North Dakota Pipeline Authority

Annual Report

July 1, 2019 – June 30, 2020

Industrial Commission of North Dakota

Governor Doug Burgum, Chairman

Attorney General Wayne Stenehjem

Agriculture Commissioner Doug Goehring

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Overview

At the request of the North Dakota Industrial Commission, the Sixtieth Legislature passed House Bill 1128 authorizing the North Dakota Pipeline Authority. It was signed into law on April 11, 2007. The statutory mission of the Pipeline Authority is "to diversify and expand the North Dakota economy by facilitating development of pipeline facilities to support the production, transportation, and utilization of North Dakota energy-related commodities, thereby increasing employment, stimulating economic activity, augmenting sources of tax revenue, fostering economic stability and improving the State's economy". As established by the Legislature, the Pipeline Authority is a builder of last resort, meaning private business would have the first opportunity to invest in and/or build additional needed pipeline infrastructure.

By law, the Pipeline Authority membership is comprised of the members of the North Dakota Industrial Commission. Upon the recommendation of the Oil and Gas Research Council, the Industrial Commission authorized the transfer of $700,000 from the Oil and Gas Research Fund during the 2019-2021 biennium for the Pipeline Authority's operations and studies. On August 1, 2008 the Industrial Commission named Justin J. Kringstad, an engineering consultant, to serve as Director of the North Dakota Pipeline Authority. The North Dakota Pipeline Authority Director works closely with Lynn Helms, Department of Mineral Resources Director, Ron Ness, North Dakota Petroleum Council President and Karlene Fine, Industrial Commission Executive Director. The Pipeline Authority has no other staff and receives no direct General Fund appropriation. The Pipeline Authority Director reports to the Industrial Commission and the Oil and Gas Research Council on a regular basis.

Statutory Authority

Statutory authority for the Pipeline Authority is found in Chapter 54-17.7 of the North Dakota Century Code (N.D.C.C.). Section 54-17.7-04 N.D.C.C. delineates the powers of the Pipeline Authority including: 1) making grants or loans or to borrow money; 2) to issue up to $800 million in revenue bonds; 3) enter into lease-sale contracts; 4) own, purchase, lease, rent and dispose of pipeline facilities or the right to capacity in any pipeline system or systems within or without the State of North Dakota; 5) enter into contracts to construct, maintain and operate pipeline facilities; 6) investigate, plan, prioritize and propose transportation corridors; and 7) participate in regional pipeline organizations.

Before the Pipeline Authority may exercise its power to construct pipeline facilities, it must follow a process defined by statute to ensure public participation and comment. In particular, the Pipeline Authority must publish a notice describing the need for the pipeline project. Entities interested in

constructing the facilities or furnishing services to satisfy the identified needs have 180 days to respond by filing a notice of intent. If the Pipeline Authority receives a notice of intent from an interested entity, it may not exercise its powers to construct unless the Pipeline Authority makes a finding that doing so would be in the public interest. In making such a finding, the Pipeline Authority shall consider the economic impact to the state, economic feasibility, technical performance, reliability, past performance, and the likelihood of successful completion and ongoing operation.

North Dakota Pipeline Regulatory Programs

The Pipeline Authority does not serve in any capacity as a regulatory agency for the pipeline industry. North Dakota's pipeline industry is regulated by several state and federal agencies. Roles of each regulatory entity are complex and the Pipeline Authority urges all interested parties to please contact the agencies below for more information on their jurisdiction of the pipeline industry.

- North Dakota Department of Emergency Services
- North Dakota Department of Health
- North Dakota Department of Environmental Quality
- North Dakota Public Service Commission
- North Dakota Industrial Commission-Department of Mineral Resources-Oil and Gas Division
- Environmental Protection Agency
- Federal Energy Regulatory Commission
- U.S. Department of Transportation-Pipeline and Hazardous Materials Safety Administration-Office of Pipeline Safety

Summary of Activities

North Dakota's petroleum industry started the 2019-2020 fiscal year with steady activity levels and reached a new daily production rate of 1.52 million barrels per day in November 2019. Crude oil prices and drilling activity were relatively stable in the second half of 2019 with steady growth expected throughout calendar year 2020. In early 2020, those near-term expectations quickly evaporated as the COVID-19 pandemic caught every sector of the global economy by surprise.

The oil price and consumer demand crash of early 2020 has devastated the petroleum industry at a level previously not believed possible. As a result, North Dakota's oil activity dropped substantially and large volumes of petroleum production was curtailed in an effort to salvage company economics. The second half of 2020 is expected to see some minor industry recovery, but continued growth in COVID-19 cases globally adds even more uncertainty.

Despite the immense near-term challenges facing the industry, the long-term outlook for North Dakota's petroleum industry remains robust. North Dakota's midstream industry continues to position itself to meet current production levels and continues to plan for further expansion in the long term. During the

past year, the Pipeline Authority has been fully engaged in continuing efforts to convert production and development information into oil and natural gas transportation solutions. Working alongside industry to produce crude oil and natural gas production forecasts to quantify future pipeline needs and time frames continues to be one of the principle tasks of the Pipeline Authority. Pipeline companies are conservative by nature and these forecasting exercises are very beneficial in providing the confidence needed to move forward with expansion project planning.

During the fiscal year the Pipeline Authority contacted, met with, and shared information with numerous interested parties including, but not limited to, the following:

Enbridge Pipeline
TC Energy
MDU/WBI Energy
ONEOK
Alliance Pipeline
Northern Border Pipeline
Basin Electric
Moody's Analytics
XTO/ExxonMobil
Bakken Midstream
Whiting Petroleum
Energy Transfer Partners
GA Group
Oasis Petroleum
PetroNerds
ATCO
Steel Reef Infrastructure
Kinder Morgan
Enable Midstream
East Daley Capital
Scotia Capital
RBN Energy
Catalyst Midstream
Neset Consulting
Citadel Global Equities
OG 360
TruWealth Financial
Croswell-Schulte Consultants
DOW Chemical
Argos Investment Partners
IHS Markit
Hess Corporation
Marathon Petroleum
True Companies
Crestwood
BNSF Railway
JP Morgan
Gtuit
Targa Resources
Sequent Energy
Barr Engineering
Pembina Pipeline
Wells Fargo
Kinder Morgan
Marathon Oil
Robert W. Baird & Co.
Golden Growers
Global Innovative Solutions
Brownstein, Hyatt, Farber and Schreck
Outrigger Energy
UBS
Continental Resources
Wood MacKenzie
Southwest Power Pool
INNIO Waukesha Gas Engines
Dakota Gold
H2Go
Border States Electric
North Dakota LNG/Alkane
Rystad Energy
Sky Skopes
FTI Consulting
Environmental Management and Planning Solutions, Inc

In addition, the Pipeline Authority worked with a number of state and federal agencies to gather information and provide expertise on pipeline issues. Those agencies and entities included:

North Dakota Public Service Commission
North Dakota Transmission Authority
North Dakota Oil and Gas Division
North Dakota Governor's Office
Department of Environmental Quality
Bank of North Dakota
US Energy Department of Energy
North Dakota Oil & Gas Research Program
Western Area Water Supply Authority
North Dakota Office of Management and Budget
North Dakota Department of Commerce
Energy and Environmental Research Center
North Dakota Department of Transportation
U.S. Department of Commerce
North Dakota Tax Department
EmPower North Dakota Commission
North Dakota State Water Commission
Upper Great Plains Transportation Institute
North Dakota Retirement and Investment Office

The Director of the Pipeline Authority also worked with the following trade associations/groups:

North Dakota Petroleum Council
North Dakota Petroleum Marketers Association
Western Dakota Energy Association
North Dakota Building Trades Union
Utilities Shareholders of North Dakota
Bismarck Mandan Chamber EDC
North Dakota Township Officers Association
North Dakota League of Cities

As noted above, the Pipeline Authority has been facilitating discussions between governmental agencies and companies interested in expanding North Dakota's midstream infrastructure.

In addition, the Director of the Pipeline Authority provided information to citizens and news media on issues related to pipelines.

Bakken Restart Task Force

The consumer demand destruction and subsequent oil price collapse associated with the COVID-19 pandemic was devastating to North Dakota's petroleum industry. In an effort to find ways to support industry employment, tax generating oil production, and overall industry health, the Bakken Restart Task Force was created. The Pipeline Authority played an active role in data collection and analytics, particularly as it related to shut-in production volumes, well completions, and forecasting. The task force is led by the North Dakota Department of Mineral Resources and includes the participants listed below:

Department of Mineral Resources
Department of Environmental Quality
Department of Trust Lands
Pipeline Authority
Office of Management and Budget
Western Area Water Supply Authority
Governor's Office
Public Service Commission
Tax Department
Department of Commerce
Bank of North Dakota
State Water Commission
Additional Subject Matter Experts

The Bakken Restart Task Force will continue into at least the 2020-2021 fiscal year. More information on the restart task force can be found on the Department of Mineral Resources website.

Crude Oil and Natural Gas Production Forecasting

The Pipeline Authority continued to develop and maintain crude oil and natural gas production forecasts for North Dakota and the United States portion of the Williston Basin. These forecasts are widely used throughout both public and private organizations. Three assumption scenarios are forecasted for the purpose of communicating the production impacts of different price and activity levels. The "Base" case was modeled as expected production assuming the Federal Energy Information Administration's (EIA) West Texas Intermediate (WTI) oil price forecasts. The "Low" case was modeled as a conservative production outlook based on lower than expected activity and/or oil prices. The new "High" case scenario was introduced during the 2019-2020 fiscal year and is intended to model production scenarios under an environment where completion technology continues to result in higher performing wells. Figure 1 is a long-term oil production forecast for North Dakota. Figure 2 shows a long-term natural gas production forecast using the three different activity scenarios for North Dakota.

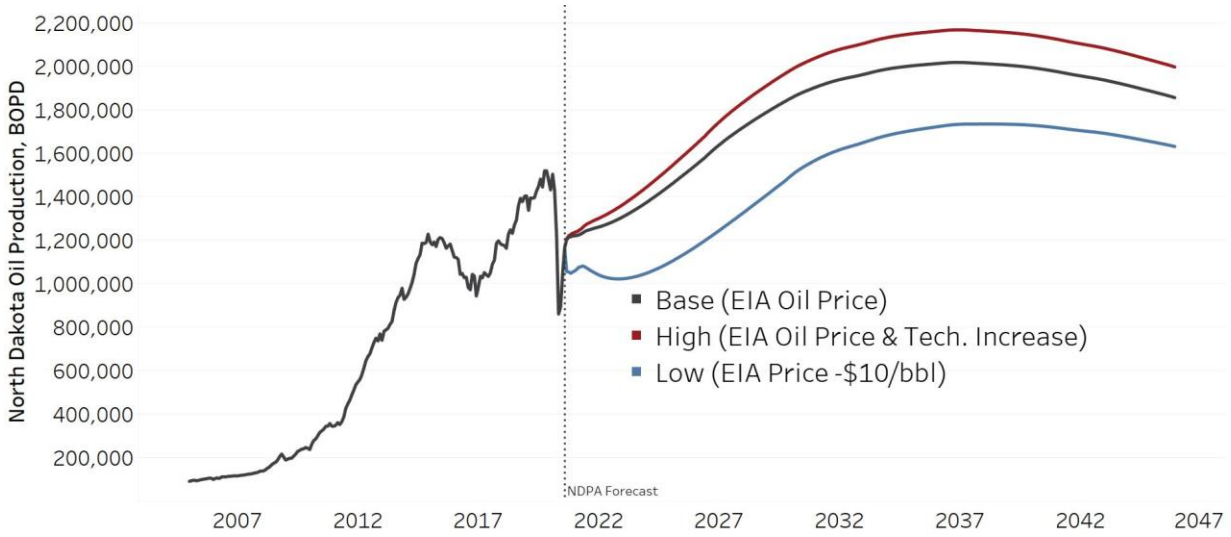


Figure 1. Long term crude oil production forecast for North Dakota starting in Aug. 2019

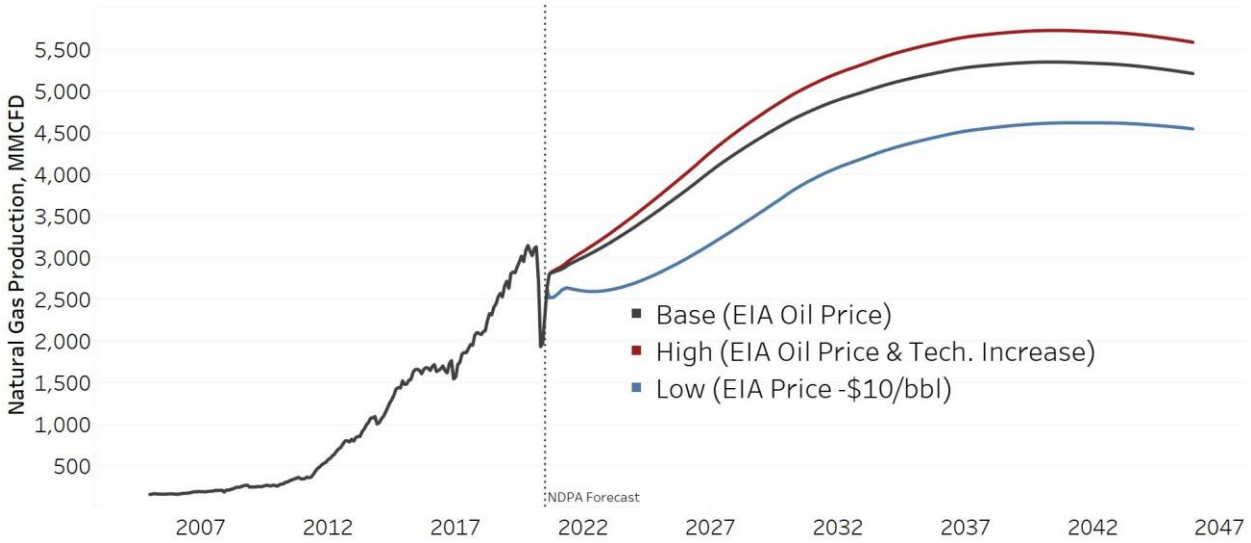


Figure 2. North Dakota natural gas production forecast starting in Aug. 2019

Given the incredible amount of market uncertainty surrounding the COVID-19 pandemic, the Pipeline Authority created a series of production forecasts based on various well completion scenarios in North Dakota. Figures 3 and 4 represent the near-term estimated oil and natural gas production levels at the stated number of new well completions per month. These scenario calculations have proven very beneficial to assist in transportation, budget, and policy planning. Additional information on this topic can be found on the Pipeline Authority website.

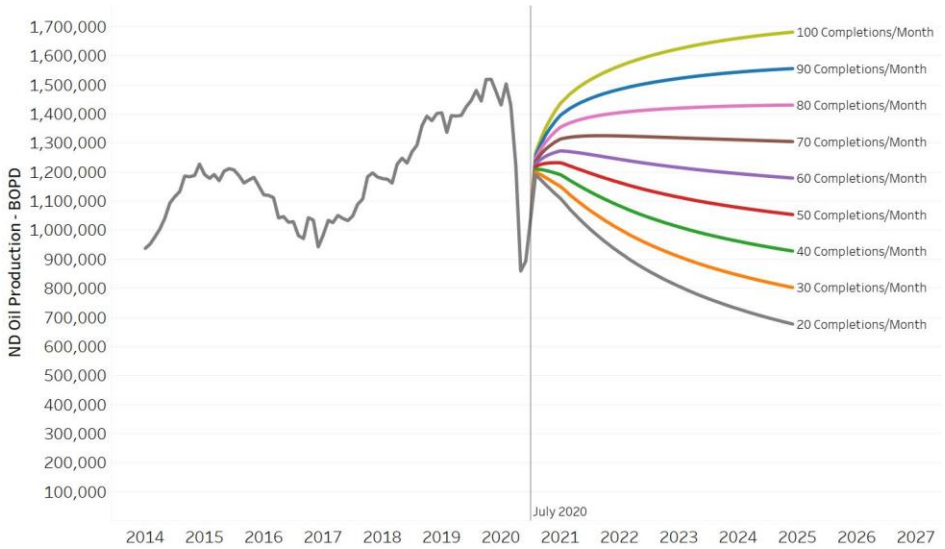


Figure 3. North Dakota oil production under various completion scenarios

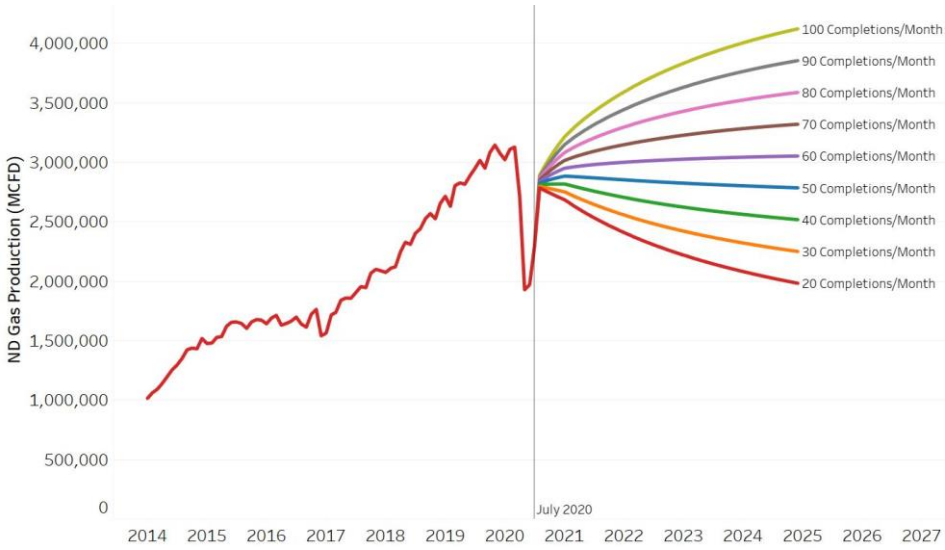


Figure 4. North Dakota natural gas production under various completion scenarios

Crude Oil and Natural Gas Production Curtailments

During the first half of 2020, crude oil pricing and demand had dropped to a critical level causing well operators in North Dakota to begin curtailing output. Curtailment strategies came in many forms including reduced operating days, reduced pumping rates, or physically shutting down well operations (a.k.a. “shutting-in”).

Figure 5 shows the Pipeline Authority’s estimated monthly shut-in volumes during the summer of 2020. May 2020 represented the largest period of shut-in production with over 6,700 wells found to be severely curtailing production by a cumulative volume of almost 500,000 barrels per day. It is anticipated that by

yearend 2020, most curtailed production will be back in service. More detailed presentations and videos analyzing production curtailments can be found on the Pipeline Authority's website.

Figure 5. Estimated monthly oil production curtailments

Natural Gas Liquids

The Pipeline Authority continued to focus considerable attention in the 2019-2020 fiscal year to the topic of natural gas liquids (NGLs). Natural gas produced from the Bakken and Three Forks Formations is very high in NGLs such as ethane, propane, and butane. Forecast models created by the Pipeline Authority were updated to better understand the production potential and required transportation infrastructure going forward.

The forecast in Figure 6 shows three potential production cases based on different activity level assumptions. North Dakota faced a significant shortfall of gross pipeline capacity until ONEOK's Elk Creek Pipeline went into service in late 2019. It is expected that NGL production will exceed pipeline capacity again in 2022 until further system expansions take place or a new market option is developed. Further complicating the NGL transportation dynamics is the fact that not all NGL pipelines can handle the same types of NGL products. In addition, natural gas plants around the region produce either purity products or unfractionated product, known as Y-grade.

There are several options going forward to address the growing volume of NGLs in North Dakota. One option would be to build, expand, or repurpose existing pipeline systems. A second option would be the development of value-added industries that would use NGL products as feedstock. Another potential use for NGLs is enhanced oil recovery (EOR) in the Williston Basin as fields continue to mature. The use of NGLs as a working EOR fluid is still in the research phase with early lab results appearing promising.

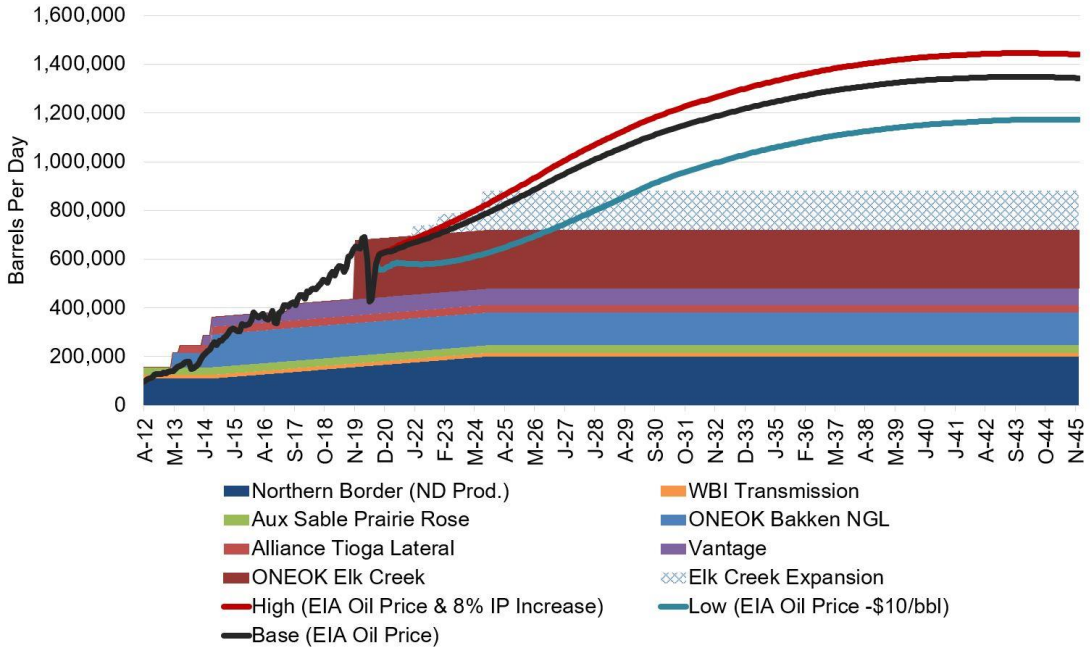


Figure 6. Forecasted North Dakota NGL production and transportation options.

Natural Gas Liquids Study

During the 2019-2020 fiscal year, the Pipeline Authority commissioned a comprehensive study on the natural gas liquid composition in North Dakota's produced gas from the Bakken petroleum system. Scientists at the Energy & Environmental Research Center (EERC) conducted the research with industry partner datasets from over 7,300 wells. The immense amount of industry provided data made the study the most comprehensive look at natural gas liquids chemistry known to date.

A study summary was provided to the Industrial Commission in the third quarter of 2020. The executive summary can be found in Appendix A and the full report is available on the Pipeline Authority website.

Natural Gas Capture

While not a regulatory agency, the Pipeline Authority plays a very active support role in helping the state maximize the amount of captured natural gas. The Pipeline Authority continually monitors and reports capture statistics and provides analysis on current and future developments to industry participants, regulators, policy makers, and the public.

Several significant actions were taken by the ND Industrial Commission in recent years that have had a positive impact on increasing natural gas capture. The first was the requirement for operating companies

to submit a natural gas capture plan to the Oil & Gas Division to outline how produced natural gas would be sold or utilized on location. The second action was an Industrial Commission order on July 1, 2014 that provided gas capture targets to the year 2020 and provided a means of enforcement at the Oil & Gas Division through the use of production and permitting restrictions.

In November 2018, the Industrial Commission updated the natural gas capture regulations for Bakken and Three Forks production. More details on the November update can be found on the Oil & Gas Division website.

The current North Dakota gas capture target rates are as follows:

- 74% Capture – Q4 2014
- 77% Capture – Q1 2015
- 80% Capture – Q2 2016
- 85% Capture – Q4 2016
- 88% Capture – Q4 2018
- 91% Capture – Q4 2020

In August 2020, the North Dakota's petroleum industry produced 2.6 billion cubic feet per day (BCFD) with a gross capture rate of 92%. Industry estimates indicate over $20 billion has been invested in pipeline and processing assets to help reach the capture targets. In order for the industry to meet future gas capture targets, significant additional investments in gas gathering, processing, and transmission will be required.

Natural Gas Processing

For reference, a North Dakota Gas Processing and Transportation map can be found on the Pipeline Authority website and a table of all gas processing plants can be found in Appendix D

New or Expanding Natural Gas Plants

Due to the vast footprint of the Bakken resource, natural gas gathering and processing operators in North Dakota have faced difficult challenges in the past to keep pace with faster, more efficient drilling and completion techniques. Despite the daunting task, industry is rising up to reap the great economic reward contained in the rich Bakken gas.

North Dakota currently has thirty-one natural gas processing/conditioning plants operating, with the capability to process roughly 3.4 BCFD. Four additional new or expanded plants are expected over the next two years and will add 0.8 BCFD of processing capacity (Figure 7). A detailed breakdown of the existing and proposed facilities can be found in Appendix D and on the Pipeline Authority website.

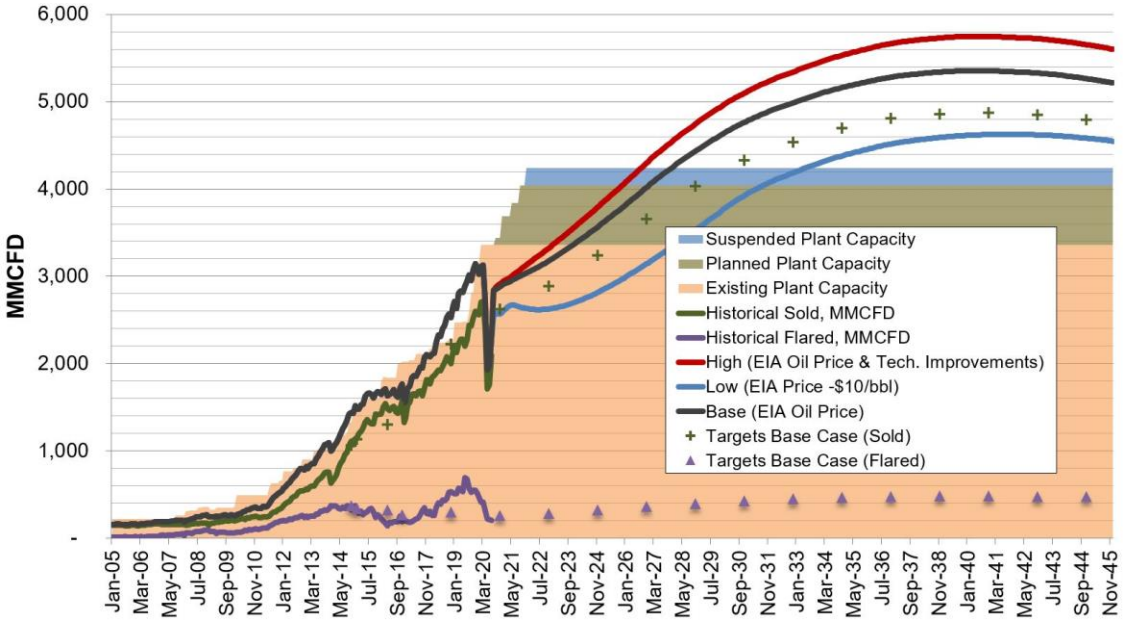


Figure 7. North Dakota natural gas processing plant intake capacity, gas production, gas forecast, and NDIC capture targets. (Forecast starts in Aug. 2020)

Williston Basin Gas Storage

One primary use of residue natural gas is heating residential and commercial buildings. Without the use of underground natural gas storage, the supply chain would be challenged to handle strong seasonal demand shifts. During the warm summer months, excess natural gas is stored in underground reservoirs and withdrawn during colder periods with higher demand (Figure 8). The reservoirs used for natural gas storage are typically depleted gas producing fields that are converted to serve a storage role.

The nearest residue gas storage field is located near Baker, MT and is operated by WBI Transmission. Located primarily in SE Montana in the Cedar Creek Anticline, the Baker field is the largest natural gas storage field in the United States. The Baker gas storage system has a working gas capacity of over 193 BCF and has been operating the past year with a balance of less than 40 BCF (Figure 8). Regional interstate residue gas pipelines provide transportation service to and from the Baker storage field.

Underground storage of raw (unprocessed) natural gas continues to be explored as an option to assist operators in meeting their gas capture requirements. An initial research study conducted by the Energy and Environmental Research Center indicated a strong potential for the practice in North Dakota. The 2019 legislature allocated up to $6 million (HB 1014) for additional pilot testing and research by the Energy and Environmental Research Center.

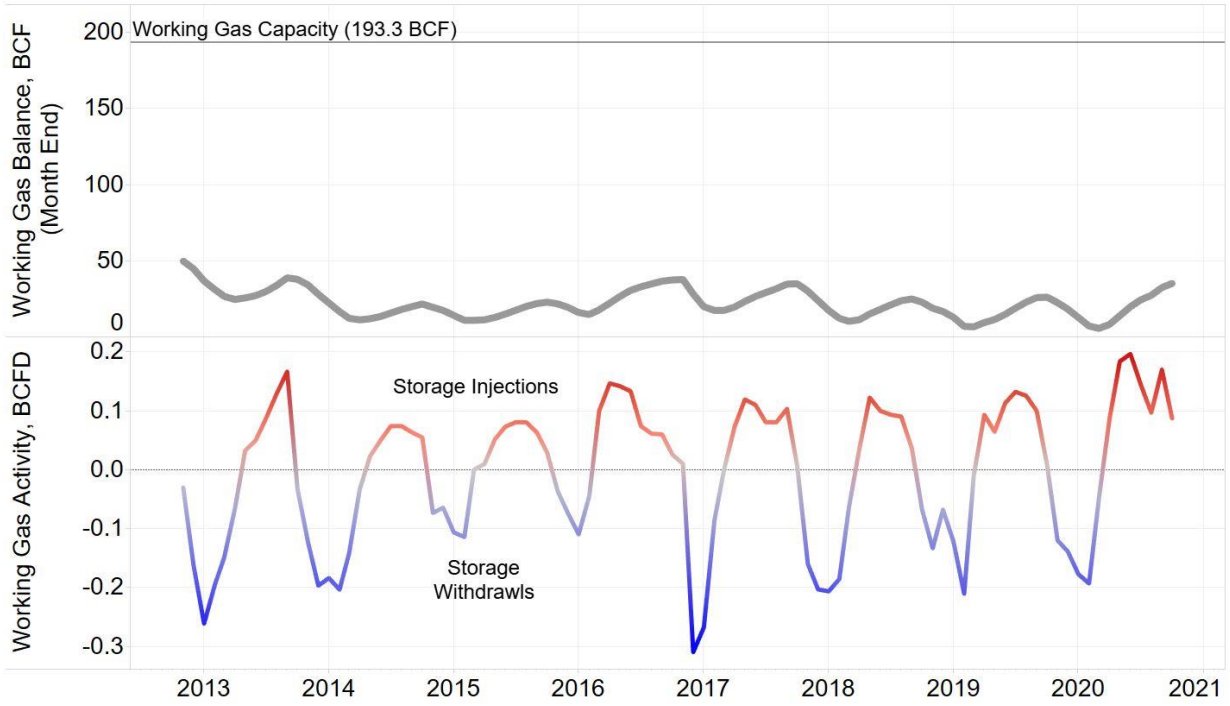


Figure 8. Baker gas storage field activity

North Dakota Freight Advisory Committee

In the fall of 2018, the Pipeline Authority Director and a number of other private and public entities joined the North Dakota Department of Transportation in an effort to create the North Dakota Freight Advisory Committee. The primary objective of the group is to improve collaboration between transportation providers, industry sectors, and government entities in order to efficiently expand North Dakota's economy.

Along with the Pipeline Authority, member entities include:

- BNSF Railroad
- Dakota, Missouri Valley, & Western Railroad
- Magnum Trucking
- Federal Highway Administration
- North Dakota Department of Commerce
- Teamsters Local 638
- Enger Grain & Livestock
- North Dakota Aeronautics Commission
- United Sugars Corporation
- North Dakota Motor Carriers Association
- North Dakota Mill and Elevator
- North Dakota League of Cities
- North Dakota Trade Office

- North Dakota Department of Transportation
- Bismarck-Mandan MPO
- Upper Great Plains Transportation Institute

Industry and Public Communications Activities

Pipeline Authority Websites

In an effort to provide industry and public users with the most timely and complete set of information, the Pipeline Authority continues to update the agency websites as new information becomes available. The websites allow the Pipeline Authority to provide users with current Williston Basin oil production data, maps, news, publications, basic pipeline information, pipeline safety information, and links to pipeline mapping systems.

Monthly Updates

During the 2019-2020 fiscal year, the Pipeline Authority produced monthly transportation and production reports to allow interested parties a quick view of how much crude oil and natural gas was produced each month and how each commodity was shipped and/or processed. Information contained in the reports is presented during monthly media events in conjunction with the ND Oil & Gas Division. Monthly reports are placed on the Pipeline Authority website and an email distribution list has been created to circulate the update to interested parties.

North Dakota Drilling Inventory and Economics

In order to assist the midstream industry in understanding current and future petroleum activity levels, the Pipeline Authority routinely publishes information exploring the economics of drilling in North Dakota's Bakken/Three Forks Formations. The research takes a detailed look at where drilling in North Dakota has been most successful in the past and then predicts where drilling may be concentrated during periods of fluctuating oil prices.

Figure 9 was generated during the drilling economics research to represent the number of drillable locations remaining in the Bakken and Three Forks system. It is clear in the graphic that economically drillable locations increase as market prices drive producer activity to lower performing sections of the play. The difference between the high and low cases in Figure 9 is connected to how much development will occur in the middle and lower Three Forks. The low case inventory assumes a very limited number of wells would be drilled to target the middle and lower Three Forks, while the high case assumes a moderate development pattern in known highly production regions. Maps were generated to show where the wells in Figure 9 are located. These maps are contained in various presentations on the Pipeline Authority website.

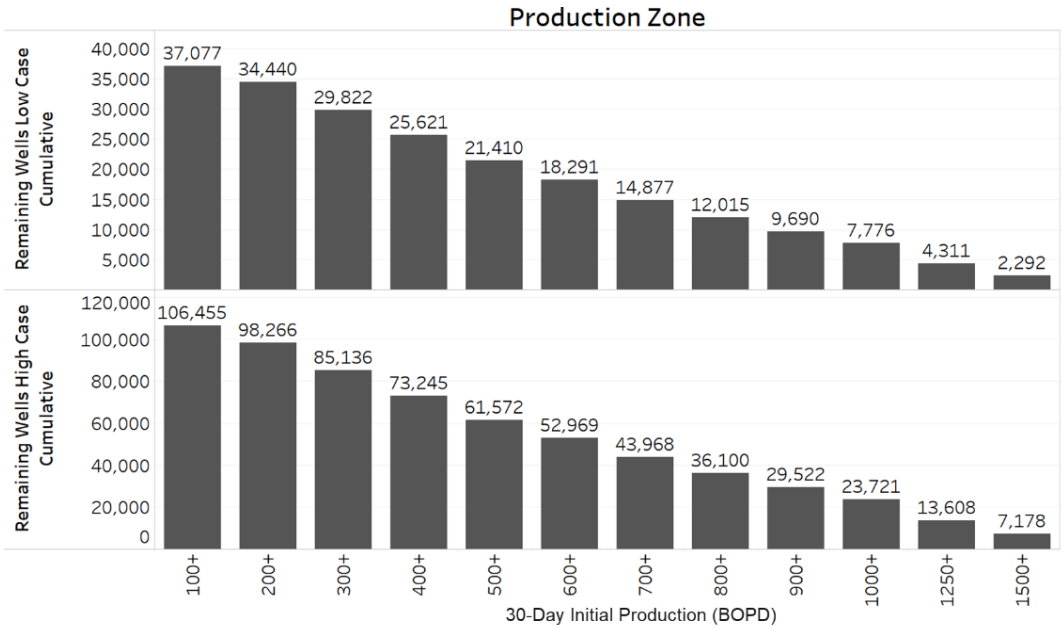


Figure 9. North Dakota drilling inventory summary

Pipeline Presentations

The Pipeline Authority has had the opportunity to make presentations at a variety of legislative, industry, and public events during the past fiscal year. Presentation topics were typically focused on North Dakota's transportation dynamics with additional material on drilling economics and production techniques. Slides from many of the major events are placed on the Pipeline Authority website as content is updated.

Williston Basin Pipeline Infrastructure

For reference, a series of North Dakota pipeline maps can be found in Appendix B

Pipeline Mileage

North Dakota's pipeline industry added 812 miles of new oil, natural gas, and produced water pipelines in 2019 (Figure 10). The majority of the new pipelines installed in 2019 operate as gathering pipelines for oil, natural gas, and produced water (Figure 11). The significant decrease in pipeline construction in 2016 through 2019 was proportional to the slowdown in well completions and a geographic concentration of activity in the core of the oil play. Data from the Federal Department of Transportation and North Dakota Oil & Gas Division indicates that North Dakota has over 29,000 miles of gathering and transmission pipelines. Further details about North Dakota's pipeline network can be found on the Pipeline Authority website.

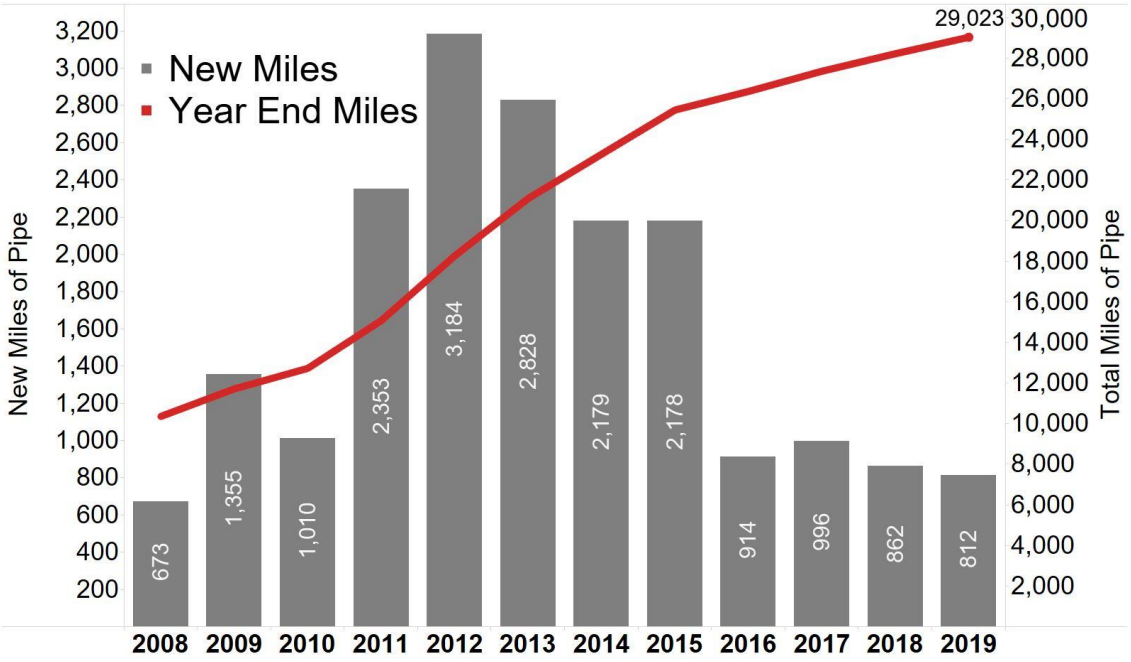


Figure 10. North Dakota pipeline mileage

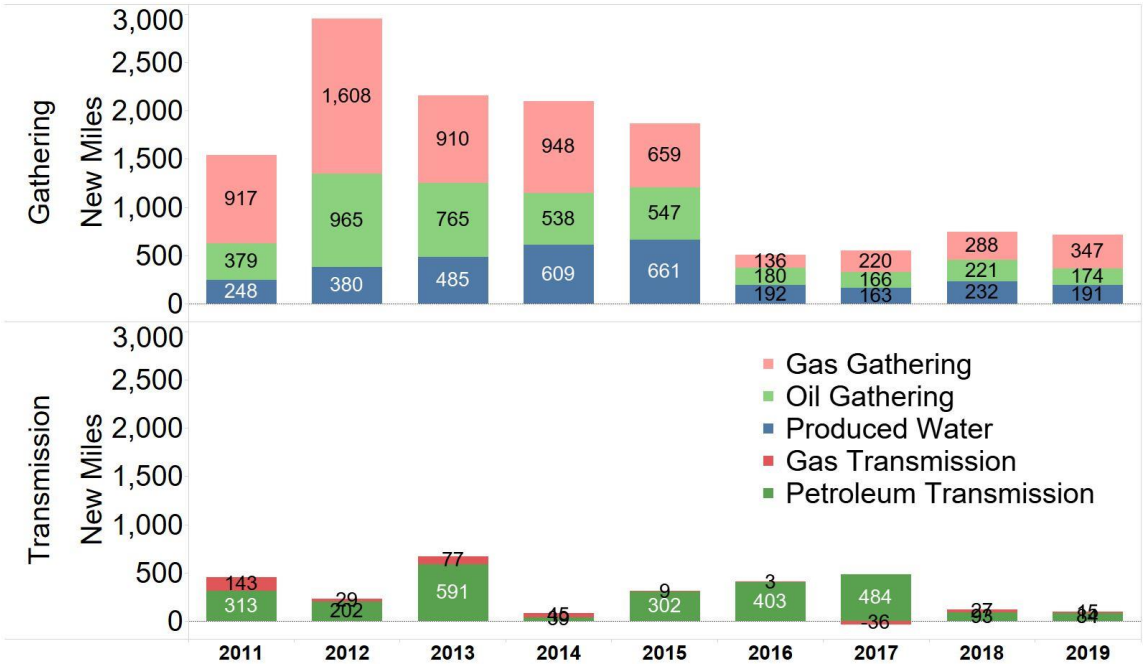


Figure 11. New North Dakota pipeline mileage by category

Crude Oil Pipelines, Refining, and Rail Transportation

Enbridge/North Dakota Pipeline Company: Having completed several expansion projects over the past number of years, Enbridge now has the capacity to move 355,000 BOPD on its pipeline system to Clearbrook, MN. Enbridge completed their work to expand north bound capacity of 145,000 BOPD in early 2013 for the larger scale "Bakken Expansion Project". Oil using the northbound route navigates the Enbridge Saskatchewan system to an interconnect with the Enbridge Mainline at Cromer, MB. Once on the Mainline system, the Williston Basin oil quickly reenters the United States and meets east bound Enbridge oil at Clearbrook, MN.

Enbridge's plans to construct the 225,000 BOPD "Sandpiper" system were deferred during the third quarter of 2016 due to unexpected market conditions in the near-term planning horizon. Enbridge plans to monitor market conditions and reevaluate potential expansion opportunities in North Dakota.

Bridger, Belle Fourche, and Butte Pipelines: Bridger and Belle Fourche Pipelines operate as intra-regional pipeline systems moving oil to several pipeline interconnects or rail facilities in the Williston Basin. One such pipeline interconnect is with the Butte Pipeline near Baker, MT. The Butte Pipeline currently has the capacity to move 260,000 BOPD to Guernsey, WY. In Guernsey, WY, the oil is transported to Wood River, IL on the Platte Pipeline, Cushing, OK on the White Cliffs Pipeline, or loaded into rail cars for further transport.

Bridger Pipeline is actively developing a multi-segment expansion project from Johnson's Corner, ND to Guernsey, WY to meet growing production levels. Proposed to be in service before the end of 2022, the 16", 137 mile "South Bend Pipeline" will be able to ship 150,000 BOPD to Baker, MT. Additionally, a 191 mile southern section of new 20" pipeline will move up to 200,000 BOPD of North Dakota and Rockies oil from Hulett, WY to Guernsey, WY. At Guernsey, WY the oil will have multiple shipping options, including the newly proposed "Liberty Pipeline" with service to Cushing, OK. The Liberty Pipeline is jointly owned by Bridger Pipeline and Phillips 66.

BakkenLink: After announcing plans in 2010 to offer a pipeline system connecting the Williston Basin to the Keystone XL Pipeline in Eastern Montana, BakkenLink has altered their current project scope. Now in service, the BakkenLink system collects crude oil from various locations along its route south of Lake Sakakawea and delivers the oil to a unit train rail facility located near Fryburg, ND. In late 2015, Andeavor (formerly Tesoro Corporation) purchased the BakkenLink pipeline and rail facility from Great Northern Midstream.

In February 2018, Andeavor sought, and was granted, approval from the North Dakota Public Service Commission to add NGL service to the existing BakkenLink crude oil system. Completed in late 2018, the additional NGL service to Fryburg, ND uses three new line segments on the north and south ends of the BakkenLink system.

Energy Transfer Partners: In early 2014, Energy Transfer Partners (ETP) held an open season to solicit interest in a new 30" pipeline from North Dakota to Patoka, IL. In June 2014, ETP announced that they had secured sufficient shipper support to move forward with the project. The "Dakota Access" pipeline collects oil north and south of Lake Sakakawea and has the ability to transport up to 520,000 BOPD. The project began construction in May 2016 and was placed into commercial service on June 1, 2017.

In 2018, two successful open seasons were held for additional service on the Dakota Access pipeline. With additional shipper commitments, the pipeline was expanded to carry up to 570,000 BOPD.

In 2019, ETP began the regulatory process to expand the Dakota Access system up to 1.1 million BOPD through the use of additional pump stations and horsepower at existing pump facilities. If all regulatory approvals are received, the expanded capacity could be in service by the end of 2021.

Plains All American Pipeline: In November 2010, Plains All American Pipeline (Plains) announced plans to construct a new 103-mile, 12-inch, pipeline from Trenton, ND to an interconnect with the existing Wascana Pipeline at the United States-Canada border in northeast Montana. The "Bakken North" pipeline went into service in May 2014, with an initial capacity of 40,000 BOPD, expandable to 75,000 BOPD.

TC Energy (TransCanada) Bakken Marketlink: On September 13, 2010, TransCanada launched a successful open season for Bakken producers interested in accessing TransCanada's proposed Keystone XL pipeline project in eastern Montana. The proposed 100,000 BOPD interconnect would be located near Baker, MT and would require new pumps and tanks to accommodate the Bakken oil. Third party shippers would be necessary to move the crude to the Baker, MT facility from North Dakota.

In November 2015, President Obama announced that the Keystone XL Pipeline was not in the national interest of the United States and that a required Presidential Permit would not be granted. In March 2017, President Trump reversed the White House decision and granted the Presidential Permit to TransCanada for the Keystone XL Pipeline. TC Energy (formerly TransCanada) continues to work through the legal and regulatory process and an updated timeline for the Keystone XL Pipeline and Bakken Marketlink has not been made public.

Marathon Petroleum Mandan Refinery (Formerly Andeavor/Tesoro): Expanded by 10,000 BOPD in 2012, Marathon Petroleum operates a 68,000 BOPD refinery in Mandan, ND. The refinery receives its light sweet feedstock though a network of pipelines in the Williston Basin. Products generated at the refinery are distributed directly from a truck rack at the facility or through the NuStar North Pipeline to Eastern North Dakota and Minnesota.

In 2017, Tesoro Corporation changed its name to Andeavor. In the second half of 2018, Andeavor merged with Marathon Petroleum and will operate under the Marathon Petroleum name.

Marathon Petroleum Dakota Prairie Refinery: In late June 2016, Tesoro Corporation purchased the Dakota Prairie Refinery from MDU Resources Group and Calumet Specialty Products Partners. The Dakota

Prairie Refinery, began processing 20,000 BOPD at its facility just west of Dickinson, ND in May 2015. The "diesel topping" refinery produces around 7,000 BPD of diesel fuel for consumption, while the remaining product is transported for further processing or use.

In 2018, a decision was made to convert the refinery to produce renewable diesel fuel by mid-2020. Beginning in June 2020, the facility will no longer use crude oil as a feedstock. Renewable diesel fuel is likely to be shipped by rail and marketed in California.

Davis Refinery: Meridian Energy Group is planning to construct a crude oil refinery in Billings County, east of the Fryburg Rail Facility in Belfield. The refinery is designed with an inlet oil capacity of 49,500 BPD. All refined products are expected to be marketed regionally with transportation taking place by truck and/or rail. Preliminary site preparation began in July 2018 with plant completion proposed in 2024.

A map of North Dakota crude oil gathering systems can be found on the Pipeline Authority website

Rail Loading Facilities: The transportation of crude oil by rail car has played a key role in moving growing volumes of crude oil from the Williston Basin to markets around the United States and Canada. Figure 12 shows the estimated Williston Basin market share percentages for rail, pipeline, and local refining. Figure 13 shows the estimated volume of oil moved by rail out of North Dakota. Maps, capacities, and additional information on the various facilities can be found on the Pipeline Authority website.

A significant decrease in crude by rail volumes can be identified during the 2015-2017 timeframe in Figures 12 & 13. The 2015-2017 volume decrease can be attributed to production declining in North Dakota and reduced market incentives to utilize crude by rail. Prior to the industry downturn in 2020, crude by rail volumes has been steadily increasing as production rose and egress pipelines were at capacity. The Pipeline Authority estimates ten of the twenty-plus rail facilities are still active loading crude oil, with the most active facilities being those with unit train loading capabilities and inbound/outbound marketing options.

The future of crude by rail utilization in North Dakota will be driven by oil production volumes, market pricing, pipeline capacity, and regulatory oversight.

A map of North Dakota oil rail loading facilities can be found in Appendix C

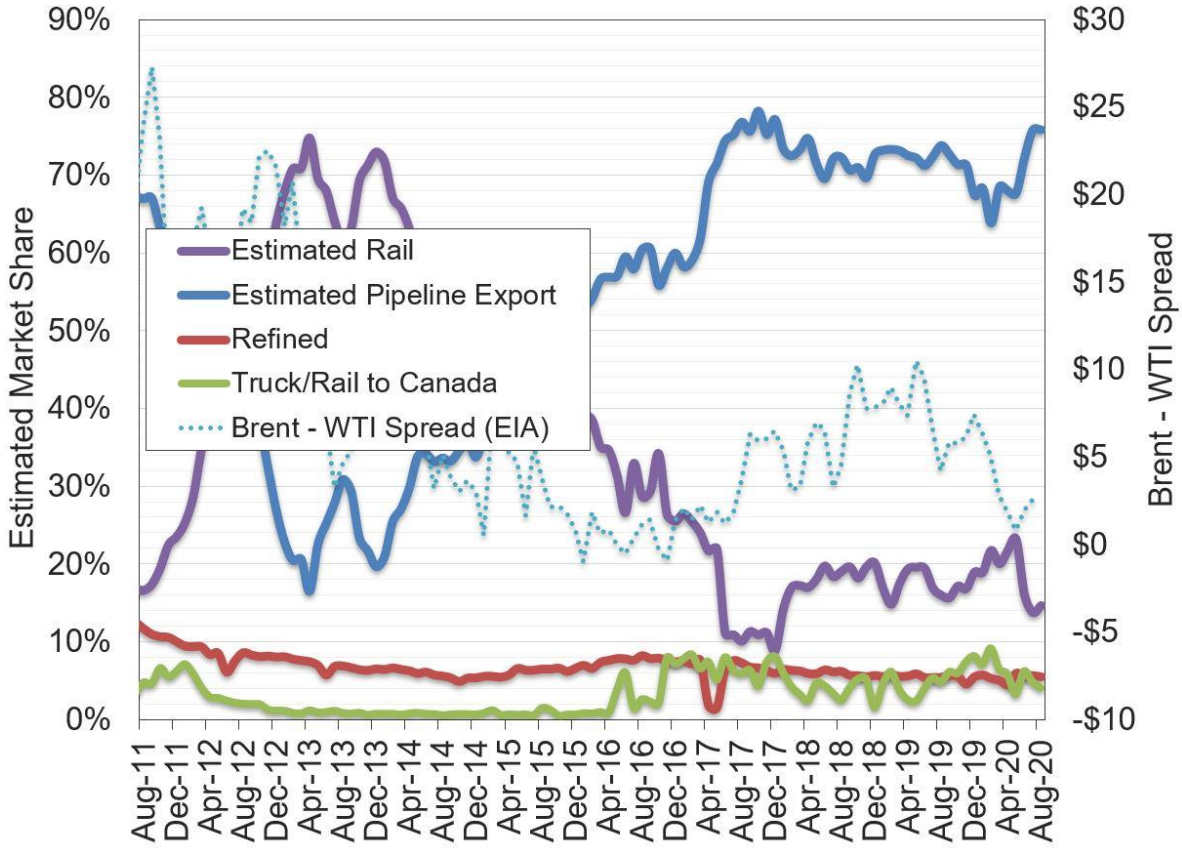


Figure 12. Estimated oil transportation by mode (Aug. 2020 data)

Figure 13. Estimated outbound crude oil rail shipments (Aug. 2020 data)

Natural Gas Pipelines

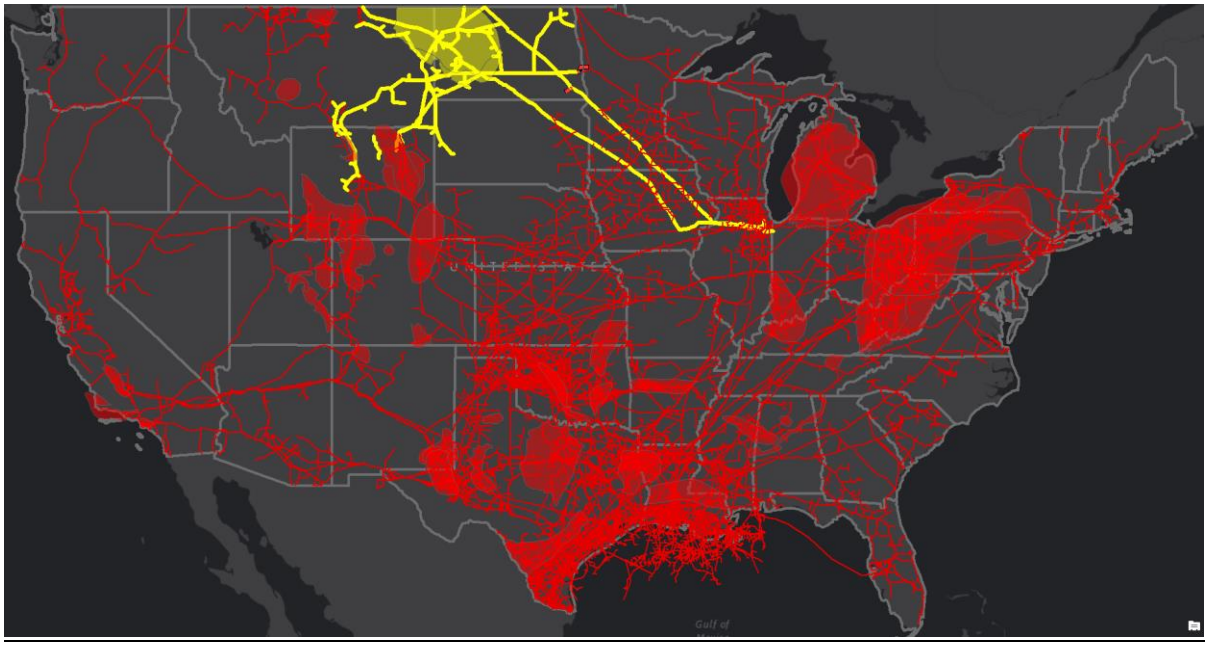


Figure 14. North Dakota's interstate gas pipelines (yellow) and the national interstate gas pipeline network (red)

Alliance Pipeline: The Alliance Pipeline is a high pressure, large diameter natural gas pipeline that originates in British Colombia, Canada and terminates at the Aux Sable gas processing plant near Chicago, IL. The Alliance Pipeline transports "dense gas" or gas that still contains high BTU natural gas liquids, such as propane and butane. In February 2010, the Alliance Pipeline began transporting rich natural gas from North Dakota via a new interconnect with the Prairie Rose Pipeline near Bantry, ND (See Aux Sable below). The 36-inch diameter United States portion of the pipeline has a certified capacity of 1.513 billion cubic feet per day (BCFD). The Alliance Pipeline has one direct North Dakota delivery point in Hankinson and one interconnect with Montana Dakota Utilities to serve industrial manufacturing in Gwinner.

In response to growing natural gas production, Alliance Pipeline announced plans on June 22, 2011, to construct a new, 80-mile, natural gas pipeline from the Hess Gas Plant in Tioga, ND to an interconnection point near Sherwood, ND. Commissioned in late 2013, the "Tioga Lateral Pipeline" has the ability to deliver liquids rich, high BTU, natural gas to Chicago, IL for further processing and transportation. The Tioga Lateral has the capacity to transport up to 126 million cubic feet per day (MMCFD).

Northern Border: The Northern Border Pipeline, owned by TC Pipelines and ONEOK Partners, is a 1,249-mile pipeline originating at the Port of Morgan in Montana and terminating near North Hayden, Indiana. The pipeline has a system receipt capacity of 2.37 BCFD, with less than half of the gas supply in 2019 originating in Canada through a receipt point with the Foothills Pipeline at the Port of Morgan. The 42-inch diameter Northern Border Pipeline receives gas deliveries at a total of seventeen receipt points in the Williston Basin with fourteen of those points for North Dakota gas supply.

As volumes are projected to grow in the Williston Basin, Northern Border has proposed two expansion options to increase service for the region. One option would be to add compression along the mainline from North Dakota to Iowa with up to 525 MMCFD of additional capacity. The second option is to repurpose the Bison Pipeline and provide up to 390 MMCFD of new gas deliveries from North Dakota to the Cheyenne, WY hub. Both projects have a proposed in-service timeline between 2022-2023 and will only move forward with sufficient commercial support.

In May 2020, Northern Border submitted a proposed tariff modification to the Federal Energy Regulatory Commission (FERC) that would limit the energy content of flows exiting North Dakota to 1,100 BTU. The FERC decision process resulted in a technical conference being held and multiple opportunities for interested party input. While the Pipeline Authority remained neutral on the proposed tariff modifications, considerable efforts were made to model and quantify the potential impacts to North Dakota's petroleum industry. FERC ultimately rejected the proposed BTU limit, but left open the opportunity for a similar proposal to be filed in the future with additional supporting evidence.

WBI Energy Transmission: Formerly known as Williston Basin Interstate Pipeline Co., WBI Energy Transmission operates more than 3,700 miles of natural gas transmission pipelines throughout North Dakota, Montana, Wyoming, and South Dakota. This network of pipelines plays a vital role in North Dakota's natural gas industry. It contains twelve interconnecting points with other regional pipelines and can also deliver natural gas to local distribution companies or natural gas storage fields. WBI continues to make system upgrades in western North Dakota in order to meet growing customer demand.

In June 2016, WBI announced an open season to connect the eastern North Dakota portion of the system with the Viking Pipeline in western Minnesota. This project, known as the Valley Expansion, does not directly support North Dakota gas production volumes, but rather would serve to provide additional gas volumes to consuming markets in eastern North Dakota. The Valley Expansion project became operational in late 2018.

In early 2019, WBI Energy announced plans to construct a new gas pipeline system called the "North Bakken Expansion Project". The system would consist of 60 miles of 24" pipe and 30 miles of 12" pipe. The project objective is to provide at least 250 MMCFD of capacity from Tioga, ND to an interconnect with the Northern Border Pipeline in McKenzie County. Projected in-service time is late 2021 pending all regulatory approvals.

Aux Sable: In June 2011, Aux Sable announced the acquisition of the Prairie Rose Pipeline and condensate recovery facility near Stanley, ND. Originally constructed by Pecan Pipeline, the 75-mile, 12-inch system went into service February 2010 and has the capability to transport over 100 MMCFD of unprocessed natural gas from Mountrail County to an interconnect with the Alliance Pipeline near Bantry, ND.

Bison Pipeline: TransCanada placed the 302-mile, 30-inch Bison Pipeline into service in early 2011. The pipeline was built to connect natural gas production in the Powder River Basin of Wyoming to the Northern Border Pipeline in Morton County, North Dakota. The pipeline has an initial capacity of 407

MMCFD and could be expanded to 1 BCFD. From 2018 to the first half of 2020, the Bison Pipeline was idle. Limited and sporadic natural gas transportation resumed in May 2020.

Natural Gas Liquids Pipelines

ONEOK Bakken NGL Pipeline: On July 26, 2010, ONEOK Partners announced plans to construct a new 12" natural gas liquids pipeline capable of moving 60,000 BPD from existing and planned facilities in the Williston Basin to an interconnect with the Overland Pass Pipeline near Cheyenne, WY. The "Bakken NGL Pipeline" was built to address the high volumes of natural gas liquids that are extracted from the rich Bakken gas during processing. The pipeline operates as a Y-grade system, with product fractionation taking place in Bushton, KS. ONEOK announced completion of the pipeline in April 2013 and an expanded capacity of 135,000 BPD in September 2014.

In February 2018, ONEOK announced a new NGL transmission system known as the Elk Creek Pipeline. The $1.4 billion project could initially connect 240,000 barrels per day of NGLs from the Williston Basin to further NGL infrastructure in Kansas. Construction of the pipeline began in 2018 and was placed in service late 2019. This project could be expanded up to 400,000 barrels per day if market conditions justify the added investment.

Vantage Pipeline: On July 15, 2010, Mistral Energy announced a new 430-mile liquid ethane pipeline from Tioga, ND to Empress, AB. With an initial capacity of 40,000 BPD, the new "Vantage Pipeline" was built to address the high concentration of ethane found in North Dakota's natural gas. Placed into service Q2 2014 in conjunction with the Hess Tioga Gas Plant Expansion, the pipeline was constructed of 10" pipe. In September 2014, Pembina Pipeline Corporation purchased the Vantage Pipeline from Mistral Midstream.

On February 10, 2015, Pembina Pipeline announced that the Vantage ethane pipeline would expand to connect to ONEOK's Stateline plants with 50 miles of 8" pipeline. The $85 million system expansion also included taking the existing mainline capacity from 40,000 bpd to 65,000 bpd. Ethane deliveries from the ONEOK Stateline plants to Vantage began in May 2017.

Carbon Dioxide Pipelines

North Dakota continues to have only one carbon dioxide pipeline in service. The Dakota Gasification Company's, 12-14 inch, 205-mile pipeline went into service in 2000 and transports roughly 150 MMCFD of carbon dioxide to oilfields near Weyburn, SK.

Two carbon dioxide pipeline projects are under development. One system would be operated by Denbury Resources and would connect the Cedar Creek Anticline oilfields in eastern Montana and southwest North Dakota to the existing Greencore Pipeline at Bell Creek, MT. The 110 mile, $150 million, extension is anticipated to be complete by 2022. The second project under development is part of Project Tundra's plan to collect carbon dioxide from the Milton R. Young Station and transport it to the Williston Basin for

either sequestration and/or enhanced oil recovery. If approved, a pipeline carrying carbon dioxide from the Young Station could be in service by the early 2020's.

The Pipeline Authority continues to work with interested parties on the development of new carbon dioxide pipelines for capture and sequestration, as well as enhanced oil recovery operations. The Pipeline Authority is an active member of the Plains CO_2 Reduction Partnership through the Energy and Environmental Research Center in Grand Forks, ND.

Planned Activities

Over the past year, the Pipeline Authority has continued to experience great success by working with industry to quantify future crude oil and natural gas production in order to provide the assurance needed to move forward with various expansion projects. The forecasted petroleum production levels will continue to be updated to reflect oil price forecasts from the U.S. Energy Information Administration. The Pipeline Authority will continue to utilize new and existing development information to gain a deeper understanding of the crude oil, natural gas, natural gas liquids, and carbon dioxide pipeline needs in the Williston Basin.

During the 2020-2021 fiscal year, the Pipeline Authority will be incorporating the results of the recently completed NGL study into the appropriate forecast models. The revised production models will be used by the NDPA and industry participants to support future petrochemical opportunities and enhance gas capture infrastructure in North Dakota.

Moving forward, the Pipeline Authority Director would like to explore the possibility of blending hydrogen into regional natural gas pipelines. The blending of hydrogen into an existing natural gas pipeline is common in some portions of the United States and could be very beneficial for North Dakota as it looks to address pipeline gas quality issues and provide a readily available market opportunity for hydrogen production in the state.

Industry and public information distribution will continue with the use of web events, presentations, monthly updates, and agency websites. The Pipeline Authority will continue to conduct information presentations to public audiences, legislative groups, and industry representatives at various events throughout the coming year.

APPENDIX A

Natural Gas Composition Study Executive Summary

ASSESSMENT OF BAKKEN PETROLEUM SYSTEM PRODUCED GAS COMPOSITIONS

EXECUTIVE SUMMARY

This report presents the results of a study conducted by the Energy & Environmental Research Center (EERC) for the North Dakota Pipeline Authority (NDPA) to assess how the chemical composition of natural gas liquids (NGLs) produced from the Bakken and Three Forks (TF) Formations varies spatially across the play and temporally through the life of a typical well. In November of 2019, natural gas production in North Dakota reached an all-time high of over 3.1 billion cubic feet per day and is expected to increase with ongoing development of the Bakken petroleum system (BPS). Better understanding of the NGL content of produced gas from the BPS and how NGL content varies spatially and temporally across the play is essential to forecasting future NGL production in the BPS. This information is fundamental for planning and optimization of gas pipelines and gas-processing facilities, as well as for evaluation of future petrochemical development opportunities in North Dakota.

The work performed through this effort comprised several key components: literature review, collection and analysis of gas composition data, geographic information system (GIS)-based mapping, and modeling and simulation. The key objectives were to:

1) Review and summarize existing literature on predicted or observed changes in natural gas chemistry over time in shale plays and/or tight reservoirs.
2) Collect and compile existing gas composition data from the EERC, the North Dakota Industrial Commission (NDIC), EERC partners, and other public sources.
3) Evaluate spatial trends in NGL content across the BPS, and assess the key geochemical and geologic factors that affect gas composition using data analytics and machine learning.
4) Develop a reservoir model to match historical measured data and to forecast gas composition from a typical Bakken and TF well after 1, 10, 20, and 30 years of production.
5) Perform simulations using the reservoir model to evaluate how produced gas enhanced oil recovery (EOR) efforts in the BPS could impact gas composition over time.

The data used in this effort included industry-supplied gas composition data from 7316 data points across 12 counties in the North Dakota and Montana portion of the BPS. The data set contained measurements of C1–C5 hydrocarbons (HCs), other heavier liquids, and non-HC gases. Geologic and geochemical data for the BPS were derived from the EERC's internal database comprising publicly available data and in-house analyses. Pressure, volume, temperature (PVT) data and associated production data for two wells were provided by EERC partners and used to perform compositional forecasting.

Based on the data used in this effort, the average composition of the gas produced from the BPS (expressed in mole percent [mol%]) is as follows: 58 mol% methane (C1), followed by 20 mol% ethane (C2), 11 mol% propane (C3), 4.9 mol% butane (C4), and 1.6 mol% pentane (C5), while concentrations of other components are very small except for N_2 (2.7 mol%). The average

initial wetness of gas produced from the BPS (defined as [{C2+C3+C4+C5}/{C1+C2+C3+C4+C5}] × 100) was estimated at 39.9%. Distinct spatial patterns in gas compositions were observed across the Bakken region; in the core area, the wetness is typically less than 40%, and some areas outside of the core have wetness values above 45%. A temporal analysis of gas content showed that, in most locations, methane content increases within the first 5 years of production then remains stable out to 7 years of production. Evaluation of changes over longer production periods were limited by data availability. Ethane content was shown to decrease slightly during the first 3 to 5 years of production, after which it levels off or begins increasing slightly in some areas. Propane content, as with butane and pentane, is variable during the first 6 months of production, after which all three components generally decline until about 18 months to 3 years of production. Starting from 18 months to 3 years of production, the propane, butane, and pentane concentrations generally remain stable throughout 7 years of production.

An evaluation of correlations between gas content and the geochemical and geologic characteristics of the BPS show that initial gas composition and gas composition throughout production correlate significantly with the thermal maturity of the Bakken shales and other associated geologic parameters, such as temperature and depth. The more thermally mature areas of the BPS tend to have drier gas, and conversely, the less thermally mature areas have wetter gas.

A series of reservoir simulation activities were performed to investigate the long-term gas composition change based on models of two wells: one located in McKenzie County and one in Williams County. An evaluation of different production scenarios showed that the long-term changes in gas composition are strongly influenced by production rates and reservoir pressure. The simulation results show that methane content generally increases within the first 5 years of production and then decreases with long-term production. Concentrations of ethane and propane remain unchanged or decrease during the first few years of production, then increase gradually over time. The long-term changes in gas composition in the simulation scenarios with normal or accelerated production from the BPS were evaluated and suggest that methane content from individual wells could decrease significantly after approximately 10 years of production, at which point NGL content could increase significantly. A comparison of the simulation data with the long-term gas composition trend data from 32 wells suggests that while the timing of the predicted changes in gas composition is consistent with measured data, the magnitude of the long-term predicted changes may be high.

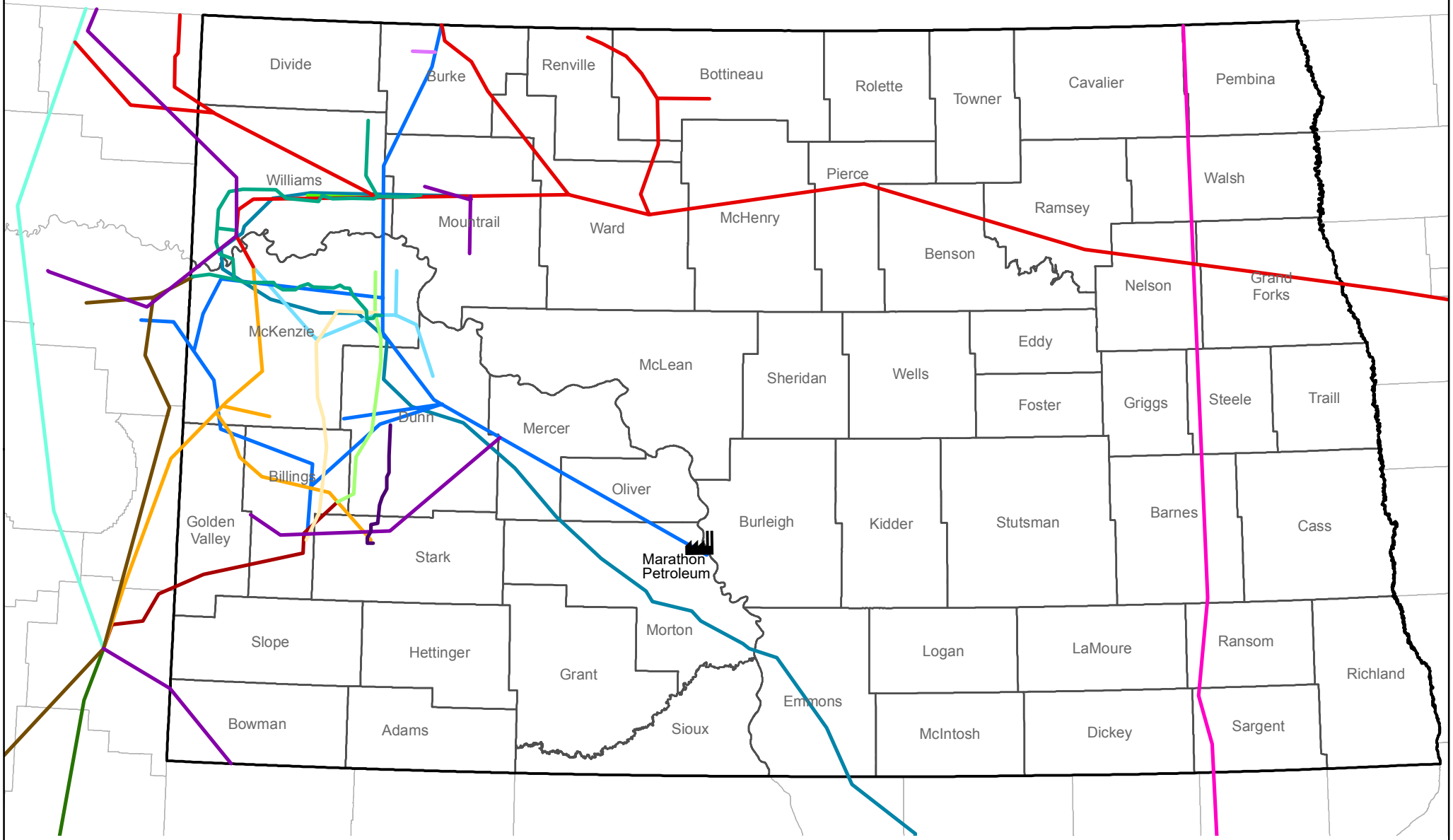
Without performing more extensive basinwide modeling and forecasting of future BPS development trends, it is difficult to determine what the long-term supplies of NGLs might look like. While it is encouraging that the long-term simulation results suggest trends of significant increases in NGL content within individual wells over time, the magnitude of that NGL contribution and the impact of the gas contribution from new wells coming online were not evaluated as part of this effort.

The reservoir model was also used to simulate changes in gas composition that may occur during CO_2-based or produced gas EOR efforts. The simulation results suggest that during produced gas EOR, the composition of the produced gas follows the composition of the injected gas. During CO_2-based EOR, the concentrations of the various produced gas components gradually decrease over time and follow similar trends.

APPENDIX B

North Dakota Pipeline Maps

North Dakota Crude Oil Pipelines



Refinery
Bakken Oil Express
BakkenLink
Basin Transload
Belle Fourche
Bridger
Butte
Crestwood
Dakota Access
Double H
Enbridge
Four Bears
Hiland
Keystone Pipeline
Little Missouri
Bridger
Targa
Marathon

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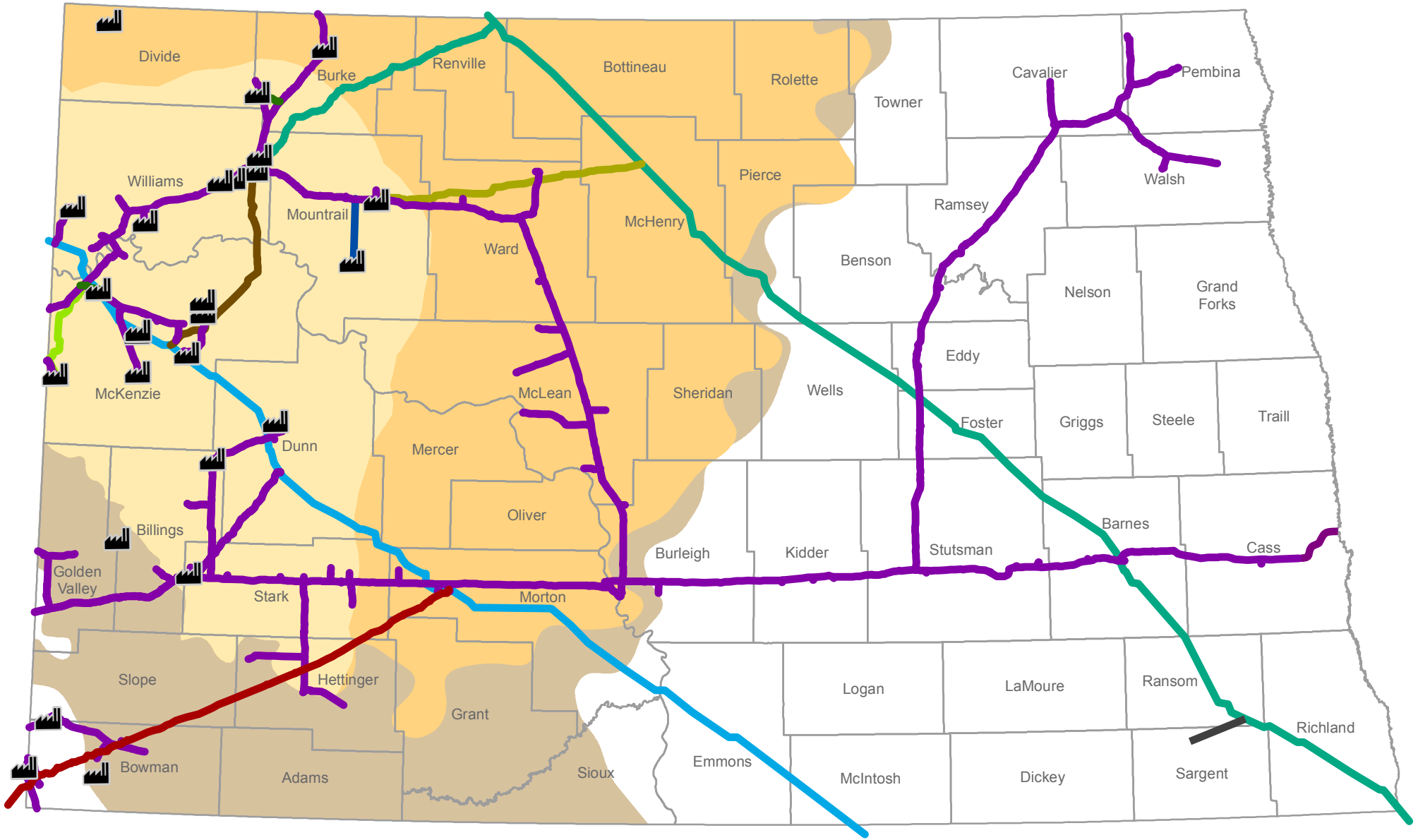
North Dakota Natural Gas Pipelines



Updated: February 2019

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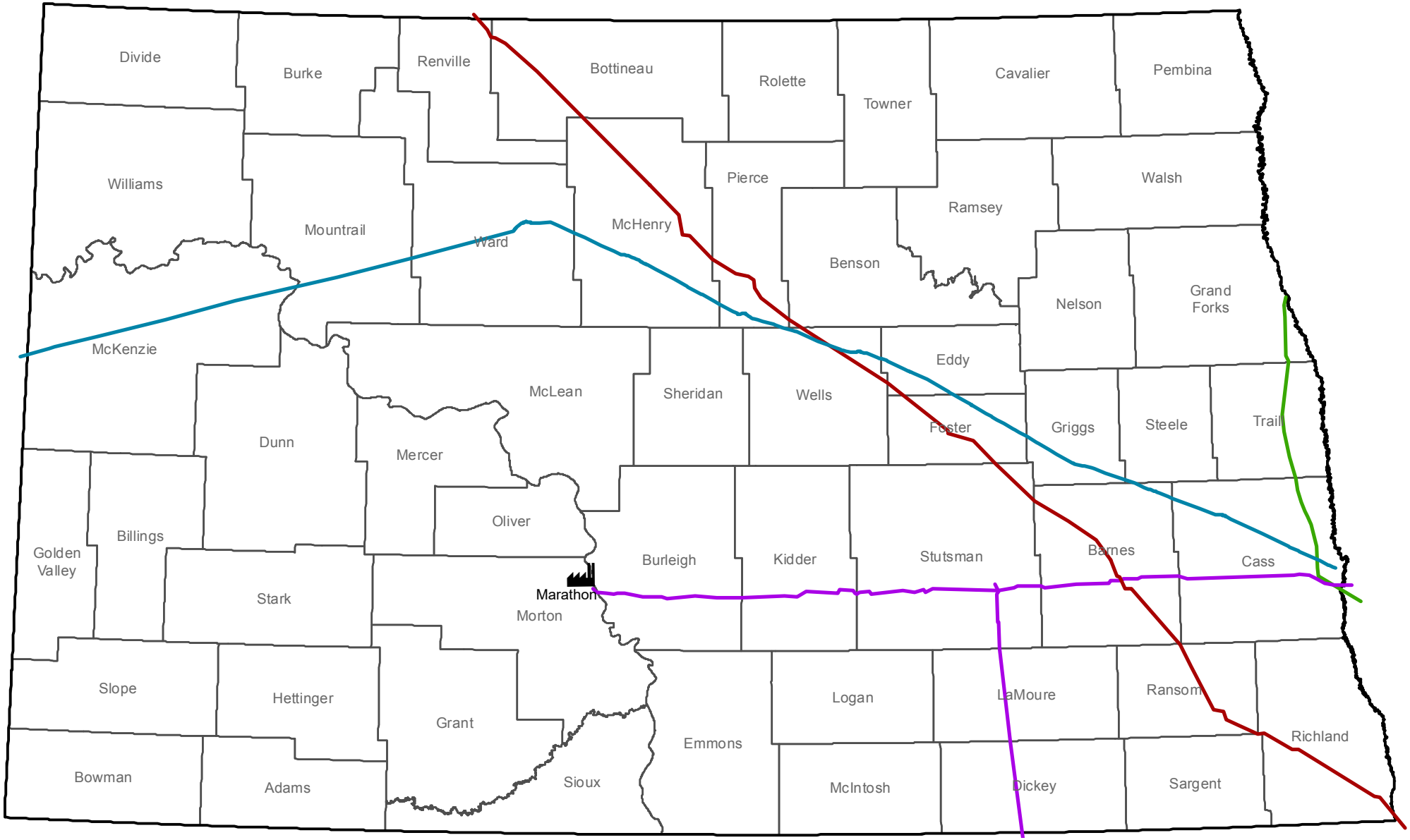
North Dakota Products Pipelines



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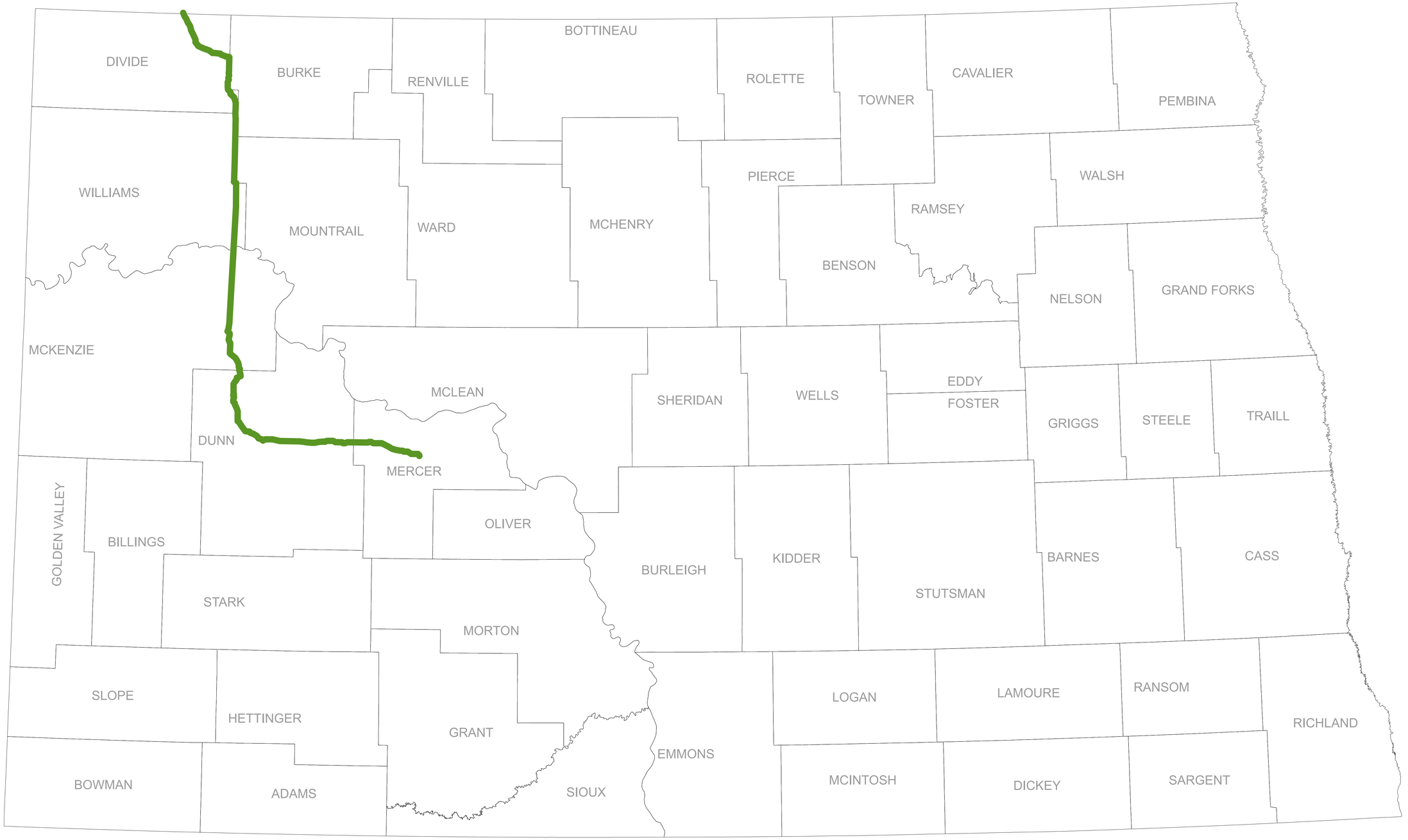
North Dakota CO_2 Pipeline

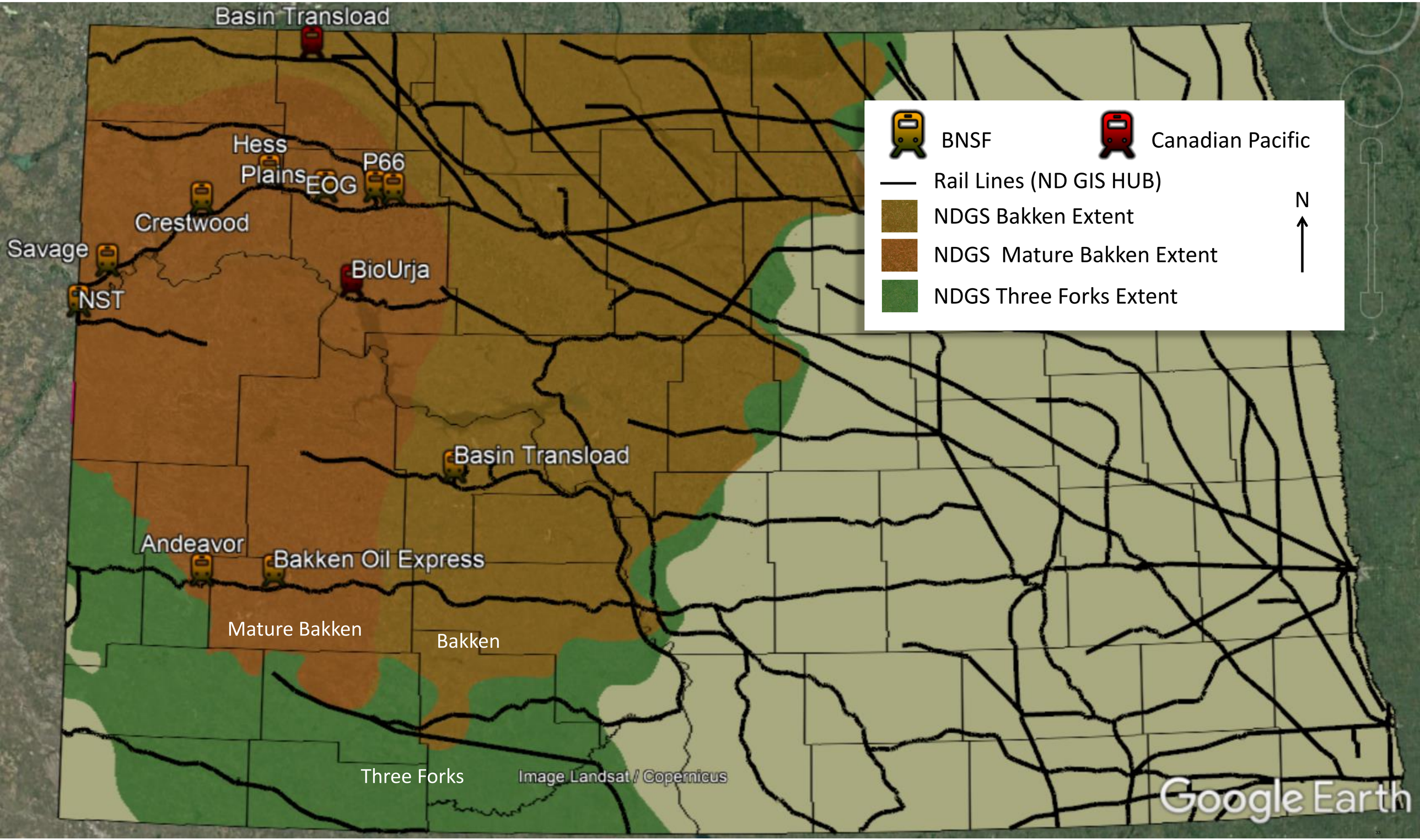


APPENDIX C

North Dakota Crude Oil Rail Loading Map

North Dakota Crude Oil Rail Loading Facilities In Service

North Dakota Pipeline Authority – July 2020



APPENDIX D

North Dakota Gas Processing Plant Table

Natural Gas Processing Capacity, Million Cubic Feet Per Day

Owner Company	Facility	County	2006	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
North Dakota																
Steel Reef	Lignite	Burke	6	6	6	6	6	6	6	6	6	6	6	6	6	6
ONEOK	Marmarth	Slope	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	NA	NA	NA	NA	NA
ONEOK	Grasslands	McKenzie	63	90	90	90	90	90	90	90	90	90	90	90	90	90
ONEOK	Stateline I	Williams	NA	NA	NA	NA	100	100	100	100	100	120	120	120	120	120
ONEOK	Stateline II	Williams	NA	NA	NA	NA	NA	100	100	120	120	120	120	120	120	120
ONEOK	Garden Creek I	McKenzie	NA	NA	NA	NA	100	100	120	120	120	120	120	120	120	120
ONEOK	Garden Creek II	McKenzie	NA	NA	NA	NA	NA	NA	120	120	120	120	120	120	120	120
ONEOK	Garden Creek III	McKenzie	NA	NA	NA	NA	NA	NA	120	120	120	120	120	120	120	120
ONEOK	Lonesome Creek	McKenzie	NA	NA	NA	NA	NA	NA	NA	NA	200	200	240	240	240	240
ONEOK	Demicks Lake	McKenzie	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	200	200	200
ONEOK	Demicks Lake II	McKenzie	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	200	200
ONEOK	Demicks Lake III	McKenzie	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Sus.
ONEOK	Bear Creek	Dunn	NA	NA	NA	NA	NA	NA	NA	NA	80	80	130	130	130	130
ONEOK	Bear Creek II	Dunn	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	200
Petro Hunt	Little Knife	Billings	27	27	27	27	27	27	27	27	27	27	27	27	27	27
True Oil	Red Wing Creek	McKenzie	4	4	4	4	4	10	10	10	10	10	15	15	15	15
Sterling Energy	Ambrose	Divide	0.5	0.5	0.5	0.5	0.5	0.5	NA	NA	NA	NA	NA	NA	NA	NA
EOG Resources	Stanley	Mountrail	NA	20	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*
Whiting Oil & Gas	Ray	Williams	NA	10	NA	NA	NA	NA	NA	10	10	10	15	25	25	25
Andeavor	Robinson Lake	Mountrail	NA	30	45	90	90	90	110	130	130	130	130	150	150	150
Andeavor	Belfield	Stark	NA	NA	NA	30	30	35	35	35	35	35	35	35	35	35
XTO - Nesson	Ray	Williams	NA	10	10	10	10	10	10	25	25	25	25	25	25	100
Hess	Tioga	Williams	110	110	110	110	110	110	250	250	250	250	265	265	265	415
Targa/Hess JV	LM4	McKenzie	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	200	200	200
Kinder Morgan	Badlands	Bowman	4	40	40	40	40	40	40	40	40	40	40	40	40	40
Kinder Morgan	Norse	Divide	NA	NA	25	25	25	25	25	25	25	25	25	25	25	25
Kinder Morgan	Watford City	McKenzie	NA	NA	NA	50	90	90	90	90	90	90	90	90	90	90
Kinder Morgan	Roosevelt	McKenzie	NA	NA	NA	NA	NA	NA	NA	NA	50	50	50	200	200	200
Liberty Midstream Solutions	County Line	Williams	NA	NA	NA	NA	NA	NA	NA	NA	20	20	30	30	30	30
Summit Resources	Knutson	Billings	NA**	NA**	NA**	NA**	NA**	NA**	NA**	NA**	NA**	NA**	NA**	NA**	NA**	NA**
Targa Resources	Badlands	McKenzie	NA	NA	NA	45	45	45	45	90	90	90	90	90	90	90
USG Midstream Bakken	DeWitt	Divide	NA	NA	NA	NA	NA	3	3	3	3	3	3	3	3	3
1804 Ltd	Spring Brook	Williams	NA	NA	NA	NA	NA	NA	NA	45	45	45	60	70	70	70
Oasis	Wild Basin	McKenzie	NA	NA	NA	NA	NA	NA	NA	NA	80	145	320	320	320	320
Arrow Field Services	Arrow	McKenzie	NA	NA	NA	NA	NA	NA	NA	NA	NA	30	30	150	150	150
Caliber Midstream	Hay Butte	McKenzie	NA	NA	NA	NA	NA	NA	10	10	10	10	10	10	10	10
Outrigger Energy II	N/A	Williams	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	250
Aux Sable - Chicago, IL																
Aux Sable	Prairie Rose Pipeline	Mountrail	NA	NA	126	126	126	126	126	126	126	126	126	126	126	126
		Total, MMCFD	**222.0**	**355.0**	**491.0**	**661.0**	**901.0**	**1,015.0**	**1,444.5**	**1,599.5**	**2,029.5**	**2,137.0**	**2,452.0**	**3,162.0**	**3,362.0**	**4,037.0**

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