Title Page
Owl Creek Mountains Studies to Plan and Manage Sustainable Use of a Productive Well

The Northern Arapaho Tribe, in collaboration with the University of Wyoming and Taprock Resources LLC, will combine data sources to inform the sustainable management of aquifers. Using remote sensing imagery and paleo-reconstruction data of naturalized water flows to define aquifer size and determine recharge area and rates. These funds will support data collection, analysis, and reports to inform decisions for the infrastructure necessary to manage the sustainable use of a productive well for a marginalized community struggling for water and to increase water reliability to improve timing, quantity, and water quality in the Owl Creek drainage.

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Owl Creek Mountains Studies to Plan and Manage Sustainable Use of a Productive Well

TABLE OF CONTENTS

Executive Summary
Owl Creek Mountains Studies to Plan and Manage Sustainable Use of a Productive Well
October 1, 2023
Northern Arapaho Tribe, Ethete, Wyoming

The Northern Arapaho Tribe, in partnership with the University of Wyoming, Dept. of Geology and Geophysics - Near-Surface Geophysics Instrument Center (UWNSG) and Taprock Resources, LLC, will conduct studies to determine quality, quantity, and recharge rate to plan a sustainable water system in the Owl Creek Drainage, on the Wind River Reservation in Hot Springs County, Wyoming. The study consists of a geophysical examination of Riley Flat to determine the geologic structures, porosity, and permeability state of the groundwater. This work will indicate the size and shape of the aquifer and the morphology of structures holding and feeding the aquifer. Recharge area studies will produce water chemical characterization to produce water fingerprints to confirm the recharge pathway and area to predict the chemistry of the well before opening and casing the well. This combination of data will be increasingly relevant as municipalities and watersheds seek new water sources. At the same time, these data will prevent the draining of historical aquifers and derive baseline data to support plans for a sustainable water supply to support wildlife habitat, livestock range, and clean drinking water for the underserved population of the Wind River Indian Reservation. Funds will support the studies and reports for water management teams.

TECHNICAL PROJECT DESCRIPTION

The Owl Creek Mountains Study for Sustainable Management of a Productive Well (Owl Creek Mountains Study)

GEOLOGY AND HYDROLOGY OF THE AREA

The Owl Creek Mountain Studies are a category A if Tribe is fiscal, B if Univ. is fiscal to use the combined collection of data and novel forms of determining water sources to inform water management decisions.

This project was initiated in the early winter of 2020 to locate a significant water source for the Arapaho Ranch of the southern Bighorn Basin. The project's initial objective has been achieved by identifying a potential fracture-derived water source. What follows is a description of the results of the geologic and hydrological investigation and recommendations for the subsequent work to evaluate the sustainable hydrologic potential of the well and, thereby, the extent of its water delivery in the Owl Creek drainage.

Naturally occurring potable water in the southern Big Horn Basin of Wyoming is a scarce commodity. Most ranches in this area along Owl Creek have existed for decades without wells producing clean, uncontaminated, low-TDS water for domestic, stock, or irrigation use. For this reason, a study was commissioned to locate a non-traditional water source on the Arapaho Ranch. A traditional water source would be a bedded sedimentary grainstone unit saturated with water. A non-traditional water source could be one of several kinds of fracture systems that tend to conduct water through fracture voids. The subsurface reservoirs that feed this type of system comprise interlocked fracture networks that can extend for miles and are often connected directly to active recharge sources. This project has been successful in locating the latter type of water resource. The Owl Creek Mountains Study will entail considerable field examination and testing to determine the volume and quality to justify the development expense and the recharge rate to drive the planning and distribution of a sustainable water project in the Owl Creek drainage.

The structure of more than a thousand square miles of the Owl Creek Mountains and the Owl Creek drainage basin was photo-mapped using color infrared stereo-pair air photos in an earlier study to find water. The initial mapping conclusions suggested that the southern Owl Creek Mountains consist of two separate uplifts. Much of the eastern and central part of the range is the result of north-to-south compression, which evolved as a transported and uplifted, south-divergent thrust block. Lateral motion on this block is estimated at 3 miles, and the vertical motion at ~4,000 feet. However, the higher, western part of the range, west of Mexican Pass, is composed of vertically uplifted Precambrian, crystalline rocks that have been forced upward ~25,000 feet. The compression appears to be oriented northeast-southwest, and the detachment surface at the base of the uplift is probably located near the Mohorovicic discontinuity (Moho), the zone deep in the crust defined by a major decrease in the velocity of seismic waves.

Vertical uplift of large blocks of Precambrian rock is a phenomenon seldom seen locally. In this case, compression of this magnitude requires input from subduction-related events that can also be linked to the introduction of the Absaroka Mountains basalts.

Because the uplift of the Owl Creek Mountains results from compressional forces, many different types of structural components are built into the configuration of the range. As a result of the compression, there are numerous anticline-syncline pairs, both in the range itself and to the north and south in the basins. There are also many fractures, including normal and reverse faults, thrust faults, and strike-slip faults, and detachments, all of which contribute their own unique signature to the overall morphology of the Mountains. The challenge was to sort through all of these structures and locate a fracture system that might be water-bearing.

After the mapping, an inventory of the oil wells drilled in the vicinity was done to better understand the stratigraphy of the area of interest. In analyzing the well data from the area near the ranch headquarters, one well was of considerable interest. It was an oil well drilled in 1949 by Continental Oil Company, the Brooke #1. The location of the well is near the crest of the Owl Creek Anticline at an elevation of 5,850 feet, about 2 1/2 miles southwest of the Arapaho Ranch headquarters. The anticline is about a mile long, oriented generally northwest-southeast, and is part of a larger doubly plunging fold with a strike length of about 3 miles. Analysis of the anticline shows it to be asymmetric in cross-section, with the northeast limb of the feature dipping at a much steeper angle, about 60 degrees, than the southwest limb, which dips at about 20 degrees.

The only data found on this well at the Wyoming Oil and Gas Commission was a well card that listed the location, the depth, 4,787 feet, the formation in which the well was bottomed, the Madison Formation, and comments. After an extended search, other data on this well was located. The data consisted of electric logs, SP logs, mud logs, and drill stem tests (DST) of the various formations penetrated by the well. Data from this packet, after analysis, indicated that 1) there was no oil in any of the formations penetrated by the well, and 2) the Tensleep Formation contained significant water from a depth of 3,797 feet to 3,841 feet. The back-calculation of the drill stem test indicated that this water would have a pressure of about 320 PSI at the wellhead. There was little information concerning water quality or water quantity contained in the data. The other pertinent data found in the records was the bottom hole temperature of the well of 108ºF.

After assimilating the CONOCO well data, remapping of the geology and structure of the area south of the well was undertaken to attempt to define the systems responsible for the high confining pressure and theoretical volume of the water potential of the well. About three miles south of the wellhead on the Owl Creek Anticline is a reverse fault that is the north boundary of an uplifted geologic block of rock known as Riley Flat. It, along with the western part of the Owl Creek Mountains, is the result of the vertical uplift of a large section of basement crystalline rock. The Riley Flat portion of the uplift was elevated only about 10,000 feet to 12,000 feet rather than the ~25,000 feet of the high part of the range. Thus, Riley Flat is several thousand feet lower than the crest of the range and is topped by sedimentary rock of Paleozoic age rather than the Precambrian crystalline basement rock that comprises the bulk of the

surface of the high Owl Creeks. This semi-coherent block is theorized to be the subsurface reservoir that feeds the Brooke #1 well.

The part of Riley Flat of interest is an uplifted block oriented generally northwest-southeast, is about 5 1/2 miles long, 3 1/4 miles wide, and has an average elevation of 6,600 feet. The north and east boundaries of Riley Flat are composed of reverse faults, which are vertical faults in which the mobile block has been physically raised above the stationary block along the fault plane, in this case, about 10,000 or so feet. The south boundary of the Flat is also the north boundary of one of the uplifted blocks that comprise the high Owl Creeks. The western extension of Riley Flat west of Rock Spring Creek dips westward into the Anchor Anticline but is isolated from the eastern part of the Flat by several normal and strike-slip faults. These faults are not impermeable, but they impede water flow to the west and slow water migration considerably. The reverse faults planes surrounding Riley Flat are wide, up to a quarter mile across, are virtually impermeable, and so are barriers to water flow across the faults on the north, east, and partially to the south of the flat. The combination of the fractured, uplifted rock of eastern Riley Flat bounded by impermeable fault planes seems to have resulted in creating a large subsurface reservoir in the eastern part of Riley Flat.

The portion of Riley Flat considered a reservoir comprises about 14 square miles. It is several thousand feet lower than the high Owl Creeks to the south and appears to be fed by the runoff precipitation that falls there. The part of the high Owl Creeks that has the potential to feed Riley Flat totals about 12 square miles. Since most of this part of the range is fairly impermeable rock, the water into Riley Flat will probably flow partly as surface water rather than totally in the subsurface. Three drainages, localized by fracture systems, cross the high Owl Creek north-bounding reverse fault, which is also the south-bounding Riley Flat fault, and feed water from the Owl Creek Mountains into Riley Flat. Much of the water flows as surface water, but significant water may migrate northward through these fractures in the subsurface. Examination of the streams using air photo inspection shows that, in some cases, they just disappear after being absorbed into the surface of the Flat. In other cases, the streams seem much diminished as they transit the Flat, suggesting they are losing water to the surface formations.

South of the Owl Creek Anticline and north of Riley Flat is an ephemeral drainage, Pumpkin Creek, that has been localized by a strike-slip fracture that postdates the uplift of Riley Flat and the rest of the range. It is right lateral in aspect and offsets the north-bounding reverse fault of Riley Flat by about a quarter mile. Photo examination of the fracture, as it penetrates the fault, indicates it is conducting water northward out of Riley Flat. The Pumpkin Creek fracture passes across the Owl Creek Anticline about 250 yards east of the Brooke wellbore, and it is suggested that this is the feeder responsible for the presence of water in the Brooke well. The asymmetry of the Owl Creek Anticline indicates that the anticline is much more densely fractured at depth, and so the Tensleep Formation in the core of the anticline seems to have acquired enough fracture permeability to conduct significant water the 250 yards from the Pumpkin Creek structure to the well bore.

The wellhead is at an elevation of 5,850 feet with a calculated pressure of 319 psi. The elevation at the point of use of the water is at an elevation of 5360 feet, an elevation drop of 490 feet. This calculates to 205 psi in additional pressure at the point of use for a total of 525 psi. Since we would have to reduce the pressure at the point of use, we might remove the energy of the water pressure in the form of electric power — hydroelectric generation. To determine the feasibility, it will be necessary to acquire more data on the flow, quantity, quality, and recharge of the well to establish the internal parameters of the well after it is cleaned and cased.

Project Location - See **Map** in Appendix

Data Management
All data from this study will be in formats compatible with GIS platforms. Both contractors of this study are professionals and have experience in data management. Analysis and synthesis of data are required to be accessible to stakeholders and boards, as well as reports for professionals in the field and professional journals.

EVALUATION CRITERIA

E.1.1. EVALUATION CRITERIA A—WATER MANAGEMENT CHALLENGES (30 points)

1. Water Management Challenge - The Arapaho Ranch consists of 8 ranches purchased in 1940 by the Northern Arapaho Tribe, a total of 350,000 acres that increased the size of the Wind River Indian Reservation. After 1900, droughts motivated landowners and the government to locate sources of more water in the important agricultural area of Owl Creek drainage in the SW corner of the Bighorn Basin. Several attempts to bring water to the Owl Creek drainage have been made; in 1909, attempts to bring Bighorn River water failed due to lack of funding; in 1944, construction of Anchor Dam began; once completed, the dam never held water, and the project was abandoned in the 70s. There are 45 residences and three businesses within 10 miles of the Brooke #1 well site that need water for domestic and ag use. Wells in the area are low-flow, hard water, unfit for drinking or even watering livestock.

The challenge is to understand the underground size and system of water that feeds Brooke #1 so that plans for sustainable water use can be made before cleaning and casing the well. Undoubtedly, the water will be a game changer in the Owl Creek drainage for irrigation and domestic water. The proposed Owl Creek Mountains Study will drive considerable agricultural, environmental, and economic development if the data establishes this as a sustainable water resource. The water has been under our feet for centuries, and bringing it to the surface with sustainability plans will improve the lives of Tribal Members of the Wind River Indian Reservation and the non-Indian families, businesses, and ag producers along the Owl Creek drainage.

2. Negative outcomes and concerns if this project isn't funded - Drought and water issues throughout North America are serious; the hardest hit populations are western states and marginalized populations in low-income, rural communities in arid zones, which describes the Wind River Indian Reservation (Reservation) which the Arapaho Ranch (Ranch) is on, and the 45 homes and businesses that share the Owl Creek drainage with the Ranch.

Wyoming's top three ag commodities are beef cattle, calves, and hay. Hay production in Wyoming is dropping rapidly. Hay production in 2022 was down 38% from 2021, and production in 2021 was down 27% from 2020– an average annual drop of 33% year on year; a disappearance in 2022 of 950,000 tons of hay. (USDA National Statistics Service, Wyoming). In Hot Springs County and on the Wind River Indian Reservation, hay production is in steady decline due to drought. The Wind River Tribal Water Engineers said increased water on the Arapaho Ranch and in Hot Springs County would help the reservation and the region to claw back hay deficits and begin to reduce hay prices for Indian and non-Indian producers. The need for more supplemental hay compounds the problem as AUMs are reduced due to drought and feral horse pressure. Cattle are being pulled off allotments earlier each year, increasing the need for hay. The cost of hay is rising, and the number of months for supplemental hay is increasing. At the same time, hay costs are increasing due to low hay production.

The longer we are in drought, the hay production and beef economy will continue to shrink, losing jobs and land in production. Compound that with already compromised communities, and we could lose all cattle production on the Reservation and its border communities. Losing water in these areas is reducing wildlife habitat as well.

3. How the project addresses water management issues in the area - The Owl Creek Mountains Study will help stakeholders determine the management and delivery of water. The study results will lead to stakeholder meetings to prioritize needs matched with money to finish the Brooke #1 well and development.

a. Water supply reliability will include reliable culinary water for Arapaho Ranch, the 45 households in the Owl Creek drainage, and possibly the 800 gallons a minute of water Thermopolis is currently seeking. Water for agriculture in hay production alone would be an economic boost for the underserved populations of the area, and an increased in stream flow of Owl Creek would support wildlife, including the migratory corridors for important ungulates and the estimated 163 rare species to be found in the area (University of Wyoming - Wyoming Natural Diversity Database).

b. Management of water deliveries - This study will generate baseline data to manage a sustainable water source that will remain reliable for hundreds of years.

c. Water Marketing - The 108°F water from the well could support a spa or two for recreational tourism, which is the largest economic driver in Wyoming behind shrinking energy industries.

d. Drought management activities - Data from the study provides the baseline data for developing a sustainable water supply and not simply stripping another aquifer of water.

e. Conjunctive use of ground and surface water - Key to the use of the Owl Creek Mountains Study is understanding the recharge area for the Brooke #1 well and managing that area to retain reliable inflow by putting water on the land - creating healthy soils and habitat. These applied science tools will lead to water supply reliability, drought management activities, and watershed health.

f. and g. Not included

h. Watershed health - By putting water back out on the land, the entire Owl Creek drainage will have increased water with higher quality and quantity in stream flow for Owl Creek itself, improving watershed health for livestock and wildlife habitat.
i. Reduce water supply imbalances and increase water reliability for ecological value. The Owl Creek Mountains study will provide the data necessary to understand the amount of water necessary for surface delivery to improve water inflow to the Owl Creek drainage that will improve habitat to sustain natural species.
j. Conservation and efficiency - The management tools of the Owl Creek Study, with subsequent planning, will focus on sustainable water use, including the efficiency or conservation necessary for sustainable outcomes.
K. Other water supply reliability improvements - Putting some groundwater on the surface will eventually make its way into the sand and gravel layers of the Owl Creek drainage. This may improve water quality and quantity available through existing wells. The improved water inflow to Owl Creek will benefit wildlife habitat and agriculture.

E.1.2. Evaluation Criterion B—Project Benefits (30 points)
1. The Need - In 2020, a study was initiated by the Arapaho Ranch (Ranch) after several stakeholder meetings at Ft. Washakie on the Reservation. The initial need was to find a 200-gallon-a-minute well for the Ranch employee housing and Field School developments at the Ranch. Like the 45 households in the Owl Creek Drainage, the Ranch has historically lacked culinary and agricultural water. The Ranch, for over 100 years, has relied on surface water, which was not potable but did provide showers. The water sources for most of the Owl Creek drainage homes are shrinking, and the water in wells is getting harder because the water sources are being drawn down, meaning the diluted solids are more concentrated, as are the microorganisms that make people sick. The well that Dr. Marlatt's initial study found will provide more than what the Ranch alone needs, and the Owl Creek Mountains Study will now inform a wider stakeholder pool for decision-making that will secure a sustainable water resource for humans, agriculture, and wildlife habitat.

2. How the Study will be applied and when - Stakeholder and water management decisions can be made with the Owl Creek Mountains Study data. The initial study of finding geologic fracture systems to locate groundwater is now followed by the Owl Creek Mountains Study with remote sensing imagery and paleo reconstruction of naturalized flows of water to determine recharge rates and define aquifer size for the infrastructure necessary to manage the sustainable use of a productive well. This process is replicable and produces data useful in helping stakeholders determine management priorities and cost structures— always with numbers that support the sustainability of a reliable water supply. The entire study, including stakeholder and management priorities set for the project, is contained within this grant output and timeline.

3. Detailed Benefits

- **Who will use the study, and how will they benefit?** Stakeholders in this project will include the Wind River Reservation Water Board, the Arapaho Ranch, the 45 households and ag producers of the Owl Creek drainage, the Hot Springs Conservation

District, NRCS, University of Wyoming Extension, and possibly the Municipal Water Department of Thermopolis. The processes of the study are replicable for other areas with similar well projects. Note that many of these organizations cannot say they support the study but can be advisory to stakeholders, boards, and management with the data from the study.

- **How water management decisions are improved.** A sustainable water system will need to include agriculture, natural resources, and culinary water because the ag and natural resource part returns water to the Owl Creek system. A culinary-only scenario would send all water out of the system. The rubrics developed by stakeholders and the management team will include sustainable water for agriculture, domestic use, and wildlife habitat.
- **To what extent are water management challenges of E1.1? addressed?** With the Owl Creek Mountains Study as a tool, all stakeholders of the Owl Creek drainage, Wind River Water Board, Arapaho Ranch, and possibly Thermopolis Municipal Water can develop a comprehensive water management plan to provide sustainable water to a rural, agricultural area that has always been struggling for water. The plan's parameters include wildlife habitat, ag production, and drinking water.

4. How does the project complement or add to other efforts in the area where the project is located? Are there other similar projects using similar methodology?

The Worland municipal water supply is provided from a well fed by similar fracture fault systems as the Brooke #1 Well - in fact, their well was also found in oil drilling cards and logs from previous oil field work. Thermopolis is looking at another abandoned oil well to meet their supplementary municipal water needs of 800 gallons a minute. Neither of these projects included a study like the Owl Creek Mountains Study. The inclusion of baseline data and flow study to inform stakeholders and professionals in management planning for a sustainable water resource has not been done in previous projects. This study informs a sustainable management plan that includes agricultural and natural resources with an eye on environmental support and economic development for marginalized populations, including rural and Native American populations.

E.1.3. EVALUATION CRITERION C—PROJECT IMPLEMENTATION (20 points)
Project Implementation Plan Descriptions

1. Approach and Methodology of the Owl Creek Mountains Study
Phase I: Data Accumulation - Scope of Work

The first component of the work to be done is to sample water from channels, springs, and seeps south of the well location, in seeps along Pumpkin Creek, on Riley Flat and in the Precambrian rocks of the high part of the Owl Creek Range. This will be to determine water quality, the major and minor elemental composition of the water updip of the well, and to establish both the source of the water and the potential recharge area. Interpreting this surface data will create an evolving fingerprint of the water from its origin, where it falls as precipitation in the high Owl Creeks down-dip into the Riley Flat reservoir and toward the well bore. By tracking the evolution of the chemical composition of the water as it moves through the various

pathways along its migration route, it may be possible to predict the water quality that will be found in the well before money is spent to repurpose it. Additionally, if we are successful, we might avoid the expense of doing another DST later in the project if it proceeds to a re-drill of the Brooke #1 wellbore for use as a water well. The second objective, and the more important one, is to examine Riley Flat to determine if it comprises the reservoir that is feeding the well.

Considerable field examination will be needed to determine if Riley Flat comprises a reservoir feeding the well and that Pumpkin Draw is the conduit. It is important to investigate the fracture systems that are thought to feed water from the south from the high part of the range to confirm that they are, or are not, the source of water and, additionally, which ones actually provide water and which ones do not and, if possible, how much, all this will help determine the recharge of the well, which will be extremely important information for the sustainable development and management plans for the well.

The geophysical examination of Riley Flat will consist of a geophysical examination of Riley Flat and bounding faults by the UWNSG with some combination of possible “deep” hydrogeophysical methods such as Controlled Source Audio Magnetotellurics (CSAMT), Nuclear Magnetic Resonance (NMR), Transient Electromagnetics (TEM) and shallow Seismic Reflection (Reflection) Surveys to determine the geologic structures present as well as the porosity and permeability state of the underground structure in Riley Flat. This work will indicate the size and shape of the aquifer and the morphology of structures holding and feeding the aquifer. Since Riley Flat has been forced upward 10,000 feet to 12,000 feet by compression, the brittle rock comprising the block will have been fractured. We need to determine the fracturing's magnitude, orientation, and density. These studies will also establish the top of the water table in the Riley Flat and determine if the water table is dipping. Combined with the porosity/permeability and water inflow data, we can make estimates of fluid flow velocities. We will partner with the Department of Geology and Geophysics at the University of Wyoming for this part of the project. The geophysical surveys, images, and seismic data will be collected concurrently with the water sampling, each beginning in April and completing in August, with analysis and synthesis of the data happening in September - October.

It is projected that 40 water samples will be needed to chemically characterize the water from its origin in the high Owl Creeks northward to Riley Flat and along the Pumpkin Creek feature. These samples will be analyzed for major and minor elements. By evaluating the chemical evolution of the water as it migrates south to north from its point of origin to point of use, we may be able to predict the chemistry of the well before re-drilling it. This also may be used to create a realistic analog of the well water composition on other systems where water in a migration pathway might be followed.

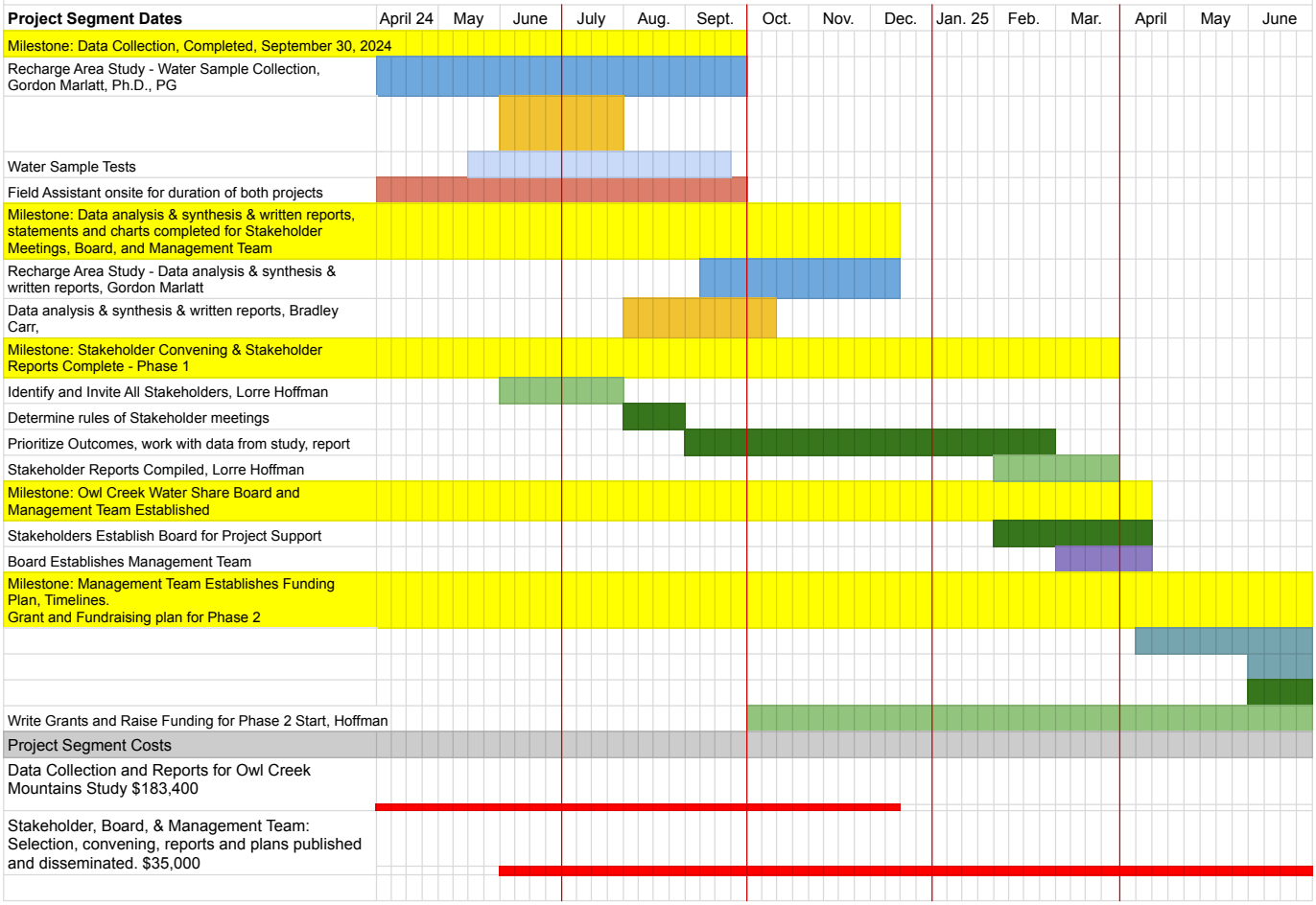
Riley Flat may represent a sub-surface reservoir containing considerable water in fracture porosity in its component rock. The size of the potential reservoir is about fourteen square miles or about 9,000 acres. The high stand of water in the drill hole in the DST was at an elevation of 6,600 feet, and the wellhead elevation is at 5,848 feet, a difference of about 750 feet. The block of rock comprising Riley Flat was uplifted vertically ~10,000 feet or, perhaps, as much as 12,000

feet as a result of horizontal compression and now has an average elevation of ~6,850 feet. The stress imposed on the rock during the uplift would have resulted in comprehensive fracturing of the entire rock body. The fracture porosity of this body may now approach 10%, which is quite a high figure when the lithology, carbonates, and crystalline rock are taken into account. Using a porosity of 5% gives a volume of about 342,000 acre-feet of water in Riley Flat, currently above the elevation of the wellhead.

2. Work Plan

a. Estimated schedule: stages, duration and segment costs on the following page.

Owl Creek Mountain Study - Milestones, Schedule Dates and Responsibilities, Project Segment Costs



3. Summary description of the anticipated products resulting from the project.

Product/Title	**Type, data, metadata, digital electronic, report, publication for community, professional journal publication, etc.**	**Product can be used to inform similar projects (ISP), ISP management, ISP data collection, ISP Tool**
Taprock Resources, LLC, Gordon Marlatt, Owl Creek Water Sample Data Collection, Analysis, and Reports	Reports for the stakeholders. Board, Management Team. Publish data and study from this project in professional scientific journals like the Journal of Geophysical Research–Solid Earth, Water Resources Research, Journal of Environmental and Engineering Geophysics, or Applied Geophysics. Outside of professional journals. Submit articles to the University and College of Engineering news media personnel and newspapers such as the Casper Star-Tribune (that reach a state-wide audience).	ISP management ISP data collection ISP Tool for baseline aquifer data & sustainable water source development protocol.
The University of Wyoming, Dept. of Geology and Geophysics - Near-Surface Geophysics Instrument Center, Bradley Carr, PhD	Reports for the stakeholders. Board, Management Team. Publish data and study from this project in professional scientific journals like the Journal of Geophysical Research–Solid Earth, Water Resources Research, Journal of Environmental and Engineering Geophysics, or Applied Geophysics. Outside of professional journals. Submit articles to the University and College of Engineering news media personnel and newspapers such as the Casper Star-Tribune (that reach a state-wide audience). Reports to the stakeholders. Board, Management Team.	ISP management ISP data collection ISP Tool for baseline aquifer data & sustainable water source development protocol.
Wyoming Analytical Laboratories, Inc.	Semi-Quantitative Scan of 40 water samples collected by Taprock Resources, LLC. Trace the water flow path in Riley Flats and understand the water quality for the management plan.	ISP management, ISP data collection, ISP Tool

4. Project partners and their roles

Partner	Role	Stages & dates
Northern Arapaho Tribe	Applicant	Fiscal agent of project
Taprock Resources, LLC	Recharge area data collection.	April 1 - Sept. 19, 2024
University of Wyoming, Dept. of Geology and Geophysics - NSG	Data Collection: geophysical examination of Riley Flat and bounding faults by UW-NSG with magnetic resonance imaging (MR) and shallow seismic surveys to determine the porosity and permeability of the rocks in Riley Flat and the surface of the water table.	June 1, 2024 - July 31
Field Assistant	Assists in all data collection and organizing facilities at the Field Station for UW housing needs.	April 1 - Sept. 19. 2024
Taprock Resources, LLC	Assimilation synthesizes recharge area data for reports.	Sept. 20 - Dec. 16, 2024
U W, Dept. of Geology and Geophysics - NSG	Assimilate and Synthesize data for reports.	Aug. 1 - Sept.16, 2024
Taprock Resources, LLC	Meets with Stakeholders, Board, and Management Teams to interpret reports and answer questions (science for decision makers).	Aug. 1 - June 30, 2025
Stakeholders Convening	Stakeholders convene, study reports, list priorities, and apply data to priorities to develop a sustainable water management plan that supports agriculture, natural resources, and habitat for wildlife, and human habitation	Aug. 1, 2024 - April 15, 2025
Lorre Hoffman	Facilitates the needs of Stakeholders	Aug.1, ‘24 - Apr. 15,‘25
Stakeholder	Stakeholder Reports Board Recommendations of Brooke #1 management plan	Dec. 1, 2024 - Jan.31, 2025
Lorre Hoffman	Reports for Stakeholders compiled and written	Feb. 2025
Owl Creek Water Share Board and Management Team Established	Board Recommendations of Brooke #1 management plan. Management solidifies plan.	April 2025
Lorre Hoffman	Takes minutes and assists with reports publication and dissemination.	Feb. - April 2025
Water Mangemt Team &Brd.	Funding and Plans for Phase 2 are established.	April - June 2025
Lorre Hoffman	Writes grants and seeks funding for Phase 2	Oct. 2024 - June 2025

5. Identify staff with appropriate credentials and qualifications.

a. Have project members accomplished projects similar in scope in the past as lead or team members?

The study, data collection, analysis, and reporting will be conducted with experts in the field. Bradley J. Carr, Ph.D. is an Associate Research Scientist and Director of the UW Near-Surface Geophysics Instrument Center (UW-NSGIC); the data collection and reports for this project are the kind of work they do routinely. Taprock Resources, LLC, Geologist Gordon Marlatt, Ph.D., PG, has researched water and oil well location, large-scale oil well production projects, and water well projects (see vitae attached).

Coordination of the dissemination of data, facilitation of the Stakeholder group, and development of the Water Share Board and Management Team will be Lorre Hoffman, MFA, who is the Development Director for the Arapaho Ranch Field Station and Grant Writer for the Northern Arapaho Tribe. Lorre has worked for the Northern Arapaho Tribe for ten years, writing grants and grants management and the Wind River Development Fund (CDFI) on the Wind River Reservation for five years, developing programs to support financial literacy, entrepreneurs, agriculture, and natural resource development. Recruiting students and constituents, facilitating projects and programs, grants writing, and management are what she has been doing for 25 years.

b. Can the project team proceed with tasks within the proposed project immediately upon entering a financial assistance agreement?

The Owl Creek Mountains Study team is committed to this project and ready to go. The Stakeholders and Board development are built during this proposal, with all studies and reports completed within the timeline of this grant funding. Stakeholder recruitment will be complete in August 2024, Stakeholders will prioritize outcomes from September 2024 to January 2025, and Reports will be completed in February 2025. The Board is recruited and appointed in March 2025, and the Management Team will be defined from April 2025 and established in April 2025.

E.1.4. Evaluation Criterion D—Dissemination of Results (10 Points)
Explain how project results will be disseminated, including how the tools and analyses developed under the proposal will be disseminated, communicated, or made available to water resources managers interested in the results.

The baseline data collection of recharge area and rate, the magnetic resonance imaging, and shallow seismic surveys to determine the porosity and permeability of the rocks are replicable tools. The Owl Creek Mountains Study perfectly explains how these data can work together to form sustainable management plans for new and existing water assets.

Publication of the data and study from this project will be presented in professional, scientific journals like the Journal of Geophysical Research–Solid Earth, Water Resources Research, Journal of Environmental and Engineering Geophysics, or Applied Geophysics. Outside of the professional journals, articles will be submitted to University and College of Engineering news

media personnel and newspapers such as the Casper Star-Tribune (that reach a state-wide audience). Reports to the Stakeholders, Board, and Management Team.

If the applicant is the primary beneficiary of the project, explain how the project results will be communicated internally and to interested stakeholders and interested water resources managers in the area, if appropriate.

The applicant and stakeholders are the beneficiaries of the Owl Creek Mountains Study. The Reports from the geophysical study and the recharge area study will be emailed to water resource managers on the Wind River Indian Reservation and water managers in the Bighorn Basin. Worland and Thermopolis, mentioned earlier, are using or intending to use fracture systems and wells abandoned by oil companies due to lack of oil but with shows of water. Neither municipality conducted baseline studies for recharge rates, and these studies could still apply to their projects and give them tools to manage their water resources sustainably. We have already seen cities in Wyoming like Laramie and Cheyenne taking steps to limit development in the recharge areas of their municipal water systems, leaving them in agricultural production or as open public land to maintain a healthy recharge system and to provide critical range and habitat. These same studies could be replicated in these municipalities and others to prepare baseline data to preserve sustainable water sources and inform management objectives for new and existing water wells.

Describe how the project results will be shared with other water managers in the West who could use the information to support water management objectives.

A case study and the scientific study reports will be shared with municipalities, water districts, conservation districts, and conferences. The science applied in this study can be conducted anywhere.

The work for this project will also be published in professional, scientific journals like the Journal of Geophysical Research – Solid Earth, Water Resources Research, Journal of Environmental and Engineering Geophysics, and Applied Geophysics. Outside of the professional journals, we would submit articles to the University and College of Engineering news media personnel and newspapers such as the Casper Star-Tribune (that reach a state-wide audience). Then, there are the reports to the various stakeholders.

E.1.5. Evaluation Criterion E—Presidential and Department of the Interior Priorities (10 points)

- **Climate Change**: **E.O. 14008**
    - **Describe how the project addresses climate change and increases resiliency.** This water project is being designed to manage for sustainability and will provide resilience to climate change not ever experienced in this region. Bringing water to the surface in a sustainable way will promote small green water cycles in the Owl Creek drainage and improve wildlife habitat and agriculture.

- **How will the project build long-term resilience to drought, and how many years of benefit?** Using the baseline data of the Owl Creek Mountains study will provide management data to develop a sustainable water plan that will last forever. Building a plan that does not deplete the aquifer or its ability to recharge makes it a forever water source.
- **This project will sequester carbon** by delivering water to the surface of a short grass prairie region of perennial grasses with long roots that remain in the ground year-round, which is long-term carbon sequestration that also builds soils, prevents erosion and flooding with a constant vegetational armor.
- **This project will advance racial equity** for the Wind River Indian Reservation and the Underserved Community of the Owl Creek drainage.
- **This project will include Tribal Consultation** with the Wind River Tribal Water Engineers, Wind River Tribal Water Board, who are all enrolled in Federally recognized Tribes, and the Arapaho Ranch Board, Northern Arapaho Tribal Members.

• Disadvantaged or Underserved Communities: **E.O. 14008 and E.O. 13985 affirm the advancement of environmental justice and equity for all through the development and funding of programs to invest in disadvantaged or underserved communities.**

- **Disadvantaged communities that will benefit from the project.**

The Wind River Reservation is all grey and associated with the disadvantaged. However, the Reservation data is reported in 4 sections: the Northeast is the location of Riley Flats, Brookes #1 well, and the Owl Creek drainage lie is within Hot Springs County. The tract is considered partially disadvantaged and is 87% white 3% American Indian, "The lands of Federally Recognized Tribes that cover 19% of this tract are considered disadvantaged." The southeastern section is similar as it also has several sections that are not Reservation with 85% white, 7% American Indian with partially disadvantaged status stating that "... Federally Recognized Tribes that cover 83% of this tract are considered disadvantaged." The western half is all Reservation and is identified as meeting more than one burden threshold for the disadvantaged and the associated socioeconomic threshold.

- **Describe how the project benefits those disadvantaged or underserved communities identified using the tool.**

The project will develop a reliable water supply for agriculture, improve water quality for drinking water both from water coming from the eventual well and from percolation of agricultural water into existing wells, and provide economic benefits for Tribal Members across the Reservation with the much-needed increase in locally grown hay from the portion of the reservation that is on the north side of the Owl Creek Mountain range.

• Tribal Benefits: The Federal Government never honored its trust responsibility to provide irrigation systems and water to any of the Wind River Reservation - this project lays the groundwork for a part of the Reservation to gain the water it badly needs.

o Describe how the project directly serves and/or benefits a Tribe and supports tribal-led conservation and restoration priorities.
The sustainable water source that can be developed from the Owl Creek Mountains Study will contribute to the conservation of a water source with management tools to keep the Brookes #1 well a forever water source. The management plan will restore wildlife habitat and range for cattle and hay that have been out of use for nearly a decade due to drought conditions associated with climate change.
o Does the proposed project support Reclamation's Tribal trust responsibilities?
The resulting water source of the Owl Creek Mountains study will fulfill the Federal Trust responsibilities to provide water for irrigation of Reservation lands and clean water for drinking. This project will benefit the Northern Arapaho Tribe and the Eastern Shoshone Tribe, located on the Wind River Reservation.

D.2.2.8 Project Budget

FUNDING SOURCES	AMOUNT
Non-Federal Entities	
1. Northern Arapaho Tribe*	$57,080
Non-Federal Subtotal	$57,080
REQUESTED RECLAMATION FUNDING	$161,320

D.2.2.9 Environmental and Cultural Resources Compliance (as applicable to the project)

The Riley Flat area where the Owl Creek Mountains study has Sage Grouse, which will not be disturbed by the process of these studies. No soils are moved or disturbed, and no more than one vehicle and three people are likely to be in a fourteen square mile area at any time, so disturbance is minimal, if any.

There are no wetlands, only small springs and seeps where no more than two individuals will collect water samples. There are no Waters of the United States in our study area.

There is no water delivery system involved in the study itself. However, the study is to determine the recharge rate, area, quality, and quantity of water delivered to a well site drilled and abandoned in 1949.

During the field study, no effects on irrigation systems will occur.

There is no National Register of Historic Places on the Wind River Indian Reservation (WRIR); therefore, none are on the study site within the WRIR.

The Owl Creek Study will not disturb any known archeological sites and will have no adverse effects on the populations in the area (no humans are living in the area, only wildlife and cattle).

The NA-THPO has determined that no ceremonial sites within the study area view. *(See attached NA-THPO Categorical Exclusion in appendix)*

Individuals working in the study take care to clean vehicles before driving them on the area, and all equipment worn or carried is also wiped down to ensure no foreign seeds of noxious or invasive species will be brought in. There is Cheatgrass in the areas near road beds.

H.1.1. National Environmental Policy Act
(See attached NA-THPO Categorical Exclusion in appendix)

H.1.2. National Historic Preservation Act
(See attached NA-THPO Categorical Exclusion in appendix)

H.2. Endangered Species Act
This study will not affect endangered species.

D.2.2.10 Required Permits or Approvals
No permits are required for this study. Approval is provided in the attached Wind River Inter-Tribal Resolution.

D.2.2.11 Overlap or Duplication of Effort Statement
There are no duplications of effort or overlaps with other grants or programs.

D.2.2.15 Letters of Support - attached appendix

D.2.2.17 Official Resolution - attached appendix

Owl Creek Mountains Studies to Plan and Manage Sustainable Use of a Productive Well

BOR - Applied Science Grant

APPENDIX

Category Exclusion - Northern Arapaho Tribal Historic Preservation Office

Commitment and Support Letters and Memos

Tribal Water Engineers

University of Wyoming, Bradley Carr Ph.D.

Taprock Resources, LLC, Gordon Marlatt Ph.D. PG.

NRCS

Other

Map

Gantt Chart - Milestones, Schedule Dates, Responsibilities, Project Segment Costs

Resolution - Wind River Inter-Tribal Council

Vitae

Bradley Carr Ph.D.

Gordon Marlatt Ph.D., PG

Gmail

Lorre Hoffman <lorre@makerspace307.org>

Categorical Exclusion Check list

Crystal Reynolds <crystal.reynolds@northernarapaho.com> Mon, Oct 16, 2023 at 4:32 PM
To: Lorre Hoffman <lorre@makerspace307.org>

Northern Arapaho THPO gives an archaeological CEQ based on a class 1 file search from 43N 97W S5 for no individual or cumulative significant effects on cultural or historical environment effects based on the water testing research project that has been proposed by Lorre Hoffman.

[Quoted text hidden]

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Northern Arapaho Tribal Historic Preservation Office

Crystal Reynolds

TRIBAL ARCHAEOLOGIST

Office: 307.856.1628

Cell: 307.851.0962

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PO Box 67 St. Stephens, WY 82524

1010 Railroad Avenue Riverton, WY 82501

SHOSHONE & NORTHERN ARAPAHOE
OFFICE OF THE TRIBAL WATER ENGINEER
BOX 217
FORT WASHAKIE, WYOMING 82514
307-332-6464
Fax 307-332-4033

To Whom It May Concern

The Office of the Tribal Water Engineers have been briefed about the Brooke #1 Well project and the study to determine the recharge area (in Riley Flats) and the size and shape of the aquifer that Riley Flats fills. The plan to develop a sustainable water source with the data from this study is a positive move toward resilience.

Although the water would sensibly remain in the Owl Creek drainage, the restoration of the many hay fields of the Arapaho Ranch and other hay fields out of production in the area due to lack of water would be a game changer for the ranching operations of the Wind River Indian Reservation and surrounding communities.

Hay production at the Arapaho Ranch alone is less than one-third of what it once was; it is all down to a lack of water. The 8 ranches that make up the Arapaho Ranch were historically big hay producers. Drought has changed hay production all over Wyoming the annual loss of hay, year on year in Wyoming, is 950,000 tons year on year for the last three years. With all cattle leases and allotments supporting fewer AUMs and shorter grazing seasons, the need for local hay will be with us for a long time.

The ripple effect of a water resource like the Brooke #1 well has great potential. As the water managers of the Wind River Reservation, we support the development of this water asset. A member of the Tribal Water Board will be able to keep us informed of the activities of the stakeholder's meetings and enable us to provide advice in the process.

Sincerely,
Lokilo J St. Clair

Interim Director OTWE

UNIVERSITY OF WYOMING | College of Engineering and Physical Sciences
Geology and Geophysics

Date: October 11, 2023
To: Bureau of Reclamation
From: Bradley J. Carr, Ph.D., Associate Research Scientist, Director - UW Near-Surface Geophysics Instrument Center (UWNSG)
Re: Northern Arapaho Tribe - BOR - Applied Science Grant Proposal

The University of Wyoming - Near Surface Geophysics Instrument Center is glad to have the opportunity to perform the geophysical examination of Riley Flat and bounding faults utilizing some combination of possible “deep” hydrogeophyscial methods such as: Controlled Source Audio Magnetotellurics (CSAMT, Nuclear Magnetic Resonance (NMR), Transient Electromagnetics (TEM) and shallow Seismic Reflection (Reflection) Surveys to determine the geologic structures present as well as the porosity and permeability state of the groundwater in and neer Riley Flat. This work will provide information about the size and shape of the aquifer and the morphology of structures holding and feeding the aquifer. These data will be valuable in the overall calculations of the volume of water available to the Brooke #1 well. This study, with Gordon Marlatt’s study to confirm the recharge area size and recharge rate as well as the chemical composition of the water, will provide planning tools for the stakeholders and management to be ready for the water when the well is cased.

UWNSG will provide collected data and a synthesized report for the stakeholders and management teams to develop the Brooke #1 well.

This combination of studies can be applied to many existing and proposed projects looking to tap into underground aquifers. The baseline data allows management to plan a sustainable well instead of draining an aquifer. Reliable water sources are key to resiliency and environmental improvements for agriculture and wildlife habitat. In this case, it can also supply water to historically underserved communities with the most basic clean water needs.

Sincerely,

Bradley Carr

Bradley J. Carr, Ph.D.

Dr. Bradley J. Carr
Assoc. Research Scientist
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Laramie, WY 82071
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307-761-3884

TAPROCK RESOURCES, LLC

307-742-6736

gmarlatt@uwyo.edu

718 S. 7th St., Laramie, WY 82070

October 12, 2023

To: Bureau of Reclamation
From: Taprock Resources, LLC, Gordon Marlatt, Ph.D., PG
Re: Northern Arapaho Tribe - BOR - Applied Science Grant Proposal

Taprock Resources, LLC, will conduct studies to determine quality, quantity, and recharge rate to plan a sustainable water system in the Owl Creek Drainage.

The compiled data and reports will inform decisions for the infrastructure necessary to manage the sustainable use of a productive well for a marginalized community struggling for water and to increase water reliability to improve timing, quantity, and water quality in the Owl Creek drainage. The Owl Creek Mountains Range recharge area study, will produce 40 water samples using chemical characterization to produce water fingerprints that collectively confirm the recharge pathway and area. Evaluating the chemical evolution of the water as it migrates south to north from the point of origin to the point of use will predict the chemistry of the well before opening and casing the well. The chemical data will create a realistic analog of the well water composition in other systems where water in the migration pathway might be tracked. This combination of data points will be increasingly relevant as municipalities and watersheds seek new water sources. At the same time, these data will prevent the draining of historical aquifers and derive baseline data to support plans for a sustainable water supply.

Taprock Resources, LLC, will provide collected data and a synthesized report for the stakeholders and management teams to develop the Brooke #1 well.

This combination of studies can be applied to many existing and proposed projects looking to tap into underground aquifers. The baseline data allows management to plan a sustainable well instead of draining an aquifer. Reliable water sources are key to resiliency and environmental improvements for agriculture and wildlife habitat. In this case, it can also supply water to historically underserved communities with the most basic clean water needs.

Sincerely,

Gordon Marlatt

Gordon Marlatt, Ph.D., PG

RESOLUTION
OF THE
WIND RIVER INTER-TRIBAL COUNCIL

RESOLUTION NO. 2023-11719
NABC RESOLUTION NO. NABC-2023-1615

A RESOLUTION AUTHORIZING THE ARAPAHO RANCH FIELD STATION TO APPLY FOR GRANT FUNDING FROM THE BUREAU OF INDIAN AFFAIRS, PROGRAMS OF THE USDA, PROGRAMS OF THE EDA, AND THE BUREAU OF RECLAMATION TO CONDUCT RESOURCE INVENTORIES, ASSESMENTS, AND OTHER PRE-DEVELOPMENT STUIDIES NECESSARY TO PROCESS AND DEVELOP GEOTHERMAL HEAT AND ENERGY. THE RESOURCE AND USES INCLUDE HYDROELECTRIC AND GEOTHERMAL HEATING, DISTRICT HEATING, AND CULINARY WATER.

WHEREAS, The Eastern Shoshone Tribe ("EST") and the Northern Arapaho Tribe ("NAT") are sovereign, federally recognized Indian Tribes with inherent sovereign authority and the right to exercise self-determination and self-governance through their individual and independent elected governments, the Northern Arapaho Business Council ("NABC") and the Eastern Shoshone Business Council ("ESBC"); and

WHEREAS, the NABC and the ESBC are authorized by a vote of their respective Tribal citizens to conduct the day to day governmental operations and set the policy and procedure of the their respective Tribe;

WHEREAS, the Wind River Inter-Tribal Council ("WRITC") was created April 17, 2017, by the NABC and the ESBC through the approval of the Wind River Inter-Tribal Accord and further defined through the June 25, 2019 approval of the Wind River Memorandum of Understanding for the Management and Oversight of Shared Tribal Programs and Resources; and

WHEREAS, the NABC and the ESBC have been functioning as the WRITC for the purpose of working collaboratively to manage shared assets and programs on the Wind River Indian Reservation; and

WHEREAS, the WRITC is composed of the NABC and the ESBC, and any action taken by the WRITC requires a majority vote of each Tribe's Business Council; and

WHEREAS, the WRITC recognizes the importance of Tribal energy independence and developing carbon-neutral energy and heating for the Tribal community; and

WHEREAS, the WRITC desires to review all forms of renewable energy to determine sources that will provide the greatest benefit to all citizens of the Wind River Indian Reservation ("Indian"); and

WHEREAS, the WRITC recognizes that there is a need to secure outside technical assistance to conduct resource inventories, assessments, and other pre-development studies to necessary to process, use, and develop renewable energy within the exterior boundaries of the Reservation; and

WHEREAS, the WRITC recognizes the need of NABC to secure the expert technical expertise of geologist, Gordon Marlatt, to assist in determining the longevity of any potential geothermal assets on the Reservation, determining the recharge area of the Brooks #1 well, gathering data from a field study and from the log of information previously derived from test drilling completed by Douglas Engineering on the Brooks #1 well; and

WHEREAS, the WRITC recognizes the need to secure funding from a host of federal programs including the BIA-EMDP, Programs of the USDA, Programs of the EDA, and the Bureau of Reclamation to conduct resource inventories, assessments, and other pre-development studies necessary to process, use, and develop renewable energy in the form of culinary water and heat and/or power for the Reservation and all tribal citizens; and

WHEREAS, the WRITC desires to receive outside technical assistance to quantity the uses of geothermal heating and energy production for the Northern Arapaho Tribe's Arapaho Ranch facilities; and

WHEREAS, the WRITC will consider the public release of information obtained from the EMDP project, so long as that information does not include any detailed proprietary data or reports. All releases of information related to this project must have the written consent of the WRITC prior to release; and

WHEREAS, the WRITC recognizes the extreme importance of preserving all tribal cultural resources and shall require that the Northern Arapaho Tribal Historic Preservation Office ("NATHPO") or the Eastern Shoshone Tribal Historic Preservation Office ("ESTHPO") conduct archaeological surveying and monitoring of all activities that involve ground disturbance within the exterior boundaries of the Reservation; and

WHEREAS, the WRITC shall require that all proposals to study or develop renewable energy within the exterior boundaries of the Reservation include funding to cover the cost of NATHPO or ESTHPO conducting all necessary and required work to guarantee that tribal cultural resources are preserved and protected.

NOW THEREFORE BE IT RESOLVED, that the WRITC approved the Arapaho Ranch Field Station to apply for BIA-EMDP, Programs of the USDA, Programs of the EDA, and Bureau of Reclamation grant funding to conduct resources inventories, assessments, and other pre-development studies necessary to process, use, and develop hydroelectricity, geothermal energy, and culinary water with the exterior boundaries of the Reservation; and

BE IT FURTHER RESOLVED, that outside technical assistance shall be secured in accordance with any and all grant requirements, to conduct the necessary resource inventories, assessments, and other pre-development studies to process, use, and develop renewable energy within the external boundaries of the Reservation; and

BE IT FURTHER RESOLVED, that the technical assistance of geologist, Gordon Marlatt, shall be used to assist in determining the longevity of any potential geothermal assets on the Reservation, determining the recharge area of the Brooks #1 well, gathering data from a field study and from the log of information previously derived from test drilling completed by Douglas Engineering on the Brooks #1 well; and

BE IT FURTHER RESOLVED, that outside technical assistance shall be used to quantity the uses of geothermal heating and energy production for the Northern Arapaho Tribe's Arapaho Ranch facilities; and

BE IT FURTHER RESOLVED, that all proposals to study or develop renewable energy within the exterior boundaries of the Reservation shall include funding to cover the cost of NATHPO or ESTHPO conducting all necessary and required work to guarantee that tribal cultural resources are preserved and protected; and

BE IT FURTHER RESOLVED, the WRITC shall consider the public release of information obtained from the EMDP project, so long as that information does not include any detailed proprietary data or reports. All releases of information related to this project must have the written consent of the WRITC prior to release; and

BE IT FURTHER RESOLVED, that this resolution supersedes all previous resolutions and other actions of the WRITC to the extent that there is a conflict; and

BE IT FINALLY RESOLVED, that the Chairman or Vice-Chairman of the Eastern Shoshone Business Council (ESBC) and the Chairman or Co-Chairman of the Northern Arapaho Business Council (NABC) are hereby delegated the authority and responsibility to sign all documents necessary to effect this action.

CERTIFICATION

The undersigned, as the Chairman of the Eastern Shoshone Business Council hereby certifies that the Eastern Shoshone Business Council, consists of six (6) members, of whom five (5) members of the Eastern Shoshone Business Council constituting a quorum, were present at a meeting duly called, noticed, convened, and held this eighth (8th) day of February, 2023; that the foregoing resolution was adopted by an affirmative vote of five (5) members of the Eastern Shoshone Business Council, and that the said resolution has not been rescinded or amended in any way.

Done at Fort Washakie, Wyoming this 8th day of February, 2023.

John St. Clair, Chairman
Eastern Shoshone Business Council

Attest:
Carolyn Shoyo, WRIC Executive Secretary

The undersigned, as the Chairman of the Northern Arapaho Business Council hereby certifies that the Northern Arapaho Business Council, consists of six (6) members, of whom six (6) members of the Northern Arapaho Business Council, constituting a quorum, were present at a meeting duly called, noticed, convened, and held this eighth (8th) day of February, 2023; that the foregoing resolution was adopted by an affirmative vote of six (6) members of the Northern Arapaho Business Councils, and that the said resolution has not been rescinded or amended in any way.

Done at Fort Washakie, Wyoming this 8th day of February, 2023.

Lloyd Goggles, Chairman
Northern Arapaho Business Council

Attest:
Nora Willow, NABC Executive Assistant