

May 19, 2023

Clean Sustainable Energy Authority  
North Dakota Industrial Commission  
600 East Boulevard Ave  
Bismarck, ND 58505

**Re: HydroStrat application for Clean Sustainable Energy Authority grant.**

HydroStrat is submitting the attached application for grant funds under the North Dakota Industrial Commission's Clean Sustainable Energy Authority program.

Every day in North Dakota, greater than \$10 million worth of minerals, which are found naturally in oil and gas produced water, are injected into disposal wells and left uncaptured. These minerals include, but are not limited to various lithium, barium, potassium, strontium, magnesium, and fluorine compounds.

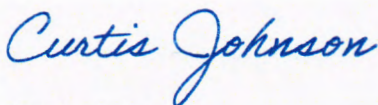
HydroStrat's mission is to provide innovative solutions to long-term water and energy challenges by using a holistic and sustainable approach to the use and conservation of natural resources.

HydroStrat will approach this unique problem with expert geologic knowledge that has identified disposal zones that are 10-50 times more prolific than the average Bakken disposal well. These next generation disposal wells will be used to consolidate large volumes of Bakken produced water in order to efficiently extract critical minerals, deemed essential to both North Dakota and the United States.

These various mineral compounds will be used to create fertilizers, chemical feedstocks, lithium-ion batteries, ceramics, and other advanced materials. HydroStrat intends to reclaim, reuse, and recycle as much water as possible throughout this process with the long-term goal of 100% capture and 0% disposal.

If you have any questions or require additional information, please do not hesitate to contact us.

Sincerely,



Curtis Johnson  
CEO & Founder

Clean Sustainable Energy Authority  

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North Dakota Industrial Commission

## Application

**Project Title:**

Enhancement of Energy Infrastructure to Enable Sustainable Resource Management, Stimulate Innovation, and Secure Domestic Supply of Critical Minerals

**Applicant:**

HydroStrat GP, LLC

**Date of Application:**

May 19, 2023

**Amount of Grant Request:**

\$10,000,000

**Total Amount of Proposed Project:**

\$2,300,000,000

**Duration of Project:**

Pilot Program: 2-3 years

Commercial Facility: 5-7 years

**Point of Contact (POC):**

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## **ABSTRACT**

### **Objective:**

The ultimate objective of this project is to provide a cleaner and more sustainable alternative to traditional salt water disposal (SWD) for the oil and gas industry while creating a beneficial use from an existing waste stream. This will be accomplished by first aggregating large volumes of produced water, then extracting potentially dozens of mineral compounds for commercial use, and finally reclaiming the remaining fresh water for industrial and agricultural applications. If the project is successful, the total investment could exceed \$2 billion over 7 years.

The overall project is complex in nature and will require significant follow-on investment upon the achievement of major milestones which advance the project towards an integrated commercialization path. For the purposes of this particular application, we will focus primarily on the first two phases of our mineral extraction pilot program. This specific project will design and construct a pilot facility capable of platforming and developing both existing and emerging mineral extraction technologies with the goal of achieving commercial viability with oilfield brines in North Dakota. HydroStrat plans to selectively partner with successful technology companies with the intent to build a commercial scale mineral extraction facility.

Many early-stage extraction technologies show promise in a laboratory, but encounter challenges with commercialization due to the burdensome task of scaling up their technology. HydroStrat's proposed pilot facility will alleviate these prohibitive barriers for aspiring technology companies by offering access to required power, large volumes of produced water, pre-treatment of produced water, product storage, and disposal of effluents at fractions of their typical cost. In addition, HydroStrat will provide facilities management, skilled labor, and the expertise to operate company equipment and oversee third party testing. As a result, the platform will attract researchers, entrepreneurs, technology companies, and investors from all over the world to North Dakota.

### **Expected Results:**

This project will result in the construction and operation of a state-of-the-art research facility that will be the first of its kind and is capable of long-term commercial mineral extraction. No other facility in the world will have the same research capabilities and capacity to develop a multitude of various extraction technologies simultaneously. This facility's primary purpose will be to act as a hub for innovation, investment, and development of mineral extraction technologies. The pilot facility will be designed to both repurpose existing "off the shelf" technologies and support emerging technologies on their path to achieving commercial viability.

Moreover, this project will expand the public knowledge of the extent and value of mineral resources within produced water across the Williston Basin. An assessment will be completed with cooperation from the Energy and Environmental Research Council (EERC) and its findings will be documented.

A successful pilot will have proven the value of undeveloped minerals (PUD Mineral Reserves) in Bakken produced water and developed the necessary technologies to extract those minerals, laying the groundwork for further investment of a large-scale and commercial mineral extraction refinery in North Dakota.

**Duration:**

The first two phases of development for the mineral extraction pilot facility are planned to progress over 24 to 36 months from the time that funds are deployed. The third phase is expected to last an additional 12 to 18 months. Full scale commercialization is estimated to begin in 5 to 7 years.

**Total Project Cost:**

Total project costs for the mineral extraction pilot facility (phases 1 & 2 only) are expected to be \$32.2 million. We ask that the Clean Sustainable Energy Authority award us \$10 million in grants, or roughly 31% of the cost, and the remainder of the project cost will be supplied in cash from HydroStrat.

**Participants:**

HydroStrat will manage the project with technical and regulatory assistance provided by the Energy and Environmental Research Center (EERC). HydroStrat will partner with Koch Engineered Solutions and Koch Technology Solutions to engineer and design the mineral extraction pilot facility. Additionally, HydroStrat plans to conduct agricultural research in close partnership with the North Dakota Department of Agriculture to understand the use cases for fertilizer production and irrigation using reclaimed water. HydroStrat will also utilize partnerships with various salt water producers, technology companies, qualified contractors, and well-known service providers to further develop the infrastructure, capabilities, and resources to successfully pilot and commercialize a mineral extraction facility in North Dakota.

**PROJECT DESCRIPTION**

**Objectives:**

The objectives of this project are to **A)** display proof of concept for HydroStrat's plans to provide cheaper and safer salt water disposal infrastructure for North Dakota's oil & gas industry, and **B)** pilot a mineral extraction and research facility to determine the relevant economics or a commercial refining facility. This project will aggregate at least 20,000 barrels of produced water per day from strategic partnerships with oil & gas industry leaders to provide the required volumes for the pilot facility. After the mineral extraction technologies have processed the produced water, the effluents will be disposed using a class II injector. Furthermore, the injection well will prove HydroStrat's proprietary disposal

zone, which is expected to offset the escalating water management concerns within the oil and gas provinces of North Dakota.

To prove the prevalence of the intended disposal zone, HydroStrat will drill a stratigraphic test well to record gamma ray, bulk density, density porosity, and resistivity logs over the interval. If the recorded log data and drill cuttings show promise, the well will be cased, cemented, and completed in order to perform a step-rate injection test. The results of this injection test will serve as empirical evidence of the formation's ability to take large volumes of produced water at low pressures and will further justify HydroStrat's plans for investment into large scale produced water infrastructure. Successful completion of the test well and its facilities will generate access to large volumes of produced water and identify HydroStrat as a profitable enterprise.

This project's objectives include the engineering design of the mineral extraction pilot facility, taking it from FEL-1 to FEL-4. Soon after engineering designs are complete, construction will begin, and mineral extraction operations will commence. At that time, HydroStrat will have secured technology rights and equipment for pre-treatment and extraction of lithium carbonate through its partnerships.

#### **Methodology:**

This project's tasks have been organized into two phases and then further subdivided by similar task requirements and chronological order. Many tasks are independent of each other and will be pursued concurrently. The progression from phase 1 to phase 2 will occur based on the needs of individual and collective technology needs. This means that it is possible to have multiple tasks across both phases at the same time. This flexibility was intentionally added so that promising technologies will be preferentially advanced further and faster.

#### *Mineral Extraction Pilot Phase 1 (Establish Operations)*

1. *Finalize Key Personnel.* The first step after receiving a grant from the Clean Sustainable Energy Authority is to hire key personnel and execute contracts with our partners to lock in stakeholders. HydroStrat will bring on full-time staff with performance-based compensation that is comparable to similar early-stage businesses.
2. *Finalize Location.* HydroStrat has already identified a multitude of suitable areas within a 5-mile radius but is intentionally waiting for CSEA funds to assist with payments to the EERC to further extend HydroStrat's existing knowledge of the regional geology. Together, we will use relevant subsurface mapping and modeling techniques to evaluate and prioritize the already high-graded locations to pinpoint the optimal injection zone.
3. *Secure Land Rights.* Due to the immense potential value of the disposal zone, HydroStrat will use internal and contracted landmen to execute its land leasing and acquisition strategy. This task is imperative to securing our long-term survival by protecting our business from future competitors and potential pore space disputes. Once the acreage is sufficiently held, we will begin any necessary permitting processes.
4. *Permit Class II Injector.* HydroStrat intends to plan and permit a class II injector with adjacent and near-adjacent facilities. The first step in the permitting process, after securing land rights, is to run

geotechnical surveys to understand environmental risks for near surface aquifers. If these test results are agreeable with the North Dakota Department of Mineral Resources, we will finalize engineering plots and plans. Next, we will complete engineering designs for drilling and completions plans. These plans will determine our expected injection capacity and thus how much capacity we need for tanks and pumps at our enhanced SWD facilities.

5. *Permit Mineral Extraction Facility.* The initial engineering design for the mineral extraction pilot facility will be independent of our designs for the class II injector and so this work will begin concurrently. The final design will be dependent on location and expected daily injection capacity. The EERC will also provide guidance and advice on the engineering designs for a pilot facility based on their experiences with their Brine Extraction Storage Test facility. We will work with the EERC and Koch Technology Solutions to meet all state requirements for permitting a treatment facility.
6. *Stratigraphic Test.* As permits are completed, drilling and construction will commence. First, we will break ground on pad construction. Second, we will bring on a rig to drill our stratigraphic test well. If the stratigraphic test is promising, we will case and cement the hole. Then we will perforate the casing over the desired injection intervals and perform a step rate injection test.
7. *Construction.* With a positive step rate test, construction of disposal and mineral extraction facilities will begin immediately. Many components of the facilities are either modular or commonly used and we will have secured access to construction materials prior to attaining positive injection test results.
8. *Contract Negotiations.* Currently and during construction, HydroStrat will continue ongoing discussions with mineral extraction technology companies and energy companies to further secure access to additional extraction technologies and volumes of produced water.
9. *Begin Business Operations.* With the first proprietary disposal well in service, we will begin operating the business and collecting revenues from salt water disposal and mineral extraction service contracts. The expected medium to long term outcome is the formation of several key strategic partnerships that will lead to co-investment and joint venture opportunities with premier businesses.

#### *Mineral Extraction Pilot Phase 2 (Implement Extraction Technologies)*

1. *Best Practices.* Because this will be the only facility of its kind, there will be a learning curve associated to the development of the technologies. After operating for several months, with staffing help from EERC, we will begin to establish processes, procedures, and best practices prior to our high-growth phase.
2. *New Employees.* With the establishment of processes and procedures by our key personnel, we will begin hiring and training new employees to take over responsibilities from EERC and prepare for growth. These future employees will be composed of mostly recent engineering and science graduates from North Dakota universities.
3. *Growth.* Once properly staffed, we will grow the business operations and improve cash flows. We will actively work to grow the business through increasing disposal volumes and signing on new technology companies to the platform program. At this point HydroStrat will be suitable for, and begin the pursuit of, federal Department of Energy grants to expand the business and its facilities.

4. *Expand Facilities.* Phase 1 of the mineral extraction pilot program will be limited by the number of users and throughput of produced water. As we bring on new customers and increase volumes, we will increase the number of skid bays and tanks for pre-treatment of produced water. This expansion will increase our capacity and propel the technical readiness level of technologies.
5. *Data Acquisition.* Once we achieve critical capacity thresholds, technologies will be tested at higher volumes. We will focus on identifying key metrics, data collection, and data analysis to improve the overall multi-stage process. The goal of this task is to gain a thorough understanding of mineral constituents in the produced water, the capital expense of installing modular technologies, the operational costs to extract those minerals, and finally, the economic yields from mineral extraction. We will also assess and begin developing preventive and mitigation strategies for potential hazards that come with commercial scale extraction.
6. *Yield & Purity Standards.* Early production of high-purity products will be in small quantities. The purpose is to test consistency of the finished products while also limiting expenses. This step is not intended to, but could create enough of high-margin products to stockpile and sell in bulk by rail car. Once consistent results are realized, the business' options for expansion become materially significant and wide ranging.
7. *Agricultural Applications.* The future commercial facility will need to be highly efficient and should mitigate costs by utilizing all available revenue streams. It is well-known that fertilizers are highly demanded in North Dakota and fertilizer feedstocks are a viable product of mineral extraction. This task is intended to utilize available and segregated land to prove that our fertilizer products have positive effects on the development of agricultural land. We will use designated plots of land to vigorously test the application of our fertilizers on multiple regional crops and soil types. A separate, but similar, experiment will be performed to test irrigation of regional crops with purified water from HydroStrat's water reclamation process.
8. *Technical Conclusions.* After several months of rigorous research, we will be able to conclude the effectiveness of developing and repurposed technologies. We will perform a comprehensive assessment and report our findings to investors and the Clean Sustainable Energy Authority.
9. *Financial Conclusions.* Using our technical results as inputs into a financial model, we will analyze and optimize our production plan. This task will determine the decision to advance the project. We will understand the feasibility and requirements of a commercial scale facility. Advancement to phase 3, will include production of some or all of our intended products at pre-commercial volumes, and signify the initial development of markets for those products. This stage will also initiate additional rounds of capitalization to fund the commercial facility with further equity, debt, and state fund contributions to realize the commercial project.

#### **Anticipated Results:**

Our anticipated result for this project is to have a cash flow positive business that demonstrates our concept for a cheaper and environmentally friendlier salt water disposal alternative for North Dakota's oil & gas industry. The stratigraphic test and subsequent step rate injection test will prove the prolific nature of our proprietary disposal zone and encourage investment into produced water infrastructure. Upon conclusion of phase 2 of our mineral extraction pilot program, we will have defined economic



thresholds and technical feasibility for a series of technologies to be chosen for implementation into a future large-scale commercial facility.

This project will also result in an assessment of the state's mineral resources contained within Bakken and Three Forks produced water. We anticipate using leased or acquired land in partnership with the North Dakota Department of Agriculture to test fertilizers and irrigation of crops using reclaimed water. We expect results to show no harmful side effects from use of our purified water on agricultural land. As applicable, HydroStrat will begin filing process patents on intellectual property gained from this project's research and development efforts.

The project results will support CSEA's mission to develop and deploy large-scale commercial projects that reduce environmental impacts and increase the sustainability of energy production.

**Facilities:**

This project will have more than sufficient facility access for its research and development efforts. HydroStrat will operate its own laboratory and treatment facilities to handle basic needs and will supplement its more advanced testing and research needs with facilities from the EERC and Koch Technology Solutions (KTS).

Phase 1 of the HydroStrat pilot facility will have an injection capacity of 50,000 barrels per day (BPD) and an initial processing capacity of 200 BPD that will scale up to 2,000 BPD (phase 2) and eventually to 20,000 BPD (phase 3). The rate at which the facility will scale up is dependent on the testing requirements of the platformed technologies. Produced water intake will come through dedicated contracts with minimum water volume commitments.

The pilot facility will have pre-treatment capabilities to filter solids, organics, suspended solids, and alter pH so that each customer has access to treated water in accordance with the standards of their technology. All essential valves, tanks, and pumps will be monitored by a series of sensors through a control room using a supervisory control and data acquisition system (SCADA). Each valve and pump will have automated and manual cutoff controls. There will be a minimum of two employees at the facility during operations in addition to 24-hour surveillance and remote control of critical safety equipment and emergency shutoff.

There will also be a modest laboratory in place to handle our basic operational research requirements in a timely manner, eliminating the need to ship samples long distances that would delay results. The laboratory will be designed based on the needs of the technologies, but will likely include at least a mass spectrometer, gas chromatograph, and X-ray fluorescence machines. These devices are used to measure which elements are present in water samples as well as their concentrations and purity. Our highly technical 4-D water sampling program and exploration for rare-earth minerals will be handled at the EERC labs in Grand Forks.

The EERC has over 254,000 square feet of facilities for technology demonstration, process modeling, and project execution. For over 70 years, the EERC has conducted research, testing, and evaluation of fossil

and renewable fuels, and emission control technologies. The engineering and scientific research staff is equipped with state-of-the-art analytical, modeling, and engineering facilities to address a wide variety of energy, environmental, and mineral resource research topics.

Koch Technology Solutions has decades of experience and hundreds of operating facilities around the world. Their ability to innovate, develop and transfer technology has created long-standing, trusted relationships with its licensing clients around the world. KTS creates preferred partnerships. By leveraging the expertise of their engineers, project managers, and operations experts they can maximize the return on capital investments for manufacturing owners. By partnering with companies in the early stages of chemical process development their team can scale solutions to commercial deployment and deliver the technology to create the next generation of process technologies.

**Resources:**

HydroStrat will utilize and leverage relationships with its strategic partners which include many renowned technical experts, premier contractors, and consultants. Some of which are:

- EERC *Research, development, and advisory services*
- Koch Engineered Solutions *Engineering design for mineral extraction pilot facility*
- Koch Technology Solutions *Lithium extraction and pre-treatment*
- Neset Consulting Service *Planning, permitting, and drilling*
- KLJ *Engineering & construction of disposal facilities*
- Stanley Milam *Inorganic chemistry*
- Cutting Edge Consultants *Regulatory*

**Techniques to Be Used, Their Availability and Capability:**

Many different techniques will be used that vary in availability and capability. The goal of the proposed project is to determine exactly which ones, and in what combinations, can be commercially scaled.

There are several main families of technologies that we intend to explore:

1. *Pre-Treatment of Produced Water.* Pre-treatment of produced water is widely available and already implemented throughout the oilfield. These techniques will remove solids and organics (hydrocarbons and naturally occurring bacteria) from the produced water.
2. *Physical & Chemical Processes.* These physical and chemical processes are well documented and have been implemented at commercial facilities across the U.S. for decades. Some of the processes we aim to utilize include multi-stage flash distillation, extraction using solvents, vacuum crystallization, and pH enhanced precipitation.
3. *Ion Exchange Resins.* Ion exchange technologies are widely used and capable at commercial scales, but have not yet been commercially successful for direct lithium extraction (DLE) of Bakken brines. Most emerging technologies in the lithium extraction space are focused on ion exchange using either absorption or adsorption techniques. The project will help develop these technologies for a specific application to Bakken brine.

4. *Membrane Filtration.* Membrane filtration is commonly used in water treatment and desalination at commercial volumes around the globe. The scientific field of membrane filtration is rapidly improving its selective extraction capabilities and continuously reducing material costs through innovation. Several of the filtration techniques HydroStrat will apply include reverse osmosis, nanofiltration, and bipolar membrane electrodialysis.
5. *Electrolysis.* Electrolysis is adopted at most desalination plants and many chemical refineries for its thorough capability to remove dissolved salts from water. This process uses an indiscriminate desalination technique and would be applied in HydroStrat's future desalination efforts.

#### **Environmental and Economic Impacts while Project is Underway:**

*Environmental Impacts.* In reference to our tasks laid out in the methodology section above, there will be no environmental impact during the phase 1 tasks 1-5, which are limited to engineering design, planning, and permitting. Environmental impacts during phase 1, tasks 6-7, will be minor and restricted to the effects of typical wellsite construction, steel warehouse construction, and drilling of the stratigraphic test well. Little to no environmental impacts are expected during operations of the class II injector and mineral extraction pilot facilities. All facilities will meet state and federal environmental standards of prevention, containment, and ability for remediation. Subsurface disposal zones will experience minimal pressures during injection and will be within the maximum allowable injection pressure (MAIP) to be supported by a step rate injection test.

*Economic Impacts.* North Dakota contractors will be used for planning, permitting, drilling, and construction. The EERC, in addition to several future North Dakotan employees, will run the maintenance and scientific research of the mineral extraction pilot facility. Altogether, approximately \$32.2 million will be spent in North Dakota on this project through phases 1 & 2.

#### **Ultimate Technological and Economic Impacts:**

*Ultimate Technological Impact.* Initial technological impacts will be achieved following completion of the proposed project. These impacts will include the advancement of mineral extraction technologies, technical applications for fertilizer production and consumption, and reclamation of produced water for industrial and agricultural use. Ultimate technological impacts will continue into the future as new technologies are platformed and developed at the project's research laboratory. The research and development laboratory will continue developing new technology throughout commercial operations with the intention of improving existing processes as well as discovering new modular applications to bolt onto the future commercial facility. When there are no scheduling conflicts with private research initiatives, the laboratory will be made available to public, state, and federal research initiatives.

*Ultimate Economic Impact.* The overall project provides a game-changing opportunity for substantial economic development in North Dakota that could exceed \$1.6 billion in invested growth capital. The ultimate investment for a full-scale refining facility and its associated infrastructure needs is anticipated to cost approximately \$2.3 billion over 10 years. Over 90% of invested dollars will go directly towards

North Dakota infrastructure, high-paying jobs, real-estate development, and energy sustainability. Projected economic impacts at full scale include:

- Over 100 direct full-time jobs created during construction of commercial facilities and pipelines.
- 200-400 direct full-time jobs to facilitate long-term operation of commercial-scale facilities.
- Over \$1 billion annually in new revenue streams from mineral extraction.
- Over \$10 million annually in local and state tax revenues.
- Approximately \$45 million per year in disposal cost savings for oil and gas producers.
- Approximately \$365 million per year in drilling cost savings for oil and gas producers.

**Why the Project is Needed:**

This project is needed to provide a cleaner and more sustainable alternative to traditional salt water disposal (SWD) for the oil and gas industry while creating a beneficial use from an existing waste stream that will additionally fortify the domestic supply of critical minerals in the United States.

The oil & gas industry is facing escalating produced water management concerns. Production volumes are increasing, water-to-oil ratios are rising, and economic salt water disposal zones are becoming challenging to source. Current injection zones are showing early signs of potentially dangerous levels of overpressure. These zones are beginning to inject slower, are filling up faster, and are holding less volume. High pressures in the Dakota group have already created hundreds of millions of dollars in unnecessary costs for oil and gas producers due to additional strings of intermediate casing across the over-pressured intervals. The combination of these issues will become a difficult challenge for the industry in the near future. North Dakota needs solutions that bring new and better reservoir for disposal, but also solutions to reduce overall disposal volumes. One such solution is to capture valuable minerals from the waste stream which simplifies the process to reclaim and recycle the produced water. This project is expected to substantially relieve near-term disposal challenges while also creating a significant reduction in overall disposal volumes over the long-term.

The United States consumption of critical and rare earth minerals is reliant on imports from nations with high geopolitical risk. These nations and businesses are either heavily influenced or owned by China and Russia. Currently, the U.S. only produces about 5% of the lithium carbonate that it consumes annually. Traditional lithium production methods are water intensive, time consuming, and damaging to the environment, which is not only expensive, but difficult to accomplish from a regulatory standpoint. What we offer is an alternative process that can handle large volumes, scale up fast, and is cleaner than traditional pit mining or evaporation ponds. A successful project means HydroStrat can significantly increase the availability of domestic supplies of critical minerals which enhances our national security and reduces supply constraints.

The COVID-19 pandemic exposed a breakdown of U.S. international supply chains which created regional shortages and historically high fertilizer prices in North Dakota. North Dakota's agriculture industry imports much of its fertilizers today, but HydroStrat aims to provide chemical feedstocks to attract a regional fertilizer manufacturer which will create more competitive pricing. The production of

these feedstocks will reduce the relative salinity of produced water, making it easier to extract fresh water which could ideally be used to irrigate crops.

Recent water shortages and droughts in North Dakota strained available resources, pitting farmers and energy industry operators against each other. These two industries make up the overwhelming majority of business in North Dakota and would greatly benefit from a meaningful increase in water supply. According to the National Drought Mitigation Center, water shortages are expected to increase in frequency and severity over the next several decades. HydroStrat could theoretically deliver enough water to satisfy the energy industry's forecasted needs, offsetting their use of fresh water aquifers and reservoirs, and directly increasing water availability for agriculture, municipalities, and other industries.

### **STANDARDS OF SUCCESS**

#### **Reduced Emissions and Environmental Impacts:**

To improve the economics of known mineral extraction processes, large volumes of brine must be aggregated safely and efficiently to a central facility. Utilization of next generation salt water disposal (SWD) wells and pipeline transportation of up to 1 million barrels per day (BPD) of produced water will reduce emissions, spills, and overall environmental impacts. Furthermore, HydroStrat intends to review the recommendations made through the EERC iPipe program and will either use or exceed these recommendations when considering construction materials and monitoring systems.

Pipeline transportation of brine will reduce emissions by eliminating the need for hundreds of trucks on North Dakota highways, which in turn will reduce the consumption of diesel and the emissions associated with exhaust. An added benefit of having less trucks on the road will be a significant reduction in the risk of small spills which could potentially go unreported.

HydroStrat's next generation of highly efficient SWD wells will dramatically reduce the total number of injectors needed to satisfy oil and gas operations, further reducing diesel consumption used for drilling and completions. These next generation SWD wells will prevent future overpressure hazards in the Dakota formations and alleviate existing over-pressured zones that inhibit oil and gas development.

Each of HydroStrat's next generation SWD wells will eliminate the future need for 10 typical SWD wells, therefore reducing the environmental footprint at the surface by a factor of 10. HydroStrat's commercial refining facility will have the initial capacity to reclaim and recycle 250,000 BPD of produced water, effectively displacing 50 typical SWD wells, and reducing the overall environmental footprint of the oil and gas industry. Eventually, the commercial facility could have a throughput capacity of 1,000,000 BPD which could displace 200 typical SWD wells.

#### **Increased Energy Sustainability:**

Current development and future production of oil and gas from the Bakken region of North Dakota is hindered by increasingly large volumes of produced water with rapidly diminishing disposal options that

meet both safety and economic criteria. HydroStrat's enhanced SWD designs will reduce capital and operational costs for oil and gas producers. This will lead to increased production and unlock previously uneconomic development. In turn, this transition will promote long-term energy sustainability for North Dakota and the United States.

For perspective, if HydroStrat achieves its intended scale of 500,000 BPD, producers could save approximately \$45 million per year in disposal costs. At current rig counts and drilling rates, HydroStrat could eventually save oil producers \$365+ million per year in capital costs by reducing overpressure in Inyan Kara zones near their future development.

At these same commercial levels, HydroStrat is expecting to produce 8,000+ metric tons of lithium carbonate per year which is roughly double the current U.S. domestic production and only 5% of current U.S. demand. Lithium carbonate is an essential component for the lithium-ion batteries used in power storage and electric vehicles. An increase in domestic supply will offset imports and satisfy a portion of domestic demand at a discounted transportation and taxable rate. The cost savings for domestic battery manufacturers and consumers will help reduce the cost of renewable energy and provide a more diverse energy grid with lower emissions.

#### **Value to North Dakota:**

By enhancing produced water disposal efficiencies, the State of North Dakota will be expanding and extending the value provided by the oil and gas industry to the state and its citizens. A developed connection between the energy industry and alternative critical minerals will assist in increasing the industry's long-term viability and license to operate in North Dakota. HydroStrat can also provide a means to increase operator's ESG scores, thus improving their image to citizens of North Dakota.

The fully commercialized extraction facility will generate products derived from critical minerals that will spur economic growth and attract new industries to the state. Tesla is just one example of a potential business that would bring new facilities to North Dakota. Once sufficient quantities of critical minerals are available, economical, and in a single location, businesses will find North Dakota an attractive location for investment.

Other potential new industries for North Dakota include fertilizer production and agricultural irrigation. HydroStrat will produce chemical feedstocks and mineral compounds to fuel the development of a regional fertilizer industry that operates in North Dakota. Commercialization of HydroStrat products will also generate a new source of low TDS water for industrial and agricultural applications, eliminating competition for fresh water sources within the state.

HydroStrat will continue to create value to North Dakota through taxes. HydroStrat will generate significant tax revenues through direct avenues such as property tax, income tax, and sales tax. Tax revenues will also increase indirectly through sustained oil and gas development as a result of the improved viability of previously non-economic acreage due to a reduction in their capital and operational costs.

### **Public and Private Use of Project's Results:**

Several of our research efforts will become publicly available shortly after the timeframe of this project. These publicly available efforts will include a 4D water sampling program led by EERC, an agricultural study to test for effects on crops by recycled produced water, and open laboratory access granted to state institutions for future research directly or indirectly related to the project.

Right now, the EERC has identified roughly 97% of constituents in Bakken produced water but the remaining 3% is left unknown. We will attempt to identify these low-concentration constituents through a series of extractions and re-concentrations in an effort to identify rare earth minerals and other highly valuable minerals that are not easily detectable with standard laboratory processes.

Most water samples are comingled, meaning that they contain produced water from many different wells, and the contribution of those wells will change over time as production slows. This poses a challenge for understanding the long-term proven reserves of the basin. In coordination with the EERC, we will oversee a 4D sampling program that will test produced water at varying geographic locations with varying frequency and varying sample collection points through time. This series of tests will help us understand the chemical changes that occur from reservoir to wellhead to separation tanks to disposal wells. There is potential mineral value being lost early in the separation process, but a test of this nature has never been attempted or quantified.

The agricultural study will require many partial acres of test plots for each type of crop and with each soil type for every region of the state. The results of this test will determine if large volumes of treated produced water can be safely recycled and reused for irrigation. Our results will be made public through PhD candidate research and doctoral theses.

Other projects will remain privately held as proprietary information. We anticipate private sector technology companies, research co-ops, certain university research, federal government agencies, and financial investors to use the project's facilities for their proprietary research. The HydroStrat facility will be instrumental in the creation of a new technology hub for North Dakota and as such it will need to protect the intellectual property of its customers. HydroStrat itself will also maintain the rights to any patentable technology or process that is developed with private funds.

### **Enhancement of Research and Development of Clean Sustainable Technologies:**

HydroStrat's unique mineral extraction pilot facility will operate as a technology platform that will not only reduce costs for emerging and developing technologies, but also provide the marketplace for their successful technology. Any and all tangible technologies that come through our platform will have the opportunity to license their equipment at our commercial facility.

Other companies have created, or are trying to create mineral extraction facilities, but they are limited in scope and only apply to niche market conditions. Our mineral extraction facility will be the only laboratory in the world to offer dozens of skid bays with access to produced water, pre-treatment of water, power, product storage, and disposal. The abundance of skid bays affords the capability to test

dozens of different technologies in varying combinations, at differing volumes, and all simultaneously. The enhanced flexibility and customization of our facility design will draw in technology companies of all sizes to pursue further development of their products and investors will eagerly pursue rapidly advancing technologies.

Another enhancement of research and development will be through our partnership with the North Dakota Department of Agriculture. We will work with North Dakota universities and government agencies to design and implement experiments using fertilizers and reclaimed fresh water on test plots of North Dakota crops. If we can show that our products are safe for farmers then new sustainable agricultural technologies will be implemented at a commercial scale.

Many processes used in mineral extraction will require cooling and reheating the brine solution. We intend to implement low temperature geothermal energy for direct heat exchange, as well as several opportunities to capture waste heat. We will partner with geothermal energy companies where applicable.

**Preservation and Creation of Jobs:**

This project will both preserve and create oil and gas jobs by extending the economic life of the existing assets and unlocking new acreage that was previously uneconomic. These jobs will be the direct result of cost savings provided to oil and gas producers by HydroStrat's more efficient disposal process. This will assist in stabilizing the North Dakota oil and gas industry from low commodity price environments.

This project's operations will generate dozens of new high-paying jobs that require science, engineering, operations, marketing, supply chain, finance, and accounting professionals. We expect to employ 300+ people in North Dakota with our full-scale commercial facility and will be equivalent in throughput to the sixth largest refinery in the United States. A commercial facility of this size will have a trickling effect that will draw more service jobs to the state to assist the business and its employees.

**BACKGROUNDS / QUALIFICATIONS**

**Summary:**

We are a company who takes a holistic approach to business and are led by a management team with over 50 years of experience in oil & gas exploration and production. We have a wide range of expertise and skillsets that make us uniquely capable for solving complex and long-term problems in the U.S. energy, environmental, and mineral production industries.

We possess both the technical expertise as well as leadership experience to execute this project. Many members of our team have previously held executive and/or board positions for large publicly traded organizations. Their successful careers and highly regarded reputations give us access to important contacts within the energy industry and large financial institutions.



**Management Team:**



**Curtis Johnson, CEO & Founder**

Previously Geologist of Oasis Petroleum, 7 years SWD experience, 11 years geology experience, 11 years oilfield experience, MBA from Rice University, M.S. in Geology from Rice University, B.S. in Geology from Lamar University, Licensed Professional Geologist in Texas since 2016



**David Pitts, CFO & Co-Founder**

Previously CFO of Carrizo Oil & Gas, Previously Audit Partner of Ernst & Young LLP, 30+ years of oil and gas experience, 30+ years of accounting and finance experience, 10 years oil and gas company executive leadership, B.S. in Accounting and Business from Southwest Baptist University, Licensed CPA in Texas



**Michael Thelen, COO & Co-Founder**

Previously Sr Reservoir Engineer and Sr Completions Engineer of Oasis Petroleum, 16 years of oilfield experience, 7 years of service company experience, 9 years E&P operator experience, B.S. Petroleum Engineering from The University of Texas at Austin, Licensed Professional Engineer in Texas since 2013

**Advisory Board:**



**Larry McVay, Advisor & Steering Committee**

Texas Tech - Mechanical Engineering 1970, VP Operations & HSE at BP from 2000-2003, COO of TNK-BP from 2003-2006, Principal of Edgewater Energy LLC, Director of Praxair/Linde 2008-Current, Previously Director at Callon Petroleum



**Scott Urban, Advisor & Steering Committee**

BS & MS Earth Science from Bowling Green State University - 1975 & 1977, Stanford Executive Program – 1995, Executive at BP/Amoco – 1977-2005, Edgewater Energy LLC Partner, Pioneer Energy Services board member, Previously Noble Energy board member, Previously Noble Lead Independent Director



**Andy Houser, Advisor & Steering Committee**

Texas A&M – Architecture/Civil – 1979, Darden Executive Program 1998, VP International at Kerr-McGee 2000-2002, VP Marketing at Kerr-McGee 2002-2005, VP Bus. Dev. at Kerr-McGee 2005-2006, VP Operations at Remora Energy 2007-2011, CEO EF Energy 2011-2015, Independent Consultant 2015-Present



**Billy McLucas, Advisor & Co-Founder**

Managing Partner & Founder - WPM Capital, Executive Chairman of Axial Global. Previously Associate of Investment Banking, Simmons & Co. International, 13 years of corporate finance experience, 15 years of oilfield experience, MBA and B.A. from Rice University

## **MANAGEMENT**

The executive team and operations management will run the facility in conjunction with the EERC. Facility employees will be hired and trained with help from EERC personnel. Management will hire EOS Worldwide to help implement the Entrepreneurial Operating System (EOS), which has been used for decades and is well proven for private companies of 10-500 employees. Their consultant will help the executive team create initial protocols and re-evaluate quarterly progress for the first two years. Executives will train employees and vendors on how to use our system. The EOS model provides a framework for how management and employees can communicate as a team.

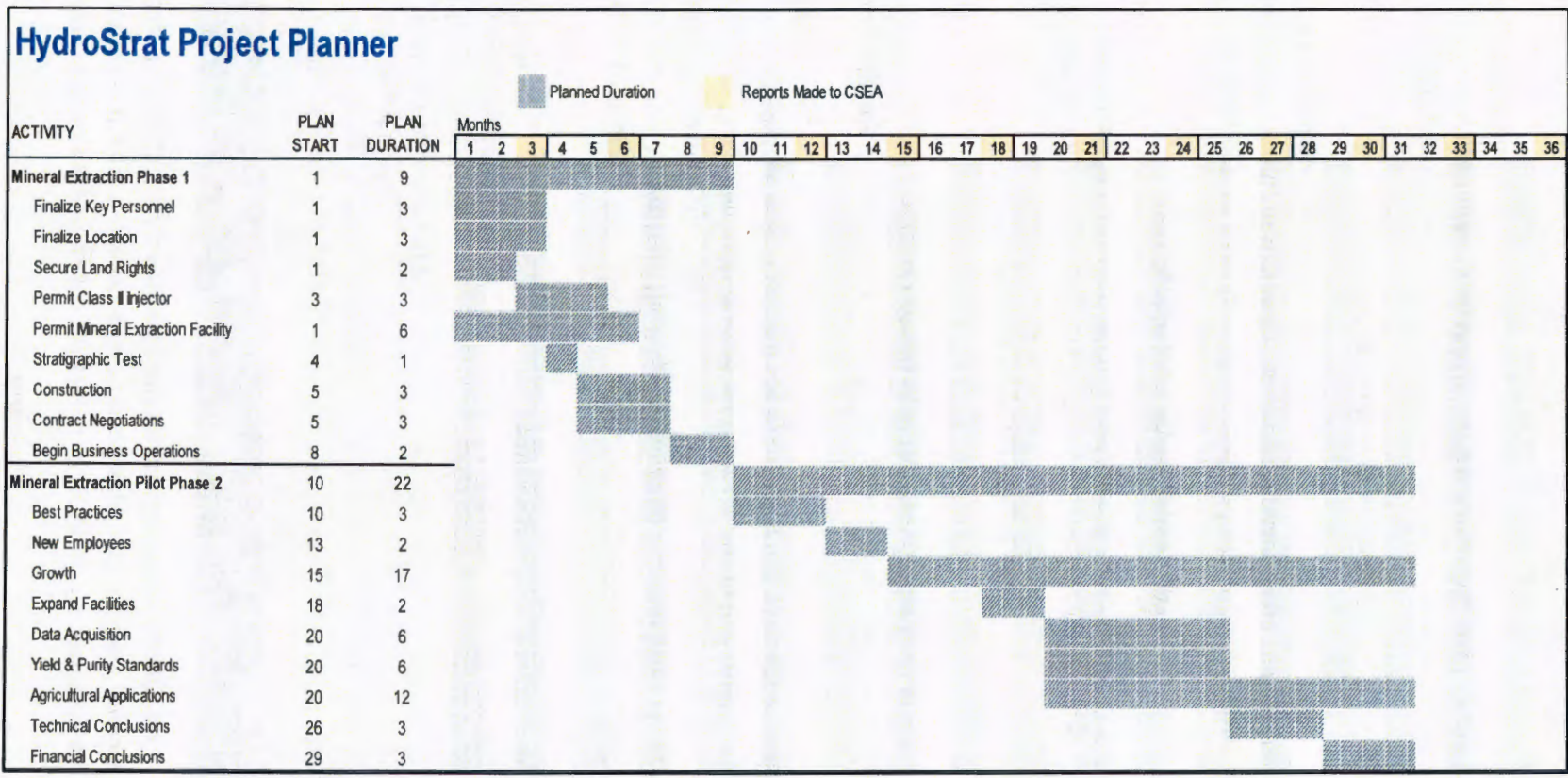
Additionally, we will implement Key Performance Indicators (KPIs) to track our progress and make quarterly reports. Our board of advisors and our board of directors will meet quarterly to review KPIs, general progress, and set goals for the business. All executive salaries and bonuses will be tied to performance. All expenditures greater than \$100,000 will require approval from the CFO. All expenditures greater than \$500,000 will require approval from the CEO. All expenditures greater than \$3,000,000 will require approval from the board of directors.

Equity and grant funds will only be spent on approved tasks which will first require that certain milestones be met. These milestones will be finalized by equity partners but are currently as follows:

1. Availability of land acquisition and leasing rights.
2. Permit class II injector.
3. Stratigraphic test success.
4. Secured commitments for produced water.
5. Engineering design of mineral extraction pilot facility meets environmental standards.
6. Cost estimates for pilot facility are acceptable.
7. Secure contracts for mineral extraction technology companies.
8. Build phase 1 of pilot facility.
9. Financial and or technical success before spending to expand into phase 2.

## **TIMETABLE**

Our estimated project schedule is based on numbers of months and starts when our capital is deployed. We will report regular updates to CSEA on a quarterly basis and provide additional reports upon completion of major milestones.



## BUDGET

Please note that the following proposed budget is not all-inclusive. For simplicity, we are only showing the associated tasks that we are requesting financial assistance for and have rounded the figures to the nearest \$50,000. The complete and detailed budget is attached to the appendices.

Task	Project Associated Expense	NDIC Grant	Applicant's Share (Cash)	Total
1.2	Geologic Characterization	\$250,000	\$1,500,000	\$1,750,000
N/A	Produced Water Characterization	\$325,000	\$325,000	\$650,000
1.5	Facility Design & Advisory Support	\$1,000,000	\$1,000,000	\$2,000,000
1.6	Stratigraphic Test	\$750,000	\$750,000	\$1,500,000
1.7	Pilot Facility Construction	\$4,000,000	\$4,000,000	\$8,000,000
1.9 - 2.3	Facility Operations	\$2,075,000	\$2,075,000	\$4,150,000
2.4	Facility Expansion	\$1,600,000	\$2,400,000	\$4,000,000
	<b>Total</b>	<b>\$10,000,000</b>	<b>\$12,050,000</b>	<b>\$22,050,000</b>

The overall proposed budget is \$32.2 million which includes \$10 million from CSEA (31% of total) and \$22.2 million in cash from HydroStrat. The Project Associated Expenses listed above are considered qualified expenses for Clean Sustainable Energy Authority and are tied to tasks from the project methodology section. These itemized expenses are the most vital to HydroStrat's operational plans. While the project will advance with or without CSEA funds, any financial support will help accelerate the projected timeline.

Project cost estimates are derived from proposals, quotes, estimates, comparable public information, and discussions with experts. Estimates already include administrative costs and an additional 10% for contingencies.

## CONFIDENTIAL INFORMATION

This project application contains confidential information. A confidentiality request form is provided in Appendix B. Additional confidential information is contained in Appendices C, D, E, F, & G.

## PATENTS/RIGHTS TO TECHNICAL DATA

HydroStrat intends to file process patents on all successful mineral extraction plans. We would also like to retain proprietary ownership of subsurface reservoir characterization and mineral reserve assessments until the project has concluded.

## STATE PROGRAMS AND INCENTIVES

HydroStrat has not participated in any State programs or incentives to date, but intends to capitalize on future grant and award opportunities with the Oil and Gas Research Council, Department of Commerce, and Department of Agriculture.

**Appendix A**  
**Letters of Support**



Energy & Environmental Research Center

15 North 23rd Street, Stop 9018 • Grand Forks, ND 58202-9018 • P. 701.777.5000 • F. 701.777.5181  
www.undeerc.org

May 12, 2023

Mr. Curtis Johnson  
Founder and CEO  
HydroStrat GP, LLC  
912 Cohn St.  
Houston, TX 77007

Dear Mr. Johnson:

**Subject: Letter of support for HydroStrat GP, LLC's Proposal "Enhancement of Energy Infrastructure to Enable Sustainable Resource Management, Stimulate Innovation, and Secure Domestic Supply of Critical Minerals"**

The Energy & Environmental Research Center (EERC) is excited to support HydroStrat GP, LLC (HydroStrat) in its proposal to the North Dakota Industrial Commission (NDIC) Clean Sustainable Energy Authority (CSEA) titled "Enhancement of Energy Infrastructure to Enable Sustainable Resource Management, Stimulate Innovation, and Secure Domestic Supply of Critical Minerals." The proposed scope of work to facilitate the development of a mineral processing facility in North Dakota directly aligns with the NDIC CSEA mission *to enhance the production of clean sustainable energy, to make the state a world leader in the production of clean sustainable energy, and to diversify and grow the state's economy* and the EERC's vision *to lead the world in developing solutions to energy and environmental challenges through innovative science and engineering.*

HydroStrat's unique business model leverages an optimized brine injection zone to allow for high-volume processing of produced water without excessive pressurization of the receiving formation, a condition that has impacted oil and gas development elsewhere in the Williston Basin. The ability to process and inject high volumes of produced water will allow HydroStrat to target the most in-demand and technically recoverable constituents in response to market conditions and extraction technology.

The EERC is pleased to be part of HydroStrat's evaluation of this novel produced water processing facility that could be a long-term, sustainable option for the management of substantial volumes of Bakken produced water, while creating additional value from this in-state resource. The EERC has conducted numerous collaborative projects with industry, state, and federal support and is a leading institution with respect to characterizing Bakken produced water, evaluating various resource recovery and/or treatment options for Williston Basin brines, and modeling the impacts of produced water injection in the Williston Basin.

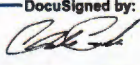
If selected, the EERC is prepared to negotiate, contract, and execute EERC Proposal No. 2023-0117 titled "North Dakota Mineral Processing Facility Development Support" in support of

Mr. Curtis/2  
May 12, 2023

HydroStrat. Specifically, the EERC will work closely with HydroStrat to support the development of a pilot processing facility for resource recovery of critical minerals from produced water. Specific activities to be conducted by the EERC will include 1) geologic site characterization, stratigraphic well drilling support, and geomodeling and reservoir simulation to define and evaluate water management and prioritize data needs; 2) produced water sampling design and analysis to quantify resources of value in Bakken brines; 3) processing facilities design and operational design for resource recovery from produced water; and 4) facility operation and management support.

We believe that the unique business model pairing an optimized injection zone to a facility for processing high volumes of produced water, and thereby allowing for high resource recovery rates, is an innovative approach that could have long-lasting economic and technological benefits for clean energy advancement for the State of North Dakota. We look forward to collaborating with HydroStrat and NDIC on this exciting critical mineral pilot processing facility. If you have any questions, please contact me by phone at 701-777-5355 or by email at [cgorecki@undeerc.org](mailto:cgorecki@undeerc.org).

Sincerely,

DocuSigned by:  
  
29499751F2B84D7...  
Charlie D. Gorecki  
CEO

CDG/bjr

October 27, 2022

To Potential Investors in HydroStrat,

It is my pleasure as the Director of Economic Development and Finance for the North Dakota Department of Commerce on behalf of the North Dakota Department of Commerce to endorse HydroStrat as a clean energy technology opportunity for investors.

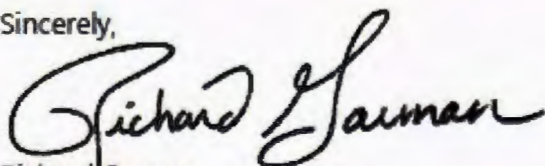
HydroStrat will consolidate hundreds of thousands of barrels of water produced as part of oil and gas extraction in North Dakota, gather this waste stream and process the water for reuse. The recycled water will be made available for agriculture, livestock, industrial use and residential gray water uses.

During the physical and chemical water processing, HydroStrat will extract and purify rare earth minerals. These minerals are critical for the continued manufacturing of batteries for electric vehicles and battery storage for renewable energy sources. This process will help make North Dakota global in the extraction and production of rare earth minerals, reducing our reliance on foreign sources of those minerals.

North Dakota's goal of Carbon Neutrality by 2030 can only be reached through an "all of the above" approach. Our State firmly supports innovation over regulation. An innovative project such as this one proposed by HydroStrat will support the continued exploration and production of the State's abundant energy resources while paving the way for rare earth mineral production supporting battery production for electric batteries.

The Department of Commerce is actively seeking projects that reinforce innovation rather than regulation in our State and thoroughly supports recycling and reuse of any water source as well as extraction of valuable commodities such as rare earth minerals.

Sincerely,



Richard Garman  
Director of Economic Development & Finance  
North Dakota Department of Commerce





**STATE OF NORTH DAKOTA**  
**DEPARTMENT OF AGRICULTURE**  
600 E BOULEVARD AVE, DEPT 602  
BISMARCK, ND 58505-0020

DOUG GOEHRING  
COMMISSIONER

To potential investors in HydroStrat:

It is my pleasure as North Dakota Agriculture Commissioner to endorse HydroStrat as a clean energy technology opportunity for investors.

HydroStrat will reclaim and recycle produced water out of oil and gas production for reuse. The recycled water will be made available for agriculture and industrial use.

During the physical and chemical water processing, HydroStrat will extract and purify rare earth minerals. These minerals are critical for continued manufacturing of batteries for electric vehicles and battery storage for renewable energy sources. Capturing the minerals domestically reduces our reliance on China and boosts national security.

North Dakota is not necessarily a water-constrained state; however, it is in our state's best interest to reclaim, remediate and find innovative uses for water.

North Dakota is the first state in the union to implement carbon sequestration on an industrial scale to support coal generation of electricity; ethanol, biodiesel and biogasoline production from corn; and domestic production of the natural resources of oil and gas production. As Agriculture Commissioner, I am one of the three officials that serve on the North Dakota Industrial Commission. I believe our approach in compliance assistance and empowering people versus enabling them is more productive. We also support recycling and reuse of water sources as well as extraction of valuable commodities such as rare earth materials.

Sincerely,

A handwritten signature in blue ink, appearing to read "Doug Goehring".

Doug Goehring  
Agriculture Commissioner

# NESET

6844 Highway 40, Tioga, ND 58852 701-664-1492

February 7, 2023

To Whom It May Concern,

I understand that HydroStrat is applying for a grant and loan from the Clean Sustainable Energy Authority to help fund the design and construction of a mineral extraction technology pilot facility capable of supporting a wide range of research programs and technological applications to create an innovative and long-term solution to saltwater disposal. Not only will this facility reduce the adverse effects of disposal zone overpressure and reduce costs for oil and gas producers, but it creates an opportunity for the extraction of critical minerals that are key to the United States supply chain.

Production of critical minerals will generate new industries for the State of North Dakota, create jobs and increase tax revenues, all while reducing the environmental footprint of saltwater disposal.

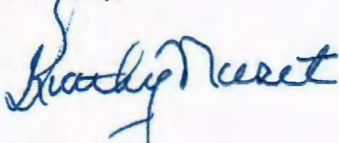
In addition to critical minerals, HydroStrat's facility will also have the potential to produce fertilizer feedstocks that could generate an at-home fertilizer industry, enabling North Dakota's agriculture industry to reduce its reliance on imported fertilizer. Furthermore, HydroStrat will be capable of capturing and recycling produced water for resale to industrial uses, offsetting their use of existing freshwater resources.

Water management is becoming an increasingly significant obstacle to oil and gas production in North Dakota. The Dakota formation, where most saltwater disposal is currently directed, has developed significantly high pressures that raise concerns for operations and environmental priorities. These problems have arisen due to the rapid production growth over the last two decades, which strained the existing processes, and forced many decision-makers into a reactionary state.

HydroStrat will improve these dynamics by focusing on long-term and proactive solutions that utilize their extensive oil and gas experience and profound understanding of North Dakota's geology. This project can quickly become a game changer for the oil and gas industry in North Dakota. For perspective, HydroStrat plans to lease, aggregate, install, and maintain the necessary infrastructure to safely and efficiently process 500,000 barrels of produced water per day or roughly one-third of daily production.

This project is an excellent candidate for the Clean Sustainable Energy Authority's approval and will benefit North Dakota across many industries, including oil and gas, agriculture, and renewables.

Sincerely,



Kathy Neset

President – Neset Consulting Service, Inc.

# NESET

6844 Highway 40, Tioga, ND 58852 701-664-1492

February 7, 2023

Clean Sustainable Energy Authority,

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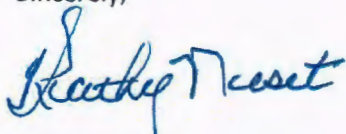
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Sincerely,



Kathy Neset

President – Neset Consulting Service, Inc.



5/15/2023

Bakken Transload  
8836 62<sup>nd</sup> St NW  
Ross, ND 58776

Subject: Letter of Support for Hydro-Strat's Industrial Processing of Produced Water to extract Lithium

I am writing to express my support for Hydro-Strat's industrial processing business and to highlight the significant strides you have made in extracting a valuable resource while reducing traditional produced water disposal methods, leading the way towards a more sustainable future.

The ability to extract Lithium and other "critical materials" out of what has traditionally been a wastewater product is an important step towards reducing our reliance on geopolitically unstable sources of these materials where growth in demand for these products will outstrip supply. It's also important that minerals like Lithium are extracted in methods that are not detrimental to the environment. Hydro-Strat's processes solve these problems.

By implementing innovative technologies and sustainable practices, Hydro-Strat has significantly reduced the reliance on traditional produced water disposal methods. Your efforts in adopting advanced produced water processing and promoting water recycling will not only reduce water consumption but will also make a positive impact on the Oil & Gas industry in the Bakken formation for years to come.

Hydro-Strat will need to have access to low-cost rail transportation to assist in bringing their "critical materials" products to market. Bakken Transload is uniquely positioned in the Bakken formation and more specifically the Ross/Stanley (North Dakota) area to be able to provide economical transloading operations for Hydro-Strat. Bakken Transload is a premier facility that supports either unit-train or manifest rail transloading of various products such as propane, butane, frac sand, and others.

Your success in balancing profitability and environmental consciousness is a testament to the fact that sustainable practices can be mutually beneficial for businesses and the environment.

In conclusion, I support Hydro-Strat's industrial processing of produced water to extract Lithium and other "critical materials" and commend your leadership in reducing traditional produced water disposal methods. Your commitment to sustainability and technological innovation is inspiring. The strides you have made in this area are invaluable contributions toward building a more sustainable future for our industry, community and beyond.

Sincerely,

A handwritten signature in blue ink, appearing to read "Jim Bennett", is written over a light blue rectangular background.

Jim Bennett  
Chairman/Managing Governor