U.S. Fish & Wildlife Service

Comprehensive River Management Plan

Nowitna Wild and Scenic River

Nowitna National Wildlife Refuge
PO Box 287
Galena, Alaska 99741

September 2025

MISSION STATEMENTS

The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people.

The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

NEPA Unique Identifier: 2024-0129091-NEPA-001
Photo: The Nowitna WSR winds through a tapestry of fall colors. Photo credit: Lisa Hupp, USFWS

TABLE OF CONTENTS

Section Page

TABLES

Page

FIGURES

GRAPHS

APPENDIXES

Image 1. Sweeping views of the Kokrine Hills from the lower Nowitna WSR create some of the river's finest scenery. Photo credit: Karin Bodony, USFWS

CHAPTER 1. INTRODUCTION

1.1 Background

Under Section 3(d)(1) of the Wild and Scenic Rivers Act (WSRA), the U.S. Fish and Wildlife Service (Service) has developed this comprehensive river management plan (CRMP) in consultation with state, local, and tribal governments and the public to guide long-term management and public use in a wild and scenic river (WSR) corridor. The CRMP is designed to protect and enhance the values that led to the river's designation and to specify public and administrative uses of the river corridor that are consistent with protection of the river's values. The Service will review and revise the CRMP as required by the Service's Wild and Scenic Rivers policy (611 FW 3).

The Service has prepared this CRMP in accordance with the mandates of the WSRA, the National Environmental Policy Act (NEPA), and other relevant laws, regulations, and policies. Development of this CRMP was accompanied by environmental analysis in a separate environmental assessment; this environmental analysis informed the content of the final CRMP.

1.2 Purpose of the Nowitna CRMP

The purpose of this CRMP, pursuant to the WSRA, as amended by the Alaska National Interest Lands Conservation Act (ANILCA), is to protect and enhance the river values (the free-flowing condition, water quality, and outstandingly remarkable values [ORVs]) for which the Nowitna WSR was designated and to identify data gaps and monitoring opportunities to protect these river values within the Nowitna WSR corridor. The ORVs for the Nowitna WSR are ecology, fish, cultural, and scenery (USFWS 2024a). In addition, the Nowitna WSR is classified as a wild river because it is free of impoundments, is generally inaccessible except by trail, has essentially primitive watersheds or shorelines, and has unpolluted waters.

In accordance with the WSRA, the CRMP will protect and enhance the river values of the designated Nowitna WSR for the benefit and enjoyment of present and future generations. Based on the baseline

conditions (at the time of designation), the existing conditions, and existing management direction, the CRMP does the following:

- Clearly identifies and describes the river's ORVs.
- Describes existing resource conditions with a focus on the river values.
- Identifies threats to the ORVs and strategies to protect them.
- Defines goals with desired future conditions and objectives that are specific, measurable, achievable, results oriented, time fixed, and spatially explicit.
- Identifies potential development of lands and facilities consistent with the wild classification.
- Identifies user capacities by monitoring and maintaining environmental and experiential criteria compatible with the river values, desired conditions, and other management directions.
- Identifies water quality concerns and instream flow requirements.
- Describes management strategies, actions, and practices to support the river values.
- Establishes collaborative roles between the Service, the State of Alaska, Tribes, and members of the public.
- Establishes corridor boundaries consistent with Section 3(b) of the WSRA. The corridor boundary adheres to ANILCA, which stipulates that boundaries shall include an average of not more than 640 acres per mile on both sides of the river, and mineral withdrawals shall be situated within one-half mile of each bank of the river.
- Identifies regulatory authorities to assist in the protection of river values.
- Describes a monitoring strategy to document current and future conditions and/or effectiveness of management actions.

1.3 Planning Context

While implementing the CRMP, the Service is obligated to adhere to laws, regulations, and policies; be consistent with Service plans, including amendments; follow government-to-government consultation protocols; and coordinate with individuals and groups interested in the planning and implementation of CRMP management actions. This section highlights applicable laws, regulations, and policies.

WSRA of 1968 (16 United States Code [USC] 1271–1287): Enacted in 1968, the WSRA establishes the framework for protecting and managing designated WSRs in the United States. It outlines the process for designating rivers as wild, scenic, or recreational, and requires the development of management plans for designated rivers.

ANILCA of 1980, as amended (16 USC 140hh-3233, 43 USC 1602–1784): The Nowitna WSR was designated on the Nowitna National Wildlife Refuge (NWR) by ANILCA. ANILCA Section 606(a) states the boundary of the WSR corridor shall include an average of not more than 640 acres per mile on both sides of the river (measured from the ordinary high-water mark). The boundary shall not include any lands owned by the State or a political subdivision of the State, nor shall such boundary extend around any private lands adjoining the river in such manner as to surround or effectively surround such private lands.

ANILCA, Title VIII, Section 810 (Public Law 96-487), subtitled Subsistence and Land Use Decisions, outlines the requirements for addressing impacts on subsistence uses of resources in the federal land-use decision-making process in Alaska. An ANILCA Section 810 evaluation is required for any decision to withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands under any provision of law authorizing such actions.

Image 2. Spectacular colors grace the Nowitna WSR every autumn. Here the Nowitna River flows across its broad floodplain toward the Yukon River and Kokrine Hills on the horizon. Photo credit: Lisa Hupp, USFWS

National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (16 USC 668dd–668ee): This act establishes a unifying mission for the National Wildlife Refuge System (System). The mission first and foremost focuses on the conservation of fish, wildlife, plants, and their habitats. It requires the preparation of a comprehensive conservation plan (CCP) for each unit of the System. Furthermore, it reinforces and expands the "compatibility standard" of the Refuge Recreation Act, which requires that public uses must be determined to be compatible with refuge and agency missions and purposes before they can be allowed and establishes a process for determining compatibility. The act also identifies six priority wildlife-dependent recreation uses; clarifies the authority of the Secretary of the Interior to accept donations of money for land acquisition; and places restrictions on the transfer, exchange, or other disposal of lands within the System.

NEPA of 1969, as amended (42 USC 4321–4347): NEPA requires federal agencies to assess the environmental impacts of proposed actions, including CRMPs for WSRs. It mandates the preparation of

environmental impact statements or environmental assessments and public involvement in the decision-making process.

The Federal Water Pollution Control Act of 1972, as amended by the Clean Water Act of 1977 (33 USC 1251 et seq.): This act's objective is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters by regulating the discharge of pollutants into waters of the United States. The act also makes it unlawful for any person to discharge any pollutant from a point source into navigable waters unless a permit is obtained under the Clean Water Act.

Executive Order 11988 (Floodplain Management): This executive order requires federal agencies to avoid actions that would adversely affect floodplains and to minimize the impact of actions that do occur in floodplains. It applies to CRMPs for WSRs to ensure responsible management of floodplain areas.

Executive Order 11990 (Protection of Wetlands): This executive order directs federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance their natural values. It applies to CRMPs for WSRs to ensure the protection of wetlands within river corridors.

Executive Order 13175 (Consultation and Coordination with Indian Tribal Governments): This executive order requires federal agencies to have an accountable process to assure opportunities for meaningful and timely input by tribal officials in the development of regulatory policies on matters that have tribal implications and to strengthen the government-to-government relationship with federally recognized Indian Tribes.

Executive Order 13112 (on Invasive Species): This executive order directs all federal agencies to ensure their actions do not promote the introduction or spread of invasive species. The intent of the order is to enhance the response and coordination of federal agencies in dealing with invasive species.

National Historic Preservation Act: Under Section 106 of the National Historic Preservation Act of 1966 and its implementing regulations at 36 Code of Federal Regulations (CFR) 800, federal agencies are required to consult with State Historic Preservation Offices regarding the eligibility of historic and cultural properties for nomination to the National Register of Historic Places (NRHP), and on determinations of effect from federal undertakings and management decisions.

Image 3. In its upper reaches the Nowitna WSR is relatively narrow and swift, and the vegetation is lush. Photo credit: Karin Bodony, USFWS

1.4 Coordination and Regulatory Authorities

1.4.1 Coordination

The Nowitna WSR benefits from partnerships supporting research, monitoring, planning, and management operations within the WSR corridor. Coordination includes input from tribal, local, state, and federal government entities. The CRMP is designed to be compatible with local and statewide planning goals of all agencies with jurisdiction over the corridor's resources. The Service has benefited from coordination with partners including the State of Alaska in fish and wildlife research related to the Nowitna WSR and intends to continue to support such efforts.

A cooperating agency is any federal, tribal, state, or local government agency that enters into formal agreement with the lead federal agency to help develop an environmental analysis. Entities that intended to participate as a cooperating agency were provided a memorandum of understanding to be signed and returned to the Service. The Bureau of Indian Affairs and State of Alaska signed memoranda of understanding for the environmental assessment for this CRMP.

The federal government works on a government-to-government basis with federally recognized Tribes because they are recognized as separate governments. Under Executive Order 13175, the federal government also consults with Alaska Native Claims Settlement Act (ANCSA) corporations on the

same basis as Tribes. As a matter of practice, the Service coordinates with all tribal governments, associated Native communities, Native organizations, and tribal individuals whose interests might be directly and substantially affected by activities on public lands. Tribes and ANCSA corporations work with the Service by sharing knowledge and resources to achieve desired outcomes for public lands and communities within statutory and regulatory frameworks.

Section 106 of the National Historic Preservation Act requires federal agencies to consult with Tribes for undertakings on tribal lands and that may affect historic properties of significance to the Tribes (36 CFR 800.2(c)(2)). Executive Order 13175 stipulates that during the NEPA process, federal agencies must consult with Tribes identified as being directly and substantially affected. Consultation with the State Historic Preservation Office was not necessary for the CRMP. The Service concluded that National Historic Preservation Act Section 106 consultation for this planning effort was not required because no specific actions are being identified in the CRMP that have the potential to affect historic properties.

1.4.2 Regulatory Authorities

The Alaska Department of Fish and Game (ADFG) has primary responsibility for managing Alaska's fish and resident wildlife populations. The Service has primary responsibility for management of migratory birds, endangered species, and other species mandated by federal law. On all refuge lands, the Service and Alaska Department of Fish and Game (ADFG) share a concern for all fish and wildlife resources and their habitats, and both are engaged in fish and wildlife conservation, management, and protection programs. In 1982, the Service and ADFG signed a master memorandum of understanding that defines the cooperative management roles of each agency and sets the framework for cooperation between the two agencies. In 1992, the federal government adopted final subsistence management regulations for federal public lands that established the Federal Subsistence Board, which makes the decisions on regulatory proposals affecting the harvest of fish and wildlife on federal public lands in Alaska.

The State of Alaska establishes fishing, hunting, and trapping regulations at the direction of the Alaska Board of Fisheries and Board of Game, while the Federal Subsistence Management Program establishes fishing, hunting, and trapping regulations on federal public lands at the direction of the Federal Subsistence Board (50 CFR 100.4(d)). State harvest regulations apply to Service lands unless superseded by federal regulations. If restrictions on hunting, fishing, or trapping are needed for reasons of conservation, they would be implemented through proposals to the Alaska Board of Fisheries and Board of Game and/or the Federal Subsistence Board or through closures or restrictions under 50 CFR 36.41 pursuant to the appropriate public rulemaking processes.

The Environmental Protection Agency (EPA) develops and enforces regulations that implement environmental laws enacted by Congress, including those associated with the federal Clean Water Act. The EPA has the authority to implement pollution control programs. The Service cooperates closely with the Alaska Department of Environmental Conservation (ADEC) and the EPA for the purpose of establishing water quality standards and for preventing, eliminating, or diminishing the pollution of state waters consistent with the federal Clean Water Act.

The ADEC, Division of Water oversees the federal Clean Water Act for the state and is responsible for establishing water quality standards, managing the Alaska Pollutant Discharge Elimination System permit program, and identifying waters that do not meet water quality standards under Clean Water Act Section 303(d) (impaired waters). The Service coordinates with the ADEC on all proposed actions that involve discharges into surface waters to ensure Service-authorized activities do not exceed State of Alaska water quality standards.

The Alaska Department of Natural Resources, Division of Mining, Land and Water authorizes water rights. A water right is a legal right to use surface or subsurface water or reserve instream flow under the Alaska Water Use Act. A water right allows a specific amount of water from a specific water source to be diverted, impounded, or withdrawn for a specific use or reservation of sufficient water to maintain a specified instream flow. In addition to managing water rights, the State of Alaska owns and manages the submerged lands under navigable waterways across the state.

In segments of the river in which the State holds title to the submerged lands, the Service would pursue an agreement with the State with the goal of coordinating management to protect and enhance the values for which the Nowitna WSR was added to the National Wild and Scenic River System (NWSRS). The State is a cooperator in the preparation of this CRMP.

CHAPTER 2. REGIONAL SETTING AND RIVER VALUES

2.1 River Setting

Deep in interior Alaska flows the Nowitna River, nestled in the heart of the Nowitna NWR, which forms much of the river's watershed (**Figure 1**). The river is a life-giving force in the region and was selected among 25 Alaska rivers to be added to the NWSRS with the passage of ANILCA in 1980. The Nowitna WSR is a place of abundance and diversity and is one of the finest geological examples in Alaska of a meandering river. From its headwaters in the Kuskokwim Mountains, the Nowitna WSR runs north across the Nowitna NWR for 220 of its 317 river miles before joining the mighty Yukon River (**Figure 2.1** through **Figure 2.8**). In its upper reaches, the Nowitna WSR's clear waters run swiftly through the narrow channels over colorful gravel as the river winds toward the tundra-capped hills that form its canyon section. Below the canyon, the floodplain broadens and the Nowitna WSR becomes a slowly meandering river typified by cut banks, sandbars, sloughs, and oxbow lakes. The river flows across a rich alluvial plain of lakes, marshes, and meandering streams and provides highly productive fish, waterfowl, and moose habitat.

Frequent spring flooding caused by ice damming along the Nowitna WSR during breakup enriches these lakes and sloughs with nutrients, as well as carbonates from the limestone bedrock in the river's headwaters. The carbonates buffer the pH of the naturally acidic wetland waters and makes these wetlands less acidic and more productive than many other areas in Alaska. On higher ground in the Nowitna WSR corridor, wetlands give way to a mosaic of spruce and deciduous forests, shaped by a natural regime of wildland fire and providing diverse wildlife habitats. In some areas, uncommonly large stands of old-growth white spruce provide nesting areas for raptors and excellent furbearer habitat. The combination of the Nowitna WSR's diverse abiotic and biotic features, including the geology, hydrology, and biodiversity, creates a unique example of boreal riparian ecosystems.

Image 4. The lower Nowitna River meanders across a wide floodplain before flowing into the Yukon River. Photo credit: Karin Bodony, USFWS

Figure 1: Nowitna WSR Overview

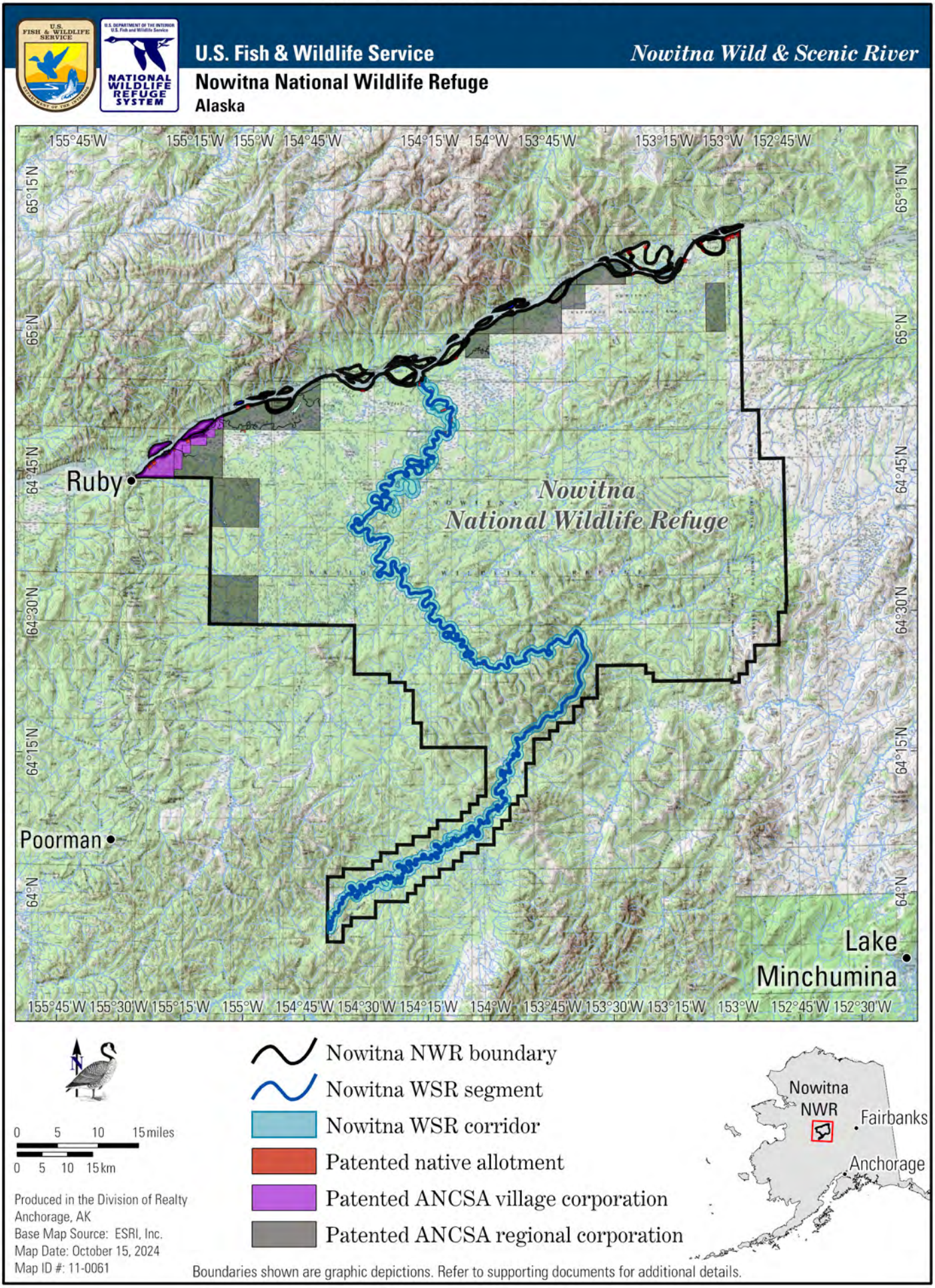


Figure 2.1: Nowitna WSR Series (1 of 8)

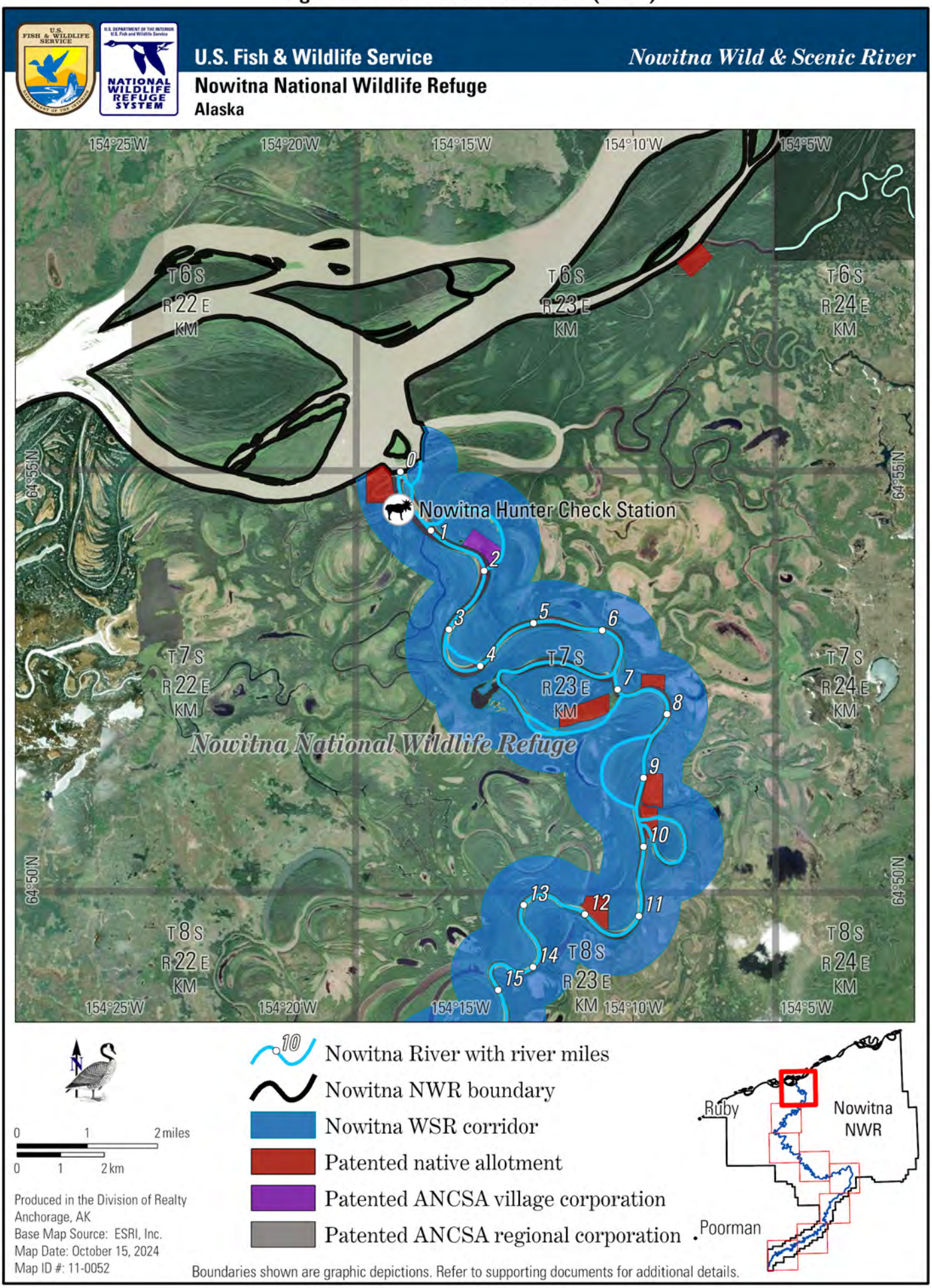


Figure 2.2: Nowitna WSR Series (2 of 8)

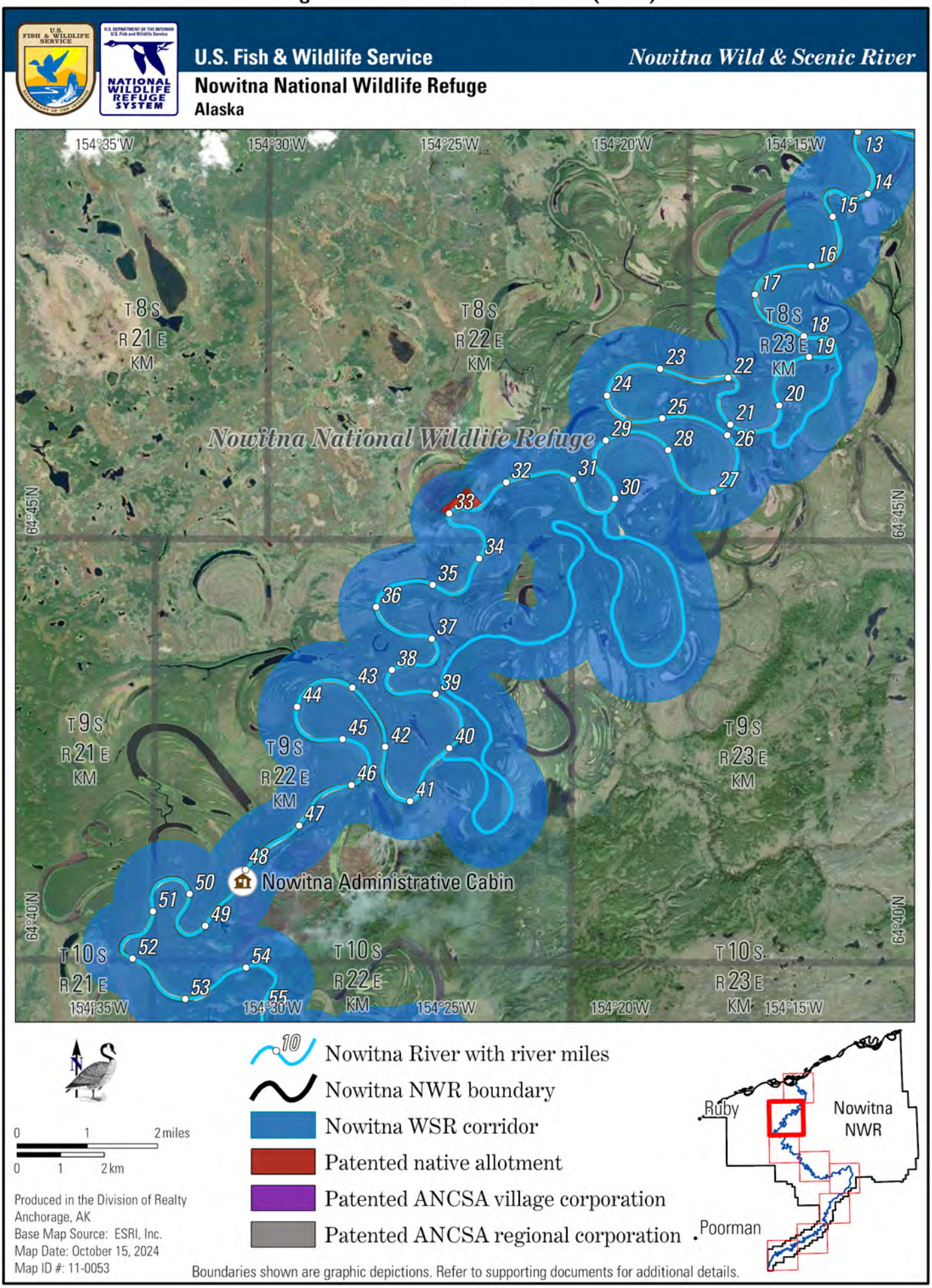


Figure 2.3: Nowitna WSR Series (3 of 8)

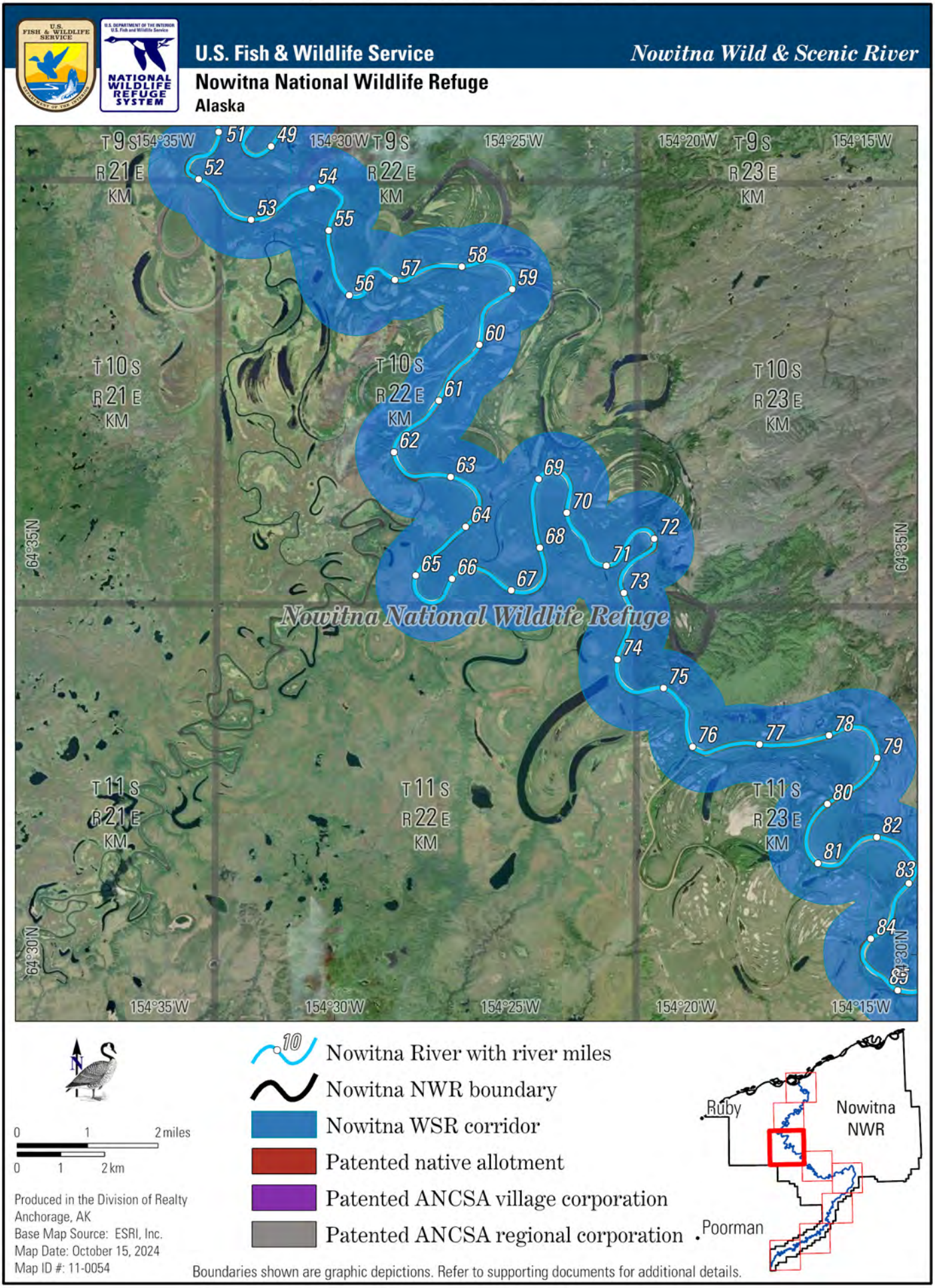


Figure 2.4: Nowitna WSR Series (4 of 8)

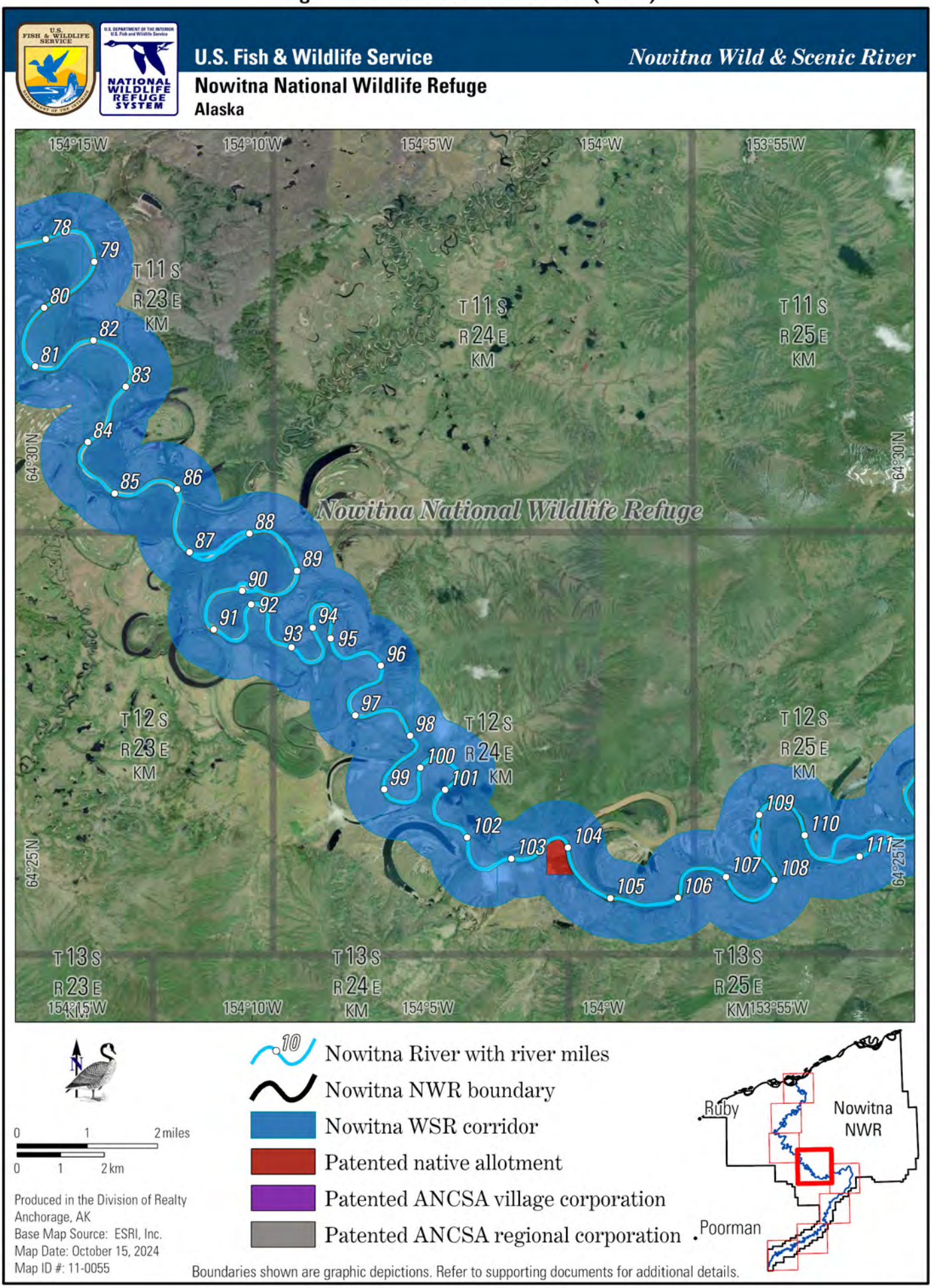


Figure 2.5: Nowitna WSR Series (5 of 8)

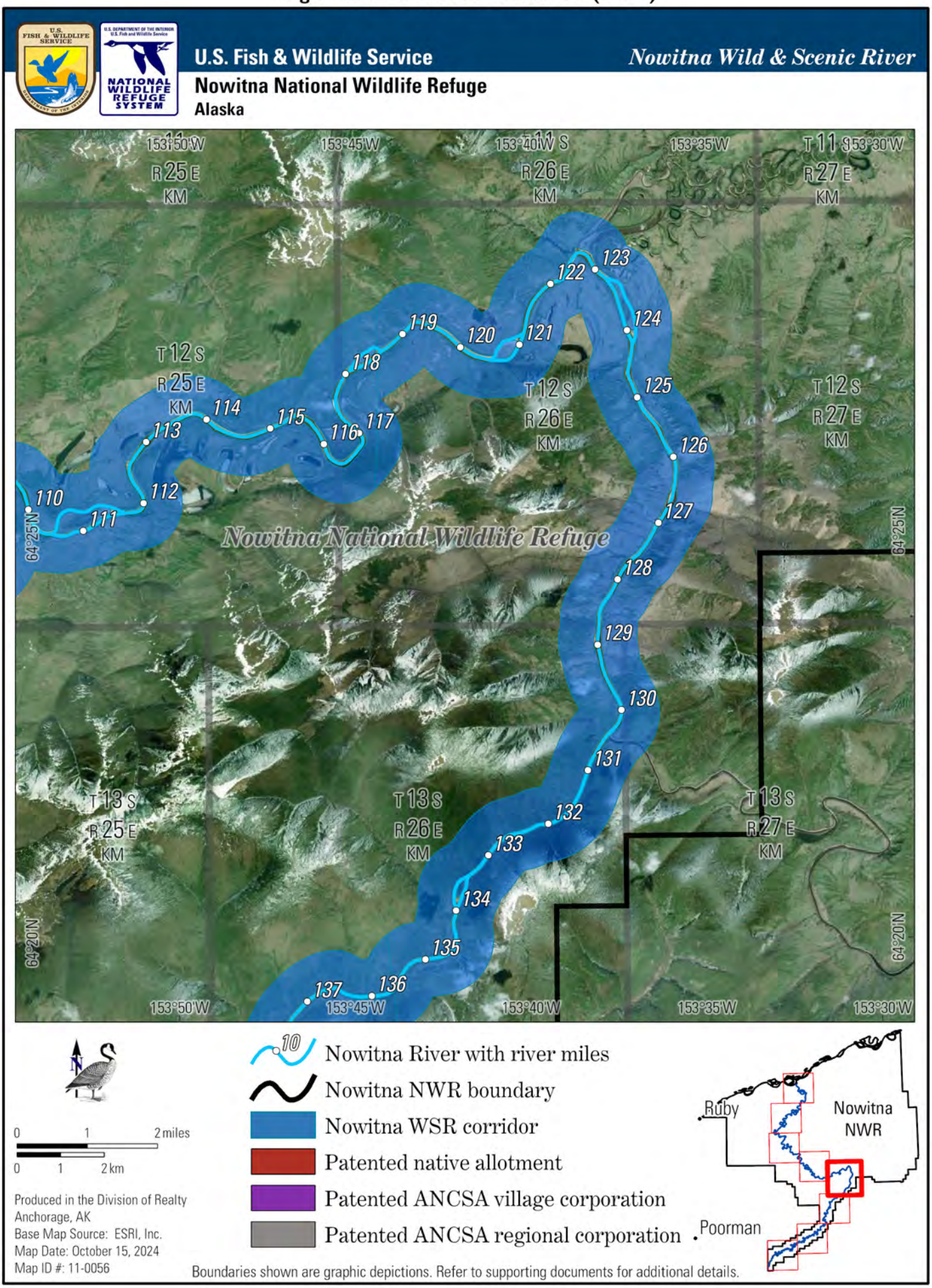


Figure 2.6: Nowitna WSR Series (6 of 8)

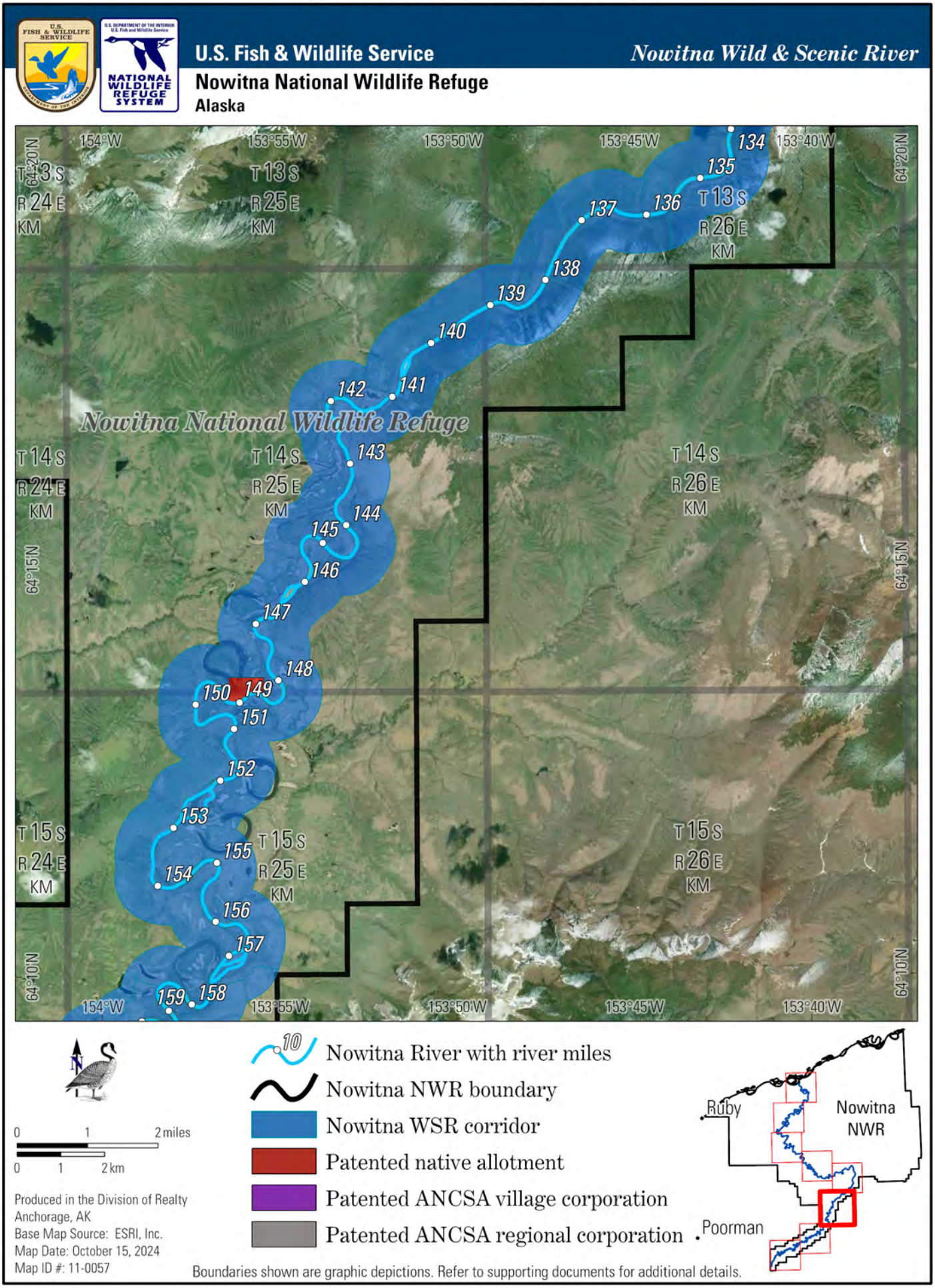


Figure 2.7: Nowitna WSR Series (7 of 8)

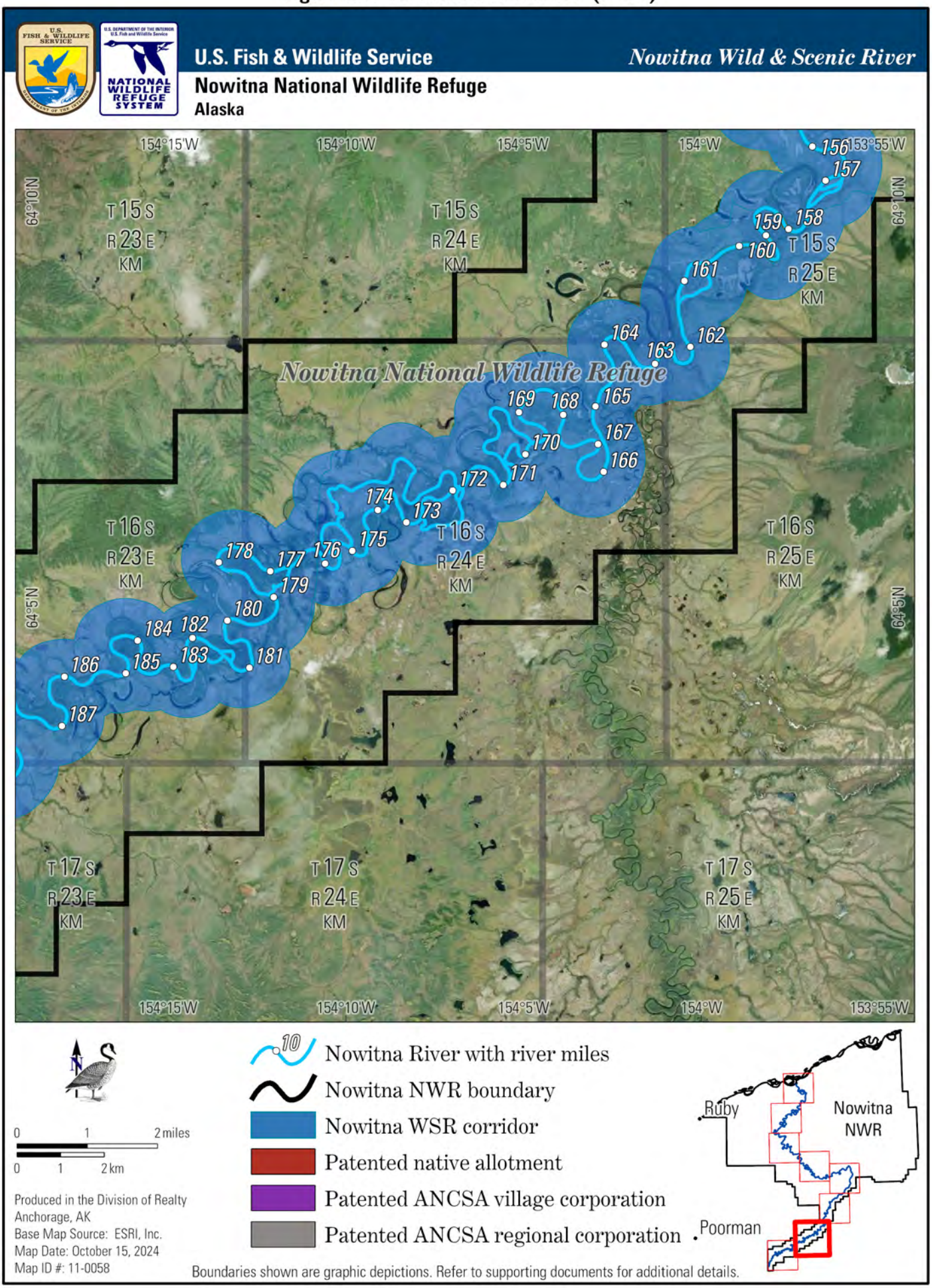
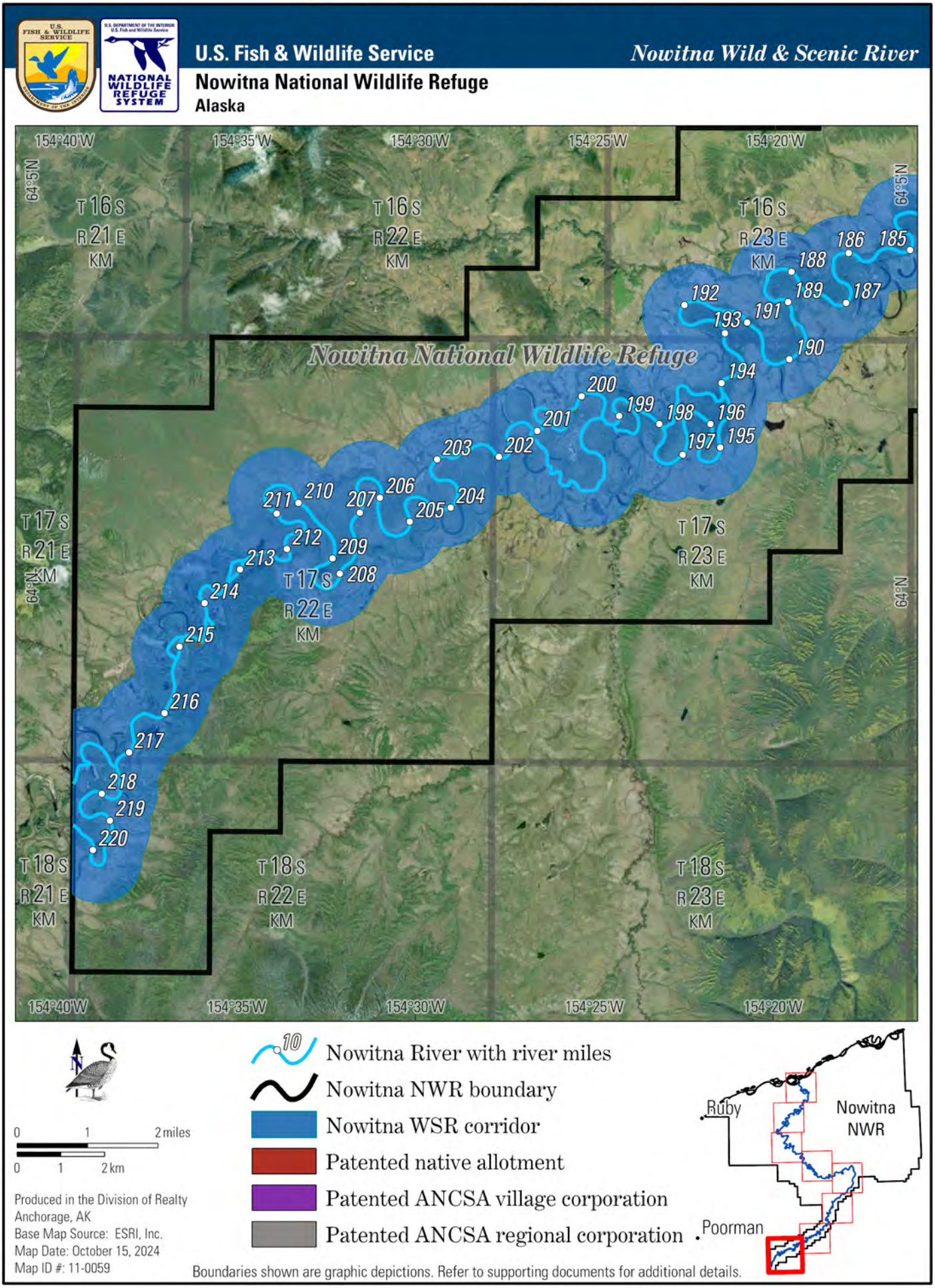


Figure 2.8: Nowitna WSR Series (8 of 8)



The Nowitna WSR's superior qualities that make it stand out among Alaska rivers have been identified and described throughout its management history, both in studies recommending its inclusion in the NWSRS and in subsequent management plans (USBOR 1973; USFWS 1987a; USFWS 2009). However, the Nowitna WSR was designated by ANILCA without comprehensive descriptions and associated baseline conditions of specific ORVs that made the river eligible for inclusion in the NWSRS. This underscores how WSR management is continually changing and emphasizes the necessity for continuous evaluation and flexible management protocols to safeguard areas like the Nowitna WSR, even with limited data, to enhance conservation strategies.

Image 5. This aerial photo of the Nowitna River canyon was taken in 1973 by the Bureau of Outdoor Recreation during one of the initial field assessments for WSR designation. Photo credit: Bureau of Outdoor Recreation

In 2023, Service staff met with representatives from the ADFG, ADEC, Alaska Department of Natural Resources, U.S. Bureau of Indian Affairs, and residents of local communities to identify and describe final ORVs (USFWS 2024a). In addition to the free-flowing condition and water quality, four ORVs were identified: ecology, fish, cultural, and scenery.

The free-flowing condition and water quality are protected for all rivers in the NWSRS. Flow regimes and water quality in the Nowitna WSR are not well studied but are generally considered to be natural and unimpaired. The river is mainly fed by snowmelt and warm-season precipitation, and maximum streamflow typically occurs in the spring during ice breakup. Ice jams during this time often cause flooding in the lower portion of the WSR. Summer flow levels can be dynamic in response to precipitation events. Water clarity varies seasonally and over the river's course. Clear water flows in the upper section, and the water becomes silty in the lower stretches during the summer months. For more

information regarding water in the Nowitna WSR, refer to **Section 2.2**, Free-Flowing Condition; **Section 2.3**, Water Quality; and **Section 2.5.1**, Ecology.

The ecology ORV encompasses the Nowitna WSR's unique combination of geology, hydrology, plant communities, and wildlife assemblage and recognizes the interconnectedness of these elements that yields intact, functioning ecosystems in the river corridor. The distinct water chemistry, flood regime, and meandering nature of the river generate diverse and highly productive riparian ecosystems that provide habitat for a broad, interconnected array of boreal plant and wildlife species (USFWS 2024a). For more information on these ecological components, refer to **Section 2.5.1**, Ecology.

The Nowitna WSR's fish community diversity and assemblage are rare in the Arctic-Yukon-Kuskokwim Region and are recognized in the fish ORV. At least 19 fish species have been documented in the Nowitna WSR corridor, surrounding wetlands, and tributaries. The assemblage of fish species is dynamic, it supports subsistence and recreational activities, and it is sustained by a unique combination of water features, including swift water underlain by gravel; productive, shallow lakes; and slow-moving (still) water in lower reaches (USFWS 2024a). For more information on Nowitna WSR fish, refer to **Section 2.5.2**, Fish.

Human relationships to the river and its resources through time are encompassed in the cultural ORV. The Nowitna WSR has undoubtedly provided resources for human use since people first came to the region in the late Pleistocene, and it continues to do so today. As an important location for resource harvest, travel, trade, and recreation, the Nowitna WSR has a long, rich, and unbroken cultural history, particularly for local Athabascans whose connection to the river goes back countless generations (USFWS 2024a). Today this relationship is expressed though hunting, fishing, recreation, and other activities in the river and corridor. For more information, refer to **Section 2.5.3**, Cultural.

The scenic beauty of the Nowitna WSR both depends on and adds to the value of the river components described above. The diversity and dynamic nature of the area's geomorphology, fish, wildlife, plant communities, natural processes, seasons, and weather combine to create the stunning visual backdrop through which the river flows (USFWS 2024a). Few rivers in Alaska provide such a variety of scenery over a relatively short distance, and some sections of the river are truly awe inspiring. For more information, refer to **Section 2.5.4**, Scenery.

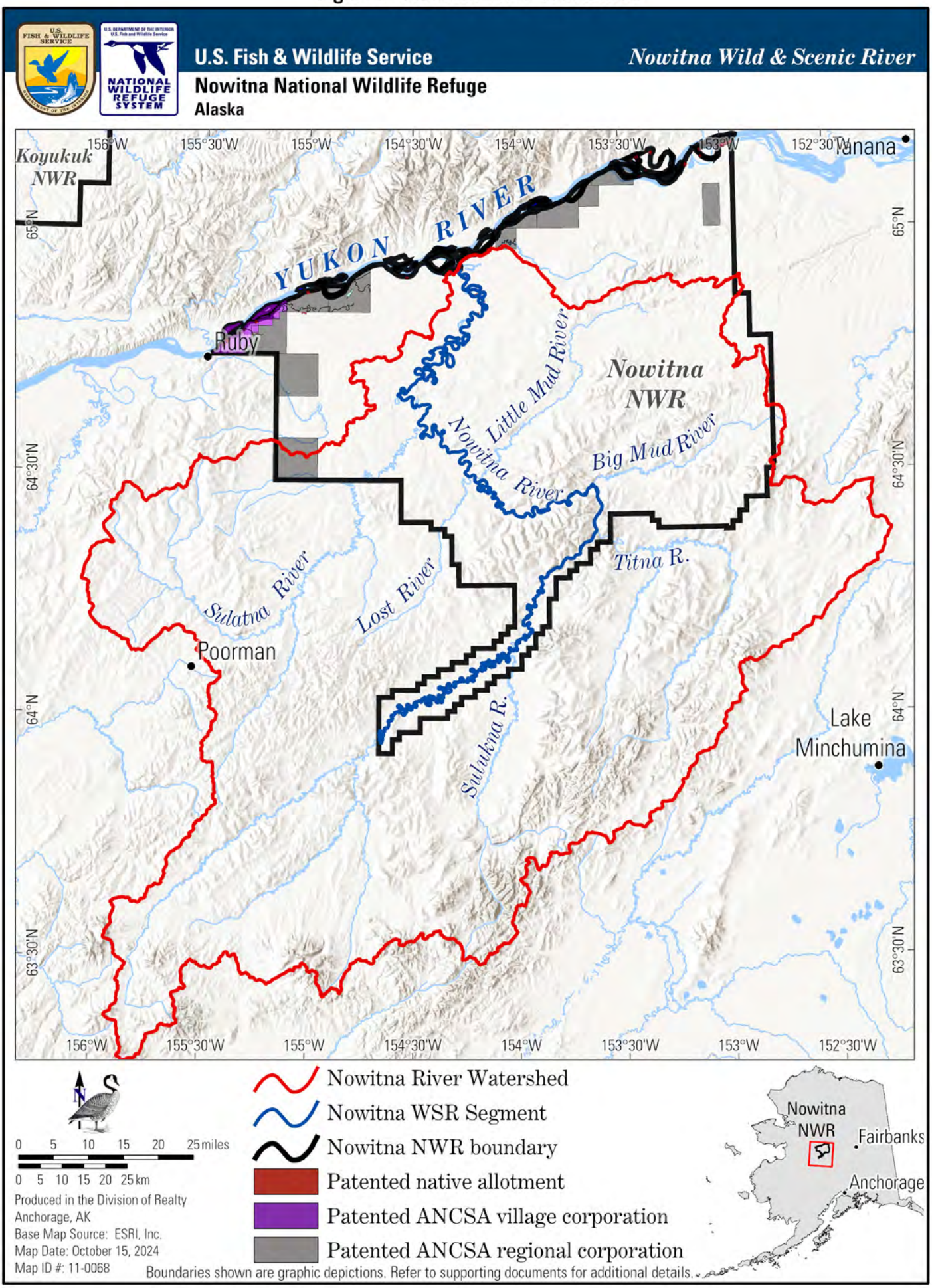
2.2 Free-Flowing Condition

No human facilities or modifications exist to impede the Nowitna WSR's free-flowing condition, either above or within the designated portions. The Nowitna WSR flows in a natural condition without impoundment, diversion, straightening, riprapping, or other modification of the waterway.

2.2.1 Hydrology

Most of the Nowitna NWR drains to the Nowitna River (refer to **Figure 3**). The river originates in the Kuskokwim Mountains to the south, flows through the entire length of the refuge, and forms a wide, meandering floodplain before emptying into the Yukon River in the north. Several sizeable tributaries feed into the Nowitna River, including the Sulukna, Titna, Big Mud, Little Mud, Lost, and Sulatna Rivers. Oxbow lakes and sloughs created by channel migration are common, particularly in the lowlands along the Nowitna River.

Figure 3: Nowitna River Watershed



Weather and climate are the main drivers of hydrology in the area. The hydrologic regime varies with changes in average daily, monthly, and annual flow based on the regional temperature and precipitation. Temperature and precipitation data have been collected at meteorological stations near Tanana, Alaska, and Galena, Alaska (NOAA 2024). The highest mean monthly precipitation at the Tanana station occurs during the summer. August is typically the wettest month with an average of 2.7 inches of precipitation. Precipitation decreases in October and remains low throughout the winter and spring (Burkart et al. 2023).

The timing, amount, and persistence of snow have major effects on surface and groundwater hydrology. The amount of water in the snowpack prior to melting in the spring and the timing and duration of snowmelt and ice breakup determine the shape and duration of the snowmelt stage peak. Normal monthly snowfall during May through September is less than an inch. The greatest monthly snowfall occurs during October through April. The highest normal monthly snowfall at both Tanana and Galena stations is in December (15.8 inches at Galena and 10.3 inches at Tanana; Burkart et al. 2023). Normal monthly snowfall at the Galena station is 2 to 6 inches higher than normal monthly snowfall at the Tanana station.

Image 6. The notes on this photograph taken during a 1973 Bureau of Recreation field assessment of the Nowitna River state: Ice inside the canyon on the 3rd of June at 2:00 in the afternoon. That is not snow, it's hard ice. Look at the size of that in comparison to the trees. You can see that's not just a small patch. Photo credit: Bureau of Outdoor Recreation

To supplement snowfall measurements made at the Tanana and Galena weather stations, the Service works with the Natural Resources Conservation Service to monitor snow depth at three locations on the Nowitna NWR. Snow depths are recorded from aerial overflights in the first week of December,

February, March, April, and May (USFWS 2009). In the Nowitna NWR, February through April snow depths range from 2 to 3 feet, with less snowpack present in other winter months (Burkart et al. 2023).

The Nowitna River typically runs free of ice in May and freezes over in October. Maximum stream volumes are associated with spring breakup and snow melt. Ice damming during breakup can cause flooding along the Nowitna River, and ice jams on both the Yukon River and the lower Nowitna River can cause flooding of the entire floodplain for a distance of up to 100 miles from the mouth of the Nowitna River (USFWS 1987a). Permafrost conditions in the watershed prevent substantial percolation, and summer rainstorms can result in a rapid stream rise of several feet. Such rain-induced river volumes typically last several hours to a few days (USBOR 1973). Ice begins to form on the Nowitna River and its tributaries in October, and the rivers are typically completely ice-covered by early November. Ice remains in place throughout the winter, and river flows decrease as inputs from surface water sources diminish. The remaining flow transitions to being fed primarily from groundwater. By late winter, ice may reach 6 feet in thickness, with many tributary waters completely freezing. Waterbodies may remain ice covered for more than half the year. Discharge in rivers during the winter is typically limited to groundwater-fed base flows. During winter and early spring, rivers and streams are at their lowest flow for the year (Burkart et al. 2023).

The Nowitna WSR flows 220 miles across the entire length of the refuge. To date, there have been no stream-gaging efforts to monitor flow in the Nowitna NWR (Burkart et al. 2023). However, in the summer of 2003, 2.3 miles upstream from its confluence with the Yukon River, the Nowitna River was 860 feet wide with a discharge of 17,600 cubic feet per second in June; in August, it was 441 feet wide with a discharge of 8,670 cubic feet per second (USGS 2024).

Numerous oxbow lakes and sloughs provide excellent fish and wildlife habitat adjacent to the river. Flooding is important ecologically for building and maintaining channel, riparian, and floodplain habitats and the exchange of sediment, organic matter, and nutrients between the floodplain and stream channel (Poff et al. 1997). High water also recharges floodplain ponds and creates pathways for the movement of fish between the stream and floodplain habitats. The timing, duration, and frequency of floods of various magnitudes are important for the life cycle of fish and riparian vegetation (Poff et al. 1997). Flooding can occur during high flows associated with spring snowmelt and ice jams, and summer and fall rain events.

The importance of groundwater in the Nowitna NWR is not well understood, but it may play an important role in influencing surface water characteristics in the Nowitna WSR (Burkart et al. 2023). Shallow groundwater flow occurs in the upper soil layers and is confined to the unfrozen active layer when permafrost is present (Williams 1970). In shallow groundwater systems, surface water percolates through unfrozen soil layers into shallow aquifers, contributing to groundwater recharge and base flow for rivers and lakes.

Image 7. Spring break-up flooding of the Nowitna River was caused by an ice jam on the Yukon River just below the Nowitna River mouth, May 2023. Photo credit: Karin Bodony, USFWS

2.2.2 Instream Flow

The WSRA declares that certain rivers that possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values "shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit of present and future generations." Section 13(c) recognizes the importance of instream flow protection in achieving a primary goal of the WSRA: to protect the free-flowing condition on a selected river. Herein, instream flow simply refers to the amount of water flowing in a river (IWSRCC 2022).

The WSRA provides for the assumption or creation of federal reserved water rights sufficient to carry out the purposes of the WSRA. Additionally, Nowitna NWR has explicit, yet unquantified, federal reserved water rights through ANILCA, which declared refuge purposes upon establishing the Nowitna NWR "(i) to conserve fish and wildlife populations and habitats in their natural diversity. . . (iv) to ensure, to the maximum extent practicable and in a manner consistent with the purposes outlined in paragraph (i), water quality and necessary water quantity within the refuge."

Image 8. When there is no wind the Nowitna River becomes a mirror, reflecting the colors of the land and sky. This picture was taken along the lower river where the topography is flat and the river is wide. Photo credit: Karin Bodony, USFWS

The National Wildlife Refuge System Administration Act and Service manuals (403 FW 1–3) direct the Service to obtain, to the extent practicable, water supplies of adequate quantity and quality for refuge purposes and trust resources, and to obtain the legal right to use that water through State laws, regulations, and procedures. In Alaska, the purposes for an instream flow reservation under the Alaska Water Use Act (Alaska Statutes 46.15.145 implemented by 11 Alaska Administrative Code [AAC] 93.141) include the protection of fish and wildlife habitat, migration, and propagation; recreation and park purposes; navigation and transportation; and sanitation and water quality. Using existing data or through the collection of hydrologic and biologic data, the Service files an application with the State of Alaska Department of Natural Resources for instream water rights (water reservations) to fulfill NWR purposes and the purposes of the WSRA.

Stream gage monitoring data are critical for acquiring and protecting State or federal reserved water rights, or both. Furthermore, stream gage monitoring data are critical to protect riverine processes (channel-maintenance flows) and understanding required flows that protect WSR ORVs. The data are also essential to developing strategies that protect aquatic habitat, riparian habitat, the floodplain, water-dependent ORVs, and instream flows. To date, there have been no refuge-wide streamflow or water quality studies. Streamflow has been measured in the Yukon River downstream of the Nowitna NWR's boundaries at Ruby, with the period of record ending in 1978.

Understanding the natural flow regime (flow rates, volume, and timing) of surface water flow is critical for determining the extent to which future management actions may protect and enhance streamflow and water-dependent ORVs. The Service plans to conduct a comprehensive investigation of water quantity to support instream flow water rights filings for the refuge. Management of instream flow for the Nowitna WSR includes developing long-term stream gage stations and recording the water level and discharge at multiple locations along the Nowitna WSR corridor and tributaries. Discrete surface water discharge measurements will be conducted six times per year, targeting periods of extreme hydrologic flow, including, but not limited to, spring breakup and summer low flows. The number of annual discrete samples required may decrease in frequency over time. Streamflow data collection will be conducted in cooperation with the Service's Water Resources Branch and other collaborators. Surface water discharge data from the water quantity investigation will be used to apply for instream flow water rights.

2.3 Water Quality

The physical and chemical characteristics of water in aquatic systems, collectively known as water quality parameters, are important measures and indicators of aquatic and terrestrial ecosystem health.

Section 303 of the Clean Water Act directs the establishment of water quality standards and implementation plans by states or authorized Tribes with EPA approval. Core components of water quality standards include (1) identifying designated uses, such as drinking water, recreation, and propagation of fish, shellfish, and wildlife; (2) establishing qualitative or numeric criteria; and (3) developing antidegradation policies. Alaska's water quality standards are found in regulations promulgated by the ADEC and 18 AAC 70, Water Quality Standards. Section 303(d) of the Clean Water Act further specifies that states identify waters within their jurisdiction that are not meeting water quality standards. Currently, no lakes or rivers in the Nowitna WSR corridor are listed as impaired under Section 303(d) (ADEC 2024).

In past studies of sites on the Nowitna River and its tributaries, specific conductivity ranged from 78 to 380 µS/cm (microsiemens per centimeter), depending on the location and year (Snyder-Conn et al. 1992). Specific conductivity was lowest in the upper Nowitna River (78–100 µS/cm) near the Nowitna NWR's southern boundary. Turbidity was low to high (4.7–160 nephelometric turbidity units [NTU]) at most sites. The Sulatna River, at a site near the southwestern boundary of the Nowitna NWR, exhibited extremely high values averaging 3,467 NTU in 1987 and 1,183 NTU in 1988 (Snyder-Conn et al. 1992).

The only U.S. Geological Survey water quality sampling site on the Nowitna River is 2.3 miles above the river's confluence with the Yukon River (gage number 645408154143400) (U.S. Geological Survey 2024). This site was sampled on June 6 and August 27, 2003. Specific conductivity (68 versus 155 µS/cm) and alkalinity (29 versus 64 milligrams per liter [mg/liter]) were approximately twice as high in August compared to June. During June, the suspended sediment concentration was 195 mg/liter. In late August, suspended sediment concentration had dropped to 17 mg/liter (Burkart et al. 2023). This variability in concentration is expected with changing flow, with higher suspended sediment loads largely correlated with spring runoff events.

The Service collected physical water quality data at study lakes in the Nowitna NWR from 1984 to 1986 as part of a large-scale fisheries and habitat survey on interior Alaska NWRs (Glesne et al. 2011). Lake types sampled included lowland and oxbow lakes. Many of these lakes are within the WSR corridor and may exchange surface water during floods (Burkart et al. 2023).

Image 9. The Nowitna River begins to widen after it leaves the canyon. The hills that form the canyon are visible on the horizon. Photo credit: Karin Bodony, USFWS

Snyder-Conn et al. (1992) conducted water quality and metals sampling of water, sediments, and fish in rivers of the Nowitna NWR during 1985–1988. Sample sites included four sites on the Nowitna River; California Creek above the confluence with the Titna River; the Sulatna River at the Nowitna NWR border; and the Sulatna, Sulukna, and Titna Rivers above or near their confluence with the Nowitna River. While some of these measurements are outside the Nowitna WSR corridor, they represent the best available data and have been included for reference. The pH at the mouth of the Nowitna WSR was near neutral (Snyder-Conn et al. 1992). The pH was slightly more basic (average of 8.0 at each site) at the Nowitna WSR near the southern NWR boundary (Snyder-Conn et al. 1992). Total alkalinity at stream and river sampling sites ranged from moderate to high with values ranging from 51 to 521 mg/liter (Snyder-Conn et al. 1992).

In the Nowitna NWR, most trace element concentrations in water and sediment were within the range expected for uncontaminated watersheds with a few exceptions. Total recoverable manganese concentrations in 1985 samples of the Sulatna and Titna Rivers and the Nowitna WSR upstream from the Titna River exceeded the EPA secondary standard for drinking water of 0.05 mg/liter for that year. In 1988 at the Sulatna River site, the measured dissolved concentration of manganese, which is typically lower than the total recoverable concentration, again exceeded this criterion (Snyder-Conn et al. 1992).

Both dissolved and total recoverable concentrations of copper were measured in 1985 and 1987; in most instances, dissolved concentrations exceeded total recoverable concentrations, indicating issues may have occurred in sampling or the laboratory analysis that make interpretation of these results problematic. Cadmium was measured, but the concentrations detected were very close to the method detection limits, so the results cannot be quantitatively interpreted. Total lead concentrations in the Titna River and Nowitna WSR, just upstream of the Titna River, were at the EPA and State criterion (when total hardness is 100 mg/liter as calcium carbonate) for protection of freshwater aquatic life from

chronic toxicity. Low hardness (45–85 mg/liter as calcium carbonate) was reported for the upper Nowitna River, suggesting that species could be sensitive to the lead concentrations observed.

In 1985, total recoverable iron concentrations in the Sulatna and Titna Rivers and some sections of the Nowitna WSR exceeded the EPA secondary drinking water standard of 0.3 mg/liter and the Alaska State criterion for protection of freshwater aquatic life from chronic toxicity of 1.0 mg/liter (if these conditions occur on 4 or more consecutive days) (Snyder-Conn et al. 1992). Again in 1987, the sites on the Nowitna River near the mouth and downstream of the southern boundary and the Sulatna River site exceeded the EPA secondary standard; the Sulatna River also again exceeded the Alaska State criterion for protection of freshwater aquatic life. These elevated concentrations may be linked to the acidity of organic-rich wetlands, the presence of naturally iron-rich soils, and the influence of permafrost dynamics (O'Donnell et al. 2024).

At the sites sampled, there was a strong positive correlation between turbidity and iron and manganese concentrations in all years measured (Snyder-Conn et al. 1992). In 1987 and 1988, the Sulatna River, which had active placer mining activity upstream, had significantly higher turbidity, iron, and manganese concentrations than sites on the upper, middle, and lower Nowitna River; the Sulukna River; and California Creek. There is no direct evidence that the presence of placer mining was related to these water conditions in the Sulatna River. It is possible to observe elevated concentrations of contaminants due to natural erosion of highly mineralized areas, events such as flooding, fires (and fire suppression), and atmospheric deposition. There are currently no active water quality monitoring sites along the Nowitna WSR.

2.4 ORVs Background

Section 1(b) of the WSRA requires administering agencies (the Service in the case of the Nowitna River) to protect a WSR's values. Section 1(b) states:

> "It is hereby declared to be the policy of the United States that certain selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations. The Congress declares that the established national policy of dam and other construction at appropriate sections of the rivers of the United States needs to be complemented by a policy that would preserve other selected rivers or sections thereof in their free-flowing condition to protect the water quality of such rivers and to fulfill other vital national conservation purposes."

Consistent with the guidelines provided in the Interagency Wild and Scenic Rivers Coordinating Council (IWSRCC) publication of the WSR Study Process (IWSRCC 1999), to qualify as an ORV, a resource must not only be river related or river dependent—owing its existence to the presence of the river—but it must be unique, rare, or exemplary within a relevant region of comparison.

Each river in the NWSRS is managed with the goal of protecting and enhancing the values that caused it to be designated. These values include the river's free-flowing condition, water quality, and the river-related resource values that have been found to be outstandingly remarkable for each WSR. These

specific river values, known as ORVs, are identified by an interdisciplinary team of resource specialists with knowledge of an area's resource distribution.

ANILCA Section 602 designated the Nowitna WSR but did not mention river-related values. The management direction of the Nowitna WSR was initially outlined in the Nowitna National Wildlife Refuge Comprehensive Conservation Plan, Environmental Impact Statement, Wilderness Review, Wild River Plan (or Nowitna CCP) (USFWS 1987a). According to the Nowitna CCP, the Nowitna Wild River [WSR] was designated because of its natural, free-flowing condition; water quality; and ORVs identified as wildlife, geology, and primitive setting.

In 2009, the Koyukuk/Northern Unit Innoko/Nowitna National Wildlife Refuges' Revised CCP (or Revised CCP) (USFWS 2009) replaced the management direction for the Nowitna CCP (USFWS 1987a) and associated records of decision. The Revised CCP for the Nowitna NWR noted that the Nowitna WSR possesses ORVs in multiple categories that were informally identified by refuge staff during the CCP development process. The identified ORVs include:

- Scenic—forested river corridor, diverse landscape, and different examples of succession
- Geologic—agates
- Hydrologic—free-flowing condition, oxbow lakes, and wetlands
- Fisheries—sheefish and whitefish populations
- Wildlife and habitats—nationally significant species of migratory waterfowl and large game
- Cultural, historic, and prehistoric—transportation corridor and abandoned camps
- Subsistence—hunting, trapping, house logs, berry picking, and firewood
- Recreational—hunting, fishing, wildlife observation and photography, floating, and camping trips

While both the Nowitna CCP and Revised CCP were validated through a public process, Interagency guidelines[1] for ORVs in the Wild and Scenic River Study Process (IWSRCC 1999) were not formally applied. In 2009, refuge staff informally applied the IWSRCC's guidance, focusing their efforts on describing river values and providing direction regarding the protection of these values. The changes to the previously identified river values (1987 and 2009) align the values with established guidelines and make the process of addressing these values more efficient and formal within the CRMP (refer to **Table 1**, below).

[1] "Department of the Interior and Agriculture Interagency Guidelines for Eligibility, Classification and Management of River Areas," published in the Federal Register (Vol. 47, No. 173; September 7, 1982, pp. 3945439461), provides direction to agencies in the study and administration of WSRs.

Image 10. Agates can be found scattered along gravel bars in the upper part of the Nowitna River. Photo credit: Dylan Undlin, USFWS

Table 1. Previous Identification of ORVs for the Nowitna WSR

Nowitna CCP (1987a)	Revised CCP (2009)	CRMP Pre-planning (2020)	CRMP (2024)
• Geology • Primitive setting • Wildlife	• Scenery • Geology • Hydrology • Fish • Wildlife and habitats • Cultural, historic, and prehistoric • Subsistence • Recreation	• Scenery • Geology • Fish • Wildlife • Cultural (prehistoric and historic) • Subsistence • Recreation • Plant community	• Ecology • Fish • Cultural • Scenery

To facilitate the processes of finalizing ORVs with public involvement and of preparing CRMPs for WSRs in Alaska, a river value identification workshop was held in Fairbanks, Alaska, in January 2020. The workshop also provided opportunities to prioritize interim WSR management direction prior to the completion of CRMPs. Interdisciplinary river management teams were assisted by the River Management Society's River Training Center (using tools and resources developed by the IWSRCC) to identify interim findings of ORVs and river values for each of the Service-administered WSRs. In anticipation of finalizing ORV designations and preparing a Nowitna CRMP, the staff at Nowitna NWR continued the internal review of Nowitna WSR values throughout 2020 using the process recommended during the workshop to summarize and document available information. Sources of information included the original U.S. Bureau of Outdoor Recreation study (USBOR1973) and associated field notes, held by the Alaska Resources Library and Information Services in Anchorage; other publications; and files from the refuge. When available, water resources information, including flow and water quality study data, were included. As a result of the efforts made in 2020, eight ORVs were identified for the Nowitna WSR: scenery, geology, fish, wildlife, cultural (prehistoric and historic), subsistence, recreation, and plant community.

In 2023, the Service staff met with representatives from the ADFG, ADEC, Alaska Department of Natural Resources, U.S. Bureau of Indian Affairs, residents of local communities, and members of local tribal organizations to identify and describe the final river ORVs to be used in the Nowitna CRMP. Many of the river values identified in previous documents were retained, but they were reorganized into four ORVs: ecology, fish, cultural, and scenery.

Information from previous ORV assessments was examined to identify commonalities and overlaps among previously identified ORVs and to group them into more comprehensive and streamlined river-related values. Changes to the previously identified river values are intended to optimize how they are addressed in the CRMP. Combining multiple resources into one river value does not in any way reduce the value of the individual parts. All river values apply to the entire river corridor, are treated equally, and retain the same status for protection under the CRMP. The final ORVs are ecology, fish, cultural, and scenery. The ORV descriptions below also appear in the Nowitna River Wild and Scenic Values report (USFWS 2024a).

Image 11. Participants in a 1973 Bureau of Recreation field assessment of the Nowitna River for WSR designation prepare a meal at their campsite. Photo credit: Bureau of Outdoor Recreation

The ecology ORV recognizes the relationship between the river's unique geology, hydrology, plant communities, and wildlife. It aims to manage and protect these values collectively as part of the river's broader ecological value. It also acknowledges that these features are deeply interconnected and changes or impacts in one area can have a ripple effect throughout the ecosystem. Collectively recognizing all these river values within the ecology ORV allows management and conservation efforts to take a more holistic approach to ensure the overall health and balance of the Nowitna WSR's natural systems.

The Nowitna WSR supports a remarkably diverse assemblage of fish species. It is a migration corridor to one of only six known sheefish spawning areas in Alaska, thus providing fish habitat that is rare in the Arctic-Yukon-Kuskokwim Region. Initially, Nowitna River fish were included within the wildlife ORV (USFWS 1987a); they were later recognized as a separate ORV (USFWS 2009). Continuing to recognize fish as a distinct ORV allows for a focused and specific approach to managing and conserving the river's fish resources while acknowledging the vital role that fish populations and their habitat play in the ecological health and overall value of the Nowitna WSR and the broader region.

The cultural ORV encompasses many aspects of the relationship between humans and the Nowitna WSR that have been consistently recognized throughout management of the Nowitna WSR. The cultural ORV for the Nowitna WSR incorporates several river values described in past documents, including "historic or prehistoric," "subsistence," "primitive setting," and "recreation." Subsistence, recreation, and other cultural values were described in the 1973 Nowitna WSR report and were identified within the primitive setting ORV in 1987. Subsistence, recreation, and a combined

prehistoric/historic/cultural ORV were identified in 2009 and 2020.The decision to use the term "cultural" as an encompassing term reflects an inclusive and respectful approach to acknowledging the diverse cultural contributions and heritage associated with human use of the river. For example, there is no local distinction between prehistoric, historic, and modern interactions between people and the river's resources; all are part of a long continuum that extends to future generations. Additionally, some activities such as boating, camping, hunting, and fishing in the river's remote, undeveloped setting are common across these previously identified values. By encompassing the full range of human interactions with the river and its resources in the past, present, and future, the cultural ORV recognizes an enduring relationship between humans and the environment that is exemplary in the state.

The scenic quality of the Nowitna WSR was initially recognized within the primitive setting ORV (USFWS 1987a). Primitive setting included the river's remoteness, diverse landscape, wildlife, river character, and the geological qualities of the Nowitna WSR. Scenery was identified as a distinct ORV in 2009 and 2020. In the process of developing final ORV determinations, scenery was briefly considered as a component of the ecology ORV; however, conversations with staff, partners, and local communities resulted in the decision to keep scenery as a separate ORV. The scenic qualities are a result of the river's diverse course and setting; however, the scenic qualities do not directly support the overall health and balance of the Nowitna WSR's natural systems in the ways that components of the ecology ORV do. The outstandingly remarkable scenic qualities of the river have been consistently recognized and are considered exemplary in Alaska's boreal region.

2.5 Baseline and Existing Conditions

The year a WSR is designated represents the baseline condition against which subsequent conditions of river values are assessed (IWSRCC 2018). The baseline condition serves as the basis on which the degree or intensity of any existing impacts can be measured, and future impacts assessed, should they occur. Often, existing conditions are relied on to represent the condition against which subsequent conditions of river values are assessed. All future activities are to be measured from this baseline to ensure continued high-quality conditions and, with respect to river values, to eliminate adverse effects (protect) or improve conditions (enhance) within the river corridor.

The remote and often inaccessible nature of the rivers in Alaska that were being considered for inclusion in the NWSRS during the 1970s presented challenges. Limited information was available about many resource values in these remote regions, making it difficult to provide detailed descriptions of the baseline conditions. Because of the remote, undeveloped nature of the Nowitna WSR and its watershed, conditions within the corridor have likely changed relatively little since the time of designation. The existing conditions described here for the Nowitna WSR's ORVs and other related resources will provide a benchmark for future management. The condition descriptions below also appear in the Nowitna Wild and Scenic River Values report (USFWS 2024a).

2.5.1 Ecology

The combination of the Nowitna WSR's abiotic and biotic features, including the geology, hydrology, and biodiversity, creates a unique example of boreal riparian ecology. The Nowitna WSR is one of the finest examples of a geologically old, meandering river in Alaska. Over its course, the Nowitna River comprises a complete transition from a narrow, swift, gravel-bottom river in its upper reaches to a relatively broad, slowly meandering river typified by cutbanks, sandbars, sloughs, and oxbow lakes in the lower floodplain region. Spring flooding enriches the oxbow lakes and sloughs with nutrients, as well as

carbonates from the limestone bedrock in the river's headwaters that increase productivity in the floodplain. The river corridor encompasses a broad range of boreal habitats influenced by terrain, wildfire history, and the winding nature of the river itself.

Image 12. Spring break-up flooding of the Nowitna River was caused by an ice jam on the Yukon River near the Nowitna River mouth, May 2023. Photo credit: Karin Bodony, USFWS

The river's distinct water chemistry, flood regime, and meandering nature generate diverse and highly productive riparian habitats within which a broad, interconnected array of northern wildlife species exists, including moose, black and grizzly bears, wolf, wolverine, red fox, lynx, marten, porcupine, snowshoe hare, river otter, muskrat, mink, weasel, squirrel, wood frog, waterfowl, raptors, songbirds, and other birds. The grassy margins of the river, surrounding lakes, and waterways provide some of the best breeding habitat in interior Alaska for trumpeter swan, greater white-fronted goose, canvasback, sandhill crane, and many other migratory waterfowl. A mixture of mature forest and early successional plant communities provides excellent moose habitat. Moose abundance is highest along the river corridor, which in turn sustains increased populations of predators. Beavers are numerous in the river and adjacent oxbow lakes.

Extensive stands of larch, a species of conservation concern in Alaska, exist in areas along the river's upper and middle portions. These trees owe their presence to the buffering action of dissolved carbonates and bicarbonates transported by the Nowitna River from its headwaters. Additionally, the river corridor contains uncommon old-growth white spruce forest communities that are nourished by

the Nowitna WSR's productive floodwaters and protected from wildfire by surrounding wetlands. Here, white spruce trees grow to an impressive size and are among the oldest found in Alaska, with many mature trees that are between 200 and 350 years old. These old-growth forests provide nesting areas for raptors and some of the best marten habitat in Alaska.

Taken as a whole, the diverse and abundant assemblage of boreal species is unique statewide and a defining characteristic of the Nowitna WSR. No other river in Alaska possesses the unique geology and diversity of wildlife and vegetation of the Nowitna WSR.

Geology

The Nowitna River drainage is stratigraphically and structurally complex. The basement rock is dominantly a Precambrian or Paleozoic metamorphic complex, including a lower group of limestones and greenstones and an upper group of mainly schists and quartzites. These rocks are overlain by Ordovician limestones. Exposed along the Nowitna River are crystalline limestone, quartzite, schist, slate, phyllite, greenstone, gneiss, and volcanics. In its middle section, the Nowitna River flows through a canyon where the channel straightens and large gravel, cobble, and bedrock are present on the river bottom. Here the rocks are crystalline limestone, greenstone, schist, and slate. Garnets, petrified wood, chalcedony, and agates are present with agates occurring in great numbers. These agates are thought to have come from volcanics bordering the upper Nowitna River above the Sulukna River. In addition to these quartz rocks, bones of Pleistocene animals may occasionally be found along the river as the river slowly erodes its banks.

A unique geological process is demonstrated in the Nowitna River drainage, which contributes to the outstanding productivity of the river and associated oxbow lakes, sloughs, and wetlands in the lower section. Nowitna River water contains dissolved bicarbonates and carbonates brought down from limestone deposits in the river's headwaters. These provide an inorganic source of carbon for photosynthetic metabolism by aquatic macrophytes and algae and also serve as an effective buffer against rapid pH changes. Frequent spring flooding (often caused by ice damming during breakup) enriches adjacent oxbow lakes and sloughs with these nutrients and carbonates, which buffer the pH of the naturally acidic wetland waters and make nutrients more available for plant uptake. As a result, wetlands in the Nowitna River floodplain are less acidic and more productive than they are in many other areas in Alaska. This unique geological process supports all other recognized ORVs for the Nowitna River.

Image 13. The upper Nowitna River winds along the base of low hills, sometimes exposing underlying bedrock. Photo credit: Karin Bodony, USFWS

Meandering River and Floodplain

The Nowitna WSR is an excellent example of an interior Alaska meandering river. The river's path of deep, sweeping turns is ever changing as it winds across its floodplain basin. The river topples trees along the outer cutbank side of bends where the water is swift, and deposits sediment on sand and gravel bars on the insides of the bends. Thus, the river is always shaping the landscape and creating new habitats for plants and wildlife. Herbs and willows sprout on gravel bars to become habitat for songbirds and moose. Spring meltwater pushes ice chunks downriver, scouring willows along the shore that will soon regrow to provide nutritious food for moose and beaver. Spring ice jams can back the river up for more than a hundred miles, affecting water levels and bringing nutrients to adjacent lakes and wetlands, as well as permitting the transfer of fish between the river and adjacent lakes and sloughs. Over time, riverbank erosion shortcuts across the river's long, looping bends to create isolated oxbow lakes that are ideal for nesting swans, geese, and ducks. All these river actions contribute to the diversity and productivity of wildlife habitats that make the Nowitna WSR special.

Image 14. Winter snow highlights the Nowitna River channel and the winding sloughs and oxbow lakes it has created in its broad floodplain. Photo credit: Karin Bodony, USFWS

The entire Nowitna River floodplain depends on the river to shape and influence its wetland and forest communities. In the river's upper portion, the floodplain extends only a few miles to each side of the active channel. Here, long, looping sloughs and narrow lakes hint at where the main channels were in the river's past. Downriver in the Nowitna canyon, the floodplain narrows, sometimes spanning less than a quarter mile where the river winds between tundra-capped hills. Below the canyon, the floodplain widens again, now to 3 or 4 miles across, and oxbow lakes begin to appear. Near the confluence of the Sulatna River, the Nowitna WSR leaves the hills and spills on to the broad flats that extend to the Yukon River. Here the floodplain basin extends 6 to 9 miles across and is covered with myriad oxbow lakes, sloughs, and wetlands. The Nowitna WSR winds through this vast, wildlife-rich network of wetlands and lakes, shaping and sustaining the ecosystems it nourishes. The rich ecology of the river corridor is a reflection of this larger floodplain and the vital interactions between the river and land.

The Nowitna floodplain basin is depicted in **Figure 4** using a digital elevation model. Oxbow lakes and old river meanders are also visible. The segment of river shown is about 3 miles downriver of the confluence of the Sulatna where the floodplain begins to substantially widen.

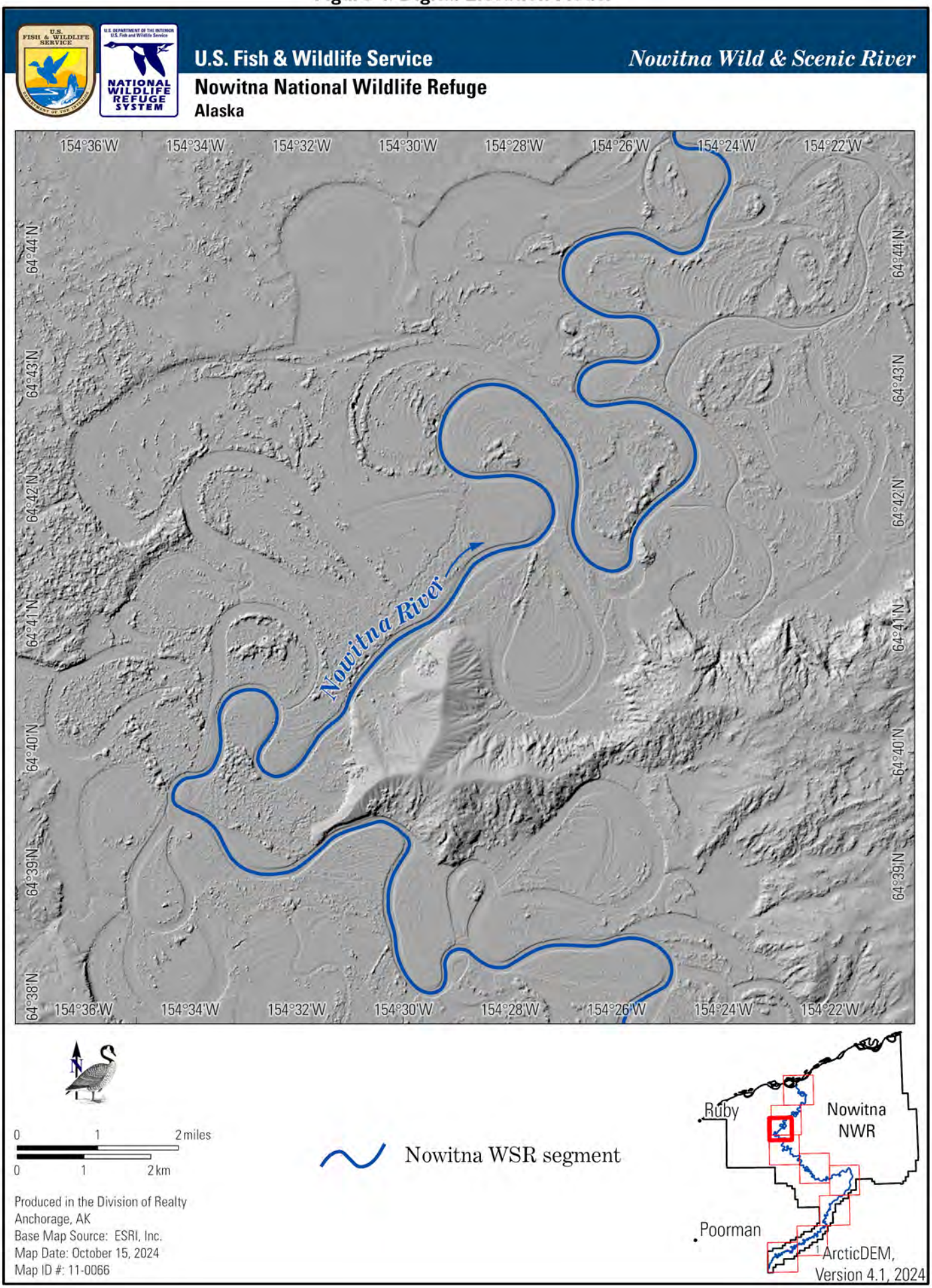
Wildlife

The Nowitna River floodplain is the refuge's most biologically productive area. The distinct water chemistry, flood regime, and meandering nature of the river generate diverse and highly productive riparian ecosystems that provide habitat for a broad, interconnected array of boreal plants and wildlife species, including moose, black bear, grizzly bear, wolf, wolverine, red fox, lynx, marten, porcupine, snowshoe hare, river otter, beaver, muskrat, mink, least weasel, red squirrel, wood frog, waterfowl, raptors, songbirds, and other birds.

Grouse, owls, woodpeckers, chickadees, Canada jays, common ravens, and redpolls are year-round residents. Thousands of migratory birds come to the Nowitna River corridor each summer. The grassy margins of the river, surrounding lakes, and waterways provide some of the best breeding habitat in interior Alaska for trumpeter swans, greater white-fronted geese, canvasbacks, sandhill cranes, and many other migratory waterfowl and songbirds.

Image 15. The lush plant communities of the Nowitna WSR corridor support healthy populations of furbearers, such as this wolverine photographed along the upper river. Photo credit: Karin Bodony, USFWS

Figure 4: Digital Elevation Model[1]



The river corridor contains an uncommon old-growth white spruce forest community that is nourished by the Nowitna River's productive floodwaters and protected from wildfire by surrounding wetlands. These old-growth forests provide nesting areas for raptors and some of the best marten habitat in Alaska.

The refuge contains a mixture of mature forest and early successional plant communities that provide excellent moose habitat. Moose abundance is highest along the river corridor, which in turn sustains increased populations of predators. Beavers are numerous in the river and adjacent oxbow lakes.

At this time, there are no federally listed threatened, endangered, or sensitive plants or animals in the Nowitna NWR. However, the Nowitna NWR has several continental birds of conservation concern, including the lesser yellowlegs, short-eared owl, and olive-sided flycatcher (USFWS 2021). Both the lesser yellowlegs and olive-sided flycatcher are associated with wetlands and riparian areas within the Nowitna WSR corridor. The lesser yellowlegs inhabits wetlands, lakes, ponds, and wet meadows interspersed with open boreal forest. The olive-sided flycatcher exists in mature spruce forests near habitat edges such as burns and riparian areas. The short-eared owl uses large, open areas such as grass lakes and meadows.

The Nowitna WSR corridor may be home to the rare Alaska tiny shrew. Four of the first known Alaska specimens of tiny shrew were collected in the Nowitna NWR (Dokuchaev 1997). Weighing under 2 grams, this is among the smallest known mammal species in the world. The similar Eurasian tiny shrew is known to be widespread but scarce across Scandinavia and northern Asia to the Bering Strait. A morphological comparison of Alaska specimens to Eurasian tiny shrew from several Russian collections suggest that the Alaska variety may be a distinct species (Dokuchaev 1997). The shrew currently has a statewide conservation priority level of V (orange), indicating "unknown status and either high biological vulnerability or high action need" (Gotthardt et al. 2012).

Image 16. Animal tracks found along the banks of the Nowitna WSR hint at the presence of plentiful but elusive wildlife. Here, mink tracks trail across a silty bank of the lower Nowitna WSR. Photo credit: Karin Bodony, USFWS

Vegetation

The Nowitna NWR consists primarily of black spruce forests, wetlands, ponds, and streams; benchlands; and foothills (Bureau of Land Management et al. 2002). The acres of land cover types for the Nowitna WSR corridor are described in **Table 2** and shown in **Figure 5**. Levels shown in **Table 2** refer to landcover classification levels based largely on Viereck et al. 1992. Level III is a subset of Level II, and so on.

Riparian vegetation is dominated by willow, cottonwood, and white spruce. Common riparian vegetation includes willow and alder thickets along gravel bars at the water's edge, stands of cottonwood trees higher on the banks, and bands of white spruce varying in width on the higher banks. Stands of paper birch and quaking aspen often mix with the white spruce forest along the river corridors. All seral stages of terrestrial and aquatic land cover types are represented where they occur in the Nowitna WSR corridor and Nowitna River floodplain.

Table 2. Acres of Land Cover Types in the Nowitna WSR Corridor

Land Cover Class Level II/III/IV	Level II Acres	Level II Percent of Cover	Level III Acres	Level III Percent of Cover	Level IV Acres	Level IV Percent of Cover
1.0 Forest	107,223.97	87.65%	0.00	0.00	0.00	0.00
1.1 Closed Needleleaf	0.00	0.00	731.23	0.60%	0.00	0.00
1.2 Open Needleleaf	0.00	0.00	42,487.14	34.73%	0.00	0.00
1.21 Open Needleleaf Lichen	0.00	0.00	0.00	0.00	3,239.61	2.65%
1.3 Woodland Needleleaf	0.00	0.00	18,842.20	15.40%	0.00	0.00
1.31 Woodland Needleleaf Lichen	0.00	0.00	0.00	0.00	3,045.95	2.49%
1.4 Closed Deciduous	0.00	0.00	22,244.61	18.18%	0.00	0.00
1.41 Closed Paper Birch	0.00	0.00	0.00	0.00	15,737.31	12.86%
1.42 Closed Aspen	0.00	0.00	0.00	0.00	0.00	0.00
1.43 Closed Balsam Poplar/ Cottonwood	0.00	0.00	0.00	0.00	0.00	0.00
1.44 Closed Mixed Deciduous	0.00	0.00	0.00	0.00	1,632.37	1.33%
1.5 Open Deciduous	0.00	0.00	333.86	0.27%	0.00	0.00
1.51 Open Paper Birch	0.00	0.00	0.00	0.00	93.37	0.08%
1.52 Open Aspen	0.00	0.00	0.00	0.00	0.00	0.00
1.53 Open Balsam Poplar/ Cottonwood	0.00	0.00	0.00	0.00	0.00	0.00
1.54 Open Mixed Deciduous	0.00	0.00	0.00	0.00	19.48	0.02%
1.6 Closed Mixed Needleleaf/ Deciduous	0.00	0.00	19,951.83	16.31%	0.00	0.00
1.7 Open Mixed Needleleaf/ Deciduous	0.00	0.00	2,633.08	2.15%	0.00	0.00
2.0 Shrub	8,806.58	7.20%	0.00	0.00	0.00	0.00
2.1 Tall Shrub	0.00	0.00	1,280.94	1.05%	0.00	0.00
2.2 Low Shrub	0.00	0.00	7,398.33	6.05%	0.00	0.00
2.21 Low Shrub Willow/ Alder	0.00	0.00	0.00	0.00	0.00	0.00
2.22 Low Shrub Tussock Tundra	0.00	0.00	0.00	0.00	2,246.38	1.84%
2.23 Low Shrub Lichen	0.00	0.00	0.00	0.00	187.26	0.15%
2.24 Low Shrub Other	0.00	0.00	0.00	0.00	0.00	0.00

Land Cover Class Level II/III/IV	Level II Acres	Level II Percent of Cover	Level III Acres	Level III Percent of Cover	Level IV Acres	Level IV Percent of Cover
2.3 Dwarf Shrub	0.00	0.00	127.31	0.10%	0.00	0.00
2.31 Dwarf Shrub Lichen	0.00	0.00	0.00	0.00	37.59	0.03%
2.32 Dwarf Shrub Other	0.00	0.00	0.00	0.00	0.00	0.00
3.0 Herbaceous	2,012.11	1.64%	0.00	0.00	0.00	0.00
3.1 Bryoid	0.00	0.00	353.20	0.29%	0.00	0.00
3.11 Lichen	0.00	0.00	0.00	0.00	0.22	0.00
3.12 Moss	0.00	0.00	0.00	0.00	352.97	0.29%
3.2 Wet Herbaceous	0.00	0.00	828.35	0.68%	0.00	0.00
3.21 Wet Graminoid	0.00	0.00	0.00	0.00	477.51	0.39%
3.22 Wet Forb	0.00	0.00	0.00	0.00	0.00	0.00
3.3 Mesic/Dry Herbaceous	0.00	0.00	830.57	0.68%	0.00	0.00
3.31 Tussock Tundra	0.00	0.00	0.00	0.00	198.36	0.16%
3.32 Mesic/Dry Sedge Meadow	0.00	0.00	0.00	0.00	67.42	0.06%
3.33 Mesic/Dry Grass Meadow	0.00	0.00	0.00	0.00	364.90	0.30%
3.34 Mesic/Dry Graminoid	0.00	0.00	0.00	0.00	38.05	0.03%
3.35 Mesic/Dry Forb	0.00	0.00	0.00	0.00	99.41	0.08%
4.0 Aquatic Vegetation	141.77	0.12%	0.00	0.00	0.00	0.00
4.1 Aquatic Bed	0.00	0.00	10.03	0.01%	0.00	0.00
4.2 Emergent Vegetation	0.00	0.00	131.76	0.11%	0.00	0.00
5.0 Water	3,929.13	3.21%	0.00	0.00	0.00	0.00
5.1 Snow	0.00	0.00	0.00	0.00	0.00	0.00
5.2 Ice	0.00	0.00	0.00	0.00	0.00	0.00
5.3 Clear Water	0.00	0.00	2,576.78	2.11%	0.00	0.00
5.4 Turbid Water	0.00	0.00	1,352.34	1.11%	0.00	0.00
6.0 Barren	216.83	0.18%	0.00	0.00	0.00	0.00
6.1 Sparsely Vegetated	0.00	0.00	197.84	0.16%	0.00	0.00
6.2 Rock/Gravel	0.00	0.00	18.99	0.02%	0.00	0.00
6.3 Mud/Silt/Sand	0.00	0.00	0.00	0.00	0.00	0.00
9.0 Cloud/Shadow	0.00	0.00	0.00	0.00	0.00	0.00
9.1 Cloud	0.00	0.00	0.00	0.00	0.00	0.00
9.2 Shadow	0.00	0.00	0.00	0.00	0.00	0.00
10.0 Other	0.00	0.00	0.00	0.00	0.00	0.00
No Level IV Classification	0.00	0.00	0.00	0.00	94,492.23	77.24%
TOTALS	**122,330.39**	**100.00%**	**122,330.39**	**100.00%**	**122,330.39**	**100.00%**

Source: Bureau of Land Management et al. 2002

Note: Surface Area within Nowitna WSR Corridor includes only acreage within public (Service) lands within the WSR corridor and does not include acreage within private lands.

Figure 5: Land Cover[1]

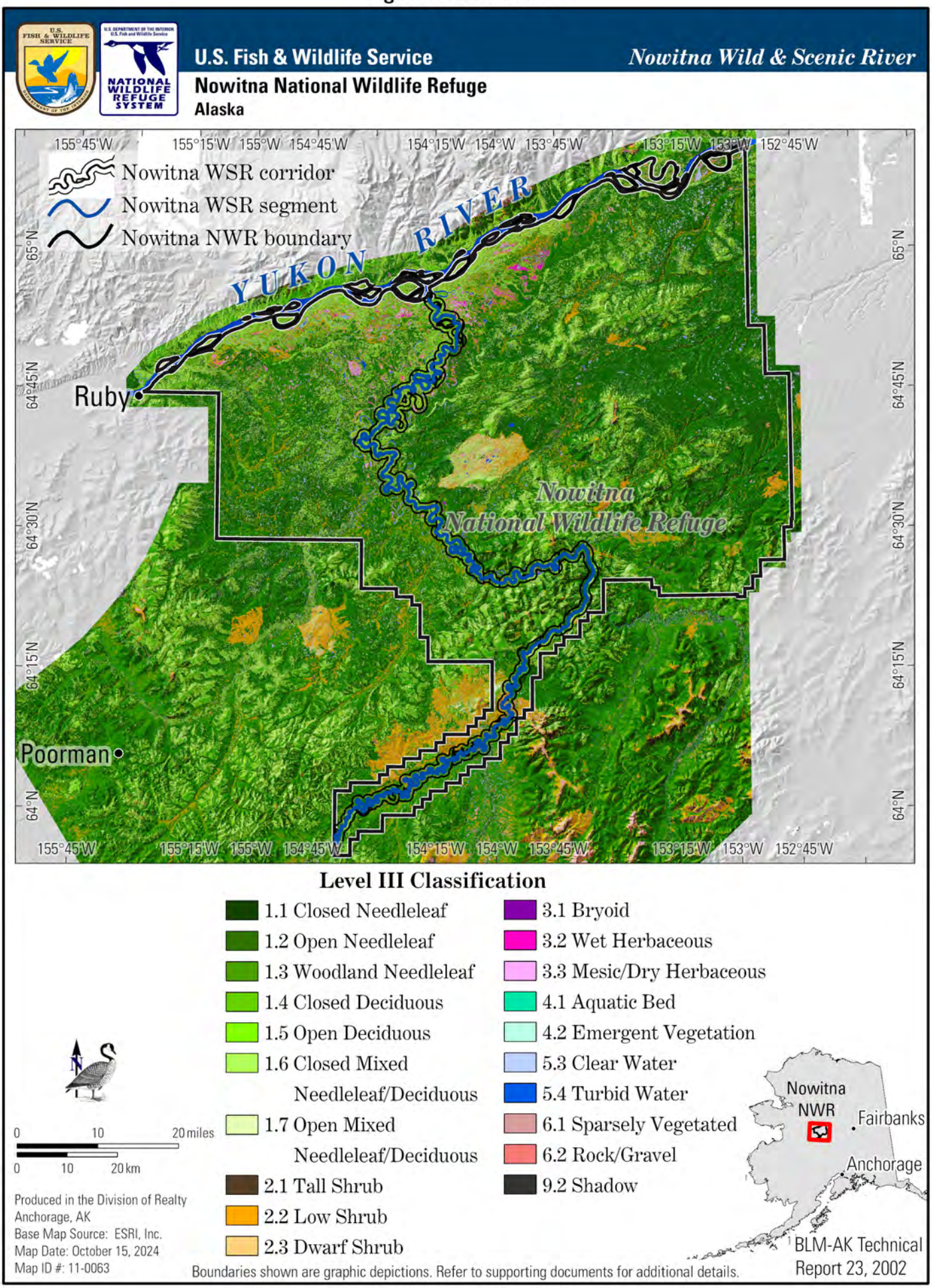


Image 17. The steep rocky slopes of the Nowitna River canyon support an interesting plant community that is unique in the corridor. Photo credit: Karin Bodony, USFWS

Wetland vegetation is site specific and varied. Refuge wetlands include upland basins, ice-formed lakes on the flats, river-flooded lowlands, oxbow lakes, and bog lakes. One or more of 12 species of pondweed occur in almost all lakes. A variety of forbs grow on recently exposed soils along river shorelines.

The herbaceous vegetation type is dominated by grasses, sedges, and flowering plants that are common to interior Alaska ecosystems. The herbaceous communities along steep slopes in the canyon area appear to be unique, but they are not well studied.

Black spruce is the dominant tree species in forests followed by white spruce, paper birch, quaking aspen, and balsam poplar. While there are pure stands dominated by a single tree species, stands typically mix and grade into one another, depending on the underlying soil type, presence of permafrost, elevation, and slope aspect (Burkart et al. 2023).

Unusually dense and extensive stands of larch occur in areas along the Nowitna River, particularly in the upper and middle portions, where they flourish due to the unique chemistry of the Nowitna River's water. Limestone from bedrock in the river's headwaters is deposited in the floodplain during flood events and fosters the growth of larch. Larch-dominated forest communities such as this are rare statewide. Larch is a species of conservation concern in Alaska due to both the drastic population reductions caused by recent infestations of invasive, nonnative insects, such as larch sawfly and eastern larch beetle (Rozell 2007; Holsten et al. 2008), and the geographic and potentially genetic separation of the Alaska population from the North American population (Boggs et al. 2019). The associated Larch Wetland Biophysical Setting is considered rare statewide and is classified as vulnerable (Boggs et al. 2019).

Image 18. In 1997 and 1998 a larch sawfly infestation caused high levels of mortality in mature larch along the Nowitna WSR. Dead larch trees are interspersed with living black spruce and willow in this photograph from 2000. Younger larch trees tended to survive the infestation. Photo credit: Karin Bodony, USFWS

Image 19. This 2023 photo of mixed larch, black spruce, and birch growing along the upper Nowitna WSR demonstrates that the larch trees that survived the sawfly infestation in the late 1990s have grown as tall as the mature trees that were killed. Photo credit: Karin Bodony, USFWS

Notable mature white spruce stands are found along the Nowitna WSR, particularly in the lower portions and near its confluence with the Yukon River. White spruce is an ecological specialist that shows evidence of high vulnerability to temperature induced drought stress (Barber et al. 2000). Large stands of mature white spruce, such as those found in the Nowitna WSR corridor, are becoming increasingly less common in Alaska. The species appears to be affected by climate dynamics, including changing temperature and precipitation patterns, fire regimes, and other environmental variables. In interior Alaska, stands of old-growth white spruce growing on well-drained alluvial and riparian soils are relatively rare. The associated White Spruce Floodplain Old-growth Forest Biophysical Setting is considered rare statewide (Boggs, et al. 2019). Due to the demand for subsistence harvest of white spruce for house logs, there are additional management issues related to sustaining harvest while protecting ecosystems.

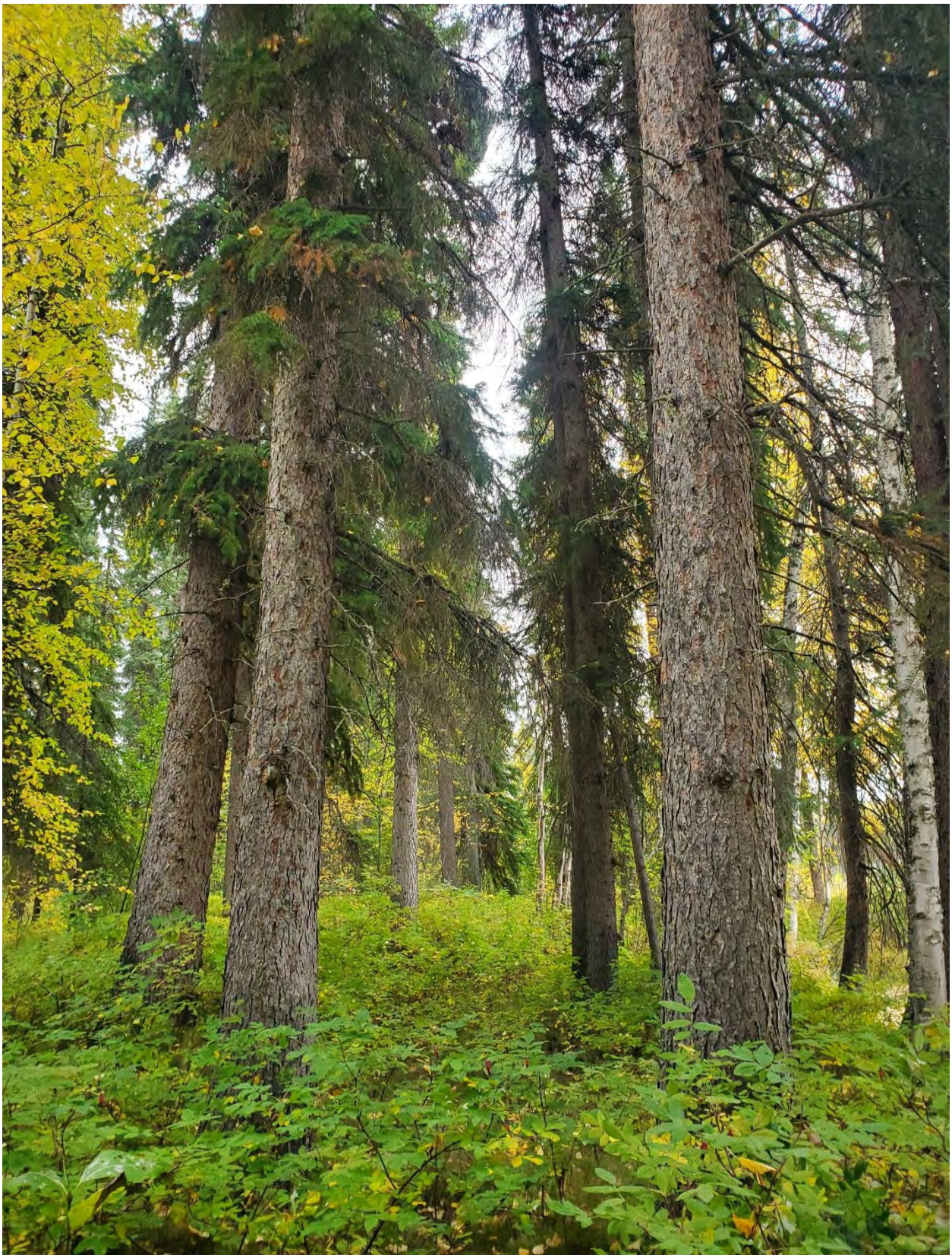


Image 20. Old growth white spruce trees achieve massive size in the fertile floodplain of the lower Nowitna WSR. Photo credit: Karin Bodony, USFWS

2.5.2 Fish

The Nowitna River supports a remarkably diverse assemblage of northern fish species. Also, it is a migration corridor to one of only six known sheefish spawning areas in Alaska. Thus, the Nowitna River provides fish habitat that is rare in the Arctic-Yukon-Kuskokwim Region. At least 19 fish species have been documented in the Nowitna WSR corridor, surrounding wetlands, and tributaries. The assemblage of fish species is dynamic; supports subsistence and recreational activities; and is sustained by a unique combination of water features, including swift water underlain by gravel, productive shallow lakes, and slow-moving (still) water in lower reaches.

This river specifically provides exceptionally high-quality foraging habitat and is a continentally important migration corridor for populations of Chinook, coho, and chum salmon (refer to salmon-use areas in **Table 3** and **Figure 6**). Chinook salmon populations have significantly declined in recent years both in the Nowitna River and elsewhere in Alaska, but it is not entirely known why this is occurring and whether the trend will continue.

Table 3. Salmon-Use Areas Within the Nowitna WSR Corridor

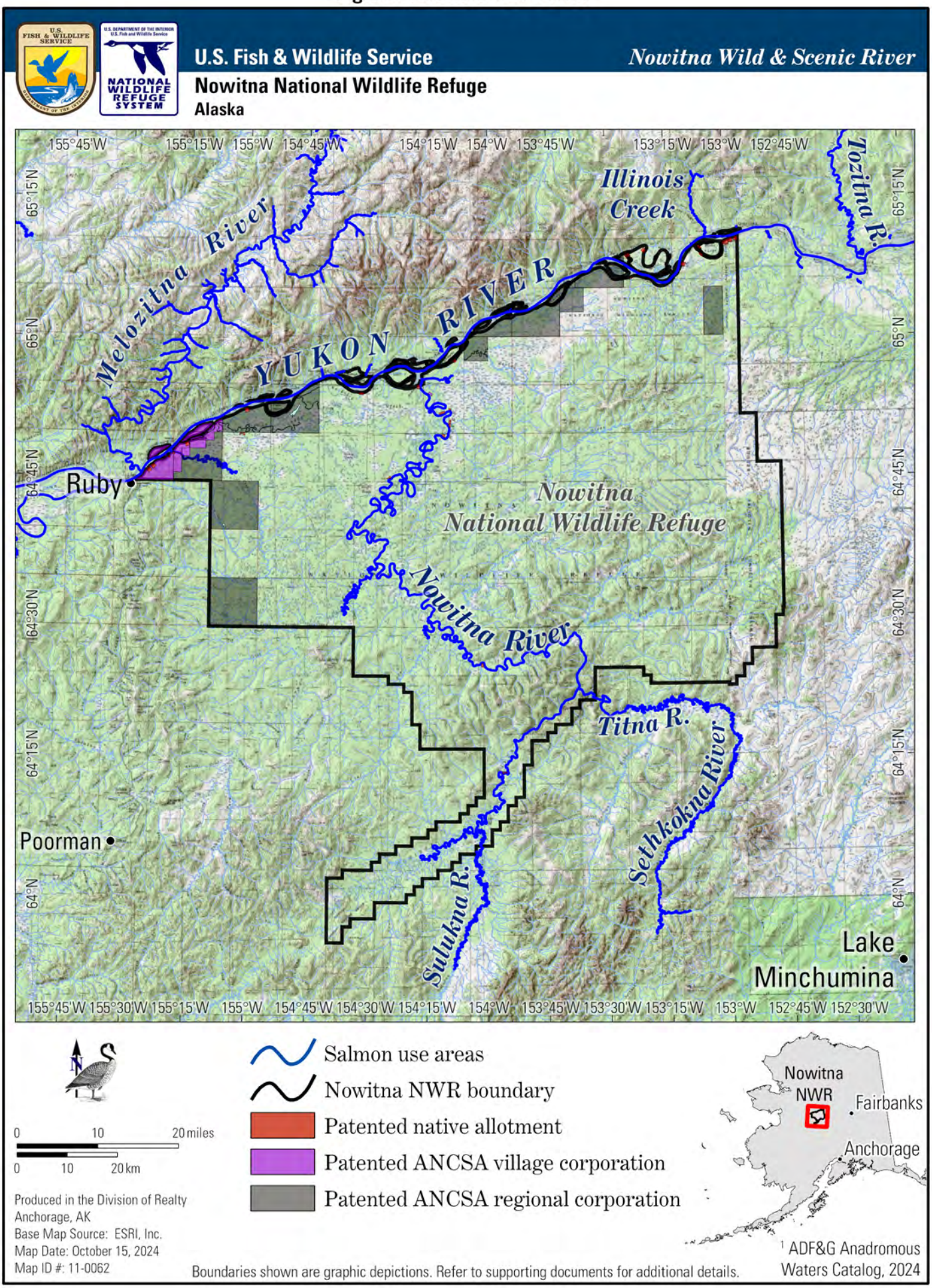
River	Distance (Miles)
Lost River	1.457
Nowitna River	210.001
Sulatna River	0.790
Sulukna River	1.549
Titna River	0.555
Total:	**214.352**

Source: ADFG 2024c

The Nowitna WSR and its tributaries are also important habitat for sheefish and other species of whitefish, as well as resident Dolly Varden, Arctic grayling, and northern pike. The sheefish that migrate up the Nowitna WSR to the Sulukna River are one of only six known spawning populations of sheefish in Alaska's Yukon River drainage. There could be a correlation between the sheefish spawning areas and upriver limestone deposits that affect water quality. Sheefish are among the most targeted subsistence and sport fishing species in the region. Like salmon, this species' migratory habits make refuge stocks susceptible to harvest impacts outside the NWR (USFWS 2009). The Nowitna WSR also contains five other species of whitefish, including broad whitefish, humpback whitefish, round whitefish, least cisco, and, occasionally, Bering cisco. The abundant northern pike are also important for recreational sport fishing in the Nowitna WSR.

The use of the Nowitna WSR by various fish species is slightly different above and below the Little Mud River. Above the Little Mud River, the headwaters and tributaries (Susulatna, Sulukna, and Titna Rivers) of the Nowitna WSR watershed harbor critical spawning and rearing habitat for both anadromous and freshwater fish species. The river's upper section also provides suitable habitat for Arctic grayling and resident Dolly Varden. Below the Little Mud River, the lower section of the Nowitna WSR supports summer foraging and overwintering habitat for multiple spawning populations of fish, including sheefish. The shallow floodplain lakes, marshes, and oxbows are uniquely important habitats that provide slack water for foraging on smaller prey fish and provide spring spawning lakes for northern pike.

Figure 6: Salmon-Use Areas[1]



[1] ADF&G Anadromous Waters Catalog, 2024

Image 21. Sport fishing for pike is a popular activity on the lower Nowitna WSR. Photo credit: Brad Scotton, USFWS

The Nowitna WSR and its unique nature provide valuable in-river habitat and a vital connection to upstream spawning habitats for a large diversity of fish species. The excellent water quality and natural seasonal patterns of dynamic flow regimes contribute to this remarkable diversity and abundance of fish. The river's role in the life cycles of such a diversity and abundance of fish, particularly sheefish, is exceptional and rare to find anywhere else in Alaska.

2.5.3 Cultural

Though the Nowitna WSR is constantly changing, the human relationship to the river and its resources has remained remarkably constant over thousands of years. The deep heritage and diverse cultural contributions that have developed through human use of the river are part of a long continuum extending from the distant past to future generations. The cultural ORV encompasses many aspects of the relationship between humans and the Nowitna WSR throughout time and includes activities such as boating, camping, hunting, and fishing in the river's remote, undeveloped setting. By encompassing the full range of human interactions with the Nowitna WSR and its resources in the past, present, and future, the cultural ORV recognizes an enduring relationship between humans and the environment that is exemplary in the state.

Image 22. William Carlo stands next to his boat on the bank of the Nowitna River. Carlo trapped in the Nowitna region with his brother beginning in the 1930s. Photo credit: Fabian Carey, Alaska Digital Archives

Currently, most activity on the Nowitna WSR is associated with hunting (especially moose) and fishing (pike and sheefish). Other activities include boating and canoeing, camping, rock collecting, wildlife observation, and photography. Trapping activities, which were the foundation of trade in earliest times, continue along the Nowitna WSR today. Gravel bars in the middle section of the river contain numerous agates that attract rock hunters. The Nowitna WSR provides a unique opportunity for public use because it is relatively close to Fairbanks and road access compared with other popular rivers, including the Koyukuk and Yuki Rivers, and other destinations farther down the Yukon River. There continues to be local dependence on resources such as fish, game, waterfowl, berries, and timber. The presence of all these resources is directly tied to the unique productivity of the Nowitna River's waters and the river-meandering action that produces a mosaic of wildlife habitats.

Because of the diversity and abundance of fish and wildlife residing in the river corridor and the unique proximity of the Nowitna WSR's headwaters and its tributaries to tributaries of the Tanana, Kuskokwim, and Innoko Rivers, the Nowitna WSR has long been an important location for travel, trade, recreation, and resource harvest for people from across Alaska. As a result, the Nowitna WSR is entwined with a rich cultural history. Hunting, fishing, trapping, camping, and boat travel on the Nowitna River are culturally important activities passed down from those who depended on the river for survival for thousands of years. Generations of Koyukon Athabascans, primarily from the communities of Kokrines, Tanana, and Ruby, once lived seasonally and year-round in the Nowitna River drainage. Families traveled the Nowitna River in all seasons, surviving by hunting, fishing, trapping, and gathering other necessities from the land and waters. Descendants of these families continue to spend time along the Nowitna River, nourished by and connected to the land and river as their ancestors were. Koyukon Athabascan culture is built around maintaining a respectful relationship to the natural environment and its resources and honoring the wisdom and tradition of elders (refer to **Figure 7**). Traditional ecological knowledge continues to be passed on between generations, building a strong stewardship ethic among communities and cultures that rely on the Nowitna WSR. A strong cultural connection also exists for some Alaskans from other parts of the state who, through their visits over many years, have come to cherish the river and their connection to its environment.

Human cultural ties to the Nowitna River likely go back to some of the earliest human arrivals to Alaska. The long, unbroken cultural connection between people and the resources of the Nowitna WSR is exemplary for Alaska.

Image 23. Water patterns, stones, and canid tracks create a collage of color along the Nowitna River's edge. Photo credit: Dylan Undlin, USFWS

Figure 7: Koyukon Land Ethics

• The land is our source of life, thought and culture. You cannot separate the land from our culture and our people.

• Our knowledge of the land comes from experience and close observation, and the wisdom shared by our elders.

• This land is vast and seems uninhabited, but people have been here for thousands of years, living from the land, learning from it, and being part of it. Always leave camping places clean, take away any trash, and honor traditional care for the environment.

• Everything around us has life. The land, animals and plants have spirits that are aware of us. We live in community with other living things and recognize that they know more than we do. This is not superstition but a way of being in the world that has evolved over thousands of years, passed down from one generation to the next.

• Skill and knowledge are essential for hunting, but equally important is a hunter's favor with the animals. Everything in nature has a spirit that is aware and sensitive and can be offended. Animals will give themselves only to people who are humble and treat them with respect. If a person violates nature their luck may vanish.

• Animals understand words spoken from far away. A person must not speak about what they intend to harvest or be boastful about their catch.

• Anything that is harvested must be treated respectfully. Animals remain aware long after they are harvested and know how they are cared for. Do not touch or bother any living thing unnecessarily. Never harvest more than you can use or waste anything gathered.

• Never forget that animals and plants give themselves to you to provide life. Always be grateful that something took care of you. Show gratitude in appropriate ways, according to what is harvested.

• Respect and care for one another and share the harvest with other people in your family and community. Respect the traditional use areas of individuals and families and don't harvest anything from other people's use areas.

• Bring children with you out on the land. That is how they learn their culture and how to respect the land. Young people have to know how to take care of themselves if they break down. Be honest, tell the truth, and teach about your culture.

• Always remember that the land has fed and nurtured us from the beginning. We care for it in return. Always leave enough fish and animals to reproduce for the future.

• We must not take the earth for granted. We love, and respect our land, and it takes care of us. In turn, we must work to ensure that the plants, animals, water and air are healthy for future generations.

This summary was created in 2024 with the help of Koyukon Athabascan elders, including elders from Hughes, Huslia, Koyukuk, Galena and Ruby. Enaa baasee' (thank you very much).

Cultural Resources

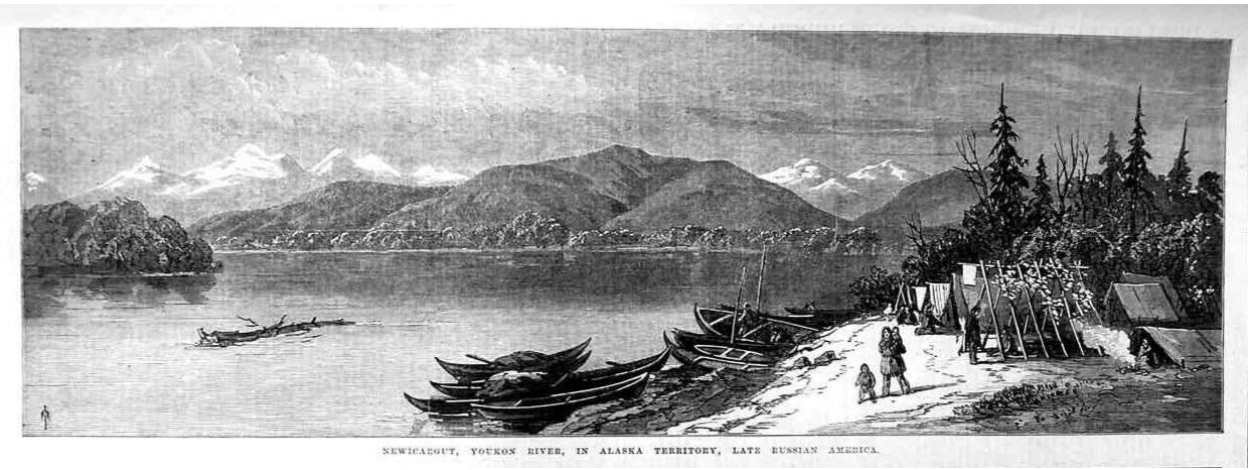


Image 24. This depiction of "Newicargut" (Nogh~~u~~ykkaakk'et), as seen by explorers Whymper and Dall in 1867, appeared in the weekly newspaper *The Illustrated London News* in 1868. Photo credit: *The Illustrated London News*, public domain

Cultural resources in the Nowitna WSR corridor include traditional cultural properties, historic properties, and archaeological resources. The Service acknowledges that the spiritual, physical, cultural, and historical connections of Alaska Native peoples and their Tribes to land, wildlife, and waters are of cultural significance. Alaska Native peoples' customary and traditional ways of life sustain a Native identity experienced through activities, oral tradition (including place-names), ceremonies, songs, and dances, as well as an economy of sharing (USFWS 2025). Within the Nowitna WSR corridor, traditional activities, such as subsistence harvest, and the settings in which these activities take place are of great importance to local communities. Locally, the connection to the Nowitna River's resources is viewed as an ongoing continuum—prehistoric, historic, and modern use are all part of the same enduring relationship that extends to future generations (USFWS 2024a).

The Nowitna River's location and abundant natural resources have drawn people to its banks, probably since their arrival to the region in the late Pleistocene. The area of interior Alaska around Nowitna WSR was unglaciated during the end of the last ice age, and paleontological remains from prehistoric animals, including mammoths, can be found within the river corridor and along the Yukon River main stem nearby. The presence of these prehistoric animals and the relatively close proximity of the highly valued Batza Tena obsidian source (approximately 70 miles north of the mouth of the Nowitna River) could signal that the Nowitna WSR was a hunting or scavenging ground and corridor to lithic raw material for some of the first inhabitants in the area. A piece of obsidian from Batza Tena was collected from a beach near the mouth of the Nowitna River in June of 1867 by explorer William Dall (Rozell 2024). Little archaeological work has been conducted in the river corridor to date, but it is possible that archaeological resources dating far back in time may be located within the WSR corridor (USFWS 2009). Due to the meandering nature of the area's streams, many older sites may already have been destroyed or covered by natural processes. There is a high likelihood of finding more recent sites on present stream banks, but older sites probably remain only on higher ground.

Image 25. This piece of Batza Tena obsidian was found by explorer William Dall in June of 1867 near the confluence of the Nowitna and Yukon Rivers. Dall visited the Native settlement at Noghʉykkaakk'et in the same vicinity. Photo credit: Jeffrey Rasic, National Park Service

The Nowitna River has been an important hunting area and travel corridor for Athabascan residents for countless generations. The Denaakk'e (Koyukon Athabascan) name for the river is Noghʉytno' (or Nogheet No'), which is derived from noghʉye, meaning frog. Indeed, frogs can be found along the grassy banks of the river, particularly in its lower reaches, but the name has a double meaning because frogs are considered lucky in the Koyukon culture. Hence the name reflects that the river has long been considered a lucky place, rich with small game, and a place of refuge in hard times. It is said that along the Nowitna River people were lucky with food sources and the country took care of them because the old people always made sure the land and animals were treated well. When someone living along the Yukon River had difficulties finding caribou or fish, they were allowed to come into the Nowitna River country to hunt, and the local residents were willing to share the bounty. This was especially true at times when moose were scarce in most of the middle Yukon region but remained relatively abundant along the Nowitna River.[2]

[2] George Yaska, USFWS, e-mail to Karin Bodony, USFWS, on November 1, 2024, regarding cultural history of the Nowitna River.

In 1867, explorers Whymper and Dall from the Scientific Corps of the Western Union Telegraph Expedition visited an important trading site and settlement called Noghʉykkaakk'et[3] at the mouth of the Nowitna River (de Laguna 2000). At the time Noghʉykkaakk'et was a substantial village of some 150 residents and was a gathering place for trade among people coming from both the Yukon and Kuskokwim watersheds. Gregory Hakorcins (later changed to Kokrines), a Russian or Creole trader, established a trading post at Fourteen Mile in 1869. Hakorcins subsequently moved his post to the site on the Yukon River currently known as Kokrines. This move resulted in the move of the entire village of Noghʉykkaakk'et (Hart 1981).

Image 26. This photograph of women, children, and dogs at Kokrines on the Yukon River was taken by J. E. Thwaites in 1909. Photo credit: J.E. Thwaites, University of Washington, Special Collections

Jesuit scholar Father Jules Jetté recorded 212 Koyukon (Denaakk'e)[4] place-names on the Nowitna (Nogheetno') River and its tributaries in the early 1900s when he lived in the area (Jetté 1910). At that time, seasonal residents of the Yukon River communities of Kokrines (or Bek'edeneekk'eze Denh) and Mouse Point (or Deeltsaa'e Nooghoyeet) spent the fall and winter months in the Nowitna River region, coming to the Yukon River for fishing in June and July, and for the midwinter feast in December. Some Denaakk'e names for villages and river features are shown in **Figure 8**.

[3] Published spelling variants include: Newicargut, Noghee Kkaakk'et, Noghʉy Kkaakk'et, Novikakat, Nowikakat, Noya-kakat, and Noyokakat.
[4] Denaakk'e is the language of the Koyukon Athabascan people.

Figure 8: Denaakk'e Place-Names

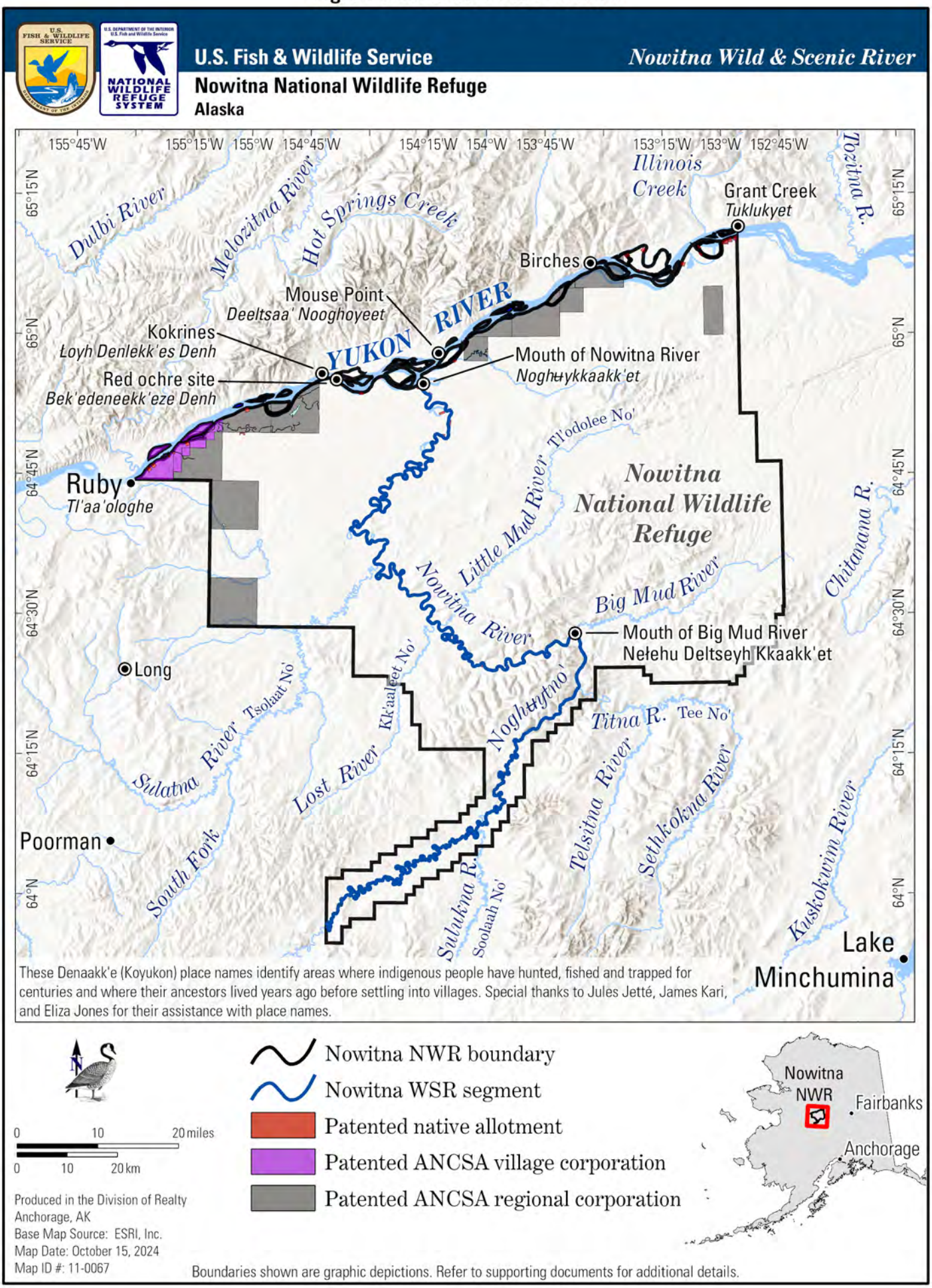


Image 27. This photograph of Ruby on the Yukon River was taken in the early 1900s during the height of the gold rush. Steam-powered sternwheelers like the ones shown here brought goods up and down the Yukon for many years. Photo credit: Frank Carpenters, Library of Congress

The discovery of gold near Ruby in 1907 triggered an influx of outsiders to the area, primarily to mining areas to the west of the Nowitna River (Hart 1981). Residents of Kokrines gradually moved downriver to the village of Ruby as it grew; by the 1950s, Kokrines no longer had year-round residents. Gold mining opportunities around Ruby waned by the 1920s, and many of the miners left the area to fight in World War I. Many remaining residents shifted their focus again to trapping for income. Trappers using the Nowitna River area generally outfitted at Tanana or Ruby and got their supplies to their base camps during open season by poling their boats up the river. They would bring out their furs in the spring by the same means following breakup (USBOR 1973). Despite this increase in trapping activities, local use of the Nowitna River resources never again reached the level that existed while people lived in Nogh~~u~~ykkaakk'et and Kokrines.

In more recent years, numerous studies and oral histories have documented the importance of the Nowitna River and its resources to the local Koyukon Athabascan people (for examples, refer to Brown et al. 2010 and the Oral History Program at the University of Alaska Fairbanks[5]). Subsistence culture

[5] https://library.uaf.edu/aprca/oral-history

and economies are adaptive by nature; therefore, use patterns have shifted over time, yet the Nowitna WSR remains culturally important to area residents as it has for thousands of years.

The surveyed portion of the Nowitna River contains two documented archaeological resources. One is a historic-aged cabin on a Native allotment.[6] The other is Noghuykkaakk'et, the settlement and trade center near the confluence of the Nowitna and Yukon Rivers (AHRS 2023). It is likely that many more archaeological sites remain undocumented within the corridor. Based on what is known about the cultural resources present in the corridor (both archaeological resources and those related to traditional use), there is great potential for locations within the WSR corridor to be determined eligible for inclusion on the NRHP, especially as they are documented further.

Subsistence Resources

The meanings of subsistence are based on cultures that have been shaped over many years by family traditions, religion, relationships with particular animals and places, and a preference for natural foods (USFWS 2009). The traditional and customary use of wild resources for subsistence purposes is regarded as a way of life rather than merely a recreational activity. In accordance with federal agency responsibilities under ANILCA, the Service ensures that rural residents engaged in subsistence uses have opportunities for continued subsistence uses on public lands, including within WSR corridors and NWRs. This was the stated intent of Congress for all ANILCA conservation system units when it passed the law in 1980 that established the Nowitna NWR and designated the Nowitna WSR (ANILCA Section 101(c)). Providing the opportunity for continued subsistence uses by local residents is one establishing purpose of the Nowitna NWR (ANILCA Section 302(6)(B)(ii)).

The 1990 Nowitna NWR Fishery Management Plan identified Galena, Ruby, and Tanana as communities on the Yukon River near the Nowitna WSR for whom subsistence use at the refuge may be of great interest (USFWS 1990). While subsistence use area mapping often only captures a portion of the total use at any given time or by a given community, more recent ADFG subsistence use data confirm subsistence use by Galena, Ruby, and Tanana residents within and around the Nowitna WSR (ADFG 2021, Brown et al. 2015). While Galena, Ruby, and Tanana are communities in the immediate vicinity of the Nowitna WSR, there may be additional communities that use the Nowitna NWR and WSR for subsistence purposes. This section provides an overview of the current level of subsistence use within the Nowitna WSR corridor using best information available directly from potentially affected subsistence communities, state and federal sources, and literature.

Based on studies by ADFG, a wide variety of fish, wildlife, and vegetation are harvested by subsistence users in these communities for many purposes, including food, fuel, arts and crafts, tools, clothing, and traditional cultural practices. Of note is that the subsistence use areas described in these studies and summarized below represent subsistence use for one segment of the population at the time of the study; subsistence use is also likely to occur outside the mapped subsistence use areas. A brief overview of subsistence use patterns for Galena, Ruby, and Tanana residents is provided below.

Galena is important as a regional service hub and population center and as the site of the refuge's headquarters. Residents in Galena rely on the Koyukuk and Nowitna NWRs for subsistence resources

[6] Alaska Native allotment is defined as a parcel or parcels of land totaling up to 160 acres, conveyed by restricted deed to an Alaska Native under the terms and conditions of the Alaska Native Allotment Act of 1906 (and 1956 amendment) and the Alaska Native Veteran Allotment Act of 1998 (43 USC 357, 357a, 357b).

(USFWS 2009). Residents in Galena mainly gather subsistence resources along the Koyukuk and Yukon Rivers and their tributaries. Subsistence food sources include salmon, whitefish, pike, waterfowl, moose, and berries. Large mammal hunting by Galena residents focuses mainly on moose, although bear and caribou are taken, when available (USFWS 2009). Comprehensive community surveys indicate that for the community of Galena, moose, Chinook salmon, summer chum salmon, fall chum salmon, and coho salmon accounted for 79 percent of subsistence harvest in 2010. Galena residents harvest fish primarily from the Yukon River (USFWS 2009); however, some subsistence resource use areas for Galena residents lie within with the Nowitna WSR corridor. Subsistence harvests in the Nowitna WSR corridor by Galena residents include moose, fish, berries, and greens (Brown et al. 2015).

Traditional Athabascan culture and subsistence practices are a focal point of life in Ruby (Alaska DCCED 2024b). Residents in Ruby mainly gather subsistence resources along the Yukon River corridor. However, the Nowitna River is also used for subsistence activities (USFWS 2009), and many Ruby residents have ancestral ties to the river (Brown et al. 2010). According to the Revised CCP, residents harvest moose, caribou, and black bear from the Koyukuk and Nowitna NWRs. Whitefish, sheefish, pike, and salmon are harvested by Ruby residents from the two NWRs by using fish nets or fish wheels, or both (USFWS 2009). According to 2010 ADFG community harvest data for Ruby, salmon comprised the most pounds harvested, followed by large land mammals, non-salmon fish, plants and berries, small land mammals, and nonmigratory birds (Brown et al. 2015). Areas used for subsistence by residents of Ruby include moose hunting areas along much of the Nowitna WSR corridor. Areas recognized for subsistence harvest of small land mammals, berries, and greens are present in the north end of the Nowitna WSR corridor.

Traditional Athabascan ways of life persist in Tanana, including gathering of subsistence resources. Residents in Tanana mainly harvest these natural resources along the Yukon and Tanana River corridors and their tributaries, including the Nowitna River (USFWS 2009). Residents primarily depend on moose and salmon, but they also harvest bear, caribou, non-salmon fish species, small game, berries, and other plant material, when available (USFWS 2009). According to 2014 ADFG community harvest data, salmon comprised the most pounds harvested for Tanana, followed by non-salmon fish, large land mammals, plants and berries, and migratory birds (Brown et al. 2016).

Areas used by Tanana residents for subsistence include moose hunting areas along much of the Nowitna WSR corridor (Brown et al. 2016). Ptarmigan and grouse hunting areas are also present near the Nowitna River. Smaller areas on Nowitna River tributaries have historically been used and continue to be used by Tanana residents to harvest plants and berries.

Image 28. The Kokrine Hills form a stunning backdrop as two motorboats enter the Nowitna River where it meets the Yukon River. Photo credit: Lisa Hupp, USFWS

Recreation and Visitor Access

The Nowitna WSR corridor possesses a combination of high-quality, remote, and undeveloped recreational opportunities. The primary purpose of most recreational visits is moose hunting. Other recreational opportunities include wildlife viewing, motorboating and floating, camping, photography, hiking, environmental education and interpretation, and agate rock hunting (USFWS 2009).

Water levels and river character vary notably along the Nowitna WSR's length and throughout the seasons, adding variety to recreational opportunities and recreational interest. The river's upper portion is fairly swift and narrow (less than 250 feet wide). The coarse graveled bottom of the upper and middle portions usually averages 1 to 2 feet deep or less along riffles, and up to 6 feet deep in pools, which provide enough volume for nonmotorized boaters, except during dry periods. The middle portion widens slightly (200–250 feet wide) and meanders, with numerous gravel bars but few oxbows, offering high-quality camping opportunities. Here, the Nowitna WSR flows through a recreationally appealing canyon where the channel straightens and large gravel, cobble, and bedrock are present on the river bottom. Below the canyon, the river slows and widens (200–450 feet wide), and the substrate is primarily sand and silt. The lower river meanders considerably, producing high cut banks on the outside of bends, sandbars on the inside of bends, and numerous sloughs and oxbow lakes. Stream depth in this location is quite variable, ranging from approximately 3 to 12 feet, with maximum depths up to 60 feet; this generally allows for motorized boating even in dry periods.

Summer access to the Nowitna WSR is generally via float plane or motorized boat from the Yukon River. Access by boat from the Alaska Highway System typically starts from the Dalton Highway Bridge located 140 road miles north of Fairbanks on the Dalton Highway, or from Nenana, which is situated 55 road miles south of Fairbanks on the Parks Highway. There is a boat launch and parking area just north of the Dalton Highway Bridge at milepost 56 of the Dalton Highway. The mouth of the Nowitna River is about 200 river miles downstream (ADFG 2024a). The mouth of the Nowitna River is approximately 250 river miles downstream of Nenana and 90 river miles downstream of the village of Tanana, where the Tanana and Yukon Rivers meet. Boaters typically launch from Nenana or the Dalton Highway Bridge, though in recent years it has become possible to launch from the end of the Tanana (Tofty) Road. The end of the Tanana Road is 50 road miles from Manley Hot Springs and 201 road miles from Fairbanks. The Yukon and Tanana Rivers and lower 40 river miles of the Nowitna River can be run by prop boats, if operated with caution. Winter access to the Nowitna WSR is typically by snowmachine or ski-equipped airplane.

There are no recreational facilities such as trails, roads, or other visitor amenities within the WSR corridor. There are several Native allotments, trapping cabins, and one administrative cabin located along the Nowitna WSR. However, most of these are not visible and generally do not detract from the river's primitive shorelines and natural character. Outside the moose hunting season and summer boat traffic on the Yukon River, visitors are unlikely to encounter each other (USFWS 2009).

Image 29. Cottony seeds of balsam poplar dot the smooth water of the Nowitna River as it flows through the canyon in early July. Photo credit: Karin Bodony, USFWS

Hunting

Wildlife harvest opportunities in the Nowitna WSR corridor include hunting seasons for moose, wolves, bears, grouse, ptarmigan, and waterfowl under both State and federal regulations. Harvest of furbearers occurs under State regulations. The Nowitna WSR corridor lies entirely within Alaska Game Management Unit 21B. By far the most popular of these harvest opportunities on the Nowitna WSR is fall moose hunting, which is available to both resident and nonresident hunters within the corridor. These hunts are managed through permits that include State registration, State drawing, and federal registration permits. There are three big game guide-use areas that include portions of the Nowitna WSR corridor. Only one of these guide-use areas currently has a permitted big game guide. Big game guides are required to report the number of clients, moose taken, and areas hunted (USFWS 2009).

Fall hunting activities along the Nowitna River are monitored at the Nowitna River moose hunter check station, which is typically operated between late August and October 1. This voluntary check station has occurred annually since 1988, and it documents the number of hunters, hunter residence, and harvest of moose, bears, and wolves. Refuge staff and volunteers run the station; in 2010 and 2012, the Friends of Alaska National Wildlife Refuge oversaw volunteer recruitment (FANWR 2010, 2012). Between 1988 and 2023, an annual average of 123 moose hunters checked in to the Nowitna check station, with a minimum of 82 and maximum of 208. The number of moose harvested has averaged 41. The smallest seasonal harvest was 19 bulls, and the greatest number harvested was 56. The average hunter success rate has been 32 percent, and has ranged between 18 and 44 percent (USFWS 2023).

Between 2003 and 2007, the moose population in Game Management Unit 21B was estimated to be approximately 4,049 ± 1,600 (ADFG 2024b). According to the Moose Trend Survey Summary (Bryant and Scotton, 2021), the Nowitna moose population has been stable at a low density. Trend counts in the WSR corridor indicate cow numbers have declined in recent years and are well below average. Bull abundance is also down but considered healthy. Calf production and survival to fall improved in 2021 compared to a poor year in 2020 and are considered average. No additional hunting opportunities are warranted based on moose trend surveys, and a population estimate may be necessary (Bryant and Scotton 2021). In 2023, there was no winter moose hunt in Game Management Unit 21B due to hunting pressure and low population numbers (DOI 2023).

Image 30. A cow and calf moose rest on the edge of the Nowitna River. Moose density is higher within the Nowitna WSR corridor than the surrounding area. Photo credit: Melanie Hans, USFWS

Trapping

Harvest of furbearers in the Nowitna WSR corridor is permitted under State trapping regulations. The Nowitna River corridor has been an important trapping area for centuries and was an important local source of income up until the past few decades. Most trapping is currently conducted by a few families with Native allotments or permitted cabins within or near the Nowitna WSR corridor.

Fishing

The most popular angling activity on the Nowitna WSR is fishing with rod and reel for northern pike and sheefish. Most sport fishing occurs within the lower 30 miles of the river and connected waters. In the past, the Service issued a small number of commercial use permits for guided fishing on the Nowitna WSR. Such permitted guides have primarily advertised opportunities to catch trophy-size northern pike. No permits have been issued since 2013.

2.5.4 Scenery

Image 31. The topography changes rapidly as the Nowitna River enters the steep hills of the canyon. Photo credit: Karin Bodony, USFWS

The scenery of the Nowitna WSR is exceptionally beautiful, diverse, and exemplary of an interior Alaska river. Over the course of only 220 miles, the river transforms from a narrow, swift, gravel-bottomed watercourse to a broad, meandering floodplain river before it joins the Yukon River. The region's varied topography, from wetland-dominated lowlands to low, rolling hills and tundra-capped mountains, intensifies the scenic beauty of this river while adding to the diversity of views. Seasonal changes weave a tapestry of color, shifting from the stark white of winter to the varied greens of spring and summer. Wildflowers flourish along the river's edge, creating swaths of vibrant hues. In autumn, deciduous foliage takes on gold, orange, and deep-red shades, with bright, golden larches and dark-green spruce standing out in sharp contrast. With the changing light of shifting clouds and dynamic weather, the result is a visual backdrop that is never the same from one moment to the next. The remote qualities of the river and dominance of natural scenery and primitive shorelines contribute to this stunning visual impact.

In the Nowitna WSR's upper portion, the relatively fast-flowing, narrow waterway skirts the base of low hills and striking bedrock bluffs. The intimacy of the upper river gives way to the power of swift water flowing in a broader channel in the river's middle portion. The breathtaking backdrop of tundra-capped mountains is a stark reminder that this river is exemplary of the interior Alaskan sub-Arctic, a wild, desolate, and often harsh northern environment. Also in the middle section, arguably the most visually

distinct section of the river, lies the majestic Nowitna River Canyon. Here, steep, gravelly hillsides drop down to flat, grassy banks cut by numerous streams and small waterfalls. In summer, wildflowers line the shore, hinting at a subtle shift in vegetation in the canyon. Colorful pebbles, including numerous agates, are scattered across the gravel bars, adding visual interest for visitors in the area.

Below the Nowitna River Canyon, the Nowitna WSR is ever broadening, with wider river views. Surrounding hills give way to broad, open horizons. The current slows, silt and sand replace gravels, and river meanders create constantly changing cut banks and sandbars, oxbow lakes, and sloughs. The summer vegetation is lush, and the rich productivity of this floodplain is evident on every turn. The mountains of the Kokrine Hills can be seen to the north, and they increasingly dominate the horizon as the river moves toward its confluence with the Yukon River.

The entire Nowitna WSR corridor provides excellent examples of riparian and postfire succession and a variety of boreal habitats and landscapes. The watershed's remote and pristine qualities contribute to the impact of the visual experience. The presence of such outstanding scenic diversity over a relatively short distance is exceptional.

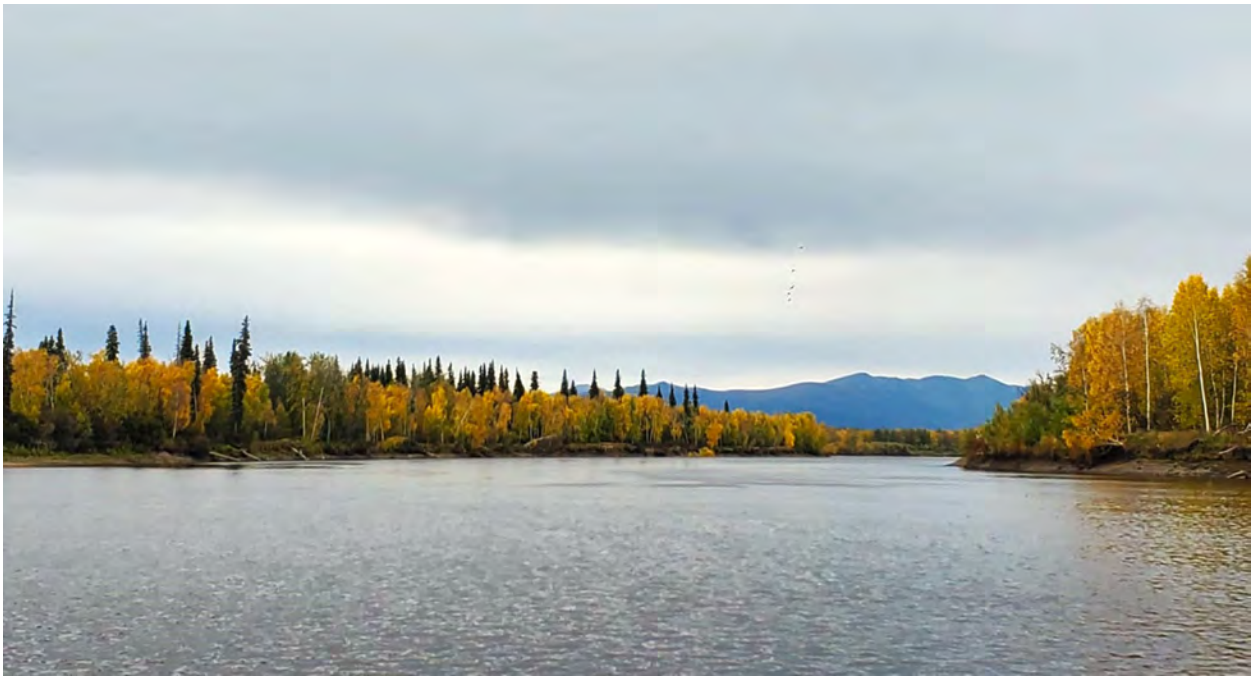


Image 32. Travelers on the lower Nowitna WSR may catch glimpses of the Kokrine Hills, which lie just to the north of the river's confluence with the Yukon River. Photo credit: Karin Bodony, USFWS

2.5.5 Conditions of Resources Related to the Outstandingly Remarkable Values

Natural and cultural resources and environmental conditions beyond those defined as ORVs have been studied. Although these resources in and of themselves did not rise to the level of outstandingly remarkable, in many cases, aspects of them are related to the river values because of the interconnection between environmental and social relationships.

Soils and Permafrost

The Nowitna NWR has loamy, wet to well-drained floodplain soils in river valleys and loamy to very gravelly soils in the lowlands. The uplands in Nowitna NWR include loamy to very gravelly, well to

poorly drained soils at the northern end of the uplands and very gravelly, well-drained soils at the southern end of the uplands (Burkart et al. 2023).

The Nowitna NWR consists of hydrologic soil groups A/D, B, B/D, and D, as defined by the Natural Resources Conservation Service (NRCS 2025; **Table 4**). The Nowitna WSR corridor typically consists of hydrologic soil groups B and B/D, as shown in **Figure 9**. Group A/D soils have a very slow infiltration rate due to a high water-table, but they will have high infiltration and low runoff rates if drained. Group B soils consist of deep, well-drained soils with a moderately fine to moderately coarse texture and a moderate rate of infiltration and runoff. Group B/D soils naturally have a very slow infiltration rate due to a high water-table, but they will have a moderate rate of infiltration and runoff if drained. Group D consists of soils with a very slow infiltration rate and high runoff potential. This group is composed of clays that have a high shrink-swell potential, soils with a high water-table, soils that have a clay pan or clay layer at or near the surface, and nearly impervious material overlayed with shallow soils (NRCS 2025).

Table 4. Acres of Soil Groups in the Nowitna WSR Corridor

Soil Group	Area of Nowitna NWR Corridor (Acres)*
A/D	5,409
B	55,796
B/D	53,944
D	7,181

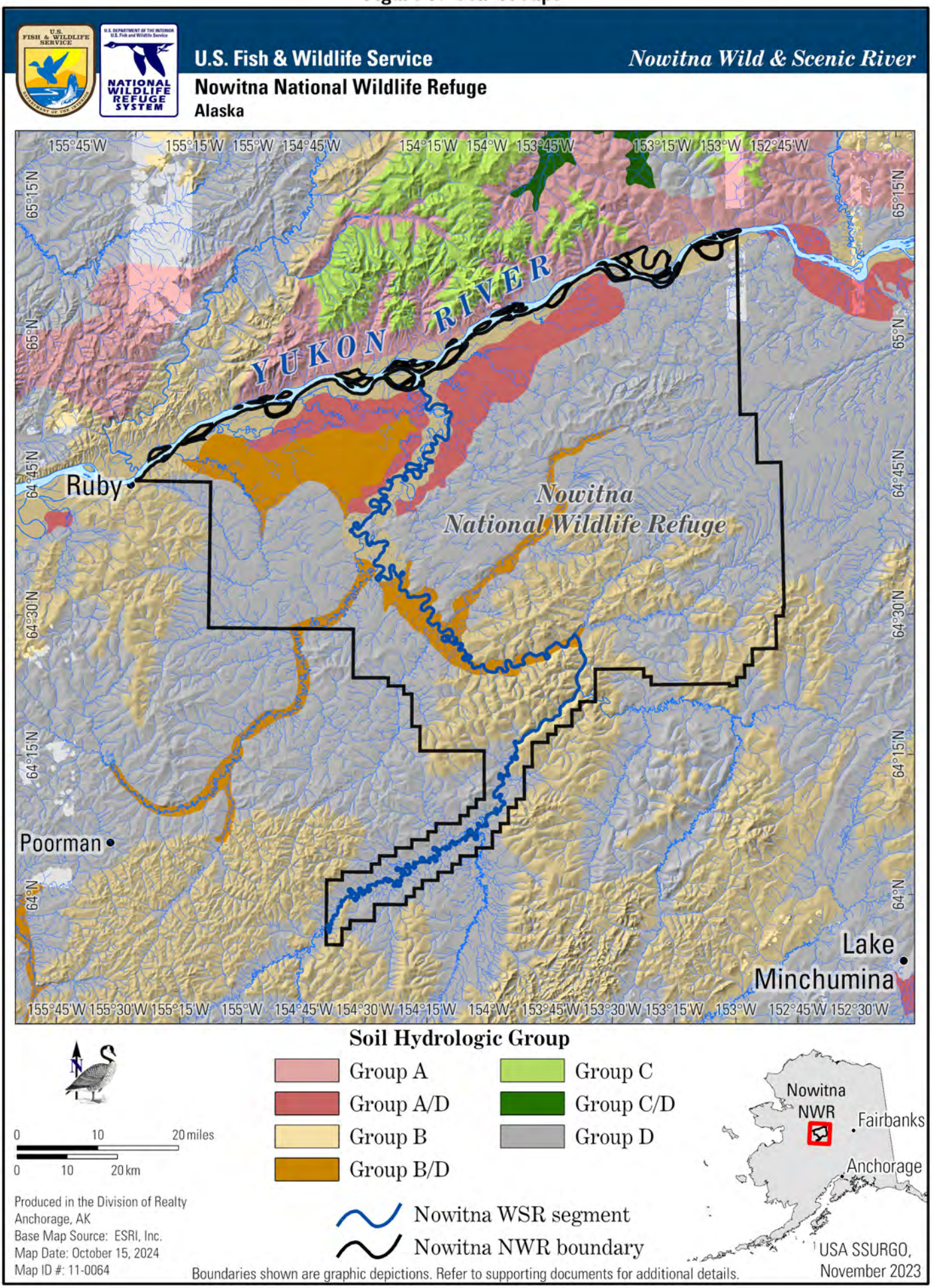
Source: NRCS 2025
Note: *Includes acreage only within public (Service) lands within the WSR corridor and does not include acreage within private lands.

Soil texture and moisture are important in influencing ecosystem dynamics. Soils' interaction with ground and surface water can result in natural changes to the water quality. Soils play a large role in the characteristics of the active permafrost layer. Gravelly soils tend to be well drained with deep, active permafrost layers; organic-rich soils tend to be poorly drained with shallow active permafrost layers.

Permafrost

Permafrost is a layer of ground that remains frozen (at or below 32 degrees Fahrenheit [0 degrees Celsius]) for 2 years or more (Burn 2023). Permafrost development and persistence rely on a cold climate and are controlled by air temperature, hydrology, soil type, vegetation, disturbance, and snowpack. As such, vast layers of permafrost extend throughout Alaska. In some regions, permafrost tends to be continuous, while in other areas it may be discontinuous or absent. The presence or absence of permafrost in soils strongly controls soil development and hydrology in Alaska (Hinzman et al. 2006; Jorgenson et al. 2013). Thawing of permafrost can have extensive impacts on ecosystems and hydrology, and can result in increased erosion or subsidence, impacting water resources (O'Neill et al. 2023). Thawing can also release previously frozen carbon and methane deposits (O'Neill et al. 2023).

Figure 9: Soil Groups[1]



In Alaska, the interaction of hydrology and permafrost plays a large role in ecosystem dynamics. Lakes and wetlands are common in permafrost areas because the frozen ground inhibits seepage and holds water close to or above the surface. In areas with permafrost, wetland vegetation reduces erosion by preventing the warming and thawing of ice-rich soils. Abundant wetlands in the northwest boreal zone of North America result largely from cool, short summers with low evapotranspiration and an impermeable permafrost layer that prevents infiltration and impedes drainage of the upper, unfrozen layer (Ford and Bedford 1987).

Permafrost can impede water infiltration and limit water flow, often leading to wet or saturated soil in the active layer[7] (Hinzman et al. 2005). In the absence of permafrost, surface soils tend to be well drained and dry. Thawing of near-surface permafrost can deepen the active layer, enhance infiltration, and lead to deeper water-flow paths in soils or below the permafrost (sub-permafrost). In some areas of continuous or discontinuous permafrost, groundwater can flow through taliks[8] in the permafrost.

Permafrost is thought to be discontinuous throughout Nowitna NWR (Jorgenson et al. 2008a). As shown in **Figure 10**, the permafrost layers are isolated along the Nowitna WSR corridor near the confluence with the Yukon River. The probability of permafrost absence is typically higher along major waterways (Burkart et al. 2023). On Service lands within the corridor, there are an estimated 127,865 acres of discontinuous permafrost (91 percent) and 12,289 acres of isolated (5–10 percent frozen) permafrost (9 percent) (USFWS 2024c). This includes acreage only within Service lands within the WSR corridor. It does not include acreage within private lands.

Climate

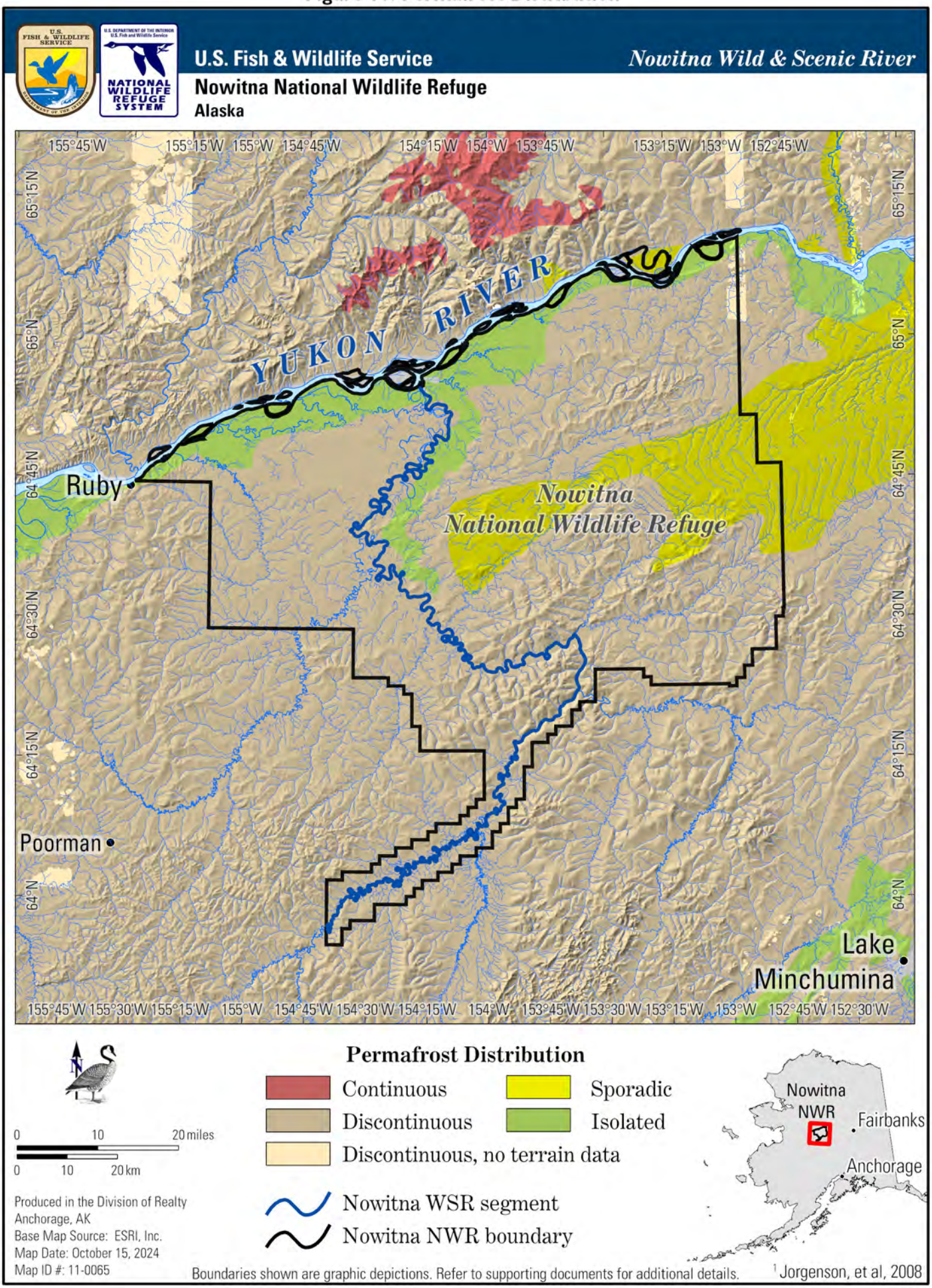
The Nowitna WSR corridor experiences extreme seasonal solar radiation variability due to its high-latitude environment. Daylight hours vary from a minimum of about 4 hours in winter to more than 20 hours in summer (UAF 2023). The Nowitna WSR corridor is inland with a continental climate (cut off from the ocean's moderating effects), which is characterized by large temperature variability, long and cold winters, warm and short summers, low humidity, and unpredictable precipitation. Summer maximum temperatures range from the upper 70 degrees Fahrenheit with extreme readings in the 90s. Winter temperatures may be minus 50 degrees Fahrenheit or lower for 2 or 3 weeks at a time. Lowlands experience frequent temperature inversions in winter (UAF 2023). Fairbanks, which is approximately 190 air miles east of the Nowitna WSR corridor, has some of the world's strongest inversions, sometimes 30 to 40 degrees Fahrenheit colder at the ground than at several hundred feet aboveground (Wendler and Nicpon 1975).

Annual precipitation usually varies from about 10 to 30 inches, with upland areas receiving more precipitation than lower areas. The seasonal precipitation pattern is normally at a minimum in spring and at a maximum in late summer, with rain contributing more to annual precipitation than snow. Summer thunderstorms are common over the hills and upland areas, and lighting is the most common cause of wildland fires. Temperature, drought, and snow melt date influences fire frequency, size, and severity, with the greatest aerial extent of burning occurring in the hottest, driest years (Grabinski and. McFarland 2025).

[7] Surface layer that thaws during summer

[8] A layer or body of unfrozen ground that occurs in permafrost due to an anomaly in thermal, hydrologic, or hydrochemical conditions

Figure 10: Permafrost Distribution[1]



[1] Jorgenson, et al, 2008

Image 33. The evening summer sun shines through fireweed (*Chamaenerion angustifolium*) blossoms along the bank of the Nowitna WSR. Photo credit: Karin Bodony, USFWS

Annual average temperatures across Alaska increased at a rate of approximately 0.7 degrees Fahrenheit per decade between the late 1970s and 2016 (Reidmiller et al. 2018), and they have increased by about 3 degrees Fahrenheit since 1925 (NOAA 2023). Statewide average temperatures in Alaska have been increasing at an accelerated rate since 2013, with the warmest and second-warmest years on record being 2019 and 2016, respectively (NOAA 2023). A 2019 summer heatwave brought record-high temperatures to southern and interior Alaska with daily high temperatures exceeding normal by more than 20 degrees Fahrenheit (Huntington et al. 2023). Most of the warming in interior Alaska since 1976 has occurred in winter (approximately 7.7 degrees Fahrenheit) and spring (4.4 degrees Fahrenheit), with the least amount of change (2 degrees Fahrenheit) in the fall (UAF 2023). Increases in air temperature can elevate water temperatures and accelerate permafrost thaw, which in turn affects hydrology (Burkart et al. 2023, Hinzman et al. 2005) and carbon balance (Schuur et al. 2022).

In Alaska, annual precipitation has steadily increased since 1970, particularly in Interior Alaska (Grabinski and McFarland 2025). Nine out of Interior Alaska's 10 driest summers occurred before 1980. However, warmer summer temperatures and a longer growing season tend to increase evapotranspiration enough to outweigh a regional increase in precipitation, potentially resulting in drier conditions (Rupp and Springsteen 2009). Hotter, drier summer conditions have led to a shift toward more frequent large fire seasons in the past 20 years in Alaska (Grabinski and McFarland 2025). These changes may lead to greater dominance of deciduous trees on the landscape (Trainor et al. 2009).

Air Quality

The Nowitna WSR corridor is in a remote and largely undeveloped area in interior Alaska, approximately 37 miles east of Ruby, Alaska. Although there are no long-term air quality monitoring stations in the Nowitna WSR corridor, based on regional monitoring and Service reports, existing air quality in the Nowitna WSR corridor is generally pristine. The primary exception is smoke and associated particulate matter that can be present during summer months when wildfires from lightning strikes are common (ADEC 2021).

Human-caused and natural air pollution impair visibility and occasionally impact public health. The main contributors to human-caused air pollution throughout interior Alaska are incomplete burning of fossil fuels used in motor vehicles, heating systems, and generators; prescribed burn emissions; and smoke from wood stoves (ADEC and EPA 2018). In rural communities, seasonal dust from dirt roads also contributes to local air pollution. Human-caused pollution emissions emanating from nearby villages and the Ruby-Poorman Road may be transported into the Nowitna WSR corridor. Additionally, winter use of cabins located within or near the WSR corridor can cause localized reductions in air quality through emissions from wood stoves, generators, and snowmachines.

Other sources of air pollution in interior Alaska include smoke from wildfires, windblown dust from open riverbeds and on rare instances, ash emissions from remote volcanic eruptions (Sassen et al. 2007; Schaefer and Nye 2008). Windy conditions along the Yukon River can produce dust when sandbars are exposed during low-water conditions in summer, winter, and early spring. High-altitude Arctic haze persists in spring and originates as dust, smoke, and human-caused pollution from parts of Asia and Europe (Shaw 1995). Due to the limited amounts of snow, rain, or turbulent air to displace pollutants from the polar air mass in spring, Arctic haze can linger for more than a month in the northern atmosphere.

Image 34. Snow caps the Kokrine Hills near the Nowitna River mouth as fall comes to the region. Photo credit: Karin Bodony, USFWS

The Clean Air Act, as amended in 1990, requires the EPA to set national ambient air quality standards (NAAQS; 40 CFR 50) for pollutants considered harmful to public health and the environment. The nearest area where air pollution persistently exceeds the NAAQS is the Fairbanks-North Star Borough urban area (EPA 2023a), which is approximately 190 air miles east of the Nowitna WSR corridor. Regional air pollutant data are available for the Yukon-Koyukuk Census Area, in which the Nowitna WSR corridor is situated. Due to the proximity of the Fairbanks-North Star Borough, 2020 emission data for both geographic regions are included below in **Table 5**.

Table 5. Air Pollutant Emissions (1,000 Tons) – 2020

Geographic Area	Carbon Monoxide	Nitrogen Oxides	PM_{10}	$PM_{2.5}$	Sulfur Dioxide	Volatile Organic Compounds
Fairbanks-North Star Borough	1,299	17	131	110	9	323
Yukon-Koyukuk Census Area	418	21	32	26	2	538
Alaska	2,883	150	290	222	21	2,227
US (including Alaska)	66,152	8,915	16,781	5,821	1,841	46,187

Source: EPA 2023b

Emissions data from 2020 indicate that Yukon-Koyukuk Census Area emissions were a fraction of those reported in the Fairbanks-North Star Borough. Prescribed fire emissions for each criteria pollutant accounted for approximately 9 to 16 percent of emissions in Alaska. In the Yukon-Koyukuk Census Area, wildfires accounted for over 90 percent of the particulate matter and sulfur dioxide emissions and 74 percent of carbon monoxide emissions (ADEC 2021).

Invasive Species

Invasive, nonnative plant species pose a large risk to ecological stability and integrity. Terrestrial nonnative plant species in Alaska have been given invasiveness scores based on ecological impacts, biological characteristics and dispersal ability, distribution, and feasibility of control (Carlson et al. 2008). Many nonnative plant species in Alaska are of limited concern due to their low capacity for rapid expansion in a natural setting. Such is the case for the following nonnative plant species currently known to exist in the Nowitna WSR corridor: lambsquarters in two places on the upper river and plantain in low numbers along both the upper and lower river. Nonnative plant species, including some that are considered highly invasive, occur more commonly in areas of human development, and human activities along the Nowitna WSR have the potential to transport unwanted species into the corridor. Nonnative plants observed in Ruby and/or along the Ruby-Poorman Road include the following species with relatively low invasiveness rank: common dandelion, pineapple-weed, common plantain, alsike clover, red clover, white clover, meadow foxtail, common timothy, and lambsquarters.

Species with higher invasiveness rankings, such as oxeye daisy, chokecherry, European bird cherry, and Siberian peashrub, exist in Ruby. Highly invasive bird vetch has been observed along the Ruby-Poorman Road and Long Creek (which flows into the Nowitna WSR via the Sulatna River) about 25 miles south of Ruby and 35 miles west of the Nowitna WSR. Numerous nonnative plants have been observed in Galena, including lambsquarters, common chickweed, pineapple-weed, common plantain, common dandelion, alsike and red clover, common timothy, Siberian pea shrub, chokecherry, European bird cherry, white sweet clover, and bird vetch. Of these, white sweetclover and bird vetch are considered the most invasive (Carlson et al. 2008), and removal efforts are ongoing. Efforts to remove Siberian pea shrub, chokecherry, and European bird cherry are also being considered in Galena.

Broadleaf cattails are native to some parts of interior Alaska; however, they are not found in this region except in the Galena area, where they may have been introduced for water treatment. They are now spreading to shallow lakes and wetlands near Galena.

The highly invasive plant species mentioned here, as well as others, are much more common and widespread in larger communities across Alaska, including Fairbanks and Anchorage. Also found in other parts of the state, but not yet in this region, is the highly invasive aquatic elodea. Elodea significantly impacts waterways elsewhere in Alaska by forming dense mats that impede fish movement, reduce native plant diversity, and hinder subsistence and recreational activities such as boating and fishing. Monitoring for the presence of elodea in waterbodies in the Nowitna WSR and surrounding region is ongoing.

Alaska Native Interests

Residents of the communities of Galena,[9] Ruby,[10] and Tanana[11] rely on subsistence resources within the Nowitna NWR and WSR corridor. The community of Tanana is on the north bank of the Yukon River near the confluence of the Yukon and Tanana Rivers and 90 river miles upriver of the Nowitna River confluence. The community of Ruby is on the south bank of the Yukon River about 35 river miles below the confluence of the Nowitna River. The community of Galena is on the north bank of the Yukon River about 85 river miles downstream of the Nowitna River confluence.

Louden Tribe,[12] the Native Village of Ruby, and the Native Village of Tanana are federally recognized Tribes and are represented in part by Doyon, Limited (an ANCSA regional corporation) and the Tanana Chiefs Conference (an ANCSA nonprofit) (Alaska DCCED 2024a, 2024b, 2024c). The village corporation for Galena is the Gana-A'Yoo Village Corporation (Alaska DCCED 2024a). The village corporation for Ruby is the Dineega Corporation (Alaska DCCED 2024b). The village corporation for Tanana is Tozitna, Limited (Alaska DCCED 2024c).

[9] The Denaakk'e name for Galena is Notaalee Denh.
[10] The Denaakk'e name for Ruby is Tl'aa'ologhe.
[11] The Denaakk'e name for Tanana is Hohudodetlaatl Denh.
[12] This designation has recently changed from Galena Village.

Image 35. Fall brings color changes to the Nowitna WSR corridor. Here highbush cranberry bushes glow red against a backdrop of cottonwood trees. Photo credit: Karin Bodony, USFWS

The Alaska Native Allotment Act of 1906 allowed Alaska Natives to receive the title for up to 160 acres of land in Alaska. The Native Allotment Act was repealed in 1971, when ANCSA became law. Under ANCSA, in exchange for settling Alaska Native land claims, land and money were distributed to the Alaska Native corporations established by ANCSA.

Alaska Native-owned lands and Native allotments are present throughout Alaska, and there are several Native allotments along the Nowitna River (USFWS 2009). **Figure 2.1** through **Figure 2.8** displays Alaska Native lands and Native allotments within the Nowitna WSR corridor. There are 779.91 acres of patented Native allotments across 9 allotments within the corridor. Dineega Corporation now owns one former Native allotment (79.96 acres), so the land is no longer classified as a Native allotment.

2.6 WSR Classification and Corridor Boundary

2.6.1 WSR Classification

When a river is added to the NWSRS, it is given a classification—wild, scenic, or recreational. These names have less to do with recreation, scenery, or wilderness, and more to do with measures of the level of development along the river at the time of designation. ANILCA added the Nowitna WSR to the NWSRS. The Nowitna WSR is classified as wild. As defined in Section 2(b) of the WSRA, wild river areas are those rivers, or sections of rivers, that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and no significant known pollution to its waters. These represent vestiges of primitive America.

2.6.2 WSR Corridor Boundary

The WSRA requires that each federally administered river in the NWSRS have a legally established boundary. Establishing a WSR boundary that includes identified river-related values is essential as a basis from which to provide necessary protection. ANILCA Section 606(a) states the boundary shall include an average of not more than 640 acres per mile on both sides of the river (measured from the ordinary high-water mark). The boundary shall not include any lands owned by the State or a political subdivision of the State, nor shall such boundary extend around any private lands adjoining the river in such manner as to surround or effectively surround such private lands. Where private lands are adjoining, they will be excluded from the river corridor by a common external boundary which in most cases is the river. Access will be provided to the entire block via the most commonly used route, which is generally the river. If necessary, a special use permit or right-of-way may be provided to allow adequate and feasible access to private parcels. This CRMP delineates the river corridor using current mapping capabilities that were not available when the Nowitna WSR was designated or at the time of CCP development (USFWS 1987a, 2009).

2.6.3 Boundary Establishment and Modification

Section 3(b) of the WSRA requires publication of a Federal Register Notice of Availability of the boundaries and classification of designated rivers. The Nowitna WSR legal boundary description (**Appendix A**) and maps (**Figure 1**, and **Figure 2.1** through **Figure 2.8**) will be transmitted to Congress for boundary establishment. Except where established by legislation, boundaries do not become effective until notice of their availability has been published in the *Federal Register* and until 90 days after they have been sent to the President of the Senate and the Speaker of the House of Representatives while Congress is in session (IWSRCC 2017). The Service is mandated to ensure geospatial data are available for the public. The WSR corridor boundaries will be available on the Data.gov website and the USFWS Open Data geoportal. Digital data will be available in standard formats such as shapefile, GPX, and KML. Maps will be available in both print format and in georeferenced PDF format.

The WSR corridor boundaries may be modified if it is determined that the existing boundaries are inadequate for protecting values for which the river was designated. For example, boundaries may be modified if it is determined that previous boundaries did not include all the values for which the river was designated or additional ORVs have been discovered, if the river has moved substantially outside of the existing boundaries, or if there are changes to the status of inholdings. Boundary amendments follow the same process required by WSRA Section 3(b) and may occur through a CRMP revision or separately if needed.

2.6.4 Corridor Boundary Delineation

Image 36. The winding Nowitna River creates numerous oxbow lakes, sloughs, and wetlands. In the distance, the Yukon River flows along the base of the Kokrine Hills. Photo credit: Karin Bodony, USFWS

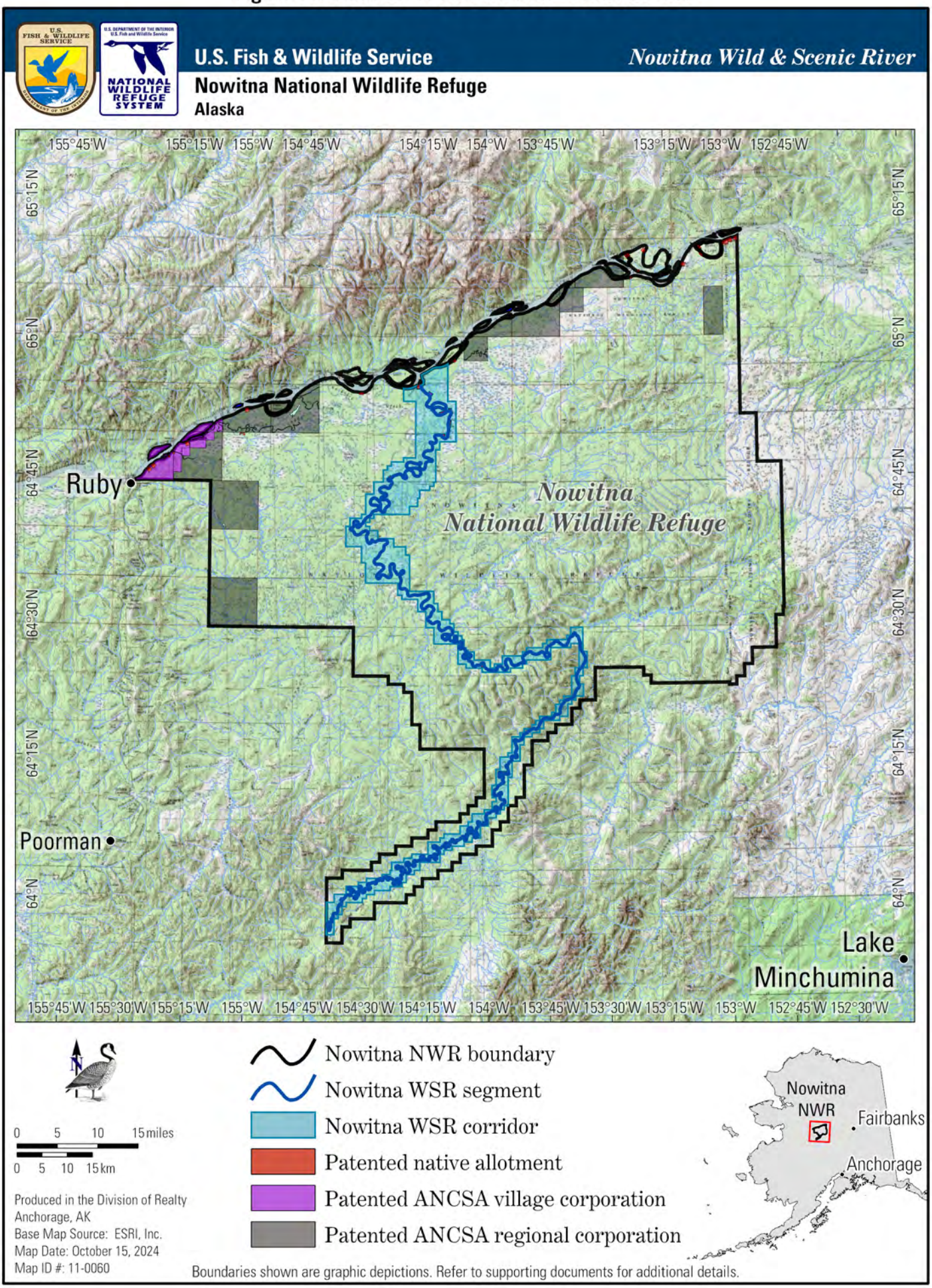
ANILCA defines the Nowitna WSR as "that portion from the point where the river crosses the west limit of township 18 south, range 22 east, Kateel River meridian, to its confluence with the Yukon River within the boundaries of the Nowitna National Wildlife Refuge." The length of this section of river was calculated to be 223 river miles in the 1987 Nowitna CCP (USFWS 1987). The WSRA as amended by ANILCA requires that the corridor not exceed an average of 640 acres per river mile.

A corridor boundary of the Nowitna WSR was described in the Nowitna CCP (USFWS 1987a) and was intended to be 142,400 acres, or an average of 638.6 acres per river mile. The corridor description was based on the Public Land Survey System (PLSS), whereby sections (1 square mile) and townships (aggregation of 36 sections) provide a foundation for legal descriptions of public and private lands. The Nowitna WSR corridor was described in terms of townships, sections, and aliquot parts (subdivisions of a section). Consequently, the corridor boundary was represented as a "stair-step" polygon comprising a series of straight lines oriented in north–south and east–west directions (**Figure 11**). This corridor was roughly centered on the centerline of the Nowitna River and was of variable width with respect to the centerline. Some portions of the corridor boundary were a mile or more away from the centerline, and other portions of the corridor boundary were less than 0.5 miles from the centerline.

The Revised CCP (USFWS 2009) also recognized a 223-mile river length for the Nowitna WSR. The WSR corridor was not changed at that time, but a more accurate calculation of the area within the corridor showed it to be 159,838 acres, which averages 766.8 acres per river mile. The most recent (2024) calculation of the area of the corridor depicted in the CCPs shows it to be just under 159,150 acres mainly due to updates such as the removal of acreage belonging to the Native allotments.

The Service determined that, due to the ambulatory nature of the Nowitna WSR, it is more accurate and efficient to use a GIS-based buffer width method to identify the WSR corridor than the PLSS method. The accuracy of the PLSS in unsurveyed townships is considered very low, as it essentially relies on projected estimations and mathematical calculations rather than actual on-the-ground measurements, making the location of property boundaries within these areas highly uncertain; essentially, it provides a theoretical grid but not precise property lines.

Figure 11: Nowitna WSR Overview - Nowitna CCP



The Service used geographic information system (GIS) software to create a digital representation of the corridor that adheres to the requirements of ANILCA Section 606(a). The multistage process is detailed in **Appendix B** and outlined in the steps below:

1) Create a polygon that follows the ordinary high-water mark of the extreme left and right banks of the Nowitna River.
2) From the polygon created in Step 1, generate a line that represents the centerline of the main channel of the Nowitna River.
3) From the polygon created in Step 1, generate buffer zones extending 0.5 miles outward from the extreme left and right banks of the Nowitna River. These 0.5-mile buffer zones represent an area of 320 acres per linear river mile on each bank of the river, for an aggregate of 640 acres per linear river mile.
4) From the buffer zones created in Step 3, remove privately owned land and any land necessary to prevent privately owned land from being effectively surrounded.
5) Use the polygon created in Step 1 (river polygon) to remove the river from the polygon created in Step 4 (corridor polygon). Islands (or portions of islands) that are below the ordinary high-water mark remain in the river polygon while those above the ordinary high-water mark are digitized and included in the corridor.

The Nowitna WSR corridor was measured equally from the ordinary high-water mark on both sides of the river, and the WSR length was measured using the generated centerline. The length of the Nowitna WSR was measured to be 220 river miles. This is a few miles shorter than the previous measurement due in part to channel changes on the meandering river. Since the last river measurement several cut-throughs have occurred, creating large oxbow lakes that no longer receive continuous river flow. Some change in the river length measurement may also be attributed to an increase in accuracy because the Service used high-resolution satellite imagery and GIS software to create the digital representation of the river's centerline.

The resulting polygon (**Figure 1** above) represents a uniform corridor that extends one-half mile outward from the ordinary high-water mark of the extreme left and right banks of the Nowitna River and excludes private land parcels and the area of the river itself (IWSRCC 2017). The corridor (**Figure2.1** through **Figure 2.8** above) encompasses all river-related values, to the extent possible, while adhering to the acreage limit stipulated by ANILCA Section 606(a).

Image 37. The floodplain of the upper Nowitna WSR is relatively narrow, confined by low rolling mountains, but the river is still meandering and creates many sloughs and oxbow lakes. Photo credit: Karin Bodony, USFWS

CHAPTER 3. MANAGEMENT DIRECTION

3.1 Introduction

The Service prepares step-down management plans when required by policy or when the plans may be necessary to provide more detailed objectives, strategies, and/or implementation schedules for meeting the management direction identified in CCPs. Service Manual 602 FW 4 Chapters 1–4 outline policy and procedures for step-down management plans. This CRMP is a step-down management plan that expands on the following in the Revised CCP (USFWS 2009):

> Goal 8: Maintain the special values of the Nowitna Wild River and Koyukuk Wilderness and the wild character of the refuge.
>
> Objective 1: Continue to monitor activities on the Nowitna Wild River and in the Koyukuk Wilderness for compliance with the WSRA and Wilderness Act and ANILCA. If problems are detected, appropriate actions would be taken.

This chapter provides management direction that must be followed when managing the Nowitna WSR corridor. Management direction involves the following:

- Continuation of current management in the Revised CCP. This is described below in **Section 3.2**, Continuation of Current Management.
- An amendment of the Revised CCP. This is described below in **Section 3.3**, Revised CCP Amendment.
- A step-down management plan that expands on the Revised CCP containing goals, desired conditions, objectives, and strategies for river values and other resources and uses occurring in the corridor. This is described below in **Section 3.4**, Nowitna WSR Management.

3.2 Continuation of Current Management

This CRMP is a step-down management plan that expands on the Revised CCP. It does not replace the Revised CCP. Current management that is relevant to the Nowitna WSR corridor is consolidated in **Appendix C** and will continue to be used to manage the Nowitna WSR corridor.

3.3 Revised CCP Amendment

Service Manual Part 602 FW Chapters 1–4 outline policy and procedures for revising CCPs and step-down management plans. In compliance with the Service's process for amending CCPs, the Revised CCP (USFWS 2009) would be modified to update the Nowitna WSR corridor to conform with ANILCA requirements. Other updates would include changing the "Nowitna Wild River" to the "Nowitna Wild and Scenic River" and updating the ORVs to those identified in the CRMP. These and other updates are explained in the CCP amendment memorandum in the environmental assessment that was prepared for this CRMP. The WSR corridor for this CRMP is described above in **Section 2.6**, WSR Classification and Corridor Boundary.

3.4 Nowitna WSR Management

This section provides management direction for the Nowitna WSR corridor. While some direction applies generally across the corridor, most is organized by resource area or use. This management applies to all future projects and activities within the corridor.

In addition to the management direction included in this chapter, Revised CCP components apply to the Nowitna WSR corridor. When CRMP and CCP components conflict, the more restrictive components prevail when they pertain to the management of the Nowitna WSR. A project- or activity-level evaluation, however, may be required to resolve the conflict.

3.4.1 Definitions of Management Direction

This chapter provides CRMP components and other content for the Nowitna WSR corridor. CRMP components include goals, desired conditions, objectives, and strategies. A goal is a descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units. An objective is a concise statement of what the Service wants to achieve, how much the Service wants to achieve, when and where the Service wants to achieve it, and who is responsible for the work. An objective is derived from goals and provides the basis for determining strategies, monitoring refuge accomplishments, and evaluating the success of strategies. All objectives

must be specific, measurable, achievable, results oriented, and time fixed. A strategy is a specific action, tool, technique, or combination of actions, tools, and techniques used to meet objectives.

3.4.2 Management Direction

Section 10(a) of the WSRA requires that river-administering agencies protect and enhance the river values (the free-flowing condition, water quality, and ORVs) for which a segment was designated. The ORVs for the Nowitna WSR are ecology, fish, cultural, and scenery. The process used to identify these values is documented in the Nowitna Wild and Scenic River Values report (USFWS 2024a).

Image 38. A falltime aurora graces the night sky over the Nowitna River and Kokrine Hills near the river mouth. Photo credit: Keith Ramos, USFWS

Currently, the Service is unaware of any conditions within the river corridor that are adversely impacting the ORVs. However, to ensure this requirement is met, the CRMP includes proposed non-ground-disturbing inventory and monitoring actions. The CRMP also includes potential management actions to ensure the river values are protected and enhanced into the future. The potential management actions may require additional site-specific review prior to implementation. The goals, desired conditions, objectives, and strategies outlined below were developed to ensure the Nowitna WSR continues to meet the overarching purpose to protect and enhance river values, while also meeting related goals and objectives defined in the Revised CCP.

Vision Statement

The Service works with partners using sound biological research and monitoring to ensure proper management and co-stewardship of the Nowitna WSR to safeguard its waters and the diverse array of

fish, wildlife, and boreal habitats it supports while honoring the long narrative of human interaction with this place and respectful harvest of its resources, established deep cultural values, and need for continued opportunities for enjoyment of the river's scenery and bounty.

Nowitna WSR Corridor Management

Theme 1: Protect the free-flowing condition of the Nowitna WSR

Free-flowing Water Goal: Conditions are managed to ensure sufficient flows protect or enhance the river's free-flowing condition[14] with a natural range of flows that provide optimum conditions for fish, wildlife, plants, and hydrological processes that shape the landscape.

Desired Conditions: The Nowitna WSR corridor is a dynamic, free-flowing river, without lateral or longitudinal impediments. The resulting hydrologic, geomorphic, and ecological complexity throughout the Nowitna WSR corridor promote and enhance the ORVs.

Objective: Collect data to quantify streamflows necessary to protect the Nowitna WSR's ORVs and file for a water reservation 10–15 years after the approval of this CRMP.

Strategies:

- Work with the Service Water Resources Branch to document the water quantity and biological use of rivers and lakes to support water reservation applications.
- Work with partners to expand water quantity monitoring for the Nowitna WSR.

Theme 2: Protect water quality in the Nowitna WSR

Water Quality Goal 1. Conditions are managed to ensure the unique physical, chemical, and biological characteristics support the Nowitna WSR's ORVs and meet or exceed the Alaska water quality standards (18 AAC 70) and other applicable water quality standards.

Desired Conditions: Unique physical, chemical, and biological characteristics, supported by the hydrologic properties of the river, meet or exceed all applicable water quality standards.

Objective 1.1: Within 5 years of the approval of this CRMP and throughout the life of the CRMP, work with the Service Water Resource Branch to design and implement a water quality inventory and monitoring program that includes consideration of factors potentially affecting water quality.

Strategy:

- Provide refuge staff with training, time, and support to conduct aquatic fieldwork.

Water Quality Goal 2. Engage with Service staff (Water Resources Branch, Ecological Services, etc.) and partners to assess water quality and collaborate to support river values.

Desired Conditions:

[14] Free-flowing condition: Flowing in natural condition without modification, diversion, or impoundment.

Collaborative efforts with Service staff and partners result in a shared understanding of water quality conditions and effective coordination to assess, maintain, and protect the physical, chemical, and biological integrity of the Nowitna WSR.

Objective 2.1: Throughout the life of the CRMP, continue to develop, facilitate, and strengthen partnerships to further water quality data collection on the Nowitna WSR and its tributaries.

Strategies:

- Participate in the Alaska Stream and Lake Temperature Action Plan development and implement monitoring protocols on the Nowitna WSR to generate river-specific data that also contribute to a statewide database.
- Partner with others (Yukon River Intertribal Watershed Council, Village of Ruby, etc.) to expand water quality monitoring for the Nowitna River.
- Work with ADEC's Water Quality Monitoring and Assessment section to understand minimum data requirements for the State to use the data for making water quality impairment and attainment decisions.

Theme 3: Ecology ORV

Ecology Goal 1: Maintain the natural diversity of high-quality habitats found in the Nowitna WSR corridor, which supports a broad, interconnected array of northern wildlife species at various life stages, including moose, black bear, grizzly bear, wolf, wolverine, red fox, lynx, marten, porcupine, hare, river otter, muskrat, mink, weasel, squirrel, wood frog, waterfowl, raptors, songbirds, and others.

Desired Conditions: The natural biological diversity and integrity of plant communities within the Nowitna WSR riparian ecosystem are maintained.

Objective 1.1: Create an updated vegetation map of the Nowitna WSR corridor using remote sensing within 5 years of the approval of this CRMP, to be updated every 10 years, to improve understanding of diversity and change in plant community type distribution.

Strategy:

- Work with Service staff and partners to determine processes, cost, expertise, and other requirements necessary to accomplishing this goal.

Objective 1.2: Within 5 years of the approval of this CRMP, implement a larch and old-growth white spruce forest distribution survey within in the Nowitna WSR to better steward these plant communities. Repeat the survey every 10 years to monitor change in these forest communities.

Strategies:

- Determine the feasibility of boat-based and aerial-based techniques to accomplish this survey and associated costs.
- Work with partners (universities, local communities, etc.) to maximize the effectiveness of this effort.

Objective 1.3: Identify environmental stressors and management strategies for high-priority habitats within the Nowitna WSR corridor. Complete a status report within 5 years of the approval of this CRMP.

Strategies:

- Collaborate with partners (universities and federal and state agencies) to identify habitats of concern.
- Conduct a thorough literature review.
- Target research on the Nowitna WSR toward this goal as opportunities arise.
- Work with partners to identify and monitor pests, invasive species, and diseases affecting plant communities within the WSR corridor.

Objective 1.4: Identify and incorporate inventory and monitoring strategies for priority Nowitna WSR plants and habitats into the inventory and monitoring plan within 5 years of the approval of this CRMP.

Strategies:

- Provide refuge staff with training, time, funding, and support to develop and implement vegetation and habitat inventory and monitoring strategies related to the Nowitna WSR.
- Upon funding, hire a full-time habitat biologist to fully integrate this CRMP with other plans, including the Revised CCP, inventory and monitoring plan, and fire management plan.

Objective 1.5: Annually review the Nowitna fire management plan and ensure practices are in line with habitat goals throughout the life of this CRMP.

Strategies:

- Hold an annual meeting prior to the start of the fire season between Nowitna biologists and the fire management officer—and possibly also Bureau of Land Management staff—to discuss habitat goals and priorities, including best practices for invasive species prevention.
- Consider Nowitna WSR priorities and recommendations whenever the Nowitna Fire Management Plan is updated.

Objective 1.6: Throughout the life of this CRMP, work with partners to identify the potential for or impact of pathogen presence on plants within the Nowitna WSR and explore mitigation options.

Strategies:

- Opportunistically survey for the presence and extent of pests, invasive species, and diseases affecting plants and plant communities within the Nowitna WSR corridor during aerial and ground- or boat-based work.
- Annually review regional and statewide forest health inventories developed by partners (Alaska Division of Forestry and Fire Protection, United States Forest Service, and others) to identify potential impacts on the Nowitna WSR.

- Work with partners to address specific concerns with targeted surveys, monitoring, and/or management.

Ecology Goal 2: Maintain the natural abundance and diversity of wildlife species found in the Nowitna WSR corridor, including moose, black bear, grizzly bear, wolf, wolverine, red fox, lynx, marten, porcupine, hare, river otter, beaver, muskrat, mink, weasel, squirrel, wood frog, waterfowl, raptors, songbirds, and others.

Desired Conditions: Wildlife populations in the Nowitna WSR ecosystem continue to thrive in their natural abundance and diversity.

Objective 2.1: Annually support the implementation of the Inventory and Monitoring Plan as it pertains to the Nowitna WSR.

Strategy:
- Provide refuge staff with training, time, and support necessary to accomplish the annual goals of the Inventory and Monitoring Plan that relate to the Nowitna WSR.

Objective 2.2: Conduct a moose population estimate for the Nowitna WSR within 2 years of adopting this CRMP, and approximately every 5 years thereafter.

Strategy:
- Provide refuge staff with the training, time, and support necessary to accomplish surveys that relate to the Nowitna WSR.

Objective 2.3: Identify climate vulnerabilities and management strategies for wildlife species found in the Nowitna WSR corridor. Complete a status report within 5 years of the approval of this CRMP.

Strategies:
- Collaborate with partners (universities and federal and state agencies) to identify species of concern.
- Conduct a thorough literature review.
- Target research on the Nowitna WSR toward this goal as opportunities arise.

Objective 2.4: Throughout the life of this CRMP, work with partners to identify the potential for or impact of parasites and diseases on wildlife species found within the Nowitna WSR and corridor and explore mitigation options.

Strategies:
- Opportunistically survey for the presence and extent of pests, invasive species, and diseases affecting plants and plant communities within the Nowitna WSR corridor during aerial and ground- or boat-based work.
- Maintain awareness of wildlife parasites and diseases occurring in the state and potential management strategies through communication with partners (ADFG, United States Geological Survey, Service's Alaska Migratory Birds Office, and others).

- Work with partners to address specific concerns (such as avian influenza, ticks, rabies, and tularemia) with targeted surveys, monitoring, and/or management.

Objective 2.4: Support wildlife species that seasonally occur within the Nowitna WSR corridor by working with partners and adjacent landowners to identify and protect essential wildlife habitat outside the management area, as needed.

Strategies:
- Work with partners to increase awareness of their role in stewarding the Nowitna WSR.
- Maintain awareness of new and changing conditions and management in areas outside the Nowitna WSR that could impact migratory wildlife species.

Ecology Goal 3: Improve the scientific knowledge of the Nowitna River's abiotic ecosystem components and ecological, fluvial, and geomorphic processes (including wildland fire, flooding, and succession) to inform management within the Nowitna WSR in the face of changing environmental conditions.

Desired Conditions: The unique abiotic and biotic features of the boreal riparian ecosystem continue to support ecological function and healthy fish and wildlife populations today and into the future.

Objective 3.1: Improve scientific understanding of the potential effects of climate variability on permafrost, hydrology, fire ecology, and soils in the Nowitna WSR corridor and possible impacts on wildlife and habitats. Identify and incorporate recommended monitoring strategies into the Inventory and Monitoring Plan within 10 years of adopting this CRMP.

Strategies:
- Use literature review, collaboration with partners, and targeted research to identify information needs and implement monitoring strategies.
- Support continued and enhanced acquisition of weather data for the Nowitna WSR through existing and new partnerships as opportunities arise.

Objective 3.2: Complete or update permafrost, hydrography, and soil inventories and maps within 10 years of adopting this CRMP to improve scientific understanding of relationships between abiotic factors and trends, plant communities, and wildlife in the Nowitna WSR corridor.

Strategies:
- Work with partners (universities, tribal organizations, etc.) to identify information needs, appropriate products, and associated costs.
- Provide refuge staff with the training, time, and support necessary to meet this objective.
- Seek opportunities for refuge staff to participate in broader-scale efforts in the Nowitna NWR and surrounding areas.

Ecology Goal 4: Minimize the introduction and impacts of invasive terrestrial and aquatic species through education, monitoring, early detection, and rapid response.

Desired Conditions: Highly invasive nonnative species continue to be absent in the Nowitna WSR corridor.

Objective 4.1: On an annual basis, increase public awareness of invasive species, including identification of species of concern, techniques to prevent introduction and spread, and ways observations may be reported.

Strategies:

- Provide outreach materials on an annual basis to guides and transporters to minimize the import of nonnative aquatic and terrestrial species.
- Provide outreach materials and programs on a biennial basis to local communities by working with tribal organizations, schools, etc.

Objective 4.2: Conduct biennial early detection surveys at critical access points and areas of high human use in the Nowitna WSR and corridor to detect the presence of aquatic and terrestrial invasive plant species.

Strategies:

- Identify locations of hunting camps and other human use areas from law enforcement, guides, and transporters, and through direct observation.
- Identify areas of concern for elodea infestation in the lower Nowitna WSR.
- Work with local partners to conduct boat-based surveys in the lower Nowitna WSR.
- Communicate with Service staff and external partners, such as the Alaska Invasive Species Partnership, Fairbanks Soil and Water Conservation District, and Alaska Exotic Plants Information Clearinghouse, to report and address exotic plant observations and keep aware of new or rising concerns and best detection and response strategies.

Objective 4.3: Conduct canoe-based surveys of the upper Nowitna WSR at least once every 5 years to detect the presence of aquatic and terrestrial invasive plant species, in addition to recording and reporting any observations collected opportunistically.

Strategies:

- Ensure biologists conducting annual goose float surveys or other boat-based surveys in the river corridor are aware of invasive plant species, are provided identification and survey tools, and document and report any suspected invasive species observed.
- Use past reports and the Alaska Exotic Plants Information Clearinghouse database to identify areas where past invasive species' observations and infestations have occurred.
- Communicate with Service staff and external partners, such as the Alaska Invasive Species Partnership, Fairbanks Soil and Water Conservation District, and Alaska Exotic Plants Information Clearinghouse, to report and address exotic plant observations and keep aware of new or rising concerns and best detection and response strategies.

Objective 4.4: Apply rapid response protocols as identified in the Alaska Region Rapid Response Plans within one year of detection of highly invasive, nonnative species.

Strategies:

- Develop materials and conduct outreach about invasive species' prevention, early detection, and reporting methods to local communities, guides, transporters, and visitors to facilitate rapid detection.
- Communicate with Service staff and external partners, such as the Alaska Invasive Species Partnership, Fairbanks Soil and Water Conservation District, and Alaska Exotic Plants Information Clearinghouse, to keep aware of new or rising concerns and best detection and response strategies.
- Preplan response strategies, including maintaining relationships with Service staff and external partners that can assist with rapid response.

Theme 4: Fish ORV

Fish Goal 1: Build a collective understanding of the uniquely diverse and dynamic fish community of at least 19 anadromous and freshwater fish species found in the Nowitna WSR to identify and protect habitat and maintain natural diversity and abundance of fish in the face of changing environmental conditions.

Desired Conditions: The fish ecosystem diversity (species presence, habitat complexity, and ecosystem services provided) in the Nowitna WSR are undiminished now and into the future.

Objective 1.1: In cooperation with ADFG and other partners, develop and initiate fisheries and habitat surveys for the Nowitna WSR and tributaries within 5 years of the approval of this CRMP.

Strategies:

- Create a summary report of what is known about Nowitna River fish (species occurrence, habitat use, locations of habitat critical to various life stages, and data needs).
- Provide refuge staff with training, time, and support necessary to accomplish the annual goals of the Inventory and Monitoring Plan that relate to salmon and other fish species occurring within the Nowitna WSR.
- To increase current knowledge of existing fish species diversity, work with partners and the Service's Fairbanks Field Office and Water Resource Branch to develop inventory and monitoring protocols for fish and their habitats.
- Incorporate monitoring for the presence of invasive species into habitat surveys.
- Investigate potential impacts of changing precipitation patterns, air and water temperature regimes, breakup phenology, and fire frequency on fish species occurring in the Nowitna WSR.

Objective 1.2: Complete or update permafrost, hydrography, geology, and soil inventories and maps within 10 years of adopting this CRMP to improve scientific understanding of

relationships between abiotic factors and trends, and the fish community in the Nowitna WSR.

Strategies:
- Work with partners to identify past work, prioritize future information needs, and determine processes, costs, expertise, and other requirements necessary to accomplish this goal.
- Seek opportunities for NWR staff to participate in broader-scale efforts in the Nowitna NWR and surrounding areas.

Objective 1.3: Throughout the life of this CRMP, work with partners and adjacent landowners to identify and protect essential habitat of Nowitna WSR fish species that spend parts of their life cycle outside the management boundaries.

Strategies:
- Work with partners to increase awareness of their role in stewarding the Nowitna WSR.
- Maintain awareness of new and changing conditions and management in areas outside the Nowitna WSR that could impact fishery resources.

Fish Goal 2. Improve the scientific knowledge of the unique geomorphology, hydrology, and other characteristics of the Nowitna WSR that combine to make suitable sheefish spawning habitat and support other whitefish species.

Desired Conditions: Healthy populations of sheefish and other species of whitefish continue to spawn in the Nowitna WSR.

Objective 2.1: Obtain data on composition (abundance, range, etc.) for sheefish within 5 years of the approval of this CRMP.

Strategy:
- Expand on past research and initiate a sheefish habitat study to identify key spawning habitat requirements.

Objective 2.2: Throughout the life of the CRMP, facilitate information exchange related to habitat use by sheefish in other areas to better understand sheefish in the Nowitna WSR.

Strategy:
- Collaborate with partners to gather information about sheefish habitat.

Fish Goal 3: Monitor effects of changing conditions on pike to identify any potential management needs.

Desired Conditions: Healthy populations of pike continue to thrive in the Nowitna WSR.

Objective 3.1: Obtain data on composition (abundance, age structure, etc.) and habitat conditions for pike in the Nowitna WSR within 10 years of the CRMP's approval.

Strategies:

- Document any past research on pike abundance and harvest levels.
- Track water temperature or other river conditions expected to affect pike populations.
- Develop a monitoring strategy for pike or pike habitat, or both.

Theme 5: Cultural ORV

Goal 1: Build a collective understanding of the cultural resources found along the Nowitna WSR that provide important links to the human history of travel, trade, recreation, and resource harvest of the river corridor, including historic and archaeological sites, cultural landscapes, and ethnographic resources.

Desired Conditions: The integrity of cultural, historic, archaeological, and ethnographic resources is safeguarded for future generations.

Objective 1.1. Within 5 years of the approval of this CRMP, conduct cultural resource surveys to identify resources and potential threats.

Strategies:

- Work with Service archaeologists and other knowledge bearers to identify and prioritize areas to be surveyed.
- Investigate potential impacts of shifts in seasonal phenology, river flow dynamics, permafrost thaw, and extreme weather events on the security of cultural resources.
- Identify cultural resources that are at risk for being lost due to erosion.
- Work with Service archaeologists and other partners (universities, local communities, etc.) in conducting cultural resource surveys.

Objective 1.2. Throughout the life of the CRMP, upon discovery of any cultural resources or sites of cultural significance within the Nowitna WSR corridor, the NWR staff will work with its archaeologist and local Tribes to gain a better understanding of the cultural resource and its history and work to design and implement protective and preservation measures pursuant to the resource type.

Strategy:

- Have NWR and regional archaeological staff consult and collaborate with tribal partners and the State Historic Preservation Office to complete cultural surveys, evaluation and management recommendations, and data recovery, if necessary.

Objective 1.3: Throughout the life of the CRMP, develop a narrative history of the river's use within the Nowitna WSR. Develop a summary report or outreach materials, or both, within 10 years of this CRMP's completion.

Strategy:

- Conduct elder interviews and a thorough literature review of historical documents, place-names, and oral history recordings to develop a narrative history of the Nowitna WSR.
- Document traditional ecological knowledge specific to the Nowitna WSR.

Goal 2: Ensure the Nowitna WSR continues to conserve wildlife, fish, and plant resources for the customary and traditional uses of wild renewable resources.

Desired Conditions: The Nowitna WSR provides river users with opportunities to harvest wild renewable resources now and into the future.

Objective 2.1: Throughout the life of the CRMP, evaluate valuable wild renewable resources to ensure healthy sustainable food sources are available for harvest.

Strategies:

- Continue cooperating with the State of Alaska to conduct the annual moose hunter check station at the mouth of the Nowitna WSR to document trends in river use and wildlife harvest.
- Work with partners such as the Service's Fisheries and Ecological Services and the State of Alaska to monitor contaminants in fish, especially those that are top predators and important to subsistence users, and other harvestable wildlife.
- Monitor fish harvest, as needed, through subsistence harvest surveys, guide-use reporting, etc.
- Investigate berry harvest and effects of shifting temperature and precipitation regimes, permafrost dynamics, frequency and severity of wildland fire, and other abiotic changes on this resource.

Goal 3: Continue to foster high-quality hunting, fishing, trapping, wildlife observation, and boating opportunities in a natural setting.

Desired Conditions: The Nowitna WSR provides river users high-quality opportunities for wildlife-dependent activities now and into the future.

Objective 3.1: Periodically communicate with river users to monitor trends in visitation levels and the quality of experiences.

Strategies:

- Document recreational experiences on the Nowitna WSR during village visits, at the Nowitna River moose hunter check station, and through other outreach efforts.
- Investigate the use of social media to gain feedback on visitor experiences.
- Distribute guide-use evaluation forms to document user experiences on the Nowitna WSR.
- Adhere to requirements of the National Wildlife Refuge System Improvement Act of 1997.

Objective 3.2: Increase awareness and stewardship of the Nowitna WSR within local communities, diverse groups, and the general public and promote a sense of ownership and responsibility for the protection of the Nowitna WSR's river values.

Strategies:

- Develop materials and conduct outreach to local communities, guides, transporters, visitors, and the general public to foster stewardship of the Nowitna WSR for future enjoyment.
- Identify key audiences and develop Leave No Trace outreach and environmental education programs.
- Encourage local community participation in river conservation efforts through volunteer programs, community events, river cleanups and partnerships.

Theme 6: Scenery ORV

Goal 1. Protect the Nowitna WSR's natural viewshed (characterized by a varied topography, diverse plant communities, and dynamic water features) to ensure it continues to support a rich and diverse scenic experience for river users.

Desired Conditions: The Nowitna WSR provides a varied, wild, and beautiful scenic experience for river users now and into the future.

Objective 1.1. Monitor changes in vegetation, water clarity, and human disturbance that may impact the scenic qualities of the Nowitna WSR on an annual basis and resolve any issues as they arise.

Strategies:

- Use the annual goose production survey to monitor changes that may impact the scenic quality on the upper and middle portion of the Nowitna WSR.
- Work with partners to conduct biennial boat-based surveys of high-use areas in the lower and middle corridor and perform cleanups as necessary.
- Work with law enforcement to ensure the regulations regarding public storage of camping and other equipment are enforced.
- Investigate the potential impacts of changes in vegetation communities and wildlife distribution driven by wildland fire, permafrost dynamics, and shifts in temperature and precipitation regimes on scenic values.
- Collect data on natural intactness and human disturbances, develop outreach materials, and encourage co-stewardship.

Objective 1.2. Ensure current and any potential future cabins or other structures, such as fish towers, weather stations, and communication towers, blend in or will be compatible with the natural surroundings.

Strategies:

- Use the cabin permitting process to mandate that permitted cabins are not situated directly on the bank of the river (set back a minimum of 100 feet, leaving at least a 50-foot buffer of standing vegetation, following Firewise[15] best practices).

[15] A national program that provides communities and neighborhoods with a collaborative framework to mitigate wildfire risk.

- Consider the expansive viewshed that exists on the Nowitna WSR between the confluence of the Sulukna River and the confluence of the Little Mud River when considering permitting of towers or other structures.

Objective 1.3. Increase public awareness about the Nowitna WSR's scenic value and foster a sense of stewardship among river users through annual outreach programs and communications.

Strategies:

- Develop and distribute outreach materials to local communities, guides, transporters, visitors, and the general public via village visits, the Nowitna River moose hunter check station, websites, social media, etc.
- Encourage local community participation in river conservation efforts through volunteer programs, community events, and partnerships that promote a sense of ownership and responsibility for the protection of the Nowitna WSR's river values.
- Develop Leave No Trace outreach materials and environmental education programs for key audiences.

3.5 Development of Lands and Facilities

This CRMP determines the appropriate types and levels of development (for example, trails and boat launches) for the WSR. These management decisions are based primarily on the WSR's wild classification. The Nowitna WSR is classified as wild because it is free of impoundments and it is generally inaccessible, except by trail. The watersheds and shorelines are essentially primitive with no significant known pollution to its waters. Any developments would be designed and constructed to ensure the free-flowing condition, water quality, and ORVs of the river are not adversely impacted.

3.6 Evaluation of Water Resource Projects

Section 7(a) of the WSRA directs federal agencies to evaluate federally assisted or permitted water resource projects to ensure existing conditions of designated river values are not diminished. No Section 7 water resource projects have been identified at this time. If water resource projects are identified later, they will meet the requirements of Section 7 of the WSRA and NEPA prior to implementation. Depending on the location of the water resource project proposal, the Service will use one of the following evaluation standards:

- Water resources projects within the Nowitna WSR corridor—The Service will evaluate water resources project proposals under the "direct and adverse effect" standard.
- Water resources projects below, above, or on a stream tributary of the Nowitna WSR corridor—The Service will evaluate water resources project proposals under the "invade the area or unreasonably diminish" standard.

CHAPTER 4. VISITOR USE MANAGEMENT AND CAPACITY

Image 39. This serene scene of the Nowitna River where it enters the Yukon River at the base of the Kokrine Hills is an example of the area's beauty. Photo credit: Karin Bodony, USFWS

4.1 Overview

To identify a visitor capacity, managers of federal lands identify the maximum kinds and amounts of visitor use that will maintain and achieve desired conditions. In this CRMP, the use of the term "visitor capacity" is synonymous with the term "user capacity," which is a CRMP component required by the WSRA. Section 3(d)(1) of the WSRA directs agencies to address visitor capacities for public use in a CRMP to ensure that use levels in the river area do not threaten river values or established desired conditions.

The goal for visitor use management within the Nowitna WSR corridor is to provide opportunities for the public to enjoy and experience the river while also protecting the river values for which the river was designated. Public use is defined as visitor use and WSR-specific administrative use within the WSR corridor. Visitor capacity determinations are not required for other uses, including subsistence activities (IWSRCC 2018),[16] but are considered in assessing baseline and current conditions to inform visitor use capacity. The Nowitna WSR supports a wide variety of subsistence activities, including motorized and nonmotorized boating, hunting, fishing, trapping, plant harvesting, and camping activities. Current

[16] https://www.rivers.gov/sites/rivers/files/2023-02/user-capacities.pdf

conditions and use patterns for recreational, commercial, and administrative uses are discussed in **Section 4.2**, Current Visitor Use, through **Section 4.4**, Administrative Use.

4.2 Current Visitor Use

The Nowitna WSR provides opportunities for a variety of recreational activities and attracts visitors from local communities and around the state. The amount of visitor use that the Nowitna WSR receives varies substantially by location and the time of year. Despite initial expectations following the passage of ANILCA, the designation of Nowitna WSR has not led to increased visitor use of the river.

Understanding demand for visitor use is useful for determining trends and planning for future use. Because this river is relatively remote and difficult to access, visitation is not expected to increase substantially. However, there has not been in-depth research or comprehensive monitoring to document characteristics of use, including the amount, type, timing, and distribution of activities and behaviors, especially for non-hunting visitation. **Table 6**, below, lists sources of information about visitor use.

Table 6. Visitor Use Data Collection

Data Type	Dates Collected	Information
Moose hunter check station	Annually since 1988	Voluntary – only required in 1997. Currently, only registered hunters in a group are counted.
Commercial guide-use reports	Annually since 2010	One permitted guide uses camps situated both inside and outside the corridor. Not all clients spend the entire time in the Nowitna WSR corridor.
Air taxi operator reports	Annually	Refuge special-use permits are issued annually, but use depends on client request. No clients have been reported in recent years.
Recreational floaters	Annually (informally)	Annual narratives (1982–1996), incidental observations during NWR fieldwork, and reports from other users

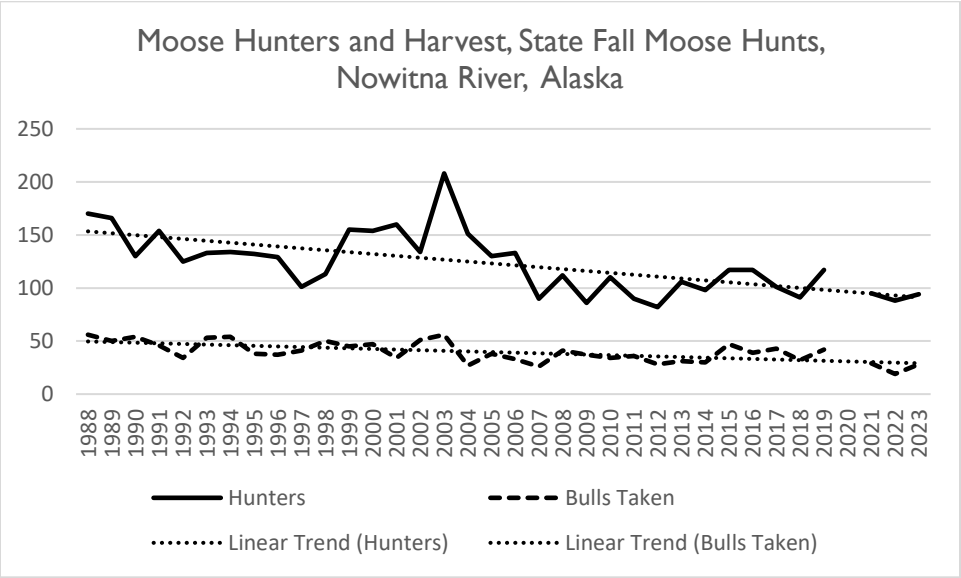
4.2.1 Recreational and Subsistence Hunting

A primary visitor use for the Nowitna NWR is moose hunting. The best hunting is found in grass lakes near the river area (USFWS 2024b), but moose may also be observed along the river itself. Refuge records indicate that hunters camp on the riverbanks or near adjacent sloughs, and the duration of stay ranges from 3 days to 3 or 4 weeks (USFWS 1982). During the 1987 hunting season, 26 hunting groups were recorded along 223 miles of the Nowitna River (USFWS 1987b). In 2023, 30 separate hunting parties were recorded (USFWS 2023) during the hunting season.

Image 40. The moose hunter check station, located near the mouth of the Nowitna WSR, has welcomed visitors every September since 1988. Photo credit: Brad Scotton, USFWS

The Service manages an annual moose hunter check station during the hunting season to track moose hunting. Information collected summarizes overall hunter success rates, the numbers of hunters in each group, and the location of residency for each hunter. The number of hunters participating in the State moose hunts has declined somewhat over the past several decades (**Graph 1**). During the 2023 State moose hunting season (September 5 to 25), 94 hunters registered at the moose hunter check station. A total of 28 moose—comprising 28 bulls and zero cows—were harvested under these State hunting permits (USFWS 2023). These recent totals are lower than what was recorded in the 1980s. According to a 1987 Nowitna National Wildlife Refuge Annual Narrative Report, annual moose harvest from 1981 to 1986 ranged from 49 to 79 animals (USFWS 1987b). Moose harvest data from the Nowitna moose hunter check station indicate that moose harvest has generally declined since 1988 (**Graph 1**), which can be explained by a decline in total hunters. The moose hunter success rate has been variable over the same time period, but the average success rate has been stable (**Graph 2**). Of the 94 State-permitted hunters who hunted along the Nowitna River in 2023, 15 percent were local residents (from Ruby, Tanana, and Galena), 43 percent were Fairbanks residents, 37 percent were other residents (from Anchorage, Juneau, Wasilla, etc.), and 5 percent were nonresidents. The annual narrative reports, spanning from 1982 to 1989, indicated an increase in moose hunting on the refuge by Fairbanks residents (USFWS 1982, 1983, 1984, 1985, 1986, 1987b, 1988, 1989). Nowitna check station data show a decreasing trend in subsequent years.

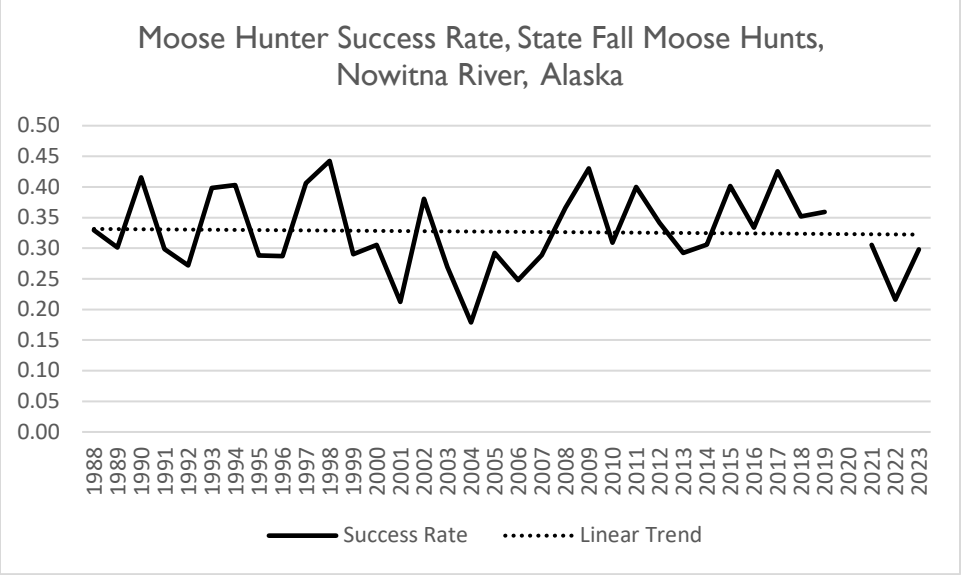
Graph 1. Moose Hunters and Harvest, State Fall Moose Hunts, Nowitna River, Alaska



Source: USFWS 2023

Note: Nowitna River moose hunter check station data from 1988 to 2023. Data for all years except 1997 represent only those hunters stopping at the mouth of the Nowitna River and do not usually include fly-in hunters or those hunting only the sloughs of the Yukon River. 1997 was a registration hunt, and fly-in hunters are included. In 2020 the check station was not operated.

Graph 2. Moose Hunter Success Rate, State Fall Moose Hunts, Nowitna River, Alaska

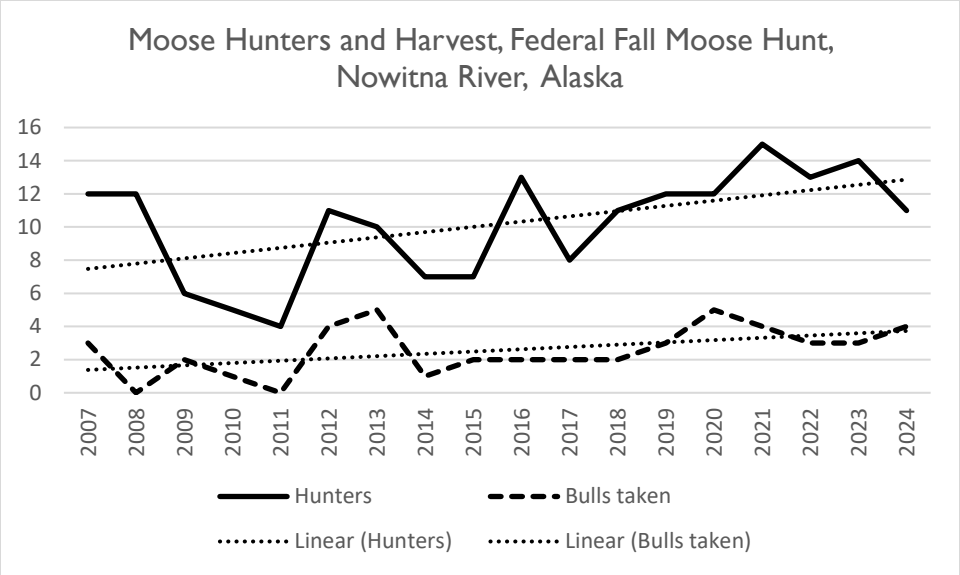


Source: USFWS 2023

Note: Nowitna River moose hunter check station data from 1988 to 2023. Data for all years except 1997 represent only those hunters stopping at the mouth of the Nowitna River and do not usually include fly-in hunters or those hunting only the sloughs of the Yukon River. 1997 was a registration hunt, and fly-in hunters are included. In 2020 the check station was not operated.

A fall federal subsistence moose hunt was initiated in the Nowitna River region in 2007. Nowitna moose hunter check station data indicate an increase in participants in the fall federal subsistence moose hunt since that time (**Graph 3**). During the 2023 federal moose hunt, 14 permits were issued, and 3 bull moose were harvested. Hunting was permitted from September 26 to October 1. All 14 permits were issued to local residents (4 were Ruby residents and 10 were Tanana residents).

Graph 3. Moose Hunters and Harvest, Federal Fall Moose Hunt, Nowitna River, Alaska



Source: USFWS 2024d

Hunting for black and grizzly bears is permitted in the Nowitna River corridor under the State game management regulations for Game Management Unit 21B. The annual harvest of bears in the corridor is not precisely known (USFWS 2023) but is not thought to be very high. Sealing records indicate that annual brown bear harvest in Game Management Unit 21B averaged less than one bear per year (0.6 bears) between 1986 and 2023 and has never been more than two bears in a single year (ADFG 2024d).

4.2.2 Waterfowl Harvest

Fall waterfowl harvest is open to Alaska residents and non-residents under State Migratory Game Bird Hunting Regulations. Residents of qualified rural areas may also participate in the Federal Alaska Subsistence Spring/Summer Migratory Bird Harvest. A State hunting license and an Alaska State Duck Stamp are required to hunt in any season by anyone who does not qualify for license and duck stamp exemptions. Non-resident hunters and some resident hunters are required to have a Federal Duck Stamp.

Waterfowl have always been an important subsistence resource for people living in the Nowitna region. For thousands of years people have depended on geese, ducks, and other migratory birds for food, particularly in springtime when other sources of food were less available. Subsistence harvest of waterfowl continues to this day, though in lower quantities than in the past.

Subsistence harvest surveys have been conducted periodically in Tanana, Ruby, and Galena since the 1980s. Species harvested include greater white-fronted goose, Canada goose, tundra swan, mallard, northern pintail, and American wigeon. Waterfowl are primarily harvested in spring but are also hunted

in the fall season. In a 1984 subsistence survey in Ruby, 40 of 48 households reported participation in spring waterfowl hunting and 17 in fall waterfowl hunting, with 10 households reporting hunting in both spring and fall (USFWS 1984). Results of surveys conducted by ADFG indicate that, in terms of estimated pounds harvested, waterfowl harvest in the early 2010s was about a third of what it had been in the mid-1980s in Galena and Tanana. However, residents were still participating in both spring and fall waterfowl harvest in the 2010s, and it is expected that hunting during both seasons continues today (Brown et al. 2015, Brown et al. 2016, Case and Halpin 1990, Marcotte 1990).

Because of challenging travel conditions, spring waterfowl hunting is generally limited to a fairly small area around each village and is likely occurring only in very low levels within the Nowitna WSR corridor. This activity is probably only conducted by families with Native allotments or permitted cabins located in or near the Nowitna WSR corridor. Waterfowl may be hunted along the Nowitna WSR during the fall moose hunt, but conversations with hunters at the moose hunter check station indicate that hunting for spruce and ruffed grouse is more popular.

Image 41. Above the canyon, the Nowitna WSR is typified by narrow channels, gravel bars, and cutbanks. Photo credit: Dylan Undlin, USFWS

4.2.3 Fishing

Fishing is often conducted in conjunction with other activities, such as hunting or river float trips. Northen pike and sheefish are the most sought-after species, and fishing is generally light from June to August and greatest in September during moose season. Data on current use trends are lacking, since the activity is often incidental to other activities.

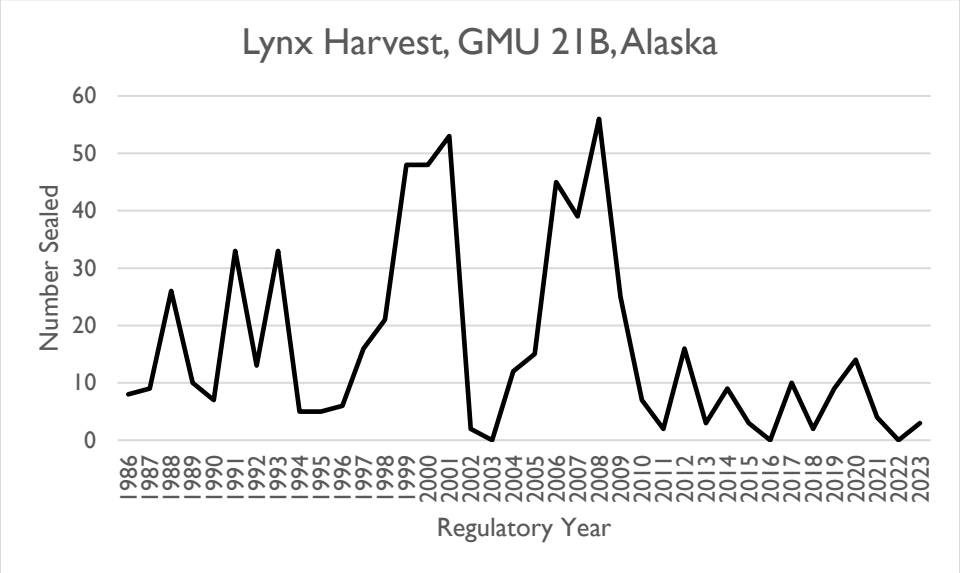
4.2.4 Non-hunting Recreation

Current levels of recreational boating use are not well documented, but they are estimated to be less than five groups of unknown size per summer. Groups are unlikely to encounter others while floating the Nowitna WSR, if they boat outside the September moose hunting season.

4.2.5 Trapping

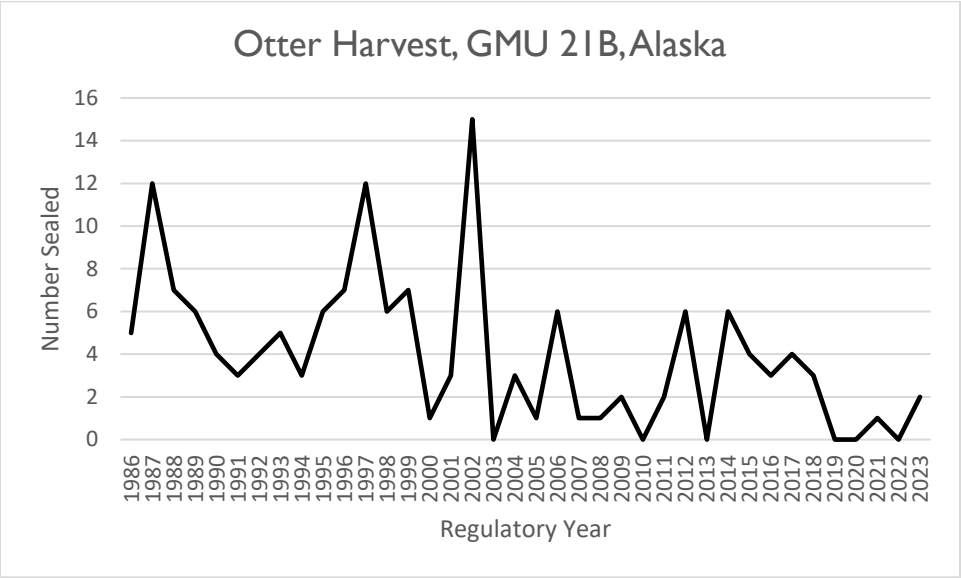
Trapping has been a common visitor use, primarily for residents of nearby Ruby and Tanana. Eight cabins permitted to refuge trappers were reported in 1985. At that time, six trappers typically operated out of the cabins from late October through April (USFWS 1985). Between 1984 and 1991 at least 14 trappers were utilizing the Nowitna NWR, although not all operated in all years (Paragi 1991). The minimum number of furbearers harvested on the Nowitna NWR from the 1986–87 season through 1996–97 was identified using ADFG sealing records (Johnson 1998). The number of beaver harvested per season ranged between 5 and 176 and averaged 60. Lynx harvest ranged from 2 to 25 and averaged 9. Otter harvest ranged from 0 to 12 and averaged 3. Wolf harvest ranged between 0 and 19 and averaged 8. Wolverine harvest ranged from 0 to 15 and averaged 3. In the past several decades furbearer sealing records for Game Management Unit 21B (which encompasses the Nowitna River drainage) have shown a decline in harvest of lynx, otter, wolf, and wolverine (refer to **Graph 4** through **Graph 7**) (ADFG 2024e). Lynx harvest fluctuations reflect the natural lynx population cycle. Wolverine harvest has remained relatively steady at low numbers. Currently at least six trappers, including one family with a cabin permit, actively trap in the WSR corridor.

Graph 4. Lynx Harvest, GMU 21B, Alaska



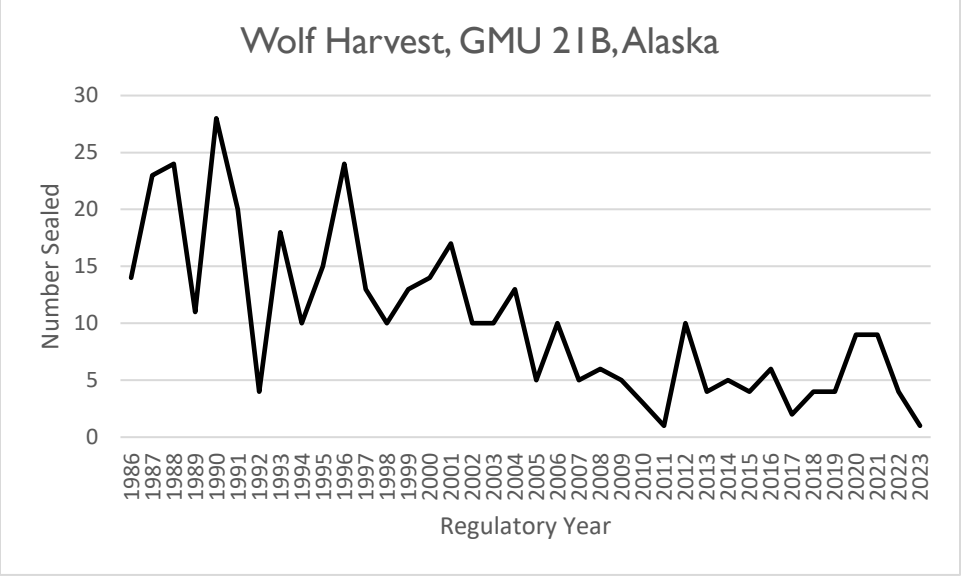
Source: ADFG 2024e

Graph 5. Otter Harvest, GMU 21B, Alaska



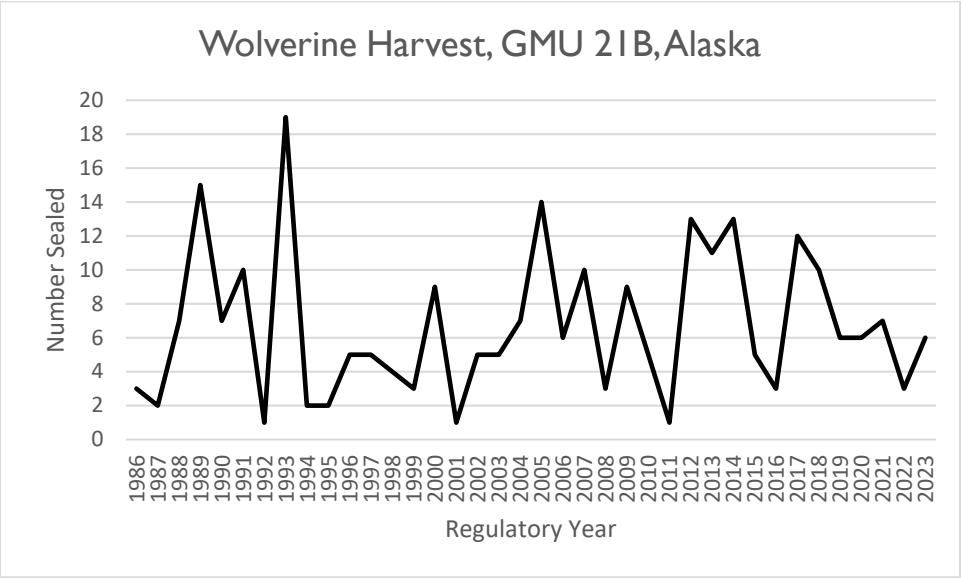
Source: ADFG 2024e

Graph 6. Wolf Harvest, GMU 21B, Alaska



Source: ADFG 2024e

Graph 7. Wolverine Harvest, GMU 21B, Alaska



Source: ADFG 2024e

4.3 Current Commercial Use

Game Management Unit 21B consists of that portion of Game Management Unit 21 in the Yukon River drainage upstream from Ruby and east of the Ruby-Poorman Road, downstream from and excluding the Tozitna River and Tanana River drainages, and excluding the Melozitna River drainage upstream from Grayling Creek. Game Management Unit 21B contains all of the Nowitna NWR (ADFG 2024d) and has one authorized commercial hunting guide.

Annually, the permitted hunting guide for Game Management Unit 21B averages six clients during the fall hunting season. The typical stay per client ranges from 7 to 12 days. On average, two to three commercial air taxi operators are issued special-use permits, but they have not provided services to clients on the Nowitna NWR recently. Historically, there was one commercial use permit issued for guided fishing, but no permits have been issued since 2013.

4.4 Administrative Use

Image 42. Service field crews use the Nowitna River administrative cabin during summer wildlife surveys. Photo credit: Karin Bodony, USFWS

There is one administrative cabin located along the Nowitna WSR between river mile 48 and 49. It is not visible from the river and does not detract from the river's primitive shorelines and natural character. On average, two refuge staff use the cabin three to four times a year for logistic support during field surveys. The refuge staff conduct surveys throughout the year (**Appendix D**), and the annual Nowitna River goose production float survey in July is the only boat-based study occurring along a substantial length of the Nowitna WSR.

4.5 Visitor Use Management Monitoring

In many locations, natural resource conditions and recreational use levels can be correlated; however, existing use on the Nowitna WSR does not currently reveal a negative correlation. Tracking changes to the primary indicators, thresholds, and objectives will ensure river values are protected in the Nowitna WSR corridor.

An "indicator" is a specific resource or social attribute that can be measured to track changes in conditions associated with human use. Indicators in combination with thresholds warn river managers about deteriorating conditions and help river managers assess progress towards attaining desired conditions.

Indicator: Presence of trampled vegetation or bare soil

River Values: Water quality, ecology ORV, fish ORV, and scenery ORV

Threshold: This will be determined after monitoring occurs as identified in the CRMP monitoring strategy.

Objective: Observations of new trampling of vegetation beyond the existing footprint at campsites do not increase.

Rationale: Compaction of soil, trampling of vegetation, and erosion cause sedimentation to negatively impact the ecology and fish ORVs and water quality. The scenery ORV could be negatively impacted by campsite footprints increasing in size caused by trampled vegetation, cutting of brush, or unattended property left in the Nowitna WSR corridor.

Indicator: Presence of riparian, terrestrial, and aquatic invasive species

River Values: Water quality, ecology ORV, fish ORV, and scenery ORV

Threshold: This will be determined after monitoring occurs as identified in the CRMP monitoring strategy.

Objective: Detection of highly invasive riparian, terrestrial, or aquatic invasive species does not increase.

Rationale: Riparian and aquatic invasive plant species are known to degrade water quality and disrupt natural function of riparian ecosystems. Early detection and rapid response to growth and/or spread of existing infestations and new invader species prevents infestations from growing so rapidly that treatment becomes unmanageable.

4.6 Visitor Capacity

Visitor capacity is defined as the maximum amounts and types of visitor use that an area can accommodate while achieving and maintaining the desired resource conditions and visitor experiences that are consistent with the purposes for which the area was established (IVUMC 2019). To identify visitor capacities, the Service followed the Visitor Use Framework and recommended steps from the IWSRCC to identify visitor capacity for the Nowitna WSR.

For the capacity analysis, the Service analyzed the Nowitna WSR as one geographic river management area, since the access, use, and desired conditions are the same for the entire corridor. Current conditions and use patterns for recreational, commercial, and administrative uses described in **Section 4.2**, Current Visitor Use, through **Section 4.4**, Administrative Use, illustrate that overall use is low to moderate, depending on the time of year and location. Visitation is not expected to increase substantially. To maintain desired conditions and protect the river values, current use levels can be maintained, and no management actions are recommended at this time. Existing conditions are within the thresholds for the area, and visitor use does not appear to be currently threatening the river values.

While the exact number of users is not known, estimates can be made based on available information. Visitation to the Nowitna WSR is estimated at 300 annual users, with most use occurring in August and September. Based on the analysis above, the amount of use on the Nowitna WSR could increase moderately while continuing to protect and enhance the river values.

Image 43. Autumn brings a new tapestry of color to the Nowitna WSR corridor. The Kokrine Hills dominate the horizon near the Nowitna River mouth. Photo credit: Karin Bodony, USFWS

4.6.1 Future Analyses

The above analysis uses the best available information to identify a visitor capacity for the Nowitna WSR. To manage into the future, the Nowitna NWR staff will implement new data collection methods via a monitoring strategy for the purposes of assessing changes to resource conditions and visitor experiences, so that threats to conditions essential to the river's values' defining characteristics can be identified early. The strategy must include indicators (the attributes that can be measured to track changes in conditions) and thresholds (the minimally acceptable conditions) so that managers know when to take timely actions to uphold their responsibilities to maintain, and where possible, enhance the river values.

Should there be changes, including amount, type, timing, distribution of activities and behaviors, and those outlined below, the refuge staff may reevaluate and update the visitor capacity based on the results of their monitoring efforts. The criteria that may warrant a reevaluation of capacity or updating strategies to manage to capacity include, but are not limited to:

- There is evidence that thresholds are being approached.
- There is evidence that Nowitna WSR conditions are trending away from desired conditions (**Section 3.4.2**, Management Direction).

- The refuge staff have meaningful new knowledge or understanding of the relationship between visitor use and impacts on resources or visitor experiences.

The visitor use management strategy takes an adaptive approach to respond to changing conditions and to provide flexibility in responding to resource concerns. The Service recognizes that identified visitor capacities may need to be reviewed and revised as more data become available. In addition to immediately establishing a monitoring strategy with identified indicators and thresholds to measure changes affecting river values if, in the future, thresholds are approached and events or actions are found to have the potential to threaten river values, the Service will increase education and outreach efforts about the threats and how visitors can mitigate them. This is in addition to other visitor use management tools managers use to mitigate threats, as well as intensifying the monitoring strategy to assess the need for management actions. If it is determined more intensive management actions, such as decreasing the visitor capacity, are needed, the monitoring strategy would be revised to also evaluate the efficacy of the management actions taken.

CHAPTER 5. CRMP MONITORING

5.1 Introduction

Monitoring is the periodic and ongoing measurement of specific variables related to a resource condition or river corridor experience. It proactively tracks conditions and trends and assesses the effectiveness of various management actions. The WSRA does not explicitly require monitoring for designated rivers. However, monitoring is an important aspect of protecting and enhancing river values (the free-flowing condition, water quality, and ORVs) and addressing visitor use.

5.2 Current Monitoring

The Nowitna WSR is currently monitored and managed under guidance of the Revised CCP and associated step-down plans to measure resource and social conditions to make sure progress is being made toward meeting the refuge's purposes, goals, and objectives. The monitoring includes determining how the refuge staff are implementing the CRMP and whether actions being taken are effective in meeting CRMP objectives. Refuge staff use an adaptive management approach (that is, information gained from monitoring is used to evaluate and modify refuge objectives and management direction, as needed). Monitoring is coordinated with appropriate partner agencies and organizations to enhance the efficiency and usefulness of the results. The approach builds on past and present monitoring work.

Image 44. River beauty (*Chamaenerion latifolium*) grows on a gravel bar opposite a black spruce forest along the upper Nowitna WSR. Photo credit: Karin Bodony, USFWS

The Revised CCP (Section 4: Implementation and Monitoring) recognizes numerous step-down plans that describe specific management strategies and details necessary to implement the goals and objectives related to each plan's topic. These step-down plans contain guidance for monitoring some resources that are specifically related to the Nowitna River's values (the free-flowing condition, water quality, and ORVs). Several additional documents also provide priorities and recommendations for monitoring specific to the Nowitna WSR's values. These plans and documents, in addition to the goals of this CRMP, form the backbone of monitoring on the Nowitna WSR. As associated step-down plans are updated, care should be taken to ensure that priorities and needs of the CRMP are recognized and included.

Specific details regarding monitoring strategies for the Nowitna WSR are contained within the refuge step-down plans, in other guiding documents, and in the goals section of this CRMP. A generalized list of CRMP monitoring priorities is shown in **Table 7**, below, along with the associated reference. **Appendix D** contains more specific information about the relevant monitoring strategies found in the following documents:

- Executive Summary: Wildlife Inventory Plan Koyukuk/Nowitna/Innoko National Wildlife Refuge Complex 2014 (USFWS 2014)
- Identification of Priority Resources of Concern: Methods and Results, Koyukuk, Nowitna, and Innoko National Wildlife Refuges (USFWS 2022)
- Water Resources Inventory and Assessment: Koyukuk, Nowitna, and Innoko National Wildlife Refuges, Alaska (Burkart et al. 2023)
- Koyukuk/Nowitna National Wildlife Refuge Complex Cultural Resource Guide (USFWS 1995)
- Koyukuk, Northern Unit Innoko and Nowitna National Wildlife Refuge Wildland Fire Management Plan (USFWS 2010)
- Nowitna National Wildlife Refuge Fishery Management Plan (USFWS 1990)
- Plan of Study: Hydrologic Resources Investigation Nowitna National Wildlife Refuge (USFWS 1998)
- Whitefish Biology, Distribution, and Fisheries in the Yukon and Kuskokwim River Drainages in Alaska: A Synthesis of Available Information (USFWS 2012)

Appendix D also identifies whether the strategies are currently being implemented or are recommended for implementation as part of this CRMP.

Currently, refuge staff observe the Nowitna River corridor annually during ongoing monitoring and management activities. This includes an annual goose production float survey in the upper and middle sections (July), aerial moose (May and November) and goose (July) production surveys, and a moose hunter check station and law enforcement activities (September). These activities provide opportunities for the Service to ensure it is meeting requirements of the WSRA as well as the goals and objectives of the Revised CCP. The moose hunter check station is operated annually for 4 weeks on the lower river to ensure compliance with hunting regulations and to provide an opportunity to meet directly with the largest user group on the river. Additional public use data are obtained from annual guide-use reports for the NOW-03 Guide Use Area. The goals included in this CRMP provide recommendations for more directed monitoring of corridor conditions in the future.

Table 7. Generalized List of CRMP Monitoring Priorities

River Value	Monitoring Strategy	Step-down Plan or Other Guidance
Free-flowing condition	Establish flow, followed by monitoring for change.	Plan of Study: Hydrologic Resources Investigation Nowitna National Wildlife Refuge CRMP free-flowing water goal Water Resources Inventory and Assessment: Koyukuk, Nowitna, and Innoko National Wildlife Refuges, Alaska
Water quality	Establish conditions for water temperature, turbidity, and chemistry. Prioritize areas important to Nowitna River fish and areas with the potential for upstream mining. Monitor for deviation from standards.	Plan of Study: Hydrologic Resources Investigation Nowitna National Wildlife Refuge CRMP water quality goal 1 Water Resources Inventory and Assessment: Koyukuk, Nowitna, and Innoko National Wildlife Refuges, Alaska
Ecology ORV	Monitor abundance of priority wildlife and plant species and distribution and diversity of plant communities.	Koyukuk/Nowitna/Innoko National Wildlife Refuge Complex Inventory and Monitoring Plan CRMP ecology goal 1
Ecology ORV	Monitor habitat diversity and the spatial distribution of plant communities, particularly rare or sensitive plant communities.	CRMP ecology goal 1 Koyukuk, Nowitna, and Innoko National Wildlife Refuge Wildland Fire Management Plan
Fish ORV	Monitor abundance of priority fish species and the condition of critical habitat areas.	Nowitna National Wildlife Refuge Fishery Management Plan Koyukuk/Nowitna/Innoko National Wildlife Refuge Complex Inventory and Monitoring Plan CRMP fish goal
Fish ORV	Monitor for contaminants in fish, especially fish that are top predators and important to subsistence users.	Water Resources Inventory and Assessment: Koyukuk, Nowitna, and Innoko National Wildlife Refuges, Alaska
Ecology, fish, cultural, and scenery	Monitor for the presence of invasive terrestrial and aquatic species within the river and corridor.	CRMP ecology goal 4 Water Resources Inventory and Assessment: Koyukuk, Nowitna, and Innoko National Wildlife Refuges, Alaska

River Value	Monitoring Strategy	Step-down Plan or Other Guidance
Cultural and scenery	Monitor the viewshed, including the impacts of visitor use, including trash, stored field gear, or other visible impacts of visitor use.	CRMP cultural goal 3 CRMP scenery goal 1
Cultural	Identify and document sites of potential archaeological importance.	Nowitna Cultural Resource Management Guide CRMP cultural goal 1

5.3 CRMP Monitoring Strategy and Implementation

The CRMP monitoring objective is to protect the Nowitna WSR's free-flowing condition, water quality, and ORVs (ecology, fish, cultural, and scenery). Monitoring is conducted to assess the relative success of CRMP management strategies and to ensure changes stay within acceptable levels that will not compromise the protection and enhancement of the river values.

Image 45. This is a quintessential scene of the upper Nowitna WSR. In the distance are the low rolling mountains that form the Nowitna River canyon. Photo credit: Karin Bodony, USFWS

This section helps the Service determine whether steps must be taken to address issues degrading river values. Indicators in **Table 8**, below, have been identified to assess the success in protection and enhancement of river values. For each monitoring focus, a threshold (or standard to meet) is set. This threshold value indicates the point at which river management objectives are no longer met, triggering action to be taken to meet the standard. In many cases, the priority is to establish existing conditions to assist in the determination of deviation from desired conditions. The existing low use of the Nowitna WSR means that current conditions of many indicators are likely far from needing action to meet standards. In cases where limited data are currently available, reaching a threshold could result in further investigation, monitoring, and evaluation. Additional monitoring strategies may be codesigned and implemented as new needs arise or more resources become available.

Table 8. Nowitna WSR Monitoring

River Value	Monitoring Focus	Threshold	Action
Free-flowing condition	Natural flow, seasonal flow patterns, and natural flood regime	Deviation from documented flow, seasonal flow patterns, and/or natural flood regime	Work with partners to initiate studies to understand the mechanism of flow change and potential impacts and develop management actions to mitigate impacts.
Water quality	Basic water chemistry and physical characteristics or toxic and other deleterious organic and inorganic substances	Water quality exceeds State of Alaska freshwater water quality criteria for pH, dissolved oxygen, temperature, total dissolved solids, and turbidity	Work with partners, including ADEC, to identify the cause of conditions and take management actions to restore water quality.
Ecology ORV	Healthy condition of priority wildlife, fish, and plant species	Observed population decline that exceeds normal variation	Work with partners to identify the cause of decline and take appropriate management actions to restore the natural abundance.
Ecology ORV	Habitat diversity and spatial distribution of plant communities	Change from existing conditions that has a potential negative impact on rare or sensitive plant communities or other ecosystem components	Identify causes of the change and determine appropriate management actions to mitigate effects, if possible.
Fish ORV	Natural diversity and abundance of fish species	Observed population decline that exceeds normal variation	Work with partners to identify the cause of decline and take appropriate management actions to restore the natural population levels.
Fish ORV	Suitability of important fish habitat	Observed degradation of fish habitat that has potential to negatively impact populations	Identify causes of degradation and determine appropriate management actions to restore conditions or mitigate effects.
Fish and cultural ORVs	Contaminant levels in fish, especially top predators and those important to subsistence users	Observed contaminants in fish at levels that are unsafe for humans or that pose a threat to ecosystems	Work with the Service's Fisheries and Ecological Services and the State of Alaska to identify sources of contamination and conduct appropriate mitigation efforts.

River Value	Monitoring Focus	Threshold	Action
Ecology, fish, and scenery ORVs and water quality	Presence of riparian, terrestrial, and aquatic invasive species	Detection of highly invasive riparian, terrestrial, or aquatic species	Follow appropriate Service rapid response plans to control or eliminate invasive species or mitigate effects.
Ecology, fish, and scenery ORVs	Presence of wildlife and plant disease, pathogens, and pests	Detection of disease, pathogens, or pests that have the potential to substantially affect fish, wildlife, or plant species	Work with partners to initiate necessary studies and/or take appropriate management action.
Cultural ORV	Documentation of cultural sites	Discovery of archaeological or historic sites, particularly those at risk of erosion by river action	Work with the Service's regional archaeologist, the State Historic Preservation Office, and/or other partners to document the site and evaluate it for inclusion on the NRHP.
Cultural and scenery ORVs	Natural condition of river corridor and impacts of visitor use	Presence of trash, trampling, erosion, or other impacts of visitor use	Clean and rehabilitate disturbed sites. Increase messaging to the public about appropriate camp etiquette, including Leave No Trace practices.
All	Natural condition of soils at dispersed campsites	New trampling of vegetation beyond the existing footprint; new, fully bare soil areas beyond existing footprint	Use area measurements and photographs to track changes. Increase Leave No Trace outreach. Close and rehabilitate newly disturbed sites beyond the original footprint.

5.4 Future Monitoring Strategy Modification

Some components of the monitoring strategy may need to be adjusted in the future as better data are collected. The monitoring plan may be modified if more effective or efficient monitoring methodologies become available; if changes to objectives, indicators, metrics, measurement, and assessment frequencies or thresholds are needed as understanding of the river values improves; to more effectively answer monitoring questions; or to better ensure protection of river values. Assessing the need for modifying the monitoring plan should occur at established intervals and be completed in collaboration with appropriate partners, community members, and subject matter experts. Any modifications will be documented in the project file, and the CRMP will be updated administratively.

CHAPTER 6. REFERENCES

ADEC Division of Water (Alaska Department of Environmental Conservation, Division of Water). 2024. Integrated Water Quality Monitoring and Assessment Report. Internet website: https://dec.alaska.gov/water/water-quality/integrated-report/.

ADEC and EPA (Alaska Department of Environmental Conservation and the U.S. Environmental Protection Agency). 2018. Rural Alaska Dust Toolkit. Anchorage, Alaska.

ADFG (Alaska Department of Fish and Game). 2021. Technical Paper No. 476. Regional Spatial Analysis of Subsistence Activity in Interior Alaska. Anchorage, Alaska.

_____. 2024a. Nowitna River Pike. Yukon Drainage Management Area. Internet website: https://www.adfg.alaska.gov/index.cfm?adfg=ByAreaInteriorYukonDrainage.fishingOpps&fishery=Nowitna+River+Pike.

_____. 2024b. DM802 Permit Hunt Information. ADFG. Juneau, Alaska. Internet website: https://www.adfg.alaska.gov/index.cfm?adfg=huntingmaps.hunt_details&huntfile_id=25683.

_____. 2024c. Anadromous Waters Catalog. Anchorage, Alaska.

_____. 2024d. Game Management Unit (GMU) Information, Unit 21. Internet website: https://www.adfg.alaska.gov/index.cfm?adfg=huntingmaps.gmuinfo&gmu=21.

_____. 2024e. Wildlife Information Network, Anchorage, Alaska.

AHRS (Alaska Heritage Resource Survey). 2023. RUB-000006. Alaska Office of History and Archaeology. Internet website: https://dnr.alaska.gov/parks/oha/ahrs/ahrs.htm.

Alaska DCCED (Alaska Department of Commerce, Community, and Economic Development). 2024a. Galena Community Story Map. Internet website: https://dcra-cdo-dcced.opendata.arcgis.com/search?q=galena.

_____. 2024b. Ruby Community Story Map. Internet website: https://dcced.maps.arcgis.com/apps/MapJournal/index.html?appid=f0a9a0b5e6aa44a18d9dec735de4626a.

_____. 2024c. Tanana Community Story Map. Internet website: https://dcced.maps.arcgis.com/apps/MapJournal/index.html?appid=70f74d3f3d5a417992597f9867eb1a1d.

Barber, V., G. Juday, and B. Finney. 2000. Reduced growth of Alaskan white spruce in the twentieth century from temperature-induced drought stress. *Nature* 405:668–673. Internet website: https://doi.org/10.1038/35015049.

Boggs, K., L. Flagstad, T. Boucher, M. Carlson, A. Steer, B. Bernard, M. Aisu, P. Lema, B. Heitz, and T. Kuo. 2019. Alaska Ecosystems of Conservation Concern: Biophysical Settings and Plant Associations. Report prepared by the Alaska Center for Conservation Science, University of Alaska, Anchorage for the Alaska Department of Fish and Game. 300 pp.

Brown, C. L., N. M. Braem, M. L. Kostick, A. Trainor, L. J. Slayton, D. M. Runfola, E. H. Mikow, et al. 2016. Harvests and Uses of Wild Resources in Four Interior Alaska Communities and Three Arctic Alaska Communities, 2014. ADFG Division of Subsistence, Technical Paper No. 426, Fairbanks.

Brown, C. L., A. R. Brenner, H. Ikuta, E. H. Mikow, B. Retherford, L. J. Slayton, A. Trainor, et al. 2015. The Harvest and Uses of Wild Resources in Mountain Village, Marshall, Nulato, Galena, and Ruby, Alaska, 2010. ADFG Division of Subsistence, Technical Paper No. 410, Fairbanks.

Brown, C. L., D. Koster, and P. Koontz. 2010. Traditional Ecological Knowledge and Harvest Survey of Nonsalmon Fish in the Middle Yukon Region, Alaska, 2005–2008. Final report to the U.S. Fish and Wildlife Service Office of Subsistence Management to fulfill obligations for Study No. FIS 06-253. Alaska Department of Fish and Game Division of Subsistence Technical Paper No. 358, Fairbanks.

Bryant, J., and B. Scotton. 2021. Moose Trend Survey Summary 2021. Koyukuk/Nowitna/Innoko NWR Complex (Game Management Units 21A, 21B, 21D, and 24D). Galena, Alaska.

Bureau of Land Management, U.S. Fish and Wildlife Service, and Ducks Unlimited, Inc. 2002. Galena Military Operations Area/Nowitna National Wildlife Refuge Earth Cover Classification. Alaska Bureau of Land Management Technical Report 23. September 2002.

Burkart, G. A., C. Flanagan, and M. A. Geist. 2023. Water Resources Inventory and Assessment: Koyukuk, Nowitna, and Innoko National Wildlife Refuges. U.S. Fish and Wildlife Service. Anchorage, Alaska.

Burn, C.R. 2023. Permafrost and periglacial features, permafrost. Pages 464–474 in S.A. Elias and C.J. Mock, editors. *Encyclopedia of Quaternary Science*. 2nd edition. Reference Module in Earth Systems and Environmental Sciences. Elsevier, Amsterdam, The Netherlands.

de Laguna, F. 2000. Travels among the Dena: Exploring Alaska's Yukon Valley. The University of Washington Press, Seattle.

Carlson, M. L., I. V. Lapina, M. Shephard, J. S. Conn, R. Densmore, P. Spencer, J. Heys, et al. 2008. Invasiveness Ranking System for Non-native Plants of Alaska. USDA Forest Service, R10-TP-143. Anchorage, Alaska.

Case, M., and L. Halpin. 1990. Contemporary Wild Resource Use Patterns in Tanana, Alaska, 1987. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 178.

DOI (U.S. Department of the Interior). 2023. Decision to close winter moose hunt on federal public lands in GMU 21b. Koyukuk/Nowitna/Innoko National Wildlife Refuge. Galena Alaska. Internet website: https://www.doi.gov/subsistence/news/hunting/decision-close-winter-moose-hunt-federal-public-lands-gmu-21b.

Dokuchaev, N. E. 1997. A new species of shrew (Soricidae, Insectivora) from Alaska. *Journal of Mammalogy* 78:811–817.

EPA (Environmental Protection Agency). 2023a. Green Book. Alaska Nonattainment/Maintenance Status for Each County by Year for All Criterial Pollutants. Internet website: https://www3.epa.gov/airquality/greenbook/anayo_ak.html.

_____. 2023b. 2020 National Emissions Inventory. Online Data Retrieval Tool. Internet website: https://awsedap.epa.gov/public/single/?appid=20230c40-026d-494e-903f-3f112761a208&sheet=5d3fdda7-14bc-4284-a9bb-cfd856b9348d&opt=ctxmenu,currsel.

FANWR (Friends of Alaska National Wildlife Refuges). 2010. Nowitna Moose Hunt Check Station. Internet website: https://alaskarefugefriends.org/projects-list/past_projects.php?opp_id=199.

_____. 2012. Nowitna Moose Hunt Check Station. Internet website: https://alaskarefugefriends.org/projects-list/past_projects.php?opp_id=252.

Gotthardt, T. A., K. M. Walton, and T. L. Fields. 2012. Setting Priorities for Alaska's Wildlife Action Plan. Alaska Natural Heritage Program, University of Alaska, Anchorage.

Glesne, R. S., W. K. Carter III, and D. W. Daum. 2011. Lake Habitat and Fish Surveys on Interior Alaska National Wildlife Refuges, 1984–1986. Alaska Fisheries Data Series Number 2011-12. U.S. Fish and Wildlife Service, Fairbanks Fish and Wildlife Field Office, Fairbanks, Alaska.

Grabinski, Z. & H. R. McFarland. 2025. Alaska's Changing Wildfire Environment 2.0. Alaska Fire Science Consortium, International Arctic Research Center, University of Alaska Fairbanks. Internet website: www.frames.gov/afsc/acwe.

Hart, B. 1981. The History of Ruby, Alaska "The Gem of the Yukon." National Bilingual Materials Development Center, Rural Education, University of Alaska.

Hinzman, L. D., N. D. Bettez, W. R. Bolton, F. S. Chapin, M. B. Dyurgerov, C. L. Fastie, B. Griffith, et al. 2005. Evidence and implications of recent climate change in northern Alaska and other Arctic regions. *Climatic Change* 72:251–298.

Hinzman, L.D., W.R. Bolton, K.C. Petrone, J.J. Jones, and P.C. Adams. 2006. Watershed hydrology and chemistry in the Alaskan boreal forest: the central role of permafrost. Pages 269–284 in F.S. Chapin, M.W. Oswood, K. Van Cleve, L.A. Viereck, and D.L. Verbyla, editors. *Alaska's Changing Boreal Forest*. Oxford University Press, New York, New York, USA

Holsten, E. H., P. Hennon, L. Trummer, J. Kruse, M. Schultz, and J. Lundquist. 2008. Insects and Diseases of Alaskan Forests. USDA Forest Service, Alaska Region, State and Private Forestry, Forest Health Protection. Publication R10-TP-140.

Huntington, H.P., C. Strawhacker, J. Falke, E.M. Ward, L. Behnken, T.N. Curry, A.C. Herrmann, et al. 2023. Chapter 29. Alaska. *In* A.R. Crimmins, C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, editors. *Fifth National Climate Assessment*. U.S. Global Change Research Program, Washington, D.C., USA. Internet website: https://doi.org/10.7930/NCA5.2023.

IVUMC (Interagency Visitor Use Management Council). 2019. Visitor Capacity Guidebook: Managing the Amounts and Types of Visitor Use to Achieve Desired Conditions. Lakewood, Colorado. Internet website: https://visitorusemanagement.nps.gov/VUM/Framework.

IWSRCC (Interagency Wild and Scenic Rivers Coordinating Council). 1999. The Wild & Scenic River Study Process. Internet website: https://www.rivers.gov/sites/rivers/files/2023-07/study-process.pdf.

_____. 2017. Establishment of Wild and Scenic River Boundaries. A Technical Report of the Interagency Wild and Scenic River Coordinating Council. Washington, DC. Internet website: https://www.rivers.gov/sites/rivers/files/2023-07/boundaries.pdf.

_____. 2018. Steps to Address User Capacities for Wild and Scenic Rivers. Internet website: https://www.rivers.gov/rivers/sites/rivers/files/2023-02/user-capacities.pdf.

_____. 2022. Instream Flow Protection Strategies for Wild and Scenic Rivers. Internet website: https://www.rivers.gov/apps/sites/rivers/files/2023-07/instream-flow-protection-strategies.pdf.

Jetté, J. 1910. On the Geographical Names of the Ten'a. Microfilm AL 17:132-353. JOPA, Gonzaga University.

Johnson, W. N. 1998. Analysis of the 1996–97 Marten Harvest on the Nowitna National Wildlife Refuge, Alaska. Progress Report FY 98-06. Koyukuk/Nowitna National Wildlife Refuge Complex, Galena, Alaska.

Jones, E., and J. Jetté. 2000. Koyukon Athabaskan Dictionary. University of Alaska Fairbanks, Alaska Native Language Center.

Jorgenson, M. T., J. Harden, M. Kanevskiy, J. O'Donnell, K. Wickland, S. Ewing, K. Manies, et al. 2013. Reorganization of vegetation, hydrology, and soil carbon after permafrost degradation across heterogeneous boreal landscapes. *Environmental Research Letters* 8(035017):13.

Marcotte, J. R. 1990. Subsistence Harvest of Fish and Wildlife by Residents of Galena, Alaska, 1985–86. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 155.

NOAA (National Oceanic and Atmospheric Administration). 2023. Climate at a Glance: County Time Series. National Centers for Environmental Information. May 2023. Internet website: https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/county/time-series.

_____. 2024. U.S. Climate Normals Data. Internet website: https://www.ncei.noaa.gov/maps/normals/.

NRCS (National Resources Conservation Service). 2025. Soils Survey Geographic Database (SSURGO). Internet website: https://www.nrcs.usda.gov/resources/data-and-reports/soil-survey-geographic-database-ssurgo.

O'Donnell, J.A., M.P. Carey, J.C. Koch, J.C., C. Baughman, K. Hill, C.E. Zimmerman, P.F. Sullivan, R. Dial, T. Lyons, D.J. Cooper, B.A. Poulin. 2024. Metal mobilization from thawing permafrost to aquatic ecosystems is driving rusting of Arctic streams. *Communicatons Earth & Environment* 5, 268. https://doi.org/10.1038/s43247-024-01446-z

O'Neill, H. B., S. L. Smith, C. R. Burn, C. Duchesne, and Y. Zhang. 2023. Widespread permafrost degradation and thaw subsidence in northwest Canada. *Journal of Geophysical Research: Earth Surface*. 128 (8): 815-820.

Paragi, Thomas. 1991. Summary of Data on Martens and Marten Trapping from the Nowitna National Wildlife Refuge, Alaska, 1984–91. Koyukuk/Nowitna National Wildlife Refuge Complex, Galena, Alaska.

Poff, N. L., J. D. Allan, M. B. Bain, J. R. Karr, K. L. Prestegaard, B. D. Richter, R. E. Sparks, and J. C. Stromberg. 1997. The natural flow regime - A paradigm for river conservation and restoration. *Bioscience* 47(11):769–84.

Reidmiller, D. R., C. W. Avery, D. R. Easterling, K. E. Kunkel, K. L. M. Lewis, T. K. Maycock, and B. C. Stewart. 2018. Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II. United States Global Change Research Program, Washington, DC. Internet website: https://nca2018.globalchange.gov/downloads/.

Rozell, N. 2007. Alaska tamaracks still hanging on after attack. Alaska Science Forum no. 1851, Geophysical Institute, University of Alaska Fairbanks.

Rozell, N. 2024. The Recent History of a Black Rock. Alaska Science Forum, Geophysical Institute, University of Alaska Fairbanks.

Rupp, T. S., and A. Springsteen. 2009. Projected Climate Change Scenarios for the Bureau of Land Management Eastern Interior Management Area, Alaska, 2001–2099. University of Alaska Fairbanks Scenarios Network for Alaska Planning. Prepared for U.S. Department of the Interior, Bureau of Land Management, Fairbanks, Alaska.

Sassen, K., Z. Jiang, P. Webley, K. Dean, and P. Cobb. 2007. Volcanic ash plume identification using polarization lidar: Augustine eruption, Alaska. *Geophysical Research Letters* 34(8). Internet website: https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2006GL027237.

Schaefer, J., and C. Nye. 2008. The Alaska Volcano Observatory – 20 Years of Volcano Research, Monitoring, and Eruption Response. *Alaska GeoSurvey News* 11(1). State of Alaska Division of Geological and Geophysical Surveys. March 2008. Internet website: https://avo.alaska.edu/pdfs/cit4443.pdf.

Schuur, E. A. G., B. W. Abbot, R. Commane, J. Ernakovich, E. Euskirchen, G. Hugelius, and G. Grosse. 2022. Permafrost and climate change: Carbon cycle feedbacks from the warming arctic. *Annual Review of Environment and Resources* 47: 343–71. Internet website: https://www.annualreviews.org/content/journals/10.1146/annurev-environ-012220-011847.

Shaw, G. E. 1995. The Arctic haze phenomenon. *Geophysical Institute* 76(12):2403–414.

Snyder-Conn, E., T. Patton, M. Bertram, P. Scannell, and C. Anthony. 1992. Contaminant baseline data for water, sediments, and fish of the Nowitna NWR, 1985–1988. Ecological Services Technical Report NAES-TR-92-02. Ecological Services, U.S. Fish and Wildlife Service, Fairbanks, Alaska.

Trainor, F. S., M. Calef, D. Natcher, F. S. Chapin III, A. D. McGuire, O. Huntington, P. Duffy, T.S. Rupp, L. DeWilde, M. Kwart, N. Fresco, and A.L. Lovecraft. 2009. Vulnerability and adaptation to climate-related fire impacts in rural and urban interior Alaska. *Polar Research* 28(1):100–118. Internet website: https://doi.org/10.3402/polar.v28i1.6105.

USBOR (U.S. Bureau of Outdoor Recreation). 1973. Nowitna Wild and Scenic River Report. Anchorage, Alaska.

USFWS (U.S. Fish and Wildlife Service). 1982. Nowitna National Wildlife Refuge Annual Narrative Report. National Wildlife Refuge System. Galena, Alaska.

_____. 1983. Nowitna National Wildlife Refuge Annual Narrative Report. National Wildlife Refuge System, Galena, Alaska.

_____. 1984. Nowitna National Wildlife Refuge Annual Narrative Report. National Wildlife Refuge System, Galena, Alaska.

_____. 1985. Nowitna National Wildlife Refuge Annual Narrative Report. National Wildlife Refuge System, Galena, Alaska.

_____. 1986. Nowitna National Wildlife Refuge Annual Narrative Report. National Wildlife Refuge System, Galena, Alaska.

_____. 1987a. Nowitna National Wildlife Refuge Final Comprehensive Conservation Plan, Wild River Plan, Wilderness Review and Environmental Impact Statement. Anchorage, Alaska.

_____. 1987b. Nowitna National Wildlife Refuge Annual Narrative Report. National Wildlife Refuge System, Galena, Alaska.

_____. 1988. Nowitna National Wildlife Refuge Annual Narrative Report. National Wildlife Refuge System, Galena, Alaska.

_____. 1989. Nowitna National Wildlife Refuge Annual Narrative Report. National Wildlife Refuge System. Galena, Alaska.

_____. 1990. U.S. Fish and Wildlife Service Nowitna National Wildlife Refuge Fishery Management Plan. Fish and Wildlife Enhancement Fishery Assistance Office, Fairbanks, Alaska.

_____. 1995. Koyukuk/Nowitna National Wildlife Refuge Complex Cultural Resource Guide. Galena, Alaska.

_____. 1998. Plan of Study: Hydrologic Resources Investigation Nowitna National Wildlife Refuge. Galena, Alaska.

_____. 2009. Revised Comprehensive Conservation Plan for the Koyukuk/Northern Unit Innoko/Nowitna National Wildlife Refuges. Anchorage, Alaska.

_____. 2010. Koyukuk, Northern Unit Innoko and Nowitna National Wildlife Refuge Wildland Fire Management Plan. Galena, Alaska.

_____. 2012. Whitefish Biology, Distribution, and Fisheries in the Yukon and Kuskokwim River Drainages in Alaska: A Synthesis of Available Information. Internet website: https://www.fws.gov/sites/default/files/documents/d_2012_04_revised.pdf.

_____. 2014. Executive Summary: Wildlife Inventory Plan Koyukuk/Nowitna/Innoko National Wildlife Refuge Complex 2014. Galena, Alaska.

_____. 2021. Birds of Conservation Concern 2021. United States Department of the Interior, U.S. Fish and Wildlife Service, Falls Church, Virginia. Internet website: https://www.fws.gov/media/birds-conservation-concern-2021.

_____. 2022. Identification of Priority Resources of Concern: Methods and Results, Koyukuk, Nowitna, and Innoko National Wildlife Refuges. Anchorage, Alaska.

_____. 2023. Nowitna Moose Hunter Check Station Summary. Galena, Alaska.

_____. 2024a. Nowitna Wild and Scenic River Values. Anchorage, Alaska. Internet website: https://ecos.fws.gov/ServCat/Reference/Profile/168028.

_____. 2024b. Nowitna National Wildlife Refuge. Internet website: https://www.fws.gov/refuge/nowitna/visit-us/activities/hunting.

_____. 2024c. Alaska Permafrost Zones. Internet website: https://services.arcgis.com/8df8p0NlLFEShl0r/arcgis/rest/services/Alaska_Permafrost_Zones/FeatureServer.

_____. 2024d. Nowitna Moose Hunter Check Station Summary. Galena, Alaska.

_____. 2025. Service Manual Part 510 FW 2. The Service's Alaska Native Relations policy. Internet website: https://www.fws.gov/policy-library/510fw2.

U.S. Geological Survey. 2024. Nowitna R 2.3 MI AB Mouth NR Ruby Alaska – 645408154143400. Internet website: https://waterdata.usgs.gov/monitoring-location/645408154143400/#period=P1Y&showMedian=true.

Viereck, L. A., C. T. Dyrness, A. R. Batten, and K. J. Wenzlick. 1992. The Alaska Vegetation Classification. General Technical Report PNW-GTR-286. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, Oregon.

Wendler, G., and P. Nicpon. 1975. Low-level temperature inversions in Fairbanks, central Alaska. *Monthly Weather Review* 103(1):34–44.

Williams, J. R. 1970. Ground Water in the Permafrost Regions of Alaska. Geological Survey Professional Paper 696. U.S. Department of the Interior, Washington, DC.

Image 46. A tundra-capped mountain towers over black spruce forest along the upper Nowitna WSR. River beauty (*Chamaenerion latifolium*) blooms in the foreground. Photo credit: Karin Bodony, USFWS

Appendix A

Nowitna Wild and Scenic River Corridor Legal Description

Appendix A
Nowitna Wild and Scenic River Corridor
Legal Description
September 18, 2025

The Nowitna Wild and Scenic River corridor consists of lands and those waters disconnected from the continuous flow of the Nowitna River between 0.5 mile upland of the ordinary high water mark of the extreme left bank and 0.5 mile upland of the ordinary high water mark of the extreme right bank of the waters comprising the continuous flow of the Nowitna River within the state of Alaska, extending approximately 220 river miles from the boundary of Nowitna National Wildlife Refuge at the west boundary of section 6, T. 18 S., R. 22 E., northerly to the confluence of the Nowitna River with the Yukon River in section 31, T. 6 S., R. 23 E., and section 6, T. 7 S., R. 23 E., Kateel River Meridian, as depicted on the attached maps.

The Nowitna Wild and Scenic River corridor described above is located within the following townships and sections:

Kateel River Meridian, Alaska

T. 9 S., R. 21 E., unsurveyed,
secs. 25, 35, and 36.

T. 10 S., R. 21 E., unsurveyed,
sec. 1.

T. 8 S., R. 22 E., unsurveyed,
secs. 13 and 14, secs. 23 thru 28, and secs. 33 thru 36.

T. 9 S., R. 22 E., unsurveyed,
secs. 1 thru 4, secs. 8 thru 17, and secs. 20 thru 33.

T. 10 S., R. 22 E., unsurveyed,
secs. 2 thru 11, secs. 14 thru 17, secs. 21 thru 28, and secs. 33 thru 36.

T. 11 S., R. 22 E., unsurveyed,
secs. 1 thru 4 and sec. 12.

T. 17 S., R. 22 E., unsurveyed,
sec. 1, secs. 9 thru 17, secs. 20 thru 24, and secs. 27 thru 33.

T. 18 S., R. 22 E., unsurveyed,
secs. 5 thru 8 and sec. 18.

T. 6 S., R. 23 E., unsurveyed,
secs. 31 and 32.

T. 7 S., R. 23 E., unsurveyed,
secs. 4 thru 11, secs. 14 thru 28, and secs. 32 thru 36.

T. 8 S., R. 23 E., unsurveyed,
secs. 2 thru 5, secs. 7 thru 11, secs. 16 thru 21, and secs. 28 thru 32.

T. 9 S., R. 23 E., unsurveyed,
secs. 4 thru 9 and secs. 17 and 18.

T. 10 S., R. 23 E., unsurveyed,
secs. 30 and 31.

T. 11 S., R. 23 E., unsurveyed,
secs. 5 thru 10, secs. 14 thru 18, secs. 20 thru 23, secs. 25 thru 28, and secs. 33 thru 36.

T. 12 S., R. 23 E., unsurveyed,
secs. 1 thru 3 and secs. 11, 12, and 13.

T. 16 S., R. 23 E., unsurveyed,
sec. 13 and secs. 22 thru 36.

T. 17 S., R. 23 E., unsurveyed,
secs. 1 thru 10 and secs. 15 thru 18.

T. 11 S., R. 24 E., unsurveyed,
sec. 31.

T. 12 S., R. 24 E., unsurveyed,
secs. 5 thru 9, secs. 15 thru 23, secs. 25 thru 29, and secs. 33 thru 36.

T. 15 S., R. 24 E., unsurveyed,
secs. 25, 35, and 36.

T. 16 S., R. 24 E., unsurveyed,
secs. 1 thru 4, secs. 7 thru 22, and secs. 30 and 31.

T. 12 S., R. 25 E., unsurveyed,
secs. 12 thru 16, secs. 19 thru 25, and secs. 27 thru 33.

T. 13 S., R. 25 E., unsurveyed,
sec. 36.

T. 14 S., R. 25 E., unsurveyed,
secs. 1 and 2, secs. 10 thru 15, and secs. 21, 22, 23, 26, 27, 28, 32, 33, and 34.

T. 15 S., R. 25 E., unsurveyed,
secs. 3, 4, and 5, secs. 7, 8, and 9, secs. 16 thru 22, and secs. 28 thru 33.

T. 16 S., R. 25 E., unsurveyed,
sec. 6.

T. 12 S., R. 26 E., unsurveyed,
secs. 2, 3, and 4, secs. 7 thru 11, secs. 13 thru 19, secs. 22 thru 27, and secs. 30, 34, and 35

T. 13 S., R. 26 E., unsurveyed,
sec. 1, secs. 11 thru 15, secs. 22, 23, and 24, secs. 26 thru 29, and secs. 31 thru 34.

T. 14 S., R. 26 E., unsurveyed,
secs. 5, 6, and 7.

T. 13 S., R. 27 E., unsurveyed,
secs. 6, 7, and 18.

Excepting therefrom the following patented lands:
U.S. Survey Nos. 7426 Lot 1, 7426 Lot 2, 7427, 7428, 7449, 7773, 12654, 13770, 13987, and 13988.

The following are also excluded from the Nowitna Wild and Scenic River corridor:
All waters of the ambulatory main channel of the Nowitna River and all ambulatory through-connected side channels and sloughs which comprise the continuous flow of waters of the Nowitna River, extending from the boundary of Nowitna National Wildlife Refuge along the west boundary of T. 18 S., R. 22 E. to the confluence of the Nowitna River with the Yukon River in Tps. 6 and 7 S., R. 23 E., Kateel River Meridian.

The areas described aggregate approximately 122,330 acres.

The upland boundary of the 0.5 mile-wide buffer on the extreme left and right banks of the Nowitna River shall remain static, as developed in the Nowitna Wild and Scenic River Comprehensive River Management Plan, until a subsequent boundary amendment is initiated in accordance with the Alaska National Interest Lands Conservation Act and the Wild and Scenic Rivers Act. The ordinary high water mark of the Nowitna River is ambulatory and may change

over time. Such lateral shifts of the ambulatory ordinary high water mark of the Nowitna River will result in corresponding changes in the width of the 0.5 mile-wide corridor on the extreme left and right banks of the Nowitna River.

The boundaries shown upon Exhibit “A” are attached hereto and made a part hereof. Official boundary maps and boundary data dated September 18, 2025, are filed in the U.S. Fish & Wildlife Service, Alaska Region Division of Realty, Anchorage, Alaska. Such official maps and boundary data supplement this legal description and are made a part hereof.

This river corridor boundary description was created using GIS technology and was derived from submeter-resolution (0.31 – 0.60 meter) satellite imagery acquired by the WorldView-2 satellite operated by Digital Globe (Maxar), Inc., and distributed by Environmental Systems Research Institute (ESRI, Inc.). Imagery was acquired between May 17, 2012 and May 18, 2020.

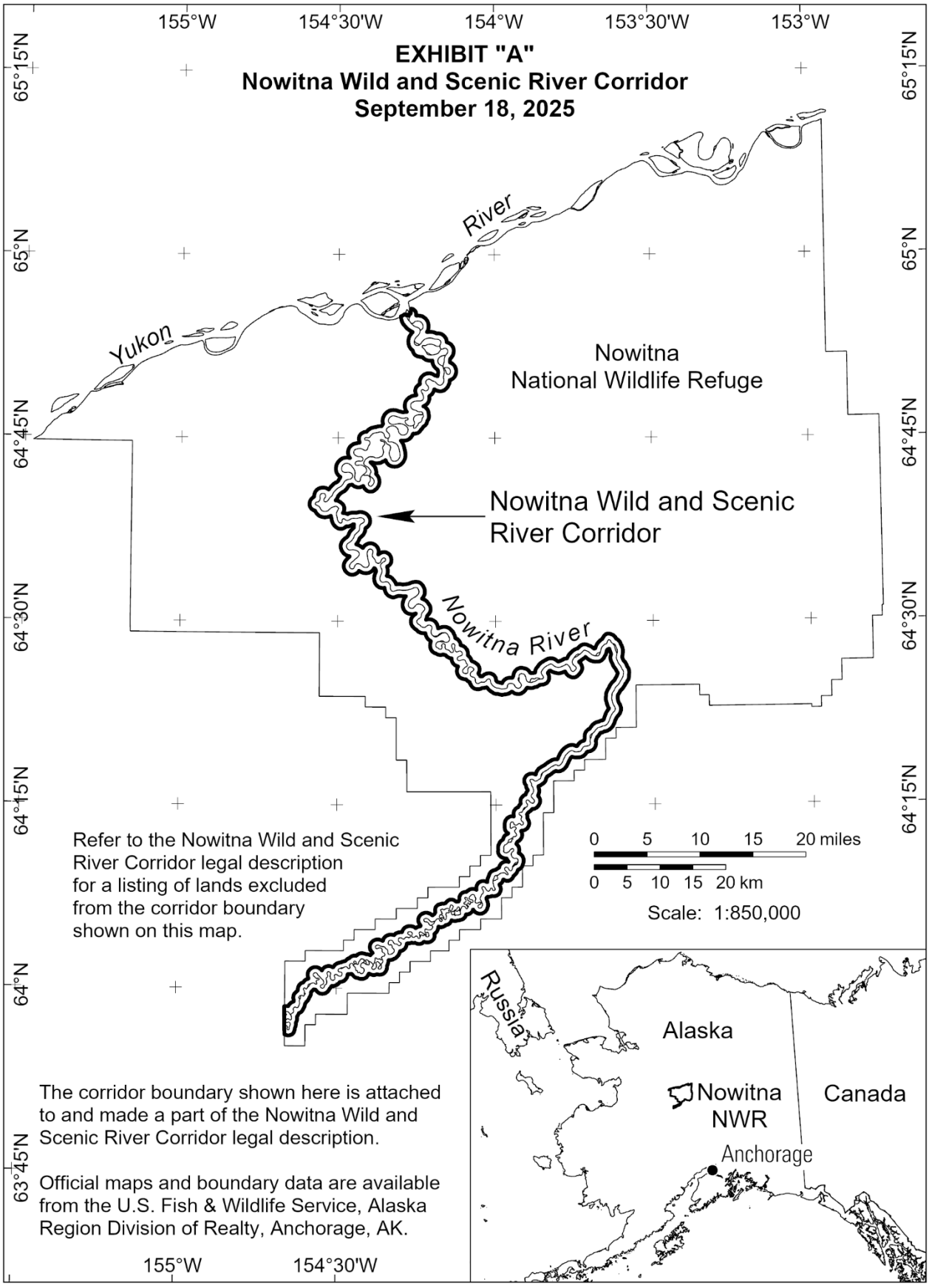


EXHIBIT "A"
Nowitna Wild and Scenic River Corridor
September 18, 2025
155°W
154°30'W
154°W
153°30'W
153°W
65°15'N
65°N
64°45'N
64°30'N
64°15'N
64°N
63°45'N
Yukon River
Nowitna
National Wildlife Refuge
Nowitna Wild and Scenic
River Corridor
Nowitna River
Refer to the Nowitna Wild and Scenic River Corridor legal description for a listing of lands excluded from the corridor boundary shown on this map.
0 5 10 15 20 miles
0 5 10 15 20 km
Scale: 1:850,000
Russia
Alaska
Nowitna
NWR
Canada
Anchorage
The corridor boundary shown here is attached to and made a part of the Nowitna Wild and Scenic River Corridor legal description.
Official maps and boundary data are available from the U.S. Fish & Wildlife Service, Alaska Region Division of Realty, Anchorage, AK.

Appendix B

Digitizing standards for wild and scenic river corridors

Digitizing Standards for Wild & Scenic River Corridors

In most cases, the boundaries of Wild & Scenic River corridors are derived from the ordinary high-water line of the left and right banks of the designated rivers. This requires that the riverbanks be digitized before any other products can be produced.

Because there may be more than one person digitizing the riverbanks, it is essential that everyone follow standard digitizing procedures for this project. This document describes the process for digitizing only the **ordinary high-water line of the extreme left and right banks** of the rivers, and any islands between the left and right banks. *It does not address any other products derived from the riverbanks; those products will be created by the cartographers in the Region 7 Division of Realty.*

General Procedure

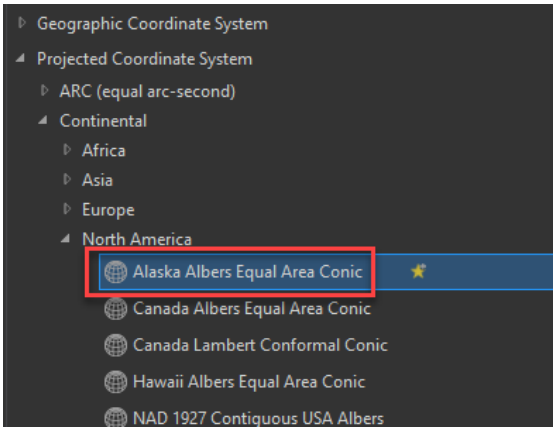
1) Use the ESRI World Imagery layer as the reference for the riverbanks.
2) DO NOT USE STREAM MODE DIGITIZING.
3) Digitize at a map scale of 1:3,000.
4) Manually place vertices to achieve an accurate representation of the riverbanks.
5) Send completed data to Scott McGee, R7 Division of Realty (scott_mcgee@fws.gov)

Detailed Procedure

1) You must use the **ESRI World Imagery** satellite image layer as the reference from which to identify and digitize the riverbanks. This imagery is the best, most current, most consistent satellite imagery that is available across the entire state of Alaska. Using this imagery will ensure that all rivers digitized are consistent with each other.

2) **DO NOT USE STREAM MODE DIGITIZING**. Stream mode digitizing is faster than manually placing each vertex, but you have less control of the placement and density of vertices that are automatically placed. This results in significantly more vertices than are needed and it creates lines that can be jagged in nature when you zoom in. Manually placing vertices takes more time than stream mode digitizing, but it results in a better, more accurate representation of the riverbanks. This is important because other products (river centerline, river corridors) will be derived from the digitized riverbanks, so the digitized riverbanks must be of the highest quality. Additionally, the products produced for this project will be used for many years, for many purposes, and by many people and agencies. It is therefore essential that the digitized riverbanks be of the highest quality possible, even if it takes more time and effort to digitize them. In this project, quality is more important than the time it takes to produce a product.

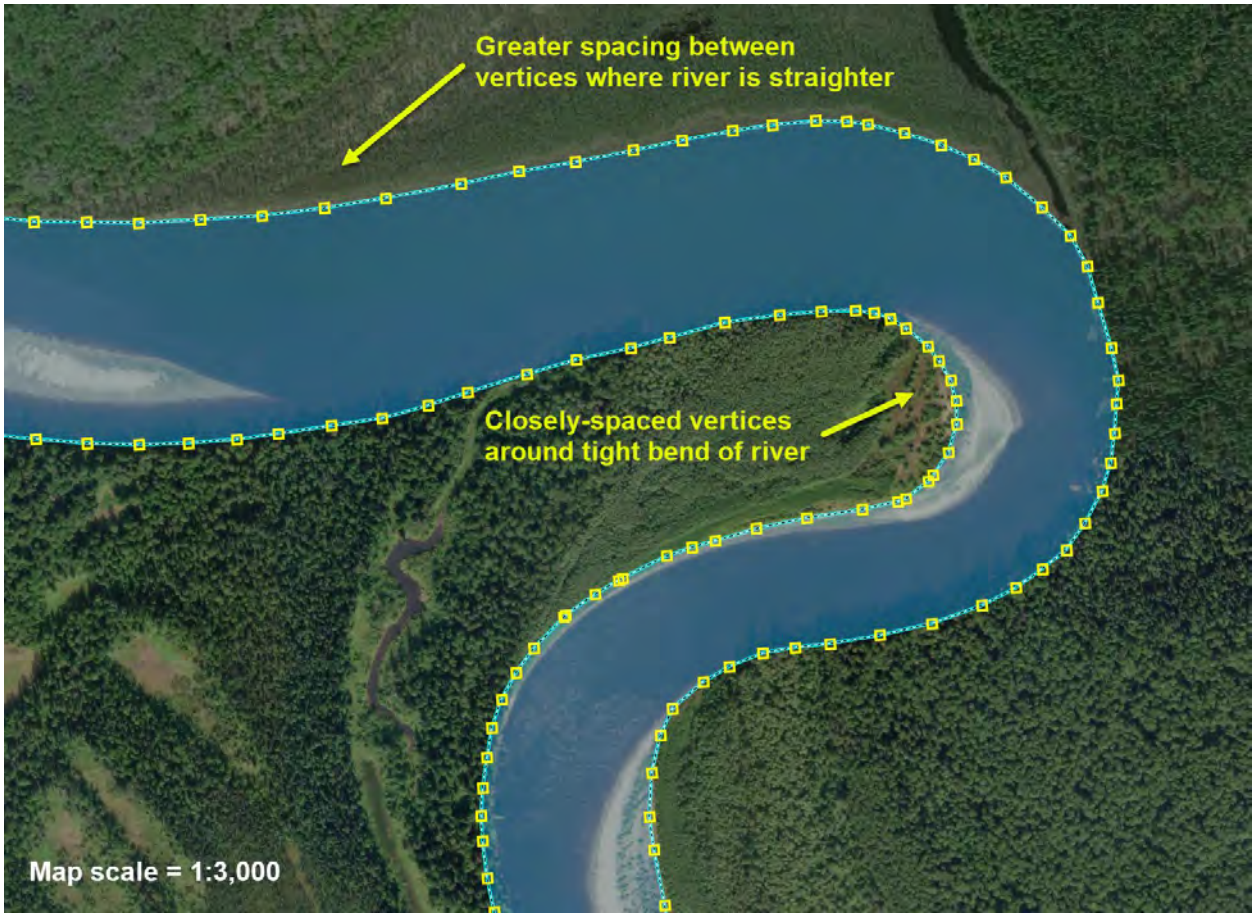
3) Create a new, empty feature class to contain the digitized riverbanks. For this project, don't be concerned with adding specific attribute fields; just accept the default fields that are created. For the coordinate system, specify the following **projected coordinate system**:



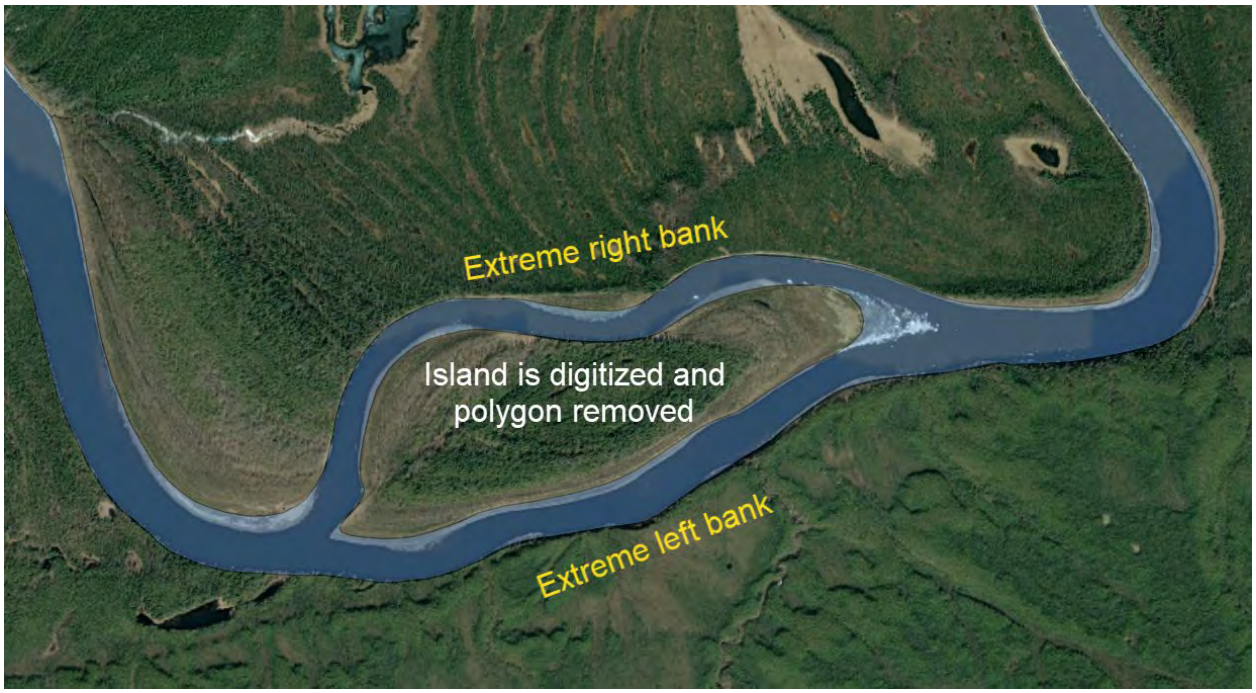
4) The nominal **map scale** for digitizing the riverbanks is **1:3,000**. This is the scale at which you must perform the digitizing. In cases where there is much river detail or where there are tight bends in the river that are difficult to digitize at 1:3,000, it is acceptable to zoom in to a larger scale, although the maximum map scale available for the ESRI World Imagery is 1:1,100.

5) Digitize a polygon that represents the ordinary high-water line of the extreme left and right banks of the river. Designation of the left and right banks is determined by the viewer's position. When the viewer is looking downstream (in the direction of the river's flow), the left bank is on the viewer's left and the right bank is on the viewer's right.

   The goal of this project is to digitize a polygon that faithfully represents the riverbanks without being too jagged or having an excessive number of vertices. Aim for a visually smooth-looking line at the nominal map scale of 1:3,000. In areas where the river is relatively straight, fewer vertices are needed, while more vertices will be needed along tight bends in order to produce a smooth line. See the following example.



6) In many cases, the extreme left and right banks of the river will surround islands. In these cases, after you have digitized the river polygon, you will need to split the river polygon at the ordinary high-water line of the island(s), and then delete the polygon(s) that represents the island(s). The result will be a polygon that represents only the water of the river. See the following example.

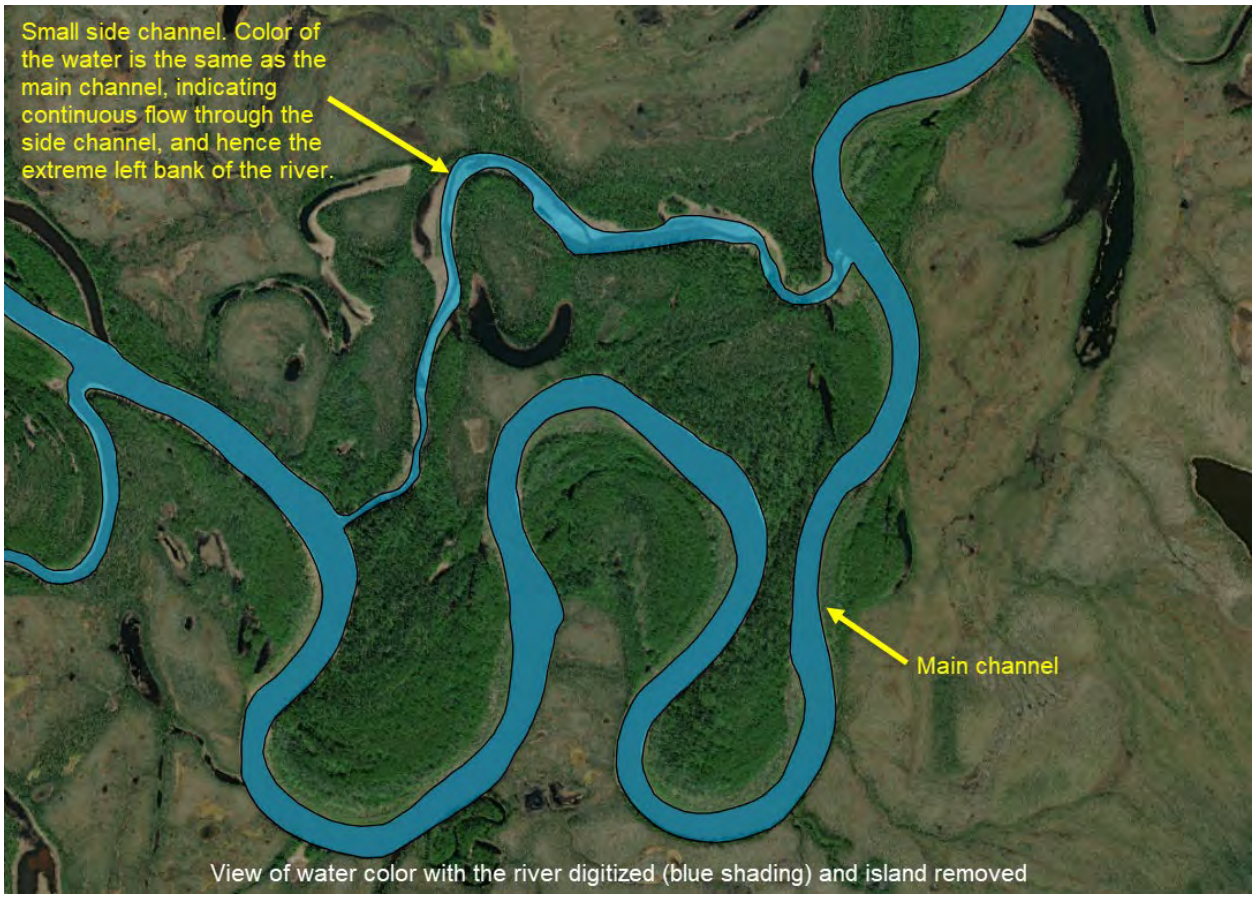


7) Visually estimate the line of ordinary high-water. This is just an approximation of where you believe the average high-water line is located, but it should be possible to get it relatively close to the actual location. Factors to consider are the time of year the satellite image was acquired, color of the river water, and steep vegetation-free cutbanks versus low-angle vegetation-free sand/gravel bars. Examples of these factors are given below.

8) **Satellite image acquisition date**. All imagery shown by the ESRI World Imagery layer was acquired during non-winter months – typically from late spring to early fall. Generally speaking, low-water periods are in late winter to early spring before snowmelt increases river volume. Conversely, glacial rivers may experience extreme high water levels during periods of prolonged sunshine due to increased melting of glaciers. You can determine the acquisition date of the imagery used in the ESRI World Imagery layer by adding the following layer to your ArcPro project:

https://services.arcgisonline.com/arcgis/rest/services/World_Imagery/MapServer/4

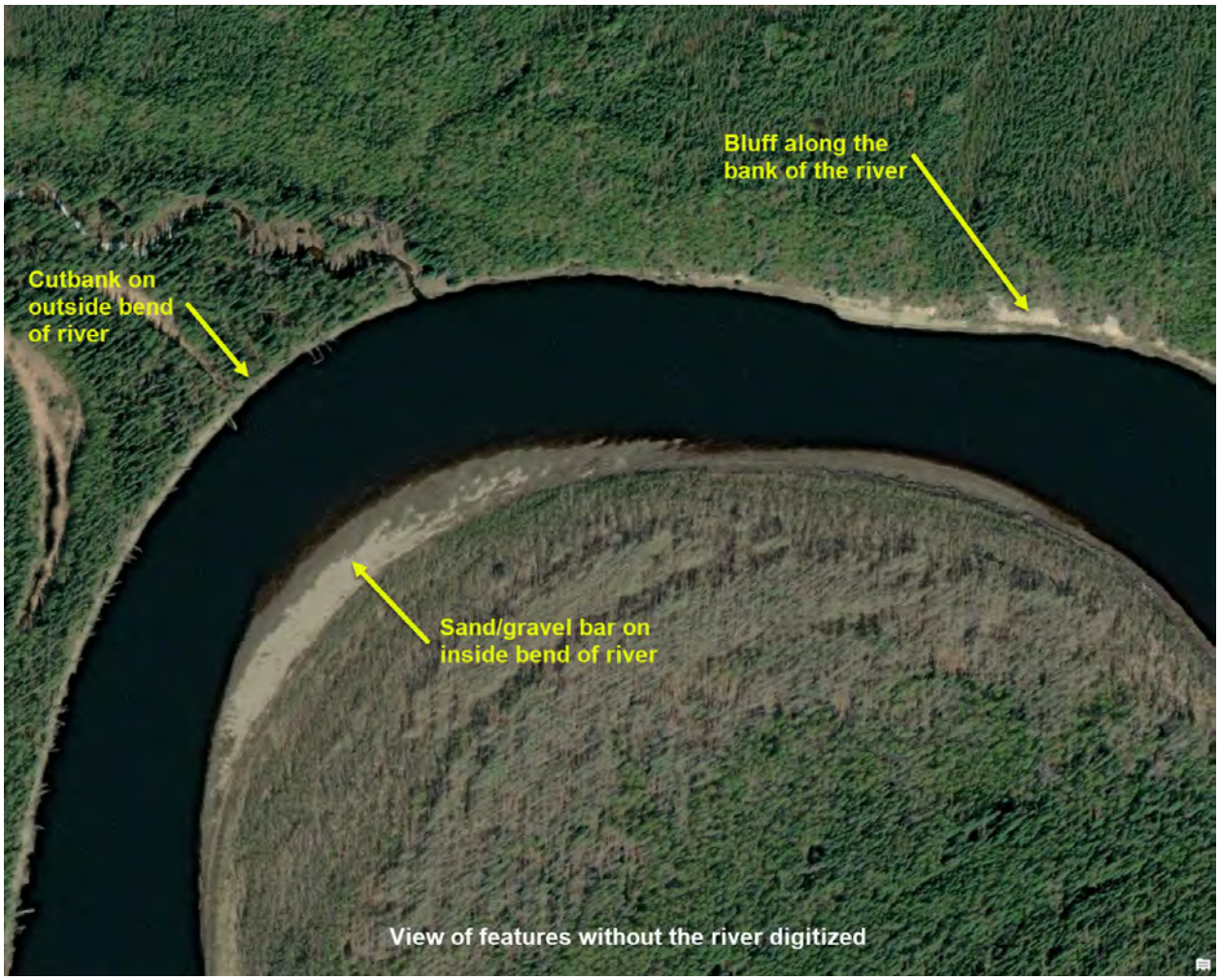
9) **Color of the river water**. In some cases, it is possible to use the color of the river water to help determine where the extreme left and right banks of the river are located. For example, there may be a small side channel that branches off the main river channel. If the small channel does not connect back to the main channel, it could be a dead remnant of a former flowing river channel. In this case, you would not digitize the side channel, but rather cut across the mouth of it where it connects to the main channel. In other cases, the small side channel may reconnect to the main channel some distance downstream. In this situation, you can use the color of the river water as an indicator of continuous flow through the side channel. If the color of the water in the side channel is the same as that of the main channel, that is evidence that the extreme left or right bank of the river should be digitized along the side channel. See the examples below.

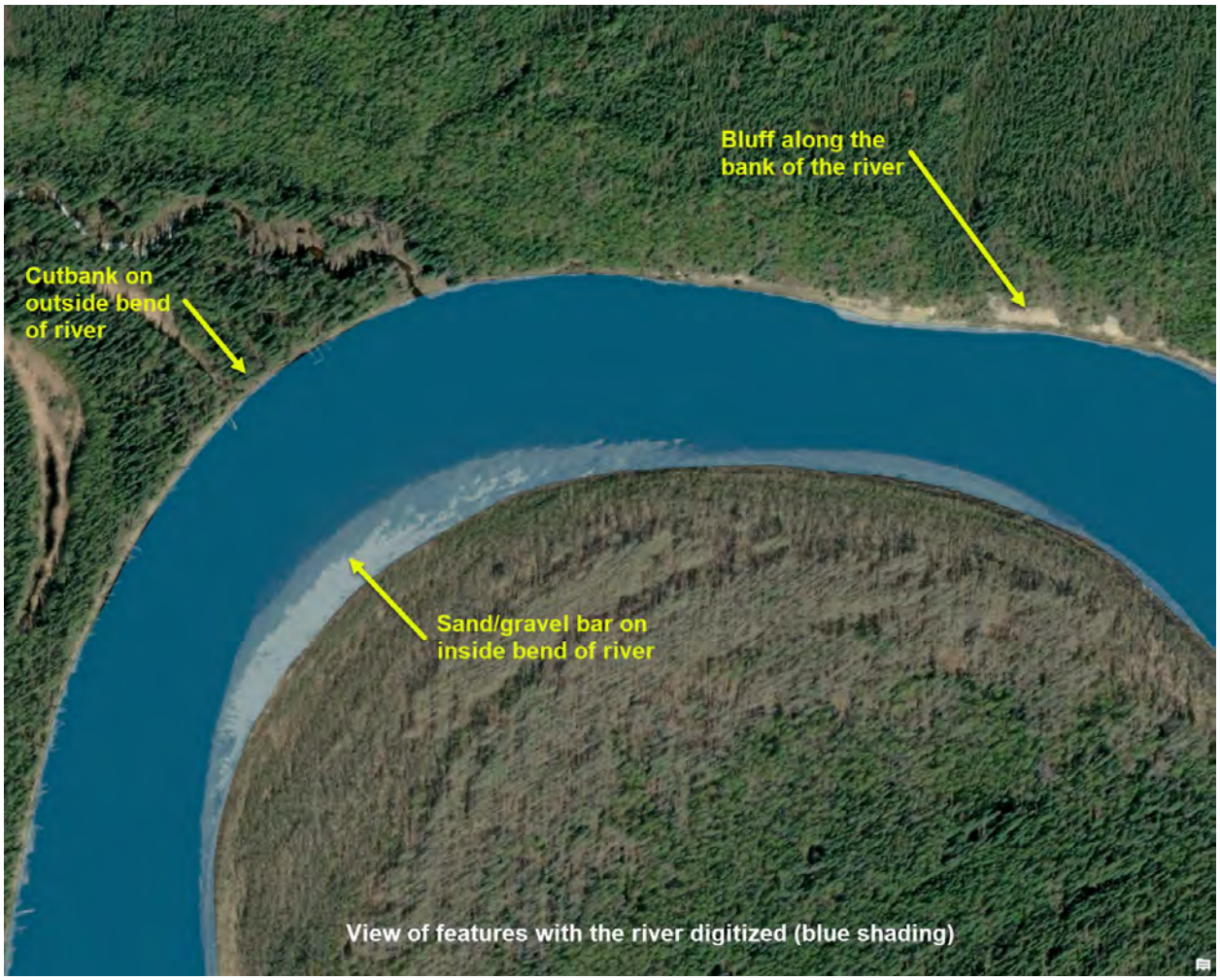


In other cases, there might be a small side channel that branches off a turbid glacial river, and in which the color of the water is different from the main channel. This might be an indication that the side channel is fed more by the surrounding terrain than by the main channel. In this case, you likely would not digitize the small side channel as the left of right bank of the river.

10) **Cutbanks/bluffs versus sand/gravel bars**. Generally speaking, vegetation-free areas are usually periodically underwater, which is an indication that they are likely below the ordinary high-water line. An exception to this, and one which is common on Alaska rivers, is steep-sloped, vegetation-free cutbanks and bluffs along a river. These typically occur around the outer bend of rivers, along areas of high topographic relief adjacent to the river, or areas where the river is incised into the terrain. In areas such as these, determination of the ordinary high-water line cannot be based solely on the absence of vegetation. Rather, you will have to closely examine the imagery and estimate, based on the surrounding terrain, where the ordinary high-water line is likely to be located.

    Conversely, other vegetation-free areas typically include sand and gravel bars which are typically found along the inner bend of rivers. These are areas where the water velocity is slower, thereby depositing sand and gravel. In these areas, the ordinary high-water line can usually be estimated as being around three-quarters (or more) of the distance between the water and the adjacent vegetated areas. Refer to the examples below.





11) In many cases tree branches will overhang the riverbanks. In these situations, do not digitize along the edges of the branches/vegetation. Rather, visually estimate where you believe the riverbank is beneath the overhanging branches/vegetation and digitize that.

12) When you have completed digitizing the ordinary high-water line of the left and right banks of the river, you should have only one polygon. Use the metadata feature of ArcPro (or ArcMap) to add your author information and any other pertinent details about your digitizing work. Then send the complete, zipped file geodatabase to Scott McGee in the R7 Division of Realty (scott_mcgee@fws.gov). He will then review the digitized river, incorporate it into the larger WSR geodatabase, and create the various derivative feature classes.

Appendix C

Current Management Direction

APPENDIX C: CURRENT MANAGEMENT DIRECTION

Management direction for the Nowitna WSR corridor found in the Revised CCP is consolidated below in **Table C1** and will continue to be used to manage the Nowitna WSR corridor. The following are definitions for terms used as identified in the Revised CCP Chapter 2.5:

Allowed—The activity, use, or facility is allowed under existing NEPA analysis, appropriate use findings, refuge compatibility determinations, and applicable laws and regulations of the Service, other federal agencies, and the State of Alaska.

May be allowed—The activity, use, or facility may be allowed subject to site-specific NEPA analysis, an appropriate use finding (when required), a specific refuge compatibility determination (when required), and compliance with all applicable laws and regulations of the Service, other federal agencies, and the State of Alaska.

May be authorized—The activity, use, or facility may be allowed; a special-use permit or other authorization is required.

Table C1. Current Management Direction (Revised CCP) for the Nowitna WSR Corridor

Resource	Current Management Direction
Revised CCP Decision Summary	
Ecosystem Management - Prescribed Fire	Allowed in Minimal and Wild River Management.
Travel – Snowmobiles	Permitted for traditional activities, on or off designated trails, in period of adequate snow cover and on ice-covered rivers, subject to reasonable regulation.
Public Use – Admin Field Sites	Use of existing sites allowed including replacement of existing facilities as necessary; new sites may be allowed in Wild River and Minimal Management.
Recreation – Boat Launches and Docks	May be allowed.
Public Use – Visitor Contact Facilities	May be allowed under Minimal and Wild River Management categories.
Transportation - Includes transmission lines, pipeline, telephone and electrical power lines, oil and gas pipelines, communications systems, roads, airstrips, and other necessary related facilities. Does not include facilities associated with on refuge oil and gas development.	May be authorized under Wild River Management and Minimal Management categories but will require a CCP amendment.
Revised CCP	
Ecosystem and Landscape Management	
Collecting Information on and Monitoring Ecosystem Components Data gathering, monitoring, and maintaining a comprehensive database of selected ecosystem components (plants, animals, fish, water, and air).	Allowed
Research and Management Access and collection of data necessary for management decisions or to further science by the Service.	Allowed
Access and collection of data necessary for management decisions or to further science by ADFG.	Allowed

Resource	Current Management Direction
Access and collection of data necessary for management decisions or to further science by other researchers.	May be authorized
Research and Management Facilities May be permanent or temporary structures or camps, including weirs, counting towers, and sonar counters.	May be allowed
Fish and Wildlife Habitat Management	
Describing, Locating, and Mapping Habitats Development of quantitative, written, and graphic descriptions of fish and wildlife habitat, including water, food, and shelter components.	Allowed
Habitat Management *Mechanical Treatment:* Activities such as cutting, crushing, or mowing of vegetation; water control structures; fencing; and artificial nest structures.	May be allowed (with exceptions consistent with section 2.3.5 Revised CCP)
Chemical Treatment: Use of chemicals to remove or control non-native species.	May be allowed
Manual Treatment: Use of hand tools to remove, reduce, or modify hazardous plant fuels or exotic plant species, or to modify habitats (e.g., remove beaver dams).	May be allowed
Aquatic Habitat Modifications Activities such as stream bank restoration, passage structures, fish barriers, or removal of obstacles which result in physical modification of aquatic habitats to maintain or restore native fish species.	May be allowed (consistent with section 2.3.5 Revised CCP)
Fire Management—Prescribed Fires Fire ignited by management actions to meet specific management objectives.	May be allowed
Fire Management—Wildland Fire Use The planned use of naturally occurring fires to meet management objectives.	May be allowed
Fire Management—Fire Suppression Management actions intended to protect identified resources from a fire, extinguish a fire, or alter a fire's direction of spread.	Allowed
Non-native and Pest Plant Control Monitoring, extirpation, control, removal and/or relocation, and other management practices for pest and nonnative plant species.	May be allowed
Water Quality and Quantity Management Monitoring of water quality and quantity to identify baseline data and for management purposes; includes installation of gauging stations.	Allowed
Fish and Wildlife Population Management	
Reintroduction of Species The reintroduction of native species to restore natural diversity of fish, wildlife, and habitats.	May be allowed

Resource	Current Management Direction
Fish and Wildlife Control The control, relocation, sterilization, removal, or other management of native species including predators, to maintain natural diversity of fish, wildlife, and habitats; favor other fish or wildlife populations; protect reintroduced, threatened, or endangered species or to restore depleted native populations.	May be allowed
Non-native Species Management The removal or control of non-native species (including predators).	May be allowed
Pest Management and Disease Prevention and Control Relocation or removal of organisms that threaten human health or survival of native fish, wildlife, or plant species. Management practices directed at controlling pathogens that threaten fish, wildlife, and people, such as rabies and parasite control.	May be allowed
Fishery Restoration Actions taken to restore fish access to spawning and rearing habitat, or actions taken to restore populations to historic levels. Includes harvest management, escapement goals, habitat restoration, stocking, egg incubation boxes, and lake fertilization.	May be allowed
Fishery Restoration Facilities Fisheries facilities may be permanent or temporary and may include hatcheries, fish ladders, fish passages, fish barriers, and associated structures.	May be allowed
Fishery Enhancement Activities applied to a fish stock to supplement numbers of harvestable fish to a level beyond what could be naturally produced based upon a determination or reasonable estimate of historic levels.	May be allowed
Fishery Enhancement Facilities May be permanent or temporary and may include hatcheries, egg incubation boxes, fish ladders, fish passages, fish barriers, and associated structures.	May be authorized
Native Fish Introductions Movement of native fish species within a drainage on the Refuge to areas where they have not historically existed.	May be allowed
Subsistence Activities	
Fishing, Hunting, Trapping, and Berry Picking The taking of fish and wildlife and other natural resources for personal consumption, as provided by law.	Allowed
Collection of House Logs and Firewood Harvesting live standing timber greater than 6 inches diameter at breast height for personal or extended family use.	May be authorized

Resource	Current Management Direction
Collection of House Logs and Firewood Harvesting live standing timber between 3- and 6-inches diameter at breast height for personal or extended family use.	20 trees or less per year allowed; more than 20 trees per year may be authorized
Collection of Plant Materials Harvesting trees less than 3 inches diameter at breast height, dead standing or downed timber, grass, bark, and other plant materials used for subsistence purposes.	Allowed
Temporary Facilities Establishment and use of tent platforms, shelters, and other temporary facilities and equipment directly related to the taking of fish and wildlife.	Tent platforms may be authorized; all others may be allowed
Subsistence Access - subject to reasonable regulations under provisions of Section 811 of ANILCA	
Use of snowmobiles, motorboats, four-wheelers, and other means of surface transportation traditionally employed for subsistence purposes.	Allowed
Access	
Foot	Allowed
Dogs and Dog Teams	Allowed
Other Domestic Animals Includes horses, mules, llamas, etc. (certified weed-free feed required).	Allowed
Nonmotorized Boats Includes canoes, kayaks, rafts, etc.	Allowed
Use of snowmobiles, motorboats, airplanes, and nonmotorized surface transportation methods for traditional activities and for travel to and from villages and home sites.	Allowed
Off-Road Vehicles (All-Terrain Vehicles) Includes air boats and air-cushion vehicles.	Not allowed (with exceptions consistent with Section 2.2.12.2 Revised CCP)
Helicopters Includes all rotary-wing aircraft.	May be authorized
Public Use, Recreation, and Outreach Activities	
Hunting, Fishing, Wildlife Observation, Wildlife Photography, Interpretation and Environmental Education Note: All activities listed are priority public uses.	Allowed
Trapping, Walking, Hiking, Camping at Undeveloped Sites, and Dog Sledding	Allowed
General Photography	Allowed
Outreach Activities	Allowed
Designated Off-Road Vehicle (All- Terrain Vehicle) Trails and Routes	May be allowed
Cleared Landing Strips and Areas Includes unimproved areas where airplanes land. Minor brush cutting or rock removal by hand is allowed for maintenance.	May be allowed

Resource	Current Management Direction
Constructed Hiking Trails Includes bridges, boardwalks, trailheads, and related facilities.	May be allowed
Designated Hiking Routes Unimproved and unmaintained trails; may be designated by signs, cairns, and/or on maps.	Allowed
Boat Launches and Docks Designated sites for launching and storing watercraft or tying up a float plane.	May be allowed
Visitor Contact Facilities A variety of staffed and unstaffed facilities providing information on the Refuge and its resources to the public; facilities range from visitor centers to kiosks and signs. (Refer to Section 2.4.15, Revised CCP.)	May be allowed
Hardened Campsites Areas where people can camp that are accessible by vehicle or on foot but where the only facilities provided are for public health and safety and/or resource protection; may include gravel pads for tents, hardened trails, and/or primitive toilets.	Allowed
Temporary Facilities Includes tent frames, caches, and other similar or related facilities; does not include cabins. Refer also to SUBSISTENCE, COMMERCIAL USES, and Administrative Facilities.	Tent platforms may be authorized; all others may be allowed
Cabins	
Administrative Cabin Any cabin primarily used by refuge staff or other authorized personnel for the administration of the Refuge.	May be allowed
Subsistence Cabin Any cabin necessary for health and safety and to provide for the continuation of ongoing subsistence activities; **not** for recreational use.	Existing cabins allowed to remain; new cabins may be authorized
Commercial Cabin Any cabin which is used in association with a commercial operation, including but not limited to commercial fishing activities and recreational guiding services.	Existing cabins allowed to remain; new cabins may be authorized
Other Cabins Cabins associated with authorized uses by other government agencies.	May be authorized
Administrative Facilities	
Administrative Field Camps Temporary facilities used by refuge staff and other authorized personnel to support individual (generally) field projects; may include, but not limited to, tent frames and temporary/portable outhouses, shower facilities, storage/maintenance facilities, and caches.	May be allowed

Resource	Current Management Direction
Administrative Field Sites Permanent facilities used by refuge staff or other authorized personnel for the administration of the Refuge. Includes administrative cabins and related structures (refer to Cabins) and larger multi-facility administrative sites necessary to support ongoing field projects, research, and other management activities. Temporary facilities, to meet short-term needs, may supplement the permanent facilities at these sites.	Use of existing sites allowed including replacement of existing facilities as necessary; new sites may be allowed
Hazardous Materials Storage Sites, including appropriate structures and equipment, necessary for the storage and transfer of fuels and other hazardous materials used for administrative purposes; must be in compliance with all federal and State requirements.	May be allowed
Boat Launches and Docks Designated sites for launching and storing watercraft or tying up a float plane.	May be allowed
Radio Repeater Sites Sites used to maintain radio communications equipment; may include helispots for access.	May be allowed
Commercial Uses - Commercial Recreation	
Guiding and Outfitting	May be authorized
Transporting	May be authorized
Fixed-Wing Air Taxis	May be authorized
Helicopter Air Taxis	May be authorized
Commercial Uses - Mineral Exploration	
Surface Geological Studies Includes surface rock collecting and geological mapping activities (includes helicopter or fixed-wing access).	May be authorized
Geophysical Exploration and Seismic Studies Examination of subsurface rock formations through devices that set off and record vibrations in the earth. Usually involves mechanized surface transportation but may be helicopter supported; includes studies conducted for the Department of the Interior.	May be authorized
Core Sampling Using helicopter transported motorized drill rig to extract subsurface rock samples; does not include exploratory wells; includes sampling conducted for Department of the Interior.	May be authorized
Other Geophysical Studies Helicopter-supported gravity and magnetic surveys and other minimal impact activities that do not require mechanized surface transportation.	May be authorized

Resource	Current Management Direction
Commercial Uses - Other Commercial Activities	
Commercial Filming, Videotaping, and Audio taping	May be authorized
Commercial Fishery Support Facilities At or below 1979 levels.	Allowed
Commercial Fishery Support Facilities Above 1979 levels.	May be authorized
Commercial Timber and Firewood Harvest	May be authorized
Transportation and Utility Systems Includes transmission lines, pipelines, telephone and electrical power lines, oil and gas pipelines, communication systems, roads, airstrips, and other necessary related facilities. Does not include facilities associated with on-refuge oil and gas development.	May be authorized; would require a Revised CCP amendment
Navigation Aids and Other Facilities Includes air and water navigation aids and related facilities, communication sites and related facilities, facilities for national defense purposes and related air/water navigation aids, and facilities for weather, climate, and fisheries research and monitoring; includes both private and government facilities.	May be authorized

Appendix D
Current Monitoring

APPENDIX D: CURRENT MONITORING

Current monitoring from the following sources that are relevant to the Nowitna WSR corridor is consolidated below in **Table D1** and will continue to be used for monitoring in the Nowitna WSR corridor:

- Executive Summary: Wildlife Inventory Plan Koyukuk/Nowitna/Innoko National Wildlife Refuge Complex 2014 (USFWS 2014)
- Identification of Priority Resources of Concern: Methods and Results, Koyukuk, Nowitna, and Innoko National Wildlife Refuges (USFWS 2022)
- Water Resources Inventory and Assessment: Koyukuk, Nowitna, and Innoko National Wildlife Refuges, Alaska (Burkart et al. 2023)
- Koyukuk/Nowitna National Wildlife Refuge Complex Cultural Resource Guide (USFWS 1995)
- Koyukuk, Northern Unit Innoko and Nowitna National Wildlife Refuge Wildland Fire Management Plan (USFWS 2010)
- Nowitna National Wildlife Refuge Fishery Management Plan (USFWS 1990)
- Plan of Study: Hydrologic Resources Investigation Nowitna National Wildlife Refuge (USFWS 1998)
- Whitefish Biology, Distribution, and Fisheries in the Yukon and Kuskokwim River Drainages in Alaska: a Synthesis of Available Information (USFWS 2012)

Table D1. Current and Recommended Monitoring Related to the Nowitna WSR Corridor

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Executive Summary: Wildlife Inventory Plan Koyukuk/Nowitna/Innoko National Wildlife Refuge Complex (USFWS 2014)					
Ecology ORV	Moose	Aerial moose surveys of standardized trend areas are flown every year during November (post-hunt/rut).	Because moose are the most important subsistence and general hunting species, the Service has to answer questions on the status and health of populations on the refuge. Annual information on bull/cow ratios, calf/cow ratios, recruitment, harvest patterns, and predation has been collected since 1981 and provided to the Subsistence Division, ADFG advisory committees, Native groups, the Regional Office, and the public.	x (1999)	
Ecology ORV	Moose	Large-scale moose population estimates are obtained for large portions of the Complex every 5–10 years using the Geospatial Population Estimator Method.	The plan includes specific criteria on age and sex ratios obtained from trend counts that trigger concern for a population, and at which point more data and possible regulatory proposals are warranted.	x (1999)	
Ecology ORV	Moose	Annual moose twinning surveys are conducted in May at peak calving.	The information provides an index for moose habitat quality and cow body condition and informs future management.	x (1998)	
Ecology ORV	Moose	Nowitna River moose hunter check station is operated.	Moose hunter check stations are operated on both the Nowitna and Koyukuk Rivers to obtain accurate and immediate harvest totals in the most intensely hunted areas.	x (1988)	
Ecology ORV	Geese	Nowitna River goose production float surveys (canoe) are conducted.	Goose production trend surveys along three rivers in the Complex and concurrent aerial molting surveys in three areas provide an index of total adults; breeding pairs; and young, molting, and nonbreeding adults. They also provide an estimate of the minimum total numbers present.	x (1976)	

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Ecology ORV	Swans	Swan production: The inventory and monitoring plan identifies a minimal number of trend maps to be surveyed aerially every year. A refuge-wide survey that is part of the statewide cooperative survey is planned for every fifth year.	Annual trend surveys and follow-up distribution studies should be conducted at or near the 5-year migratory birds management statewide trumpeter swan census to better enumerate population changes for each species on the refuge. A study conducted from 2004 to 2006 showed 100 percent trumpeter swans on the Nowitna NWR with no tundra swans nesting on the refuge.	x (1968)	
Ecology ORV	Raptors	Refuge staff are currently conducting a Complex-wide raptor nest inventory (begun in 2009) and are evaluating adding a bald eagle and osprey nesting and productivity component to the inventory and monitoring Plan.	Raptors are a species that are very sensitive to disturbance and hence serve as indicator species.	x (2009)	
Ecology ORV	Beavers	Fall aerial beaver cache survey: The inventory and monitoring plan identifies a minimal number of trend maps to be surveyed aerially, rotating annually between the Koyukuk/Kaiyuh Unit of Innoko[17] and the Nowitna NWRs.	Beavers have a considerable impact on wetland regimes on the Complex. Trapping historically held beaver numbers much lower than present levels. The Complex staff has been surveying beavers at part of the Inventory and Monitoring Plan since 1991.	x (1991)	

[17] The Kaiyuh Unit of Innoko NWR has also been called the Northern Unit of Innoko NWR.

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Ecology ORV	Wolves	Standardized aerial wolf surveys using the ADFG sampling unit population estimator method have been implemented on the Nowitna, Kaiyuh Unit of Innoko, and Koyukuk NWRs as part of the Complex inventory and monitoring plan since 1991. Surveys are to be repeated every 5 to 10 years and perhaps more often if dictated by resource problems or controversies. The Sampling Unit Population Estimator aerial snow track surveys are supplemented with an annual incidental wolf pack observation record.	Wolf density and predation rate information in combination with moose density data are required to estimate sustainable harvests of ungulates. The Service must be able to make supportable comments to sport and subsistence hunting regulation proposals.	x (1991)	
Ecology ORV	Landscape monitoring	Development, design, and testing of ecosystem- or landscape-based monitoring protocols for habitats and plant species include moose browse, wetland lake species diversity and distribution, snow depth and density, permafrost, soils, phenology, biomass, insect and disease presence, and weather.	ANILCA mandates conservation of fish and wildlife populations and their habitats in their natural diversity. It has become increasingly evident that monitoring of single animal species, while perhaps necessary for management purposes, often provides incomplete insight as to why changes in abundance occur over time. Much of the collected habitat data are used in correlation with wildlife surveys to help explain population fluctuations.	x (1994)	
Ecology ORV	Environmental monitoring	Investigations of abiotic conditions on the Complex include snow depth monitoring, spring snow and ice phenology surveys (aerial), temporal and spatial moose willow mapping, phenological monitoring of plants and animals, and permafrost monitoring.	The health and abundance of refuge resources is often related to abiotic environmental conditions. The Service continues to seek out projects that will increase understanding of how changes in abiotic conditions may affect ecosystems in the Complex.	x (1988)	

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Identification of Priority Resources of Concern: Methods and Results, Koyukuk, Nowitna, and Innoko National Wildlife Refuges (USFWS 2022)					
Ecology ORV	Larch	Larch are monitored along the Nowitna River.	As a species, larch is of conservation concern due to both the drastic population reductions caused by infestations of larch sawfly and the geographic and potentially genetic separation of the Alaska population from to the North American population. Unusually extensive areas of larch forest occur in the upper and middle portions of the Nowitna River drainage. Larch-dominated forest communities such as this are rare statewide.		x
Ecology and cultural ORVs	White spruce	Old-growth white spruce are monitored along the Nowitna River.	White spruce is an ecological specialist that shows evidence of vulnerability to drought. Large stands of mature white spruce are becoming increasingly less common in Alaska. Notable mature white spruce stands are found in the lower Nowitna River corridor. Large old-growth white spruce trees are sought after for cabin logs.		x
Water Resources Inventory and Assessment: Koyukuk, Nowitna, and Innoko National Wildlife Refuges, Alaska (Burkart et al. 2023)					
Ecology ORV	Abiotic and vegetation mapping	Support initiatives and cooperate with the Service's Inventory and Monitoring Program, National Wetland Inventory, and other partners to complete or update baseline permafrost, wetland, hydrography, soil, and vegetation inventories and maps.	The Service supports these initiatives to enhance the ability to evaluate the ecological impacts of climate change and local anthropogenic activity and infrastructure development.		x
Ecology ORV, fish ORV, and water quality	Climate monitoring	Coordinate with other agencies to support the establishment of new meteorological stations and maintenance and operation of existing long-term climate monitoring stations.	Reliable long-term climate data, especially reliable year-round precipitation estimates, are needed to aid in modeling efforts to better predict responses to climate change.	x (1992)	

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Ecology ORV, fish ORV, and water quality	Climate monitoring	Develop alternative management strategies for aquatic ecosystems expected to be impacted by climate change. Use the resist-accept-direct framework to evaluate the potential for alternative management strategies in a changing climate.	The extent to which climate change will alter natural hydrologic systems is unknown, but implementing these recommendations should help the refuges' staff manage water quality and quantity to conserve fish and wildlife populations in a changing environment.		x
Fish ORV	Anadromous fish	Identify additional anadromous fish habitat. When anadromous habitats are identified, submit nominations for inclusion in the State of Alaska's Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes.	The Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes is important because it specifies which streams, rivers, and lakes are important to anadromous fish species and therefore afforded protection under Alaska Statute 16.05.871.	x (1980s)	
Water	Water quality	Support expansion of the U.S. Geological Survey and Intertribal Watershed Council's long-term water quality monitoring efforts for the Nowitna River.	Working with partners improves communication and increases the amount and value of data collection by sharing resources and providing a broader context for data analysis.		x
Water	Water quality and quantity	Work with the Service's Water Resource Branch and others to document baseline conditions, establish water quality and quantity requirements, and develop a strategy to monitor and protect flow and water-quality dependent ORVs on the Nowitna WSR.	The Service's Water Resource Branch can provide expertise to develop and implement data collection related to these needs.		x
Ecology and fish ORVs	Invasive species	Complete Step 1 Strategic Tasks defined in the Service 2020 Rapid Response Plan for Elodea in Alaska.	This step outlines actions that entities should take immediately to increase capacity to respond to any new report of elodea in Alaska. This is an integral step for rapid response.		x

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Water	Climate monitoring	Support studies to develop a better understanding of interactions between permafrost and groundwater.	The presence or absence of permafrost strongly affects hydrology. Relationships between groundwater, permafrost, and climate change are not well understood on the Complex and changes could have substantial impacts on fish, wildlife, and habitats.		x
Fish ORV and cultural ORV	Contaminants (fish)	Work with the Service's Fisheries and Ecological Services and the State of Alaska to monitor contaminants (with a focus on methylmercury) in fish, especially fish that are top predators and important to subsistence users.	Contaminants found in subsistence resources such as fish can pose health risks to subsistence users. There is more methylmercury (a neurotoxin) in predatory and long-lived fish such as pike.	x (2006)	
Water	Water quality	Evaluate the ADEC's water quality monitoring efforts associated with ongoing mining efforts in the regions of hydrologic influence to ensure monitoring is statistically rigorous enough to detect negative impacts on water quality.	Properly managed mining operations should not have negative impacts on water quality within the watershed. Water quality monitoring must be able to detect negative impacts so that they can be corrected to preserve water quality and ecosystem health.		x
Water	Water quality	Collect data on waters suspected of impairment and nominate those that are impaired to ADEC for inclusion on the 303(d) list.	Section 303(d) of the Clean Water Act requires states to create a list of impaired water comprised of all waters where the required pollution controls are not sufficient to attain or maintain applicable water quality standards.		x
Water	Water quality	Review the State's guidance for nominating Tier 3 waters as outstanding national resource waters and determine whether it is appropriate for assessing waters in the refuges that may meet eligibility.	Outstanding national resource waters are waterbodies that are of exceptional recreational or ecological significance and are designated under state water quality standards and the federal Clean Water Act. These waters receive enhanced protection against degradation.		x

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Water	Water quality	Ensure the responsible agency is performing adequate monitoring to detect potential water quality issues associated with areas of known or suspected contamination.	Both natural and anthropogenic factors can affect the water quality of surface and groundwater. Water quality degradation in the refuges is a concern due to changes in environmental conditions, altered inputs of nutrients, or contaminants from external sources.		x
Water, fish, ecology, and cultural ORVs	Water quantity	Work with the Service's Water Resource Branch to initiate stream gaging and lake monitoring efforts needed to apply for reservations of water.	When the United States reserves public land for uses such as NWRs, it also implicitly reserves sufficient water to satisfy the purposes for which the reservation was created. Water requirements need to be assessed prior to application for water reservations.		x
Water	Water quantity	Document the biological use of rivers and lakes on the refuges to support water reservation applications.	When the United States reserves public land for uses such as NWRs, it also implicitly reserves sufficient water to satisfy the purposes for which the reservation was created. Water requirements need to be assessed prior to application for water reservations.		x
Water	Water quantity	Work with the Service's Water Resource Branch to complete applications for water reservations using biological and hydrologic data for the streams and lakes.	Alaska's instream flow law is unique within the United States in that it allows federal, state, and local government agencies to apply for a reservation of water. The applicant must support the quantification with sound hydrologic and biological proof of need. Reserved water rights were written in the Alaska Lands Act for most refuges, although quantification is necessary to validate those rights.		x

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Fish and ecology ORVs	Invasive species	To prevent the introduction and spread of aquatic invasive species during refuge activities, initiate a Hazard Analysis Critical Control Point analysis with support of the Regional Invasive Species Program.	Hazard Analysis and Critical Control Point planning features five integrated steps that can reduce the risk of spreading invasive species and other nontargets via human-based pathways and examines activities to determine whether and when invasive species might be unintentionally moved.		x
Water, fish, and ecology ORVs	Water quality	Participate in planning and review of large-scale development projects, including addressing the implications of state and federal mining leases.	Both natural and anthropogenic factors can affect the water quality of surface and groundwater. Water quality degradation in the refuges is a concern due to changes in environmental conditions, altered inputs of nutrients, or contaminants from external sources. Potential agents of change to water quality include climate change, mining, proposed oil and gas development, and inputs of contaminants from long-range and near-field sources.		x
Water	Water quality	Design and implement a water temperature monitoring network in the Nowitna and Innoko NWRs. Collaborate with the Service's Water Resource Branch and the Alaska Refuges Inventory and Monitoring Program to identify sampling sites and develop a data management plan and site-specific monitoring protocols.	Water temperature determines the rate of chemical and biological reactions and is a major factor in aquatic ecosystem health. Cold-water species such as salmon require temperatures that do not exceed certain thresholds for survival and viability. Climate projections for the refuge predict warmer summer climatic conditions in the future that will likely result in increases in surface water temperatures.		x
Water	Water quality	Provide existing staff with time and support for training to conduct aquatic fieldwork.	Sufficient staff time and training are often limiting factors in the accomplishment of ecosystem monitoring activities.		x

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Nowitna National Wildlife Refuge Fishery Management Plan (USFWS 1990)[18]					
Fish ORV	Fish	Conduct fish distribution and habitat utilization studies by sampling with standard sampling gear.	Information on fish distribution and habitat utilization on the Nowitna NWR is currently very limited.		x
Fish ORV	Sheefish and northern pike	Conduct radio telemetry surveys to determine key spawning and overwintering areas for sheefish and northern pike.	Sheefish and pike were specifically identified by Congress in ANILCA when citing the purposes for creating Nowitna NWR. Sheefish is regionally important for both subsistence and recreational fishing. Pike is an important predator in the boreal ecosystem, and the fish is valued both for subsistence and recreational harvest.		x
Fish ORV	Sheefish	Estimate and monitor trends in sheefish population on spawning grounds.	Sheefish is specifically mentioned in the establishing purposes set forth in ANILCA for Nowitna NWR. Sheefish is regionally important for both subsistence and recreational fishing.		x
Fish ORV	Sheefish and northern pike	Describe characteristics of populations of sheefish and northern pike in terms of age, length, and maturation.	Sheefish and pike were specifically identified by Congress in ANILCA when citing the purposes for creating Nowitna NWR. Sheefish is regionally important for both subsistence and recreational fishing. Pike is an important predator in the boreal ecosystem, and the fish is valued both for subsistence and recreational harvest.		x
Fish ORV	Sheefish and northern pike	Sample potential rearing areas downstream and in river-connected lakes for relative abundance of juvenile sheefish and northern pike.	Sheefish and pike were specifically identified by Congress in ANILCA when citing the purposes for creating Nowitna NWR. Sheefish is regionally important for both subsistence and recreational fishing. Pike is an important predator in the boreal ecosystem, and the fish is valued both for subsistence and recreational harvest.		x

[18] Monitoring of fish species, their habitats, and fish harvest will be done in coordination with ADFG.

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Fish and cultural ORVs	Fish	Monitor sport fish harvests.	Sport fishing on Nowitna NWR should be maintained in balance with maintenance of healthy fish populations.		x
Fish ORV	Chum salmon	Conduct radio telemetry surveys to determine key spawning areas for chum salmon in the Nowitna River watershed.	Pacific salmon species, including chum salmon, are a management concern due to their importance for subsistence, their high vulnerability to climate change, and their roles as both keystone and trust species. Congress specifically identified salmon in ANILCA among the purposes for which Nowitna NWR was created. Nowitna NWR waters provide globally important habitat for spawning and rearing salmon and critical anadromous migration corridors.		x
Fish ORV	Coho salmon	Conduct radio telemetry surveys to determine key spawning areas for coho salmon in the Nowitna River watershed.	Pacific salmon species, including coho salmon, are a management concern due to their importance for subsistence, their high vulnerability to climate change, and their roles as both keystone and trust species. Congress specifically identified salmon in ANILCA among the purposes for which Nowitna NWR was created. Nowitna NWR waters provide globally important habitat for spawning and rearing salmon and critical anadromous migration corridors.		x

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Fish ORV	Salmon	Sample potential rearing areas downstream and determine relative abundance to identify important reaches for rearing salmon.	Pacific salmon species are a management concern due to their importance for subsistence, their high vulnerability to climate change, and their roles as both keystone and trust species. Congress specifically identified salmon in ANILCA among the purposes for which Nowitna NWR was created. Nowitna NWR waters provide globally important habitat for spawning and rearing salmon and critical anadromous migration corridors.		x
Fish ORV	Chum salmon	Monitor fall chum escapement trends in the Nowitna River through test netting.	Pacific salmon species, including fall chum salmon, are a management concern due to their importance for subsistence, their high vulnerability to climate change, and their roles as both keystone and trust species. Congress specifically identified salmon in ANILCA among the purposes for which Nowitna NWR was created. Nowitna NWR waters provide globally important habitat for spawning and rearing salmon and critical anadromous migration corridors.		x
Fish ORV	Fish	Collect tissue samples for electrophoretic stock identification.	Electrophoresis provides an important method for measuring the genetic discreteness of stocks and for the study of genetic relationships among stocks. This can be valuable information in fisheries management.		x

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Fish ORV	Fish	Evaluate test netting trends to develop a plan to expand monitoring effort for fall chum escapement, should preliminary findings warrant an increase in effort.	Pacific salmon species, including fall chum salmon, are a management concern due to their importance for subsistence, their high vulnerability to climate change, and their roles as both keystone and trust species. Congress specifically identified salmon in ANILCA among the purposes for which Nowitna NWR was created. Nowitna NWR waters provide globally important habitat for spawning and rearing salmon and critical anadromous migration corridors.		x
Fish and cultural ORVs	Fish	Conduct creel census of subsistence harvest along the Nowitna River.	One of the establishing purposes of Nowitna NWR is to provide the opportunity for continued subsistence uses by local residents.		x
Water and fish ORV	Water quality and quantity	Collect water quality and quantity data from established monitoring stations on the Nowitna, Sulukna, Titna, and Sulatna Rivers.	Both natural and anthropogenic factors can affect the water quality of surface and groundwater. Water quality degradation in the Nowitna NWR is a concern due to changes in environmental conditions, altered inputs of nutrients, or contaminants from external sources. Changes occurring in tributaries of the Nowitna River may affect water quality in the main stem.		x
Water and fish ORV	Water quantity and fish	Quantify the minimum flow necessary to maintain fishery habitat on the Sulukna River.	The Sulukna River has important spawning habitat for Nowitna River fish species, including sheefish, humpback and broad whitefish, least cisco, and potentially salmon and Dolly Varden.		x

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Plan of Study: Hydrologic Resources Investigation Nowitna National Wildlife Refuge (USFWS 1998)					
Water	Water quantity	Conduct stream discharge gaging on the Nowitna main stem and tributaries annually for at least 5 years to establish a baseline. Collect continuous stage records at a given transect within the selected stream reach.	A minimum of 5 full years of mean daily discharge records on a stream is required by the State Department of Natural Resources to quantify water necessary to protect fish and wildlife habitats. Five years of discharge records allow for the reasonably accurate calculation of mean annual and seasonal discharges.		x
Water	Water quantity	Conduct periodic measurement of discharge in each reach to develop the stage/discharge relationship (rating curve).	This rating curve (mathematical relationship) is used to convert the continuous stage record to a mean daily discharge record.		x
Water	Water quantity	At each study reach, determine the river water surface elevation associated with adjacent water-dependent riparian plant communities important to waterfowl and mammal species, such as nesting habitats and winter habitats.	This is needed to determine water quantities necessary to support wildlife populations and habitat.		x
Water	Water quality	Collect physical water quality parameters (water temperature, pH, specific conductivity, dissolved oxygen content, and turbidity) several times each year at each stream-gaging station.	This is done for the purpose of documenting baseline water quality trends.		x
Water	Water quality	Collect water samples for laboratory analysis several times each year. Send these samples to a water quality laboratory and analyze them for basic physical and chemical parameters, including pH, specific conductance, total dissolved solids, hardness, sodium, potassium, calcium, magnesium, carbonate, bicarbonate, sulfate, total and ortho phosphorus, nitrate, nitrite, arsenic, lead, iron, and zinc.	This is done for the purpose of documenting baseline water quality trends.		x
Water	Water quantity	Document the average high-water stage.	This is done for the purpose of documenting baseline flow characteristics.		x

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Fish ORV	Fish	Document fishery resources, life stage, and absence or presence for each fish species.	Nineteen species of fish have been reported on the Nowitna NWR. However, more species may be present since few comprehensive fishery inventories have been completed to date.	x (1985)	
Water and fish ORV	Fish	Quantify, where possible, habitat suitability (depth, velocity, cover, spawning substrate, etc.) of each fish species.	Information on fish distribution and habitat utilization on the Nowitna NWR is currently very limited.		x
Whitefish Biology, Distribution, and Fisheries in the Yukon and Kuskokwim River Drainages in Alaska: a Synthesis of Available Information (USFWS 2012)					
Fish ORV	Whitefish (including sheefish)	Assist in collection of high-quality, drainage-wide, annual harvest data for sheefish, broad whitefish, and humpback whitefish. Investigate the demographic composition of the harvest.	An estimate of the number of fish of each species harvested is essential for population assessment or harvest management studies. Annual harvest data for broad and humpback whitefish within the Yukon River and Kuskokwim River drainages are very poor.		x
Fish ORV	Whitefish	Contribute to the development of genetics baselines for known populations of broad and humpback whitefish and subsequent development of population baselines capable of distinguishing among populations or groups of populations.	Genetics baseline data may permit the proportional contributions of multiple populations of a priority species in the harvests.		x
Fish ORV	Whitefish	Attempt to locate and confirm broad and humpback whitefish spawning areas in the Nowitna River drainage.	Locating spawning habitats is the first step toward any population assessment work, genetics collections, or habitat protection activities. Once identified, spawning habitats may be protected from development impacts.		x
Fish ORV	Whitefish (including sheefish)	Collect population-specific length and age data for sheefish, broad whitefish, and humpback whitefish.	Shifts in age or length distributions may reveal population declines or large recruitment events.		x

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Fish ORV	Broad whitefish	Contribute to the development of methods to estimate the abundance or otherwise monitor variation in broad whitefish spawning populations.	While monitoring broad whitefish populations may be the first step to any population assessment, activities will be to identify the spawning populations. The abundance of the spawning population may enable monitoring of the effects of a fishery.		x
Koyukuk/Nowitna National Wildlife Refuge Complex Cultural Resource Guide (USFWS 1995)					
Cultural ORV	Archaeological overview	Prepare an overview of the current state of knowledge for interior archaeology in collaboration with other interior Alaska refuges. The overview should include a summary of the past and present environments, history of research, and regional cultural histories, and a summary of current knowledge and directions of research. Linguistic and physical anthropological information should be incorporated.	Little or no archaeological work has been done on most interior Alaska refuges.		x
Cultural ORV	Ethnographic interviews	Interviews of particularly knowledgeable individuals conducted in the Koyukuk/Nowitna National Wildlife Refuge Complex's villages would be particularly helpful. Refuge staff is interested in information on species' distributions and abundances, resource use, fire history, historic settlements and camps, place-names, and local history.	Knowledge of fish and wildlife population dynamics, ecology, and behavior is integral to people and cultures dependent on these resources. This local knowledge, though generally not quantifiable, can be an excellent supplement to information collected by quantifiable scientific means. It can provide current information on population status and perceived changes, as well as historical perspective on what things were once like.	X (1992)	
Cultural ORV	Archaeological field surveys	Survey the Nowitna River corridor for sites.	To locate new sites, update old site information, and confirm the locations of archivally reported sites, field work is necessary.		x

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Cultural ORV	Archaeological field surveys	Search for Noghuykkaakk'et	The site on the Alaska Heritage Resources Survey is reported at the mouth of the Nowitna River but has never actually been located.	x (2023)	
Koyukuk, Northern Unit Innoko and Nowitna National Wildlife Refuge Wildland Fire Management Plan (USFWS 2010)					
Ecology, fish, and cultural ORVs	Fire management	Ensure the natural character, vigor, and species diversity of the refuge boreal forest and tundra ecosystems by perpetuating a fire regime (both natural and prescribed) that maintains a mosaic of habitats native to interior Alaska.	Fire is the main driver of ecosystem change within the refuge. New fire management practices need to be continually integrated into refuge habitat management. The fire management plan provides management strategies that enable the refuge staff to conserve, protect, and enhance habitats. Objectives within the fire management plan address ecological relationships and human health and safety.	x (1980s)	
Ecology, fish, and cultural ORVs	Nowitna WSR fire management unit	Protect identified Nowitna WSR fire management unit values: • Intermixed Doyon, Limited land and Native allotments • Critical year-round moose habitat • Resident sheefish habitat in the Nowitna River • The character of the Nowitna River, a "wild river" under the federal WSRA, and its corridor	Protecting the unit ensures fire management aligns with other refuge goals and priorities and the needs of other landowners within the refuge's boundaries.	x (1980s)	
Ecology, fish, and cultural ORVs	Nowitna WSR fire management unit	Do not allow the use of aerial retardant or heavy equipment due to the proximity to the Nowitna River.	This prohibition protects Nowitna River water quality.	x (1980s)	

River Value	Monitoring Focus	Activity	Rationale	Ongoing (Year Initiated)	Anticipated
Ecology, fish, and cultural ORVs	Nowitna WSR fire management unit	Full Suppression (one parcel in the northernmost portion): • Protect Native allotments and Doyon, Limited lands using aggressive suppression to minimize the presence of uncontrolled fire. • Consider fire for resource benefit strategies only if initial attack is not initiated and/or suppression forces are not available.	This is done to protect the interests of other landowners within the refuge's boundaries.	x (1980s)	
Ecology, Fish, and cultural ORVs	Nowitna WSR fire management unit	Limited Suppression (the remainder of the fire management unit): • Allow fires to spread while providing protection for human life and site-specific values. • Manage most natural ignitions to maintain fire's natural role in the boreal spruce ecosystem, to provide an array of early seral and seral habitats and reduce the risk of catastrophic wildfires. • If management action is needed, use low-impact suppression methods, including minimum-impact suppression tactics, whenever possible.	This allows the natural fire regime to persist for the benefit of fire-dependent ecosystems and landscape diversity while protecting human life and other values specifically identified in the plan.	x (1980s)	

Note: This is a table of monitoring activities prescribed by other refuge step-down plans and documents that are relevant to the Nowitna WSR.

Appendix E
Acronyms and Abbreviations

ACRONYMS AND ABBREVIATIONS

	Full Phrase
µS/cm	microsiemens per centimeter
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act
CCP	comprehensive conservation plan
CFR	Code of Federal Regulations
CO_2e	carbon dioxide equivalent
Complex	Koyukuk, Nowitna, and Innoko National Wildlife Refuge Complex
CRMP	comprehensive river management plan
EPA	Environmental Protection Agency
GIS	Geographic Information System
IWSRCC	Interagency Wild and Scenic Rivers Coordinating Council
mg/liter	milligrams per liter
NAAQS	national ambient air quality standards
NEPA	National Environmental Policy Act
NRHP	National Register of Historic Places
NTU	nephelometric turbidity units
NWR	National Wildlife Refuge
NWSRS	National Wild and Scenic River System
ORV	outstandingly remarkable value
PLSS	Public Land Survey System
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter

PM_{10}	particulate matter less than 10 microns in diameter
Service	United States Fish and Wildlife Service
System	National Wildlife Refuge System
USC	United States Code
WSR	wild and scenic river
WSRA	Wild and Scenic Rivers Act

Appendix F
Species Names

Common Name	Denaakk'e[19] Name	Latin Name
Alaska tiny shrew	oodolts'eyhdle shrew	*Sorex minutissimus* or *Sorex yukonicus*
American wigeon	seseeye	*Mareca americana*
alder	kk'es	*Alnus viridis* ssp. *crispa* and *A. incana* ssp. *tenuifolia*
alsike clover		*Trifolium hybridum*
Arctic grayling	tleghelbaaye	*Thymallus arcticus*
Bering cisco		*Coregonus laurettae*
beaver	noye'e	*Castor canadensis*
bird vetch		*Vicia cracca*
black bear	daa etl'edze or h~~u~~lzen[20]	*Ursus americanus*
black spruce	ts'ebaa t'aa	*Picea mariana*
broad whitefish	telaaghe	*Coregonus nasus*
broadleaf cattail		*Typha latifolia*
Canada goose	belaalzene	*Branta canadensis*
Canada jay	z~~u~~ghe	*Perisoreus canadensis*
canvasback	nendaale = duck	*Aythya valisineria*
chickadees	k'ets'eh~~u~~ltoone and k'elots'eggegge	*Poecile atricapilla* and *P. hudsonica*
Chinook salmon	ggaa	*Oncorhynchus tshawytscha*
chokecherry		*Prunus virginiana*
chum salmon	noolaaghe	*Oncorhynchus keta*
coho salmon	saanlaaghe	*Oncorhynchus kisutch*
common chickweed		*Stellaria media*
common dandelion		*Taraxacum officinale*
common plantain		*Plantago major*
common raven	dotson'	*Corvus corax*
cottonwood	t'eghe	*Populus balsamifera* ssp. *balsamifera*
Dolly Varden	hok'elbaaye	*Salvelinus malma*
eastern larch beetle		*Dendroctonus simplex*
elodea		*Elodea* spp.
Eurasian tiny shrew		*Sorex minutissimus*
European bird cherry		*Prunus padus*
greater white-fronted goose	k'edot'aagge'	*Anser albifrons*
grizzly bear	tlaaghoze	*Ursus arctos horribilis*
grouse	doldoye and tsonggude	*Canachites canadensis* and *Bonasa umbellus*
humpback whitefish	holeghe	*Coregonus pidschian*
lambsquarters		*Chenopodium album*
larch	taat'eghe	*Larix laricina*
larch sawfly		*Pristiphora erichsonii*
least cisco	tsaabaaye	*Coregonus sardinella*
least weasel	koneede	*Mustela nivalis*

[19] Denaakk'e is the language of the Koyukon Athabascan people. Denaakk'e terms in this table may be found in the Koyukon Athabascan Dictionary (Jetté and Jones 2000).
[20] These terms mean "black one." The actual name (*ses*) is reserved for use by men.

Common Name	Denaakk'e[19] Name	Latin Name
lesser yellowlegs	dzolno ge	*Tringa flavipes*
lynx	kaazene	*Lynx canadensis*
mallard	tletlkk~~u~~ghuyh	*Anas platyrhynchos*
marten	sooge	*Martes americana*
meadow foxtail		*Alopecurus pratensis*
mink	deets'oodze	*Neovison vison*
moose	deneege	*Alces americanus*
muskrat	bekenaale	*Ondatra zibethicus*
northern pike	k'oolkkoye	*Esox lucius*
northern pintail	k'ee naa de	*Anas acuta*
olive-sided flycatcher	d~~u~~htseeneeye	*Contopus cooperi*
owls	no du , negoodzeghe, k'etleedzodze and e keeh doldoye	*Strix nebulosi*, *Bubo virginianus*, *Surnia ulula*, and *Aegolius funereus*
oxeye daisy		*Leucanthemum vulgare*
paper birch	kk'eeyh	*Betula alaskana*
pineapple-weed		*Matricaria matricariodes*
pondweed		*Potamogeton* spp.
porcupine	legedze	*Erethizon dorsatum*
quaking aspen	t'eghe kk'ooge'	*Populus tremuloides*
red clover		*Trifolium pratense*
red fox	nohbaaye	*Vulpes vulpes*
red squirrel	tsegheldaale	*Tamiasciurus hudsonicus*
redpolls	delotodelghoze	*Acanthis flammea and A. hornemanni*
river otter	belaazone	*Lontra canadensis*
round whitefish	h~~u~~ ten'	*Prosopium cylindraceum*
sandhill crane	deldoole	*Antigone canadensis*
sheefish	telaaghe	*Stenodus leucichthys nelma*
short-eared owl	kk'oondzaah	*Asio flammeus*
Siberian peashrub		*Caragana arborescens*
snowshoe hare	gg~~u~~h	*Lepus americanus*
timothy		*Phleum pratense*
trumpeter swan	tobaa = swan	*Cygnus buccinator*
tundra swan	tobaa	*Cygnus columbianus*
white clover		*Trifolium repens*
white spruce	ts'ebaa	*Picea glauca*
white sweet clover		*Melilotus alba*
whitefish	ook'e fish	*Coregonus* spp.
willow	kk'~~u~~yh	*Salix* spp.
wolf	teekkone	*Canis lupus*
wolverine	ne tsee	*Gulo gulo*
wood frog	nogh~~u~~ye	*Lithobates sylvaticus*
woodpeckers	dekeltlaale	*Dryobates villosus*, *D. pubescens*, *Picoides arcticus*, and *P. dorsalis*

Appendix G

Glossary

Archaeological resources: Any material remains of past human life or activities that are of archaeological interest, including pottery, basketry, bottles, weapons, weapon projectiles, tools, structures or portions of structures, pit houses, rock paintings, rock carvings, intaglios, graves, and human skeletal materials that are at least 100 years of age (as defined in the Archaeological Resources Protection Act of 1979).

Cultural resources: A broad term used to refer to the diverse human record found in sites, structures, objects, and places created and/or used by people. It is inclusive of a wide variety of resources, including, but not limited to, archaeological sites, isolated artifacts, features, records, manuscripts, historical sites, and traditional cultural properties.

Free-flowing: The condition of a river, or section of a river, moving in a natural condition without impoundment, diversion, straightening, riprapping, or other modification of the waterway. A river must be in a free-flowing condition to be eligible for inclusion in the National Wild and Scenic Rivers System.

Historic Property: Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian Tribe or Native Hawaiian organization that meet the National Register criteria (as defined in the National Historic Preservation Act and its implementing regulations found at 36 CFR 800.16(l)(1)).

Monitoring: Evaluation of the condition of river value-related indicators to determine whether they are protected and enhanced or to detect adverse impacts and to inform the need for adaptive management actions.

Objective: A concise statement of what the Service wants to achieve, how much the Service wants to achieve, when and where the Service wants to achieve it, and who is responsible for the work. An objective is derived from goals and provides the basis for determining strategies, monitoring refuge accomplishments, and evaluating the success of strategies. All objectives must be specific, measurable, achievable, results oriented, and time fixed.

Ordinary high-water mark: That line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas (33 CFR Part 328.3(e)).

Other use: Use within a WSR corridor other than public use, such as federally authorized mining, forestry, grazing, subsistence hunting and fishing, road use and management, administrative use for other than WSR purposes, and use on non-federal lands in a WSR corridor that have a potential to affect river values. Other use also includes any use on federal or nonfederal lands that border upon or are adjacent to a WSR corridor that may substantially interfere with public use and enjoyment of river values.

Outstandingly remarkable value (ORV): A scenic, recreational, geological, fish and wildlife, historical, cultural, or other similar river-related value that is a unique, rare, or exemplary feature and is significant when compared with similar values from other rivers at a regional or national scale.

Public use: Visitor use and WSR-specific administrative use within a WSR corridor.

River corridor: A river and the adjacent area within the boundaries of a designated river, or a river and the adjacent area generally within one-quarter mile of the banks of a congressionally authorized study river. This includes portions of undesignated tributaries within the corridor.

River values: The values for which a river is designated or congressionally authorized for study. These are the river's free-flowing condition, water quality, and ORVs.

Subsistence uses defined in ANILCA, Title VIII, Section 803: The "customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible byproducts of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade."

Strategy: A specific action, tool, technique, or combination of actions, tools, and techniques used to meet objectives.

Traditional cultural properties: Resources associated with the cultural practices, traditions, beliefs, arts, crafts, or social institutions of a living community (USFWS 2016). Traditional cultural properties are also considered historic properties.

User/visitor capacity: The maximum amounts and kinds of public use that a WSR collectively or by analysis area can accommodate without degrading river values.

Visitor experience: The perceptions, feelings, and reactions that a visitor has before, during, and after a visit to an area.

Visitor use: Human presence in an area for recreational purposes, including education, interpretation, inspiration, and physical and mental health.

Visitor use management: The proactive and adaptive process for managing characteristics of visitor use and the natural and managerial setting using a variety of strategies and tools to achieve and maintain desired resource conditions and visitor experiences.

Wild (WSR classification): Rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These rivers represent vestiges of primitive America.

Wild and scenic river (WSR): A river and the adjacent area within the boundaries of a component of the National Wild and Scenic Rivers System.

WSR-specific administrative use: Use within a WSR corridor by the river manager, including ranger patrols, maintenance activities, field research, staff visits to administer contracts or facilities, search and rescue, and interpretative programs for the purpose of protection or enhancement of river values.

Appendix H
List of Preparers

LIST OF PREPARERS

An interdisciplinary team of staff from the Service and AECOM prepared this CRMP. The following tables contain people who prepared or contributed to this CRMP.

Table G-1. List of Preparers–Service

Team	Name	Role/Responsibility
Management	Karin Bodony	Biologist/environmental educator, ORV background
	Douglas Calvin	Deputy Refuge Manager (former)
	Nicole Gustine	Project manager
	David Zabriskie	Refuge Manager (former)
Interdisciplinary	Jake Adams	Archaeology, cultural
	Randy Brown	Fisheries
	Greta Burkart	Water resources
	Jon Gerken	Fisheries
	Hunter Gravley	Vegetation
	Ray Hander	Fisheries
	Jeremy Havener	Subsistence
	Jeremy Karchut	Archaeology, cultural
	Robbin Lavine	Subsistence
	Andrea Medeiros	Communication strategies
	Scott McGee	GIS, landownership
	Meg Perdue	Water quality
	Jennifer Reed	Visitor use
	Wyatt Snodgrass	Fisheries
	John Trawicki	WSR policy, water resources
	Shane Walker	Refuge planning
	Michael Winfree	Water rights
	Emily Yurcich	Climate, Refuge planning

Table G-2. List of Preparers–AECOM (Consultant)

Team	Name	Role/Responsibility
Management	Brandt Bates	Deputy project manager, WSR
	Derek Holmgren	Project manager
Interdisciplinary	Jared Baxter	Lands and realty and recreation
	Beth Boatright	Technical editor
	Noelle Crowley	Scenic resources, recreation and visitor services
	Kevin Doyle	Cultural, tribal, and subsistence
	Rob Lavie	GIS specialist
	Perry Lown	Cultural, subsistence, and Alaska Native interests
	Nicole Morris	Wildlife, vegetation, and fisheries
	Kim Murdock	Technical editor
	Allison Piazzoni	Scenic resources, recreation and visitor services
	Shine Roshine	Air quality and climate change
	Eddie Sanchez	Decision file
	Cindy Schad	Word processing
	Josh Schnabel	Socioeconomics
	David Scott	Water resources and quality, soils, and permafrost
	Andy Spellmeyer	Section 508 compliance
	Megan Stone	Subsistence and Alaska Native interests
	Morgan Trieger	Wildlife, vegetation, and fisheries

Tribes; federal, state, and local agencies; and other individuals were consulted during the CRMP drafting and review process, including the individuals in the following table.

Table G-3. List of Individuals Consulted

Name	Organization
Tirzah Bryant	Louden Tribe
David Esse	Bureau of Land Management – Central Yukon Field Office
Jeff Fisher	State of Alaska – Department of Environmental Conservation
Catherine Heroy	State of Alaska – Department of Natural Resources
Cade Kellam	ADFG
Terri Lomax	State of Alaska – Department of Environmental Conservation
Sarah Meitl	State of Alaska – Office of History and Archaeology
Jennifer Nolanwing	ADFG
Glenn Stout	ADFG
Lisa Stuby	ADFG
Noel Turner	Bureau of Land Management – Central Yukon Field Office