ONEOK

June 1, 2023

Mr. Reice Haase
Deputy Director
North Dakota Industrial Commission
State Capitol 14th Floor
600 East Boulevard Avenue Dept. 405
Bismarck, ND 58505-0840

Dear Mr. Haase:

Subject: Proposal Entitled "Roughrider Carbon Storage Hub" in Response to the North Dakota Industrial Commission Oil and Gas Research Program Solicitation

ONEOK, Inc., is pleased to propose a research project designed to encourage and promote the use of new technologies that have a positive economic and environmental impact on oil and gas exploration, production, and processing in North Dakota. The ONEOK team has been involved with North Dakota's oil and gas industry for the past 35 years. We see the proposed research of evaluating a prospective CO_2 storage hub as an opportunity to not only address the objectives of the Oil and Gas Research Program (OGRP) but also advance Governor Burgum's goal of a carbon-neutral North Dakota. The proposed research will lay the technical groundwork that informs investment decisions and prudent development strategies for natural gas-processing operators seeking to produce low-carbon product.

ONEOK believes the potential long-lasting economic and technological benefits of the proposed project far exceed the requested investment from the OGRP, and ONEOK is prepared to complement U.S. Department of Energy (DOE) and OGRP funding with in-kind cost share to pay for the balance of the project's estimated costs.

ONEOK is confident that its commitment to provide professional and financial resources, as well as providing our project partner, the Energy & Environmental Research Center (EERC), with the necessary access to information, field infrastructure, operational and technical support, and other such items as necessary, will accomplish the proposed research project and bring tremendous value to OGRP and state of North Dakota. Enclosed please find an original and one copy of the subject proposal. A check for $100 will be delivered to the NDIC office. If you have any questions, please contact me by telephone at (918) 732-1476.

Sincerely,

Chad Schneeberger
Director, Renewable Project Development
ONEOK, Inc.

ONEOK, Inc.
100 West Fifth Street
Tulsa, OK 74103
www.oneok.com

Oil and Gas Research Program

North Dakota

Industrial Commission

Application

Project Title: Roughrider Carbon Storage Hub

Applicant: ONEOK, Inc.

Principal Investigator: Chad Schneeberger

Date of Application: June 1, 2023

Amount of Request: $1,050,000

Total Amount of Proposed Project: approximately $16,550,000

Duration of Project: 24 months

Point of Contact (POC): Chad Schneeberger

POC Telephone: (918) 732-1476

POC E-Mail Address:

chad.schneeberger@oneok.com

POC Address: ONEOK, Inc., 100 West 5th Street, Tulsa, OK 74103

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ABSTRACT

Objective: The objectives of the Roughrider Carbon Storage Hub are to accelerate wide-scale deployment of carbon capture, utilization, and storage (CCUS) by assessing and verifying the feasibility of using stacked storage complexes in McKenzie County, North Dakota, for the safe and cost-effective commercial-scale (i.e., ≥50 Mt within 30 years) storage of anthropogenic CO_2 emissions captured from ONEOK and Cerilon (planned) hydrocarbon-processing facilities in northwestern North Dakota. Through the execution of the scope of work, the prospective CO_2 storage resource of the area of interest in McKenzie County will be advanced to a contingent storage resource as classified under the Society of Petroleum Engineers CO_2 Storage Resources Management System (SRMS). In addition, the proposed project will complete a thorough feasibility study for both technical and economic viability as well as develop and implement region-specific plans to engage communities and stakeholders.

Expected Results: This project will provide new information to enable operators, investors, regulators, and other stakeholders to make informed decisions regarding potential CO_2 storage resource in the central portion of the Williston Basin. The stratigraphic test well planned for this project will be drilled near the depocenter of the Williston Basin and will extend to the base of the stratigraphic section (i.e., to the Precambrian surface).

Duration: 24 months (full project duration)

Total Project Cost: The total cost of the project is estimated at $16,550,000. The amount requested from the Oil and Gas Research Program (OGRP) is $1,050,000. The U.S. Department of Energy (DOE) is contributing $9,000,000 through a recent award (currently in negotiation) to the Energy & Environmental Research Center (EERC) at the University of North Dakota from the CarbonSAFE Initiative. If OGRP grants the requested funds ($1,050,000), ONEOK's in-kind cost share is estimated to be $6,500,000.

Participants: ONEOK, the EERC, and Neset Consulting Service (Neset). Letters of support from the EERC, Neset, and others can be found in Appendix A.

PROJECT DESCRIPTION

Objective: The Roughrider Carbon Storage Hub (DE-FOA-0002610 Carbon Storage Assurance Facility Enterprise [CarbonSAFE] Phase II – Storage Complex Feasibility) is a recently awarded 2-year project to determine the feasibility of developing a commercial-scale carbon dioxide (CO_2) geologic storage project (Appendix B). This feasibility study will investigate the safe, permanent, and economical storage of 50+ million metric tons of CO_2 captured from several gas-processing plants owned and operated by project partner, ONEOK, Inc., and a planned gas-to-liquids (GTL) plant by Cerilon.

This CO_2 storage hub scenario includes aspects that make it a highly qualified candidate for a feasibility study with a notably reduced project risk profile: 1) a project partner with a committed goal to reduce greenhouse gas (GHG) emissions associated with North Dakota oil and gas production; 2) prior subsurface data analysis results supporting a stacked storage scenario with adequate CO_2 storage resource; 3) commitment from local, regional, and state-level stakeholders; and 4) a state with Class VI primacy. Potential also exists for expansion/flexibility to include additional CO_2 sources. In aggregate, these project characteristics combined with the Energy & Environmental Research Center's (EERC's) extensive experience with carbon capture, utilization, and storage (CCUS) through the Plains CO_2 Reduction (PCOR) Partnership Program and previous CarbonSAFE efforts (Phases II and III) make our scenario a viable CCUS stacked storage system that can realistically be constructed and permitted for operation. The project risk profile is reduced by the existence of established and tested pore space ownership legislation and the long-term liability policy of the state of North Dakota. North Dakota is one of two states with underground injection control (UIC) Class VI well primacy. This status has proven to be a strong driver for the growth of CCUS project planning in the state, as is public acceptance of the four EERC-led Class VI permits now approved.

Previous subsurface data analysis by both the PCOR Partnership and a specific investigation sponsored by ONEOK identified the Inyan Kara, Broom Creek, Mission Canyon, and Deadwood Formations as potential secure CO_2 storage horizons in the area of interest (AOI). Data analysis and

modeling results indicate the prospective CO_2 storage resource potential of these formations in the AOI to be nearly 200 Mt in a 36-square-mile area (one township). In addition, the proposed approach leverages economies of scale and the potential for efficiency and optimization through the grouping of natural gas-processing facilities, a proposed GTL plant, and an existing pipeline right of way (ROW). This synergy facilitates success of the project.

The discrete geologic data sets derived from the proposed activities will enable the development of comprehensive 3D geocellular models with reduced uncertainty compared to earlier basin-scale evaluations. These models will be used in dynamic simulation activities to accurately determine the area of review (AOR) extent associated with CO_2 and pressure plume development. Understanding the potential extent of the CO_2 and pressure plumes will provide a foundation for understanding the magnitude of future pore space-leasing requirements and monitoring, verification, and accounting activities.

Methodology: The proposed scope of work is based on sound scientific and engineering principles, as evidenced by the EERC's record of conducting similar assessments in central North Dakota, resulting in four approved CO_2 storage facility permits. In addition, the project team has decades of experience managing field activities, successful major construction projects, and operation of gas-processing facilities, all of which require understanding and application of scientific and engineering principles. The proposed tasks will leverage the existing experience, knowledge, lessons learned, and relationships within the project team to characterize a storage complex with the potential to securely store 50 Mt of anthropogenic CO_2. Collected and interpreted data, as well as execution of societal considerations and impacts assessments and plans, will build a foundation upon which future decisions can be made regarding the implementation of commercial-scale CCUS operations in McKenzie County. The tasks are designed to systematically identify and address both technical and nontechnical challenges; collaborate with team members and key stakeholders to provide solutions and paths toward commercialization; and communicate results to the state of North Dakota, local communities, the U.S. Department of Energy (DOE), and other stakeholders.

Task 1.0 – Project Management: This task includes the activities for managing project tasks, milestones, and deliverables and ensuring coordination and planning of the project with the North Dakota Industrial Commission (NDIC), DOE, and other project participants. This includes briefings, as requested, and routinely scheduled conference calls. A final topical report summarizing key results and recommendations from this feasibility study will be completed. In addition, the EERC will ensure compliance with all technical briefing and presentation requirements, including but not limited to NDIC and DOE program peer review meetings.

Task 2.0 – Societal Considerations and Impacts Assessment and Plans: Through a social characterization analysis, activities within this task will, from the standpoint of the project and associated goals, identity communities and stakeholders to determine effective ways to engage and build relationships with those audiences, listen to their needs and concerns, and develop meaningful outcomes for those stakeholders. This work will include developing messaging goals and content, selecting methods for engaging stakeholders (e.g., media campaigns, open houses, etc.). strategies for incorporating stakeholder feedback, and materials development.

Task 3.0 – Storage Complex Characterization: This task covers all the activity required to characterize up to four prospective CO_2 storage complexes (stratigraphic zones) within the AOI of the proposed project. This effort includes updates to existing geologic and hydrogeologic evaluations based on new data from existing geologic resources; the collection of new data in the form of collection and analysis of new core, subsurface fluid samples, and well logs; and the acquisition and reprocessing of existing seismic surveys. Significant activity in this task is to locate, permit, and drill a geologic characterization well (stratigraphic test well) in the study area. This well will be drilled on private land, 4-inch core will be taken from the cap rock and reservoir sections of up to four stratigraphic pairs, and a comprehensive logging suite will be collected from the well. Once sampling and logging processes are completed, this well will be plugged and abandoned according to procedures established by NDIC. Data acquired and analyzed during this task will be used in the development of Task 4.0 – Geologic Modeling and Simulation.

Task 4.0 – Geologic Modeling and Simulation: The geologic site characterization data (logs, core analysis, and seismic) will be integrated into geocellular models that account for the properties of the study areas, which comprise the injection horizons and overlying sealing formations that serve as barriers to prevent out-of-zone migration. The geologic models will provide the foundation for dynamic simulations of potential injection scenarios. Dynamic simulations are required to predict how CO_2 and its associated pressure plume would be distributed in the study areas and the effectiveness of the sealing formation at the site during the carbon capture and storage (CCS) time frame. Simulation results will provide key design and operational parameters for 1) the injection well and infrastructure; 2) a technical risk assessment; 3) AOR determination; 4) monitoring, reporting, and verification (MRV) planning; and 5) installation expenditures.

Task 5.0 – Technical and Economic Analysis: This task will be conducted to evaluate the technical and economic feasibility of the proposed CO_2 storage project, including various project options such as adjacent and distributive (collection and pipelining of CO_2 streams to a central location) storage potentials. The expansion of conceptual pipeline designs leveraging the existing ROWs and the experience of ONEOK in the operating conditions that include the design, construction, operation, and access of pipelines will be used. This task will include examining more specific economic needs and the incentives in place or additional CO_2 volumes required to make the proposed scenarios economically feasible for the project partners.

Task 6.0 – Site Development Plan: This task will create a detailed plan to develop a subsequent complete site characterization effort to support a potential future UIC Class VI permitting process for a potential future commercial CCUS facility. This plan will be based on the results of the other project tasks and will include a geologic characterization strategy for the potential injection site(s), a CO_2 management strategy for acquiring and transporting CO_2 to the injection site, and a risk assessment to identify project risks and provide mitigation strategies. The site development plan will be developed under applicable North Dakota Administrative Code sections.

Anticipated Results: This project will facilitate CCUS deployment and infrastructure development in an area of North Dakota that has had minimal exploration for CO_2 storage resource by reducing uncertainties and providing solutions to technical and nontechnical challenges. The results of the proposed work will enable the development of environmentally sound, low-carbon-intensity natural gas processing and utilization by providing essential technical and economic information regarding the various components of the CCUS value chain (i.e., CO_2 capture, transport, storage). Data collected from the stratigraphic test well (e.g., core, geophysical logs, fluid samples) that is planned to extend to the Precambrian basement will provide new insight into the nature of the deep subsurface in the McKenzie County portion of the Williston Basin. In addition to supporting the assessment of storage resource potential, these data will provide new information on potential underdeveloped hydrocarbon plays and geothermal resources.

Facilities: Most of the data collection and manipulation, reservoir characterization, modeling, laboratory analysis, facilities assessment, and product development work will be conducted at EERC facilities in Grand Forks, North Dakota. Modeling hardware at the EERC includes a high-performance computer cluster dedicated to advanced reservoir modeling and simulations. The EERC uses industry-standard modeling and simulation software and has staff proficient in their use. EERC facilities include several laboratories and personnel with more than two decades of experience conducting standard and advanced core and fluid studies, including geomechanical, petrographic, geochemical, exposure, and flow-through studies. The EERC has x-ray diffraction (XRD), x-ray fluorescence (XRF), and scanning electron microscopy systems, as well as the ability to conduct wet-chemistry and trace elemental analyses. The EERC's staff encompass geology, chemistry, physics, and engineering disciplines.

Resources: Project partners, the EERC and ONEOK, conducted an initial screening study of northwestern North Dakota using publicly available legacy well data. The screening study area included the AOI for this project in central McKenzie County, North Dakota. The NDIC Oil and Gas Division provides online access to all geophysical logs related to deep well drilling in North Dakota. These data will be used, along with new data collected as part of this research effort, to construct 3D geocellular models of the targeted

CO_2 storage complexes. Legacy 3D data available in the project area will be purchased from a data exchange company. The legacy 3D data will be reprocessed with modern processing techniques and will be interpreted at the EERC for the purpose of extending the point characterization data collected at the test well laterally for several miles to evaluate the structural and stratigraphic continuity of the target geologic horizons.

Techniques to Be Used, Their Availability and Capability: Industry-standard geologic characterization and reservoir engineering practices will be employed. Static and dynamic modeling activities will be conducted on computer hardware and software currently existing at the EERC. All personnel, equipment, space, and software to conduct the laboratory and modeling activities will be available throughout the duration of the project.

Environmental and Economic Impacts While Project Is Under Way: Most of the project will be conducted at the EERC. Fieldwork focused on the drilling of a stratigraphic test well, core collection, and well logging will be conducted following industry-standard practices on an existing well pad; thus minimal environmental impact is expected over the 2-year period of performance.

Ultimate Technological and Economic Impacts: ONEOK's midstream assets in North Dakota include over 12,000 miles of natural gas-gathering pipelines, over 300 miles of natural gas liquid pipelines, and six processing facilities with the capacity to process and treat almost 2 billion cubic feet per day of natural gas. This natural gas network employs approximately 485 personnel. As a midstream service provider experienced in the gathering, transportation, storage, and distribution of natural gas, ONEOK is well-positioned to provide similar CO_2-related services for companies in need of a CO_2 storage solution.

As the Williston Basin continues to mature, natural gas production will continue to grow with increasing gas-to-oil ratios, which will result in more demand for natural gas processing. Achieving a goal of net carbon neutrality for the state will require the capture and geologic storage of CO_2. This scenario will retain and even increase quality jobs, and as gas production volumes increase and processing capacity is developed to accommodate that growth, additional sources of CO_2 emissions will need to be captured,

transported, and stored, thereby creating additional high-quality, good-paying jobs and a lower-carbon-intensity oil and gas industry in North Dakota.

The EERC and ONEOK are currently working with Cerilon, which is developing a state-of-the-art GTL facility in northwestern North Dakota to produce low-carbon liquid transportation fuels. Cerilon is including CO_2 capture technologies in its engineering designs for the facility, and ONEOK is assisting by studying CO_2 gathering, transportation, and storage alternatives. Cerilon expects to employ 77 people at the time of operations, which will be new high-quality jobs in the project area. The development of a CO_2 storage hub in northwestern North Dakota would create an opportunity to aggregate and store CO_2 emissions from several sources across multiple industries, thereby potentially saving and generating hundreds of quality jobs. It would also reduce CO_2 emissions that are projected to increase in the area over time while facilitating increased production of oil and gas resources vital to energy security.

Why the Project Is Needed: Currently there are no permitted CO_2 storage facilities in the major oil-producing counties of northwestern North Dakota (McKenzie, Mountrail, Billings, Williams, Burke Counties). The proposed Roughrider Carbon Storage Hub project will provide infrastructure to safely, efficiently, and cost-effectively store CO_2 generated in the major oil-producing counties of North Dakota that would otherwise contribute to increased concentrations of CO_2 in the atmosphere. ONEOK has analyzed CO_2 sources in the project area and determined that there are over 2.2 Mt of CO_2 produced each year by industries such as natural gas gathering, processing, and transportation; power generation; and ethanol production. ONEOK anticipates continued growth in these industries in future years, which will increase the volume of CO_2 produced. Cerilon, which is supportive of this project, plans to develop a GTL facility in the area that is expected to produce between 1.2 and 4.0 Mt of CO_2 each year. Like ONEOK, many of the companies operating assets in northwestern North Dakota have environmental and sustainability goals to reduce their GHG emissions in the coming years, and CO_2 capture, transportation, and storage are expected to further the goal of reducing these emissions. A viable CO_2 storage hub will be critical to managing CO_2 emissions from natural gas processing and use in North Dakota and is essential to achieving Governor Burgum's challenge of a carbon-neutral North Dakota by 2030.

Funding through DOE will help offset the development costs of CO_2 storage projects, and incentives such as 45Q will provide tax credits that make CO_2 capture, transportation, and storage economically viable. The project team believes that as more CCS projects are developed, the costs of the technologies employed will continue to fall and projects such as this will become more economically attractive.

STANDARDS OF SUCCESS

Success will be measured according to the timely achievement of project milestones and the development of deliverables. Several success criteria have been developed to help track the progress of the project and to indicate the successful completion of project objectives. For example, the successful completion of Milestone (M) 2 (stratigraphic well drilling) will allow the core to be available for analysis and testing, and data from the interpretation and analysis of core samples will provide site-specific data to the geologic model. The successful completion of a first geologic model will allow for the initiation of dynamic simulation (M6) as well as critical input to the site characterization plan; the successful completion of the technical and feasibility review and assessment (D7) will allow for the team to confirm and validate the subsequent risk assessment, monitoring and mitigation strategies. The successful completion of M10 will allow the project team to identify and evaluate project risks and complete the site development plan (Deliverable [D] 9).

The development of a CO_2 storage hub in northwestern North Dakota would create an opportunity to aggregate and store CO_2 emissions from several sources across multiple industries, thereby potentially saving and generating hundreds of quality jobs. It would also reduce CO_2 emissions that are projected to increase in the area over time while facilitating increased production of oil and gas resources vital to energy security. The results of this project will facilitate environmentally sound exploration and production methods and technologies to develop the state's oil and gas resources and support research and educational activities concerning the oil and gas exploration, production, and processing industry. The project will also provide the foundation for future commercial gas storage (CH_4, H_2, CO_2) development in western North Dakota. The educational contribution of the project will be fulfilled by conference presentations and publications, which may include presentations at the Williston Basin Petroleum

Conference, public reporting, and engagement with the North Dakota Petroleum Council's outreach and education program. ONEOK and the EERC will work closely with NDIC through project meetings and quarterly reporting to ensure project quality and timeliness.

BACKGROUND/QUALIFICATIONS

Wesley Peck, EERC Assistant Director for Subsurface Strategies, will be the project manager and principal investigator (PI) on the DOE-funded project. Other key personnel include Mr. Chad Schneeberger, ONEOK Renewable Project Development Director, who will serve as a project advisor and direct and coordinate efforts by ONEOK to assist in project activities and provide land and data access. Mr. Schneeberger will work closely with the EERC team to ensure project team members have the appropriate resources/information and that ONEOK meets internal deliverables for the proposed project. Mr. Schneeberger has over 25 years of experience in midstream operations. Resumes of key personnel are provided in Appendix C.

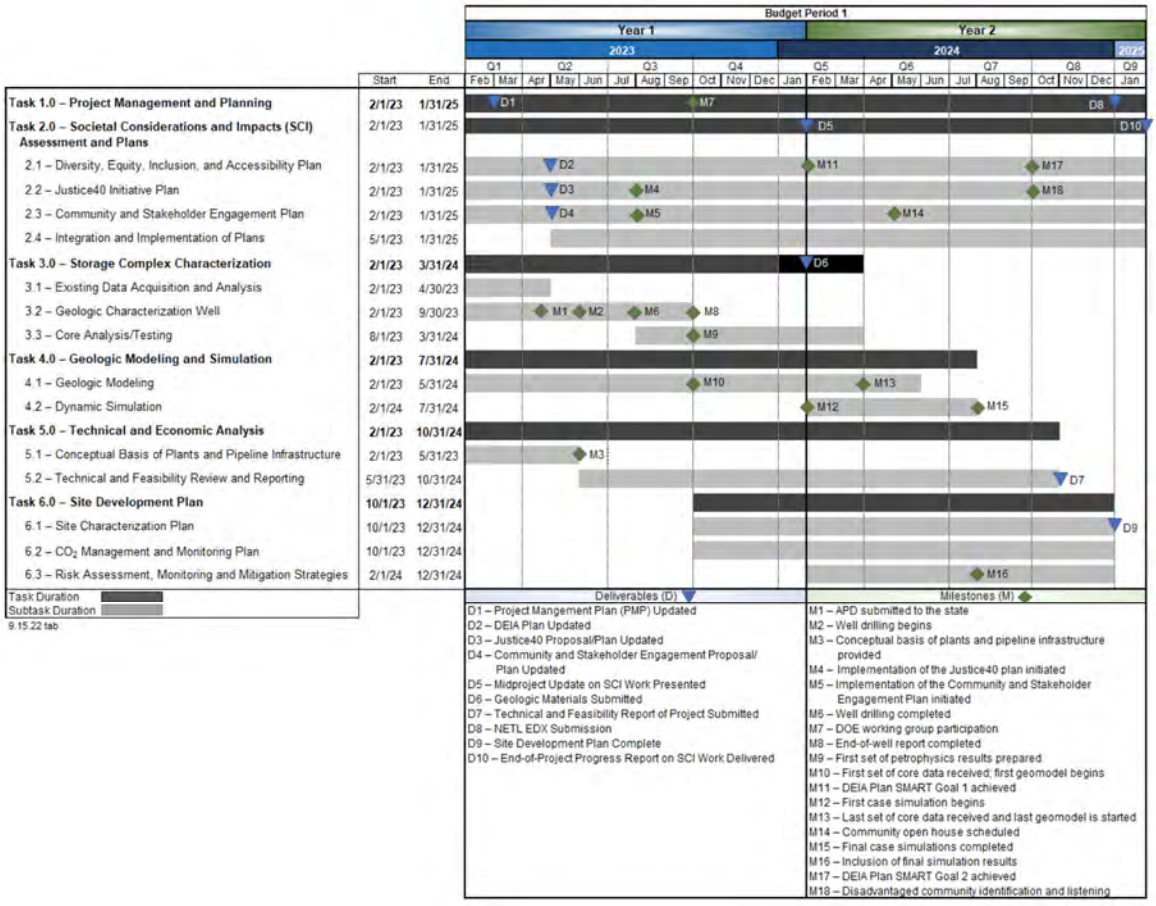
The EERC is a high-tech, nonprofit branch of UND that operates like a business and is dedicated to moving applied research into the commercial marketplace. The EERC, practicing under a long-standing philosophy of collaboration and an interdisciplinary approach, brings a specialized technical group focusing on the design and implementation of new approaches to the exploration, development, and production of oil and gas. Previous EERC carbon storage projects have focused on characterizing storage resources in North Dakota, developing advanced methods for monitoring injected CO_2, and developing CO_2 storage facility permits under the North Dakota Class VI well-permitting program. Neset Consulting Services (Neset) has overseen the drilling, core collection, and geophysical logging of hundreds of wells in North Dakota, including stratigraphic test wells for CO_2 storage resource evaluations.

MANAGEMENT

The EERC will lead the project with support from project partners, ONEOK and Neset. SLB (formerly Schlumberger Technology Corporation) and Computer Modelling Group Ltd. (CMG) will provide the industry-standard software packages needed to execute the proposed scope of work. Each of the proposed tasks will be led by qualified individuals from the EERC who will work with the project partners as

appropriate to accomplish task goals and corresponding project goals. Deliverables and milestones will be incorporated into a contractual agreement to ensure the project is being carried out on schedule and in a manner that best ensures the objectives will be met. Progress reports will be prepared quarterly (due 30 days at the end of each calendar quarter) and will serve to evaluate the project for budget, schedule, and technical achievement. The evaluation points (i.e., deliverables and milestones) are identified in the following Gantt chart. The actual dates will be adjusted when the final contract with DOE is in place.

TIMETABLE



BUDGET

The overall estimated cost for the 2-year project is $16,550,000 (Appendix B). DOE is contributing $9,000,000 in funding support through the CarbonSAFE Initiative. This proposal requests $1,050,000 from NDIC through its Oil and Gas Research Program (OGRP), and ONEOK anticipates providing an

estimated $6,500,000 in 15 cofounding for the remainder of the project cost. The ONEOK and NDIC contributions will support the drilling and testing of the stratigraphic test well. Operating costs not directly associated with the costs of the project are not shown. Successful achievement of all of the project's objectives is dependent upon timely completion of each proposed component of the project. The knowledge that will be generated by successful completion of the proposed activities is necessary to build and maintain momentum for possible future deployment of commercial-scale CCS in McKenzie County. Lower-than-requested funding levels could result in significant delays to execution of the proposed activities. Current federal tax incentives for CCS have a limited time frame during which they will be available, and delays in developing the necessary data required to determine the viability of McKenzie County will delay commercialization and adversely impact the business model.

Total Project Expense	NDIC's Share	Applicant's Share (cash)	DOE's Share
$16,550,000	$1,050,000 (6%)	$6,500,000 (39%)	$9,000,000 (55%)

TAX LIABILITY

ONEOK, Inc., a leading midstream service provider and one of the nation's premier natural gas liquids systems, connecting NGL supply in the Rocky Mountain, Mid-Continent and Permian regions with key market centers and an extensive network of natural gas gathering, processing, storage and transportation assets is current with all tax filings and liabilities in the state of North Dakota.

CONFIDENTIAL INFORMATION

Although there is no confidential information included in the proposal, there is a reasonable expectation that confidential information will be involved in, or created during, the execution of the project. In such cases, confidential information will be withheld from public disclosure. However, the intent is to make as much information publicly available as possible while protecting the interests of ONEOK.

PATENTS/RIGHTS TO TECHNICAL DATA

Patents or rights do not apply to this proposal.

STATUS OF ONGOING PROJECTS (IF ANY)

ONEOK has not previously requested or received OGRP funding.

APPENDIX A

LETTERS OF SUPPORT

EERC
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 31, 2023

Mr. Chad Schneeberger
ONEOK Renewable Project Development Director
ONEOK, Inc.
100 West 5th Street
Tulsa, OK 74103

Dear Mr. Schneeberger:

Subject: OGRP Proposal Entitled "Roughrider Carbon Storage Hub"

The Energy & Environmental Research Center (EERC) is excited to support ONEOK in its proposal to the North Dakota Industrial Commission (NDIC) Oil and Gas Research Program (OGRP) entitled "Roughrider Carbon Storage Hub." The proposed scope of work directly aligns with the NDIC OGRP mission to *promote the growth of the oil and gas industry through research and education* and the EERC's vision *to lead the world in developing solutions to energy and environmental challenges through innovative science and engineering*.

As you know, the U.S. Department of Energy (DOE) recently announced the EERC as the recipient of a $9 million award to investigate the feasibility of developing a CO_2 storage hub in western North Dakota. Through the proposed research effort, the EERC will work closely with ONEOK to evaluate a prospective CO_2 storage hub as an opportunity to not only address the objectives of OGRP and DOE but also make major strides toward achieving Governor Burgum's goal of a carbon-neutral North Dakota. The proposed research will lay the technical groundwork to inform investment decisions and prudent development strategies for natural-gas processing operators seeking to produce a low-carbon product.

We believe that the proposed research's potential long-lasting economic and technological benefits far exceed the requested investment from NDIC OGRP, and the EERC is prepared to leverage our experience and provide the necessary technical resources to ensure the successful execution and fulfillment of reporting requirements for the research activities. We look forward to collaborating with ONEOK and NDIC on this exciting effort. If you have any questions, please contact me by phone at (701) 777-5472 or by email at jhamling@undeerc.org.

Best regards,

DocuSigned by:
6AD3DF00E40048F...
John A. Hamling
VP for Strategic Partnerships

Approved by:

DocuSigned by:
29499751F2B84D7...
Charles D. Gorecki, CEO
Energy & Environmental Research Center

JAH/rlo

KELLY ARMSTRONG
AT-LARGE, NORTH DAKOTA

ENERGY AND COMMERCE COMMITTEE
CONSUMER PROTECTION AND COMMERCE
ENERGY

Congress of the United States
House of Representatives
Washington, DC 20515

WASHINGTON OFFICE:
1740 LONGWORTH HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225-2611

DISTRICT OFFICES:
3217 FIECHTNER DR., SUITE B
FARGO, ND 58103
PHONE: (701) 353-6665

U.S. FEDERAL BUILDING
220 E ROSSER AVE., ROOM 228
BISMARCK, ND 58501
(701) 354-6700

ARMSTRONG.HOUSE.GOV

July 21, 2022

Mr. John A. Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear John:

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

I write to express my support for the Energy & Environmental Research Center's (EERC) efforts to secure funding through the U.S. Department of Energy's CarbonSAFE Phase II – Storage Complex Feasibility funding opportunity, DE-FOA-0002610.

I am a champion of North Dakota's vibrant energy resources and those enterprises that responsibly produce and develop these assets. I am particularly proud of my frequent opportunities to highlight the ongoing leadership of the EERC in formulating an economically viable reduced carbon future for our nation and world.

The EERC's proposed efforts will examine the potential development of a world-class and world-scale carbon storage enterprise in North Dakota. I am confident that this initiative will further propel North Dakota's leadership in the pursuit of long-term energy solutions.

I strongly support the EERC's efforts, which will lead to exciting opportunities for the state of North Dakota and the nation.

Sincerely,

Kelly Armstrong
Member of Congress

NORTH Dakota | Governor Doug Burgum

Be Legendary.™

July 21, 2022

National Energy Technology Lab
U.S. Department of Energy
Morgantown Campus
3610 Collins Ferry Road
P.O Box 880
Morgantown, WV 26507-0880

Subject: Support for EERC CarbonSAFE Proposal Titled "Roughrider Carbon Storage Hub"

To whom it may concern:

Please accept this letter of support for the Energy & Environmental Research Center's (EERC's) efforts to secure funding through the U.S. Department of Energy's CarbonSAFE Phase II – Storage Complex Feasibility funding opportunity, DE-FOA-0002610.

Among my duties as governor of North Dakota is to chair the North Dakota Industrial Commission, which is the primary regulator of North Dakota's vast subsurface mineral resources. North Dakota has a long history of responsible development and environmental stewardship. The EERC has had a long-term commitment to making geologic sequestration of CO_2 a viable option in our quest to make North Dakota carbon neutral by 2030 through innovation.

North Dakota's energy industries are global leaders in energy development and production, implementing long-term strategies that provide meaningful and abundant contributions to our nation's energy needs. This includes fossil fuels as well as renewable resources. The project proposed by the EERC will facilitate continual environmental progress in the utilization of our state's abundant natural resources by investigating the feasibility of developing an integrated carbon storage complex.

We strongly support the efforts of the EERC and look forward to the exciting opportunities this work will bring to the state of North Dakota and our country in resolving our energy challenges.

Regards,

Doug Burgum
Governor

COMPUTER MODELLING GROUP LTD.
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Tel: +1.403.531.1300 ▪ Fax: +1.403.289.8502
cmgl@cmgl.ca ▪ www.cmgl.ca

September 13, 2022

Mr. Wesley Peck
Assistant Director for Subsurface Strategies
Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Peck:

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

I am writing to confirm Computer Modelling Group Ltd.'s (CMG's) commitment to partner with the team being assembled by the Energy & Environmental Research Center (EERC) in response to The U.S. Department of Energy's CarbonSAFE Phase II – Storage Complex Feasibility funding opportunity
DE-FOA-0002610.

CMG is focused on providing practical solutions for modeling and simulation of oil and gas and CO2 storage opportunities and as such, we are very supportive of projects that will enable the continued use of our nation's energy resources in an environmentally responsible manner. The results of the project will provide the natural gas industry with data and knowledge critical to implementing commercial-scale CO_2 storage.

As indicated in the subject proposal, CMG is committed to provide reservoir simulation software licenses and technical support for the duration of 18 months. We will provide three licenses each of GEM MAX and CMOST, plus one license of WINPROP. The total value of this contribution is shown below

Software Type (Number of Licenses)	GEM MAX (3), WINPROP (1), CMOST (3), BUILDER (4), RESULTS (4)
Total License Fees (18 mo.)	**$747,150**
Amount to Be Paid by EERC (BUILDER, RESULTS) (18 mo.)	**$124,800**
Total Contribution (18 mo.)	**$747,150**

We welcome this opportunity to collaborate with the EERC and the rest of the team on addressing the critical challenges associated with the development of a commercial-scale CO_2 storage site.

Sincerely,
Computer Modelling Group Ltd.

Sandra Balic
Vice President, Finance & CFO

KEVIN CRAMER
NORTH DAKOTA

SUITE 330
HART BUILDING
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July 21, 2022

Mr. John A. Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear John:

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

I am writing to express my support for the University of North Dakota Energy & Environmental Research Center's (EERC's) efforts to secure funding through the U.S. Department of Energy's CarbonSAFE Phase II – Storage Complex Feasibility funding opportunity, DE-FOA-0002610.

As you know, I have been persistent in my support for our state's all-the-above energy industry and for the world-class energy research across multiple disciplines undertaken by the EERC. I introduced and worked on multiple pieces of legislation to encourage research, development, and implementation of carbon capture, utilization, and storage (CCUS) technologies.

North Dakota is among the nation's premier states in energy production and environmental conservation. I am a proponent of an all-the-above strategy for the development and production of all of the state's energy resources—conventional and renewable—and believe North Dakota's energy research and policies should serve as a model for the rest of the country. The EERC's proposed efforts will fast-track the development of an integrated carbon storage complex in North Dakota, which will lead to an expansion of the opportunities for our state's and nation's energy industries.

I am a strong advocate of the work being done at the EERC and remain supportive and committed to the opportunities being pursued, including proposals like the geologic carbon storage project, and the promise they provide for the state of North Dakota and the nation.

Sincerely,

Kevin Cramer

Kevin Cramer
United States Senator

JOHN HOEVEN
NORTH DAKOTA
338 RUSSELL SENATE OFFICE BUILDING
TELEPHONE: (202) 224-2551
FAX: (202) 224-7999
hoeven.senate.gov

United States Senate

WASHINGTON, DC 20510

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July 20, 2022

Mr. John A. Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

RE: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

Dear John:

I am writing to express my support for the Energy & Environmental Research Center's (EERC's) efforts to secure funding through the U.S. Department of Energy's CarbonSAFE Phase II – Storage Complex Feasibility funding opportunity (DE-FOA-0002610).

After nearly 15 years of effort, we have placed North Dakota at the forefront of energy development. Our state not only serves as an energy powerhouse for our nation, but we are also leading the way in innovative new technologies, like carbon capture, utilization and storage (CCUS), which will empower the United States to continue utilizing all of our abundant energy resources with better environmental stewardship. In particular, we:

- Developed and passed through the North Dakota legislature, a regulatory framework for long-term carbon sequestration in the state.
- Established trust funds for state oversight and for long-term liability.
- Secured approval from the Environmental Protection Agency to give North Dakota regulatory primacy over Class VI wells.

These are among the critical elements that set our state apart in making geologic sequestration a reality, and the EERC has been a central player throughout these efforts. Now under this proposal, the EERC is seeking to investigate the feasibility of housing an integrated carbon storage hub in North Dakota. Such a facility would be an important resource in accelerating the implementation of CCUS in our state, while supporting the energy security of our nation.

Accordingly, I hope this application receives favorable consideration. Thank you for your continued work toward these important goals, and feel free to contact my office should you need any further assistance.

Sincerely,

John Hoeven

John Hoeven
U.S. Senator

July 15, 2022

INDUSTRIAL COMMISSION OF NORTH DAKOTA

Doug Burgum
Governor

Drew H. Wrigley
Attorney General

Doug Goehring
Agriculture Commissioner

Mr. John A. Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear John:

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

The North Dakota Industrial Commission (NDIC) Clean Sustainable Energy Authority (CSEA) is pleased to support the Energy & Environmental Research Center's (EERC's) proposed project to investigate the geologic storage of CO_2 in western North Dakota in response to CarbonSAFE Phase II – Storage Complex Feasibility DE-FOA-0002610.

The purpose of CSEA is to support research, development, and technological advancements through partnerships and financial support for the large-scale development and commercialization of projects, processes, activities, and technologies that reduce environmental impacts and increase sustainability of energy production and delivery. The U.S. Department of Energy's interest in carbon capture aligns with the goals and objectives of CSEA.

North Dakota is at the forefront of energy development and production, investigating long-term strategies that incorporate all the state's energy resources—traditional and emerging—to meet the nation's growing energy demand in an environmentally responsible manner. The project proposed by the EERC will investigate the feasibility of a commercial storage complex hub in North Dakota, leading to expanded opportunities for the state's energy industries. If the proposed project is awarded, CSEA may be able to provide additional funding opportunities in the form of grants and/or loans to support future developmental work.

We look forward to working with the EERC team on this important project.

Sincerely,

Alan Anderson
Director

Karlene Fine, Executive Director and Secretary
State Capitol, 14th Floor - 600 E Boulevard Ave Dept 405 - Bismarck, ND 58505-0840
E-Mail: kfine@nd.gov
Phone: (701) 328-3722
www.nd.gov

NORTH Dakota | Mineral Resources
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July 21, 2022

Mr. John A. Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear John:

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

The North Dakota Industrial Commission's (NDIC's) Department of Mineral Resources (DMR) is pleased to provide the Energy & Environmental Research Center (EERC) with this letter of support for the proposed studies to investigate a commercial-scale geologic carbon storage hub in western North Dakota in response to the U.S. Department of Energy's CarbonSAFE Funding Opportunity DE-FOA-0002610.

As you know, North Dakota is one of the nation's largest providers of energy. Because energy production is such a vital part of the North Dakota economy, we are very supportive of the development of technologies that will enable the continued use of our energy resources in an environmentally responsible manner.

We are particularly excited about the proposed CarbonSAFE opportunity because it will help support the natural gas-processing facilities in western North Dakota. If successfully funded, the EERC's CarbonSAFE project will characterize storage sites in North Dakota to help qualify a portion of our vast CO2 storage potential. The results of the project will provide the natural gas industry with data and knowledge critical to implementing commercial-scale CO2 storage in deep saline formations across the state.

Should the feasibility study be funded, we understand the EERC is planning to permit and drill one stratigraphic test well under NDIC guidelines. As the state regulator for underground injection control (UIC) Class VI storage permits, to support this effort, NDIC DMR is prepared to work with the EERC to ensure all required documents are submitted with the permit applications and that they are reviewed and approved in a timely manner.

In closing, we look forward to working with the EERC and proposal team on this important project. We wish you the best in your efforts to secure this funding opportunity.

Sincerely,

Lynn D. Helms
Director

Bruce E. Hicks
ASSISTANT DIRECTOR
OIL AND GAS DIVISION

Lynn D. Helms
DIRECTOR
DEPT. OF MINERAL RESOURCES

Edward C. Murphy
STATE GEOLOGIST
GEOLOGICAL SURVEY

600 E Boulevard Ave – Dept 405 | Bismarck, ND 58505-0840 | PHONE: 701-328-8020 | FAX: 701-328-8022 | dmr.nd.gov

INDUSTRIAL COMMISSION OF NORTH DAKOTA

OIL AND GAS RESEARCH PROGRAM

Brent Brannan, Director
E-Mail: brentbrannan@gmail.com

Governor
Doug Burgum
Attorney General
Drew Wrigley
Agriculture Commissioner
Doug Goehring

July 21, 2022

Mr. John A. Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear John:

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

The North Dakota Industrial Commission's (NDIC's) Oil and Gas Research Program (OGRP) is pleased to support the Energy & Environmental Research Center (EERC) proposed project to investigate the geologic storage of CO_2 in western North Dakota in response to U.S. Department of Energy (DOE) CarbonSAFE Phase II – Storage Complex Feasibility Funding Opportunity Announcement DE-FOA-0002610.

One of the functions of OGRP is to promote efficient, economical, and environmentally sound exploration, development, and use of North Dakota's oil and gas resources; preserve and create jobs involved in the exploration, production, and utilization of North Dakota's oil and gas resources; and ensure economic stability, growth, and opportunity in the oil and gas industry. DOE's interest in carbon capture for the purpose of developing net-carbon-negative generation technologies aligns well with the goals and objectives of OGRP.

North Dakota is at the forefront of energy development and production, investigating long-term strategies that incorporate all of the state's energy resources—traditional and emerging—to meet the nation's growing energy demand in an environmentally responsible manner. The project proposed by the EERC will investigate the feasibility of a commercial CO_2 storage hub in North Dakota, leading to expanded opportunities for the state's energy industries.

We look forward to working with the EERC team on this important project.

Sincerely,

Brent Brannan

NORTH DAKOTA
PETROLEUM
COUNCIL

100 West Broadway, Ste. 200 | P.O. Box 1395 | Bismarck, ND 58501-1395
701.223.6380 | ndpc@ndoil.org | www.NDOil.org

July 21, 2022

Mr. John A. Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

Dear Mr. Harju:

The North Dakota Petroleum Council (NDPC) is pleased to submit this letter of support for the team being assembled by the Energy & Environmental Research Center (EERC) to investigate the geologic storage of CO_2 in western North Dakota in response to CarbonSAFE Phase II – Storage Complex Feasibility DE-FOA-0002610.

Established in 1952, the NDPC is a trade association that represents more than 600 companies involved in all aspects of the oil and gas industry, including oil and gas production, refining, pipeline, transportation, mineral leasing, consulting, legal work, and oil field service activities in North Dakota, South Dakota, and the Rocky Mountain Region.

Part of NDPC's mission is to promote and enhance the discovery, development, production, transportation, refining, conservation, and marketing of oil and gas in our region as well as promote opportunities for open discussion, lawful interchange of information, and education concerning the petroleum industry. We support the important work being done by the EERC and believe there is great potential in this research.

We strongly encourage consideration of the EERC proposal and look forward to the results of this important project.

Sincerely,

Ron Ness

Ron Ness
President
North Dakota Petroleum Council

NESET

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

September 13, 2022

Mr. Wesley D. Peck
Assistant Director for Subsurface Strategies
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Peck:

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

NESET is pleased to partner with the Energy & Environmental Research Center to support the investigation of a commercial-scale geologic storage hub for CO_2 in northwestern North Dakota in response to the U.S. Department of Energy's CarbonSAFE Funding Opportunity DE-FOA-0002610. The past 70 years has proven that the Williston Basin possesses a vast amount of energy potential. The petroleum resource of the Williston Basin continues to provide our society with energy needed to fuel our economy. We are honored to support and assist in the project in the following capacity.

NESET will work as a subcontractor to the EERC and serve as the General Contractor during the well drilling and core collection portion of the project. Activities will include planning and development of procedures with the EERC, Gantt chart development, AFE development, competitive bidding process, vendor selection in conjunction with the EERC, vendor management, development, and management of master service agreements (MSAs) with all vendors, payment to all vendors, daily activity reporting, daily cost reporting, and invoice development for the EERC. NESET has successfully operated in the Williston Basin from its headquarters in Tioga, ND, for 40 years, providing a wide range of drilling, production, and geological services to over 170 oil and gas companies. Operating on as many as 99 rigs simultaneously during the height of the latest Bakken boom, NESET has successfully contributed to the completion of over 7750 wells in the Williston Basin. NESET is well positioned to meet or exceed every requirement in this contract.

NESET will also provide advice and support to the societal considerations and impacts task. The company philosophy includes investment in education, job retention, and the community. A certified woman-owned business, NESET maintains a current WBENC (Women's Business Enterprise National Council) certification. NESET proactively invests in mentoring young STEM professionals, especially women, has integrated community service into the work life of its employees, and encourages "giving back," examples of which are our on-premises childcare facility and serving on governing boards spanning the North Dakota Petroleum Council, the State

Board of Higher Education, regional foundations, and local charitable and religious organizations.

We wish the EERC the best of luck in this project. NESET fully supports the important work being done with CCUS in North Dakota.

Sincerely,

Kathleen Neset
President, Geologist

Letter of Commitment

September 14, 2022

Mr. Wesley Peck
Assistant Director for Subsurface Strategies
Energy and Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND. 58202-9018

Dear Mr. Peck

This letter confirms our commitment in supporting the Energy and Environmental Research Center's Proposal No. 2022-0174 to the U.S. Department of Energy' CarbonSAFE Program (DE-FOA-0002610) entitled "Roughrider Carbon Storage Hub" to investigate carbon storage in central North Dakota.

Schlumberger is a recognized leader in modeling complex geologic systems, reservoir evaluations, and the management of CO_2, with decades of experience in field testing for the oil and gas industry. As such, Schlumberger is focused on providing practical solutions for the characterization, modeling, and simulation of oil, gas, and saline reservoirs to assist in answering challenging questions associated with the identification of suitable targets for CO_2 injection, reservoir behaviors in response to injection, and the long-term fate of the injected fluid. Schlumberger's technology expertise coupled with the EERC's research capabilities and wealth of knowledge regarding geologic analysis and characterization, 3D geocellular modeling, and geologic storage of CO_2 creates an ideal method to conduct the proposed feasibility assessment of an integrated Carbon Capture Storage project in North Dakota.

Schlumberger and EERC have a strong track record of collaboration through technical data gathering, analysis, modeling, field service work, and consulting. Schlumberger will continue to offer our software package licensing through the University Donation Program and will support graduate and undergraduate students as they carry out research on such projects.

We welcome the opportunity to partner with and support the EERC and University of North Dakota in researching the feasibility of developing a commercial-scale CO_2 storage site in the great state of North Dakota.

Sincerely,

Erik Borchardt

Erik Borchardt
Business Development Manager -Reservoir Performance/New Energy
303-241-0815
eborchardt@slb.com

WESTERN DAKOTA ENERGY ASSOCIATION

July 17, 2022

Mr. Wesley D. Peck
Assistant Director for Subsurface Strategies
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Peck:

Subject: Support for EERC CarbonSAFE Proposal Entitled Roughrider Carbon Storage Hub

The Western Dakota Energy Association is a membership organization comprised of the cities, counties and school districts in the energy-producing region of western North Dakota. WDEA is pleased to provide the Energy & Environmental Research Center (EERC) with this letter of support for the proposed studies to investigate a commercial-scale geologic carbon storage hub in western North Dakota in response to the U.S. Department of Energy's CarbonSAFE Funding Opportunity DE-FOA-0002610.

WDEA's advocacy goals include ensuring a solid economic future for our communities, strong infrastructure which promotes safety for our citizens, and sensible management of our natural resources to ensure their viability for generations to come.

North Dakota is at the forefront of energy development and production, investigating long-term strategies that incorporate all the state's energy resources—traditional and emerging—to meet the nation's growing energy demand in an environmentally responsible manner. The project proposed by the EERC will investigate the feasibility of a commercial storage complex hub in North Dakota, leading to expanded opportunities for the state's energy industries, its communities and its citizens.

We look forward to working with the EERC team on this important project.

Sincerely,

Geoff Simon
Executive Director

Western Dakota Energy Association
1661 Capitol Way, Bismarck ND 58501
www.ndenergy.org • 701-527-1832

APPENDIX B

ADDITIONAL SUPPORTIVE DOCUMENTATION

PROJECT NARRATIVE

Proposed Project Title:	Roughrider Carbon Storage Hub
Funding Opportunity Number:	DE-FOA-0002610 Carbon Storage Assurance Facility Enterprise (CarbonSAFE) Phase II – Storage Complex Feasibility
Area of Interest 1:	Single- or Multi-Source (Hub) Onshore Storage Facilities
Name and Address of Applicant:	Energy & Environmental Research Center (EERC) University of North Dakota (UND) 15 North 23rd Street, Stop 9018 Grand Forks, ND 58202-9018
Team Member Organizations:	UND EERC ONEOK Neset Consulting Service
Technical Point of Contact:	Wesley D. Peck Phone: (701) 777-5195 Fax: (701) 777-5181 Email: wpeck@undeerc.org
Business Point of Contact:	Sheryl A. Eicholtz-Landis Phone: (701) 777-5124 Fax: (701) 777-5181 Email: slandis@undeerc.org
Federal Share of Costs:	$9,000,000
Nonfederal Share of Costs:	$7,550,000
Date of Application:	September 15, 2022

TABLE OF CONTENTS

INTRODUCTION

The proposed Roughrider Carbon Storage Hub scenario in northwestern North Dakota will store CO_2 captured from several gas-processing plants owned and operated by project partner ONEOK, Inc., and a planned gas-to-liquids (GTL) plant by Cerilon (Figure 1). This feasibility study will evaluate the aggregation of CO_2 captured from seven sources for injection into geologic storage complexes in a stacked storage configuration. The hub scenario includes several aspects that make it a highly qualified candidate for a feasibility study with a notably reduced project risk profile. These include 1) a project partner with a committed goal to reduce greenhouse gas (GHG) emissions; 2) prior subsurface data analysis results supporting a stacked storage scenario with adequate CO_2 storage volume; 3) commitment from local, regional, and state-level stakeholders, and 4) a state with Class VI primacy. In addition, there is potential for expansion/flexibility to include additional CO_2 sources (including direct air capture). In aggregate, these project characteristics combined with the Energy & Environmental Research Center's (EERC's) extensive experience with carbon capture, utilization, and storage (CCUS) through the Plains CO_2 Reduction (PCOR) Partnership Program Initiative and previous Carbon Storage Assurance Facility Enterprise (CarbonSAFE) efforts (Phases II and III) make our scenario a viable CCUS stacked storage system that can be realistically constructed and permitted for operation. Collectively, this CarbonSAFE Phase II proposal efficiently and effectively meets the goals and objectives of the overall U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) CarbonSAFE Initiative.

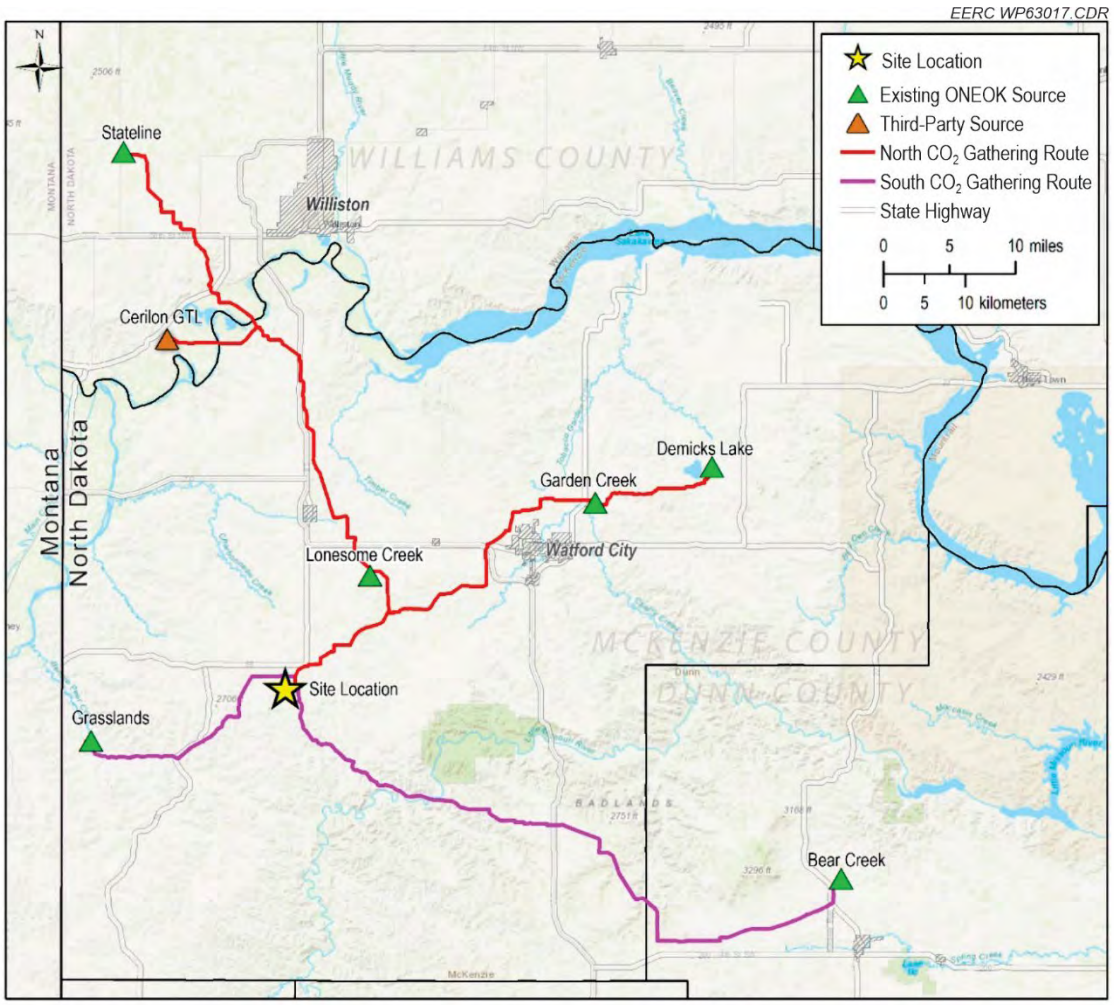

Figure 1. Proposed CarbonSAFE Roughrider Carbon Storage Hub scenario envisioned for northwestern North Dakota. Notional pipeline routes are depicted.

PROJECT OBJECTIVES

The proposed project objectives are to accelerate wide-scale deployment of CCUS by assessing and verifying the feasibility of using stacked storage complexes in northwestern North Dakota for the safe and cost-effective commercial-scale (i.e., ≥ 50 MMt within 30 years) storage of anthropogenic CO_2 emissions captured from ONEOK and Cerilon facilities in northwestern North Dakota. Through the execution of the proposed scope of work, the prospective storage resource of the area of interest (AOI) will be advanced to contingent storage resource as classified under the Society of Petroleum Engineers CO_2 Storage Resources Management System (SRMS). In addition, the proposed Phase II project will complete a rigorous feasibility study for both technical and economic viability as well as identify societal considerations and impacts of the proposed research, including impacts on disadvantaged communities and subpopulations, to develop and implement regional-specific plans to engage communities and stakeholders.

MERIT REVIEW CRITERIA (MRC)

MRC1: Project Readiness

MRC1a–1e

MRC1 is addressed fully in the separate CarbonSAFE Phase II Project Readiness document, providing evidence of a well-developed storage complex prefeasibility evaluation supporting potential for commercial storage as well as evidence of suitable CO_2 sources that will use the storage resource.

MRC1 Subsection	Location in Project Readiness Document
MRC1a	Section 1.0 Northwestern North Dakota Scenario Analysis
MRC1b	Section 2.0 Technical Subbasinal Evaluation
MRC1c	Section 3.0 Regional Analysis
MRC1d	Section 4.0 CO_2 Technical Analysis
MRC1e	Section 5.0 Stakeholder Analysis
MRC1f	Section 4.4 Pipeline ROW Analysis

MRC2: Scientific and Technical Merit

MRC 2a – Thoroughness of Proposed Project with FOA and AOI Research Objectives

The objectives and tasks in the statement of project objectives (SOPO) address the overarching goals of the FOA and each of the prescribed key activities. The proposed work will accelerate wide-scale deployment of CCUS by assessing and verifying a safe and cost-effective commercial-scale storage site for anthropogenic CO_2 emissions captured from ONEOK and Cerilon facilities in northwestern North Dakota. The team will acquire, analyze, and interpret geologic information to investigate the feasibility of a storage complex in the region to demonstrate storage resources for commercial volumes of CO_2 (50 MMt within 30 years). Through the execution of the proposed scope of work, the prospective storage resource of the AOI will be advanced to contingent storage resource as classified under the Society of Petroleum Engineers CO_2 SRMS (Storage Resources Management System).

MRC2b – Feasibility of the Proposed Concept, Based on Sound Scientific and Engineering Principles

The proposed scope of work is based on sound scientific and engineering principles, as evidenced by the EERC's record of conducting similar assessments in central North Dakota, resulting in three approved CO_2 storage facility permits and one pending approval. In addition, the project team has decades of experience managing field activities, successful major construction projects, and operation of gas-

processing facilities, all which require understanding and application of scientific and engineering principles.

MRC3: Technical Approach and Understanding

MRC3a – Adequacy and Feasibility of Approach to FOA and AOI Objectives
Each task in the SOPO is essential for addressing the primary objective of accelerating wide-scale deployment of CCUS.

The proposed tasks will leverage the existing experience, knowledge, lessons learned, and relationships within the project team to characterize a storage complex with the potential to securely store 50 MMt of anthropogenic CO_2. Collected and interpreted data, as well as execution of societal considerations and impacts (SCI) assessments and plans, will build a foundation upon which a successful application could be subsequently submitted for CarbonSAFE Phase III: Site Characterization and Permitting. The tasks are designed to systematically identify and address both technical and nontechnical challenges; collaborate with team members and key stakeholders to provide solutions and paths toward commercialization; and communicate results to DOE, the communities, and other stakeholders.

Task 1, a project management and planning activity, will span the duration of the project and ensure that all subsequent tasks and activities are completed according to the specified timelines and that DOE-compliant reporting occurs. Task 2 – SCI Assessment and Plans consists of the development and implementation of the Societal Considerations and Impacts package that will address Community and Stakeholder Engagement, DEIA (diversity, equity, inclusion, and accessibility), and energy and environmental justice through the Justice40 Initiative. Faculty from the UND Nistler College of Business & Public Administration will assist with implementation of the SCI plans. Task 3 – Storage Complex Characterization comprises all of the activity required to perform geologic characterization of the planned storage targets and their overlying sealing formations. Task 4 – Geologic Modeling and Simulation encompasses the effort to integrate data into a geocellular model of the study area, which provides the foundation for dynamic simulations of potential injection scenarios. Task 5 – Technical and Economic Analysis includes an evaluation of the entire proposed CO_2 storage hub, including options to address potential challenges as well as a complete design study for the CO_2 transport. Task 6 – Site Development Plan comprises the creation of 1) a detailed plan for development of a subsequent complete site-characterization effort for the potential injection site, 2) a CO_2 management strategy for acquiring and transporting CO_2 to the injection site, and 3) a risk assessment to identify project risks and provide mitigation strategies.

Collectively, the activities embraced by these tasks will facilitate wide-scale CCUS deployment and infrastructure development by reducing uncertainties and providing solutions to technical and nontechnical challenges. Results of the proposed work will enable development of environmentally sound, low-emission natural gas processing and utilization by providing essential technical and economic information regarding the various components of the CCUS value chain (i.e., CO_2 capture, transport, storage).

MRC3b – Feasibility, Rationale, and Completeness of SOPO
The proposed project is scheduled to take 24 months with the six-task structure presented in the SOPO. The objectives and tasks in the SOPO further address the overarching goals of the FOA and each of the prescribed Phase II: Storage Complex Feasibility research objectives. In summary, the proposed work will define and assess a storage complex through data collection; geologic analysis; identification of contractual and regulatory requirements and development of plans to satisfy them; subsurface modeling to support geologic characterization, risk assessment, and monitoring; and public engagement as well as

complete a feasibility study for both technical and economic viability. More detail is provided in the SOPO section of this project narrative document.

MRC3c – Adequacy and Completeness of the Project Management Plan
The project management plan (PMP) describes the elements necessary to successfully manage the proposed work and establishes timelines and deliverables for achieving the project objectives. The deliverables, milestones, success criteria, cost profile, and schedule are based on the proposed task structure detailed in the SOPO and portrayed in the PMP. The milestones and success criteria provide discrete points documenting successful progress toward attainment of the project's goals, as described in the SOPO and PMP. In addition to delineating a spend plan of DOE and cost-share funds by fiscal year for the EERC, a project funding profile by budget period (BP) is provided. A Gantt chart in the PMP outlines the project schedule by task and subtask, as described in the SOPO, including the deliverables from the SOPO and the milestones from the PMP. The risk management plan identifies potential project risks and mitigation strategies that will be employed to address those risks.

The reader is directed to the PMP (PMP.pdf).

MRC4: Technical and Management Capabilities, Facilities, and Resources

MRC4a – Adequacy of Preexisting Wells and Equipment/Facilities
Preexisting wells near the location for the proposed stratigraphic test well will be reviewed for integration into the geologic models to be built in the course of the proposed project. Any preexisting equipment or facilities will be reviewed for repurposing and/or replacement as required to meet the requirements of this project. The selected site location has a preexisting well pad ideal for the proposed project efforts.

MRC4b – Preexisting Data Availability and Usage
Project partners EERC and ONEOK conducted an initial screening study of northwestern North Dakota using publicly available legacy well data. The screening study area included the AOI for this project in central McKenzie County, North Dakota. The Oil and Gas Division of the North Dakota Industrial Commission (NDIC) provides online access to all geophysical logs related to deep well drilling in North Dakota. These data will be used, along with new data collected as part of this research effort, to construct 3D geocellular models of the targeted CO_2 storage complexes.

Legacy 3D data available in the project area will be purchased from a data exchange company. The legacy 3D data will be reprocessed with modern processing techniques and will be interpreted at the EERC for the purpose of extending the point characterization data collected at the test well laterally for several miles to evaluate the structural and stratigraphic continuity of the target geologic horizons.

MRC4c – Evidence of Interest/Commitment from Relevant Parties
The partners that have provided letters of commitment/support for this effort are committed fully within their individual scopes and spheres of influence to move CCUS forward in a manner that is economically attractive and publicly acceptable. Regarding cost-share commitment, ONEOK has committed to drilling a dedicated stratigraphic test well valued at over $9,000,000 which will comprise in-kind support for the project. This notable contribution speaks to the seriousness of ONEOK's intent to support the goal of the DOE CarbonSAFE Program. ONEOK's and other letters of commitment are included as separate attachments with this proposal package.

MRC4d – Availability of the Project Team and Subcontractors to Perform the Project
The proposed team has committed to the project and has ensured the availability of the key personnel for the time frame of this project.

MRC4e – Degree of Evidence of Organizations and Individuals Credentials, Experience, and Capabilities

The organization of the project team is described in the PMP. The EERC will lead the project with support from project partners ONEOK and Neset Consulting Service (NESET). Schlumberger Technology Corporation (Schlumberger) and Computer Modelling Group Ltd. (CMG) will provide the industry-standard software packages needed to execute the proposed scope of work. Each of the proposed tasks will be led by qualified individuals from the EERC who will work with the project partners as appropriate to accomplish task goals and corresponding project goals. The principal investigator (PI) and lead for Task 1 is Mr. Wesley Peck, EERC Assistant Director for Subsurface Strategies. In this role, Mr. Peck will handle project management, planning, and reporting activities. He will ensure successful completion of the project on schedule and budget, coordinate and direct subcontractor activities, and ensure transfer of data and products to the DOE NETL Energy Data eXchange (EDX). Mr. Peck will also lead efforts to complete required National Environmental Policy Act (NEPA) documentation. Mr. Peck has served as PI on several DOE projects at the EERC, including both a Phase II and Phase III project (ongoing) within the DOE CarbonSAFE program. Mr. Peck has broad expertise in CO_2 geologic storage, including geologic site characterization. Mr. Peck served as the task lead for the regional characterization effort of the PCOR Partnership Program, one of seven regional partnerships established under the DOE NETL Regional Carbon Sequestration Partnerships (RCSP) Initiative in 2003. Mr. Peck is very familiar with the geology of the key formations and will help guide characterization efforts.

Task 2.0 will be led by Ms. Charlene Crocker, EERC Senior Research Scientist and Outreach Team Lead, who will be responsible for implementing and refining the plans laid out in Task 2.0. Ms. Crocker has nearly 20 years of experience developing and implementing CCUS outreach. She currently serves as the task lead on outreach for the current North Dakota CarbonSAFE Phase III project, has served as the task lead on the Red Trail Energy Ethanol CCUS project, and was a team member for the outreach and education task under the PCOR Partnership. As the coordinator of the EERC's Energy Hawks Program, a multidisciplinary summer internship focused on understanding the impacts of and adding value to North Dakota's energy landscape, Ms. Crocker mentors multicultural graduate and undergraduate students studying at six of North Dakota's colleges and universities. Outreach programs Ms. Crocker has developed have focused on fossil energy transformations, CO_2 emissions, critical minerals, water quality and use, and fish consumption advisories and include general public, K–12, and post-secondary education, and documentary development, writing, and production.

Task 3.0 will be led by Mr. Ryan Klapperich, EERC Principal Geoscientist, responsible for overseeing all aspects of the storage complex characterization effort. Mr. Klapperich has expertise in CO_2 storage, geologic site characterization, monitoring program assessments, design and implementation of near-surface monitoring programs, and interpretation of monitoring data. Mr. Klapperich is actively involved in several site characterization and CO_2-monitoring activities at the EERC, including leading the characterization tasks on the North Dakota CarbonSAFE Phase II and III projects. Mr. Klapperich serves as Co-PI on the Brine Extraction and Storage Test (BEST) project, which is demonstrating the use of active reservoir management (ARM) techniques to improve reservoir storage potential in saline formations with CO_2 storage potential. Mr. Klapperich previously served as Co-PI on a project principally funded by the IEA Greenhouse Gas R&D Programme (IEAGHG) focused on understanding the use of ARM schemes to enhance CO_2 storage and reduce monitoring, verification, and accounting (MVA) costs.

Task 4.0 will be led by Dr. Matthew Burton-Kelly, EERC Senior Geologist, who will be responsible for geologic modeling and simulation. Dr. Burton-Kelly has expertise and experience in well log, core, and thin-section petrophysical analysis; CO_2 storage efficiency; data science; stratigraphy, paleogeography, and geologic characterization; geocellular reservoir modeling; and geologic storage of CO_2. He is currently involved in multiple DOE-funded projects. Previously, Dr. Burton-Kelly led the development and publication of a new method to delineate area of review for CO_2 storage projects as part of the PCOR

Partnership Initiative and led development and simulation of an ensemble of geologic models to support DOE's Science-Informed Machine Learning for Accelerating Real-Time Decisions in Subsurface Applications (SMART) Initiative. Dr. Burton-Kelly has also contributed to multiple storage facility permit applications for commercial geologic storage of CO_2 in the state of North Dakota.

Task 5.0 will be led by Mr. Mike Warmack, EERC Principal Oil and Gas Facilities Engineer, who will be responsible for leading the technical and economic analysis. Mr. Warmack supports the planning, design, and selection of materials/treatment programs; costing, reporting, and/or upgrade/retrofit efforts related to production facility optimization for unconventional oil plays; injection, production, and recycle infrastructure associated with enhanced oil recovery (EOR)/incremental oil recovery (IOR) in conventional and unconventional oil and gas plays; infrastructure associated with capture and injection of CO_2 for geologic storage; and other emerging challenges associated with oil and gas injection/production processes. Mr. Warmack has more than 38 years of experience in production, operations, facilities design and installation, chemical treatment and optimization, and hands-on experience in multiple engineering disciplines.

The lead of Task 6.0 will be Mr. Barry Botnen, EERC Senior Hydrogeologist, who will be responsible for the overall site development plan. He currently supports multiple projects evaluating the feasibility and implementation of CCUS technologies for both dedicated and associated CO_2 storage. Most recently, Mr. Botnen has been working to develop and implement MVA concepts for large-scale (>1 MMt/yr) CO_2 storage and EOR operations. Mr. Botnen has over 20 years of experience in CO_2 storage, contaminated site assessment, contaminant release investigation, remedial design/action, wetlands identification/ delineation, biota studies, and the stewardship of contaminated nuclear sites.

Mr. Chad Schneeberger, ONEOK Renewable Project Development Director, will serve as a project advisor and direct and coordinate efforts by ONEOK to assist in project activities and provide land and data access. Mr. Schneeberger will work closely with the EERC team to ensure project team members have the appropriate resources/information and that ONEOK meets internal deliverables for the proposed project. Mr. Schneeberger has over 25 years' experience in midstream operations.

Mr. James Randall, ONEOK Director for Commercial Development and Renewable Energy Ventures, will serve as project advisor. Mr. Randall currently leads the Economic Planning and Projects Analysis teams at ONEOK and supports development opportunities to identify and evaluate strategic investment opportunities in renewable energy technologies and future growth platforms.

Mr. Scott Porter, ONEOK Manager of Mechanical Integrity and Reliability, will serve as project advisor. Mr. Porter has extensive experience in investigation, policy, and risk management.

The EERC has demonstrated the needed experience and capabilities to lead and carry out the proposed project through a wide variety of previous work. As a culminating effort of nearly 20 years of CCUS research through the EERC-led PCOR Partnership of the DOE RCSP Initiative,[1] the Bell Creek demonstration project deployed a research-monitoring program to better understand incidental CO_2 storage associated with a commercial EOR project. The program successfully integrated operations data with commercial and emerging monitoring techniques. In addition, the EERC published best practices manuals (BPMs) for the assessment of storage projects, which incorporate 1) site characterization, 2) modeling and simulation, 3) MVA, and 4) risk assessment.[1] The PCOR Partnership successfully demonstrated these technical elements across a variety of pilot- and commercial-scale projects, with the

[1] Hamling, J.A., Glazewski, K.A., Leroux, K.M., Kalenze, N.S., Bosshart, N.W., Burnison, S.A., Klapperich, R.J., Stepan, D.J., Gorecki, C.D., and Richards, T.L., 2017, Monitoring 3.2 million tonnes of CO_2 at the Bell Creek Oil Field: Energy Procedia, v. 114, p. 5553–5561.

aim of improving the efficiency of storage operations, reducing associated costs, and lowering risk profiles.[1,2]

The PCOR Partnership is succeeded by the recently awarded PCOR Partnership Initiative, also led by the EERC. The PCOR Partnership Initiative is fostering the development of infrastructure and accelerated deployment of CCUS in the northwestern quadrant of North America, comprising 13 U.S. states and four Canadian provinces. The PCOR Partnership Initiative utilizes the network of organizations from current and past initiatives in the region to address the critical challenges for expanding CCUS technology in the region.

MRC4f – Discussion of Previous and Current CCS Projects of Proposed Partners

The research, field experience, and partnership investment that has been built through the PCOR Partnership and PCOR Partnership Initiative enables the EERC to confidently propose the Roughrider Storage Hub program. As stated above, the PCOR Partnership Program has covered all aspects of developing CO_2 storage projects and has led directly to developing new carbon capture and storage (CCS) storage programs in the region. For example, the EERC assessed the technical and economic feasibility of integrating CCUS with ethanol production in western North Dakota (Leroux and others, 2018).[3] The EERC worked with Red Trail Energy to develop a CCS Program and obtain Class VI permitting documents for a CO_2 storage project and assisted with implementing the project, which became operational in June of 2022 (Red Trail Energy, 2022).[4] Red Trail's Class VI permit was the first issued by the State of North Dakota and the second issued in the United States.

The EERC previously led the North Dakota CarbonSAFE Phase II project involving multiple project partners, including Minnkota Power Cooperative, BNI Coal, North American Coal, ALLETE Clean Energy, Schlumberger, and CMG. The EERC and these partners have successfully conducted a variety of geologic characterization, data acquisition, laboratory testing, sample evaluation, storage operations planning, and outreach activities for the Phase II project. The EERC, Minnkota, and BNI then successfully transitioned to the North Dakota CarbonSAFE Phase III Program, which selected a storage site, completed full characterization of the site, and acquired a Class VI storage facility permit from the State of North Dakota.[5,6] Minnkota's Class VI storage facility permit was the second issued by the State of North Dakota and among the first such permits issued in the country.

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[2] Azzolina, N.A., Torres, J.A., Chimote, S.A., Pekot, L.J., Livers-Douglas, A.J., Kovacevich, J.T., Burton-Kelly, M.E., Dotzenrod, N.W., Bosshart, N.W., Dalkhaa, C., Ayash, S.C., Li, C., Nakles, D.V., Gorecki, C.D., and Vettleson, H.M., 2018, Development of intelligent monitoring system (IMS) modules for the Aquistore CO_2 storage project: Deliverable D5 final technical report for U.S. Department of Energy National Energy Technology Laboratory Cooperative Agreement No. DE-FE0026516, EERC Publication 2018-EERC-11-19, Grand Forks, North Dakota, Energy & Environmental Research Center, November.

[3] Leroux, K.M., Ayash, S.C., Klapperich, R.J., Jensen, M.D., Kalenze, N.S., Azzolina, N.A., Bosshart, N.W., Torres Rivero, J.A., Jacobson, L.J., Stevens, B.G., Nakles, D.V., Jiang, T., Oster, B.S., Feole, I.K., Fiala, N.J., Schlasner, S.M., Doll, T.E., Wilson, W.I., Gorecki, C.D., Pekot, L.J., Hamling, J.A., Burnison, S.A., Smith, S.A., Botnen, B.W., Foerster, C.L., Piggott, B., and Vance, A.E., 2018, Integrating carbon capture and storage with ethanol production for potential economic benefit: Presented at the 14th International Conference on Greenhouse Gas Control Technologies, GHGT-14, Melbourne, Australia, October 21–25.

[4] Red Trail Energy LLC, 2022, Red Tail Energy begins carbon capture and storage: Published in Carbon Capture Magazine, July 19. https://carboncapturemagazine.com/articles/284/red-trail-energy-begins-carbon-capture-and-storage (accessed August 2022).

[5] Minnkota Power Cooperative, 2022, Minnkota receives CO_2 storage permit from NDIC: press release Jan 21, www.projecttundrand.com/post/minnkota-receives-co2-storage-permit-from-ndic (accessed August 2022,).

[6] Clark, K., 2022, Minnkota Power, Summit Carbon Solutions launch CO_2 storage partnership: Power Engineering, April 29. www.power-eng.com/emissions/minnkota-power-summit-carbon-solutions-launch-co2-storage-partnership/ (accessed August 2022).

The EERC is also working with Summit Carbon Solutions, a Minnkota partner that previously explored potential CO_2 storage options in central North Dakota. Through this agreement, Summit receives access to Minnkota's currently permitted storage resource of 100 million tons while Summit and the EERC work to characterize and acquire Class VI permits for an additional estimated 100 million tons.[6] These Class VI permits are currently under development. The SASSA (scalable, automated, sparse seismic array) project, being conducted at the Bell Creek oil field, is demonstrating and validating two new geophysical technologies that provide a low impact means of detecting CO_2. These technologies require minimal processing, can be designed to operate remotely and/or autonomously, and provide actionable data in a near-real-time manner to inform operational decisions.[7] The EERC-led Intelligent Monitoring System $(IMS)^2$ project integrated continuous and periodic monitoring data sets from the Aquistore site in Saskatchewan with an automated history-matching process that could ultimately allow a commercial storage site operator to monitor, respond to, and predict storage performance of a site with minimal user input. Experience from these projects will inform proposed efforts to apply machine learning (ML) to commercial CCUS projects.

The EERC is also currently serving as the Task 4 lead for DOE's SMART Initiative. Task 4 focuses on applying ML for accurate, timely forecasts for geologic CO_2 storage via real-time measurement integration. As the task lead organization, the EERC is managing a team of seven national laboratories and five universities and cross-cutting teams that interact with the other four SMART Initiative tasks.

The EERC and ONEOK have a solid relationship built upon past projects including the initial site screening done for this effort, as well as collaboration on the PCOR Partnership Initiative and a DOE-funded project examining improving production in conventional oil fields through the use of mixed CO_2 and rich gas EOR practices. The CO_2 and rich gas project includes project partners ONEOK, Denbury Resources, Schlumberger, and CMG. ONEOK and the EERC endeavor to continue future work together on this project and others.

ONEOK, NESET, and Cerilon are active members of the PCOR Partnership (i.e., one of the five DOE regional partnership initiatives). In addition, ONEOK and Cerilon have worked separately with the EERC on regional CO_2 site-screening efforts (i.e., prefeasibility). The EERC and NESET are currently partnered on efforts funded by the state of North Dakota to characterize the potential to develop underground storage of natural gas and related gases in subsurface salt formations.

MRC5: Societal Considerations and Impacts/Economic Revitalization and Job Creation Questionnaire

MRC5a–d – Social Considerations and Impacts (SCI)

Quality (MRC5a), Support (MRC5b), SCI Team and Resources (MRC5c), Integration (MRC5d), Influence (MRC5e)

The research, experience, and partnership investment that have been built through the PCOR Partnership, PCOR Partnership Initiative, and prior CarbonSAFE efforts enable the EERC to confidently propose the Roughrider Storage Hub Program. The commitment and experience needed to develop and implement an SCI package consisting of individual plans and development proposals specifically to address the topics of Community and Stakeholder Engagement, Justice40 Initiative, and DEIA are described in the proposal package DEIA plan, J40 Plan, and CSEP documents.

[7] Burnison, S.A., Livers-Douglas, A.J., Salako, O., Hamling, J.A., and Gorecki, C.D., 2016, Design and implementation of a scalable, automated, semi-permanent seismic array for detecting CO_2 extent during geologic CO_2 injection: Presented at the 13th International Conference on Greenhouse Gas Control Technologies (GHGT-13), Lausanne, Switzerland, November 14–18, 2016.

The attached SCI documents detail the specifics set forth to plan, develop goals, and implement strategies to advance goals through SMART objectives and milestones and ongoing evaluation.

As the PMP indicates, Task 2 is dedicated to SCI activities, deliverables, and milestones. While each plan in the SCI package will center on its own unique focus, all three plans are components of the overarching SCI package and will be integrated and implemented concurrently. Integrated throughout all plans in the SCI package is providing all project team members the tools and training needed to carry out SCI-related activity as appropriate to their roles and responsibilities in the project.

Above and Beyond the Requirements for Compliance (MRC5f), Previous Efforts/Lessons Learned (MRC5g)

Given their extensive experience working in North Dakota on CCS projects, pipeline rights-of-way (ROWs), and regional hydrocarbon development, project partners EERC, ONEOK, and NESET know that the success of energy projects depends on relationship building and partnerships with communities and stakeholders. This is done through engagement early and through all project phases, transparent and trustworthy actions, and commitment and investment in the project communities. Experience from the work described in MRC4f has shown the positive results and successful outcomes of engaging communities and key stakeholders early and often. The project partners are active in promoting STEM (science, technology, engineering, and math) education, demonstrating DEIA principles, providing monetary support, and encouraging sweat equity.

MRC5a–d – Economic Revitalization and Job Creation Questionnaire

Future Activity That Creates or Retains High-Quality, Good-Paying Jobs.

ONEOK's midstream assets in North Dakota include over 12,000 miles of natural gas-gathering pipelines, over 300 miles of natural gas liquid pipelines, and six processing facilities with the capacity to process and treat almost 2 billion cubic feet per day of natural gas. This natural gas network employs approximately 485 personnel. As a midstream service provider experienced in the gathering, transportation, storage, and distribution of natural gas, ONEOK is well positioned to provide similar CO_2-related services for companies in need of a CO_2 storage solution.

As the Williston Basin continues to mature, natural gas production will continue to grow with increasing gas-to-oil ratios that will result in more demand for natural gas processing. This scenario will retain quality jobs, and as volumes increase and processing capacity is developed to accommodate that growth, additional sources of CO_2 emissions will need to be captured, transported, and stored, thereby creating additional high-quality, good-paying jobs.

The EERC and ONEOK are currently working with Cerilon, which is developing a state-of-the-art GTL facility in northwestern North Dakota to produce low-carbon liquid transportation fuels. Cerilon is already including CO_2 capture technologies in its engineering designs for the facility, and ONEOK is assisting by studying CO_2 gathering, transportation, and storage alternatives. Cerilon expects to employ 77 people at the time of operations, which will be new, high-quality jobs in the project area.

Development of a CO_2 storage hub in northwestern North Dakota would create an opportunity to aggregate and store CO_2 emissions from several sources across multiple industries, thereby potentially saving and generating hundreds of quality jobs. It would also reduce CO_2 emissions that are projected to increase in the area over time while facilitating increased production of oil and gas resources vital to energy security.

Future Activity That Supports Workforce Development.
Finding creative solutions to improve the environmental effects of the oil and gas and coal industries in North Dakota not only creates energy sustainability for our nation but also assists in employment retention as well as workforce development. Work described in Task 2.0 specifically aims to educate and engage job seekers and K–12 educators and students to encourage energy literacy and interest in STEM careers as specified in the plans described in the attached DEIA plan, J40 Plan, and CSEP (community and stakeholder engagement plan) documents.

Future Activity That Provides Workforce Opportunities in Disadvantaged or Energy Communities.
Communities surrounding the project area include rural, disadvantaged populations, and tribal areas. Building infrastructure via the development of a regional geologic CO_2 storage hub to protect the region's oil, gas, and coal industries would help retain jobs that would otherwise be displaced and create opportunity for new quality jobs that would positively impact disadvantaged communities and tribal populations.

Recruitment and Training Objectives.
Attracting and retaining employees who value diverse background, ideas, and opinions has long been a cornerstone of both the EERC and ONEOK cultures. This commitment strengthens the companies and supports the communities relying on the companies and their employment opportunities.

STATEMENT OF PROJECT OBJECTIVES
Roughrider Carbon Storage Hub

A. OBJECTIVES
The objective of this project is to determine the feasibility of developing a commercial-scale CO_2 geologic stacked storage complex able to store 50+ million metric tons of CO_2 in northwestern North Dakota safely, permanently, and economically. This objective is being met through the evaluation of a CO_2 storage complex in northwestern North Dakota suitable for storing CO_2 aggregated from multiple sources in a stacked storage configuration. CO_2 will be captured from several gas-processing plants in the area owned and operated by the project partner and a planned gas-to-liquids (GTL) plant in the project area. This effort is bolstered by progressive North Dakota pore space ownership and long-term liability laws, North Dakota primacy of the U.S. Environmental Protection Agency's (EPA's) Class VI CO_2 injection regulations, and commitment from local, regional, and state-level stakeholders. These elements, in combination with a motivated, experienced team, create an ideal synergistic scenario for ensuring success of the Carbon Storage Assurance Facility Enterprise (CarbonSAFE) Initiative and promoting national energy security through North Dakota's statewide vision for carbon management. The details of this scenario evaluation are described in the CarbonSAFE Phase II Project Readiness document.

B. SCOPE OF WORK
The objectives of the project will be achieved through the six tasks described in Section C. Task 1.0, a project management, planning, and reporting activity, will span the duration of the project and ensure that all subsequent tasks and activities are completed according to the specified timelines and that U.S. Department of Energy (DOE)-compliant reporting occurs. Task 2.0 includes societal considerations and impacts assessment and plans that incorporate plans for diversity, equity, inclusion, and accessibility; Justice40 (J40) Initiative; and community and stakeholder engagement. Task 3.0 will include activities required to characterize the storage complex within the study areas of the proposed project, including the permitting and drilling of a new geologic characterization well. Task 4.0 will integrate the data collected from Task 3.0 into the construction of geologic models that accurately represent the stacked storage opportunity in the study area. These models will also serve as the foundation for dynamic simulations, which will be used to define the boundaries of a 50-million-metric-ton CO_2 plume at that site for the

purposes of developing permitting, MVA (monitoring, verification, and accounting), risk assessment, and outreach plans. Task 5.0 will include a technical and economic analysis of the project. Task 6.0 will highlight the site characterization plans of the project to support the underground injection control (UIC) Class VI permitting process and will assess regulatory requirements necessary to move forward with future phases of the project, with a specific focus on permits required by the State of North Dakota and EPA UIC rules.

C. TASKS TO BE PERFORMED

Task 1.0 – Project Management

The recipient shall manage and direct the project in accordance with a project management plan (PMP) to meet all technical, schedule, and budget objectives and requirements. The recipient will coordinate activities in order to effectively accomplish the work. The recipient will ensure that project plans, results, and decisions are appropriately documented and project reporting and briefing requirements are satisfied.

The recipient shall update the PMP 30 days after award and as necessary throughout the project to accurately reflect the current status of the project. Examples of when it may be appropriate to update the PMP include 1) project management policy and procedural changes; 2) changes to the technical, cost, and/or schedule baseline for the project; 3) significant changes in scope, methods, or approaches; or 4) as otherwise required to ensure that the plan is the appropriate governing document for the work required to accomplish the project objectives.

Management of project risks will occur in accordance with the risk management methodology delineated in the PMP in order to identify, assess, monitor, and mitigate technical uncertainties as well as schedule, budgetary, and environmental risks associated with all aspects of the project. The results and status of the risk management process will be presented during project reviews and in quarterly progress reports with emphasis placed on the medium- and high-risk items.

The recipient shall participate in cross-project working groups once the working groups are established by the National Energy Technology Laboratory (NETL).

This task includes the necessary activities for managing project activities and ensuring coordination and planning of the project with NETL and other project participants. This includes briefings, as requested, along with routinely scheduled conference calls and regular email updates. This also includes, but is not limited to, the submission and approval of required National Environmental Policy Act (NEPA) documentation. The project is restricted from taking any action using federal funds that would have an adverse effect on the environment or limit the choice of reasonable alternatives prior to DOE providing a final NEPA decision regarding the project.

Reports will be prepared and submitted in accordance with the Federal Assistance Reporting Checklist, DOE F4600.2. A final topical report summarizing key results and recommendations from this feasibility study will be completed. In addition, the EERC will ensure compliance with all technical briefing and presentation requirements, including but not limited to DOE program peer review meetings.

The EERC will work with NETL project officers annually to assess if there are data that should be submitted to Energy Data eXchange (EDX) (D8) and identify the proper file formats prior to submission. Select data generated by this project will be submitted to EDX, including but not limited to 1) data sets and files, 2) metadata, 3) software/tools, and 4) articles developed as part of this project.

Task 2.0 – Societal Considerations and Impacts Assessment and Plans
The recipient is also required to implement the project in accordance with the Diversity, Equity, Inclusion, and Accessibility (DEIA) Plan provided in the application and the development of the Justice40 Plan (J40P), and the Community and Stakeholder Engagement Plan (CSEP) based on the development proposals provided in the application. It is expected that these plans will be updated within 90 days of award and provided to the NETL Project Manager. In addition, it is expected that key milestones associated with these plans will be incorporated into the milestone log as part of the overall PMP and that there will be at least one milestone a year associated with each plan. The quarterly progress reports and the final technical reports shall include updates on the progress and challenges throughout the course of the award.

Through a social characterization analysis that looks at the history and context of the region, this task's activities will identity communities and stakeholders—including diverse and disadvantaged subgroups—determine effective ways to engage and build relationships with those audiences, listen to their needs and concerns, and develop meaningful outcomes for those stakeholders. The analysis will inform an iterative process of plan development, implementation, and evaluation for three audience-specific plans, each corresponding to its own subtask. A societal considerations and impacts (SCI) advisory group comprising representatives of project partners and key stakeholders will be formed to provide guidance and feedback for all SCI activities. The exact roles and responsibilities of the group will be specified in the CSEP under Subtask 2.3. A SCI Mid-Project Update (D5) will include implementation status for all the plans, and updated plans will be submitted at the end of the project as part of a publicly available End-of-Project Progress Report on SCI work (D9).

Subtask 2.1 – Diversity, Equity, Inclusion, and Accessibility Plan
The DEIA Plan included with this proposal describes the actions that will be implemented throughout the project to foster a welcoming and inclusive environment; support people from groups traditionally underrepresented in STEM and/or applicable workforces; advance equity; and encourage the inclusion of individuals from these groups in future phases of the project. The DEIA Plan will be updated according to DOE comment (D2), which may include new impacts, metrics, or ways of processing information. Through feedback on plan implementation, new knowledge, and lessons learned, continual evaluation and updates to the DEIA Plan will occur throughout the life of project.

Subtask 2.2 – Justice40 Initiative Plan
The J40P Development Proposal included with this proposal will be implemented to create a J40P. Consisting of two-parts, Part 1 will begin with an in-depth Energy and Environmental Justice Assessment (EEJ Assessment) that will assess the project benefits and impacts. Learnings from the EEJ Assessment will be used to inform and develop Part 2, the Justice40 Implementation Strategy section that will explain actions the project team will take to maximize benefits and minimize negative impacts in areas related to energy and environmental justice. the content of the J40P, including background, milestones and timeline, assessment of risks and barriers and resource summary. DOE's proposal evaluation, which may include new impacts, metrics, or ways of processing information, will be incorporated to create an initial J40P (D3) that outlines concrete steps the project will take to implement EEJ efforts. Through feedback on plan implementation, regular evaluation, new knowledge, and lessons learned, the J40P will be viewed as a living document with continual updates being incorporated throughout the life of project.

Subtask 2.3 – Community and Stakeholder Engagement Plan
The CSEP Development Proposal included with this proposal will be implemented to create a CSEP. This work will include in-depth social characterization of the project area in the context of the greater region; identification of audiences, including communities with environmental justice concerns, disadvantaged communities, and tribes; developing messaging goals and content; selecting methods for engaging stakeholders (e.g., media campaigns, one-on-one contact, listening sessions, open houses, etc.); strategies

for incorporating stakeholder feedback; materials development; developing a timeline for implementation of the plan; and creating a system for tracking engagement outcomes and gauging impact. The draft CSEP will be submitted to DOE for review and comment (D4). Through feedback on plan implementation, new knowledge, and lessons learned, continual evaluation and updates to the CSEP will occur throughout the life of the project.

Subtask 2.4 – Integration and Implementation of Plans

The plans discussed in Subtasks 2.1–2.3 each have a unique community or stakeholder focus but are all components of the overarching SCI package and will be implemented concurrently. This approach will not only maximize efficiency and use of materials and resources, but also provide consistent trustworthy messaging to enhance existing community relationships and foster new ones. For example, one SCI advisory group member may focus on environmental justice while another aims to build relationships that help broaden the appeal of STEM. A project webpage hosted on the EERC website will be developed and will incorporate principles of DEIA and environmental justice, while providing information on project objectives, status, fact sheets, project partners, and contact information.

While the specific SCI activities will be determined by the needs of the communities and stakeholders in the greater project area and outlined in the Subtask 2.1–2.3 plans, implementation will likely include the following:

- Project team training on SCI elements and tracking procedures.
- Tracking SCI activities and audience feedback regarding outreach products, engagement activities, communication, and interactions.
- SCI Tool Kit – Development of materials to support public outreach efforts, including at least 2 fact sheets 3 posters, and a general project slide presentation for community events.
- Media Kit – Development of a background document, press releases, frequently asked questions, and the packaging of those materials with items from the information tool kit for print and electronic media.
- Meetings and other communication to inform, educate, and engage state, county, local, and tribal officials, regional opinion leaders, landowners, and other stakeholders.
- Educational Outreach – Periodic educational sessions geared to students and teachers in local schools and educational meetings and events.
- Community/Stakeholder Open House – Community meeting in McKenzie County tied to major project milestones and hosted by the project team.
- Community Listening Sessions – Opportunities for community members to learn about the project, ask questions, express their opinions, share concerns, and give feedback.
- Stakeholder opinion survey developed to collect feedback from engagement participants or to gauge stakeholder knowledge of, interest in, or comfort with concepts related to energy and CCS.

Task 3.0 – Storage Complex Characterization

This task conducts all the activity required to characterize up to four prospective CO_2 storage complexes within the area of interest (AOI) of the proposed project. This effort includes updates to existing geologic and hydrogeologic evaluations based on new data from existing geologic resources; the collection of new data in the form of analysis of new core, subsurface fluid samples, and well logs; and the acquisition and reprocessing of existing seismic surveys. Data acquired and analyzed during this task will be used in the development of Task 4.0 – Geologic Modeling and Simulation.

Subtask 3.1 – Existing Data Acquisition and Analysis

The prospective CO_2 storage complexes in the AOI will be evaluated to determine formation characteristics (such as porosity, permeability, injectivity, mineralogy, fluid composition, geochemical

conditions stratigraphy, cap rock integrity, etc.) within the project study areas. Existing data from offset wells will be compiled and digitized (as necessary) in preparation for use in Task 4.0 activities. Additionally, data sets that may be purchased from private entities will be identified and assessed for potential inclusion in Phase III activities.

This subtask will also acquire new or updated data sets that relate to land surface use and ownership within the study areas to identify pore space owners, geopolitical characterization, environmentally sensitive areas, and various ROWs (including pipelines). This information will be used to identify conflicts or opportunities for project development within the study areas and will be incorporated into Tasks 4.0–6.0.

Subtask 3.2 – Geologic Characterization Well

Activities in this subtask will locate, permit, and drill a geologic characterization well (stratigraphic test well) in the study area. This well will be drilled on private land, 4-inch core will be taken from the cap rock and reservoir sections of up to four stratigraphic pairs, and a comprehensive logging suite will be collected from the well. The well-logging suite will be analyzed to understand the distribution of petrophysical and lithologic properties throughout the characterization well for incorporation into Task 4.0. Once sampling and logging processes are completed, this well will be plugged and abandoned according to procedures established by the North Dakota Industrial Commission (NDIC).

Subtask 3.3 – Core Analysis/Testing

This subtask includes testing and analysis of core and fluid samples collected in Subtask 3.2. A suite of petrographic, petrophysical, geomechanical, and geochemical analyses will be performed on core samples to better understand factors that influence the long-term containment of CO_2, to aid in the calibration and correlation of well logs, and to improve the accuracy of geologic and simulation models. Specific analytical techniques (e.g., thin-section analysis, x-ray diffraction, x-ray fluorescence, scanning electron microscopy, steady-state relative permeability, helium porosimetry, and capillary pressure testing) will provide direct insight regarding the pore size distribution of the target reservoir and cap rock, potential for two-phase flow in a system dominated by high-salinity brine, zones of heterogeneity within the reservoir, and major and minor mineral phases. Geomechanical studies conducted in this task will focus on mechanical strength testing and will be interpreted to determine the maximum injection integrity of the cap rock. This work will be performed by the EERC's Applied Geology Laboratory.

Core and other geologic samples obtained during the project will be provided to NETL for inclusion in its core repository (D6 – Geologic Materials Submission). North Dakota law requires, at a minimum, half of the collected core be delivered without charge to the state geologist.

Task 4.0 – Geologic Modeling and Simulation

The geologic site characterization data (logs, core analysis, and seismic) will be integrated into geocellular models that account for the properties of the study areas, which comprises the injection horizon(s) and overlying sealing formation(s) that serve as barriers to prevent out-of-zone migration. The geologic models will provide the foundation for dynamic simulations of potential injection scenarios. Dynamic simulations are required to predict how CO_2 and its associated pressure plume would be distributed in the study areas and the effectiveness of the sealing formation at the site during the carbon capture, utilization, and storage (CCUS) time frame. Simulation results will provide key design and operational parameters for 1) the injection well and infrastructure; 2) a technical risk assessment; 3) area of review (AOR) determination; 4) monitoring, reporting, and verification (MRV) planning; and 5) installation expenditures.

Subtask 4.1 – Geologic Modeling

The proposed stacked storage horizons will be evaluated in this subtask through detailed reservoir modeling efforts using Schlumberger's Petrel geologic modeling software. The models will integrate the known and acquired geologic, structural, and fluid data of the study area (for both the reservoir and confining zones) that were collected and analyzed in Task 3.0. These models may be used to assess seal effectiveness in CO_2 containment, CO_2 density under reservoir conditions, CO_2 storage resource, total and effective pore volume, both lateral and vertical geologic heterogeneity (as interpreted from 2D and/or 3D seismic data sets), and AOR for regions likely to experience CO_2 saturation during injections resulting in 50+ million metric tons of CO_2. The geologic model will also provide the foundation for dynamic simulation of potential injection scenarios (Subtask 4.2).

Subtask 4.2 – Dynamic Simulation

Activities in this subtask will focus on dynamic simulations to determine the potential distribution and extent of a 50-million-metric-ton CO_2 plume injected over a 30-year time frame. These simulations will be based on the geologic assessments of the stacked storage reservoirs conducted in previous tasks. Simulation models will be developed using Computer Modelling Group Ltd.'s (CMG's) GEM dynamic simulation module. Injectivity of the stacked storage complexes will be assessed to confirm potential for injection of 50+ million metric tons of CO_2 at the project site into the minimum number of injection wells and develop the smallest footprint. Development of the plume will be tracked throughout various simulations of the 30-year injection period to determine AOR and CO_2 plume extents through time. Simulations will also evaluate potential for conflicts with existing subsurface injection or production operations, although these are anticipated to be minimal based on current understanding of regional activities.

Task 5.0 – Technical and Economic Analysis

This task will be conducted to evaluate the technical and economic feasibility of the proposed CO_2 storage project, including various project options such as adjacent and distributive (collection and pipelining of CO_2 streams to a central location) storage potentials. The expansion of conceptual pipeline designs leveraging the existing ROWs and the experience in the operating conditions that include the design, construction, operation, and access of pipelines of the project partner will be utilized. This task will include examining more specific economic needs and the incentives in place or additional CO_2 volumes required to make the proposed scenarios economically feasible for the project partners. Local, state, and federal incentives will be evaluated for their potential contribution to offsetting project costs. These activities will form the basis for detailing the cost and likely performance of the proposed geologic storage system that would have a capacity to store 50 million metric tons of CO_2 or more and could receive and store that amount in 30 years or less.

A feasibility report (D7) will provide a summary of the geology and risks associated with the potential storage site. It will address the regulatory, legislative, technical, public policy, commercial, financial, etc., challenges specific to this proposed project, and it will include a strategy that would enable an integrated capture and storage project to be economically feasible and publicly acceptable.

Work in this task will also form a conceptual-level design study to evaluate the technical and economic feasibility of CO_2 transportation for the storage hub and will be included.

Subtask 5.1 – Conceptual Basis of Plants and Pipeline Infrastructure

After a detailed review based on the selection of the project partner's plants, a conceptual pipeline design will be made based on the plant volume and utilizing the project partner's ROW corridors to transport the captured CO_2 to a central injection site. The design of the system will highlight the project partner's experience with securing ROWs and interacting with landowners in the area. While the project partner

has a multitude of ROWs secured in the project area, new ROWs will be required. Any new ROWs will be secured based on the project partner's experience in the project area.

Subtask 5.2 – Technical and Feasibility Review and Reporting
Based on the conceptual design realized from Subtask 5.1, a technical and feasibility study will be provided. An economic analysis reflecting the cost of the capture, transportation, and injection of the CO_2 from the project partner's plants will be provided. The technical and feasibility study for this project will reflect any incentives available to the project. Additionally, any identifiable alternative available to this project will be highlighted and incorporated into the report.

Task 6.0 – Site Development Plan
This task will create a detailed plan (D9) for development of a subsequent complete site characterization effort to support UIC Class VI permitting process (i.e., Phase III of CarbonSAFE). This plan will be based upon the results of the other project tasks. It will include a site characterization plan for the potential injection site(s), a CO_2 management strategy for acquiring and transporting CO_2 to the injection site, and a risk assessment to identify project risks and provide mitigation strategies.

Subtask 6.1 – Site Characterization Plan
A detailed plan for a complete site characterization phase will be completed for characterizing and testing an injection site to reduce uncertainty in the subsurface and to address regulatory requirements specific to developing a Class VI-qualified site and other stakeholder requirements. These data can define MVA needs and improve CO_2 storage performance forecasts. Characterization and testing, required for the approval of any Class VI wells and/or certification of associated CO_2 storage credits, may include collecting data related to the storage capacity of the chosen formations, determining the ability of the sealing formation to prevent migration from the storage complex, defining injection performance, and inspecting the mechanical integrity of the wellbore. The plan will thus provide for geologic core collection, downhole wellbore geophysical testing, laboratory testing of both rock and fluid samples as deemed appropriate and include a subject matter expert (SME) review of materials to be used in the infrastructure both on the surface and within the injection wells.

An assessment will also be made of local, state, and federal permits that may be needed for future installation of the injection site. This assessment will include data needs and potential timelines for acquisition of these permits to understand the potential permitting process needed for future CarbonSAFE phases. The site characterization plan will be developed pursuant to North Dakota Administrative Code (NDAC) Sections 43-05-01-05 §1b(3) and 43-05-01-05.1 §2a in anticipation of future phases.

Subtask 6.2 – CO_2 Management and Monitoring Plan
The EERC will develop a preliminary CO_2 management plan focused on providing a reliable supply of captured CO_2 to the proposed carbon storage hub. The goal is to ensure that one or more reliable source(s) of CO_2 are accessible to the project. Sources that are both currently available and those that may be available by the projected start of injection operations (in the 2025 time frame) will be considered. The CO_2 management plan will account for known and expected variances for the selected sources in the variables known to impact gathering and transportation infrastructure, such as CO_2 quality, quantity, composition, pressure, temperature, water content, and/or rate of delivery. The management plan will show how these sources can be combined and delivered to the proposed injection site developed in Subtask 6.1. In addition, an evaluation of pipeline needs and how they could vary under a range of CO_2 source options will be performed.

Subtask 6.3 – Risk Assessment, Monitoring, and Mitigation Strategies
This subtask will conduct a preliminary risk assessment with mitigation plans for the entire CO_2 transport and storage project. The risk assessment process includes 1) risk identification, 2) risk analysis, 3) risk

evaluation, and 4) risk treatment. Risk identification will be conducted to identify both technical and nontechnical risks that would prevent potential candidate storage reservoirs within the study areas from serving as commercial storage sites. Quantitative assessments of each identified risk will be made by assessing and scoring the probability that a risk event will occur and the impact that will result if it does occur. For technical risks, the project team will assess probability scores by incorporating the most current site characterization data and available modeling and simulation results. Risk evaluation will include an uncertainty assessment to evaluate the variability in the risk probability and impact scores from the risk analysis. The uncertainty assessment will be used to develop representative most likely and maximum (worst-case) scores. Outliers, or unusually low or high scores, will trigger follow-up evaluation. The project team will define risk rank thresholds to identify high-ranking risks that warrant treatment or further analysis.

Once the risk assessment has been completed, a risk treatment strategy will be formulated. Risk treatment includes several different strategies for negative risks, including avoidance, transfer, mitigation, and acceptance, and for positive risks, including exploitation, sharing, enhancing, and acceptance. A risk mitigation plan will be developed should any of these risks materialize. Communication is necessary during every step of the risk assessment process to assure stakeholders that the risks are being regularly monitored and effectively managed at all stages of the project.

D. DELIVERABLES

The periodic and final reports shall be submitted in accordance with the "Federal Assistance Reporting Checklist" and the instructions accompanying the checklist. In addition to the reports specified in the "Federal Assistance Reporting Checklist," the Recipient must provide the following to the NETL Project Manager (identified in Block 15 of the Assistance Agreement as the Program Manager)**.**

A catalog of geologic materials/samples collected under the project must be developed and maintained throughout the project. Throughout the life of the project, the Recipient must provide to DOE physical access to available materials/samples upon request ensuring this request does not impede ongoing or planned investigations. If the Recipient does not wish to retain the materials/samples, then the Recipient must offer DOE the opportunity to obtain possession of available materials/samples before the materials/samples are disposed.

The following guidance applies to all tasks performed under this FOA:

- In accordance with Executive and DOE Orders, any data products generated as a result of federally funded research and development shall be provided to NETL for inclusion in the Energy Data eXchange (EDX), https://edx.netl.doe.gov/. The data owner should work with its NETL/FECM Federal Project Manager annually to assess if there is data that should be submitted to EDX and identify the proper file formats prior to submission.
- Data products resulting from federally funded research and development include but are not limited to software code, tools, applications, webpages, portfolios, images, videos, and datasets.
- All final data products shall be submitted to EDX by the project Principal Investigator (PI)/performer one (1) month prior to the end date of the project. Note, EDX offers the contributor the option to request a delay in release to the public for any given contribution. Thus, if there are compelling reasons to delay release (e.g., patent application pending, publication pending, etc.), such requests can be easily accommodated but all agreed to data products still should be submitted by the Project PI/performer to EDX and that contribution process used to request the delay.
- EDX supports a wide variety of file types and formats including 1) data, 2) metadata, 3) software/tools, and 4) articles (provided that there is an accompanying Government use license). A partial list of file formats accepted by EDX is provided below, however, EDX is designed for

flexibility and accepts all types of file formats. Please contact EDXsupport@netl.doe.gov for any questions regarding file types and formats.

- EDX uses federation and web services to elevate visibility for publicly approved assets in the system, including connections with DOE's OSTI systems, Data.gov and Re3Data. This ensures compliance with federal requirements, while raising visibility for researcher's published data products to promote discoverability and reuse.
- It is strongly encouraged that all published research products obtain an OSTI Digital Object Identifier (DOI) to ensure more visibility in other search repositories (i.e., osti.gov, data.gov, Google Scholar, etc.). EDX has a custom-built API within the standard contribution workflow that allows contributors the option for obtaining an OSTI DOI by completing just a few additional fields.
- If there are questions about contributions to EDX, Project PIs should work with their Federal Project Manager. EDX help information is also available at https://edx.netl.doe.gov/about or edxsupport@netl.doe.gov.

Common Data Product Submission Formats: ASC, AmiraMesh, AVI, CAD, CSV, DAT, DBF, DOC, DSV, DWG, GIF, HDF, HTML, JPEG2000, JPG, MOV, MPEG4, MSH/CAS/DAT, NetCDF, PDF, PNG, PostScript, PPT, RTF, Surface, TAB, TIFF, TIFF Stacks, TXT, XLS, XML, Xradio, ZIP, and others.
Geographic Formats: APR, DBF, DEM, DLG, DRG, DXF, E00, ECW, GDB, GeoPDF, GeoTIFF, GML, GPX, GRID, IMG, KML, KMZ, MDB, MrSID, SHP, and others.

A full list of proposed deliverables is included in Table 1.

Table 1. Proposed Project Deliverables

Task/Subtask No.	Deliverable Title	Due Date
1.1	Project Management Plan	Update due 30 days after award. Revisions to the PMP shall be submitted as requested by the NETL Project Manager.
2.1	Diversity, Equity, Inclusion, and Accessibility Plan	Update due 90 days after award. Revisions shall be submitted as required by the NETL Project Manager.
2.2	Justice40 Plan	Update due 90 days after award. Revisions shall be submitted as required by the NETL Project Manager.
2.3	Community Engagement and Stakeholder Plan	Update due 90 days after award. Revisions shall be submitted as required by the NETL Project Manager.
2.0	Midproject Update on SCI Work Presented	An update on all SCI work will be presented midproject.
3.0	Geologic Materials Submission	Annually
5.2	Technical and Feasibility Report	A technical and feasibility report will be submitted at the completion of Task 5.0
1.0	NETL EDX Submissions	Annually
6.0	Site Development Plan	A site development plan will be submitted at the completion of Task 6.0.
2.0	End-of-Project Progress Report on SCI Work Delivered	An end-of-project progress report on SCI work will be delivered at the end of the project.

E. BRIEFINGS/TECHNICAL PRESENTATIONS
The Recipient shall prepare detailed briefings for presentation to the NETL Project Manager at their facility located in Pittsburgh, PA, Morgantown, WV, Albany, OR, or via WebEx. The Recipient shall make a presentation to the NETL Project Manager at a project kickoff meeting held within ninety (90) days of the project start date. At a minimum, two annual briefings shall also be given by the Recipient: 1) to explain the plans, progress, and results of the technical effort and 2) a separate, annual, peer review meeting. A final project briefing at the close of the project shall also be given.

At least one presentation will be given by a member of the project team at a national or international conference during the project. The specific conference(s) will be selected based on conversations with the DOE Project Officer.

>>END OF SOPO<<

RELEVANCE OUTCOMES/IMPACTS
The proposed Roughrider Carbon Storage Hub Project will provide infrastructure to safely, efficiently, and cost-effectively store CO_2 that would otherwise contribute to increased concentrations of CO_2 in the atmosphere.

ONEOK has analyzed CO_2 sources in the project area and determined that there are over 2,200,000 metric tons of CO_2 produced each year by industries such as natural gas gathering, processing, and transportation; power generation; and ethanol production. ONEOK anticipates continued growth in these industries in future years which will increase the volume of CO_2 produced. Cerilon, which is supportive of this project, plans to develop a GTL facility in the area that is expected to produce between 1,200,000 and 4,000,000 metric tons of CO_2 each year. Like ONEOK, many of the companies operating assets in northwestern North Dakota have environmental and sustainability goals to reduce their GHG emissions in the coming years, and CO_2 capture, transportation, and storage is expected to be one of the primary contributors to reducing these emissions.

Funding through DOE will help offset the development costs of CO_2 storage projects, and incentives such as the 45Q will provide tax credits that make CO_2 capture, transportation, and storage economically viable. The project team believes that as more carbon capture and storage projects are developed, the costs of the technologies employed will continue to fall and projects such as this will become more economically attractive.

Members of the project team have a strong record of commitment to environmental protections, environmental justice, community engagement, and DEIA. The plans and plan development proposals provided as a part of this application have been developed to address the considerations provided by the FOA. Continuous improvement on these programs are core values for project participants, and as outlined in the application material, it is the intent of the project to meet DOE's goals to advance these programs throughout the life of the project.

ROLES OF PARTICIPANTS
The project team comprises the EERC, ONEOK, NESET, Schlumberger, and CMG. The EERC will be the prime recipient, lead all tasks as described in the SOPO, and work closely with partners to ensure that objectives are met according to the established criteria and timelines. Mr. Wesley Peck will serve as the PI and Task 1.0 lead and will focus on the overall success of the project by providing management and leadership to all research activities, ensuring that the project is carried out within budget, schedule, and scope. The EERC will hold regular meetings with the project team and advisors to ensure the project is conducted in accordance with the statement of project objectives and project management plan. The EERC will keep all partners informed of project progress, coordinate activities, and be responsible for the timely submission of all project deliverables and transfer of data and products to the team.

ONEOK will secure site access to the project field location as well as provide cash and in-kind cost share for the drilling of the stratigraphic test well (Task 3.0) and provide source CO_2 data from its select locations for the technical and economic analysis (Task 5.0) and site development plan (Task 6.0). ONEOK will also bring its expertise and insight into midstream natural gas industry to other project activities, including risk assessment, community and stakeholder engagement, and economic evaluations. ONEOK has long-standing DEIA values and community investment and will contribute to Task 2.0 activities.

Cerilon is actively planning to develop a GTL facility in the area that is expected to produce between 1,800,000 and 4,000,000 metric tons of CO_2 each year. Cerilon is supportive of this project and has committed to provide technical and economic information for its GTL facility and evaluate the viability of storing CO_2 at the proposed storage hub. A letter of support/commitment is attached.

NESET is a wellsite services provider that was founded in North Dakota in 1980 and provides wellsite geology and mudlogging services across North Dakota, Montana, Wyoming, and South Dakota. Their crews are educated, trained, and skilled geo-steering wellsite geologists and mudloggers. They provide on-site technical geologic data to the operator and other stakeholder teams using the latest technology available. NESET has extensive experience and knowledge of the geology of Williston Basin and the drilling conditions that will be encountered during the proposed project. A certified woman-owned-business, NESET is committed to DEIA, environmental justice, education, and community engagement. A letter of support is included in the proposal package.

Schlumberger is a leading service provider for the oil and gas industry and has been a pioneer in addressing the challenges of safely, reliably, and efficiently storing CO_2 in the subsurface using proven technologies. Schlumberger has committed to provide critical software licenses and support to conduct the geocellular modeling activities.

CMG's focus is on providing the best modeling and simulation software for subsurface characterization to address the challenging questions associated with the long-term fate of CO_2 and other fluids injected into the reservoir. CMG will support the project by providing reservoir simulation software licenses and technical support.

Table 2 summarizes the roles of key personnel.

Table 2. Key Personnel Roles

Key Personnel	Role(s)
Wesley Peck (EERC)	PI; Task 1.0 lead
Charlene Crocker (EERC)	Task 2.0 lead
Ryan Klapperich (EERC)	Task 3.0 lead
Matt Burton-Kelly (EERC)	Task 4.0 lead
Michael Warmack (EERC)	Task 5.0 lead
Barry Botnen (EERC)	Task 6.0 lead
Chad Schneeberger (ONEOK)	Project Advisor

MULTIPLE PRINCIPAL INVESTIGATORS

The proposed project will not have multiple PIs. Mr. Wesley Peck, EERC, will be the sole PI.

FACILITIES AND OTHER RESOURCES

The EERC research complex comprises 254,000 square feet of laboratories, fabrication facilities, technology demonstration facilities, and offices. The EERC has established working relationships with

over 1300 clients, including federal and state agencies, universities, energy exploration and production companies, utilities, research and development firms, equipment vendors, architecture and engineering firms, chemical companies, and other organizations in all 50 states and 53 countries.

The EERC houses eight analytical laboratories dedicated to research focused on coal combustion and utilization, coal by-product utilization, water resource characterization, conventional and unconventional petroleum resources, alternative fuels, environmental chemistry, and CCUS.

The Williston Basin has a history of hydrocarbon production dating back to 1892. As a result of a long history of production, extensive oil and gas data sets are available. Most notably, data sets are publicly available for free from NDIC which the EERC regularly accesses and utilizes for oil- and gas-related projects, with data from over 30,000 wells. These data sets consist of both spatial and tabular databases. Other available data (for free and/or purchase) include seismic surveys (2D and 3D), geophysical well logs, core data, water quality data, groundwater well locations and water salinity.

The North Dakota Geological Survey's Wilson M. Laird Core and Sample Library is located less than 1 mile from the EERC as both facilities are part of the University of North Dakota campus. The climate-controlled facility currently houses over 375,000 feet of core and 30,000 boxes of drill cuttings obtained from oil and gas wells which represents about 75% of the cores cut in the North Dakota portion of the Williston Basin and about 95% of the samples collected. This includes the few remaining samples of Broom Creek Formation core currently available. Use of the facility is free of charge.

The EERC also has access to a library of geologic models within the North Dakota portion of the Williston Basin because of a history of creating geologic models for DOE and internationally funded projects. These basin- and subscale models include structural surfaces, isopachs, and petrophysical properties. Properties within the models have been derived from previous log analysis and core measurements and distributed via geostatistical methods.

The EERC has extensive modeling and simulation capabilities, including multiple high-end workstation computers and a dedicated high-performance parallel computing cluster. The cluster comprises eight computing nodes consisting of 232 total cores available for modeling and simulation usage. All the nodes/threads share a network-based power vault with a massive file server. Additionally, the project team has access to industry-level geologic modeling and simulation software and database capabilities for managing data that will be collected and generated during the project.

Finally, the EERC has also obtained a letter of support from the field site landowner that will allow necessary access for drilling of the stratigraphic test well.

EQUIPMENT

EERC Laboratories

The EERC has laboratory equipment directly applicable to conducting the proposed work. The EERC has equipment for analyzing the field-based fluid and gas samples and to conduct the laboratory testing of rock core materials outlined in the scope of work (Table 3).

Table 3. Existing Equipment in EERC Laboratories Applicable to Proposed Work

Equipment	Capability
High-Pressure Flow-Through System	Relative permeability with ability to flow CO_2, rich gas, and brines at elevated pressure and temperature; hysteresis measurements, helium porosimeter.
Gas Chromatography (GC)–Mass Spectrometry (MS)	Organic compound identification.
Bruker AXS D8 ADVANCE X-Ray Diffractometer	X-ray diffraction with diffraction pattern matching software for identification and quantification of major and minor minerals, clay types, and noncrystalline materials.
Rigaku ZSX PRIMUS II X-Ray Fluorescence System	Wavelength-dispersive x-ray system for semiquantitative identification of atomic elements present within a sample, used in conjunction with other techniques to identify mineralogy and composition of a sample.
JEOL 5800 Series Scanning Electron Microscopes (SEM)	Microscopic imaging and chemical analysis of samples to identify and characterize both the material composition (mineralogy) and physical structure of a sample (mineral distribution and diagenetic relationships), porosity characterization.
Nikon Binocular Optical Microscopes	Thin-section analysis of core samples to determine depositional features, mineral composition, and porosity characterization.
Perkin Elmer Optima 2100 Inductively Coupled Plasma Optical Emission Spectrometer	Identification and quantification of cations and other trace metals in water samples.
Dionex ICS3000 Ion Chromatograph	Identification and quantification of anion species in water samples.
Shimadzu TOC-L TOC Analyzer	Identification and quantification of dissolved and total organic and inorganic carbon species in water samples.
General Wet Chemistry Laboratory	Equipment and materials necessary to evaluate water sample characteristics, composition, total dissolved solids, and trace minerals and metals.

Computing

The EERC has extensive modeling and simulation capabilities, including multiple high-end workstation computers and a dedicated high-performance parallel computing cluster. The cluster comprises eight computing nodes consisting of 232 total cores available for modeling and simulation usage. All the nodes/threads share a network-based power vault with a massive file server. Additionally, the project team has access to industry-level geologic modeling and simulation software. A computer workstation will be purchased to augment the EERC's modeling and simulation capabilities to address the requirements of the proposed scope of work.

Fieldwork

The EERC has the necessary personal protection equipment (PPE) and equipment to oversee the collection of core samples and water samples in the project area.

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None.

BIBLIOGRAPHY

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PROJECT MANAGEMENT PLAN

for

ROUGHRIDER CARBON STORAGE HUB

DATE PREPARED
September 15, 2022

SUBMITTED BY
Energy & Environmental Research Center (EERC)
University of North Dakota (UND)
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

PRINCIPAL INVESTIGATOR
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SUBMITTED TO
U.S. Department of Energy
National Energy Technology Laboratory

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A. EXECUTIVE SUMMARY

The proposed project objectives are to accelerate wide-scale deployment of carbon capture, utilization, and storage (CCUS) by assessing and verifying the feasibility of using stacked storage complexes in northwestern North Dakota for the safe and cost-effective commercial-scale (i.e., ≥50 MMt within 30 years) storage of anthropogenic CO_2 emissions captured from ONEOK and Cerilon facilities in northwestern North Dakota. Through the execution of the proposed scope of work, the prospective storage resource of the area of interest (AOI) will be advanced to contingent storage resource as classified under the Society of Petroleum Engineers CO_2 Storage Resources Management System. In addition, the proposed Phase II project will complete a rigorous feasibility study for both technical and economic viability as well as identify societal considerations and impacts of the proposed project, including impacts on disadvantaged communities and subpopulations, to develop and implement region-specific plans to engage communities and stakeholders.

B. PROJECT ORGANIZATION AND STRUCTURE

Organizational Chart

Figure 1 shows the project organizational chart.

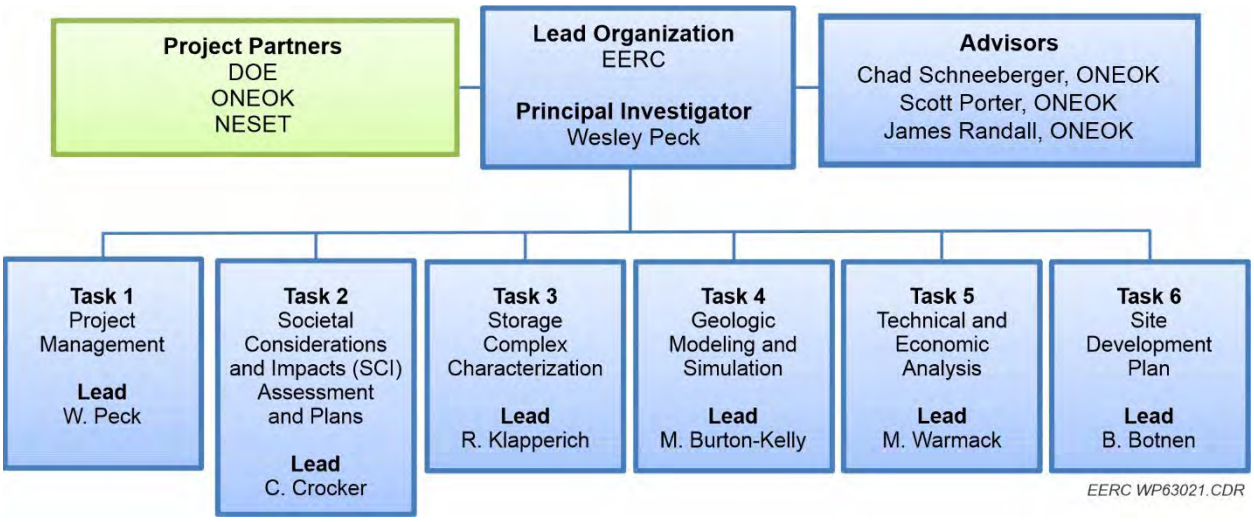

Figure 1. Project organizational chart.

Roles and Responsibilities of Participants

The project team comprises the University of North Dakota (UND) Energy & Environmental Research Center (EERC), ONEOK, Neset Consulting Service (NESET), Schlumberger, and Computer Modelling Group Ltd. (CMG). The EERC will be the prime recipient, lead all tasks as described in the statement of project objectives (SOPO), and work closely with partners to ensure that objectives are met according to the established criteria and timelines. Mr. Wesley Peck will serve as the principal investigator (PI) and Task 1.0 lead and will focus on the overall success of the project by providing management and leadership to all research activities, ensuring that the project is carried out within budget, schedule, and scope. The EERC will hold regular meetings with the project team and advisors to ensure the project is conducted in accordance with the SOPO and this project management plan (PMP). The EERC will keep all partners informed of project progress, coordinate activities, and be responsible for the timely submission of all project deliverables and transfer of data and products to the team. Faculty from the UND Nistler College of Business & Public Administration will assist with implementation of the SCI plans (Task 2.0).

ONEOK will secure site access to the project field location as well as provide cash and in-kind cost share for the drilling of the stratigraphic test well (Task 3.0) and provide source CO_2 data from its select locations for the technical and economic analysis (Task 5.0) and site development plan (Task 6.0). ONEOK will also bring its expertise and insight on the midstream natural gas industry to other project activities, including risk assessment, community and stakeholder engagement, and economic evaluations. ONEOK has long-standing diversity, equity, inclusion, and accessibility (DEIA) values and community investment and will contribute to Task 2.0 activities.

NESET is a wellsite services provider that was founded in North Dakota in 1980 and provides wellsite geology and mudlogging services across North Dakota, Montana, Wyoming, and South Dakota. Its crews are educated, trained, and skilled geosteering wellsite geologists and mudloggers who provide on-site technical geological data to the operator and other stakeholder teams using the latest technology available. NESET has extensive experience and knowledge of the geology of the Williston Basin and the drilling conditions that will be encountered during the proposed project. A certified woman-owned business, through WBENC (Women's Business Enterprise National Council), NESET will also bring its experience in and commitment to community engagement and education and DEIA values and practices to the societal considerations and impacts effort (Task 2.0).

Schlumberger is a leading service provider for the oil and gas industry and has been a pioneer in addressing the challenges of safely, reliably, and efficiently storing CO_2 in the subsurface using proven technologies. Schlumberger has committed to provide critical software licenses and support to conduct the geocellular modeling activities.

CMG's focus is on providing the best modeling and simulation software for subsurface characterization to address the challenging questions associated with the long-term fate of CO_2 and other fluids injected into the reservoir. CMG will support the project by providing reservoir simulation software licenses and technical support.

Cerilon is actively planning to develop a gas-to-liquids (GTL) facility in the area that is expected to produce between 1,200,000 and 4,000,000 metric tons of CO_2 each year. Cerilon is supportive of this project and has committed to providing technical and economic information for its GTL facility and evaluate the viability of storing CO_2 at the proposed storage hub. A letter of support is attached.

Decision-Making and Communication Strategy

Since the majority of the activities outlined in this proposal will occur at EERC facilities, recurring project update meetings will be scheduled and held at regular intervals to ensure that project team members are progressing toward the project's objectives. Decisions affecting the project scope, cost, and

schedule will be executed by Mr. Peck in coordination with task leads as well as the input of key technical scientific and engineering personnel and project advisors. Decisions and communications requiring the input of subcontractors (Schlumberger), especially during well-drilling activities, will occur through regular phone calls, e-mail correspondence, conference calls, Webinar presentations and, when necessary, in-person meetings hosted either at the EERC or external offices. Representatives from the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) will be invited to participate in key update and decision-making conference calls and meetings and will also receive regular quarterly reports detailing progress, accomplishments, challenges, and any variance from the project objectives. Any significant variance in schedule, budget, or scope will be discussed with the DOE project officer for approval.

The EERC will prepare detailed briefings for presentation to the project officer at DOE NETL facilities located in Pittsburgh, Pennsylvania, or Morgantown, West Virginia. The EERC will give a presentation to the NETL project officer at a project kickoff meeting held within 90 days of the project start date. At a minimum, annual briefings will also be given by the EERC to explain the plans, progress, and results of the technical effort. Subsequent review and update briefings will be provided to the project officer on a periodic basis as requested by the project officer or as warranted by project developments. Finally, a project briefing at the close of the project will also be given at DOE NETL facilities in Pittsburgh, Pennsylvania, or Morgantown, West Virginia. During this meeting, the overall results of the project, as presented in the final project report, will be presented to the DOE project officer and other interested DOE staff. Presentations will also be given by a member of the project team at one national or international conference during the project. The specific conference will be selected based on conversations with the DOE project officer.

Management Capabilities

As shown in Figure 1, the PI and lead for Task 1.0 is Mr. Wesley Peck, Principal Geologist and Geosciences Group Lead at the EERC. As such, Mr. Peck will handle the project management, planning, and reporting activities. He will ensure successful completion of the project on schedule and budget, coordinate and direct consultant activities, and ensure transfer of data and products to DOE NETL's Energy Data eXchange (EDX). In addition to having served as the PI/project manager on several DOE projects at the EERC, Mr. Peck serves as the task lead for the regional characterization effort of the Plains CO_2 Reduction (PCOR) Partnership Program, one of seven regional partnerships established under the DOE NETL Regional Carbon Sequestration Partnerships (RCSP) Initiative in 2003. He is a coauthor of a PCOR Partnership topical report that examined the potential for geologic storage of CO_2 in the Lower Cretaceous system of the Williston Basin, which includes the formation that will serve as the test reservoir for the recently awarded BEST (brine extraction and storage test) project. As such, Mr. Peck is very familiar with the geology of the key formations that will be used for the project and will provide guidance with respect to their characterization.

Task 2.0 will be led by Charlene Crocker, EERC Senior Research Scientist and Outreach Team Lead, who will be responsible for updating and implementing the societal considerations and implication (SCI) plans. Ms. Crocker has been a member of North Dakota CarbonSAFE (Storage Assurance Facility Enterprise) Phases II and III teams since its inception in June 2017, developing outreach materials, working with the Outreach Advisory Board, and providing input and guidance to the project timelines, budgets, and objectives. She has served as an Outreach Team member for the PCOR Partnership Program since its inception in 2003 and was the associate producer and cowriter for seven carbon capture and storage (CCS)-related public television documentaries.

Task 3.0 will be led by Mr. Ryan Klapperich, EERC Senior Hydrogeologist, who will be responsible for overseeing all aspects of the storage complex characterization effort. Mr. Klapperich has expertise in CO_2 EOR (enhanced oil recovery) and storage, including geologic site characterization, monitoring program assessments, design and implementation of near-surface monitoring programs, and interpretation of

monitoring data. Mr. Klapperich is actively involved in many site characterization and CO_2-monitoring activities at the EERC. He has served as the Co-PI on a project principally funded by the IEA Greenhouse Gas R&D Programme (IEAGHG) focused on understanding the use of active reservoir management (ARM) schemes to enhance CO_2 storage and reduce monitoring, verification, and accounting (MVA) costs. Mr. Klapperich currently serves as the Co-PI on the recently awarded BEST project which will demonstrate the use of ARM techniques to improve reservoir storage potential in saline formations with CO_2 storage potential. Mr. Klapperich also currently serves as the task lead for the PCOR Partnership's Water Working Group, a working group comprising members of DOE's RCSP Program focused on developing an understanding and solutions for issues at the nexus of CCS and water.

Task 4.0 will be led by Dr. Matthew Burton-Kelly, EERC Senior Geologist and Geomodeling Team Lead, who will be responsible for geologic modeling and simulation. Dr. Burton-Kelly has expertise and experience in well log, core, and thin-section petrophysical analysis; geologic characterization and data management; geostatistical applications; geocellular reservoir modeling; EOR utilizing CO_2; and geologic storage of CO_2. He is currently involved in multiple DOE-funded projects involving modeling and numerical simulation efforts aimed at increasing our understanding of CO_2 storage, residual oil zones, and CO_2 EOR; CO_2 storage efficiency, brine extraction for reservoir pressure management, risks associated with CO_2 storage, and management of these risks through existing and novel MVA activities; and determining the long-term fate of injected CO_2. He is a member of the American Institute of Professional Geologists and the Geological Society of America.

Mr. Michael Warmack, EERC Principal Oil and Gas Facilities Engineer, will lead Task 5.0 with the technical and economic analysis. He serves on EERC project teams and works with EERC clients to improve the development and production of domestic energy. Mr. Warmack supports the planning, design, selection of materials/treatment programs, costing, reporting, and/or upgrade/retrofit efforts related to production facilities optimization for unconventional oil plays; injection, production, and recycle infrastructure associated with EOR/incremental oil recovery (IOR) in conventional and unconventional oil and gas plays; infrastructure associated with capture and injection of CO_2 for geologic storage; and other emerging challenges associated with oil and gas injection/production processes. Mr. Warmack has more than 38 years of experience in production, operations, facilities design and installation, chemical treatment and optimization, and hands-on experience in multiple engineering disciplines. He holds a B.S. degree in Chemical and Petroleum Refining Engineering from the Colorado School of Mines. Prior to his position at the EERC, Mr. Warmack worked for Denbury Resources, most recently as a Facilities and Optimization Engineer at the Delhi EOR Unit.

The lead of Task 6.0 will be Mr. Barry Botnen, EERC Hydrogeologist, who will lead the overall site development plan. Mr. Botnen is a task lead on the current North Dakota CarbonSAFE Phase III project. He currently supports multiple activities for the PCOR Partnership Program. Most recently, Mr. Botnen has been working to develop and implement MVA concepts for large-scale (>1 million tons per year) CO_2 storage and EOR operations. Mr. Botnen also served as the task lead for the Terrestrial Field Validation Test portion of the PCOR Partnership. Mr. Botnen has over 20 years of experience in CO_2 sequestration/storage, contaminated site assessment, contaminant release investigation, remedial design/action, wetlands identification/delineation, biota studies, and the stewardship of contaminated nuclear sites.

Mr. Chad Schneeberger, ONEOK Renewable Project Development Director, will serve as a project advisor and direct and coordinate efforts by ONEOK to assist in project activities and provide land and data access. Mr. Schneeberger will work closely with the EERC team to ensure project team members have the appropriate resources/information and that ONEOK meets internal deliverables for the proposed project. Mr. Schneeberger has over 25 years' experience in midstream operations.

Mr. James Randall, ONEOK Director for Commercial Development and Renewable Energy Ventures, will serve as project advisor. Mr. Randall currently leads the Economic Planning and Projects Analysis teams at ONEOK and supports development opportunities to identify and evaluate strategic investment opportunities in renewable energy technologies and future growth platforms. Mr. Scott Porter, ONEOK Manager of Mechanical Integrity and Reliability, will serve as project advisor. Mr. Porter has extensive experience in investigation, policy, and risk management.

C. RISK MANAGEMENT PLAN

The EERC has integrated risk management practices throughout all aspects of the PCOR Partnership Program and has developed an AMA that ensures successful project implementation while remaining flexible to each project's unique attributes. To aid in the selection of specific reservoirs for commercial storage within the CO_2 study areas, the EERC will implement its risk assessment process, which includes 1) risk identification, 2) risk analysis, 3) risk evaluation, and 4) risk treatment. A preliminary analysis of the potential risks associated with the proposed scope of work did not identify situations or events that have a high likelihood of significantly impacting the success of the project. An ALARA (as low as reasonably achievable) approach is being used to adopt mitigation strategies for risks identified through the risk management plan. Our initial assessment of the technical; resource; environmental, health, and safety (EHS); site access; pore space ownership; and management risks that have the potential to impede project progress is summarized below.

Table 1. Perceived Risks and Mitigation Strategies

Perceived Risk	Risk Rating			Mitigation/Response Strategy
	Prob-ability	Impact	Overall	
	(Low, Medium, High)			
Financial Risks				
Lack of Cost Share	Low	High	Low	The EERC has an existing relationship with project partner ONEOK on multiple projects, including the PCOR Partnership, and ONEOK is very committed to provide cost share on the project.
Cost/Schedule Risks				
Inability to Maintain Schedule of Tasks	Low	Medium	Low	The six project tasks are mainly independent of one another so work can occur concurrently, minimizing risk of schedule delays.
Budget Insufficient to Complete Project	Low	High	Low	The PI will work with task leads to ensure priority is given to schedule and use of allocated hours. Hours and schedule will be tracked using the EERC's internal project cost-tracking system.
Insufficient Data Availability	Low	High	Low	The EERC has a technical team with extensive experience performing fieldwork across North Dakota, including through an initial screening with ONEOK in the proposed project area.
Technical/Scope Risks				
Lack of Technical Expertise	Low	Medium	Low	The EERC and ONEOK are a multidisciplinary team with many years of experience and will leverage established relationships to obtain any unforeseen technical expertise that is not currently accounted for.
CO_2 Sources Inadequate	Low	High	Low	ONEOK will generate sources of CO_2 from its multiple gas-processing facilities in the region with a capacity of 1.8 Bscfd of raw natural gas inlet. Cerilon's new GTL facility will produce up to 1.8 MMt of CO_2/yr, with a proposed second phase nearly doubling the amount to 4 MMt CO_2. Additionally, the region has other CO_2 sources that can be

Continued . . .

Table 1. Perceived Risks and Mitigation Strategies (continued)

Perceived Risk	Risk Rating			Mitigation/Response Strategy
	Prob-ability	Impact	Overall	
	(Low, Medium, High)			
Technical/Scope Risks (continued)				
				considered to ensure a minimum of 50 MMt of CO_2 in a 30-year period.
Management, Planning, and Oversight Risks				
Lack of Resource Availability	Low	High	Low	The EERC is committed to providing the necessary personnel and software resources to carry out project activities. The EERC has long-standing relationships with CMG and Schlumberger and has used their software on multiple projects.
Poor Communication Leads to Schedule or Cost Overruns	Low	High	Medium	Regular update meetings will be held with the project team to ensure objectives are being pursued and that activities are focused on completing the project milestones. External project partners and other stakeholders will be included as needed. The planned schedule and budget will be periodically reviewed to ensure there are no deviations. Communication regarding progress, including any potential deviations from the planned schedule or budget, will occur with the DOE Project Manager via phone calls, e-mail, and quarterly reports.
Loss of PI, Task Lead, or Key Researcher(s) to Health Matters or Attrition	Low	High	Low	Project goals, milestones, and schedule will be communicated to task leads and all researchers regularly. Additionally, a research manager will assist the PI and project team with all matters of the project and will provide continuance should a loss occur.
ES&H Risks				
Fieldwork-Based Injuries (e.g., coring, drilling, logging, and sampling)	Low	High	Low	EERC personnel have completed all safety training and exercised journey management practices to deployment and will participate in on-site safety meetings prior to fieldwork. Personal protective equipment will be standard practice and worn for all field activities, including fire-resistant out covering, hardhat, safety glasses, and steel-toed boots.
Office-Based Computer Work Injuries	Low	Low	Low	Safe office practices will be employed, such as proper ergonomics.
External Factor Risks				
Lack of Site Access for Fieldwork	Low	High	Low	The EERC has obtained a commitment letter from the landowner and will negotiate through ONEOK to obtain site access.
Weather Incidents Delay Fieldwork	Low	Medium	Medium	The EERC will conduct well-drilling fieldwork in late spring 2023 to alleviate significant weather delays to on-site work due to harsh winter conditions.

D. MILESTONE LOG

Table 2. Project Milestones

Task/ Subtask	Milestone Title	Planned Completion Date	Verification Method
3.2	M1 – APD (application of permit to drill) submitted to the state	4/22/23	Reported in subsequent quarterly report.
3.2	M2 – Well drilling initiated	5/31/23	Reported in subsequent quarterly report.
5.1	M3 – Conceptual basis of plants and pipeline infrastructure provided	5/31/23	Reported in subsequent quarterly report
2.2	M4 – Implementation of the Justice40 plan initiated	7/31/23	Reported in subsequent quarterly report.
2.3	M5 – Implementation of the community and stakeholder engagement plan initiated	7/31/23	Reported in subsequent quarterly report.
3.2	M6 – Well drilling completed	7/31/23	Reported in subsequent quarterly report.
1.0	M7 – DOE working group participation initiated	9/30/23	Reported in subsequent quarterly report.
3.2	M8 – End of well report completed	9/30/23	Reported in subsequent quarterly report.
3.3	M9 – First set of petrophysics results prepared	9/30/23	Reported in subsequent quarterly report.
4.1	M10 – First set of core data received; first geomodel initiated	9/30/23	Reported in subsequent quarterly report.
2.1	M11 – DEIA plan SMART Goal 1 achieved	1/31/24	Reported in subsequent quarterly report.
4.2	M12 – First case simulation initiated	1/31/24	Reported in subsequent quarterly report.
4.1	M13 – Last set of core data received and last geomodel initiated	3/31/24	Reported in subsequent quarterly report.
2.3	M14 – Community open house scheduled	4/30/24	Reported in subsequent quarterly report.
4.2	M15 – Final case simulations completed	7/31/24	Reported in subsequent quarterly report.
6.3	M16 – Inclusion of final simulation results	7/31/24	Reported in subsequent quarterly report.
2.1	M17 – DEIA plan SMART Goal 2 achieved	9/30/24	Reported in subsequent quarterly report.
2.2	M18 – Disadvantaged community identification and listening session scheduled	9/30/24	Reported in subsequent quarterly report.

E. COSTING PROFILE

Table 3. Spend Plan by Fiscal Year

	FY2023		FY2024		FY2025		Total	
	DOE Funds	Cost Share	DOE Funds	Cost Share	DOE Funds	Cost Share	DOE Funds	Cost Share
Applicant	$4,737,643	$5,033,333	$3,875,164	$2,516,667	$387,193	–	$9,000,000	$7,550,000
Total	$4,737,643	$5,033,333	$3,875,164	$2,516,667	$387,193	–	$9,000,000	$7,550,000

Table 4. Spend Plan – Expenditure of Task Funds by Fiscal Year

	FY2023		FY2024		FY2025		Total	
	DOE Funds	Cost Share	DOE Funds	Cost Share	DOE Funds	Cost Share	DOE Funds	Cost Share
Task 1	$233,618	–	$350,427	–	$116,809	–	$700,854	–
Task 2	$253,670	–	$380,505	–	$126,835	–	$761,010	–
Task 3	$3,416,735	$5,033,333	$1,708,368	$2,516,667	–	–	$5,125,103	$7,550,000
Task 4	$730,557	–	$913,196	–	–	–	$1,643,753	–
Task 5	$103,063	–	$154,594	–	$51,531	–	$309,188	–
Task 6	–	–	$368,074	–	$92,018	–	$460,092	–
Total	$4,737,643	$5,033,333	$3,875,164	$2,516,667	$387,193	–	$9,000,000	$7,550,000

F. PROJECT TIMELINE

See Figure 2 for the proposed project timeline.

G. SUCCESS CRITERIA

This project has one budget period (BP) that corresponds to several project milestones. Several success criteria have been developed to help track the progress of the project and to indicate the successful completion of project objectives.

- Task 2.0 – Societal Considerations and Impacts. The successful initiation of M4 (Subtask 2.2) and M5 (Subtask 2.3) will empower project team members to build and strengthen community and stakeholder relationships while providing consistent messaging and mechanisms to incorporate feedback into future planning and messaging and relationship building.
- Subtask 3.2 – Geologic Characterization Well. The successful completion of M2 (well drilling) in this subtask will allow core collected from the stratigraphic test well to be available for analysis and testing (Subtask 3.3), and data from the interpretation and analysis of core samples will provide site-specific data to the geologic model (Subtask 4.1).
- Subtask 4.1 – Geologic Modeling. The successful completion of a first geologic model will allow for the initiation of dynamic simulation (Subtask 4.2, M6) as well as critical input to the site characterization plan (Subtask 6.1).
- Subtask 5.2 – Technical and Feasibility Review and Reporting. The successful completion of the technical and feasibility review and assessment (D7) will allow for the team to confirm and validate the subsequent risk assessment, monitoring and mitigation strategies.
- Subtask 6.3 – Risk Assessment, Monitoring and Mitigation Strategies. The successful completion of M10 will allow for the identification and evaluation of project risks by the full project team and the completion of the site development plan (D9).

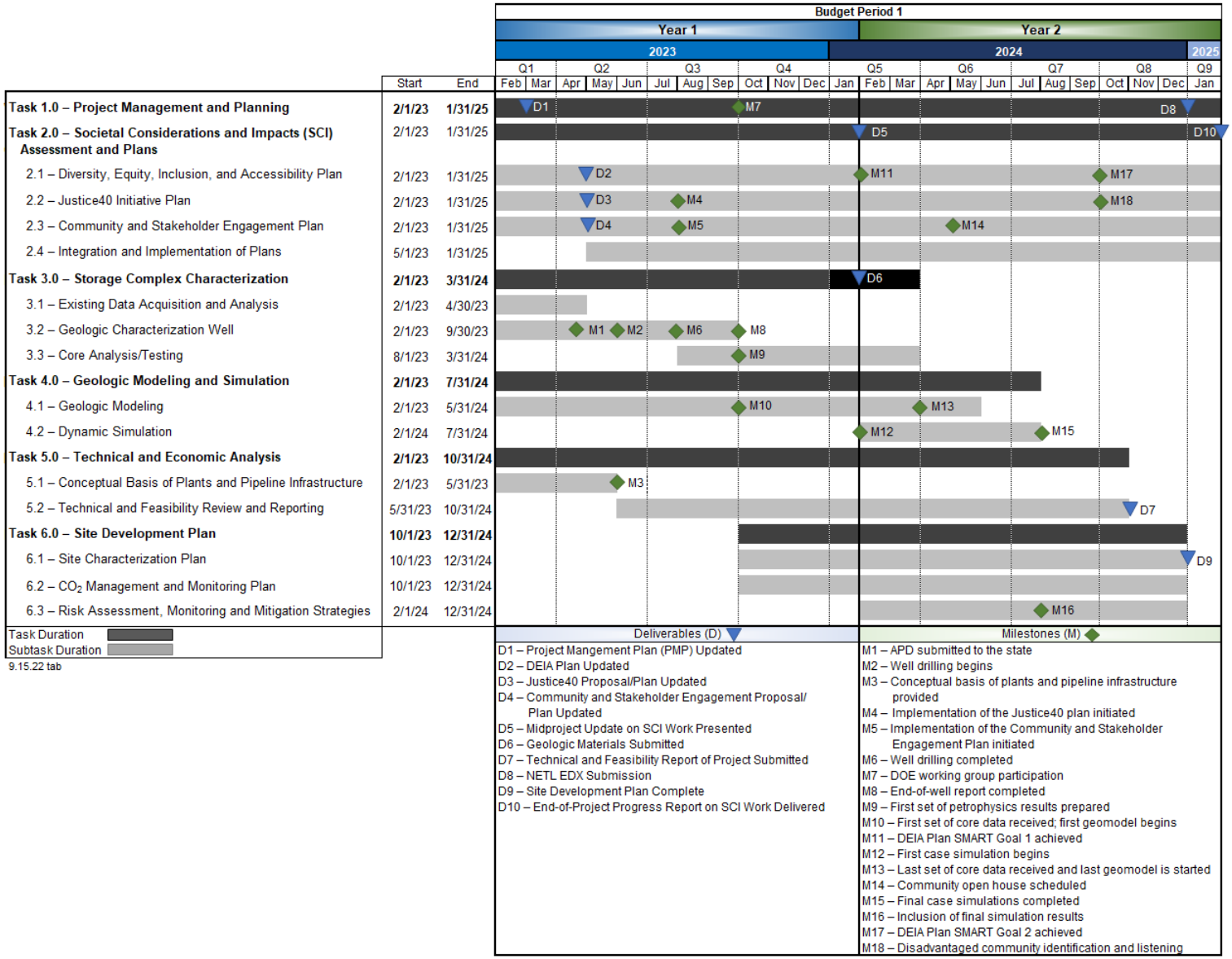

Figure 2. Proposed project timeline. Milestones for the project can be found in Table 2.

APPENDIX C

RESUMES OF KEY PERSONNEL

CHAD SCHNEEBERGER

Tulsa, OK · 580-761-3557
Chad.Schneeberger@oneok.com

Experienced leader with over 25 years of experience in midstream operations. Proven ability to build and lead teams of people to manage compliance, engineering, measurement and other operations support functions. Able to develop and execute greenfield and brownfield projects to manage volume and commercial growth on midstream assets. Placing an emphasis on the analysis of data to develop Key Performance Indicators that help improve asset and people performance.

EXPERIENCE

2007 – PRESENT

ONEOK, INC.

Renewable Project Development Director – research renewable technologies and market opportunities and identify and recommend project investments.
Gas Measurement Director – direct data processing, asset balancing and engineering support to ensure accurate L&U for natural gas gathering and transmission operations.
Environmental Director – oversee environmental team responsible for permitting and programs to improve operations compliance for midstream natural gas assets.
Engineering Director – direct team of engineers and construction managers responsible for the execution of large capital projects and operation support projects for operations

2005 – 2007

INVISTA S.A.R.L

Global Compliance Manager - responsible for transportation compliance with national and international regulations for all modes of transportation for over 45 domestic and international facilities.

1995 – 2005

KOCH PIPELINE COMPANY

Compliance Manager – responsible for environmental, safety and health, PSM, DOT and Coast Guard compliance programs for operating segment.
Operations Supervisor – responsible for daily operations of crude oil gathering and trucking, natural gas liquids gathering, natural gas gathering and processing operations and terminal operations.
Operations Engineer – responsible for engineering and project management for crude oil gathering and trucking operations.

EDUCATION

DECEMBER 1994

BS MECHANICAL ENGINEERING, OKLAHOMA STATE UNIVERSITY

SKILLS

- Employee selection and development
- Compliance management programs
- Diverse operations knowledge
- Customer service
- Team building
- Strategy and initiative development
- Project management & execution
- Cost effectiveness
- ESH management
- Creative problem solving

WESLEY D. PECK
Assistant Director for Subsurface Strategies
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Principal Areas of Expertise

Mr. Peck's principal areas of interest and expertise include geology, geologic storage of CO_2, CO_2 enhanced oil recovery (EOR), and geographic information systems (GIS).

Education and Training

M.S., Geology, University of North Dakota, 1992. Thesis: The Stratigraphy and Sedimentology of the Sentinel Butte Formation (Paleocene) in South-Central Williams County, North Dakota.
B.S., Earth Science, North Dakota State University, 1987.

Research and Professional Experience

2020–Present: Assistant Director for Subsurface Strategies, EERC, UND. Mr. Peck leads efforts in subsurface resource development with emphasis on Williston and Powder River Basins. Serves as principal investigator (PI) on multiyear U.S. Department of Energy (DOE)-sponsored North Dakota CarbonSAFE Phase III Characterization and Permitting project. Served as task lead and PI for regional geologic characterization component of Plains CO_2 Reduction Partnership (PCOR) Partnership Program, focused on CO_2 storage in central North America. Led full-CO_2-chain techno-economic investigation in North Dakota linking lignite mining and electric generation to CO_2 EOR. Expertise includes geology, geologic storage of CO_2, CO_2 enhanced oil recovery (EOR), and geographic information systems (GIS).

2015–2019: Principal Geologist, EERC, UND. Mr. Peck was involved in subsurface resource development with an emphasis on the Williston and Powder River Basins. He served as PI on the multiyear DOE-sponsored North Dakota CarbonSAFE feasibility project. He also served as task lead and PI of the regional geologic characterization component of the PCOR Partnership Program. Mr. Peck recently led a full-CO_2-chain techno-economic investigation in North Dakota linking lignite mining and electric generation to CO_2 EOR.

2011–2015: Research Manager, EERC, UND. Mr. Peck's responsibilities include overseeing a staff of geologists and GIS specialists involved with oil and gas research activities in the Williston Basin as well as regional geologic characterization activities associated with the PCOR Partnership.

1991–2011: Research Scientist, EERC, UND. Mr. Peck oversaw major GIS activities at the EERC, served as task leader for the regional characterization component of the PCOR Partnership, and wrote reports and proposals.

1989–1991: Graduate Research Assistant, EERC, UND. Mr. Peck acquired and managed geologic data related to Cretaceous and Tertiary geology of the Williston Basin. He also assisted in the collection of Cretaceous and Tertiary fossils and stratigraphic information in western North Dakota and eastern Montana.

Publications

Mr. Peck has authored and coauthored numerous professional publications.

JAMES A. SORENSEN
Director of Subsurface Research and Development
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Principal Areas of Expertise
Mr. Sorensen's primary areas of interest and expertise are enhanced oil recovery (EOR) in unconventional tight oil formations, CO_2 utilization and storage in geologic formations, and tight oil resource assessment and development.

Education and Training
M.Eng., Petroleum Engineering, University of North Dakota, 2020.
B.S., Geology, University of North Dakota, 1991.

Research and Professional Experience
October 2019–Present: Director of Subsurface Research and Development, EERC, UND. Mr. Sorensen is responsible for developing and managing programs and projects focused on conventional, unconventional, and enhanced oil and gas production; the geological storage of CO_2; geothermal; and other energy and environmental research.

July 2018–September 2019: Assistant Director for Subsurface Strategies, EERC, UND. Mr. Sorensen developed business opportunities, provided technical support and guidance regarding emerging areas of research, and served as a principal investigator and task manager for projects related to the sequestration of CO_2 in geologic media and the sustainable development of tight oil resources.

1999–July 2018: Principal Geologist, EERC, UND. Mr. Sorensen served as manager and co-principal investigator for programs to develop strategies for CO_2 utilization and storage. He also led research focused on enhanced oil recovery (EOR) in the Bakken.

1997–1999: Program Manager, EERC, UND. Mr. Sorensen managed projects focused on produced water management and environmental fate of natural gas-processing chemicals.

1993–1997: Geologist, EERC, UND. Mr. Sorensen conducted field-based hydrogeologic investigations focused on natural gas production sites.

1991–1993: Research Specialist, EERC, UND. Mr. Sorensen assembled and maintained comprehensive databases related to oil and gas drilling, production, and waste management.

Professional Activities
Member, Society of Petroleum Engineers

Publications
Mr. Sorensen has coauthored nearly 200 publications.

DR. JOHN A. HARJU
Vice President for Strategic Partnerships
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Principal Areas of Expertise

Dr. Harju's principal areas of interest and expertise include carbon sequestration, enhanced oil recovery, unconventional oil and gas development, waste management, geochemistry, technology development, hydrology, and analytical chemistry, especially as applied to the upstream oil and gas industry.

Education and Training

Ph.D., Petroleum Engineering, University of North Dakota, 2022.
M.Eng., Petroleum Engineering, University of North Dakota, 2020.
B.S., Geology, University of North Dakota, 1986.

Research and Professional Experience

2002–Present: EERC, UND.
July 2015–Present: Vice President for Strategic Partnerships. Dr. Harju leads efforts to build and grow dynamic working relationships with industry, government, and research entities globally in support of the EERC's mission to provide practical, pioneering solutions to the world's energy and environmental challenges. He represents the EERC regionally, nationally, and internationally in advancing its core research priorities: coal utilization and emissions, carbon management, oil and gas, alternative fuels and renewable energy, and energy–water.

2003–June 2015: Associate Director for Research. Dr. Harju led a team of scientists and engineers building industry–government–academic partnerships to carry out research, development, demonstration, and commercialization of energy and environmental technologies.

2002–2003: Senior Research Advisor. Dr. Harju developed, marketed, managed, and disseminated research programs focused on the environmental and health effects of power and natural resource production, contaminant cleanup, water management, and analytical techniques.

2017–Present: Adjunct Lecturer, Department of Petroleum Engineering, UND.

1999–2002: Vice President, Crystal Solutions, LLC, Laramie, WY. Dr. Harju's firm was involved in commercial E&P produced water management, regulatory permitting and compliance, and environmental impact monitoring and analysis.

1997–2002: Gas Research Institute (GRI) (now Gas Technology Institute [GTI]), Chicago, IL.

2000–2002: Principal Scientist, Produced Water Management. Dr. Harju developed and deployed produced water management technologies and methodologies for cost-effective and environmentally responsible management of oil and gas produced water.

1998–2000: Program Team Leader, Soil, Water, and Waste. Dr. Harju managed projects and programs related to the development of environmental technologies and informational products related to the North American oil and gas industry; formulated RFPs, reviewed proposals, and formulated contracts; performed technology transfer activities; and supervised staff and contractors. He served as Manager of the Environmentally Acceptable Endpoints project, a multiyear program focused on rigorous determination of appropriate cleanup levels for hydrocarbons and other energy-derived contaminants in soils. He led GRI/GTI involvement with industry environmental consortia and organizations, such as PERF, SPE, AGA, IPEC, and API.

1997–1998: Principal Technology Manager (1997–1998) and Associate Technology Manager (1997), Soil and Water Quality.

1988–1996: EERC, UND.
1994–1996: Senior Research Manager, Oil and Gas Group. Dr. Harju served as:
- Program Manager for assessment of the environmental transport and fate of oil- and gas-derived contaminants, focused on mercury and sweetening and dehydration processes.
- Project Manager for field demonstration of innovative produced water treatment technology using freeze crystallization and evaporation at oil and gas industry site.
- Program Manager for environmental transport and fate assessment of MEA and its degradation compounds at Canadian sour gas-processing site.
- Program Manager for demonstration of unique design for oil and gas surface impoundments.
- Director of the National Mine Land Reclamation Center for the Western Region.
- Co-PI on project exploring feasibility of underground coal gasification in southern Thailand.
- Consultant to an International Atomic Energy Agency program entitled "Solid Wastes and Disposal Methods Associated with Electricity Generation Fuel Chains."

1988–1994: Research Manager (1994), Hydrogeologist (1990–1994), Research Specialist (1989–1990), and Laboratory Technician (1988–1989).

Professional Activities
Member, National Coal Council (appointed 2018)
Member, National Petroleum Council (appointed 2010)
Member, Mainstream Investors, LLC, Board of Governors (2014–present)
Member, DOE Unconventional Resources Technology Advisory Committee (2012–2014)
Member, Interstate Oil and Gas Compact Commission (appointed 2010)
Member, Rocky Mountain Association of Geologists

Publications
Dr. Harju has authored or coauthored more than 100 professional publications and nearly 300 technical presentations.