

Completion of New Back-Up Well

Joffre Site Caustic Disposal System

March 2017



Background

- The generation of waste caustic is a necessary / unavoidable part of petrochemical production. NOVA Chemicals has safely used a caustic disposal well system at the Joffre Site since 1979. The system is used for the disposal of waste caustic generated as part of the ethylene manufacturing process.
- In 2016, we undertook the installation of a second, back-up caustic deep well on the site to enhance reliable operations and to provide flexibility for system maintenance. Without a back-up, a longer outage could require reduced rates and / or shutdown of the ethylene and polyethylene manufacturing units.
- The back-up well will not change the source, characteristics or quantity of fluids being injected into the disposal system.
- For facilities like the Joffre Site, disposal of waste caustic in a deep well is a responsible choice when compared to other disposal options such as incineration or waste truck transportation to a licensed disposal site.

The current disposal system is operated, maintained and monitored to the strict requirements of the Alberta Energy Regulator (AER), which will also apply to the new disposal well.

Overview: Existing Disposal Well and New Well

The new disposal well is now drilled and it is located in close proximity (about 70 metres [m]) to the existing well which is near the Cogeneration facility.

The current and new disposal wells are more than 2,130 m (more than 2 kilometres [km]) below the surface in the Leduc Zone.

The disposal well system is gravity fed. Once waste caustic is injected, a siphon-like effect is created because of low pressure in the formation. The injected solution is isolated within the shale barrier. The level of the solution does not go up or down.

Since we began operations at the Joffre Site more than 30 years ago, we have no indication of any change in the available volume of the large capacity Leduc Zone formation.



The new disposal well was drilled during the latter part of 2016 and completions work was done in January 2017.

What is Waste Caustic?

Caustic (sodium hydroxide) is used in the ethylene manufacturing process to remove carbon dioxide (CO₂) from the ethane feedstock after it passes through the cracking furnaces.

The reaction of the CO₂ together with caustic creates a waste caustic stream including:

- > 95% water;
- < 2% sodium bicarbonate (non-hazardous);
- < 2% sodium hydroxide; and
- < 1% various dissolved hydrocarbons including benzene.

Approximately 90,000 cubic metres (m³) per year of waste caustic is injected into the system. This would translate into about 12 large tanker truck loads per day.

We value your input and suggestions at any phase of this project.

Please contact us for more information:

Community Relations
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Community Considerations

Responsible Care® procedures related to environment, safety and community guide all NOVA Chemicals' ongoing operations as well as new projects.

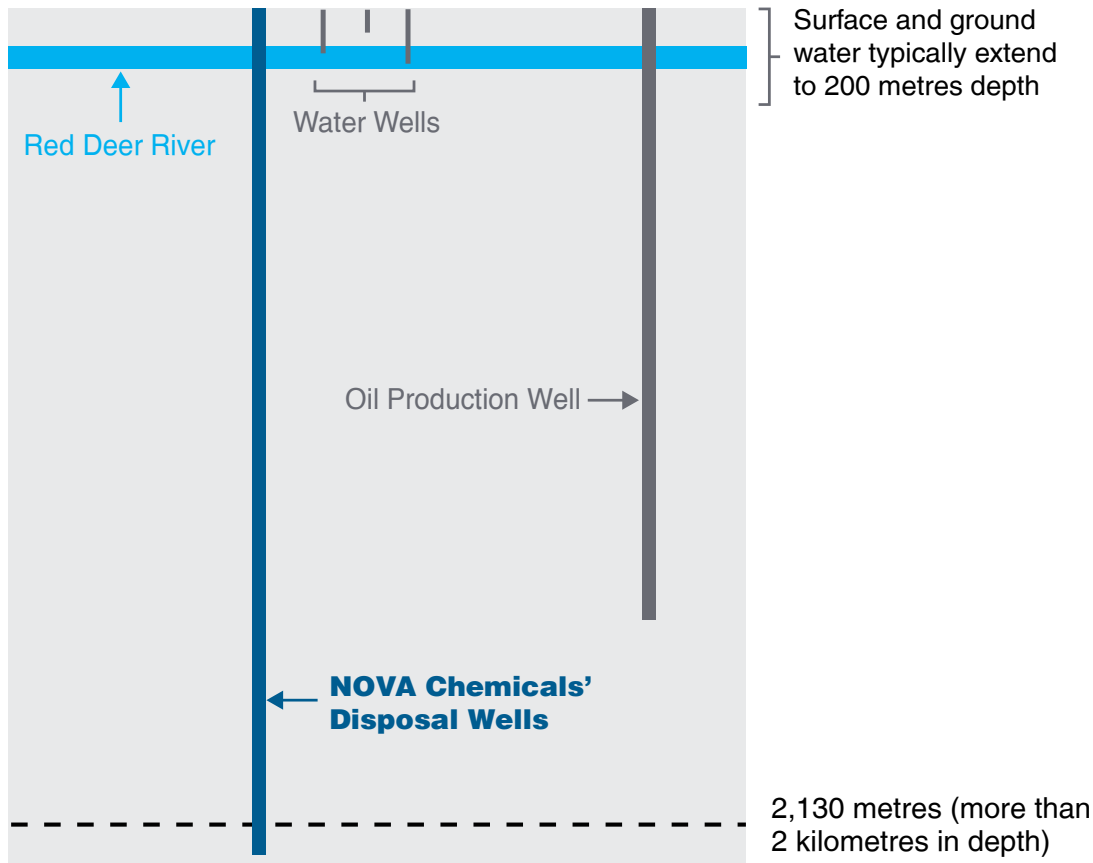
The current system and new disposal well are covered by existing site emergency response plans and are within the existing emergency planning zone.

Additional Regulatory Requirements

We received regulatory approval to drill the new well (under AER Directive 056) in September 2016. We expect to make additional regulatory applications this Spring under AER Directive 051 (well design and designation) and Directive 065 (amend the existing disposal scheme approval). This will be done once surface rights holders within 0.5 km of the wellhead and subsurface rights holders within 2.4 km are formally notified.

We expect the regulatory process to be complete in 2017. Assuming all necessary approvals are received, the new disposal well will be operational in 2017.

No amendment to the Joffre Site's Operating Approval with Alberta Environment and Parks was required, nor were Development Permits with Lacombe County.



Simplified bedrock cross-section showing the disposal well system is more than 10 times deeper than surface and groundwater sources.

Disposal System Integrity and Groundwater Monitoring

We are fortunate the geology below the Joffre Site is favourable for deep well injection. It has provided a proven and reliable method of disposal. There have been no impacts from the existing caustic well disposal system at the Joffre Site.

The new disposal well is part of a system with proven integrity:

- At a depth more than 2,130 m, the wells are much deeper than groundwater levels (typically accessed at less than 200 m depth in the Joffre area).
- Steel casing, cemented in place, extends to the bottom of both wells in the shale zone where injection of the waste caustic stream occurs.
- We conduct daily and annual testing to ensure there is no leakage. We provide the AER regular testing reports.
- NOVA Chemicals has an extensive groundwater monitoring program with wells at varying depths around the site.

