, thereby limiting exposure at the surface. Since the sediment does not exceed the level II SQT for aquatic sediment, another option would be to simply allow the excavated material to gradually wash downstream, where it would mix with similar aquatic sediment. A final option would be to landfill the excavated material, where it would be buried to eliminate human exposure.

Permits required to complete work related to sediment and contaminants include National Pollution Discharge Elimination System/State Disposal System (NPDES/SDS) construction stormwater (CSW) permit. The MPCA is the unit of government responsible for issuing permits. Specific requirements for mitigation and monitoring would be further identified and developed during the permitting process.

3.4. Plant Communities, Wildlife, Fish, and Sensitive Ecological Resources

This section describes the plant communities, wildlife, fish, and sensitive ecological resources within or potentially within the AMA, potential impacts to these resources related to project implementation and project alternatives, and measures proposed to monitor and avoid, minimize, or mitigate impacts.

3.4.1. Plant Communities

3.4.1.1. Affected Environment

The Hinckley AMA occurs within the Mille Lacs Upland Subsection of the Western Superior Uplands. The overburden soils in the area of the dam consist of sandy loam to loam and were deposited by melt waters from the most recent glacier that receded from this area approximately 10,000-12,000 years ago. This area historically consisted of a mosaic of plant community types including hardwood, coniferous, and mixed forests interspersed with peatlands and other wetland types. Natural disturbance from fire and windthrow strongly influenced vegetation prior to European settlement. Currently, three plant communities are present at the AMA based on information provided in the Hinckley AMA Management Guidance Document. These plant communities include upland hardwood forest, wooded wetlands, and shallow lake (DNR, 2017).

The upland hardwood forest on the Hinckley AMA is representative of a Northern Wet-Mesic Hardwood Forest (DNR plant community code: MHn46) native plant community. These communities occur as wet-mesic lowland hardwood forests on level sites with clayey subsoils or high local water tables. Quaking aspen and silver maple are most abundant, with oaks, elm, basswood, and red maple present. Most of the shoreline along the river is dominated by trees and shrubs typically found in wetland forest systems including eastern cottonwood, boxelder, willows, black ash, and specked alder. Herbaceous vegetation composition was not recorded in the AMA guidance document, but species typical of this plant community type include lady fern, wild sarsaparilla, Canada mayflower, dwarf raspberry, large-leaved aster, sweet-scented bedstraw, and Pennsylvania sedge (DNR, 2016). No ecological condition rank has been assigned to the upland hardwood forest at the AMA.

However, the invasive shrub common buckthorn is reportedly abundant and indicates likely degradation. Northern Wet-Mesic Hardwood Forest is assigned a conservation status rank of S4 by the DNR, meaning it is "apparently secure; uncommon but not rare."

The wooded wetlands at the Hinckley AMA form a wetland complex adjacent to the Grindstone Reservoir. According to the Level 1 wetland delineation report conducted for this EIS, these wooded wetlands include predominantly floodplain forest and alder thicket based on the Eggers and Reed wetland plant community classification system, with small areas of fresh wet meadow and sedge meadow. Equivalent DNR Native Plant Community classifications respectively include: Black Ash-Silver Maple Terrace Forest (DNR plant community code FFn57a), Willow-Dogwood Shrub Swamp (DNR plant community code WMn82a), and Sedge Meadow (DNR plant community code WMn82b). No ecological condition rank has been assigned to the wooded wetlands within the AMA. Similar to the upland hardwood forest, the invasive shrub common buckthorn is reportedly abundant and indicates likely degradation. Black Ash-Silver Maple Terrace Forest is assigned a conservation status rank of S3 by the DNR, meaning it is "vulnerable to extirpation." The Willow-Dogwood Shrub Swamp and Sedge Meadow communities are assigned an S4 or S5 rank depending on composition, which range from "apparently secure; uncommon but not rare" to "secure, common, widespread, and abundant".

The Grindstone Reservoir comprises the aquatic plant community within the AMA and consists of a shallow lake community impounded by the Grindstone dam. Bathymetry contours surveyed in 1989 indicated a maximum depth of 10 feet just upstream of the dam with a median depth of 3.3 feet (DNR, 1993). More recent bathymetric surveys by DNR staff indicate a maximum depth of 8 feet. The small size and shallow depth limit the capacity for game fish species. Submerged aquatic vegetation includes common species such as coontail, northern water milfoil, Canada waterweed, and several pondweeds (*Potamogeton* spp.). Floating-leaf and emergent vegetation are also present and include yellow water lily, cattail, and arrowhead. Shallow lake plant communities are not included in the DNR native plant community classification system and therefore are not assigned a conservation status rank.

3.4.1.2. Environmental Consequences

3.4.1.2.1. Proposed Project

The upland hardwood forest, wooded wetland, and shallow lake plant communities would all likely be permanently impacted to varying degrees by the change in surface water and groundwater conditions. The shallow lake community would be eliminated by dam removal and replaced with a river channel, riparian shoreland, floodplain, and upland.

The wooded wetland communities present are dependent on surface water maintained by the existing dam. Proposed dam removal could lower the water table and potentially change the water depth, vegetation, and associated wildlife use of these wetlands, or convert them to non-wetland areas. Wetland hydrology would reestablish in new areas as the river reconnects with the floodplain following dam removal. Wetland impacts are discussed specifically in Section 3.1.

The upland hardwood forest could be affected by a lower water table. Northern Wet-Mesic Hardwood Forest is a plant community that may depend on a high local water table in spring that decreases slowly over the growing season (DNR, 2016). Site hydrology of the existing community is unknown, but could be affected by the impoundment, geomorphic position, soils creating a perched water table, and interactions with precipitation. If the water table was lowered in the wet-mesic hardwood forest, species with an affinity for more well-drained soils may colonize the community. Changes would likely not be rapid and existing trees and shrubs would persist as dominant vegetation in coming decades. Long-term, the wet-mesic forest could transition to a mesic forest community such as Central Mesic Hardwood Forest (Eastern) (DNR plant community code MHc36). A drier forest community could increase the abundance of tree species such as northern red oak, sugar maple, paper birch, and bigtooth aspen, which may benefit some wildlife species. Hydrologic disturbance to the forest community could facilitate colonization or expansion of invasive species such as common buckthorn, which is already abundant. Invasive species impacts are discussed specifically in Section 3.4.5.

3.4.1.2.2. No Action Alternative

The no action alternative would not affect the existing plant communities unless the dam failed. Uncontrolled release could dewater the shallow lake and adjacent wooded wetland communities and expose sediments. Without active restoration of exposed sediments, invasive plant species could become established in these areas. Changes to the upland hardwood forest could result in similar shifts to slightly drier conditions as described for the proposed project.

3.4.1.2.3. Partially Engineered Alternative

A partially engineered restoration would likely result in similar impacts to plant communities as described for the proposed project.

3.4.1.3. Proposed Mitigation and Monitoring Measures

Mitigation of plant community impacts would focus on restoration of exposed shallow lake sediments to a floodplain plant community. The sediments would be seeded with a native plant mix. Select trees could be planted in the following year. Vegetation establishment would be expected to take two to five growing seasons to fully establish, though newly-exposed reservoir sediments typically experience significant vegetation growth during the first growing season. The restoration site would be monitored for invasive species. Existing wetland plant communities and upland forest could also be impacted to varying degrees by hydrologic changes and may be vulnerable to invasion. Areas within the AMA would be monitored for invasive species and managed according to the Hinckley AMA Management Guidance Document (DNR, 2017).

3.4.2. Wildlife

3.4.2.1. Affected Environment

The proposed project is located within a natural area containing the native plant communities described above in Section 3.4.1.1 and provides habitat for a variety of species. The following section describes wildlife and wildlife habitat in the project vicinity. Rare and sensitive species are discussed separately below.

Numerous wildlife species are adapted to the mesic hardwood forest community, including several species of greatest conservation need. Important habitat features of the mesic hardwood forest include large tracts of contiguous forest, a dense understory, a closed canopy, snags and downed trees, large trees near water, and early successional or disturbed forests with dense understories. Although the forest is relatively narrow in width and contains a significant amount of edge habitat, it likely provides several of these habitat features that benefit a wide variety of wildlife. The forest is contiguous along the narrow corridor adjacent to much of the Grindstone River, both upstream and downstream of the dam. This corridor provides local connectivity within a landscape fragmented by the City of Hinckley, roads, and agricultural land use.

Shallow lakes are considered important habitat for many wildlife species, particularly as breeding areas for waterfowl, shorebirds, and herpetofauna. The abundant aquatic vegetation within the impoundment serves as food and habitat for zooplankton, insects, fish, waterfowl, and other wildlife. No formal wildlife surveys have been conducted for the AMA, but common wildlife species present include deer, furbearers, songbirds, reptiles, and amphibians.

3.4.2.2. Environmental Consequences

3.4.2.2.1. Proposed Project

Proposed dam removal could result in both temporary and permanent impacts to wildlife. Temporary impacts would primarily be a result of project construction, dewatering of the reservoir, and associated sediment release. During project construction and drawdown there could be potential for direct impacts to some wildlife and aquatic species. Temporary impacts to wildlife could include direct mortality from construction. Dewatering could result in mortality or displacement of less mobile aquatic species such as some invertebrates (e.g. mussels). Reptiles and amphibians are unlikely to be affected as the drawdown would be completed after they emerge from hibernacula and before they enter winter hibernation. Indirect temporary impacts include disturbance from human activity such as increased noise and visual disturbance. Human disturbance could cause wildlife to experience stress or disperse. Due to the temporary nature of these direct and indirect impacts, they are not expected to cause significant or long-term declines in populations and any dispersed wildlife are likely to return once the project is complete.

Significant permanent impacts are not expected to wildlife dependent on wetland and wet-mesic forest plant communities. Though existing wetlands adjacent to the reservoir could be dewatered, floodplain wetlands are expected to develop and provide similar wildlife habitat long-term. The wet-mesic forest community could shift to a mesic forest community, but will maintain general habitat characteristics of upland hardwood forest.

Permanent impacts to wildlife communities would result from dewatering of the reservoir and associated shift in the shallow lake plant community and would be largely beneficial. The shallow lake community would be eliminated and could displace species reliant on this habitat such as waterfowl. However, waterfowl also use shallow water areas of streams such as point bars, near shore, and pools. Depending on spring conditions in a given year, the resulting stream habitat could provide higher quality nesting/brood rearing cover for waterfowl and shorebirds. The floodplain of the stream would be temporarily flooded during spring migration, and typically come down as the growing season ensues and broods begin hatching. The close proximity of nesting cover to the persistent stream could help with brood success. Species composition might change as the deep water habitat is eliminated (i.e. from a higher percentage of diving ducks to a higher percentage of dabbling ducks). The restored river channel created by dewatering the shallow lake community would have beneficial impacts for many aquatic organisms such as fish, amphibians, reptiles, mussels, and other invertebrates (specific effects to fish and mussels are discussed in sections below). The restored river would provide connectivity and habitat for aquatic organisms. Connectivity links fragmented populations and could improve fitness and habitat for riverine species (Bennet et al., 2009, Hunt et al., 2013).

Removal of the dam would also restore habitat throughout the river system both upstream and downstream of the dam via restoration of natural sediment transport. The dam creates an unnatural impediment to sediment transport resulting in unnatural accumulation of sediment in the upstream reaches of the reservoir. As a result of the dam's impoundment of water, sediment is deposited in the upstream reservoir. Consequently, the water downstream of the dam is sediment-hungry (has an increased capacity to carry sediment), resulting in bed and bank erosion downstream of the dam. Restoring sediment transport would ultimately improve habitat for riparian and aquatic species via increased stream stability, reduced erosion caused by the dam, and improved water quality (turbidity and temperature). Therefore, the overall permanent impacts from the proposed project would likely benefit wildlife in the long-term.

3.4.2.2.2. No Action Alternative

The no action alternative would not affect existing wildlife unless the dam fails. Existing fragmentation for aquatic organisms within the Grindstone River would persist, along with negative impacts to aquatic organisms associated with altered hydrology caused by the dam. Uncontrolled release from dam failure could cause direct mortality of less mobile and fully aquatic organisms via dewatering within the impoundment. Downstream sedimentation from an uncontrolled release could cause direct mortality of less mobile species and indirect impact via habitat loss. Uncontrolled release could also displace aquatic organisms to downstream locations.

3.4.2.2.3. Partially Engineered Alternative

A partially engineered restoration would likely result in similar impacts to wildlife as described for the proposed project.

3.4.2.3. Proposed Mitigation and Monitoring Measures

Sediment release is the main potential adverse effect to wildlife associated with the dam removal phase of the proposed project. To minimize effects, demolition of the dam would be done during a time of normal to low flow, preferably between July 1 and August 31. The reservoir would be drawn down gradually prior to and during demolition. Demolition would proceed at a rate that would limit excessive flow. Erosion control BMPs would be used on newly exposed soils. These may include the use of wildlife friendly natural fiber, erosion control blankets, silt fencing, synthetic fiber-free hydro-mulch, and rock checks; specifications for BMPs and allowed materials would be included in contracts, construction documents, and permits. Exposed areas of sediment would be stabilized as soon as possible and seeded with an approved native plant mix to establish vegetative cover.

The proposed project is expected to benefit wildlife species in the long-term. No significant temporary or permanent adverse effects are expected to wildlife species.

3.4.3. Fish

3.4.3.1. Affected Environment

The fish assemblage of the Grindstone River consists of warm water and cool water species. Thirty-one fish species were sampled in a 2017 population assessment. These species included numerous gamefish species such as crappie, bluegill, northern pike, smallmouth bass, walleye, yellow perch, channel catfish, hybrid sunfish, green sunfish, pumpkinseed, and rock bass. The lowest diversity of fish species occurred within the reservoir and upstream in the north and south forks of the Grindstone River. In contrast, the fish community near the mouth had more species, a greater number of species intolerant of pollution, and a higher percentage of species that require clean, coarse substrates to spawn, indicating high quality habitat. Species diversity near the mouth of the river is likely enhanced due to the proximity and connectivity to the Kettle River, which has a high number of fish species. When combined with other recent surveys by the DNR and MPCA, there have been 45 native fish species documented in the Grindstone River system; 34 species documented in the river downstream of the dam, 15 species documented in the reservoir, and 25 species documented in the north and/or south forks of the river upstream of the reservoir.

The Grindstone Reservoir was stocked with various fish species between 1965 and 2003. The goal was to create a "put-grow-and-take" fishery for local anglers. Primary species stocked were northern pike, black crappie, and bluegill. Despite stocking efforts, surveys of the reservoir showed low numbers of fish present. Fish surveys in the river downstream of the dam suggested that significant numbers of stocked fish were leaving the reservoir by swimming over the dam. Limited available habitat due to small size and shallow depth along with low dissolved oxygen levels in the reservoir in winter could have also affected fish numbers. Angling pressure was never formally surveyed but observed use of the fishing pier is low. Stocking was discontinued due to the cost and low return of stocked fish to anglers.

3.4.3.2. Environmental Consequences

3.4.3.2.1. Proposed Project

The removal of the Grindstone River dam would restore approximately 6,750 linear feet of river habitat that is currently part of the shallow reservoir. The dam presents a significant barrier to fish passage, and removal would restore connectivity between the main stem of the Grindstone River and 24 miles of the north and south forks of the river.

Studies of the impact of barriers on fish have shown that species richness is generally lower upstream of barriers compared to downstream, especially for pollution or temperature intolerant, stream dependent, and imperiled species. Removal of barriers has resulted in recolonization of fish species in river reaches where they were absent, as well as increased the catch per unit effort for many species (Aadland, 2015).

Many fish species use rocky areas with swift currents for spawning. Removing the dam would expose an important section of the river that has a steeper gradient, which would increase dissolved oxygen levels in the river and provide important spawning habitat for species that utilize riffles for reproduction.

The dam unnaturally increases the water surface area upstream of the dam, thereby increasing uptake of solar energy, increasing water temperature, and decreasing dissolved oxygen. Removing the dam would allow the system to return to a more natural temperature regime, which would benefit fish species with preferences for cooler temperatures and increased oxygen levels. Dam removal would restore natural sediment transport and improve fish habitat as described above.

The removal of the Grindstone River dam is expected to have a positive impact on the fish community over the long term and contribute to the resiliency of the ecosystem. This project would complement watershed restoration projects implemented under the Kettle River Watershed Restoration and Protection Strategies (WRAPS) plan.

3.4.3.2.2. No Action Alternative

The no action alternative would not affect the existing fish community unless the dam fails. Existing fragmentation and migration barriers for aquatic organisms within the Grindstone River would persist, along with negative impacts to fish associated with altered hydrology caused by the dam. Uncontrolled release from dam failure could cause mortality associated with stranding or exposed spawning areas. Downstream sedimentation associated with uncontrolled sediment release could cause habitat loss.

3.4.3.2.3. Partially Engineered Alternative

A partially engineered restoration would likely result in similar impacts to fish as described for the proposed project.

3.4.3.3. Proposed Mitigation and Monitoring Measures

Mitigation measures proposed for fish are similar to those proposed for wildlife in the preceding section (3.4.2.3). The proposed project is expected to benefit fish communities in the long-term. No significant temporary or permanent negative impacts are expected to fish.

3.4.4. Sensitive Ecological Resources

A query of the Minnesota Natural Heritage Information System (NHIS) (ERDB20190379) was completed and found several rare animal species near the proposed project including mussels, Blanding’s turtle, and mudpuppy. Lake sturgeon, a state-listed species of special concern have also been reported in the Grindstone River. Each of these species are discussed individually according to species-specific affected environment, environmental consequences or proposed project and alternatives, and proposed mitigation and monitoring measures.

3.4.4.1. Mussels

3.4.4.1.1. Affected Environment

The Natural Heritage review letter documented records of the state-listed threatened mussel species mucket (*Actinonaias ligamentina*), elktoe (*Alasmidonta marginata*), and fluted-shell (*Lasmigona costata*) in the Grindstone River just downstream of the dam. In addition to the species identified in the NHIS query, the creek heelsplitter (*Lasmigona compressa*), a mussel species of special concern, has been documented in the river downstream of the dam. The review letter indicated a mussel survey was required to determine the potential for take of state-protected mussels and potential need for relocation.

A freshwater mussel survey was conducted by the DNR, Center for Mollusk Programs in September 2020 to determine the distribution and species composition of mussels within the reservoir and downstream of the dam (DNR 2021e). Following the Minnesota Freshwater Mussel Survey and Relocation Protocol, ten sites were sampled within the reservoir, three sites downstream of the reservoir, and one site in the North Fork Grindstone River. Within the reservoir, unionid (freshwater bivalve) mussels were limited to a narrow strip (approximately 5 meters wide) of sandy, or sand, gravel, and cobble substrate along the banks (area of wave action preventing silt accumulation). Only common species were collected in the reservoir; Wabash pigtoe (*Fusconaia flava)*, fat mucket (*Lampsilis siliquoidea)*, giant floater (*Pyganodon grandis*), and paper pondshell (*Utterbackia imbecillis*). All four of these species appear to be recruiting young mussels into the assemblage, as young unionids (<= 5 years old) were found. Both the giant floater and paper pondshell are opportunistic species (Hornbach et al., 2017), typical of disturbed areas with soft substrates (Sietman, 2003). The fat mucket and Wabash pigtoe are considered equilibrium species, but are found in a variety of habitats (Moore et al., 2021; Hornbach et al. 2017; Sietman, 2003). Further from shore, the substrate changes to silty/sand, sandy/silt, and sandy/clay, which becomes deeper with distance from the bank (DNR, 2021e; WSB, 2021). Sediment surveys conducted by the DNR indicated 1 to 2 meters of sediment accumulation in the lower reservoir. Most species of unionid mussels are not adapted to deep silt substrate and only a few individual mussels were found in the deep silt. However, the giant floater and paper pondshell can occur in deeper silt and may be scattered throughout the deeper parts of the reservoir. Unionid mussels were generally more abundant as flow increased near the dam and the fishing pier just upstream of the dam (1.5 unionids/minute), compared to the other reservoir sites (0.3 to 0.5 unionids/minute) (DNR, 2021e).

Downstream of the dam, unionids were absent within approximately 70 meters of the dam. Unionids were also not found within 50 to 100 meters downstream of low head dams in other studies (Barnett and Woolnough, 2021; Heise et al., 2013; Tiemann et al., 2016). Unionids are typically absent from the zone immediately downstream of low head dams due to the scour rendering substrate unsuitable. However, unionids were fairly abundant from 70 meters downstream of the dam to the old Highway 61 bridge. The exact distribution of unionids within this reach was not reported. Seven species were collected from 70 meters down of the dam to Old Highway 61, including four species threatened in Minnesota: spike (*Eurynia dilatata*), mucket (*Actinonaias ligamentina*), elktoe (*Alasmidonta marginat*a), and fluted shell (*Lasmigona costata)*. In the previous 2000 study, creek heelsplitter (*Lasmigona compressa)* and round pigtoe (*Pleurobema sintoxia*), both special concern species in Minnesota, were also found downstream of the Grindstone Dam (Table 3-2). Round pigtoe was also collected upstream of the reservoir in the North Fork Grindstone River in this and the 2000 survey. All of the species collected below the dam are considered equilibrium (usually in stable, productive habitats) or periodic species (species that persist in areas subjected to large-scale or cyclic disturbance) (Haag, 2012; Hornbach et al., 2017; Moore et al., 2021). Abundance downstream of the dam was greater than immediately upstream of the dam, ranging from 2.03 to 4.58 unionids/minute, however, fewer young unionids were found. Of the 280 mussels found downstream of the dam, only seven were less than or equal to five years old.

Table 3-2. Unionid species upstream, within, and downstream of the Grindstone Dam Reservoir. Life history information from Hornbach et al., 2017 and Moore et al., 2021. Host fish information from Illinois Natural History Survey (INHS) host fish database (INHS, 2021).

Species	Common Name	MN status (T=Threatened SC=Special Concern)	Found Upstream in 2000	Found Upstream in 2020	Found Within Reser-voir in 2020	Found Downstream in 2000	Found Downstream in 2020	Life History	Primary Host Fish Family
Amblema plicata	Threeridge	none	not found	not found	not found	2	3	Equilibrium	Generalist
Eurynia dilatata	Spike	T	not found	not found	not found	not found	1	Equilibrium / Periodic	Centrarchidae (e.g. sunfish, largemouth bass), Percidae (e.g.
Fusconaia flava	Wabash pigtoe	none	85	46	119	77	10	Equilibrium	Centrarchidae (e.g. sunfish, largemouth bass), Cyprinidae (e.g. shiner, dace)
Pleurobem a sintoxia	Round pigtoe	SC	14	3	not found	1	not found	Equilibrium	Cyprinidae (e.g. shiner, dace)
Cyclonaias pustulosa	Pimplebac k	none	not found	not found	not found	1	not found	Equilibrium	Ictaluridae (e.g. bullhead, catfish)
Actinonaias ligamentin a	Mucket	T	not found	not found	not found	212	44	Equilibrium	Centrarchidae (e.g. sunfish, largemouth bass),

Species	Common Name	MN status (T=Threatened SC=Special Concern)	Found Upstream in 2000	Found Upstream in 2020	Found Within Reser-voir in 2020	Found Downstream in 2000	Found Downstream in 2020	Life History	Primary Host Fish Family
									Percidae (e.g. walleye, perch)
Lampsilis cardium	Plain pocketbook	none	not found	not found	not found	9	1	Periodic	Centrarchidae (e.g. sunfish, largemouth bass), Percidae (e.g. walleye, perch)
Lampsilis siliquoidea	Fatmucket	none	20	2	21	371	146	Equilibrium	Centrarchidae (e.g. sunfish, largemouth bass), Percidae (e.g. walleye, perch), Percidae
Alasmidonta marginata	Elktoe	T	not found	not found	not found	34	9	Periodic	Catastomidae (e.g. suckers), Cyprinidae (e.g. shiner, dace)
Anodontoides ferussacianus	Cylindrical papershell	none	9	not found	not found	not found	not found	not found	Generalist

Species	Common Name	MN status (T=Threatened SC=Special Concern)	Found Upstream in 2000	Found Upstream in 2020	Found Within Reser-voir in 2020	Found Downstream in 2000	Found Downstream in 2020	Life History	Primary Host Fish Family
Lasmigona costata	Flutedshell	T	2	not found	not found	83	55	Periodic	Generalist
Lasmigona compressa	Creek heelsplitter	SC	4	not found	not found	10	not found	Periodic	Generalist
Pyganodon grandis	Giant floater	none	49	not found	8	3	not found	Opportunistic/ Periodic	Generalist
Strophitus undulatus	Creeper	none	8	not found	not found	181	11	Periodic	Generalist
Utterbackia imbecillis	Paper pondshell	none	not found	not found	1	not found	not found	Opportunistic	Generalist
Total number			191	51	149	984	280		
Number of species			8	3	4	12	9		
CPUE (number mussels/min.)			1.16	0.43	0.60	2.49	1.75		
% <= 5 years old			24%	0	25%	9.5%	2.5%		

3.4.4.1.2. Environmental Consequences

3.4.4.1.2.1. Proposed Project

According to the DNR Rare Species Guide, dams are acknowledged as a threat to all mussel species. Mussels are dependent on host fish species in the early stages of life; fish movement helps to disperse mussels throughout available habitat. The four threatened mussel species identified downstream of the existing dam could benefit from the restored connectivity and habitat in the river system. However, few long-term studies have been conducted demonstrating this benefit (Barnett and Woolnough, 2021), and decades may be required for unionid species to colonize upstream areas (Barnett and Woolnough, 2021; Heise et al., 2013; Kappes and Haase, 2012; Sethi et al., 2004; Tiemann et al., 2016). Although long-term dam removal should be beneficial to unionid mussels, unionids could be impacted by the dam removal process through changes in water quality, sedimentation, and local hydraulics.

3.4.4.1.2.1.1. Proposed project - short term impacts:

Short term impacts to mussel species upstream of the dam could include dewatering of the reservoir margins and instream construction activities near the dam. All of the species collected in the reservoir were common species, but any left stranded during dewatering of the reservoir would likely suffer mortality. Slow release of water from the reservoir could allow some of the mussels along the reservoir margins to move into deeper water, particularly in areas with steeper sloping banks. Sethi et al. (2004) reported 95% mortality in a reservoir dewatered quickly (36 hours) and having extensive area exposed in Wisconsin. However, minimal mortality was reported by Heise et al. (2013) in a reservoir dewatered slowly (over 2 to 3 weeks), though very little previously inundated substrate was exposed during the drawdown. A slow drawdown is planned for the Grindstone Reservoir. A slow dewatering rate (4 centimeters/day) was found to decrease mortality compared to a faster dewatering rate (120 centimeters/day), but mortality still occurred with slow dewatering (Galbraith et al., 2015). Slow dewatering could decrease impacts to mussels, particularly where exposed areas are sloped, as mussels tend to move to deeper water in sloped areas, but tend to move randomly in flatter areas (Newton et al., 2015). Impacts could be further reduced by collecting mussels along the reservoir banks as the water level recedes and relocating them to deeper water. However, fatmucket and Wabash pigtoe may not survive in the deep silt substrate further from the bank. These species could be moved to free-flowing areas upstream of the reservoir in areas currently supporting mussels.

Within the reservoir, unionids were most abundant along the southwest bank near the dam in flowing water. Any instream activity of construction equipment in this area could impact mussels. These mussels could also be moved to existing mussel beds downstream of the impact zone or upstream of the reservoir.

Riffles will be constructed at the dam site and upstream of the dam, but no construction activity is planned downstream of the dam. Mussels were not found within 70 meters downstream of the dam and construction activity will be limited to within the upper reach. No direct impacts are expected.

Unionid mussels could be indirectly impacted downstream of the dam by increases in turbidity during construction and sediment deposition over unionid beds during dam removal. Sediment mobilization minimization measures are discussed in sections 2.1.3 and 2.1.4 and include gradual drawdown of the reservoir allowing sediments to consolidate, gradual removal of the dam to prevent scouring flows and erosion, installing riffle grade controls preventing rapid sediment mobilization, installing bank stabilization structures and vegetating banks to prevent erosion. Sedimentation and contaminants are discussed in section 3.3 and H&H effects are discussed in section 3.2.

Unionid mussels are filter feeders and can be affected by sudden increases in turbidity, particularly in clear streams (Tuttle-Raycraft and Ackerman, 2019). Temporary increases in turbidity could affect mussel feeding, respiration, and spawning success but should not result in mortality.

Most riverine unionids, including the three threatened species identified in the project area, cannot withstand long-term or deep sediment deposition. The heavy shells of these species can cause them to sink in the sediment and become smothered. Dam removal studies indicate that sedimentation from dewatering reservoirs can affect unionid assemblages for a considerable distance downstream. In a Michigan study of several areas below low head dams and larger dam removal sites, unionid species richness and diversity was greater downstream of low head dams compared to stream reaches downstream of larger dam removal sites due to higher percentages of silt/clay and sand, and lower percentages of coarser substrates released from larger dam removal areas (Barnett and Woolnough, 2021). Some recovery of species richness and diversity was documented at sites where dams had been removed for 16 years (Barnett and Woolnough, 2021). They found some reservoirs may take 50 to 100 years for stored sediment to be released, and most sediment was deposited within 1 kilometer of the dam. Sethi et al. (2004), found unionids buried under 10 to 20 centimeters of silt along stream margins 1.7 kilometers downstream of a dam removal site three years post dam removal. However, the rate of drawdown was not reported in these studies. The rate at which sediments move through a system depends on the particle size and amount of stored sediment, the flow regime of the system, stabilization efforts within the impoundment, and local precipitation. Mussels downstream of a dam removal site may be able to cope with pulses of sediment release if the material is quickly transported through the system; however, persistent siltation can cause mortality (Box & Mossa, 1999; Houp, 1993; Vannote and Minshall, 1982). Downstream sedimentation will be minimized through upstream substrate consolidation, slow drawdown of the reservoir, and grade controls. However, the extent of downstream sediment movement and deposition is unknown (see section 3.3).

Additionally, fine sediments can contain chemicals that are harmful to unionids, such as unionized ammonia and heavy metals. Unionids are more sensitive to many metals and ammonia than test organisms used for establishing water quality standards (Wang et al., 2007; Wang et al., 2010). Metals detected in reservoir sediments were below Level 1 SRV. However, these levels were tested in sediment. The level of pore water metals in any deposited sediment cannot be predicted. Likewise, ammonia was detected in some sediments and could impact mussels if sediment deposition on beds occurs.

3.4.4.1.2.1.2. Proposed project – long-term impacts:

Although some unionid mortality may occur in the short term, dam removal and subsequent stream channel restoration would likely benefit mussels in the long-term. Very few mussels were found within the reservoir due to reduced flow and lack of suitable substrates. State-threatened and special concern species were only found in the riverine areas in the North Fork Grindstone River and downstream of the dam. Restoring a free-flowing river channel within the AMA would allow suitable mussel habitat to develop and allow passage of host fish species. Fish hosts for these species include sunfish, darters, minnows, and suckers; all species that could benefit from restored riverine habitat. Removal of the dam and restoration of riverine habitat would allow host fish potentially carrying glochidia to facilitate colonization of newly available habitat. For example, two of the four rare mussel species identified in the mussel survey (mucket and elktoe) are not currently known to inhabit river reaches upstream of the dam, possibly due to poor connectivity for fish host species (DNR, 2021e).

Changes in hydraulic characteristics upstream and downstream of the dam could affect unionids. Unionids tend to occur in stable heterogeneous substrate areas that have some water velocity at low discharge but are not scoured or displaced at high discharge. Unionid beds tend to form in stable areas of streams (Key et al., 2021). Changes in local hydraulic conditions (shear stress, Froude no., bed mobility) can affect mussel distribution (Christian et al., 2020). Increases in flow velocity and depth can affect local hydraulics and mussel bed stability. H&H effects are discussed in section 3.2. Velocity and depth patterns may change as the river downstream adjusts in response to changes in grade. HEC-RAS models predict that flow velocity and depth will not increase within the modeled area (6.4 miles downstream of the dam). Mussel beds downstream should not be affected, but mussels should be monitored, as small changes in hydraulic conditions can affect mussel distribution. Substrate changes in the tailwater area of the dam that is currently devoid of mussels may become more conducive to mussel colonization. This area is currently sediment starved and some fine sediment should fall out of suspension in this area following dam removal. Upstream changes to riverine conditions would allow formation of riffles and pools, and allow recruitment of gravel substrates that benefit most mussel species. However, few studies have monitored mussel colonization and several decades may be needed to see positive effects.

3.4.4.1.2.2. No Action Alternative

The no action alternative would not affect the existing mussel communities unless the dam failed. Uncontrolled dam failure could quickly dewater the bank areas within the reservoir where unionids have been documented and make it difficult for the mussels to migrate to deeper water. Additionally, if dam failure occurred during very hot or cold weather, direct mortality may result due to limited mobility of unionids and subsequent exposure to extreme temperature change. An uncontrolled release could also result in uncontrolled hydraulic changes and sedimentation downstream of the dam where threatened species reside.

3.4.4.1.2.3. Partially Engineered Alternative

The partially engineered alternative would have the same impacts as the proposed alternative. Partially engineered features would occur within the reservoir area and would not affect Minnesota threatened species that occur downstream of the dam.

3.4.4.1.3. Proposed Mitigation and Monitoring Measures

Impacts to mussels within the reservoir include mortality due to stranding, but effects would be limited to common species. Downstream mussels could be affected by sedimentation and hydraulic changes. These impacts would be mitigated through slow reservoir drawdown and dam removal, installation of grade controls, and erosion control. Downstream sedimentation is expected to be minimal and no hydraulic changes are expected. However, a permit to take state-listed threatened mussels will be required from DNR due to potential sedimentation and local changes in hydraulic conditions. Monitoring of impacts to state-protected species will be required in the permit to take. The specifics of the monitoring will be developed during the permit to take process, though some recommendations are provided below. An alternative to obtaining a permit to take would be to prepare an avoidance plan that sufficiently demonstrates impacts to mussels would be avoided.

Mussels stranded during drawdown would partly be mitigated through the slow dewatering process. Unionids may move to deeper water as the water recedes. Movement toward deeper water was observed in the Mississippi River where water was lowered at a rate of 5 centimeters/day (Newton et al., 2014). Mortality was lower in areas with high slopes (9 to 12%) than areas with low slopes (6 to 8%). Mortality of upstream mussels could also be mitigated by moving thinner shelled species (giant floater and paper pondshell) to deeper water in the siltier substrates, and thicker shelled species to upstream or downstream of the reservoir into areas with existing mussel assemblages.

Direct impacts are not expected downstream of the dam during construction. Mussels may be indirectly affected by increased turbidity and sedimentation during drawdown, dam removal, and riffle construction. These effects would be minimized by slow drawdown, grade controls, and erosion control. However, monitoring of turbidity and sediment deposition is recommended, particularly over mussel beds during dam removal and riffle construction. If mussels are exposed to high turbidity over extended periods, measures should be implemented to contain turbidity within construction areas such as silt curtains or berms. Likewise, sediment deposition near mussel beds could be monitored to ensure state-listed species are not smothered.

Monitoring is recommended for any mussel assemblages containing Minnesota threatened species within indirect impact areas. Monitoring plans could include turbidity testing and sediment accumulation during construction, and any substrate and flow changes within mussel assemblages following dam removal. If sediment deposition within downstream mussel beds is detected, sediments could be tested for metals and ammonia, as mussels are more sensitive to these than test organisms used for establishing standards (Wang et al., 2007; Wang et al., 2010).

3.4.4.2. Blanding's Turtle

3.4.4.2.1. Affected Environment

According to the Natural Heritage review letter, Blanding's turtles (*Emydoidea blandingii*) have been reported in the vicinity of the proposed project, but outside of a one-mile radius around the dam. The Blanding's turtle is a state-listed threatened species. Both wetland and upland habitats are required by Blanding's turtles during their life cycle (DNR, 2021a). In Minnesota, Blanding's turtles primarily inhabit marsh and pond habitats, but use many other wetland types and nest in sandy uplands. Calm, shallow water bodies with mud bottoms and abundant aquatic vegetation are preferred. Small temporary wetlands that remain saturated or inundated early in the growing season are important feeding areas. The absence of fish in these small wetlands facilitate significant amphibian and invertebrate populations that serve as prey for the Blanding's turtle. Nesting occurs in open (grassy or brushy) uplands with sandy soil and may occur up to a mile from wetlands. While nesting frequently occurs in natural sandy upland areas, developed land with suitable substrates can also be used. Blanding's turtles require deeper marshes and ponds during the winter where they overwinter in muddy bottoms protected from freezing.

The life history and phenology of Blanding's turtles is critical to understanding habitat use. Individuals emerge from overwintering in late March to early April, typically staying near wetlands. Nesting occurs in June and may involve travel of up to a mile from wetlands to sandy uplands. Nesting females may travel through a variety of land use types during the journey to a nesting site, and they may return to the marsh within 24 hours of laying. From mid-August through early-October, hatchlings leave the nest site and return to wetlands, again traveling long distances through a variety of habitats. All ages and sexes may move between wetlands from April through November, with movements peaking in June and July and again in September and October. In late autumn (typically November), Blanding's turtles bury themselves in the muddy bottoms of deeper wetlands to overwinter.

Potential Blanding's turtle habitat is present within the Grindstone River, Grindstone Reservoir, adjacent wetlands, and in surrounding uplands with sandy soil. The Blanding's turtle may pass through any area in the project vicinity while traveling to preferred habitat in April through November.

3.4.4.2.2. Environmental Consequences

3.4.4.2.2.1. Proposed Project

Permanent impacts to the Blanding's turtle include potential habitat loss from the elimination of the reservoir and associated shallow lake and adjacent wetlands. However, new wetland habitat could naturally develop in the floodplain or be incorporated into the project design. There is the potential for direct mortality and temporary disturbance of Blanding's turtles during project construction since some of the proposed project would occur within upland habitat adjacent to wetlands. However, direct impacts to the turtles appear unlikely based on the distance to known Blanding's turtle records that occur over one mile from the project site.

3.4.4.2.2.2. No Action Alternative

The no action alternative would not affect the Blanding's turtle unless the dam failed. Uncontrolled release could result in direct mortality of any turtles utilizing the reservoir for overwintering habitat. If dewatering occurred in winter, overwintering turtles in the reservoir could perish due to exposure and freezing. If uncontrolled release occurred during the active season, Blanding's turtles present within the reservoir could be displaced downstream. Indirect impacts to Blanding's turtles could occur from dewatering and subsequent loss of open water habitat.

3.4.4.2.2.3. Partially Engineered Alternative

The partially engineered alternative would have similar impacts as the proposed alternative.

3.4.4.2.3. Proposed Mitigation and Monitoring Measures

Actions to avoid or minimize disturbance to Blanding's turtles will include the following:

- Timing of dewatering would take place during a period of normal to low flow between June 1 and August 31, preferably July 1 through August 31. Drawdowns would reach their lowest level by September 1 to prevent stranding of overwintering turtles.
- To the extent feasible, in-stream work would not take place between November 1 and April 15. Any areas where there would be in-stream work would be checked for turtles prior to disturbance.
- Areas where there would be bank and upland construction during turtle active season (April 15 through October 31), would be checked for turtles prior to the use of heavy equipment or ground disturbance.
- Use of erosion control netting would be limited to 'bio-netting' or 'natural netting' types that do not contain plastic mesh or other components. Hydro mulch, if used, would not be allowed to have synthetic additives.

- Contractors would be educated about the possibility of Blanding's turtles on site. If turtles are observed while working, they would be relocated to a safe place.

3.4.4.3. Mudpuppy

3.4.4.3.1. Affected Environment

According to the Natural Heritage review letter, the mudpuppy (*Necturus maculosus*) has been found in the Grindstone River both upstream and downstream of the dam. The mudpuppy is a state-listed species of special concern. The mudpuppy is entirely aquatic and remains active year-round. Throughout its range, the mudpuppy inhabits rivers, lakes, reservoirs, and sluggish streams (DNR, 2021b). Mudpuppies prefer rivers with rocky or gravelly substrates in eastern Minnesota, while in western Minnesota they are typically found in rivers and lakes with rocky substrate. Rock structures such as flat rocks, boulders, rock piles, and talus provide refuge and nesting habitat. Other aquatic microhabitats like large sunken woody debris and dense aquatic plant mats located deep in the littoral zone are also used. Mudpuppies have a unique symbiotic relationship and are the only known larval host for the state-endangered salamander mussel (*Simpsonaias ambigua*), which occupies similar habitat but is only known to occur in the lower St. Croix River in Minnesota. Potential mudpuppy habitat is likely present within the Grindstone River and Grindstone Reservoir.

3.4.4.3.2. Environmental Consequences

3.4.4.3.2.1. Proposed Project

Proposed dam removal could result in both temporary and permanent impacts to the mudpuppy. Temporary impacts include disturbance from project construction and dewatering of the reservoir. Mudpuppies are especially sensitive to siltation and could be impacted by increased sediment disturbance from in-water work and dewatering activities. However, the proposed project would likely benefit the existing population of mudpuppies by restoring a free-flowing river channel through the reservoir. Mudpuppies in eastern Minnesota prefer rivers with rocky or gravelly substrates, and the restoration of a natural free-flowing channel would re-expose buried substrates, thereby potentially increasing suitable habitat. Removal of the dam would also connect the two populations of mudpuppies that have been documented upstream and downstream of the dam since the existing dam functions as a physical barrier to mudpuppies.

3.4.4.3.2.2. No Action Alternative

The no action alternative would not affect the mudpuppy unless the dam fails. Uncontrolled release from dam failure could displace individuals. Sedimentation from an uncontrolled release downstream of the dam could cause direct mortality and indirect impacts via habitat loss. Existing fragmentation within the Grindstone River would persist if the dam remains in place, along with negative impacts associated with altered hydrology caused by the dam.

3.4.4.3.2.3. Partially Engineered Alternative

The partially engineered alternative would have similar impacts as the proposed alternative.

3.4.4.3.3. Proposed Mitigation and Monitoring Measures

The main potential adverse impact to mudpuppies is sedimentation. The erosion and sediment control measures proposed for wildlife and fish above also apply to mitigation measures for the mudpuppy. The proposed project is expected to benefit the mudpuppy in the long-term by improving aquatic connectivity. Restoration of natural sediment transport and flows could also provide more rocky and gravelly substrate preferred by the mudpuppy.

3.4.4.4. Lake Sturgeon

3.4.4.4.1. Affected Environment

Lake sturgeon (*Acipenser fulvescens*), a state-listed species of special concern, are present in the Kettle River system. Lake sturgeon are most often found in moderately clear, large rivers and lakes with firm sand, gravel, or rubble bottoms (DNR, 2021c). The Kettle River population is small but growing slowly (DNR, 2021d). The population is unique as it appears to be a resident population that occupies the river year-round, rather than occupying lakes for part of the year.

A 1956 fish survey found sturgeon in the section of the Grindstone River downstream of the dam. Sturgeon have not been found in any recent surveys; however, sturgeon are not specifically sampled for by DNR Fisheries and the type of sampling equipment used would rarely detect sturgeon. No physical barriers are present that would prevent movement of the Kettle River population into the Grindstone River downstream of the Grindstone dam. The Grindstone River contains suitable lake sturgeon habitat, and it is possible that lake sturgeon use the river during certain times of the year.

3.4.4.4.2. Environmental Consequences

3.4.4.4.2.1. Proposed Project

Lake sturgeon would likely not experience adverse impacts from dam removal, with long-term benefits to populations in the Kettle River and to those sturgeon potentially using the Grindstone River. Potential adverse impacts from sediment release on the known population in the Kettle River are unlikely since the project site is located approximately 6.5 miles upstream of the confluence. Sediment release at the project site will likely be comprised of sand and silt, most of which would likely be deposited in the Grindstone River before reaching the Kettle River and any known spawning sites. Lake sturgeon are long-lived and should be able to tolerate any temporary disturbance from sedimentation within the Grindstone River.

Long-term, the restored connectivity of the Grindstone River and riffle habitat near the project site, as well as a restored free-flowing river channel through the existing reservoir could allow for increased use of the river by the Kettle River population.

3.4.4.4.2.2. No Action Alternative

The no action alternative would not affect the lake sturgeon. Existing fragmentation within the Grindstone River would persist, along with negative impacts associated with fish passage and altered hydrology caused by the dam. Uncontrolled release associated with dam failure would be unlikely to directly affect the known population in the Kettle River (approximately 6.5 miles downstream). Downstream sedimentation could result in loss of suitable habitat.

3.4.4.4.2.3. Partially Engineered Alternative

The partially engineered alternative would have similar impacts as the proposed alternative.

3.4.4.4.3. Proposed Mitigation and Monitoring Measures

No significant adverse effects are expected to the lake sturgeon by the proposed project. The mitigation measures proposed for wildlife and fish above would diminish any temporary impacts to lake sturgeon. The proposed project is expected to benefit the lake sturgeon in the long-term.

3.4.5. Invasive Species

3.4.5.1. Affected Environment

Several invasive upland plant species have been documented within the AMA and surrounding area. Invasive herbaceous species include Canada thistle, sow thistle, common mullein, spotted knapweed, birdsfoot trefoil, Kentucky bluegrass, and reed canary grass. Invasive shrubs include common buckthorn and exotic honeysuckles. One aquatic invasive plant species, curlyleaf pondweed, has been observed in the Grindstone Reservoir. Common carp, an invasive fish species, has been sampled in the past in the Grindstone Reservoir, with the last occurrence in 2003. This species is very rare in the Kettle River watershed.

3.4.5.2. Environmental Consequences

3.4.5.2.1. Proposed Project

No significant impacts from invasive species are expected from the proposed project, though there is risk of spread from invasive plant species. Several terrestrial invasive plant species are present in the existing wetland and upland plant communities. The invasive shrub common buckthorn is reported to be abundant. Plant community shifts in wetland and upland communities could occur from dewatering. Dewatering could facilitate disturbance and subsequent colonization or expansion of invasive plant species.

The invasive aquatic plant curly-leaf pondweed is present in the Grindstone Reservoir. Dewatering of the shallow lake community would eliminate the primary habitat for curly-leaf pondweed. Though curly-leaf pondweed can persist in riverine systems, it does not form problematic dense mats when significant flow is present.

The Grindstone River and Grindstone Reservoir are not listed as infested waters as of April, 2022. Common carp is the only invasive fish species known in the Grindstone River and Kettle River watersheds. This species has been found in the Grindstone Reservoir upstream of the dam in the past but not in recent surveys. Removal of the dam would not provide an opportunity for carp to move into areas where they have not already been documented. Other invasive carp species have been sampled infrequently in the lower St. Croix River; however, the dam at St.

Croix Falls is a complete barrier to fish migration to upstream watersheds, including the Kettle and Grindstone River watersheds.

Transportation of construction equipment and materials to the project site carries risk of spreading invasive plant and animal species. The DNR maintains a strict policy to prevent the spread of invasive species on project sites. This policy applies to all contractors, special interest groups, volunteers, or other cooperators. Measures to prevent spread of invasive species during proposed project activities are described in the next section.

3.4.5.2.2. No Action Alternative

The no action alternative would not affect existing invasive species populations unless the dam failed. Uncontrolled release could dewater the shallow lake and adjacent wetland communities and expose sediments that could be quickly colonized by invasive plants.

3.4.5.2.3. Partially Engineered Alternative

A partially engineered restoration would likely result in similar impacts to invasive species as described for the proposed project. Construction activities proposed downstream of the dam could inadvertently spread invasive species by mobilization of equipment and materials.

3.4.5.3. Proposed Mitigation and Monitoring Measures

Significant vegetation restoration and management is proposed for areas exposed by dewatering, and the restored areas and surrounding habitat would be managed as part of AMA operations in the future. Management would include invasive vegetation control. The DNR could consider interagency and non-governmental partnerships to aid invasive species management.

Transport of invasive species via equipment or materials brought onto the site would be managed by incorporating standard specification language requiring the prevention of contaminated equipment spreading terrestrial or aquatic invasive species.

3.5. Geology (Karst)

This section describes the karst geology that is known to exist in Pine County near the Grindstone Dam, the potential impacts of the proposed project related to this unique geology, and proposed monitoring.

3.5.1. Affected Environment

The overburden soils in the area of the dam were deposited by melt waters from the most recent glacier that receded from this area approximately 10,000-12,000 years ago. Ice approximately one mile thick existed over the Hinckley area prior to this time period. The overburden soils in the area consist of the Hinckley Outwash Plain, which is composed of reddish-brown sandy loam to loam in the upper portions of the deposit with peat in low lying depressions. Two well logs in the area (one from 1968 and one from 1998) indicate that clay loam soils exist at depth and extend to the bedrock surface.

The uppermost bedrock in the area of the Grindstone Dam is the Precambrian Hinckley Sandstone. The Hinckley Sandstone is a quartz arenite. The Hinckley Sandstone is reported to be up to 500 meters thick at the Hinckley Fault, which is a line that runs from Askov through Hinckley and down to Pine City (Shade et al., 2015). The ability of the Hinckley Sandstone to permeate water appears to be controlled by fractures and depositional features. Well logs in the area identify the surface of the sandstone at depths of 42 to 46 feet below the existing surface. This depth to bedrock is confirmed by recent DNR resistivity imaging (Line 15) that was performed in the area (Berg, 2021).

Approximately 15 miles northeast of the Grindstone Dam, hundreds of sinkholes have been mapped in the Hinckley Sandstone near Sandstone and Askov, Minnesota (Shade et al., 2015). Karst is a geologic term for a landscape feature created over soluble rock with efficient drainage. The sandstone bedrock in a karst region dissolves or settles over time to produce enlarged joints and cracks. Karst areas are characterized by sinkholes, caves, springs, and blind valleys. Sinkholes are surface depressions on the earth formed by a collapse of the overlying soil or bedrock. Streams can lose some of their flow into sinkholes. Blind valleys are valleys that have no surface outlet so that stormwater runoff enters into the ground and then into the karst bedrock.

Most sinkholes in Minnesota appear where there is less than about 50 feet of overburden over carbonate over sandstone bedrock (MPCA, 2021b). Since the overburden is 42 to 46 feet thick in the area of the Grindstone Dam, the development of sinkholes and other karst features is possible.

3.5.1.1. Resistivity Study

During scoping for the EIS, the DNR determined that the proposed project area had the potential to contain sensitive geologic features, such as karst. Staff from the DNR Hydrogeology and Groundwater Unit conducted a study to better understand potential impacts from the proposed project due to the geology of the area (Appendix F). The FSDD for the Grindstone Dam removal project recommended that the study collect site-specific information regarding the electrical resistivity of subsurface geological materials near the dam and in nearby cleared terrestrial areas within a 250-meter zone. Under favorable conditions, the resistivity method can show karst fractures, especially if the resistivity survey lines are oriented approximately perpendicular to fracture and karst trends.

The study began with a review of LIDAR hillshade Imagery of the area. Twenty-two small circular depressions were identified that could indicate sinkholes (Figure 3-4). On April 30, 2021, Jim Berg, DNR hydrogeologist, and University of Minnesota Professor Emeritus Dr. E. Calvin Alexander, Jr. visited 12 of the features to determine if they were closed depressions that could be sinkholes. Three locations (two on the same property) were interpreted as probable or possible sinkholes. Unfortunately, the landowner denied access for a resistivity survey for one location, and the other two locations were in forested areas that could not be directly accessed with resistivity survey equipment.

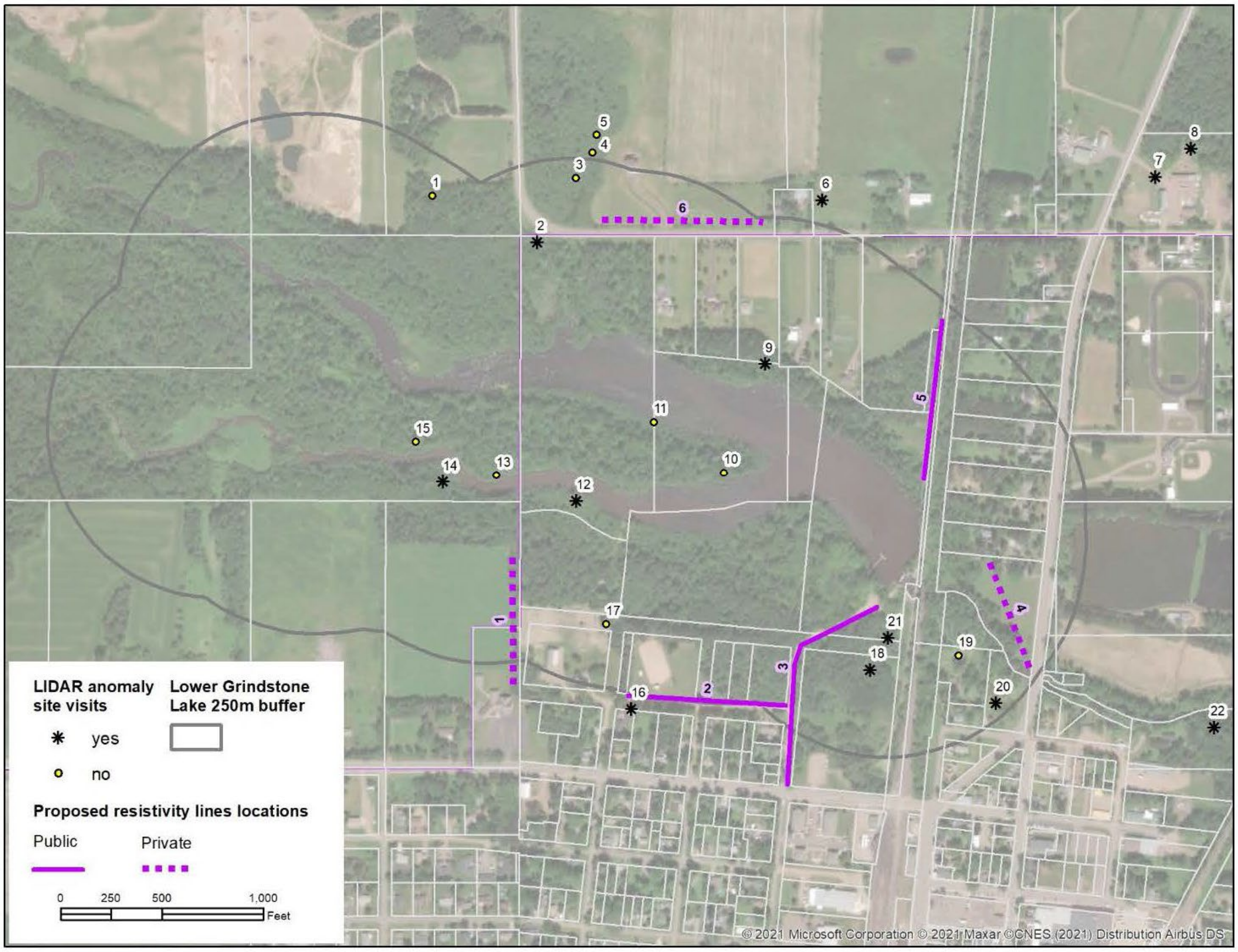

Figure 3-4. Locations of LIDAR surface anomalies and proposed resistivity lines

The study described in the FSDD suggested conducting up to 10 resistivity lines. The major orientation of known sinkholes and caves near Hinckley is approximately southwest-northeast. Thus, an ideal resistivity line orientation might be perpendicular to those features, or approximately northwest-southeast in the Grindstone Dam area.

Initially six locations were considered for resistivity surveys (Figure 3-4). Ultimately only two of the locations were surveyed due to a lack of access permission from private landowners at proposed locations 4 and 6, underground utilities at proposed location 3, and buried rock fill at location 5.

Resistivity data were to be collected along proposed lines 1 and 2, renamed Pine 15 and Pine 14, respectively. The lines were called Pine 14 and Pine 15 because they are the 14th and 15th resistivity lines collected in Pine County (lines 1-13 were collected for other projects). After reviewing data from the line at Pine 14, the DNR team determined that water and sewer pipes from the City of Hinckley underlay the entire area near Pine 14, so the team did not collect data along Pine 14 (proposed line 2).

The resistivity imaging method uses standard arrays developed as sounding techniques and modifies them to create two-dimensional resistivity profiles. A line of electrodes is placed at equal 3-meter intervals along the desired profile. Four electrodes are used at one time. Two electrodes inject current into the ground and the other two read the electrical potential between them. The resistivity meter and switch box automatically read many combinations of current and potential electrodes from short offsets to long offsets starting at one side of the electrode spread and moving toward the opposite end. The short offsets analyze the shallow earth, and the longer offsets penetrate more deeply.

Resistivity line Pine 15 (proposed line 1) shows glacial material overlying Hinckley Sandstone. Line Pine 15 (proposed line 1) runs south to north (Figure 3-4) and is located on the east edge of a soybean field. The area interpreted as likely Hinckley Sandstone has higher resistivity than the overlying glacial sediment (Figure 3-5). The resistivity data show glacial material overlying Hinckley Sandstone to a depth of approximately 15 meters. The Hinckley Sandstone south of electrode 36 has slightly lower apparent resistivity than the rest of the line. This anomaly may indicate weathered sandstone, but that cannot be confirmed without drilling.

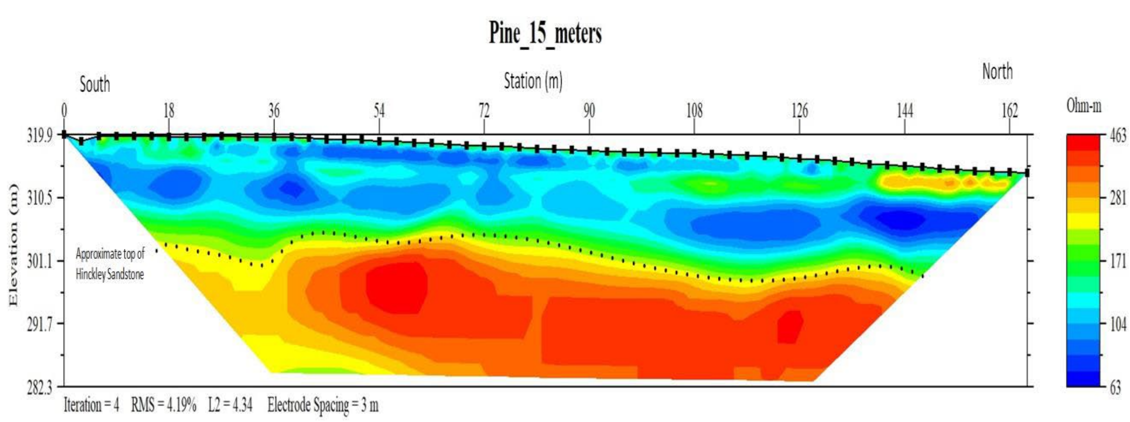

Figure 3-5. Resistivity imaging line Pine 15 showing interpretation of Hinckley Sandstone. Horizontal coordinates are in meters.

The study design described in the FSDD had recommended "If bedrock anomalies are identified by the resistivity study, shallow (approximately 5 to 25 feet) augured borings would be drilled at these locations to determine if these anomalies represent sinkholes or conduits associated with karst." This anomaly may indicate the presence of weathered sandstone, but that cannot be confirmed without drilling. The anomaly detected at Pine 15 is probably 40 to 60 feet deep. This depth range is deeper than the shallow interval of 5 to 25 feet outlined in the FSDD for the Grindstone Dam removal project. Shallow karst features were assumed to present a higher risk for land subsidence than deeper features that would be farther below the lowered water table after the reservoir was drained. Therefore, this deeper feature imaged on Pine 15 did not justify a higher level of scrutiny that drilling and coring might have provided.

Prior to these investigations the consensus of the DNR geoscientists involved was that the risk was low to negligible for land subsidence in the area from reservoir drainage and associated water table affects. After these limited surface and geophysical surveys, the risk is still considered low to negligible.

3.5.2. Environmental Consequences

3.5.2.1. Proposed Project

Removal of the Grindstone Dam will lower water levels in the reservoir behind the dam by up to 7 feet. Karst features that may exist below the water level of the reservoir could be exposed. Exposing the features would slow karst development and would reduce the possibility that surface water would enter the subsurface. Both of these consequences would be considered environmental benefits.

Karst can also develop in areas with declining water levels and associated head pressure in the water table aquifer. The lower head pressure can change the buoyancy of the rock in the aquifer, allowing joints and cracks to develop with the changing stresses on the rock. Karst features may develop along the joints and cracks. This condition is fairly unusual and is not likely in the sandstone bedrock below the reservoir.

Karst features could be exposed if sediment is eroded or removed from the bed of the reservoir. A sinkhole would appear as a closed depression and may have water visibly running into it and disappearing below ground. The exposed feature could potentially expand in size and could increase the possibility of surface water contaminants affecting groundwater.

Even with these considerations, the risk is low to negligible for land subsidence in the area from reservoir drainage and associated water table affects, which was also the conclusion of the DNR survey of karst features (Berg, 2021).

3.5.2.2. No Action Alternative

The no action alternative of leaving the dam in place would not change groundwater resources and would not have any immediate effects on any sinkholes that may exist in the area.

The no action alternative includes the risk of a future dam failure. Dam failure would have the same effect on groundwater as the proposed project. The risk for land subsidence in the area would be low to negligible.

3.5.2.3. Partially Engineered Restoration

The partially engineered restoration alternative may have slightly different impacts to groundwater levels compared to the proposed project. Groundwater levels would remain higher in upstream areas that would not be drained as much as the area by the dam. Considering that the risk for land subsidence is low to negligible, a partially engineered restoration would not have environmental benefits compared to the proposed project.

3.5.3. Proposed Mitigation and Monitoring

Although the potential for encountering karst features is low, it will be important that an observational approach be used during the deconstruction of the dam and the engineering restoration work. Construction oversight could provide instruction regarding signs of potential land subsidence. A knowledgeable geotechnical engineer/geologist with karst experience could be on-call if signs of land subsidence related to karst appear. If water begins channelizing into a potential sinkhole, the location should be documented and a mitigation plan developed.

3.6. Groundwater (Private Wells)

This section describes groundwater in the vicinity of the Grindstone Dam and describes how private wells may potentially be affected by the proposed project and measures proposed to avoid, minimize, or mitigate impacts. This issue was found to warrant an additional study during scoping of the EIS.

3.6.1. Affected Environment

The geology of the area surrounding the Grindstone Dam and the reservoir is described in section 3.5. The primary bedrock aquifer is the Hinckley Sandstone. Most of the Hinckley Sandstone is a fine- to medium-grained sandstone composed of about 96 percent quartz. Quartz sandstones tend to retain good primary porosity characteristics., which are typical of productive aquifers. Karst features discussed in Section 3.5 can also add secondary porosity to the aquifer. The Hinckley Sandstone aquifer is widely used throughout Pine County for both municipal and residential water supply (Berg, 2004).

The glacial deposits above the Hinckley Sandstone include layers of clay, sand, and gravel of variable thickness and depth. In the area of the Grindstone Dam, the glacial deposits vary in thickness from 16 to 50 feet, as indicated by well logs in the Minnesota Well Index (MWI) (MDH, 2021). The sand and gravel layers are aquifers that could be used for residential water supply. However, all of the wells in the study area (2,000-foot radius around the Grindstone dam) that are listed in the MWI extend to the deeper Hinckley Sandstone aquifer. It is possible that some shallower wells included in the well survey but not found in MWI (discussed in Section 3.6.2.1.1 below) may be completed in the shallower sand and gravel layers. If present, the clay layers could act as confining layers that could lessen the impacts of changing surface water and shallow groundwater elevations on deeper bedrock wells.

The Grindstone River generally serves as a groundwater discharge zone for the water table aquifer, which means that groundwater typically flows from the water table aquifer into the Grindstone River. In the area surrounding the Grindstone Reservoir, the opposite is true (water flows from the reservoir into the water table aquifer). This is because the water level in the reservoir has been artificially increased to approximately 1,019 feet above mean sea level. The water level of the river immediately downstream of the dam is considerably lower than that in the reservoir. This elevation difference creates a “mound” in the water table aquifer, where the high reservoir elevation locally maintains a higher water table elevation.

3.6.2. Environmental Consequences

If the reservoir water level is decreased, nearby groundwater levels will also decrease, which could cause water levels to drop below the pumps in domestic wells. A bathymetric map of the Grindstone Reservoir, prepared by DNR in 1990, indicates the maximum depth of the reservoir to be approximately 10.5 feet at a location immediately upstream of the dam. The reservoir level is only actually about 7 feet above the water level of the downstream hydraulic control (riffle) of the river bed, indicating that the maximum drop would be about 7 feet if the dam were removed without any riffle construction. However, riffles proposed at the site could reduce this difference to about 6 feet. Therefore, assuming a maximum 7-foot decline in water levels in both the reservoir and groundwater levels represents a conservative worst-case scenario. The water level decline caused by dam removal would diminish moving upstream from the dam site.

The Groundwater Technical Analysis Workgroup of the DNR Division of Ecological and Water Resources prepared a Groundwater Technical Review to evaluate the potential impacts of the dam removal on private water supply wells in the area (Seaberg, 2021) as summarized in the following section.

3.6.2.1. Proposed Project

The DNR conducted a survey via mail of residences within 2,000 feet of the dam asking if there were wells on the property. Wells were also identified in the MWI. A total of 37 operating wells were identified within 2,000 feet of the dam, as listed in Table 3-3 and shown on Figure 3-2. All the wells listed are domestic supply wells, with three exceptions:

1. DNR (804703), monitoring well;
2. Bergquist Field 1 (260934), public non-community transient water supply well; and
3. Hinckley-Finlayson School District 2165 (805861), public non-community supply well.

Table 3-3. Wells within 2,000 feet of Grindstone Dam. Annotation guide: [a] V = verified location; U = unverified location, in MWI; [b] Feet BGS = Feet Below Ground Surface; [c] N = No further action, I = Inspection of well by licensed well driller to obtain necessary information and take mitigative measures if necessary; [d] U = Unknown; [e] NA = Not Applicable; [f] Since the well location is unverified, this distance may be inaccurate.

Unique Well # or PIN	In MWI? [a]	Distance to the dam (feet)	Completed depth (feet BGS) [b]	Static water level (feet BGS) [b]	Pump depth (feet BGS)	Water column above pump (feet)	Vulnerability based on water column above pump	Water column above bottom of well (feet)	Likelihood to mitigate impact by lowering the pump	Recom-mended Action [c]
177538	V	1,310	40	18	20	2	Most	22	Maybe	I
720817	V	1,524	47	15	31	16	Most	32	Likely	I
436770	V	1,660	50	17	27	10	Most	33	Likely	I
436744	U	1,405 [f]	55	16	27	11	Most	39	Likely	I
520533	V	1,921	55	20	38	18	Somewhat	35	Likely	N
582345	V	1,258	66	18	40	22	Somewhat	48	Likely	I
598022	V	1,906	58	16	39	23	Somewhat	42	Likely	N
758122	U	1,158 [f]	80	12	30	18	Somewhat	68	Likely	I
142909	V	942	61	16	49	33	Least	45	Likely	N
805861	V	NA [e]	100	20	60	40	Least	80	Likely	N
219358	V	1,946	40	16	U [d]	U [d]	U [d]	24	Maybe	N
260934	V	1,367	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	I
552648	V	1,965	55	15	U [d]	U [d]	U [d]	40	Likely	N
685625	V	760	50	1.5	U [d]	U [d]	U [d]	48.5	Likely	I
804703	V	1,100	15	7	NA [e]	NA [e]	NA [e]	8	Unlikely	N
277375	U	1,140 [f]	45	18	U [d]	U [d]	U [d]	27	Maybe	I
277377	U	1,682 [f]	33	15	U [d]	U [d]	U [d]	18	Unlikely	I
277378	U	1,668 [f]	31	16	U [d]	U [d]	U [d]	15	Unlikely	I
444087	U	684 [f]	19	14	U [d]	U [d]	U [d]	5	Unlikely	I

Unique Well # or PIN	In MWI? [a]	Distance to the dam (feet)	Completed depth (feet BGS) [b]	Static water level (feet BGS) [b]	Pump depth (feet BGS)	Water column above pump (feet)	Vulnerability based on water column above pump	Water column above bottom of well (feet)	Likelihood to mitigate impact by lowering the pump	Recom-mended Action [c]
444088	U	684 [f]	14	7	U [d]	U [d]	U [d]	7	Unlikely	I
444089	U	684 [f]	19	13	U [d]	U [d]	U [d]	6	Unlikely	I
150134000	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	N
400120000	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	I
400123000	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	I
405032000	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	I
405007000	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	I
400107000	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	I
400101000	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	I
400125000	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	I
400124000	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	I
150130000	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	N
150133000	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	N
150128001	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	I
400099000	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	N
405129000	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	N
405078000	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	I
400092000	No	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	U [d]	I

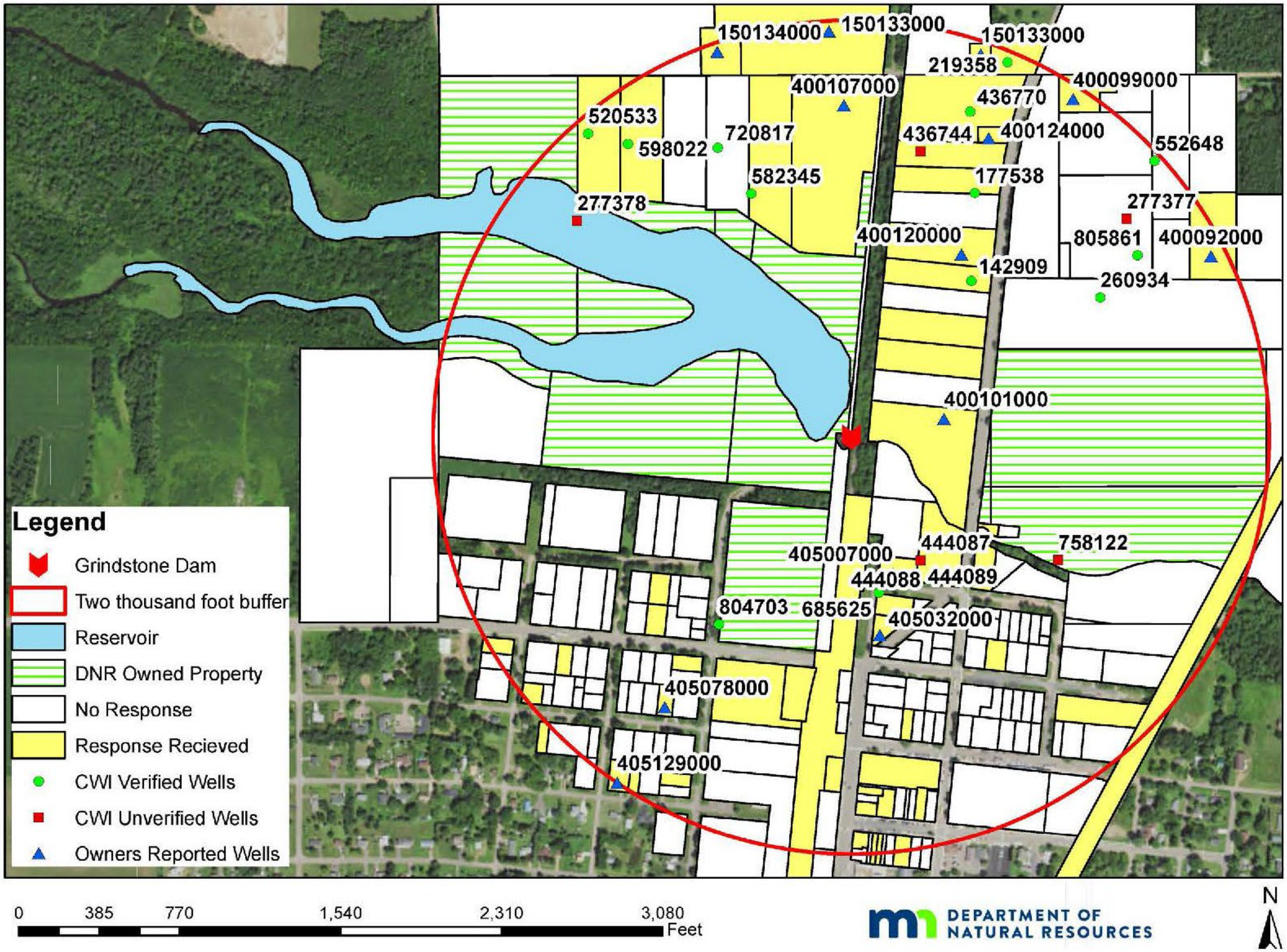

Figure 3-6. Well Locations

The DNR also recorded the following data for each of the wells:

- **Completed depth (feet below ground surface).** This is the total depth of the well.
- **Static water level (feet below ground surface).** This is the water level in the well when the pump is not operating. This level is recorded at the time the well was drilled, but may vary over time.
- **Pump depth** (feet below ground surface).
- **Water column above pump (feet).** This is the difference between the static water level and the pump depth. This is also the available head above the pump.
- **Water column above bottom of well (feet).** This is the difference between the static water level and the completed depth.

The potential impact to an individual well depends on the water level in the well, the depth of the pump, and the total depth of the well. All pumps require a few feet of water above the pump in order to work properly. If the water level in the well falls below the level required to operate the pump, the well owner may lose access to water and/or the pump may fail prematurely. One solution is to lower the pump in the well, if the well is sufficiently deep. This can be done for a relatively low cost. If the water level approaches the bottom of the well so that a pump can no longer operate, then a deeper well is required. It may be possible to extend the depth of some existing wells, but generally drilling a new, deeper well is required, which is much more expensive than simply lowering the pump.

For each well in Table 3-3, the available head was compared to the water level decline assumed under a worst-case scenario. The worst-case water level decrease is expected to be approximately 7 feet—the maximum difference in present pool elevation and expected stream elevation near the dam once it is removed. In evaluating the risk to wells, we will conservatively assume the worst-case scenario of a 7-foot reduction in the water level for each well regardless of its location. Based on this 7-foot drop, the risk of impact to the wells is determined based on the height of water column above the pump in each prior to dam removal as follows:

- Least vulnerable—greater than 27 feet above pump intake;
- Somewhat vulnerable—17 - 27 feet above pump intake; and
- Most vulnerable—less than 17 feet above pump intake.

It should be noted that even the most vulnerable wells are not likely to experience problems due to the removal of the dam and the lowering of the surface water elevation.

A 7-foot drop in groundwater levels is an unlikely worst-case scenario that will actually be much less at the well locations depending on the distance from the reservoir and the presence of confining clay layers above the aquifer.

Of the 37 wells included in the survey, only 10 could be assessed for vulnerability. This was due mostly to the lack of available information about the depth of the pump. Four wells were classified as most vulnerable. The four wells are clustered northeast of the reservoir. They are all relatively shallow (50 feet or less), and their well logs show 23 to 26 foot depth to bedrock and do not indicate any confining layers above the bedrock aquifer.

3.6.2.2. No Action Alternative

The no action alternative of leaving the dam in place would not change groundwater resources.

The no action alternative includes the risk of a future dam failure. For wells located upstream of the dam, the risks of a dam failure would be similar to the risks associated with the proposed project, as described in section 3.6.2.1. Groundwater levels in wells would decrease as the water level in the reservoir decreased, potentially by as much as 7 feet. For wells downstream of the dam, the risks would be limited to wells that could be temporarily flooded due to the dam break. Flooded wells would be at risk of contamination by surface water. Contaminated wells would need to be disinfected by a licensed well contractor. This process usually takes several hours, but would only need to be completed once for each well.

3.6.2.3. Partially Engineered Restoration

A partially engineered restoration could potentially affect groundwater resources differently than the proposed project. The partially engineered restoration has the same maximum 7 foot decrease in the level of surface water and groundwater, although the decrease may be less in some areas. Evaluation of the worst-case scenario, as described above, would still be appropriate even for a partially engineered restoration.

3.6.3. Proposed Mitigation and Monitoring

Based on information available regarding water table elevations and well construction details, in a worst-case scenario, there is potential for supply wells to be impacted if the Grindstone Dam is removed. Since hydrologic changes would result from the Proposer's action, the mitigation of any adverse impacts to water supply wells would be the responsibility of the Proposer. Two common mitigation methods were considered for wells with decreased water levels:

- Connecting to a municipal water supply so that the well is no longer necessary.
- Lowering the pump in the well.

The City of Hinckley municipal water system does not extend to the area north of the Grindstone dam. Connecting to this system would not be an option for the four wells classified as "Most Vulnerable". Extending the municipal water supply to serve a few well owners in this area would be prohibitively expensive.

Lowering the pump in the well is a more cost-effective mitigation method. If the information was available in the MWI well logs, the depth of the standing column of water in the study area wells was used to evaluate the potential for lowering the pump in the well. This assumes that the well is of sufficient diameter, is outfitted with a submersible pump, and the pump can be lowered into the well with a longer drop pipe, which is not necessarily the case for each well. Table 3-3 also presents the depth of the standing column of water in the well based on the difference between the well depth and the static water level and indicates the likelihood of mitigating the impacts in each well by lowering the pump using the following criteria:

- Unlikely—less than 20 feet of standing water in the well;
- Maybe—20 - 30 feet of standing water in the well; and
- Likely—greater than 30 feet of standing water in the well.

Of the four wells that were listed as "Most Vulnerable", mitigation by lowering of the pump was categorized as "Likely" for 3 wells and "Maybe" for one well.

Two approaches to mitigate potential well impacts are proposed and are described below.

1. Mitigation approach 1: This mitigation is based on the review conducted by the DNR Groundwater Technical Analysis Workgroup described above and shown in Appendix G. Based on information in the review, this mitigation approach would be to conduct well inspections on 25 of the 37 wells within 2,000 feet of the dam that were not sealed to determine what if any further mitigation steps are needed. This approach is based on the conservative, worst-case scenario that there would be a 7-foot decrease in water levels in all the wells. Based on the DNR Groundwater Technical Analysis Workgroup staff's professional experience and judgement, the worst-case scenario is unlikely to happen especially given the distance of the wells

from the dam. This approach would require the Proposer to collect additional information for 25 wells. Furthermore, the cost of hiring a licensed well driller to do the inspections could be prohibitive.

2. Mitigation approach 2: Given the low probability of impacts to wells and the high cost of inspecting the wells, a second mitigation approach would be for the project Proposer to notify owners of possible impacts to their wells prior to dam removal and for the Proposer to develop a contingency plan to immediately mitigate the water supplies of any well owners that might be impacted. Lowering the pump in a domestic well or drilling a new well are common solutions for providing a permanent water supply if a well has been impacted. These are likely options to include in the contingency plan. Other actions that could be considered would be providing a temporary water supply using water trucks or a temporary line connected to the Hinckley municipal supply until a permanent solution is implemented.

The project Proposer would need to select and implement a mitigation approach prior to beginning work on the dam removal project.

3.7. Public Waters and Riparian Rights

This section discusses information related to Minnesota public waters and how it relates to the Grindstone Reservoir. The section also discusses land ownership within the project area and potential impacts to riparian rights from the proposed project. DNR legal counsel provided a formal memo that provided information and analysis discussed within this section.

3.7.1. Affected Environment

The Minnesota legislature has adopted a definition of public waters which includes all water basins and watercourses as defined in Minn. Stat. § 103G.005, subd. 15. The Grindstone Reservoir, which was created by damming the Grindstone River, is a public water because it meets the definition of a water basin and a natural and altered watercourse. *See* Minn. Stat. § 103G.005, subd. 15(7) (defining a public water as a water basin where the state of Minnesota holds title to the beds or shores) and § 103G.005, subd. 15 (9) (defining a watercourse as an altered or natural watercourse with a total drainage area greater than two square miles). It is listed on the Public Water Inventory

(PWI) as both a water basin (PWI-58-0121-00) and a watercourse (PWI-58077a). The Grindstone Reservoir has a shoreland classification of Recreational Development assigned by the Commissioner of Natural Resources.

Waters in the state, including all public waters, are not capable of private ownership. *See Pratt v. State Dept. of Natural Resources,* 309 N.W. 2d 767, 772 (Minn. 1981). Primary jurisdiction over public waters rests with the State, which is required to manage those waters for the benefit of the public. *See Pratt v. State Dept. of Natural Resources,* 309 N.W. 2d 767, 771-774 (Minn. 1981) (holding the state holds title to the public water in its sovereign capacity and is required to manage said waters for the benefit of the public). Persons owning property abutting a public water, including the Grindstone Reservoir, have riparian rights to the "reasonable" use of the water their property abuts. *See Pinney v. Luce,* 46 N.W. 561, 561-62 (Minn. 1890) (holding a riparian owner "[by] virtue of his ownership the banks and lands in front thereof [,] . . . has right to the use of the water . . . without diminution or obstruction."), and *Red River Roller Mills v. Wright*, 15 N.W. 284, (Minn. 1883) (holding that a riparian owners right to the use of water is limited by the rights of other riparian owners and the rights of the public.). An abutting owners riparian rights is subject to the requirement that the use is reasonable. *State by Korrer,* 148 N.W. 641, 642 (Minn. 1900). Uses that have been found to be reasonable include the right to access, the right to construct a dock, the right to boat, and the right to swim.

Riparian rights are, however, subject to regulation by the State. *See Pratt v. State Dept. of Natural Resources,* 309 N.W. 2d 767, 771-774 (Minn. 1981). The DNR's jurisdictional/regulatory boundary over a public water that is a water basin is the Ordinary High Water Level (OHWL), which is defined in Minn. Stat. 103G.005, subd. 14. The DNR regulates activities in public waters under Minn. Stat. § 103G.245 (Work in Public Waters) and Minn. R. 6115.0150 – 6115.0280 (Standards and Criteria for Granting Permits to Change the Course, Current, or Cross-Section of Public Waters). Dam construction and maintenance is regulated under Minn. Stat. § 103G.501 – 103G.561 and under Minn. 6115.0300 – 6115.0520. Removal of an existing dam to restore a river to its natural state is subject to the public waters permitting process.

The Grindstone Reservoir (PWI 58-0121-00) was created by construction of the Grindstone Dam in 1932 and the impoundment of water from the North and South Forks of the Grindstone River, both of which are public watercourses. The Grindstone Reservoir is approximately 26 acres, with a maximum depth of about 9 feet. The Grindstone Reservoir lies within the Hinckley Aquatic Management Area (AMA), which provides public recreational opportunities such as fishing and wildlife viewing. The Grindstone Reservoir is nearly entirely surrounded by the Hinckley Aquatic Management Area (AMA), with the exception of a corner of one property that abuts the shoreline of the Grindstone Reservoir that is in private ownership. In its current state, the private landowner has riparian rights.

Prior to construction of the Grindstone Dam, the DNR purchased large tracts of land that were riparian to the North and South Forks of the Grindstone River in the area where the reservoir was to be located. Prior to inundation and creation of the reservoir, the DNR was the sole riparian landowner in the area. After construction of the dam, the inundation footprint of the reservoir extended beyond DNR owned land onto the property of one private landowner. The fact that this parcel is adjacent to the created public water basin has created riparian rights associated with this abutting parcel.

If the level of a public water is raised, use of the underlying land may change to the benefit or detriment of the landowner. Flowage easements are typically obtained when water levels are raised (e.g. when a flowage, or reservoir is created) and Minn. Stat. 103G.245 Subd. 10 (a) establishes a public waters-work permitting process for when water levels are raised. There is no record of a flowage easement or other agreement between the DNR and the subject private landowner or prior owners of the property.

Removal of the Grindstone Dam would result in removal of the Grindstone Reservoir. With the Grindstone Reservoir diminished the private property referenced above would no longer be an abutting owner and, therefore, would no longer have riparian waters. In essence, if the Grindstone Dam is removed by the state, the state will have taken a property interest associated with the private property.[1] The Minnesota Constitution requires that "[p]rivate property shall not be taken, destroyed or damaged for public use without just compensation therefore, first paid or secured." Minnesota Constitution, Art. I, § 13. Thus if the state or another public entity wishes to remove the Grindstone Dam it must first institute a condemnation suit, pursuant to Minn. Stat. Ch. 117, to compensate the landowner for the taking of the riparian rights associated with the property. Proposed mitigation options are listed in section 3.7.3.

[1] Minnesota Statute § 117.025, subd. 2 defines the term taking as "every interference . . . [with] possession, enjoyment, or value of private property interest."

3.7.2. Environmental Consequences

3.7.2.1. Proposed Project

The Grindstone Reservoir is 26. 6 acres in size and is nearly 9 feet deep, just behind the dam. The reservoir is about 350 feet wide near the dam; however, it narrows within the branches where the North and South Forks of the Grindstone Rivers enter, extending about 3,900 feet upstream on the north arm of the reservoir, and 3,400 feet upstream on the southern arm. The proposed project would result in the elimination of the 26.6-acre Grindstone Reservoir and result in approximately 7,400 linear feet of restored river. Removal of the dam and allowing the North and South Branches of the Grindstone River to restore naturally would result in an unknown location of river flow after project completion. However, based on bathymetry data, it is expected that the rivers would reform within the old riverbed, which is approximately within the center of the current reservoir (Figure 2-1) and would result in a loss of direct access to the shoreland of a public water by the existing private riparian landowner. This would remove the riparian rights from the parcel and result in diminishment of the land rights held by the parcel owner. The resulting changes from the proposed project would be subject to discussions with the neighboring landowner. Any outcomes of these discussions would be beyond the scope of the EIS.

3.7.2.2. No Action Alternative

The no action alternative would not affect the private landowners access to the shoreland of the Grindstone Reservoir, unless the dam failed. Sudden release of water due to dam failure would likely result in loss of access to the shoreland by the neighboring landowner.

3.7.2.3. Partially Engineered Restoration

The partially engineered alternative involves directing the new channel formation of the North Branch of the Grindstone River toward a meander along the north valley wall of the current reservoir (see Figure 2-2). The proposed meander location would abut the neighboring landowner’s property, and would provide access from the property to the shoreland of the newly routed Grindstone River. This alternative would maintain riparian rights, however, the type of waterbody present would change from a reservoir to a watercourse. Use of the underlying land may change to the benefit or detriment of the landowner with the change from a reservoir to a watercourse. The resulting changes from the partially engineered restoration alternative would be subject to discussions with the neighboring landowner. Any outcomes of these discussions would be beyond the scope of the EIS.

3.7.3. Proposed Mitigation and Monitoring

Actions to avoid or mitigate impacts to the private landowner's riparian rights could be completed in the following ways:

- Maintain riparian rights through selection of the partially engineered alternative.
- Offer an easement to the landowner on DNR land extending from the existing parcel, across DNR land to the restored river
- Provide a corridor to edge of new river to landowner by transferring property from DNR to the land owner that would extend the existing parcel to the restored river.
- Enter into an agreement with the parcel owner to pay damages (for loss of property value, for example) or commence a condemnation action pursuant to Minn. Stat. Ch. 117.

Final mitigation decisions would be made based on conversations with the landowner.

A public waters work permit will be required under Minn. Stat. 103G.245 (Work in Public Waters) and Minn. R. 6115.0150 – 6115.0280 (Standards and Criteria for Granting Permits to Change the Course, Current, or Cross-Section of Public Waters).

4. CUMULATIVE POTENTIAL EFFECTS

Cumulative potential effects (CPE) are environmental effects that result from the proposed project in conjunction with other projects in a given area. The effects from any one project may be small; however, the aggregated effects from all the projects together may be significant (Minnesota Rules 4410.0200, subpart 11a.)

Topics analyzed for the EIS and included in the CPE analysis are listed below. Analyses of public waters impacts and riparian rights impacts are not included because the scope of CPE analysis is limited to environmental effects per Minnesota Rules 4410.0200, subpart 11a.

- Wetlands
- Hydrological Effects
- Sediment and Contaminants
- Plant Communities, Wildlife, Fish, and Sensitive Ecological Resources
- Geology
- Groundwater

4.1. Overview of Geographic Scale and Timeline

The inclusion of future projects in the CPE analysis is determined by assessing geographic scale and timeline of the proposed project and potential future projects. The geographic scale and timeline must be described for the proposed project on an impact-by-impact basis. Future projects must then be assessed to determine if they are within the geographic scale of an impact and within the specified timeline of the proposed project.

Geographic scale is identified by defining the environmentally relevant area for each impact of the proposed project. The environmentally relevant area may be considered the area where impacts from the proposed project could potentially overlap with impacts of other projects. The environmentally relevant area is determined on a case-by-case, impact-by-impact basis for each EIS topic. Defining the timeline for the proposed project is necessary to identify other future projects that could contribute to CPE. The timeline for inclusion of future projects is determined by considering if a basis for expectation has been laid for a project.

Inclusion of future projects in the CPE analysis must pass a two-part test that factors in the basis of expectation as well as the available information about the future project. The first half of the test determines whether the future project is "reasonably likely to occur". Several sources of information to review are listed in Minnesota Rules 4410.0200, subpart 11a, to aid determination of if a project is reasonably likely to occur. Such information includes whether applications for permits have been filed with units of government; whether detailed plans and specification have been prepared, whether the future development is indicated by comprehensive plans or other documents; historic or forecasted development trends, or any other factors found relevant to the RGU such as funding status.

The second half of the test determines whether sufficiently detailed information is available about a future project to contribute to the understanding of CPE. This half is only applied if the first half of the test is met and the future project is determined reasonably likely to occur. If a project is reasonably likely to occur but does not have sufficient information to contribute to understanding of the CPE, then it was not considered in the EIS analysis for CPE.

4.2. Geographic Scale and Timeline of the Proposed Project

The geographic scale of the proposed project includes the 26.6-acre Grindstone Reservoir, which would be permanently eliminated, the area immediately surrounding the dam, access routes for construction equipment, and downstream areas that may receive sediment.

The timeline of the proposed project would include (in sequential order): 1) drawdown of the reservoir, 2) consolidation of sediments, 3) dam removal and 4) floodplain grading and construction of riffles and associated erosion control methods. Drawdown, consolidation, and dam removal is expected to occur over 4-6 weeks during summer months. Floodplain grading and construction are anticipated to take place one year following dam removal once the main channel is established and soils are consolidated.

Each topic for the proposed project was assessed individually for geographic scale, timeline, and specific impacts.

4.2.1. Wetland Impacts

The geographic scale for wetlands includes those adjacent to the Grindstone Reservoir and those present within access routes for construction. The timeline for wetland impacts is expected to be concurrent with implementation of the proposed project. Dam removal would create wetland within the restored floodplain/existing reservoir. Existing floodplain wetlands would be fully or partially drained, with strongest effects immediately upstream of the dam. Existing wetlands and a portion of the restored floodplain may be impacted from the temporary construction access/permanent angler foot path or boardwalk dependent on final design.

4.2.2. Hydrological Effects

The geographic scale for hydrological effects includes the Grindstone Reservoir, the North and South Branch Grindstone reaches immediately upstream of the reservoir, and the Grindstone River reach immediately downstream of the dam. The timeline for hydrological effects is expected to be concurrent with implementation of the proposed project, though a long-term scenario was also considered that accounts for fine sediment mobilization over several years. The modeled water surface elevations show a decrease upstream of the existing dam in all recurrence intervals up to 1 mile upstream of the dam on South Branch of the Grindstone River and up to 0.6 mile upstream of the dam on the North Branch of the Grindstone River. The maximum decrease in in the 100-year storm recurrence interval would occur at the dam location, and would decrease by about 7.6 feet in the short term proposed project (surveyed thalweg) and about 7.7 feet in the long term proposed project (predicted thalweg). The hydraulic modeling indicates there would be no change to the flood hydraulics of the bridges and other river stations of the Grindstone River downstream of the existing dam.

4.2.3. Sediment and Contaminants

The geographic scale for sediment and contaminants includes not only the approximately 26 acres where sediment has accumulated behind the Grindstone dam, but also the receiving waters downstream that would receive legacy sediment mobilized as a consequence of the dam removal. These waters include the Grindstone River below the dam, the Kettle River below its confluence with the Grindstone, and the St. Croix River below its confluence with the Kettle. The timeline for impacts from fine-sediment is expected to be relatively short and concurrent with the proposed project timeline. Transport of coarse sediment may take longer to mobilize downstream.

The new stream channel would mobilize existing legacy sediment downstream as it cuts its new path. Mobilization of fine sediment would cause short-term increases in turbidity. Sediment in four of seven sediment cores collected from the reservoir exceeded Level 2

SRVs and is likely naturally occurring based on regional aquatic geochemistry. Fine grained sediment enriched in the likely naturally occurring arsenic would be transported downstream. The sediment will likely be deposited in slack water environments or floodplains where arsenic concentrations might be similar. Mobilization of coarse sediment (sands) may migrate and aggrade downstream, raising the streambed elevation in discrete, transitory locations. Downstream nutrient loads may increase slightly.

Relative to other human activities that mobilize sediment and nutrients in the Grindstone and nearby watersheds, the impact of removing the Grindstone dam is likely to be small. Cropland is an important driver of sediment and nutrient loads in many watersheds, but only about 4% of the land area in the Grindstone River watershed is cropland (MPCA 2021c). While sediment and nutrient loads in the Grindstone are above unimpacted natural loads, they are not large relative to other tributaries of the St. Croix. Plus, the shallowness of the Grindstone Reservoir implies that much of the fine sediment, with adsorbed nutrients, may not be trapped efficiently and mostly passed downstream already. Consequently removing the dam will not likely have a major impact on sediment and nutrient loads in this context. Nonetheless we point out that, relative to the 34 main tributaries to the St. Croix River, the Kettle River, to which the Grindstone is tributary, is the fourth largest loader of phosphorus, at about 36 metric tons of phosphorus per year. The total maximum daily load (TMDL) report for Lake St. Croix, impaired by eutrophication from excess phosphorus, targets a reduction of 5.5 metric tons, or about 15%, of the phosphorus loads from the Kettle (MPCA and WDNR 2012). While removal of the Grindstone dam could increase phosphorus load to the St. Croix by a small amount, this cost appears to be small relative to the improvement in stream biology.

The enrichment of arsenic in the shallow, fine sediment within the existing reservoir appears to be the result of natural sources, transport, and processes. Dredging and dispersal of this sediment redistributes arsenic in quantities and concentrations that are natural and found elsewhere in the aquatic system. No new arsenic is being added to the system from outside sources, and one can argue that dispersal of the sediment could dilute its concentrations to safer values. In any event, aquatic organisms appear to be resistant to the concentrations found at the site, and arsenic in aquatic sediments pose little threat to humans because of no obvious means of exposure.

In the context of changing climate, greater annual precipitation totals would generate larger streamflows, which in turn would likely erode banks as the stream cross-sectional area adjusted to the larger flows. We speculate that the Grindstone Reservoir would be overwhelmed with new sediment and filled, such that its trapping and storage function would be eliminated. Removal of the Grindstone dam in this context would facilitate the downstream transport of sediment.

4.2.4. Plant Communities, Wildlife, Fish, and Sensitive Ecological Resources

4.2.4.1. Plant Communities

The geographic scale for impacts to plant communities includes the Grindstone Reservoir and adjacent wetlands and uplands. The timeline for impacts includes both the immediate effects concurrent with the proposed project and long-term changes to plant communities that would be expected to take decades. Upland forest and wetland plant communities could transition to communities with drier hydrologic regimes long-term. Plant community shifts could facilitate colonization or expansion of invasive species like common buckthorn. The shallow lake community would be eliminated and replaced by riverine, riparian shoreline, floodplain, and upland plant communities.

4.2.4.2. Fish and Wildlife

The geographic scale for impacts to fish and wildlife includes not only the Grindstone Reservoir, but also the upstream and downstream watercourses where connectivity would be restored. The timeline for impacts would both be concurrent with the proposed project implementation and on the scale of several years to decades as habitat quality, ecological processes, and connectivity develop. The restored river and floodplain would provide new habitat for many wildlife species. Some wildlife species would be displaced and immobile invertebrates may perish due to dewatering of the reservoir and loss of shallow lake community. Long-term, positive impacts to habitat quality and connectivity would provide net benefit to wildlife. Fish communities, including lake sturgeon, would benefit greatly from the dam removal via increased habitat connectivity and quality.

4.2.4.3. Sensitive Ecological Resources

The geographic scale for impacts to sensitive ecological resources includes not only the Grindstone Reservoir, but also the upstream and downstream watercourses where connectivity would be restored. The timeline for impacts would both be concurrent with the proposed project implementation and on the scale of several years to decades as habitat quality, ecological processes, and connectivity develop. Although long-term effects of dam removal should be beneficial to unionid mussels, unionids could be impacted by the dam removal process through changes in water quality, sedimentation, and local hydraulics. Impacts to the Blanding's turtle could include habitat loss from eliminating deep water overwintering habitat and direct mortality from project construction. Although long-term dam removal should be beneficial to the mudpuppy, individuals could be impacted by the dam removal process through changes in water quality, sedimentation, and local hydraulics.

4.2.5. Geology

The geographic scale for geological impacts is a 250-meter buffer surrounding the Grindstone Reservoir. The timeline for impacts is expected to be concurrent with implementation of the proposed project. The risk of land subsidence from reservoir drainage and associated water table affects is low to negligible.

4.2.6. Groundwater

The geographic scale for groundwater impacts is a 2,000-foot buffer surrounding the Grindstone dam. The timeline for impacts is expected to be concurrent with implementation of the proposed project. Private wells are not likely to experience problems due to dam removal.

4.2.7. Discussion of Reasonably Foreseeable Projects

Several agencies and units of government were contacted to inquire about projects in the environmentally relevant area that are reasonably likely to occur and that may interact with environmental effects from the proposed project within similar geographic scales and timelines identified for the proposed project. These agencies and units of government included the City of Hinckley, Pine County Soil and Water Conservation District, Pine County Planning and Zoning, DNR Fisheries, and DNR Parks and Trails. Three reasonably foreseeable projects were identified by the inquiry.

4.2.8. Munger Trail Improvements

The Willard Munger Trail crosses the Grindstone River via a bridge approximately 70 feet downstream of the dam. Associated recreation facilities to the trail include a parking area and water access site. Projects reasonably likely to occur include the rehabilitation of the trail parking lot by repaving the deteriorated surface and the replacement of the decking on the DNR trail bridge (ID BR01350).

4.2.9. County Road 140 Bridge Replacement

In 2022, Pine County submitted a work in public waters application that proposed to replace Bridge 58815 crossing County Road 140, located approximately 1 mile downstream of the Grindstone dam. The project has not yet been permitted. The purpose of the proposed bridge replacement is to replace the structurally deficient bridge and improve roadway safety. The existing bridge is a 3-span pre-stressed voided slab bridge and would be replaced with a proposed 1-span pre-stressed beam bridge and approach work will occur to tie into existing conditions.

4.2.10. Water Intake for DNR Fish Ponds

The Grindstone Reservoir currently provides a water source for three drainable fish rearing ponds operated by DNR Fisheries. The permanent water level change resulting from the removal of the dam would require an alternate water source for the ponds. An alternate design that would use the Grindstone River as a water source has been designed by DNR engineering staff, conditional upon the dam being removed.

The fish rearing ponds are located 0.2 miles downstream from the dam along the Grindstone River. The ponds are separated from the river by an earthen dike. The southernmost pond was built in the late 1930s; two additional ponds were added in the 1940s. The three ponds currently provide approximately 20 percent of the DNR's annual muskellunge fingerling production. Currently, the DNR draws water from the Grindstone Reservoir to fill the ponds under a long-term DNR water appropriation permit (2018-0240). Beginning in April each year the ponds are filled via a gravity-fed pipeline running from the water intake structure in the reservoir to a pump house adjacent to the ponds. Approximately 15 million gallons of water are required to fill all three ponds. Once filled and dependent upon summer rainfall amounts, the ponds generally only require occasional additional inputs of water during the summer unless there is significant loss from evaporation.

In June, muskellunge that have been reared in a hatchery are placed in the ponds and allowed to grow. After about four months of growth, the muskellunge are collected and the ponds are drained with the water allowed to flow back into the river. This fill/drain process has been used annually since 2009 when improvements were made to the drainage of the second and third ponds, but the annual cycle of filling, muskellunge rearing, and draining has taken place for over 40 years.

DNR Fisheries has been considering replacement of this actively leaking and deteriorating water line in favor of an alternative for some time. The current pipe has been re-lined once already and recent efforts to have it televised to inform potential additional repairs were unsuccessful. Further, the permanent water level change resulting from the removal of the dam and the elimination of the reservoir would render the current water intake at the reservoir unusable. DNR Engineering staff have designed a system that would use the Grindstone River as the water source. Preliminary plans included the installation of a filter bed measuring approximately 50 feet x 10 feet in the streambed near the southernmost pond. A new wet well and pumphouse would be constructed on the adjacent dike, with approximately 1,000 feet of PVC pipe to be buried to facilitate filling of the three ponds. This project would also involve the burying of electrical lines for a similar distance. A short-term, in-channel stream diversion is planned to dewater the immediate area during construction of the filter bed. The water line currently in use, which runs from the reservoir to the existing pond pumphouse, would be capped and abandoned in place. Funding has not yet been secured, but ideally would take place in concert with or prior to the removal of the dam in an attempt to minimize disruption to fish production. Other than changes to the water supply, no other changes to rearing pond operations are anticipated.

4.3. Determination of CPE and Significant Environmental Effect

This section of the CPE analysis discusses how the three reasonable and foreseeable projects could contribute to CPE for each of the seven EIS topics.

4.3.1. Wetland Impacts

No effects to wetlands are expected from the proposed Munger Trail improvements. Improvements would be limited to existing infrastructure.

No effects to wetlands are expected from the proposed County Road 140 bridge replacement. The Grindstone River was the only aquatic resource identified within the project area by the permit applicant.

The water intake for DNR fish ponds would likely not include permanent wetland impacts under current design. Some temporary impacts could occur depending on the placement of the PVC pipe, but would be restored in accordance with state and federal wetland regulations following project completion.

4.3.2. Hydrological Effects

No effects to H&H are expected from the proposed Munger Trail improvements. Improvements would be limited to existing infrastructure and not significantly modify the features.

No negative impacts to H&H are expected from the proposed County Road 140 bridge replacement. Hydraulic analysis indicated that a minor decrease in upstream flood damage potential would result from the proposed bridge design.

The preliminary design for a new water intake for the DNR fish rearing ponds includes permanent installation of a filter bed within the streambed of the Grindstone River. This would not have a significant effect on the H&H of the river, so long as the filter bed is constructed at the same elevation as the current riverbed. A short-term, in-channel stream diversion would be necessary to construct the filter bed. Any impacts to the H&H are expected to be temporary.

4.3.3. Sediment and Contaminants

No effects to sediment and contaminants are expected from the proposed Munger Trail improvements. Limited, if any, ground disturbance would be proposed.

Both the County Road 140 bridge replacement and the water intake for the DNR fish rearing ponds would include soil and sediment disturbance potentially resulting in sediment release. The scale of disturbance proposed is relatively small for both of these projects and standard BMPs required during permitting would minimize potential effects from implementation.

4.3.4. Plant Communities, Wildlife, Fish, and Sensitive Ecological Resources

No effects to plant communities, wildlife, fish, or sensitive ecological resources are expected from the proposed Munger Trail improvements. Direct impacts associated with the proposed improvements would be limited to developed land.

The proposed County Road 140 bridge replacement would include construction within the stream channel and potentially affect sensitive ecological resources. A total of 6,525 square feet of combined excavation and fill are proposed within the channel and could potentially result in direct mortality of mussel species and indirect loss of habitat. Due to potential presence of state-listed mussel species within the project area, a mussel survey was conducted within the project area by the DNR Center for Mollusk Program staff. One state-listed threatened species was documented within the survey area and was relocated outside of the impact area. No Blanding's turtle or mudpuppy observations (species observed near the Grindstone dam) are recorded within the vicinity of the proposed bridge replacement. The types of impacts proposed are unlikely to result in impacts to these two species either via direct mortality or disturbance or indirectly through habitat loss. However, Blanding's turtles use a wide variety of habitat during their active season and DNR may recommend implementation of avoidance and minimization BMPs. The proposed bridge replacement is unlikely to have other significant effects on plant communities, wildlife, fish, or sensitive ecological resources.

The preliminary design for a new water intake for the fish rearing ponds includes construction within the stream channel and could potentially affect sensitive ecological resources. State-listed mussel species are known to be present within the vicinity of the proposed filter bed location. Due to the potential presence of state-listed mussel species within the project area, a mussel survey will likely be required. If state-protected mussels are present, a permit to take would likely be required by the DNR. The permit to take may include additional mitigation requirements. Direct mortality of mussels could occur from in water construction activities and dewatering. Some habitat loss could result due to the placement of the filter bed though the amount of habitat loss is expected to be small. No other indirect impacts to mussels would be expected.

The preliminary water intake design for the DNR fish ponds is unlikely to have other significant effects on plant communities, wildlife, fish, or sensitive ecological resources. The proposed direct impact within the stream channel is relatively small and there are unlikely to be significant indirect downstream effects to hydrology and sedimentation. Outside of the channel, impact areas currently consists of the fish ponds and associated terrestrial lands, which mostly comprise of dikes. These are highly managed and disturbed landscapes that do not consist of native plant communities or quality wildlife habitat. Direct impacts to other sensitive species such as the Blanding's turtle or the mudpuppy likely would be avoided by use of standard BMPs.

4.3.5. Geology

No effects to geology are expected from the proposed Munger Trail improvements. Improvements would be limited to existing infrastructure.

No effects to geology are expected from the proposed County Road 140 bridge replacement. No significant changes to surface water or groundwater hydrology are anticipated that would risk land subsidence related to karst geology.

No effects to geology are expected from the water intake for DNR fish ponds. No significant changes to surface water or groundwater hydrology are anticipated that would risk land subsidence related to karst geology.

4.3.6. Groundwater

No effects to groundwater are expected from the proposed Munger Trail improvements. Improvements would be limited to existing infrastructure.

No effects to groundwater are expected from the proposed County Road 140 bridge replacement. Impacts are limited to those affecting surface waters only.

No effects to groundwater are expected from the water intake for DNR fish ponds. Water pumped from the wet well will be replenished by surface water from the river, not groundwater. Leakage from the fish rearing ponds to the groundwater will be minimal.

5. COMPARISON OF ALTERNATIVES

The EIS includes analysis of the proposed project and two alternatives to inform and identify the potentially significant environmental impacts of each scenario. The information provided "shall be used as a guide in issuing, amending, and denying permits and carrying out other responsibilities of governmental units to avoid or minimize adverse environmental effects and to restore and enhance environmental quality" (Minnesota Rules 4410.0300.)

According to Minnesota Rules, part 4410.2300, item G, the EIS should compare the potentially significant impacts of the proposed project with those of other reasonable alternatives. The two alternatives analyzed in this EIS are the no action alternative and a partially engineered restoration. The no action alternative consists of keeping the dam in place with ongoing maintenance and possible major repairs, and includes risk of dam failure. The partially engineered restoration entails a modified design similar to the proposed project with the addition of an excavated meander. Complete descriptions of the proposed project and the two alternatives are provided in Section 2.

The comparison of alternatives is presented in Table 5-1 and summarizes the analyses discussed in Section 3. The intent of the comparison is to guide permitting and other responsibilities of governmental units to avoid or minimize adverse environmental effects and to restore and enhance environmental quality.

Table 5-1. Comparison of alternatives.

Topic	Proposed Project	No Action Alternative	Partially Engineered Alternative
Wetland Impacts	• Wetlands would be created within the restored floodplain/existing reservoir. • Existing floodplain wetlands would be fully or partially drained, with strongest effects immediately upstream of the dam. • Existing wetlands and a portion of the restored floodplain may be permanently filled from the temporary construction access/permanent angler foot path. Design options would consider permanent angler access that does not impact wetlands (e.g. boardwalk).	• No effect unless the dam fails. • If the dam failed, uncontrolled release could drain existing wetlands or alter and degrade hydrology. Without active restoration of exposed sediments, invasive plant species could establish.	• Similar impacts to the proposed project. • Some additional temporary impacts could occur if access through wetlands is needed for construction of the meander.

Topic	Proposed Project	No Action Alternative	Partially Engineered Alternative
Hydrological Effects	• The modeled water surface elevations show a decrease upstream of the existing dam in all recurrence intervals up to 1 mile upstream of the dam on South Branch of the Grindstone River and up to 0.6 mile upstream of the dam on the North Branch of the Grindstone River. • The maximum decrease in in the 100-year storm recurrence interval would occur at the dam location, and would decrease by ~7.6 feet in the short term proposed project (surveyed thalweg) and ~7.7 feet in the long term proposed project (predicted thalweg). • The hydraulic modeling indicates there would be no change to the flood hydraulics of the bridges and other river stations of the Grindstone River downstream of the existing dam.	• No effect unless the dam fails. • A dam failure would cause an immediate and major safety concern for people utilizing the Grindstone Reservoir and at the downstream bridge crossings. In the short term, the sudden change in velocity and water elevation of the river would increase risks for injury to people and river biota as well as present hazards associated with erosion and debris transport downstream. In the long-term, once the H&H conditions equilibrate following a dam failure, the resulting conditions may be similar to the proposed project. • Specific H&H changes under dam failure are difficult to predict without conducting a dam failure analysis model.	• Similar impacts to the proposed project.

Topic	Proposed Project	No Action Alternative	Partially Engineered Alternative
Sediment and Contaminants	• The new stream channel would mobilize existing legacy sediment downstream as it cuts its new path. • Mobilization of fine sediment would cause short-term increases in turbidity. • Fine-grained sediment enriched in likely naturally occurring arsenic would be transported downstream. The sediment will likely be deposited in slack water environments or floodplains where arsenic concentrations might be similar. • Mobilization of coarse sediment (sands) may migrate and aggrade downstream, raising the streambed elevation in discrete, transitory locations.	• The dam will continue trapping sediment and nutrients, but with decreasing efficiencies as it gradually fills with accumulated sediment. • If the dam fails, sediment release would be a large, uncontrolled event.	• Similar impacts to the proposed project.
Plant Communities, Wildlife and Sensitive Ecological Resources	• Upland forest and wetland plant communities could permanently transition to communities with drier hydrologic regimes long-term. • Plant community shifts could facilitate colonization or expansion of invasive species like common buckthorn, permanently impacting plant communities in the absence of	• No effect unless the dam fails, though negative impacts associated with the dam such as migration barriers and altered hydrology and sediment transport would persist. • If the dam fails, uncontrolled release could dewater plant communities to a similar extent	• Similar impacts to the proposed project.

Topic	Proposed Project	No Action Alternative	Partially Engineered Alternative
	management. • The shallow lake community would be eliminated and permanently replaced by riverine, riparian shoreline, floodplain, and upland plant communities. • Some wildlife individuals would be temporarily or permanently displaced, and immobile invertebrates may perish due to dewatering of the reservoir and loss of shallow lake community. Long-term, positive impacts to habitat quality and connectivity would provide net benefit to wildlife. • Fish communities, including lake sturgeon, would benefit greatly from the dam removal via increased habitat connectivity and quality. • Although long-term dam removal should be beneficial to unionid mussels, individual unionids could be temporarily or permanently impacted by the dam removal process through changes in water quality, sedimentation, and local hydraulics.	as the proposed project. Without active restoration, invasive species could become established in areas of exposed sediment. • If the dam fails, uncontrolled release could cause direct mortality of less mobile and fully aquatic organisms via rapid dewatering of the impoundment. Examples include mussels or overwintering Blanding's turtles. Uncontrolled release could also displace aquatic organisms to downstream locations and bury downstream organisms in sediment.	

Topic	Proposed Project	No Action Alternative	Partially Engineered Alternative
	• Impacts to the Blanding's turtle could include permanent habitat loss from eliminating deep water overwintering habitat. Individuals could experience direct mortality from project construction. • Although long-term dam removal should be beneficial to mudpuppy populations, individuals could be temporarily or permanently impacted by the dam removal process through changes in water quality, sedimentation, and local hydraulics.		
Geology (Karst)	• The risk of land subsidence from reservoir drainage and associated water table affects is low to negligible.	• No effect. In the event of dam failure, the risk of land subsidence would be low to negligible.	• Similar to the proposed project, the risk of land subsidence from reservoir drainage and associated water table affects is low to negligible.
Groundwater (Private Wells)	• Private wells are not likely to experience problems due to dam removal, though there may be a decrease in groundwater levels in wells close to the dam.	• No effect unless the dam fails. • If the dam fails, the risks to wells upstream of the dam would be similar to the risks associated with the proposed project. • For wells downstream of the dam, the risks would be limited	• Similar impacts to the proposed project, though the decrease in groundwater levels may be less in some areas.

Topic	Proposed Project	No Action Alternative	Partially Engineered Alternative
		to wells that could be temporarily flooded due to the dam break. Flooded wells would be at risk of contamination by surface water.	
Public Waters and Riparian Rights	• Based on bathymetry data, it is expected that the river would reform within the old riverbed, which is approximately within the center of the current reservoir and would result in a loss of direct access to the shoreland of a public water by the existing private riparian landowner. This would remove the riparian rights from the parcel and result in diminishment of the land rights held by the parcel owner.	• No effect unless the dam fails. • Sudden release of water due to dam failure would likely result in loss of access to the shoreland by the neighboring landowner.	• The proposed meander location would abut the neighboring landowner's property, and would provide access from the property to the shoreland of the newly routed Grindstone River. • This alternative would maintain riparian rights, however, the type of waterbody present would change from a reservoir to a watercourse. Use of the underlying land may change to the benefit or detriment of the landowner.

6. PROPOSED AND RECOMMENDED MITIGATION AND MONITORING

6.1. Introduction

Minnesota Rules, part 4410.2300 states that an EIS must include mitigation measures that could reasonably eliminate or minimize any adverse environmental, economic, employment, or socioeconomic effects of the proposed project. The term “mitigation” has different meanings depending on the resource being mitigated or whether it is required or described by federal, state or local regulations. For example, mitigation for wetland impacts is highly regulated with specific requirements. Monitoring may be recommended or required to comply with mitigation requirements or determine need for mitigative action.

6.2. Proposed Mitigation and Monitoring Recommendations

Mitigation and monitoring measures were developed throughout the scoping process and in draft EIS development and are summarized in Table 6-1. Further detail on mitigation and monitoring measures described in Table 6-1 can be found in Section 3: Affected Environment and Environmental Consequences for each topic. Further recommended measures may be developed based on public comment. Mitigation and monitoring measures discussed within this EIS are not formal commitments for implementation. Rather, the measures are a list of actions that could mitigate impacts, advise their implementation and effectiveness, and inform the permitting process.

Mitigation and monitoring measures are listed in Table 6-1 as either “proposed” or “recommended”. Proposed measures are anticipated to be required by permits or necessary for implementation of the proposed project. Recommended measures are monitoring or mitigation actions suggested during technical review of potential impacts and may be included as permit conditions by individual permit authorities, dependent on their review of the project and determination of mitigation requirements.

Table 6-1. Proposed mitigation, monitoring, and required permits and government approvals for each EIS topic. Each potential impact is for the proposed project only.

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
Wetland Impacts	• Wetlands would be created within the restored floodplain/existing reservoir. • Existing floodplain wetlands would be fully or partially drained, with strongest effects immediately upstream of the dam. Existing wetlands and a portion of the restored floodplain may be temporarily or permanently impacted from the temporary construction access/permanent angler access route. Design options would consider permanent angler access that does not impact wetlands (e.g. boardwalk).	**Proposed Mitigation and Monitoring** • Mitigation and monitoring would be completed, at a minimum, according to state and federal regulatory requirements if determined necessary. • Drainage or wetland type conversion may be considered as "no-loss" due to the project purpose of fish and wildlife habitat restoration, meaning that WCA would not consider these impacts to result in permanent loss or impact to wetlands. • Temporary construction access impacts would be restored post-construction. A proposed permanent	• USACE Section 10 permit • USACE Section 404 permit • Wetland Conservation Act decision • MPCA 401 water quality certification

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
		angler access route may be considered a permanent impact depending on design, and could require a wetland replacement plan under WCA and MPCA rules. • Federal regulations may require compensatory wetland mitigation similar to the WCA replacement plan depending on qualification for general permits, final project design, and agency review. **Recommended Mitigation and Monitoring** • None	
H&H Effects	• The modeled water surface elevations show a decrease upstream of the existing dam in all recurrence intervals up to 1 mile upstream of the dam on South Branch of the Grindstone River and up to	• **Proposed Mitigation and Monitoring** • To be determined based on final design, permitting, and recommended mitigation and monitoring measures described below. • **Recommended**	• FEMA Letter of Map Revision (if needed)

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
	0.6 mile upstream of the dam on the North Branch of the Grindstone River. • The maximum decrease in in the 100-year storm recurrence interval would occur at the dam location, and would decrease by ~7.6 feet in the short term proposed project (surveyed thalweg) and ~7.7 feet in the long term proposed project (predicted thalweg). • The hydraulic modeling indicates there would be no change to the flood hydraulics of the bridges and other river stations of the Grindstone River downstream of the existing dam.	**Mitigation and Monitoring** • A post-construction bathymetric survey to confirm pre-project assumptions of sediment mobilization should be completed one year after project completion. • Inspection of the constructed riffles should be completed one year after project completion to confirm they are constructed and operating as designed. The operation and maintenance plan for the project should include inspections of the constructed riffle. • Monitoring of downstream the downstream DNR-owned bridge and structure should be conducted after the	

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
		removal of the dam to confirm the proposed project is operating as expected. • Monitoring of tributaries upstream of the existing dam should be completed routinely after the completion of the project. Bank erosion assessments should be completed if there appears to be any head cutting in tributaries or near the junction of tributaries with the Grindstone River as a result of the water levels changes that occurred from the project.	
Sediment and Contaminants	• The new stream channel would mobilize existing legacy sediment in the reservoir downstream as it cuts its new path. • Mobilization of fine	**Proposed Mitigation and Monitoring** • To be determined based on final design, permitting, and recommended mitigation and monitoring	• National Pollution Discharge Elimination System/State Disposal System (NPDES/SDS) construction stormwater (CSW) permit

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
	sediment would cause short-term increases in turbidity. • Fine-grained sediment enriched in likely naturally occurring arsenic would be transported downstream. The sediment will likely be deposited in slack water environments or floodplains where arsenic concentrations might be similar. • Mobilization of coarse sediment (sands) may migrate and aggrade downstream, raising the streambed elevation in discrete, transitory locations.	measures described below. • A slow drawdown of the reservoir water levels is critical to the downstream transport of fine sediment into small temporary pulses of turbidity that do not overwhelm or bury the aquatic biota (notably mussels). **Recommended Mitigation and Monitoring** • Both the water and biota should be monitored downstream of the dam during its dismantling to document the timing and magnitude of the turbidity pulse, plus its effective reach downstream. • The plan to minimize sediment mobilization includes removing the dam gradually during low-flow conditions, allowing	

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
		sediment consolidation, installing in-stream riffles as grade-control structures, installing bank stabilization structures, seeding with native plant mixtures, and planting floodplain-tolerant tree saplings. Full establishment of vegetation on the newly exposed substrate is expected to take two to five years.	
Plant Communities, Wildlife and Sensitive Ecological Resources	• Upland forest and wetland plant communities could transition to communities with drier hydrologic regimes long-term. • Plant community shifts could facilitate colonization or expansion of invasive species like common buckthorn. • The shallow lake community would be eliminated and replaced by	**Proposed Mitigation and Monitoring** • Mitigation of plant community impacts would focus on restoration of exposed shallow lake sediments to a floodplain plant community. • A slow drawdown of the reservoir water levels is critical to meter the downstream transport of fine sediment into small	If an avoidance plan cannot be prepared or demonstrates unavoidable impacts to mussels, a permit to take state-threatened mussels would be required from DNR.

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
	riverine, riparian shoreline, floodplain, and upland plant communities. • Some wildlife species would be displaced and immobile invertebrates may perish due to dewatering of the reservoir and loss of shallow lake community. Long-term, positive impacts to habitat quality and connectivity would provide net benefit to wildlife. • Fish communities, including lake sturgeon, would benefit greatly from the dam removal via increased habitat connectivity and quality. • Although long-term dam removal should be beneficial to unionid mussels, unionids could be impacted by the dam removal process through changes in water quality,	temporary pulses of turbidity that do not overwhelm or bury the aquatic biota – see monitoring and mitigation measure proposed for Sediment and Contaminants. • Erosion control BMPs would be used on newly exposed soils to address potential impacts to wildlife and fish, including sensitive species. These may include the use of wildlife friendly natural fiber, erosion control blankets, silt fencing, synthetic fiber-free hydro-mulch, and rock checks; specifications for BMPs and allowed materials would be included in construction documents. • A permit to take state-listed threatened mussels will be required due to	

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
	sedimentation, and local hydraulics. • Impacts to the Blanding's turtle could include habitat loss from eliminating deep water overwintering habitat and direct mortality from project construction. • Although long-term dam removal should be beneficial to the mudpuppy, individuals could be impacted by the dam removal process through changes in water quality, sedimentation, and local hydraulics.	potential sedimentation and local changes in hydraulic conditions. Monitoring of impacts to state-protected species will be required in the permit to take. The specifics of the monitoring will be developed during the permit to take process. • Actions to avoid or minimize disturbance to Blanding's turtles may include timing work to avoid stranding and disturbing turtles based on their phenology; use of BMPs described above; and educating contractors. **Recommended Mitigation and Monitoring** • A mussel avoidance plan could be prepared to demonstrate impacts to mussels would be avoided. Avoidance measures would	

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
		include slow reservoir drawdown, grade control, and erosion control BMPs. • Additional monitoring for turbidity, sediment accumulation, and sediment pollutants could be conducted for the purpose of monitoring potential impacts to mussel species downstream of the dam.	

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
Geology (Karst)	The risk of land subsidence from reservoir drainage and associated water table affects is low to negligible.	**Proposed Mitigation and Monitoring** • To be determined based on final design, permitting, and recommended mitigation and monitoring measures described below. **Recommended Mitigation and Monitoring** • Construction oversight could provide instruction regarding signs of potential land subsidence. A knowledgeable geotechnical engineer/geologist with karst experience could be on-call if signs of land subsidence related to karst appear. If water begins channelizing into a potential sinkhole, the location should be documented and a mitigation plan developed.	None.

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
Groundwater (Private Wells)	Private wells are not likely to experience problems due to dam removal.	**Proposed Mitigation and Monitoring** • To be determined based on final design, permitting, and recommended mitigation and monitoring measures described below. **Recommended Mitigation and Monitoring** • In a worst-case scenario, there is potential for supply wells to be impacted if the Grindstone Dam is removed. The mitigation of adverse impacts to water supply wells as a result of the Proposer's action would be the responsibility of the Proposer. • If a well is impacted, lowering the pump in the well is the most cost effective mitigation method. • Two mitigation approaches for well impacts	None.

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
		are proposed. The project Proposer would need to select and implement a mitigation approach prior to beginning work on the proposed project. o Conduct well inspections on 25 of the 37 wells within 2,000 feet of the dam that were not sealed to identify which wells are likely to require mitigation. o Notify owners of possible impacts prior to dam removal and develop a contingency plan to immediately mitigate the water supplies of any well owners that might be impacted.	

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
Public Waters and Riparian Rights	Loss of direct access to the shoreland of a public water by the existing private riparian landowner. This would remove the riparian rights from the parcel and result in diminishment of the land rights held by the parcel owner.	**Proposed Mitigation and Monitoring** • Loss of riparian rights mitigation will be determined based on conversations with the landowner. **Recommended Mitigation and Monitoring** Action to avoid or mitigate impacts include: • Maintain riparian rights through selection of the partially engineered alternative. • Offer an easement to the landowner on DNR land extending from the existing parcel, across DNR land to the restored river • Provide a corridor to edge of new river to landowner by transferring property	DNR Public Waters Work Permit

Topic	Potential Impact	Proposed and Recommended Mitigation and Monitoring Description	Required Permits and Approvals
		from DNR to the land owner that would extend the existing parcel to the restored river. • Enter into an agreement with the parcel owner to pay damages (for loss of property value, for example) or commence a condemnation action pursuant to Minn. Stat. Ch. 117.	

7. CONSULTATION AND COORDINATION

7.1. Agency Coordination

State agencies have participated in the preparation of the draft EIS. Following is a description of the core agencies involved.

7.1.1. Minnesota Department of Natural Resources

Staff in the DNR Divisions of Ecological and Water Resources, Fish and Wildlife, and Operation Services were involved with the preparation of the draft EIS. The DNR Division of Ecological and Water Resources acts as the Responsible Government Unit (RGU) for this EIS and provided project management support for the draft EIS process which included review and approval of work plans, analyses, impact assessments, and technical reports/memoranda.

7.1.2. Minnesota Pollution Control Agency

The MPCA was consulted regarding sediment and contaminant impact analysis, and regarding wetland impacts as they pertain to Section 401 water quality certification.

7.1.3. Board of Water and Soil Resources

BWSR was consulted regarding wetland impacts and potential mitigation and monitoring requirements.

7.2. Public Involvement

The EIS scoping process included public notifications and opportunities for the public to learn about and comment on the Grindstone Dam Removal Project. On October 12, 2020, the DNR published the Scoping Environmental Assessment Worksheet (SEAW) and the Draft Scoping Decision Document (DSDD) in the *EQB Monitor*, initiating a 30-day public review and comment period. The comment period ended on November 12, 2020. The DNR held an online public information meeting on November 5, 2020, to provide information on the proposed project and EIS scoping process. The meeting also included a question and answer session and a formal, verbal public input session. Comments received during the 30-day public review and comment period informed the Final Scoping Decision Document (FSDD).

The draft EIS will be circulated in accordance with the rules and requirements of Minnesota Rules Chapter 4410.2600. The draft EIS will allow for a public comment period; written comments will be accepted during this time. A public information meeting will also be held. Comments received at the public meeting and during the draft EIS comment period will be considered, and all substantive comments will be responded to in the Final EIS.

The final EIS will be circulated in accordance with the rules and requirements of Minnesota Rules Chapter 4410. The final EIS will be distributed to allow for a 10-day public comment period. Comments received on the final EIS will be considered in assessing the adequacy of the final EIS.

8. LIST OF PREPARERS

8.1. Department of Natural Resources

Name	Qualifications
Luther Aadland	River Scientist (retired) B.A. Concordia College – Moorhead, MN; M.S. North Dakota State University; Ph.D University of North Dakota 41 years of experience in river research and restoration
Jason Boyle	State Dam Safety Engineer B.S. Civil Engineering, University of North Dakota,; Master of Engineering, Environmental /water resources, University of North Dakota 20 years of experience in dam safety
Kate Fairman	Environmental Review Planning Director B.S. Environmental Science, Emphasis in Soils and Wetland Sciences, University of Minnesota – Twin Cities; M.P.A., Public Administration, Minnesota State University – Mankato 14 years environmental permitting and planning experience.
Leslie George	Hinckley Area Fisheries Supervisor B.S., Fisheries and Wildlife Management, University of Minnesota – Twin Cities; M.S., Fisheries Management, University of Minnesota – Twin Cities 18 years of experience with DNR Fisheries
Neil Haugerud	River Ecologist B.A. Gustavus Adolphus College-St. Peter, MN; M.S. South Dakota State University 19 yrs of experience in river research and restoration

Name	Qualifications
Jon Hendrickson	Principal Engineer B.S. Civil and Environmental Engineering – South Dakota State University 23 years of experience in Conservation Engineering
Amanda Hillman - Roberts	Restoration Coordinator B.A. Minnesota State University – Moorhead; M.S. Portland State University 10 years of river research and restoration
Becky Horton	Project Manager B.S. Biology and Geology, University of Wisconsin – Eau Claire 20 years of experience in ecology and regulatory review
Heidi Lindgren	Area Hydrologist/Regional Appropriation Hydrologist B.A. University of Minnesota Morris; M.S. Environmental Science with Hydrology emphasis, University of Idaho
Crystal Payment	Graduate Engineer 2 B.S. Environmental Engineering, Michigan Technological University; M.S. Civil Engineering, Michigan Technological University 18 years experience in hydrology, hydraulics, stream restoration and dam modification/removal
Greg Root	Water Appropriations Hydrologist/Assistant Regional Manager B.S University of Wisconsin – Superior; M.S. University of Louisiana at Lafayette 10 years' experience in environmental regulation and permitting

Name	Qualifications
John Seaberg	Groundwater Specialist B.S. Geology and Geophysics University of Wisconsin, Madison; M.S. Geology with hydrogeology emphasis and a minor in Civil Engineering, University of Minnesota, Twin Cities, 36 years of experience in hydrogeology
Jill Townley	Environmental Review Unit Supervisor B.E.D Landscape Architecture, University of Minnesota – Twin Cities; M.U.R.P., Urban and Regional Planning, emphasis in Environmental Planning, University of Minnesota – Humphrey Institute 15 years of experience in environmental planning

8.2. MPCA

Name	Qualifications
Jim Brist	401 Water Quality Certification Coordinator (retired) 34 years of varied state experience

8.3. Consultant Coordination

The following sub-contractors and individuals consulted on preparation of the draft EIS.

Name	Qualifications
Jim Almendinger	Water Quality and Sediment Specialist B.A. Botany, Ohio Wesleyan University, Botany; Ph.D Ecology, University of Minnesota 30+ years of experience
Heidi Dunn	Aquatic Ecologist & Malacologist B.S. Purdue University; M.S. Southern Illinois University 35+ years of experience

Name	Qualifications
Brett Emmons	Project Manager B.S. Forest Sciences, University of Illinois; M.S. Civil & Environmental Engineering, University of Wisconsin 35 years of experience
Ryan Fleming	Water Resources Engineer B.S. Geological Engineering, University of Minnesota 21 years of experience
Steve Gale	Geologist & Geotechnical Engineer B.S.C.E. Civil/Structural Engineering, Ohio State University; M.S. Geotechnical Engineering, Ohio State University 40+ years of experience
Stu Grubb	Assistant Project Manager & Geologist B.A. Geology, Carleton College; M.S. Water Resources Science, University of Michigan; M.B.A. University of St. Thomas 35 years of experience
Mike Majeski	Ecologist B.A. Environmental Biology, St. Mary's University 22 years of experience
Jimmy Marty	Environmental Analyst and Wetland Specialist B.A. Biology, Luther College; M.S. Ecology, Utah State University 7 years of experience
Jason Naber	Ecologist & Wetland Specialist B.A. Biology, St. John's University 33 years of experience
Madison Rogers	Water Resources Engineer B.S. Bioproducts and Biosystems Engineering, University of Minnesota 6 years of experience

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