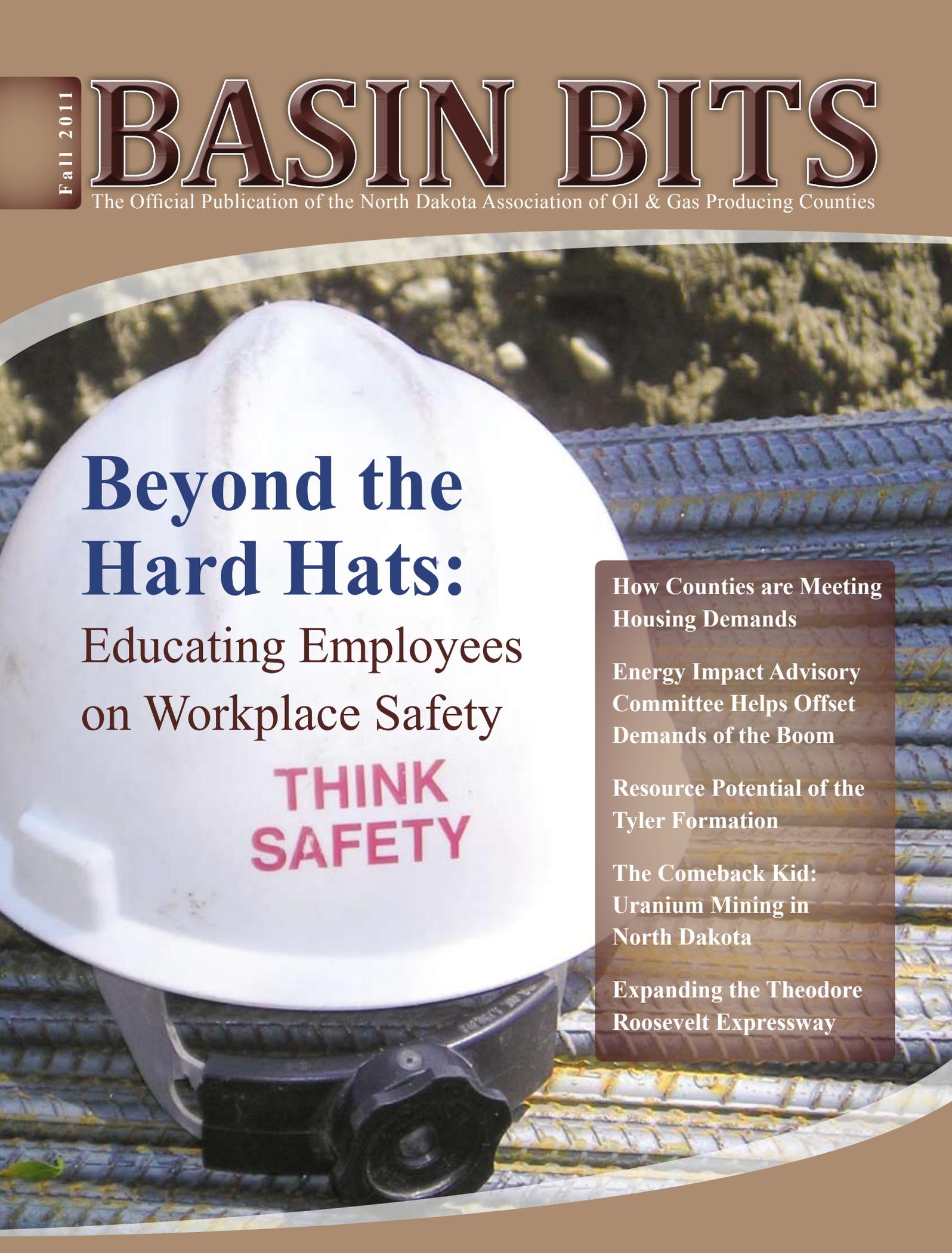


Fall 2011

BASIN BITS

The Official Publication of the North Dakota Association of Oil & Gas Producing Counties



Beyond the Hard Hats: Educating Employees on Workplace Safety

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SAFETY**

**How Counties are Meeting
Housing Demands**

**Energy Impact Advisory
Committee Helps Offset
Demands of the Boom**

**Resource Potential of the
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**The Comeback Kid:
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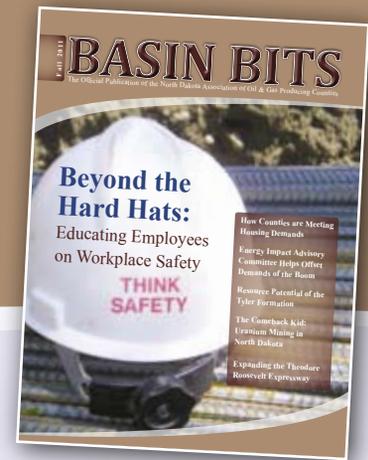
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From the Desk of the North Dakota Association of Oil and Gas Producing Counties' President



Greg Boschee
 President
 North Dakota Association of Oil
 and Gas Producing Counties
 Mountrail County Commissioner

This willingness to work out the issues is critical for our continued success during this historic oil boom. By working together, we will see greater results than working alone.

GREETINGS!

As a farmer, the summer is a busy time for my wife and I, especially with the heavy spring rains. The unusual rain meant the roads didn't dry out like we'd hoped and that caused all kinds of problems in my county, Mountrail. The counties are playing some catch up to get the roads shaped up for the fall.

Our Association continues to work on ways to get road information to the industry. We have added road updates from the counties to our webpage so that road closures don't catch anyone by surprise. Our truck permit operator, Janet Sanford, has posted information and we are working to make that more uniform and easier to understand.

Last June, members of our Association held meetings with county commissioners and road superintendents from western North Dakota and the North Dakota Department of Transportation. There was one held in Killdeer, ND and one in Stanley, ND. The state legislature appropriated \$142M for county and township roads with an emphasis on paved roads.

The counties came together to figure out how much each county would use from the \$142M pot. I am proud of the way county officials discussed the needs of their counties and those of their neighboring areas. In some cases, they gave up some dollars because they knew the neighboring county needed it more than they did or they were not able to use it this year but will ask support for their roads in the future.

This willingness to work out the issues is critical for our continued success during this historic oil boom.

By working together, we will see greater results than working alone. It's just like the work on the farm, everyone pitches in and works together to get it done.

The Association's annual meeting will be held on Thursday, October 6, 2011 in Medora, ND. Two of the speakers will be Lynn Helms, ND's oil expert and Rayola Dougher, senior economic advisor for the American Petroleum Institute. Registration information will be on our website, www.ndenergy.org. If you would like to be placed on the *Basin Bits* mailing list, please e-mail your request to sweinberg@matrixgroupinc.net.

Enjoy the fall season!

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From the Desk of the North Dakota Association of Oil and Gas Producing Counties' Executive Director



Vicky Steiner
Executive Director
North Dakota Association of Oil
and Gas Producing Counties
North Dakota House Representative
for District 37, Dickinson, ND

For a quality workforce, the cities must provide adequate housing and quality of place. This investment will pay off for generations.

What a wild summer it was! Only in North Dakota do I try to cram six months of work and play into three. But the fall season has a new rhythm. I love the warm days, cool nights and sounds of geese above. Hopefully a dry fall to give Minot and Bismarck a chance to recover and put the flood behind them.

The Bakken workers picked up their pace this summer—not a good time for Mother Nature to slide Highway 22 down the hill. It remained closed, forcing hundreds of trucks onto Highway 85, creating more chaos in the process.

It wasn't a surprise we lost some friends in highway accidents. A lot of us, including myself, seem to be hurried, distracted, tired or speeding because we've sat in road construction. In mid-July, the North Dakota Department of Transportation (DOT) and the North Dakota Petroleum Council rolled out a safety program to drill the message of safety on the roads. I know I need to add more driving time around western North Dakota; that's why we dedicated this issue to safety. If we all keep safety top of mind, it will be safer for everyone on the roads and at work. In 2009, 140 people died on North Dakota roads, according to the DOT, an increase from the previous year.

The State's 2011-2013 executive budget proposal plans to spend \$371M from the Permanent Oil Tax Trust Fund for

state, county and township road construction and maintenance in the 17 oil-producing counties. Specifically, \$142M was designated for county roads, emphasizing paved roads that could serve as oil industry arterial roads. The gravel roads must meet a significant match and during the next biennium of 2013-15, legislators will see a request for funding those non-paved county artery roads.

The state increased the energy impact fund from \$8M per biennium to \$100M. Of the \$100M appropriation for the next two years, \$5M was set aside for rapidly growing western school districts. Of the remaining \$95M, large and small cities, along with counties, emergency services and townships, could apply for grants. Stanley, Watford and Crosby need the ability to expand trunk lines and build infrastructure to accommodate the workforce. As Williston City Commissioner Brad Bekkedahl says, "When this is all over, we hope to be a better community than before it all began."

To assist the North Dakota University and School Lands Board in the decisions of the impact funding, our Association helped organize an advisory council to determine grant recommendations. Governor Jack Dalrymple appointed Billings County Commissioner Jim Arthaud, Mountrail County Commissioner David Hynek, Bowman City Commission President Lyn James and Watford City Mayor Brent Sanford. Representing the townships is Floyd

Miller and representing emergency services is Burke County Sheriff Barry Jager. The DOT, along with Land Commissioner Lance Gaebe and Energy Impact Advisor Jeff Engelson, round out the participants.

At the July state Land Board meeting, the commissioners approved \$21M in grants for the state's three largest cities in oil country—Williston, Dickinson and Minot. The smaller cities received \$32.5M, which included \$12.3M for Watford City, \$7.7M for Tioga and \$4.1M for Stanley. Since the impact fund will start accumulating \$8M per month in September, the fund will be able to start paying out finished projects next year.

The North Dakota Land Board consists of Governor Dalrymple, Attorney General Wayne Stenehjem, State Treasurer Kelly Schmidt, Department of Instruction Dr. Wayne Sanstead and Secretary of State Alvin Jaeger. The advisory council forwards its recommendations and the land board makes the final decision.

It's anticipated the impact fund will continue to need at least \$100M in the 2013-15 biennium. For a quality workforce, the cities must provide adequate housing and quality of place. This investment will pay off for generations. It's estimated that there will be 28,000 oil wells drilled in Phase 1 of the Williston Basin Exploration and about 2,000 new wells are expected to be drilled in 2011.

Be sure to listen for the geese this fall.
God Bless!



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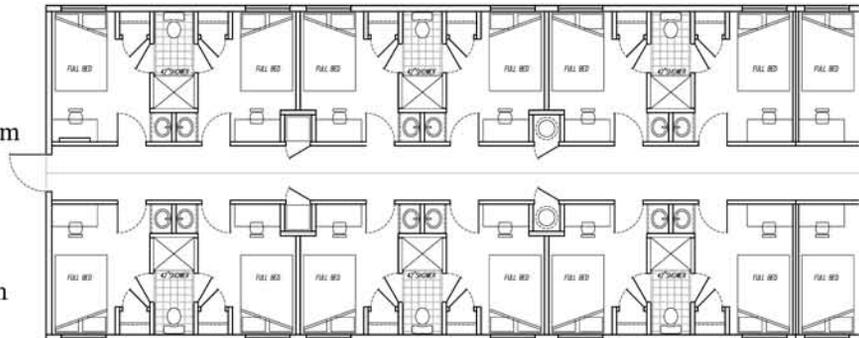
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Beyond the Hard Hats



With the fast-paced growth the oil and gas boom in North Dakota has caused, it's important that those working on and off the oilfields are focused on safety in the work environment.

By Kelly Wald, Communications Manager, North Dakota Petroleum Council

For decades, North Dakota has welcomed new businesses, jobs and people. That North Dakota hospitality has landed our state in the national spotlight. It's these types of investments in our communities that will sustain us into the future. We can't ignore the heavy traffic, tight housing or other challenges that come with growth. But we can put our best effort forward to handle unforeseen obstacles that arise and to plan for the future.

Though the growing pains are an inconvenience, we know these conditions are not permanent.

"They are part of the changes that have become a constant in our lives; a time of

progress that moves us toward an even brighter future," says Ron Ness, president of the North Dakota Petroleum Council.

But in the midst of all this improvement, the looming concern on everyone's mind is, how do you manage all of this safely?

PLAYING IT SAFE

From the time an industry employee signs a job contract, to the time they retire or choose a different career, safe behavior is stressed and continually encouraged.

Safety plays a part in virtually every action you make in a given day. From looking both ways before you cross a street, to blowing out a candle flame before leaving your home,

safety is a natural instinct. But a partnership between our state's oil and gas industry, government and law enforcement is about to change all that.

While having safe behaviors engrained in your habits is a positive thing, not actively making conscious decisions to be safe can lead to human errors or mistakes that can be detrimental to you or someone else. The intent behind a public safety campaign recently released by the Petroleum Council and partners is to deliver continual reminders to make safe decisions to those living and working in western North Dakota through the use of billboards, radio advertisements, window decals and vehicle air fresheners.

OIL CAN! PLAY A POSITIVE ROLE

In the oil and gas industry, safety isn't something you do when you have the time. It's a priority.

Safety for the oil and gas industry means successfully managing several different aspects, including well site safety, underground utility maintenance, contractor management, infrastructure improvements and road safety.

People don't generally have the perspective that industry employees are members of the public for the remaining 12 to 16 hours each day when they aren't at work. Instead, they may be criticized for the poor decision of one individual who happens to work in the industry. The reality is industry employees are our neighbors. They buy groceries at the same stores we do, their kids play in Little League with our kids and we sit next to them on Sunday mornings in church. They are as much a part of our communities as any native North Dakotan and being a good neighbor to all of western North Dakota is paramount for oil and gas companies operating in the state. This is why members of the Petroleum Council are working very hard to improve safety both on- and off-the-job.

The Petroleum Council's *Oil Can!* program is an education and outreach effort on behalf of the oil and gas industry companies operating in North Dakota. The program is designed to open the lines of communication and encourage cooperative relationships between North Dakota's petroleum industry and key stakeholder groups such as property owners, policy makers, community leaders and the general public. It serves to connect people, promote safety and ensure oil development remains a positive benefit to North Dakota.

Through the *Oil Can!* program, the Petroleum Council is reaching out to industry and community members alike, stressing the importance of safety in western North Dakota. This starts with partnerships, a critical part of ensuring all these different parts are managed concurrently and are in harmony with one another. For this initiative, the Petroleum Council is collaborating with the North Dakota Safety Council, Workforce Safety & Insurance, North Dakota Department of Transportation, North Dakota Highway Patrol, Red Cross, Department of Health and North Dakota One Call.

Additionally, the Petroleum Council is reaching out to public and industry with a recently launched campaign focused on promoting safety in oil country.



ProgressZone billboards will promote safety in the industry. Photo courtesy of the North Dakota Petroleum Council.

PROGRESSZONE

Western North Dakota is under construction. In fact, some might call it a "progress zone."

"Regardless of all the heavy equipment and moving parts on a well site, statistics show that roadways are still the most dangerous place to be in oil country," says Ness. That reality—and the need to reinforce the message that although the activity and construction occurring in western North Dakota is wearing on the patience of many, we are in a time of progress and we are building toward a better future—was the driving force behind the ProgressZone campaign. Launched on July 22, 2011, the campaign, created by the Petroleum Council in partnership with the Department of Transportation and the Highway Patrol, aims to promote traffic safety in oil country.

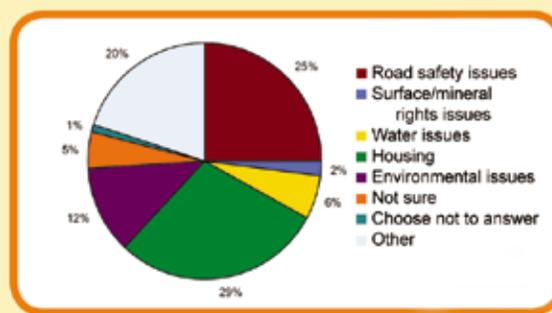
SAFE ROADWAYS

A survey completed last fall to gauge public perception of the oil and gas industry in North Dakota showed that, overall, the industry is viewed in a very positive light. Eighty-seven per cent of North Dakotans feel that the industry offers positive benefits to the state. As part of the survey, participants were asked to identify their biggest areas of concerns regarding the industry and 55 per cent responded by stating that road safety and housing shortages are the biggest issues that have arisen due to increased industry activity.

The oil and gas industry and state have heard the call for help and have responded by investing an unprecedented amount of money in road and other infrastructure improvements along with new housing developments.

Housing & Roads are Top Infrastructure Issues

Majority (55%) identified either housing (30%) or road safety (25%) as the top infrastructure issues facing the state.



“Regardless of all the heavy equipment and moving parts on a well site, statistics show that roadways are still the most dangerous place to be in oil country.”

—Ron Ness, President, NDPC

During the 2011 session, the legislature and Gov. Dalrymple approved nearly \$1B for infrastructure improvements in western North Dakota during the 2011-13 biennium. Though this budget includes a significant investment in road repairs and expansions, it also includes projects like the Western Area Water Project, which will bring relief to rural water systems right in the heart of oil development.

SAFE WELL SITES

One accident one time is one too many. This mindset is what drives the safety programs and training for all industry employees that set foot on a well site, whether they are employed by the operating company that has leased the land where a well is being drilled or they are a roughneck on a subcontractor crew. Safety standards have been established by the oil and gas industry and if you intend to set foot on a well site, it's a necessity that your training and certifications are in line with these requirements.

SAFE PIPELINES

The increasing oil development in western North Dakota has added an influx of heavy vehicles to an already strained roadway system. With the amount of trucks it takes to drill a well and move product within the first year and the large number of wells that will be drilled in 2011, the roadways in western North Dakota will be exposed to approximately four million truckloads this year.

One of the safest, most cost-effective ways to transport crude oil and gas is through pipelines. These two factors have led to increased investments in expanding the pipe-

line systems that run beneath North Dakota soil. Nearly \$4B is currently being invested in oil and gas pipelines, rail facilities and natural gas processing plants, which means less truck traffic moving product from well sites to refineries. This helps on two fronts: reducing wear and tear on the roads and reducing additional traffic.

DOING IT RIGHT

The future is bright in North Dakota and we know maintaining an active oil industry that is viewed as a benefit to communities is critical to our state's continued success.

“We're invested in North Dakota and committed to working with community and state leaders to make sure we're having a positive impact on the state,” says Ness.

The Petroleum Council is stressing safety and even better training of employees and contractors, supporting more resources in western communities for infrastructure and advocating for state agencies to increase regulations and enforcement. We can all do our part by using safe driving practices, being patient, slowing down and planning more time for our travels.

“When times get tough, the tough get going,” that is the attitude commonly exuded by North Dakotans. Though there are challenges ahead, the opportunities to follow will be many. If all the players continue to work together with the common goal of helping North Dakota prosper, the hill we're climbing won't be near as challenging.

For more information on the Petroleum Council, Oil Can!, or ProgressZone, visit www.ndoil.org. 



TRIVIA TIME

1. Safety training protects not only oil-field workers but members of the public, as well. *
2. Safety classes, equipment training and shadowing are all ways oil companies train employees about safe practices in the field. Workers receive hydrogen sulphide training, fire extinguisher training and hazard awareness training. *
3. Some oilfield employees in North Dakota undergo 118 hours of training per year. *
4. Oil workers in North Dakota are told to wear steel toed boots, flame retardant clothing and hard hats. *
5. North Dakota has the second highest rate of work-related fatalities in the nation after Montana. *
6. A National Institute for Occupation Safety and Health publication in 2007 reported that the oil and gas industry experiences a fatality rate of 32 per 100,000 workers, which is eight times the national average for all workers and ranks as high as coal miners. *
7. In 2009, Wednesdays had the highest percentage (16.4 per cent) of speed-related crashes in North Dakota.

*Statistics courtesy of the North Dakota Safety Council.



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More Than an Oil Boom: How Counties Are Meeting Housing Demands

As more workers are heading to the oilfield in North Dakota, we take a look at how counties are meeting housing demands. Here's what county commissioners had to say.

By Basin Bits Staff

COUNTY	TEMPORARY HOUSE REGULATIONS	THIS SUMMER	THIS FALL
Billings	Regulations follow state law.	One man camp was proposed and may go ahead this fall; a decision has yet to be made.	It will be getting busy with about 10 drilling rigs near Dickinson.
Bottineau	If there are three or more dwellings on one site, it is taxed differently.	A nursing home in West Hope was converted into a 20-room man camp.	Things should be quiet; some roads may be considered for work in the area.
Bowman	Groups must go through the county's zoning board.	There was only one oil well drilling so there were no man camps.	There won't be much activity until things pick up in the area.
Burke	There are health regulations and zoning changes when crew camps are put in.	No camps went up this summer; one went up last year.	There are no inquiries for man camps and probably won't be any until next year.
Divide	Crosby has regulations for temporary housing. RV parks must abide by the Upper Missouri Health District.	There were no applications for man camps but a developer proposed a mobile home park with up to 64 mobiles homes.	Truck companies are expanding north and west of Crosby to keep truck traffic down. Local investors are building a 43-unit motel (20 rooms for extended stay) and an RV park with 75 spots may be developed by spring.
Dunn	Dunn is basing regulations on those in William and Ward counties.	There were no vacancies in Killdeer; trailer parks and motels are at capacity. There is a 50-room man camp in the area and a 25-person camp was approved.	The city and school in Killdeer may put in rental units for employees.
Golden Valley	City zoning extends to one mile outside of city limits and rural areas follow the county's regulations.	An RV park with 10 spaces was rented to an oil company for the summer. Rental spaces were full and duplexes were leased to oil workers.	Temporary housing units are expected to be needed throughout the fall.
McHenry	Velva and Granville have their own regulations and other communities are working on getting their zoning back.	Two crew camps were permitted in Granville. Exploration was redirected due to the flood.	Developers are considering a new housing development in Velva.
McKenzie	Regulations follow state law.	A 280-bed camp north of Arnegard was approved. Watford passed a moratorium on temporary housing. It's still 1,000 units short of meeting demands.	Construction on the camp north of Arnegard will begin. In Watford, \$12.3M in energy impact funds will expand infrastructure. More temporary units will go up.
McLean	No information available.	Housing was tight in Garrison and there were shortages in the Makoti area but overall the county was managing.	One recreation camp may be under development this fall.
Mercer	Regulations follow state law.	There were no man camps yet. Two oil wells brought lots of traffic into the area.	People may have to live in RVs and are looking for rooms for the winter.
Mountrail	The North Dakota Health Department regulates temporary housing units. Units must be on a good road and accessible by city services.	East of Stanley, there were man camps with 450 workers. Towards Tioga, RV parks and trailers are common. Handfuls of crew camp applications were approved throughout the county bi-weekly.	Tioga has an agreement for 600 units (up to 1,000 if needed) for a gas plant expansion. Annabelle Homes will be putting up a housing complex in Stanley. Between Mountrail and Williams counties, 3,000 rooms will be available by the end of the year.
Renville	No information available.	No information available.	No information available.
Slope	No information available.	No man camps were, or are expected, to go up but housing is limited.	If things pick up, they will be more concerned about their current road situation.
Stark	Regulations use those in Williams County as a guideline. There are designated areas where crew camps can locate and provide infrastructure.	No man camps went up in Taylor but one was permitted. Rental units are low. In Dickinson, many houses and camps went up and requests came from five different camp providers.	In Taylor, construction on housing will begin, with structures ready by fall or spring. Having city services available for crew camps in Dickinson is a main goal.
Ward	Regulations within cities follow state health guidelines. Townships follow county zoning authority.	Most hotels were full. Many houses and camps went up and construction began on a camp that was approved last winter. Applications came in for units near Minot; one was approved between Burlington and Berthold.	Construction on the camp between Burlington and Berthold should start. Temporary housing outside Minot is being considered for workers and those displaced by the flood.
Williams	Planning/zoning and building requirements are regulated by the county.	Over 70 applications were approved for more than 1,900 units containing almost 9,000 beds. The busiest townships seem to be Williston, Missouri Ridge, Judson and Pherrin.	Each month, more applications for new facilities or expansions of current units come in.

“Williston is on track to doubling its size because of the oil activity.”

Dennis Lindahl, North Dakota Public Relations.

“The flood’s created a whole new set of housing issues.”

John Fjeldahl, Ward County commissioner.

“We have a fair amount of people driving 30 to 60 miles to work who might relocate if there was housing.”

Verdean Koeum, Bottineau County commissioner.

“The streets have been impacted immensely from all the truck traffic.”

Kacey Lindsay, community development director for Crosby, ND.

“Places like Parshall, Stanley and Plaza, their infrastructure wasn’t designed to handle this influx of people.”

David Hynek, Mountrail County commissioner.

“We’re low on housing and there’s a need for families that would like to come to North Dakota.”

Donna Scott, Dunn County commissioner.

“There’s a need for housing but oil booms are tough to invest for because it could shut down tomorrow.”

Frank Bitterman, Mercer County commissioner.

“We definitely need to get permanent housing out here.”

Jim Arthaud, Billings County commissioner.

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TRIVIA TIME

1. Twenty-seven per cent of North Dakota oil and gas-related claimed injuries between 2006 and 2010 fiscal years were caused by falling or slipping.
2. Seven per cent of North Dakota oil and gas-related claimed injuries between 2006 and 2010 fiscal years were caused by motor vehicles.
3. Four per cent of North Dakota oil and gas-related claimed injuries between 2006 and 2010 fiscal years were caused by cuts, punctures and scrapes.
4. Three per cent of North Dakota oil and gas-related claimed injuries between 2006 and 2010 fiscal years were caused by burns, scalding heat or cold exposure.
5. The top 10 body parts most affected by North Dakota oil and gas-related injuries, from highest occurrence to lowest, during 2006 to 2010 fiscal years:
 - a. Finger(s) – 95;
 - b. Shoulder – 77;
 - c. Lumbar Spine – 73;
 - d. Knee – 62;
 - e. Hand – 57;
 - f. Lower Leg – 40;
 - g. Ankle – 39;
 - h. Eye – 32;
 - i. Head – 22; and
 - j. Foot – 22.

Statistics courtesy of the North Dakota Safety Council.

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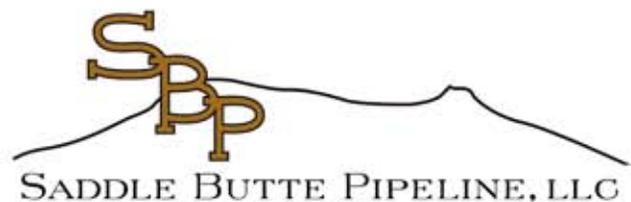
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Energy Impact Advisory Committee Helps Offset Demands of the Boom

A nearly \$100M impact fund will offset the demands of the growth caused by the boom in North Dakota. Williston, Dickinson and Minot, as hub cities in the Bakken, will receive \$33M, with smaller cities, counties, townships, emergency responders and other political subdivisions receiving almost \$62M.

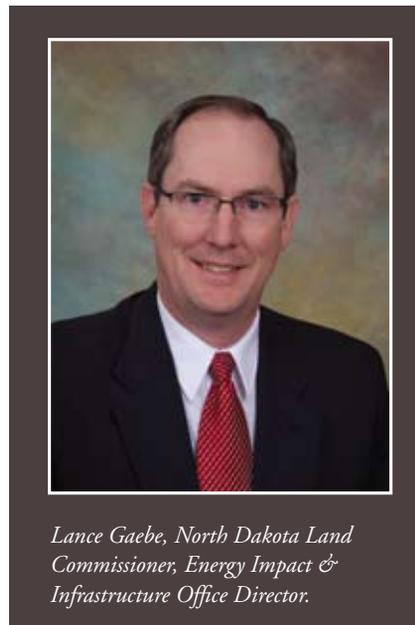
By Alexandra Walld

Recent legislative changes to North Dakota's Energy Impact Grant Program have increased the amount of money available in the Energy Infrastructure and Impact Office's (EIIO) Oil and Gas Impact Grant Fund. Upon Governor Dalrymple's recommendation, the fund was increased from \$8M to \$100M per biennium, effective July 1, 2011.

The impact fund, which has been in place for a long time, is designed to help political subdivisions in North Dakota deal with economic growth and the addition to the fund will help offset the fast-paced growth of cities, townships and subdivisions affected by the oil boom. Because the biggest goal is to make sure the funds are allocated to a variety of deserving projects throughout the oil and gas producing counties, two energy impact advisory committees have been put in place

to make recommendations to the North Dakota Board of University and School Lands (Land Board). The committees are made up of representatives of western North Dakota cities, counties and political subdivisions and include Department of Transportation Director Francis Ziegler and North Dakota State Land Commissioner Lance Gaebe.

"We thought they know about the problems out there better than anyone so the land board appointed a group of diverse members from various political subdivisions," says Jeff Engleson, former director of the Energy Development Impact Office. "The committee is very interesting—in addition to being all types of people, they are also from everywhere, from Burke County down to Bowman County down to Williams County and that was done on purpose. We were looking for a group to come up with a plan and I think we got a really good group."



Lance Gaebe, North Dakota Land Commissioner, Energy Impact & Infrastructure Office Director.

MEET THE ENERGY IMPACT ADVISORY COMMITTEES

The North Dakota Land Board was authorized by the Legislature to appoint an advisory committee that would assist in making the grant award determinations.

The first committee, which was established to make recommendations regarding policies, procedures and distributions of 65 per cent of the Oil and Gas Impact Grant Fund available to the smaller cities, counties, townships and other eligible political subdivisions, is made up of nine members:

- **Two County Representatives** – David Hynek, Mountrail County Commissioner and Jim Arthaud, Billings County Commissioner;
- **Two City Representatives** – Lyn James, Bowman Mayor and Brent Sanford, Watford City Mayor;
- **One Emergency Services Representative** – Barry Jager, Burke County Sheriff and Emergency Manager;
- **One Township Representative** – Floyd Miller, Williams County Township Officer;
- **One At-large** – Rick Larson, Energy Industry Representative (and former EDIO director);
- **Department of Transportation Director** – Francis Ziegler; and
- **State Land Commissioner** – Lance Gaebe.

The second advisory committee, which provides advice on criteria and project awards for the 35 per cent of the grant fund that is available to the three largest cities in the oil impacted area, includes:

- **Mayor of Dickinson** – Dennis Johnson;
- **Mayor of Williston** – Ward Koester;
- **Mayor of Minot** – Curt Zimbelman;
- **Department of Transportation Director** – Francis Ziegler; and
- **State Land Commissioner** – Lance Gaebe.

The Land Board, which approves grants based on the advisory committees' recommendations, includes:

- **Governor Dalrymple**;
- **Secretary of State** – Al Jaeger;
- **Attorney General** – Wayne Stenehjem;
- **State Treasurer** – Kelly Schmidt; and
- **Superintendent of Public Instruction** – Wayne Sanstead.

In terms of accepting applications and awarding grants, Gaebe says the committees are doing their best to keep it simplified and quick to respond.

“We’re trying not to have it filled with red tape and complicated applications,” says Gaebe. “But it’s also taxpayer dollars, so we’re making sure we report everything accurately and document what the money was used for.”

Of the \$100M impact fund, \$5M will go toward rapid school enrolment, \$350,000 will go to the Upper Great Plains Transportation Institute and about \$221,000 will be spent on administration expenses. Of the remaining fund for the 2011-2013 biennium, \$33M will be available for grants to projects in Williston, Dickinson

and Minot, which, as hub cities of the Bakken oil boom, have been impacted the most by the fast growth in the area. Of the money available for the hub cities, no more than 60 per cent can be appropriated to one specific city.

High priority projects in direct response to damages caused by increased oil and gas activity were a large focus of the first grant round but the advisory committee will recommend funding one-time projects related to building or improving physical assets.

Smaller cities, counties, townships, emergency responders and other political subdivisions can apply for grants of the \$61.4M that will be available for those areas and grant rounds will be held a minimum of four times per year.

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APPLICATIONS AND DISTRIBUTING FUNDS

The focus of the first grant round of this fiscal year supported projects that help to build and improve infrastructure in western North Dakota cities. Projects can include water treatment facilities, waste water facilities, trunk lines and other city initiatives intended to support population growth.

Applications for the first round were due in to the EIIO by the end of June but other eligible political subdivisions, including townships and emergency services, are encouraged to participate in the application process during upcoming quarterly grant

rounds. A political subdivision's chances of receiving a grant are greater if the application is submitted during the quarterly grant round that focuses on its type of grant.

According to Gaebe, the office received 88 applications for the first grant round—17 from the hub cities, 60 from small cities and 11 from other political subdivisions—for a combined total of \$142M. For a full list of projects approved for the first intake round, schedules and other information regarding the Oil and Gas Impact Fund, go to www.nd.gov/energyimpact. The grant rating system, developed by the advisory committees includes the following rating categories:

- Objective;
- Project readiness/achievability;
- Financial need;
- Contributes to continued economic development;
- Result of energy activity;
- Quality and vitality of life;
- Relates to health, welfare, and safety; and
- Budget.

For the first grant round, the target was to allocate \$32.5M following the advisory committees' recommendations to the land board. Once each project is well underway or completely finished, funds will be delivered but Gaebe says grant recipients should consider managing short-term financing for projects until funds are ready to be released.

In the first fiscal year, only 60 per cent of the impact fund can be dispersed for projects. Of the \$33M for Williston, Dickinson and Minot, a maximum of \$19.8M can be awarded to projects in those areas. After the first round of applications, the Land Board approved the advisory committees' recommendations on grant awards for the hub cities, awarding \$12M to Williston, \$5 to Dickinson and \$4M to Minot, for a total of \$21M.

For the remaining smaller cities, townships and political subdivisions, a maximum of \$36.8M can be appropriated in the first year. The Land Board approved the advisory committees' recommendations on grant awards, totaling \$32.5M, for smaller cities.

The combined total of awarded grants for the first grant round was \$53.5M. With all of the grants that have been awarded, the EIIO hopes to make the money available as soon as possible so that it can make an impact on the affects of the boom.

"Instead of trying to fix problems out there, the Oil and Gas Impact Grant Fund is now also helping to build infrastructure out there," says Engleson. "The advisory committee came to a consensus that we need more money; instead of putting on Band-Aids, let's actually fix something." 

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Expanding the Theodore Roosevelt Expressway

By Basin Bits Staff

Improvements to Highway 85 will help keep industry employees, tourists and corridor travelers safe, both on- and off-the-job.

When it comes to the oil and gas industry, North Dakota's roadways have become a part of the workplace. With transportation nearing the top of the list of industry safety issues, it's important to ensure highways are safe for workers and travelers. This is the main priority for the Theodore Roosevelt Expressway Association (TREA), which has proposed improvements to the Theodore Roosevelt Expressway (TRE) and is working in partnership with the Williston Basin Energy Industry to work towards those goals.

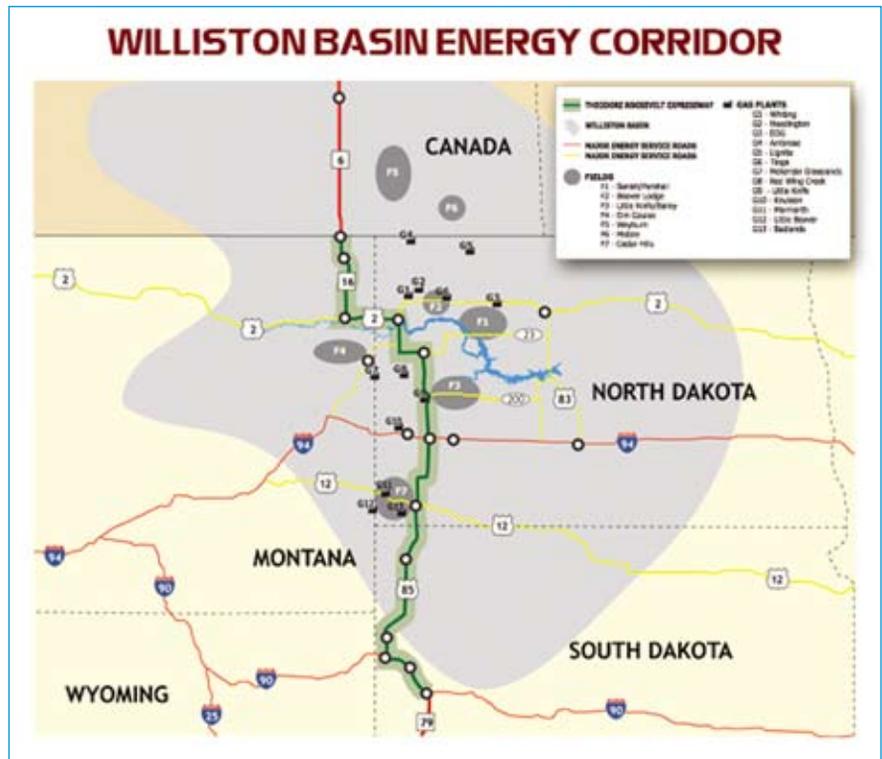
The TRE, perhaps more commonly known as Highway 85, is a federally-designated transportation corridor. As one of the busiest roadways in North Dakota, it is the northern third of the Ports to Plains Alliance (PPA), running from Rapid City, SD to Canada through the Port of Raymond in Montana. The TRE serves the Williston Basin as the central route for an expected 400,000 barrels of daily production to tank farms for pipeline transport.

The PPA is a proposed four-lane divided highway promoting trade and transportation nationally and internationally throughout the Great Plains Region. It begins in Laredo, TX and runs through nine states of the Great Plains region into Canada.

Cal Klewin, executive director of the TREA says the first phase and main focus on Highway 85 is aimed at the portion of the corridor between Watford City and Williston.

"At the present time, passing lanes are being constructed, which will hopefully end up being an extension of a four-lane infrastructure and that's going to improve the safety and efficiency of that portion of the corridor. That's one of the busier areas because of the energy play in North Dakota," says Klewin.

"Another thing we're focusing on is widening the infrastructure (Long X Bridge) crossing the Little Missouri River in North Dakota; detours of 100 to 300 miles, depending on road conditions, can be costly



The Theodore Roosevelt Expressway serves the Williston Basin, connecting North Dakota to Saskatchewan and Manitoba, Montana and South Dakota.

to private industry and business and we're looking at a bridge for the future that can handle over-height and over-width loads."

SAFETY AND LONG-TERM MANAGEMENT PLAN

Highway 85 will be updated from its current standard, two-lane format to a super two highway; the process will involve widening the shoulders, adding passing lanes on hills and placing turning lanes at intersections to help improve overall travel efficiency and safety.

Once that is finished, the TREA hopes to develop a complete four-lane infrastructure, which would complement the rest of the PPA, allowing the corridor to handle the influx of traffic.

"It's come to the point where traffic is in such excess due to energy, agriculture and tourism that the congestion is land-

locking some of the communities that rely on the infrastructure; you have people choosing not to take a route because of congestion and safety issues," says Klewin. "We'll hopefully be going into a phase of long-term planning, working with the Department of Transportation (DOT) to develop a corridor management plan to deal with issues along the expressway and the potential economic development in the region based on service transportation."

According to a Statewide Transportation Improvement Program (STIP) document from the DOT, \$47, 301,627 of federal funding and DOT dollars has gone into improving the TRE since last summer. For an approved STIP, the federal government will match every dollar the DOT invests in the project. The TRE improvements are expected to be complete by the end of the year but Jack Olson, assistant division

It's come to the point where traffic is in such excess due to energy, agriculture and tourism that the congestion is land-locking some of the communities that rely on the infrastructure; you have people choosing not to take a route because of congestion and safety issues.



TRIVIA TIME

1. Transportation-related fatalities are most common.
2. Motor-vehicle crashes are responsible for more than 25 per cent of all occupational fatalities nationwide. In the oil and gas industry, many of those fatalities occur during transportation between work sites.
3. In Dunn, McKenzie, Williams, Stark and Ward Counties, resident deaths due to motor vehicle accidents—cars, pick-up trucks, vans and heavy transport trucks—have risen from 16 deaths in the year 2000 to 22 deaths in 2009.
4. In the oil and gas industry, between April 2010 and March 2011, there were three work-related deaths, four traffic fatalities, three suicides, two drug overdoses and one homicide in Dunn, McKenzie, Williams, Stark and Ward Counties.
5. The average comprehensive costs on a *per injured person* basis were:
 - a. Death: \$4,300,000.00;
 - b. Incapacitating injury: \$216,800.00;
 - c. Non-incapacitating event injury: \$55,300.00;
 - d. Possible injury: \$26,300.00; and
 - e. No injury: \$2,400.00.

Statistics courtesy of Anna Briggs, MPH, PhD student, University of Minnesota, Occupational Health Services Research and Policy.

director in the planning asset management division with the DOT, says completion may be delayed due to the late spring. Projects relating to the TRE improvements are scheduled from 2012 into 2015 and are expected to cost \$17,315,730.

“North Dakota is heavily dependent on federal aid for its highway system; we don’t have enough money to make large investments on every roadway without demand. We’re trying to get a handle on what infrastructure needs to be in place so traffic can be handled safely and efficiently,” says Olson. “The TRE is an important corridor in North Dakota. The DOT is looking at

that corridor and others in the state, looking at the money we have to maintain safe flows. If we don’t have money, it doesn’t mean it’s not important, it just means there are limitations in resources.”

The DOT worked with the TREA to analyze traffic volumes and populations in western North Dakota, looking at demographics and other factors that would influence traffic on the TRE. They found the oil industry was the primary generator of traffic. Recent studies done by the Department of Commerce, says Olson, looked at how areas like Watford, Williston, Dickinson and Tioga will grow based on oil development and how much additional traffic will be put on the corridor as a result.

“For the long-term, we’re hoping to have a four-lane corridor through North Dakota but that will depend on funding so we’re just going to take it piece by piece,” says Klewin. “We feel very strongly that the TRE has huge potential to develop North Dakota’s economy in energy, agriculture, manufacturing and tourism.” For more information on the TRE expansion project, go to www.treexpressway.com. 

THE THEODORE ROOSEVELT EXPRESSWAY

- The TRE provides a transportation corridor for oil rigs, pipe, steel and supplies from Edmonton, Calgary and Regina to the north, and from Houston, Dallas and Denver from the south.
- The TRE is a collector corridor for six major east-west highway systems that service major oil development areas.
- The TRE is the first portion of the Ports to Plains Alliance. The second portion is the Heartland Expressway and the third portion is the Ports to Plains Trade Corridor.
- Eight of the top 10 oil producing states and five of the top six natural gas producing states are along the Ports to Plains Trade Corridor.

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The Comeback Kid: Uranium Mining in North Dakota

In the 1950s and '60s, uranium was a viable energy source in North Dakota and had a big impact on the industry. How this source could be making a return to our state's energy plan.

By Basin Bits Staff



Commissioner Kevin Cramer, North Dakota Public Service Commission.

It wasn't that long ago that uranium played a big role in North Dakota's energy industry. In the 1950s and '60s, uranium mines in the southwestern portion of the state were popular but low prices for uranium oxide—yellow cake—eventually made it a less-than-hot commodity. When prices rose in the late '70s, exploration in western North Dakota went through the roof but an accident at the Three Mile Island power plant in Pennsylvania in 1979 quickly turned excitement surrounding uranium into health-related concerns.

For nearly 30 years, the state's uranium deposits were forgotten about but Commissioner Kevin Cramer, with the North Dakota Public Service Commission believes uranium should be part of North Dakotas' future energy options and that interest in the commodity will soon be on the rise.

"North Dakota is a state rich in natural resources, especially mineral resources that have an important role in our nation's energy security. Oil and gas, lignite coal and wind are important but other mineral and metals in this case, uranium, also have potential," says Cramer.

"The demand for uranium in this county and the world has been up and down depending on the geopolitical forces and need. I'm not an expert on what's economical but there is demand and it's certainly on the rise, even with global recession we're in. North Dakota is perhaps the most savvy energy development sate in the country. We have another product that could be part of the solution to America's energy and economic challenges and if we treat it properly and find the right solutions, and if the market is right, North Dakota can lead in yet another form of energy development."

Uranium mining, says Cramer, has come a long way from the open pit mining of the '50s and '60s and people have learned from mistakes of the past. One such mistake could be the Church and Hurick pits at the Fritz mine, located in Slope County, approximately 17 miles southwest of Belfield. The open pit mines extracted nearly 40,000 tons of uraniumiferous lignite coal in the '60s, burning the coal or sending it to be processed in a nearby kiln to concentrate the uranium from its ash. The process left the land on Rocky Fritz's property useless; surface materials were contaminated with uranium, cadmium and molybdenum and until part of it was reclaimed in 1992, the property was a barren wasteland, with large

water filled pits and acid forming spoil materials. Workers had to wear radiation film badges and dust respirators due to the hazards caused by radioactive dust and had to leave clothing on-site after working hours.

Since reclamation of the property, Formation Resources has drilled 12 posthole samples on the site for project Sentinel, showing that interest in uranium has once again been piqued.

CLEAN MINING

There has been a drive toward clean, safe energy in North Dakota, says Cramer, and as such, the invention of in-situ mining has made a difference in how uranium is mined and the effects it can have on the environment.

"North Dakota has been providing energy solutions for decades and has done it quite well. I know the Department of Mineral Resources has developed rules for in-situ mining, which pumps the product out in a liquid, so it has its advantages—you don't have exposed people or livestock to an open mine. Our roles in regulating new uranium mines would be different because of the in-situ process," says Cramer. He also adds that, although it's not tied directly to domestic uranium reserves, our state shouldn't rule out the possibility of

A section of the Rocky Fritz property, post-reclamation, that was tested for uranium in 2008. Geologists collect lignite samples for germanium analysis. Photo courtesy of the North Dakota Geological Survey.



One thing about western North Dakota landowners is that they are very savvy and have a great appreciation for the fertility that provides sustainable living for many generations. I put more trust in those people than in the bureaucrats that regulate it...

The following is an excerpt from an article written by State Geologist Ed Murphy and has been reprinted with permission from the North Dakota Geological Survey.

URANIUM DEPOSITS IN WESTERN NORTH DAKOTA

The North Dakota Geological Survey (NDGS) anticipated the renewed interest in uranium and began mapping the uranium deposits in southwestern North Dakota several years ago. To date, we have identified 20 uranium deposits that encompass an area of 250,000 acres in western North Dakota (Murphy 2005, 2006 a-c, and 2007a-c). Seven of these deposits are larger than 10,000 acres and one, a deposit north of Belfield, covers more than 83,000 acres.

This is the first time that uranium deposits in North Dakota have been accurately defined (that is, mapped at scales of 1:24,000). The deposits were identified by interpreting gamma logs from coal and uranium exploration holes, NDGS test holes, oil wells, and ND State Water Commission monitoring wells. It was determined during these studies that uranium occurs primarily within lignite beds, sandstones and carbonaceous mudstones in the Fort Union Group (Paleocene).

producing nuclear power. According to Cramer, there are 103 reactors currently in the United States but none of them are in North Dakota.

“For the growing demand for emission-free electricity, nuclear power does exactly that—it’s completely clean. It’s abundant, it has a small footprint and it’s not an intrusive form of development. It’s pretty low cost compared to other things, it’s available and it’s here—we don’t have to import it because there’s a domestic supply of the fuel source,” he says.

The downside, Cramer says, is that the United States has yet to create a policy that effectively deals with the permanent storage or disposal of the spent fuel, which has created tremendous uncertainty. However, Cramer believes that the growing demand for emission-free energy drives more opportunity toward nuclear power and the demand for uranium.

“Land owners that have been part of this are quite aware of it and companies, to my knowledge, have been landowner friendly. The Sentinel project is on public land and has its advantages and disadvantages; private land that is mineral rich has its advantages, as well,” says Cramer.

“One thing about western North Dakota landowners is that they are very savvy and have a great appreciation for the fertility that provides sustainable living for many generations. I put more trust in those people than in the bureaucrats that regulate it—they are good people who know their property and land better than anybody. Being the common sense people that we are, we will make sure [uranium mining] is done in a safer manner in the future.”

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Reviewing the Resource Potential of the Pennsylvanian Tyler Formation

By Stephan H. Nordeng

The dramatic upturn in oil production from the Bakken Formation in North Dakota during the last few years underscores the value of incorporating new models of geologic thought with advances in drilling and completion technology. The development of the Bakken Formation resulted from advances in drilling and completion technology that were originally developed to exploit regionally extensive gas resources known as basin-centered gas accumulations. The breakthrough in exploration thought that led to the development of petroleum from the Bakken Formation was the realization that the same basic geologic principles used to explore for basin-centered gas resources also apply to oil.

BACKGROUND

Four basic components contribute to the formation of a basin-centered petroleum accumulation (Schmoker, 2002; Law, 2002). The first and most important is the presence of a regionally extensive organic-rich source rock. The second involves thermal maturation of kerogen in the source rock to the point of oil generation. Third is the presence of a reservoir in contact with the oil-generating source rock and the fourth involves hydraulically isolating the source and reservoir with very poorly permeable rock.

The formation of an appropriate source rock is restricted to a specific set of depositional circumstances that include environments conducive to high rates of organic productivity that at the same time allow for the accumulation and preservation of dead organic matter. This organic matter consists of complex organic compounds containing carbon, hydrogen, and lesser amounts of oxygen and other elements. Oil-prone kerogen (Type I and II) contains organic compounds rich in hydrogen and relatively poor in oxygen. These organic compounds are derived primarily from planktonic, especially algal, sources associated with marine environments or freshwater lakes. Gas-prone kerogen (Type III and some Type II) consists mainly of organic matter from land plants, which is richer in oxygen and poorer in hydrogen than the organics found in more oil-prone kerogen types.

Maturation of source rocks involves heat-driven chemical reactions that convert solid kerogen into either oil and/or gas. Because temperatures increase with depth, the thermal maturity of a given kerogen is largely controlled by the burial history of the source rock. However, variations in crustal heat flow within a basin can significantly distort the simple depth-temperature relationship described by burial history alone. Combining a source rock's burial history with the appropriate heat flow can be, in the absence of better indicators, useful in estimating where and when a source rock has reached a level of maturation capable of oil generation. The reason for this is that as temperatures increase with burial depth, the rate that kerogen converts to oil also increases but at a much faster rate. At shallow depths and low temperatures kerogen forms

oil at a negligible rate. At greater depths and higher temperatures the conversion occurs much more rapidly and continues to increase with temperature until oil generation slows as the reactive kerogen in the source becomes exhausted. As a result, there is a range of temperatures within which oil generation is at its most intense. This temperature range, and the corresponding burial depths, is called the "oil window."

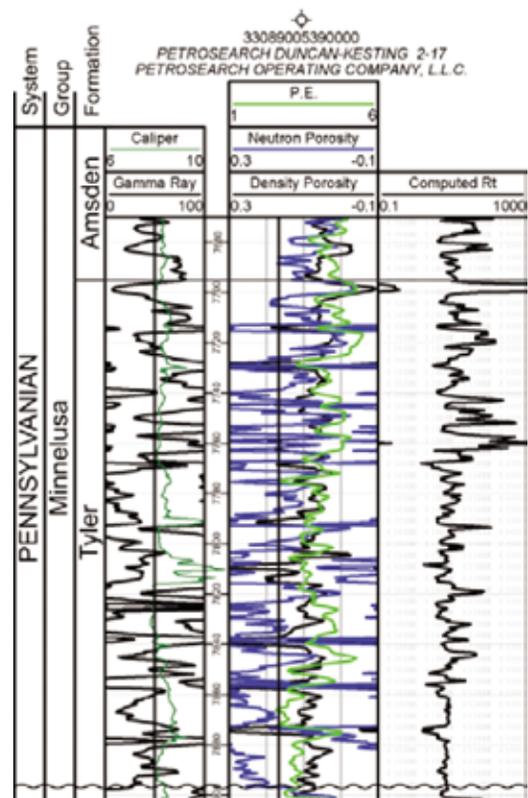


Figure 1. A set of wireline logs for the Tyler Formation from the Kesting #2-17 (API: 33-089-00539-00-00; NDIC: 14675) drilled in the SE NE, Sec. 17, T139N, R96W, Stark County, North Dakota.

Another important consideration related to the burial history of a potential source rock is when the source rock entered or passed through the oil window. This is particularly important when the rocks that encase the source rock are too impermeable to allow generated oil to escape. When this happens, pressure within the system builds up until fluids are either injected into the pore space of the surrounding rocks or the rocks fracture, releasing the trapped fluids. In either case, abnormally high pressure accumulates within and close to the source rocks. If the oil accumulation is encased in perfectly impermeable rock then pressures within the accumulation



Figure 2. Examples of core from the Government Taylor A-1. The core from a depth of 7,948 ft. (left) has a strong reddish hue that suggests that organic matter in this rock has been oxidized. The total organic carbon (TOC) in this sample is only 0.21%, indicating poor source rock quality. The dark gray to black core from the depth of 7,977 ft. (right) is an excellent, thermally mature, source rock with a TOC of 11.25%, a hydrogen index of 669 and a Tmax of 446°C. Width in photographs represent 3.25 in. of core.

could persist for indefinite periods of time. However, in the absence of perfect impermeability, over-pressured conditions could be maintained as long as the source rocks are in the oil window where maturation and expulsion continuously recharges the system.

The question as to what constitutes a reservoir rock is evolving rapidly. This is primarily due to advances in drilling and completion technologies that has transformed yesterday's tombstone (rock with very little permeability) into today's highly productive reservoir. The ability to engineer a reservoir from almost any oil-bearing formation may well be realized within the foreseeable future.

THE TYLER FORMATION

The Tyler Formation is the basal unit of the Minnelusa Group that, together with the overlying Permian Opeche, Minnekahta and Triassic Spearfish Formations makes up the Absaroka Sequence (Fig. 1). The Tyler Formation consists of inter-bedded meter- to submeter-scale beds of shale, siltstone, limestone, local sandstone lenses, thin coal and, near the top, anhydrite-bearing red beds. In general, the Tyler shoals upward from dark carbonaceous shale and limestone at the base to reddish-hued shale, siltstones, dolostones and sandstones near the top. Faunal evidence indicates that the Tyler Formation is between 318.1 and 306.5 million years old (Pennsylvanian) and that deposition occurred in a deltaic setting that included offshore marine to nearshore, terrestrial, coal swamp environments (Grenda, 1977). The clastic sediments of the Tyler Formation originated in highlands south of the Williston Basin and spread over the eroded Mississippian surface that was flooded during the initial advance of the Absaroka Sea (Gerhard and Anderson, 1988). During this time, the Williston Basin was situated in the

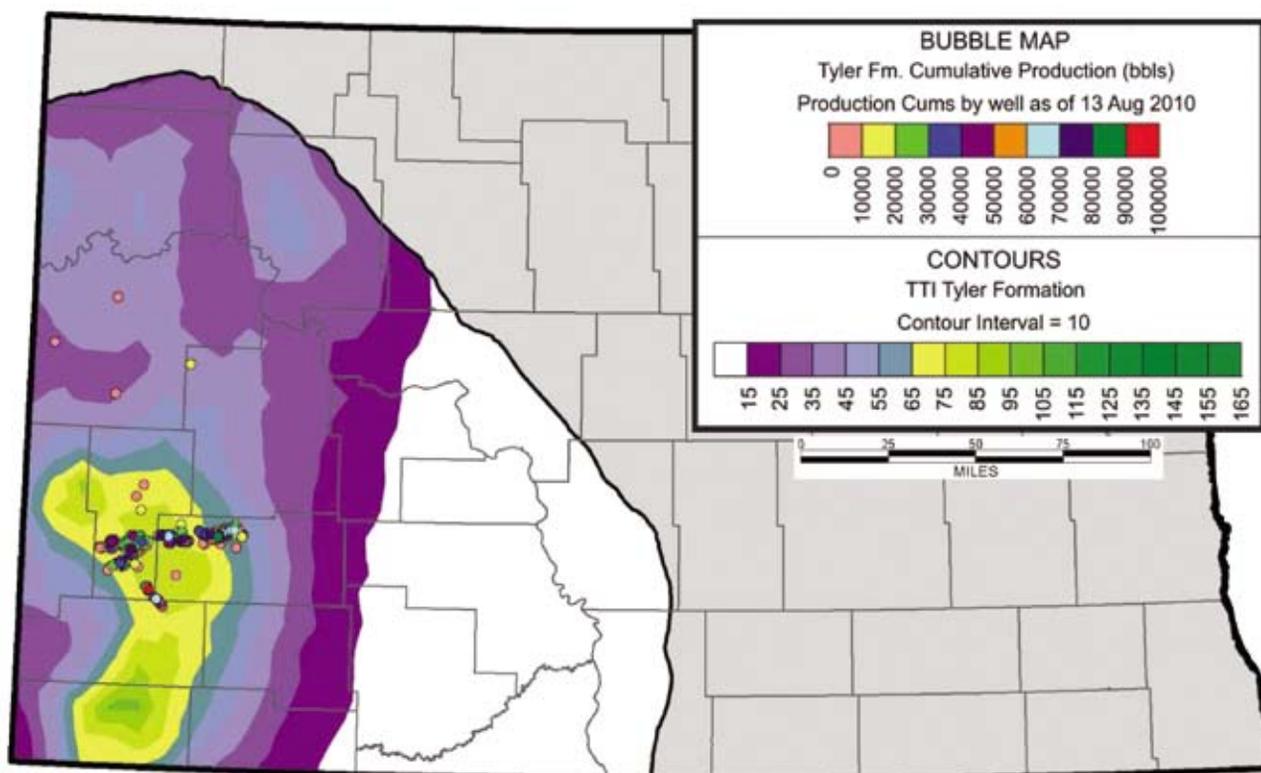


Figure 3. Index map of North Dakota showing the extent of the Tyler Formation. Areas in which the Tyler Formation are absent are in gray (modified from Anderson, 1974). The Time-Temperature Index calculated for the Tyler Formation (Lopatin, 1971; Waples, 1980) is keyed to the color bar in the upper right corner of the map. A TTI of 15 is the minimum level of maturation that could generate oil. A TTI of 75 corresponds with a level of maturation that could result in peak oil generation. Cumulative production statistics (barrels of oil) from the North Dakota Industrial Commission, are shown by the color of the circles centered on the wells that have and/or are producing oil from the Tyler Formation.

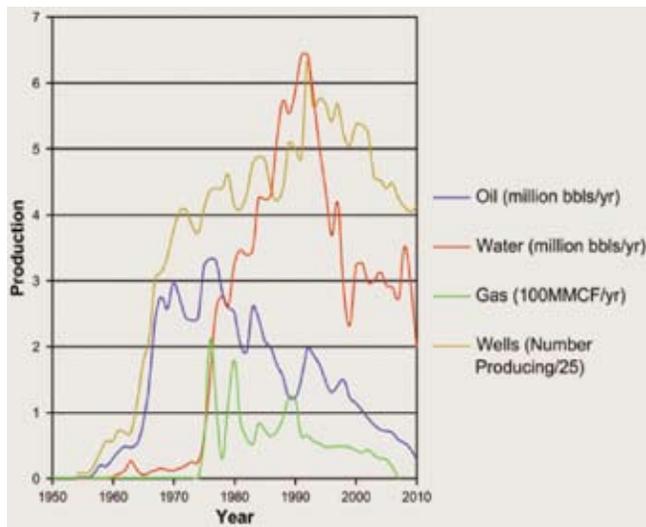


Figure 4. Annual production statistics for the Tyler Formation in North Dakota starting in 1954 and running through August 2010.

tropics so that as the Absaroka Sea advanced and sediment supplies consequently diminished; these shallow marine waters generated huge amounts of organic matter that probably included Type II and maybe Type I kerogen. This material accumulated and is preserved in the various marine shales present in the Tyler Formation. The coals deposited just above sea level in the Tyler Formation also contain significant amounts of organic carbon that is probably preserved in the form of Type III kerogen. The contact between the Tyler and the overlying Amsden Formation is gradational and may be difficult to identify, especially along the eastern margin of the Tyler where key marker horizons are absent.

Probably the most conspicuous aspect of the Tyler Formation is the distinct reddish color of the upper portion of the formation (Fig. 2). Ziebarth (1972) thought that the reddish color was caused by iron that was oxidized by ground water shortly after deposition. Dow (1974) agreed noting that not only was the color of the formation influenced by oxidation, but that oxidation also destroyed much of the previously deposited organic matter. Dow suggested that the oil potential of the Tyler Formation should be directly related to the remaining thickness of the organic-rich, dark gray or black shale, most commonly found in the lower portion of the formation.

The Tyler Formation consists of a complex vertical distribution of rock types similar to other time-equivalent Pennsylvanian sections. The complex stacking patterns found in many Pennsylvanian rocks are often explained through various combinations of episodic sediment influx and basin subsidence, all within a global framework of frequently changing sea levels (Wilson, 1975).

The Tyler Formation covers roughly the southwestern third of North Dakota and extends to the west into Montana and to the south into South Dakota (Fig. 3). The Tyler Formation to the north and east pinches out along a subcrop formed by a pre-Mesozoic unconformity (Anderson, 1974). The maximum thickness of the Tyler Formation is about 270 feet and is situated within a poorly defined depocenter in McKenzie County.

There is one significant difference between the depositional history of the Tyler Formation and the Bakken Formation. Deposition of the Tyler Formation occurred at or very near the surface and, in part, included terrestrial environments directly in contact with the atmosphere. As a result, organic matter in the Tyler Formation may have been, to some extent, modified by oxidation. Over most,

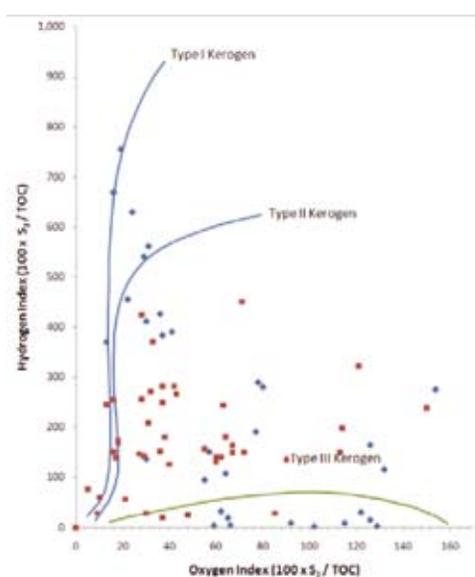


Figure 5. A modified Van Krevelen diagram that classifies kerogen on the basis of the Hydrogen Index (HI) and Oxygen Index (OI) derived from Rock Eval pyrolysis data. The blue diamonds represent the data from the Government Taylor A-1 (NDIC # 4627, SE¼ SE¼, Sec. 9, T139N, R103W) and the red squares refer to data from the State of North Dakota #41-36 (NDIC #: 4789, NE¼ NE¼, Sec. 36, T137N, R100W). These data suggest that kerogen within the Tyler Formation includes oil-prone Type I and Type II, gas-prone Type III as well as mixtures of both oil- and gas-prone kerogen.

if not all, of its extent, the Bakken Formation was never directly exposed to sub-aerial conditions, so there was much less oxidative degradation of the accumulated organic matter before burial. The difference in the degree of oxidative degradation of organic matter could make the direct comparison of the two formations difficult and should be done with caution.

Oil production from the Tyler Formation was first established early in 1954 from the Dan Cheadle Unit #1 (NDIC #: 518, SE¼ NW¼, Sec. 9, T139N, R100W) drilled by Amerada-Hess and Northern Pacific in the Fryburg Field. This well initially produced 117 barrels (bbls) of oil per day with little water and no gas from a depth of 8,271 to 8,278 ft. The well was fraced with a 7,600 gallon dieselsand slurry followed by a 3,000 gallon gel-sand mixture. The well was swabbed back and began to flow. According to the North Dakota Industrial Commission (NDIC) the Dan Cheadle Unit #1 was plugged and abandoned in 1974 after producing 74,691 bbls of oil and 13,156 bbls of water from the “Tyler pool.”

As of August 2010, the Tyler Formation has produced over 83 million bbls. Tyler production peaked in 1976 when over 3.3 million bbls of oil were produced from 109 wells (Fig. 4).

Oils from the Tyler Formation tend to have lower gravities (Mean = 34.6 API), higher viscosities (25 cp @ 100 F), and more paraffin (Average = 29.5 wt. percent) than other oils in the Williston Basin (North Dakota Geological Survey, 2002). Williams (1974) found that these oils are unique to the Tyler Formation and Dow (1974) concluded that the oil produced from the Tyler Formation was self-sourced because of the similarity between the produced oils and the oil present in the shales.

The organic geochemistry of the Tyler Formation is poorly documented. Only two wells have data on file with the NDIC that can be used to evaluate how much, what type and how mature the

Continued on page 36...

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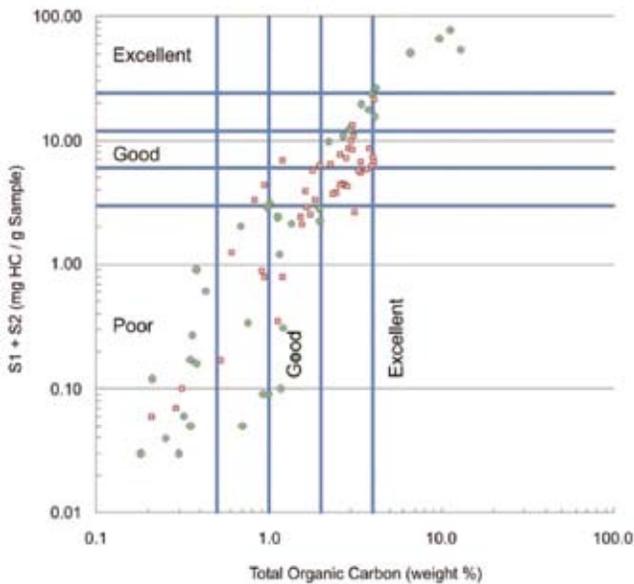


Figure 6. A kerogen quality diagram (Dembicki, 2009) constructed from the Total Organic Carbon (TOC) versus the mass of existing (S1) and potential (S2) hydrocarbons contained in samples of the Tyler Formation. The samples are from the Government Taylor A-1 (green circles) and the State of North Dakota #41-36 (red squares).

Continued from page 34...

organic carbon in the Tyler Formation is. The two wells are: Mule Creek Oil Company's Government Taylor A-1 in eastern Golden Valley County and Shell Oil Company's State of North Dakota #41-36 in western Billings County. Both wells are located close to established production and appear, on the basis of the Time Temperature Index, to be within the oil window (Fig. 3).

A total of 82 samples from these two wells were analyzed by Rock Eval pyrolysis. Rock Eval pyrolysis measures the mass of oil present in a sample (S1) as well as the mass of kerogen that is capable of generating oil (S2). The compounds measured as S1 and S2 consist primarily of hydrogen and carbon. The total mass of S2 relative to the total amount of organic carbon in the sample (TOC) approximates the amount of hydrogen in the kerogen that is bonded to carbon. The ratio $(100 \times S2)/TOC$ is called the Hydrogen Index, or HI. Rock Eval also measures the mass of carbon dioxide produced during pyrolysis (S3) relative to the total organic carbon content (TOC) approximates how much of the carbon present in a sample's kerogen is bonded to oxygen. The ratio of $(100 \times S3)$ to TOC is called the Oxygen Index or OI. The Hydrogen Index and Oxygen Index taken together can be used to classify kerogen into types that are prone to generating oil (Type I), oil and gas (Type II) or gas only (Type III). Figure 5 shows that the samples collected from the Tyler Formation include kerogen that is oil-prone (Type I or Type II), gas-prone (Type III) and mixtures of these types.



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The range of kerogen types present in the Tyler Formation is in marked contrast to the Bakken Formation. Kerogen in the Bakken Formation rarely contains enough organically bound oxygen to be classified as Type III (Nordeng et al., 2010). The oxygen-bearing organic compounds that differentiate Type III kerogen from Types I and II are probably derived from the preserved remains of land plants that make up the thin coals in the Tyler Formation.

Over half of the samples analyzed contain good to excellent amounts of total organic carbon (TOC) with over one-third of the samples containing kerogen with good to excellent quantities of hydrogen-rich (Type I and/or Type II), organic carbon (Fig. 6). The level of organic maturity of these kerogens, especially the Type I and Type II kerogens, can also be determined by Rock Eval pyrolysis. Specifically, it is given as the pyrolysis temperature that corresponds to the greatest release of S2 hydrocarbons. This temperature, called T_{max} , is frequently used as a measure of organic maturity. As a rule of thumb, a T_{max} of about 435°C marks the lower threshold that corresponds to a level of thermal maturity capable of oil generation. Most of the samples analyzed have T_{max} values within the range expected for oil generating source rocks (Fig. 7).

The Time-Temperature Index map (TTI) of the Tyler Formation (Fig. 3) indicates that, based on modern heat flow measurements and basin subsidence histories derived from stratigraphic thicknesses, a significant part of the Tyler Formation within the Williston Basin should be capable of generating oil. The organic maturation (T_{max}) measurements from the Government Taylor #A-1 and the State of North Dakota #41-36 as well as all of the known Tyler production coincide with Time-Temperature Indices that predict a level of thermal maturity that should generate oil. The TTI map is only capable of estimating the thermal maturity of a particular horizon and does not include any reference to kerogen quality. It is only the coincidence of a favorable thermal history with a high quality kerogen that should be considered potentially productive.

Hydraulic isolation is another key element that Schmoker (2002) attributed to basin-centered petroleum accumulations.

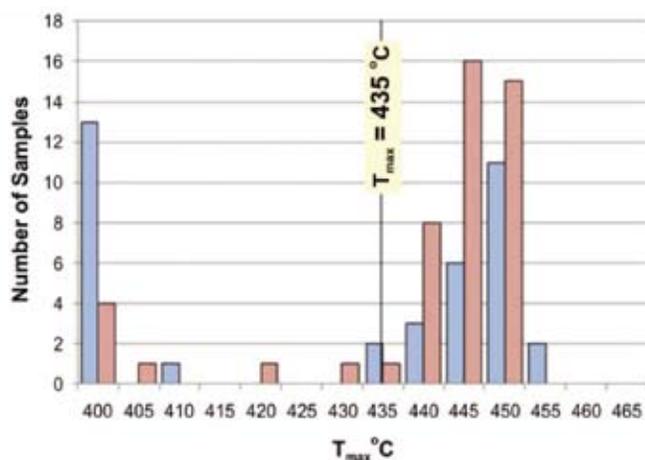


Figure 7. A frequency diagram showing that most of the samples of the Tyler Formation collected from the Government Taylor A-1 (red), and the state of North Dakota #41-36 (blue) have been thermally matured beyond the threshold that marks the onset of oil generation (T_{max} ~435°C).

Meissner (1978) recognized the importance of over-pressured conditions in the Bakken Formation in the Williston Basin. This occurs because the rocks that encase the source beds lack sufficient permeability to allow petroleum generated within the source beds to escape and migrate away. As a result, pressures within the source beds and associated reservoir rocks exhibit abnormally high or low formation pressure relative to the pressure expected in a reservoir that is in hydraulic communication with the overlying rocks. The “expected” pressure usually refers to the “hydrostatic condition,” which is equal to the pressure exerted by a column of water that extends from the surface to the depth that the pressure is measured. When this is the case, the ratio of the formation pressure to the depth of the formation is a constant known as the hydrostatic gradient. The hydrostatic gradient varies depending on the amount of dissolved material in the water from 0.43 psi/ft. for fresh water to 0.49 psi/ft. for a salt-saturated brine. Therefore, abnormally low or high pressure would yield hydraulic gradients (pressure/depth) that lie outside this range.

Modestly over-pressurized reservoir conditions in the Tyler Formation were apparently present in several fields prior to production (Nordeng and Neshiem, 2010). Over-pressurized conditions suggest that oil generation has been intense enough to “charge” the formation and that the rocks that encase the Tyler Formation are too impermeable to allow the over-pressure to dissipate. This situation indicates that the Tyler Formation is, at least partially, hydraulically isolated, and tends to confirm Dow’s argument that the oil present in the lenticular sandstone reservoirs of the Tyler Formation came from the surrounding shale.

The limited data available today suggest the Tyler Formation is a regionally extensive unit that may contain good to excellent quantities of oil-prone kerogen that is sufficiently mature to generate oil within a hydraulically compartmentalized environment. If so, then the Tyler Formation possesses the elements needed to qualify as a basin-centered petroleum accumulation. However, even though the Tyler Formation may be within the oil window on a regional scale, the amount and type of organic matter that could be converted into oil or gas is largely unknown. To address this question, the North Dakota Geological Survey is undertaking a program of sampling and analysis that will provide a picture of the regional distribution of organic carbon (TOC) as well as the types of kerogen that are present in the Tyler Formation.

AN UPDATE ON THE RESOURCE POTENTIAL OF THE PENNSYLVANIAN TYLER FORMATION

A project of this caliber typically has three or four phases. The analysis of the resource potential of the Pennsylvanian Tyler Formation is moving into the second and third phases and will likely be completed by May 2012.

“The North Dakota Geological Survey is continuing its study. We just finished the round of samplings for TOC (Total Organic Carbon) and we’re then going to be following up with a round of rock eval analysis,” says Ed Murphy, State Geologist with the Department of Mineral Resources. “We’re trying to pinpoint the maturation areas in the basin, where the Tyler was subjected to temperatures hot enough and long enough to generate oil.”

Murphy says they will have preliminary analysis results by the end of 2011 and will be reporting on that project at the Williston Basin petroleum conference in Bismarck, ND in May 2012.

Potential Use of North Dakota Sand and Clay for Natural and Manufactured Proppants

By Fred J. Anderson

The overwhelming success of the Bakken/Three Forks oil play in North Dakota can be greatly, if not wholly, attributed to the advances in hydraulic fracturing of “tight” reservoir rock. As part of the hydraulic fracturing process, proppants (commonly natural sands and manufactured ceramic spheres) are used to keep the fractures that are created open for the enhanced flow of oil and gas from the fractures into the wellbore. A typical hydraulic fracturing stimulation operation in the Bakken in North Dakota requires anywhere from 100 to 500 tons of proppant per well: roughly 150 tons on average. The North Dakota Geological Survey has been investigating North Dakota’s sand and clay resources in an effort to better characterize deposits that could potentially be used as proppants. Specifically, we are attempting to locate useable deposits of sand (and potentially clays) for hydraulic fracturing and other industrial sand applications in the Williston Basin.

Sand (and gravel) is widespread throughout North Dakota, although most is in the glaciated part of the state, where it is found in glaciolacustrine beach deposits, glaciofluvial (outwash) and modern stream deposits, and early to mid-Holocene dune fields. Most of the sand and gravel currently mined in North Dakota is used in construction and road building.

Synthetic proppants are manufactured from a variety of materials and include aluminosilicate ceramics derived from the sintering of bauxite (aluminum oxide) and kaolinite. As part of our study, therefore, we are also looking at some of North Dakota’s kaolinic clays as potential raw materials for the manufacture of ceramic proppants.

PROGRESS OF INVESTIGATION

Over 100 sand locations were sampled from across the state for this study (Fig. 1). We have identified the leading sand deposits based upon grain size, sorting, and roundness. Detailed sedimentological and engineering analyses are planned for the best candidate sands.

Members of North Dakota’s sand and gravel-producing industry are also participating in this evaluation, and several producers have submitted sand samples for consideration. The results of this study will be communicated to the industry through publication of the investigation results in 2011.

We are also characterizing these samples for use in other industrial sand applications, including well completion materials (filter and gravel packs), filter media, and foundry practices. Generally, it is said that the production of industrial sands as viable economic deposits requires materials that are usually more consistent in character, are available closer to the land surface, and require minimal processing (screening and washing). Having a better understanding of some of the characteristics of our state’s sand and clay resources is advantageous to both the industry and the people of North Dakota.

PROPPANT CHARACTERISTICS

Proppants are characterized by what they are; that is, their physical properties, and how they perform (in bulk) within the fractured oil & gas reservoir; in other words, their ability to enhance and facilitate flow (permeability) in a propped fracture. Permeability may be thought of as the rate (distance per unit time) at which a fluid (oil, gas, water)

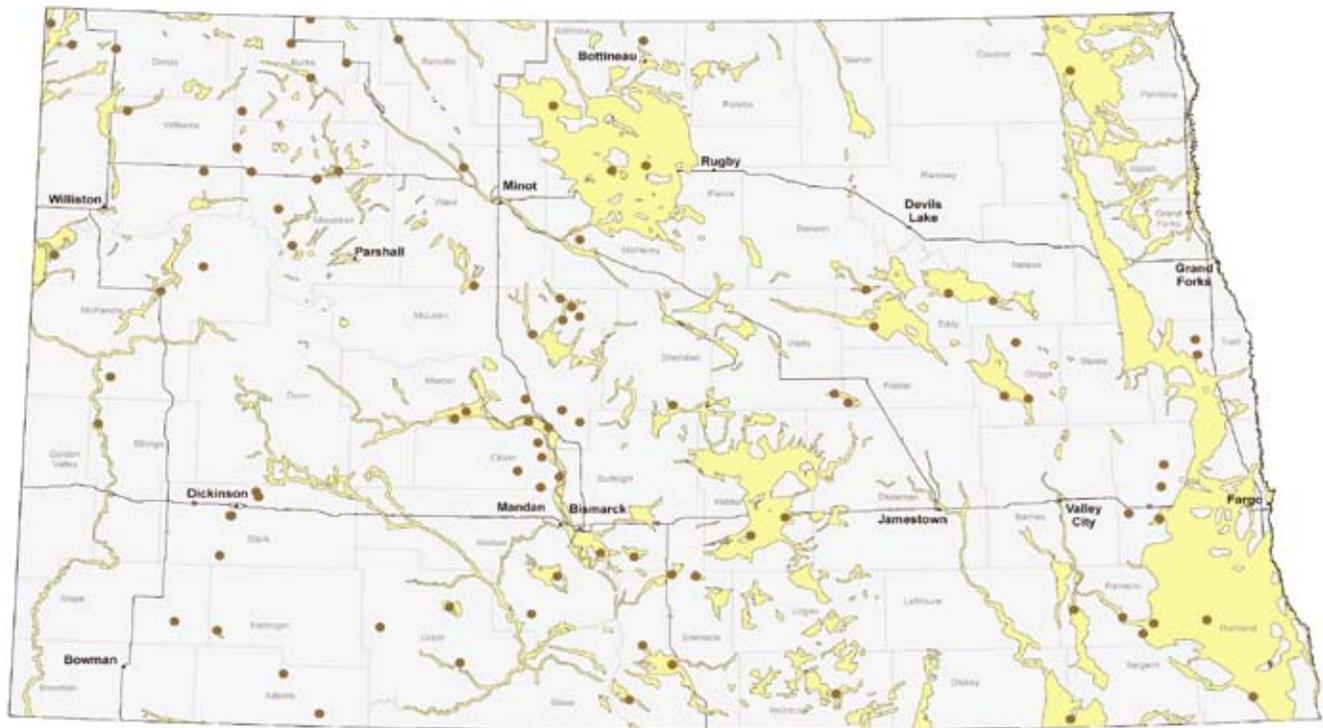


Figure 1. The sand and gravel resources of North Dakota (yellow) and locations of sand samples (brown dots) collected for possible use as proppants for the hydraulic fracturing of oil wells in the Bakken and Three Forks plays in the Williston Basin (modified from Anderson, in press).

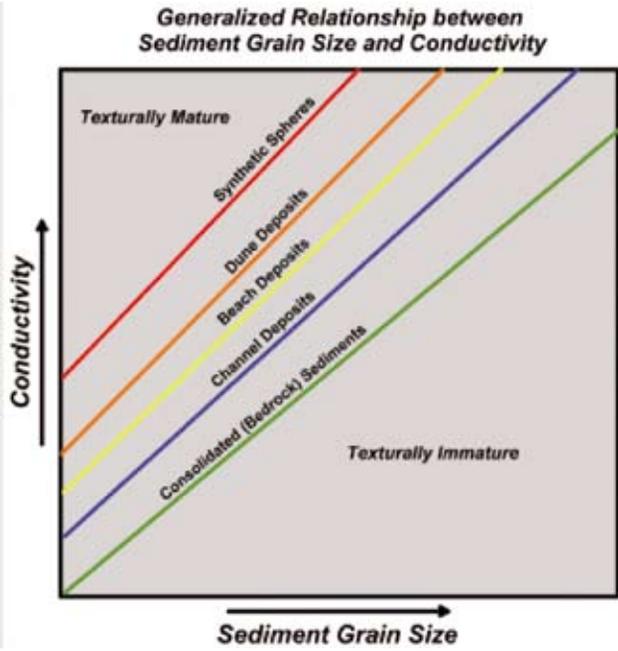


Figure 2. Generalized relationships between grain size and conductivity (permeability) of a sediment (modified from Shepherd, 1989).

can move through a particular sediment or rock. It is commonly measured in cm/sec, feet/day or the darcy, after French engineer Henry Darcy, whose pioneering work on fluid flow led to the discovery of the law that is named after him (Darcy, 1856). Texturally mature sediments generally have higher permeabilities (Fig. 2) than less texturally mature sediments. As a relevant everyday example here in North Dakota, the Bakken Formation exhibits permeabilities in the micro (10^{-6}) darcy range (Nordeng, oral commun., 2010). By comparison, oil and gas reservoirs worldwide typically have

permeabilities ranging from five to 500 millidarcies (Selley, 1998). The only way to liberate oil and gas from a “tight” reservoir like the Bakken is by hydraulic fracturing (Fig. 3).

Geologic factors such as reservoir depths, temperatures, and pressures all relate to a proppant’s ability to withstand fracture closure within the reservoir. The closure strength is the amount of strain that can be taken up by the proppant before it fails to keep the induced fractures open during production from the reservoir. When natural proppants fail, particularly when used in the Bakken Formation, individual sand grains may actually fracture under the high stresses and temperatures within the formation/reservoir (Vincent, 2010a & 2010b). These kinds of geologic factors are critically important to understand when designing fracing operations where significant reservoir depths, temperatures, and closure stresses are anticipated.

NATURAL PROPPANTS

Most natural sand proppants are sourced as two types: “white” and “brown.” “White” or Ottawa sands (referring to their primary source area around Ottawa, Illinois) (Fig. 4) are mined in parts of the upper Midwest from quartz-rich Cambro-Ordovician sandstones that are characterized by their exceptionally high degrees of purity and textural maturity. These sands were originally deposited in a shallow marine environment where geologic factors such as weathering, erosion, and repeated refinement in the surf zone have resulted in texturally mature sandstones that are composed almost entirely of quartz. “Brown” or Brady sands are found in deposits located in Texas. Because they are somewhat mineralogically and texturally less mature than Ottawa sands, Brady sands are washed during processing to remove impurities such as clays and feldspars. Natural sand proppants (Figs. 5a and b) are used mainly in shallow operations where fracture closure stresses in the reservoir rock are relatively low.

Because North Dakota’s sand deposits are so geologically young, they are much less mature, both mineralogically and texturally, meaning that they consist of compositionally more varied, less rounded, less well sorted grains than most sands commonly used in hydraulic

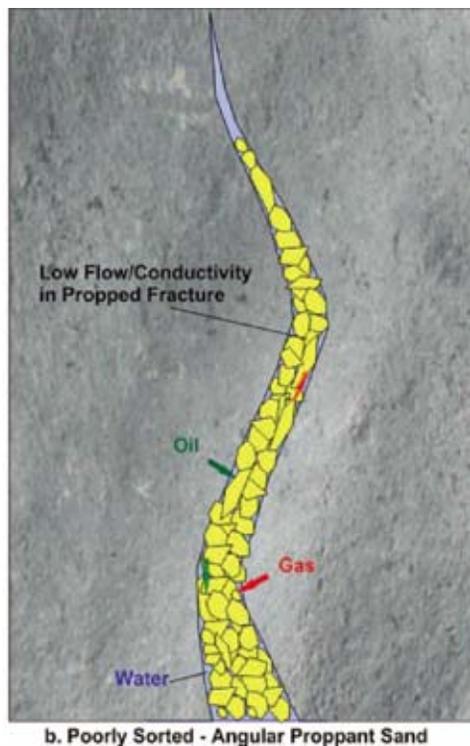
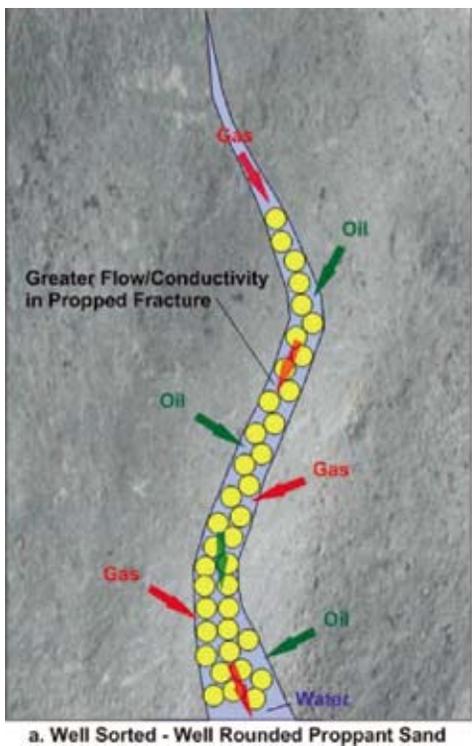


Figure 3. Schematic of an open “propped” rock fracture with proppant placed within the aperture of the fracture. Proppants that are more consistent and well-rounded as in (a), allow for greater interconnected pore space and facilitate a larger amount of flow (higher permeability) of oil and gas out of the reservoir rock and into the fracture(s) and wellbore. Proppants that are less consistent and have poor shape factors as in (b), (higher degrees of angularity) tend to pack better but result in less interconnected pore space and lower permeabilities, which results in less flow of oil and gas into and through the fracture.



Figure 4. Outcrop of the St. Peter Sandstone near Ottawa, IL. The higher degrees of sorting and mineralogical maturity of these Ordovician-age white “Ottawa” deposits allow for their economical production for use as proppants and in other industrial applications.



Figure 6. Sand dune from the Pembina dunes in northeastern North Dakota. Small-scale wind ripples are visible on the exposed dune surface, indicative of recent wind activity.

fracturing. Potential proppant sands will most likely be found in the better-sorted deposits, which tend to be of windblown origin, like the Denbigh or Pembina Dunes (Figs. 5c and 6); or fluvial sediments where geologic processes have selectively removed some of the coarser and finer grained sediments (i.e., a sand bar).

SYNTHETIC OR MANUFACTURED PROPPANTS

Synthetic, or manufactured proppants are designed to perform under specific reservoir conditions (high pressures and temperatures coupled with high fracture closure stresses) and can be engineered to perform more favorably in hostile reservoir conditions than natural proppants. Specialty aluminosilicate ceramics, made from sintered blends of bauxite and kaolinitic clays, are one example (Fig. 7). Several North Dakota clays, including those from the Bear Den Member of the Golden Valley Formation are being evaluated as potential candidates for the manufacture of these types of ceramic proppants. The Bear Den Member of the Golden Valley Formation is a multi-colored kaolinitic claystone that outcrops in several localities throughout Dunn, Mercer, Morton, Mountrail, and Stark Counties in western North Dakota (Fig. 8). The Bear Den Member has been used for decades in the manufacture of bricks by the Hebron Brick Company (Murphy, 2009).

One of the key drivers in proppant selection and use is cost. Natural proppants, when appropriate and available, arguably provide a more cost-effective solution than a custom-designed and shipped synthetic or manufactured proppant. However, since there may be a bit more variability in the character of a natural proppant, it may prove difficult to predict expected well performance from frac to frac, or within multiple fracs in a given well.

DEVELOPMENT OF PROPPANTS IN NORTH DAKOTA

Whether or not a particular deposit of sand or clay can be utilized as a source for proppants, depends on several additional factors, including the proximity of deposits to locations where hydraulic fracturing is taking place, and the degree of natural beneficiation in the deposit; that is, how many natural cycles of refinement the deposit has been exposed to over time. For example, if the deposit is texturally and mineralogically mature, there will be less processing required to produce a given amount of marketable material (Fig. 9). This also plays into costs, as the less effort one needs to put into the refining of the deposit, the less money is spent bringing the material “up to spec” and down the road to market. One current market-
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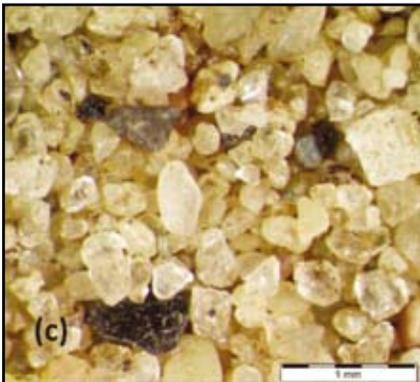


Figure 5. Photomicrographs of (a) an out-of-state proppant sand currently in use in the Williston Basin, (b) a North Dakota sand processed for use as a proppant, and (c) dune sand from Pembina County. All images are at 40x magnification.

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Figure 7. Photomicrograph of sintered bauxite ceramic proppant spheres used in the hydraulic fracturing of oil reservoirs. The uniformity of individual particle shapes combined with higher material strength, specific gravities and thermogenic resistance have resulted in the extensive use of ceramic proppants (including this one) in Bakken reservoir-related hydraulic fracturing and refracturing applications.



Figure 8. Outcrop of the colorful Bear Den Member of the Golden Valley Formation in Dunn County. The Bear Den Member is found in several areas in the heart of the ND portion of the Williston Basin and is known to contain intervals rich in kaolinite (Murphy, 2009).



Figure 9. A sand and gravel processing operation in northern Burleigh County. This plant produces material for a number of industrial applications in North Dakota.

related aspect that is interesting (and timely) is the fact that, across the nation, the availability of proppant sands from their principal source areas appears to be declining as developing gas plays in the eastern U.S. increase their demand. In addition, ceramic proppants will most likely continue to be imported into the Williston Basin from overseas markets, as more and deeper oil and gas development occurs across the nation (Besler, oral commun., 2010).

Since most, if not all, of the currently available natural sand resources are being shipped east for the stimulation of oil and gas reservoirs in Appalachia (especially the Marcellus Shale in Pennsylvania and New York), operators in the Williston Basin may be willing to take what is most readily available and economical as a bit of a frac-design/well production trade-off. Some have suggested that overall production from Bakken wells stimulated with ceramic proppants may be as great as 30 percent higher than those stimulated with natural (sands) proppants.

Overall, North Dakota's sand, and possibly clay resources are locally abundant, readily available and contain a sufficient variety of mineralogical character to allow for a diverse array of potential industrial applications. Creativity in end use, facilitated by producers in the industry, will drive the development of North Dakota's sand and clay resources. With an estimated need of three million or more tons* of proppants (around a couple of billion dollars at today's prices!) to support full development of the Bakken, gaining a better understanding of our possibilities for the production of natural and manufactured proppants is prudent and beneficial for all of North Dakota. 

** Roughly 60 million cubic yards or the volumetric equivalent of filling the tower of the North Dakota state capitol twenty-six times!*

AN UPDATE ON THE POTENTIAL USE OF NORTH DAKOTA SAND AND CLAY FOR NATURAL AND MANUFACTURED PROPPANTS

So far, researchers with the North Dakota Geological Survey submitted 10 samples for analysis, the results of which they just got back at the end of July. Since then, they have been poring through the information, evaluating the results of the study and will make the final finding available early this fall.

“For the sand side of it, we knew going into it that crushability was one of the factors we would have to look at very closely when we were analyzing our results,” says Ed Murphy, State Geologist with the Department of Mineral Resources. “On the clay side of things, we’ve been collecting samples and will continue to collect more throughout the summer.”

Murphy says they are waiting on the clay analysis and anticipates that the final report will come out in late 2011 or early 2012.



Missouri Basin Well Service: Making Safety a Number One Priority



Missouri Basin Well Service field safety representatives ensure operations run safely.

By Basin Bits Staff

Since 1979, Missouri Basin Well Service, Inc. has served western North Dakota, eastern Montana and northwestern South Dakota. The family-owned business owns and operates a commercial trucking company specializing in the transport of bulk liquid materials. The trucking division is comprised of 270 Department of Transportation approved trucks – 100 of which are certified to transport petroleum crude oil. In addition, Missouri Basin operates 26 saltwater disposal wells, 10 freshwater facilities providing water for frac operations, and three North Dakota rail sites receiving sand for frac operations and the exporting of crude oil.

Based in Belfield, ND, Missouri Basin provides service to the entire Williston Basin with two additional offices in Ross and West

We're the largest crude oil transporter in the basin and safety is always the number one priority...we have at least six weeks of training which costs about \$10,000 per employee before they even start generating revenue... safety is number one, period.

MISSOURI BASIN WELL SERVICE PROVIDES:

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- Frac Sand Hauling;
- Fresh Water Transport;
- Mowing;
- Oil Hauling Transport;
- Production (Salt) Water Transport;
- Rail Spur (Noonan, Ross and Beulah);
- Seeding;
- Swabbing; and
- Weed Spraying.

Hope and has satellite locations in Bowman, Watford City, Beach, Williston, Lignite and Sidney, MT.

Like any workplace, the oil and gas industry has opportunities for accidents to occur. Whether those accidents are related to drilling, fracing, transporting, etc., it is crucial to take safety seriously and Missouri Basin is doing everything it can to keep its employees safe.

"We're here to serve the oil and gas industry," says owner Jim Arthaud. "We're the largest crude oil transporter in the basin and safety is always the number one priority. Our

safety department has 30 full-time safety people and all our employees go through two weeks of ground school before they can go for training on a truck. Safety is number one, period."

All newly-hired Missouri Basin employees undergo extensive safety program training, covering topics such as the Environmental Protection Agency (EPA), Department of Transportation (DOT), hydrogen sulphide and occupational safety, which involves performing daily tasks to ensure employees are physically fit and can realistically perform their job. Once field employees complete training, they hit the roadways with a certified trainer for up to 30 days, learning all the fine points of the oilfield. The certified trainer observes daily progress to gauge the new employee readiness to act within Missouri Basin's safety protocol.

"We have simulators in our yard showing the complete production facility so you can understand what everything is and how it works," says Arthaud. "It's interesting enough when you grow up in the oilfield, you see a pumping unit and you know what it is but you get so many people from out of State, say Wisconsin, who know what a dairy farm is but have no idea what a pumping station is or what a treater is. We have at least six weeks of training which costs about \$10,000 per employee before they even start generating revenue."

As the oil and gas industry in the basin booms, Missouri Basin continues expanding and hopes to hire another 200 truck drivers this year; at \$10,000 worth of training each, the company is investing \$2M to properly train its team.

PERSONAL PROTECTION, BEHAVIORAL SAFETY

Because safety is a critical aspect of the industry, each Missouri Basin field employee is provided with personal protection, including fire retardant clothing, air rescue packs,



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KEEPING UP WITH THE BOOM

"We're all very involved in government. I'm a county commissioner and sit on the executive committee of the North Dakota Association of Oil & Gas Producing Counties. We're very active in lobbying at the State level to make sure the 17 oil and gas producing counties receive adequate funding to keep infrastructure where it should be," says Jim Arthaud, owner, Missouri Basin Well Service, Inc.



Missouri Basin Well Service employees receive safety training in many areas, from EPA and OSHA training to DOT and hydrogen sulphide training.

hardhats, H2S Monitors and every item of personal protective equipment needed to do their job safely, as per Operational Safety and Health Administration (OSHA) standards.

Missouri Basin strives to stay cutting edge, taking pride in its three-tier approach to safety.

Following in-depth preliminary training of all new employees, the second-tier centers on an entire team of people in command of safety; 10 in-house safety representatives offer ongoing training and administrative support while another 20 full-time safety representatives cover the field on a daily basis, responsible for following up on safety training, locating and monitoring high-risk areas where spills or accidents can occur.

The third tier relates to regulatory compliance, such as EPA, DOT, OSHA and incident management. Employees must report all incidents to Missouri Basin field safety reps, regardless of size—a quart of oil spilled on the ground is a reportable incident. Field safety reps utilize Missouri Basin's incident management software to target the root cause of each occurrence. Once identified, safety reps present corrective and/or preventative actions with the ultimate goal of avoiding future incidents.

“The biggest element in safety is behavioral safety; employees have to live and breathe it 24/7, even at home,” says Tony Hauck, Missouri Basin's CFO. “We report everything to get the big picture. The software analyzes everything—it might be a mechanical issue or it might be a training issue—and we address it from there.”

One practice of Missouri Basin's that other companies in the industry do not perform is mandatory logging for all truck drivers. While there is no law for drivers working within 100 miles of their terminals to log hours, Hauck says each Missouri Basin driver completes a log as part of company protocol. Most companies compensate drivers on a percentage basis; Missouri Basin chooses to pay employees an hourly wage, something the company believes contributes to safety on the job and on the road.

“Because we pay an hourly wage, our drivers aren't trying to pass people at all cost, on hills, around curves; they get paid the same whether they pass those people or not,” says Hauck. “We made that change 30 years ago. There's no excuse for speeding or running overloaded and heavy, no excuse, and I think it makes a big difference in our safety program.”



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