Alberta Energy Regulator

Canadian Natural Resources Limited

Application for Disposal
Lloydminster Field

July 28, 2014

ALBERTA ENERGY REGULATOR
Decision 2014 ABAER 008: Canadian Natural Resources Limited, Application for Disposal, Lloydminster Field

July 28, 2014

Published by

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ALBERTA ENERGY REGULATOR
Calgary Alberta

CANADIAN NATURAL RESOURCES LIMITED
APPLICATION FOR DISPOSAL **2014 ABAER 008**
LLOYDMINSTER FIELD **Application No. 1774949**

DECISION

[1] The Alberta Energy Regulator (AER) approves Application No. 1774949. In reaching its decision, the AER has considered all relevant materials constituting the record of this proceeding, including the evidence and argument provided by each party. Accordingly, references in this decision to specific parts of the record are intended to assist the reader in understanding the AER's reasoning on a particular matter and do not mean that the AER did not consider all relevant portions of the record with respect to that matter.

INTRODUCTION

Application

[2] Canadian Natural Resources Limited (CNRL) applied to the AER under section 39(1)(c,d) of the *Oil and Gas Conservation Act* for approval to dispose of both produced and saline water—classified in *Directive 051* as a Class II material—into the Dina Formation through its 00/03-17-051-02W4/3 (3-17) well.

Background

[3] CNRL received approval on August 21, 2012, to drill its 3-17 well. CNRL originally planned to dispose into the Dina Formation at its 3-17 well. As a result of receiving concerns from Ener T Corporation (Ener T) about these plans, CNRL modified its plan and applied to the AER (Application No. 1749907) on January 3, 2013, requesting approval to dispose into the Moberly and Cooking Lake formations instead. This application was approved by the AER on April 23, 2013.

[4] CNRL subsequently submitted the subject application on October 2, 2013, requesting approval to dispose into the Dina Formation through the 3-17 well as a result of the poor injectivity it encountered in the Moberly and Cooking Lake formations.

[5] CNRL submitted that its application meets AER requirements because the proposed Dina disposal zone is not in a hydrocarbon pool or an associated aquifer and is more than 1.6 kilometres (km) from any potentially affected hydrocarbon pools. It added that the disposal zone is isolated from adjacent producing horizons by cap rock, is porous and permeable, and is laterally extensive.

[6] The AER received a statement of concern from Ener T regarding this application.

[7] Ener T submitted that there would be direct and adverse impacts on Ener T's ability to dispose into its AB/16-07-051-02W4/4 (AB/16-7) well, which is in close proximity to the 3-17 well. Ener T submitted that CNRL's disposal into the Dina Formation at the 3-17 well could lead to the reservoir being saturated or over-pressured at an accelerated rate. As a result, this would lead to Ener T requiring higher pressures to inject into the Dina Formation and may reduce the amount of disposal fluids it could inject into the reservoir.

[8] The AER issued a notice of hearing to request participation from interested parties on February 3, 2014. The AER received a request to participate from Ener T. The AER granted full participation rights to Ener T, including the right to file written submissions, make representations and arguments orally, and question CNRL witnesses.

[9] The AER issued a notice of scheduling of hearing on March 19, 2014, giving notice that it would hold a public hearing of the application in Calgary, Alberta, commencing May 15, 2014.

[10] The public hearing started on May 15, 2014, and ended on May 16, 2014, before hearing commissioners R. C. McManus (presiding), A. H. Bolton, and J. Preugschas. Those who appeared at the hearing are listed in Appendix 1.

[11] At the end of the hearing, Ener T was required to complete a number of undertakings. The undertakings were subsequently completed and rebuttal evidence was filed by CNRL. As there were no further outstanding matters, the hearing panel closed the hearing on May 29, 2014.

ISSUES

[12] When considering any application under an energy resource enactment, such as the *Oil and Gas Conservation Act*, the AER considers the application's adherence to AER requirements; the environmental, social, and economic effects of the proposed energy resource activity; and the impacts on landowners from use of their land for that activity.

[13] In determining whether the application should be approved, and noting the concerns of Ener T, the panel focused its review on the following issues:

- the need for additional disposal capacity,
- the evaluation of alternative disposal zones,
- the capacity of the Dina Formation for injection fluids, and
- the potential for adverse effects on Ener T's AB/16-7 well.

THE NEED FOR ADDITIONAL DISPOSAL CAPACITY

[14] CNRL submitted that hydrocarbon production in the area is associated with high water cuts (high volume of produced water associated with the oil production). Its current and planned hydrocarbon production can only continue if CNRL can establish enough capacity to handle the disposal of the produced water.

[15] As an example of its need for additional disposal capacity, CNRL referenced its 00/15-32-052-01W4/0 (15-32) well, which was recently reactivated. Associated with the oil production from the 15-32 well (as of February 2014) is 261 cubic metres per day (m^3/d) of water. CNRL's requirements for water disposal have continued to increase. CNRL stated that its existing requirements are between 1200 to 1500 m^3/d, and it is looking for more volume than that. Any restriction on injection capacity restricts CNRL's ability to test and demonstrate further resource development in and around the area.

[16] CNRL explained that it currently has wells shut in because of the lack of disposal capacity in the area and is constantly moving the disposal fluid around the area to injection wells that can take the fluid. CNRL is limited on its upside development and therefore does not do oil development projects because of the lack of injection capacity. CNRL submitted that without additional disposal capacity it would be unable to maximize its oil recovery from the pools in the area that produce at high water cuts. CNRL explained that it is very active in the area and expected that its past activity levels will be equaled in the future.

[17] CNRL stated that since April 2013, it has been injecting into the Moberly and Cooking Lake formations in the 3-17 well at an average rate of 330 m^3/d. CNRL said this was significantly less than the anticipated injection rates for these zones and that it has not been able to achieve the injection rates needed to dispose of its produced water from its oil operations in the area. CNRL confirmed that 870 m^3/d would be sufficient to meet its current disposal requirements in the area but noted its disposal capacity requirements change over time as development increases in the area. As a result of poor injectivity into the formations, CNRL proposes to abandon both the Cooking Lake and Moberly formations and to use the Dina Formation as the new disposal zone in the 3-17 well.

[18] Ener T did not contest CNRL's need for additional disposal capacity; its view was that CNRL has an insatiable need for water disposal. It noted that CNRL is seeking as much disposal capacity as possible to maximize its hydrocarbon production in the area. Ener T believes that small operators in the area, such as itself, will need to compete for disposal and that the continuously increasing disposal needs of CNRL, including the proposed disposal volumes at 3-17, would accelerate an over-pressured "saturated" reservoir situation.

[19] As part of addressing its need for additional disposal capacity, CNRL evaluated its options for increasing water disposal capacity other than the 3-17 injector. These options included re-entering and converting an existing well, drilling a new well, building a new water handling facility, using third-party water disposal, and using produced water in enhanced oil recovery operations. However, CNRL explained that because of field logistics and economic reasons, as well as potential environmental concerns, the Dina interval in the 3-17 wellbore was chosen as the preferred option.

[20] The panel acknowledges that CNRL has productive oil wells that are shut in due to insufficient produced water disposal capacity. It accepts that CNRL's ability to fully exploit and maximize the recovery of oil reserves from its land holdings in the area will be constrained if additional water disposal capacity is not obtained. The panel therefore finds there is sufficient evidence to support CNRL's need for additional disposal capacity in the area.

THE EVALUATION OF ALTERNATIVE DISPOSAL OPTIONS

Location of 3-17 Well

[21] Ener T submitted that CNRL chose the location of the 3-17 well with the intention of eventually disposing into the Dina.

Subsurface

[22] Ener T stated that CNRL's selection of the 3-17 location was based solely on there being a Dina Formation anomaly at that location. CNRL submitted that the 3-17 bottomhole target intervals were chosen in order to evaluate the deeper porous carbonate strata of the Moberly and Cooking Lake formations in addition to the thick and extensive Dina sandstone reservoir of the Lower Mannville Group. It further submitted that the Dina zone was never ruled out as a possible future uphole target for disposal injection, if and when it was required. CNRL also submitted that targeting the thickest part of the Dina sand has never implied that the areal extent of the Dina is limited to that area; it is related to reservoir contact and thickness, which was successfully proven by the openhole logs for the 3-17 well. CNRL stated that the location of the 3-17 well did maximize disposal formations that CNRL encountered, including the Moberly, Cooking Lake, and Dina formations.

[23] CNRL added that the 3-17 bottomhole location was chosen in an effort to avoid the offsetting Sparky reservoir in the 04-17-051-02W4 (4-17) well. It noted that CNRL does not target formations for disposal where there would be a conservation issue.

[24] CNRL confirmed that its practice was to drill on seismic lines whenever possible. CNRL referred to seismic line MAR94-49, which intersects its 3-17 location, in addition to a synthetic at 3-17, which was generated from sonic and density logs. It stated that, for the area, 3-17 offers the best synthetic, and the seismic line is of the highest quality. CNRL explained that the 3-17 well penetrated the Paleozoic surface, which is a consistent marker in the area, therefore providing a good tie-in for the geophysical data.

[25] Ener T acknowledged that CNRL did not want to drill through the Sparky oil zone and therefore drilled the well from 4-17 to a subsurface location at 3-17. However, it was Ener T's position that there is no basis under which drilling through the Sparky oil zone would compromise the Sparky oil itself.

Surface

[26] CNRL submitted that in addition to the 3-17 well being more economically feasible for CNRL as it was already drilled, the 3-17 well also minimized surface disturbance by eliminating the need to drill an additional well. CNRL explained that it had consulted with the landowner to determine the optimal location for the lease, which required slant drilling from the 4-17 surface location to the 3-17 bottomhole location.

[27] CNRL further submitted that it has in place a facility and pipeline in the area, which means no additional surface disturbance would be necessary to transport the disposal fluids to the 3-17 well. Furthermore, CNRL was of the view that disposing produced water into the 3-17 well

was the timeliest way to develop the local oil resource. It added that a new disposal well would likely increase the potential for landowner and environmental concerns.

[28] As this is an application to change the subsurface injection zone in CNRL's existing 3-17 well, the panel finds that there will be no significant social or environmental effects if this application is approved. Furthermore, the panel notes CNRL's evidence that it consulted with the landowner when determining the surface location of its well, and the panel is satisfied that there will be no effects on the landowner if CNRL's application is approved. Its application appears to minimize the effects on the landowner by eliminating the need for additional surface impacts of a new well or additional facilities.

Evaluation of Alternative Injection Locations

[29] CNRL submitted that it examined alternative locations in the area for injection of its disposal fluids. CNRL indicated that it considered disposing into other existing well locations. CNRL referenced wells 09-18-051-02W4 and 16-18-051-02W4, which were abandoned; it stated that its confidence in the casing integrity was diminished and that a new well would have an improved chance of ensuring containment.

[30] Ener T acknowledged that CNRL did not wish to re-enter the existing well at 16-18 due to its age and casing integrity but stated that CNRL did not consider drilling a new disposal well at 16-18 where the pipeline has already been installed.

[31] The panel acknowledges that CNRL had alternative injection locations available to conduct additional disposal operations. However the panel notes the existing wells reviewed may have wellbore integrity issues and that injecting into a new well, such as 3-17, will minimize risk with regards to containment.

Evaluation of the Moberly and Cooking Lake Formations

[32] CNRL stated that numerous stimulations had been conducted on the Moberly and Cooking Lake formations in the 3-17 well to maximize injectivity potential into these formations. CNRL reported that there had been three attempts to stimulate the Moberly and Cooking Lake formations: an acid treatment on December 6, 2012; a foam cleanout on May 6, 2013; and another acid stimulation on June 5, 2013. CNRL submitted that it had performed sufficient and adequate stimulations to maximize injectivity and was of the view that injection rates were limited by the injection capacity of the formation and not related to any near-wellbore damage, facility, or wellbore integrity issues.

[33] The panel notes that the three different types of acid treatments to the Moberly and Cooking Lake formations were unsuccessful in achieving the injection rates desired by CNRL. The panel is of the view that CNRL made reasonable efforts to enhance injectivity in the Moberly and Cooking Lake formations.

Evaluation of the General Petroleum Member (GP)

[34] Ener T submitted that CNRL had not made sufficient efforts to evaluate the GP for its disposal potential. Ener T summited that the GP is more than adequate for disposal. It stated that the GP is an established disposal zone with significant aerial extent and high porosity and

permeability, comparable to the Dina. Ener T added that the GP is a true regional sand, rarely varying from its approximate 6 m thickness.

[35] Ener T stated that there were no relevant hydrocarbon occurrences within the prescribed distance that would restrict injection into the GP at 3-17. Ener T indicated that, alternatively, CNRL could have drilled a GP disposal well at the location of its AB/07-18-051-02W4/0 facility that would have not compromised anyone.

[36] In contrast, CNRL stated that the GP was not a primary zone to dispose into due to its oil-bearing nature and that it is not a proven disposal zone as compared to the Dina, Moberly, and Cooking Lake. For example, there are more than 300 wells in the region that are disposing into the Dina.

[37] CNRL referenced a zone in the 3-17 well at a depth of 551.3 to 577.5 m and stated it was an oil-bearing Sparky channel where the GP had been removed. CNRL added that the zone was considered for disposal but dismissed because of its oil-bearing nature.

[38] Ener T stated that there is a GP interval present in the 3-17 well which occurs from a depth of 606.5 to 613 m.

[39] The panel notes that the GP interval referred to by Ener T is located within the Lloydminster Member and not the GP, according to the tops marked on exhibit 20, Ener T's geological cross-section. In this instance, the panel finds that Ener T's evidence contradicts itself.

[40] The panel acknowledges that CNRL and Ener T have different geological interpretations of the GP and Sparky members. However, regardless of the nomenclature, if a zone is oil bearing in a particular well, as appears to be the case at the 3-17 well, it would not typically be approved for disposal. The panel therefore finds that CNRL's decision to apply for disposal into the Dina Formation in the 3-17 well is reasonable.

THE DINA FORMATION

Geological Interpretation

[41] Ener T submitted that the Dina reservoir into which its AB/16-7 well injects disposal fluids has limited capacity to absorb the additional injection fluids from CNRL. It submitted that at this location the Dina sand was deposited along a narrow channel incised into the Paleozoic surface. It further stated that the Dina channel sand in this area is isolated from the regional Dina Formation and would act as a closed system with limited volume.

[42] In contrast, CNRL interpreted the Dina sand to be a series of extensive interconnected fluvial sand bodies. CNRL submitted its regional net sand map which was based on applying a 70 API gamma ray cutoff to digital logs to support its interpretation that the Dina sand is extensive throughout the area, thinning and thickening on the Paleozoic erosional unconformity, but always present. CNRL agreed that there is some variability on a local scale; however, over a broad region, the Dina Member aquifer behaves like an open system.

[43] Ener T submitted that there are reservoir continuity differences within the Dina, that sands occur in different sections of the Dina, and that it is not always a contiguous sand body, even within a localized area.

[44] Ener T argued that CNRL's regional interpretation and mapping of the Dina sands was based on limited digital logs, uses a generous sand cutoff of 70–75 API, and that it contradicts actual well logs. An example is given for the C0/13-30-050-01W4/0 (13-30) well, whereby the mapping indicates 20 m of sand thickness, compared to 5 m, on well logs.

[45] In a comparison of well logs, Ener T spoke to the variability at 00/16-21-051-02W4/0 (16-21) as having some isolated sands along with silts and shales, in contrast to the extensive sands seen at the 3-17 well, or the sand at 02/06-16-051-02W4/0 (6-16) juxtaposed with the shalier portion at 16-21. Ener T noted the lack of wells that penetrated the Paleozoic surface and therefore the inability to make an assertion as to how much Dina sand there is at those locations.

[46] CNRL submitted that its Dina net pay map shows there to be approximately 40 m of sand at the 3-17 location, indicating that the Dina is a vast and extensive sand body that can handle large volumes of injected fluids. CNRL further stated that the Dina is a regionally extensive, non-hydrocarbon-bearing aquifer in the area of interest that is an ideal candidate for wastewater disposal.

[47] CNRL referenced six wells on its structural geological cross-section: three active Dina disposal wells, one historic Dina disposal well, and two stratigraphic tests with openhole wireline logs (00/12-30-050-01W4, C0/13-30-050-01W4, A2/01-12-051-02W4, 00/13-16-052-02W4, 00/16-21-051-02W4, and 00/09-04-052-02W4, respectively). CNRL stated that the wells show the Dina to be a thick and continuous zone.

[48] CNRL also referenced an additional eight well locations for which there were sonic and density logs through the Dina: 00/07-28-051-02W4, 00/10-20-051-02W4, B0/03-17-051-02W4, 02/06-16-051-02W4, 00/16-21-051-02W4, A0/07-15-051-02W4, 00/05-10-051-02W4, and 00/16-18-051-03W4. CNRL stated that within a 40 square mile area, these eight wells logs, with seismic data and synthetics, were used to create the geophysical mapping.

[49] The panel accepts Ener T's interpretation that localized barriers may exist in the Dina sand and that the quality of those sands may be variable. However, the panel finds that the limited geological evidence provided by Ener T does not support its interpretation that the Dina is a narrow channel sand that would act as a closed system. Ener T also did not provide persuasive geological evidence that localized barriers exist in the area of the 3-17 and AB/16-7 wells.

Seismic Interpretation

[50] Ener T stated that its delineation of the Dina channel sand is based on sound seismic principles and that CNRL's interpretation that the Dina sand is regionally present is not supported. Ener T submitted that 3-D seismic data are inherently far superior to 2-D data in terms of lateral continuity and leaves little room for interpretation in terms of contouring.

[51] Ener T also submitted that seismic defines a northeast-trending channel that is restricted to 250 m in width. It explained that the trend of the channel, as seen on its 3-D seismic data and the

isochron thickness from the CNRL 2-D seismic data, suggests that the 3-17 and the AB/16-7 penetrate the same Dina reservoir.

[52] CNRL submitted that extensive 2-D data in Township 51, Range 2, West of the 4th Meridian, indicate that the Dina sand is thick throughout the area and does not thin to zero pay. CNRL further stated that the Dina sand is present in a very large areal extent, and while the seismic shows thicks and thins, it never shows a zero. However, CNRL admitted that the only location it was able to interpret the sand thickness was at 3-17, where there were sonic and density logs, in addition to the seismic.

[53] Ener T stated that regional seismic has its limitations, particularly in two-dimensional seismic when contour lines are totally discretionary, and that CNRL's declaration that the Dina sand is everywhere is not seismically supportable. When referring to the Dina thickness, Ener T stated that seismic can resolve the thickness of the entire package but that it cannot resolve the sand or its quality, and certainly cannot resolve zero pay. Ener T suggested that to resolve a sand, at least 3 m of sand is needed, with a strong contrast to the zones around it.

[54] CNRL submitted that its map of the Cummings to Paleozoic isochron showed a thick isochron value on line MAR94-49, as well as being structurally high on the Cummings. It further submitted that its synthetic seismogram from 3-17 shows that the Dina is resolved on line MAR94-49 and is a thick sand. CNRL explained that the sonic data obtained while logging the 3-17 well closely match the seismic data along which the well was drilled and indicates a reasonable estimation of formation thicknesses.

[55] In the panel's view, CNRL's evidence is more comprehensive in its assessment of the Dina given that Ener T provided limited seismic evidence based on a single seismic line and only localized mapping of the Dina Formation.

Hydrogeology

[56] CNRL stated that its hydrogeological evidence shows that there is a strong hydrodynamic connection over a large area. It added that CNRL's regional hydrogeological map of the Dina Formation depicts a low hydraulic gradient indicative of a continuous aquifer with large regional permeability. CNRL explained that in a fluvial system there is a possibility of local variation; however, there is meandering, and the hydrodynamic section shows that the Dina is an extensive reservoir across many townships and ranges. CNRL submitted that its hydrodynamic study supported its view that the Dina Formation is an ideal candidate for water disposal.

[57] CNRL presented the hydrogeological mapping of the Dina aquifer in the area of the proposed 3-17 injector. Two attachments were presented: the hydraulic head distribution map and a pressure vs. elevation graph. CNRL stated that the data are indicative of a continuous aquifer with large regional permeability.

[58] Although Ener T did not provide any hydrogeological evidence, it acknowledged that CNRL's hydrodynamic study was based on limited drillstem test results, as very few companies run drillstem tests in water-laden zones.

[59] The panel acknowledges that the hydrogeological maps submitted by CNRL support its interpretation of the Dina Member aquifer as regionally extensive; however, the panel finds the maps do not provide conclusive evidence on connectivity of the Dina aquifer locally in the subject application area.

Reservoir Continuity/Capacity

[60] The panel agrees with CNRL's statement that the Dina sands in the area represent a series of extensive interconnected fluvial sand bodies. It also recognizes that although the sand may thicken and thin on the Paleozoic erosional unconformity, the evidence presented demonstrates that it is almost always present and therefore more likely to be interconnected.

[61] The panel notes that Ener T's seismic evidence was not accompanied by adequate geological evidence using available well log data as Ener T did not tie its well logs into its synthetic. In contrast, CNRL provided multiple lines of evidence to support its view of a regionally extensive Dina sand. CNRL's seismic interpretations included two 2-D seismic lines as well as supporting geological and hydrogeological evidence to support its interpretation that the Dina Formation is regionally extensive in the area.

[62] Based on the geological, seismic, and hydrogeological evidence submitted by both parties, the panel interprets the Dina reservoir to be more likely open and regionally extensive, as opposed to a limited closed system.

THE POTENTIAL FOR ADVERSE EFFECTS ON ENER T'S AB/16-7 WELL

Ener T's Operations

[63] Ener T submitted that CNRL's proposed disposal at the 3-17 location will have a detrimental effect on its operations. Ener T explained that it is a private company involved in oil and gas operations in Alberta. It has been in business for over 10 years and the AB/16-7 facility and oil production in the area represents virtually all of its assets.

[64] Ener T argued that it is not in the public interest to allow a large operator such as CNRL to effectively "wash out" a small operator's operation. It also argued that it is not in the public interest to allow large operators like CNRL to select disposal locations that have been established by small operators to be effective disposal zones and drill its well in the same zone and vicinity as the small operator with no consideration of the effects. Instead, Ener T submitted that it is in the public interest to reward people that "get somewhere first" and "incur the risk and the cost of drilling into a certain area."

[65] Ener T questioned that if there is no buffer zone around its AB/16-7 well, what is to prevent a large producer coming in and drilling in the exact same zone being used by a small producer. Ener T suggested that a restriction is necessary and within the AER's mandate. It suggested that the panel impose a 1.6 km buffer.

Injection Pressures at CNRL's 02/06-16 Disposal Well

[66] Ener T submitted that injection into CNRL's 02/06-16-051-2W4/0 (02/6-16) disposal well is contributing to higher volumes and pressures in the reservoir. Ener T also stated that injection pressure issues at the 6-16 well could be indicative that the Dina is limited in areal extent. It explained that the injection pressure issues at the 02/6-16 well demonstrates the potential for similar effects that CNRL's 3-17 well could have on Ener T's AB/16-7 well if it were permitted to inject into the Dina. Since the AB/16-7 well and the 3-17 well are in close proximity, approximately 1000 m from one another, Ener T stated that it is possible that the impacts to the AB/16-7 well could be compounded by CNRL's disposal into the 3-17 well.

[67] CNRL submitted that the injection pressure issues at the 02/6-16 injector were attributable to a near-wellbore pressure drop from skin effects and do not represent a reservoir pressure issue. The reservoir pressure increase at the 02/6-16 was at most ~1200 kilopascals (kPa) despite 1 360 000 m^3 of water disposed into the Dina Formation in that well.

[68] Ener T reported that currently approximately 450 m^3 of fluid is being injected through Ener T's AB/16-7 disposal facility at about 5000 kPa. The current excess injection capacity in the disposal facility is estimated to be approximately 150 to 200 m^3/d of fluid. Ener T submitted that less than 10% of the volume currently injected is associated with oil production from wells operated by Ener T, while the remainder is from third-party operators.

Other Injection Operations into the Dina

[69] CNRL used the analogy of the 00/12-30-050-01W4 (12-30) and the C0/13-30-050-01W4 (13-30) wells to illustrate that wells in close proximity can dispose into the Dina Formation without impact.

[70] CNRL reported that these wells are only 464 m apart and that more than 10 million m^3 of water has been injected through these wells. CNRL submitted that this example demonstrates that disposal injection into the Dina Formation by wells in close proximity can occur without adverse impacts.

[71] Ener T used the same example to support its view that injection by wells in close proximity can result in adverse effects to injection operations. Ener T presented two graphs labeled "Injection by Husky into 00/12-30 and C0/13-30-050-01W4 into the Dina overlain on one plot" and "Injection History of 02/06-16-051-02W4 with Ener T comments," and submitted that the injection performance in 12-30 had been affected by the offsetting injection in 13-30. Ener T submitted that the injection rate declined in the 12-30 well following the commencement of injection into the 13-30 well.

[72] CNRL pointed out that without the associated pressure data, it was difficult to interpret these plots in the manner suggested by Ener T.

Potential for Adverse Effects to Ener T's Injection Operations

[73] The panel notes that Ener T requested that there be a prescribed distance of 1.6 km between Ener T's AB/16-7 well and CNRL's 3-17 well. It stated that this distance would ensure that no adverse impacts could occur to Ener T's well. In final argument, CNRL responded that to

its knowledge there is no such regulation in place at the time that addressed the concept of a subsurface buffer zone around produced water disposal wells.

[74] The panel notes that the AER's regulations do not restrict the distance between disposal wells. The AER's *Directive 065* does provide that notification of a disposal application is to be given to unit operators, approval holders, well licensees, mineral lessees and lessors, and landowners within a 1.6 km radius of a proposed disposal well where the disposal zone is known to be present.

[75] The panel notes the evidence provided by CNRL regarding injection operations at the 12-30 and 13-30 wells. The case study demonstrates that injection can occur at wells in close proximity without adverse effects. This suggests to the panel that at least in some areas, the Dina has a high capacity to receive injection volumes. This case study, combined with CNRL's regional analysis, suggests that the risks of CNRL's proposed injection on loss of injectivity at the AB/16-7 well or saturation of the Dina Formation are low.

[76] Ener T relied upon evidence of reservoir pressure increase and lost injectivity into the 02/6-16 injector to support its view that the Dina reservoir is of limited size. Ener T also provided geological and seismic evidence for the area immediately surrounding the AB/16-7 and 3-17 wells. However, the panel is of the view that the evidence was not sufficient to show that the Dina is of limited extent or that local barriers exist. Accordingly, the panel finds that the Dina reservoir should be able to accept disposal fluids from both Ener T and CNRL's wells and that CNRL's proposed injection into the Dina at the 3-17 well should not adversely affect Ener T's AB 16-7 disposal well.

[77] The panel is of the view that the AER's regulatory requirements should allow both CNRL's and Ener T's disposal operations to coexist. Although any impacts to Ener T's AB/16-7 disposal well are unlikely, they would be reduced by the maximum wellhead injection pressure (MWHIP) assigned. The amount of water that CNRL will be able to inject will be limited by a default MWHIP of 3600 kPa, as assigned by table 1 in appendix O of *Directive 065*. The default wellhead pressures in table 1 are based on statistical analysis of province-wide fracture data. Appendix O states "the fracture pressure used to calculate the wellhead pressures is conservative and based on a confidence level at the 90th percentile that injection at this pressure will not fracture the formation."

[78] The panel notes that the default MWHIP may change if CNRL submits a subsequent *Directive 65* application requesting an amendment to the current MWHIP. In that case, CNRL will be required to submit sufficient step-rate injectivity test data or analogous test data supporting the proposed new injection pressure.

CONCLUSION

[79] The panel finds that the evidence in this proceeding does not support Ener T's view that injection into the Dina Formation at the 3-17 location will result in significant adverse effects to the ongoing disposal at the Ener T AB/16-7 well. While the potential for some effects to Ener T's injection operations at AB/16-7 cannot be ruled out, the panel concludes that the potential for adverse impacts to the Ener T's disposal at the AB/16-7 well is low and would be mitigated by the MWHIP limitation assigned to the 3-17 well.

[80] The panel notes that additional oil production can be brought on by CNRL if it secures additional disposal capacity for its produced water, and this additional oil production will provide a benefit to the province in the form of royalties to the Government of Alberta. Given that the panel has found the risk of adverse impact to Ener T's AB/16-7 well to be low, the panel finds there to be a positive net benefit, if the application is approved.

[81] Having considered the alternatives and the capacity of the Dina; the economic, social, and environmental effects of the applied-for disposal well; and the effects on the landowner, the AER hereby approves CNRL's application to dispose of Class II fluids into the Dina Formation through the 3-17 well.

[82] The Moberly and Cooking Lake formations will be rescinded as the approved disposal zones and replaced with the Dina Formation.

[83] Before CNRL can begin disposal into the Dina Formation in the 3-17 well, a *Directive 051* application must be submitted to the AER. *Directive 051* includes the requirements for wellbore design, wellbore integrity logging, operational monitoring, and reporting requirements for injection and disposal wells, which will ensure that the 3-17 well meets the requirements for disposal into the Dina zone.

Dated in Calgary, Alberta, on July 28, 2014.

ALBERTA ENERGY REGULATOR

<original signed by>

R. C. McManus
Presiding Hearing Commissioner

<original signed by>

A. H. Bolton, P.Geo.
Hearing Commissioner

<original signed by>

J. Preugschas
Hearing Commissioner

APPENDIX 1 HEARING PARTICIPANTS

Principals and Representatives (Abbreviations used in report)	Witnesses
Canadian Natural Resources Limited P. McGovern, Counsel	M. Skipper C. McColl N. Orr G. Webb K. Huey
Ener T Corporation P. Anic, Counsel	B. Tobman D. Stewart P. Malenica
Alberta Energy Regulator staff B. Kapel Holden, AER Counsel L. Stubbs-Adeloye A. Zemlak B. Lawrence E. Armeneau G. Swiatylo P. Trinh R. Pelletier (Pelletier Geophysical Inc.)	

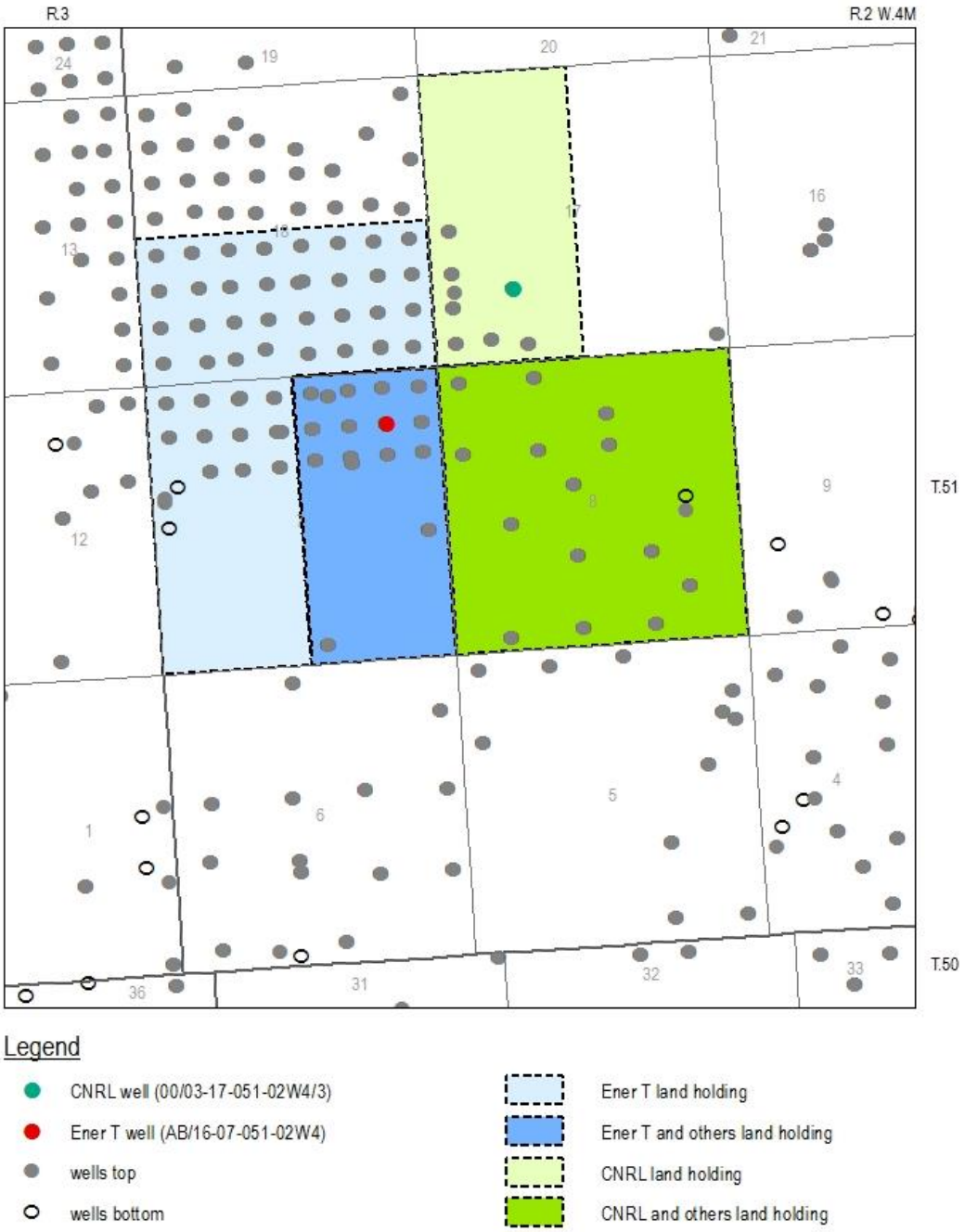

Figure 1. Map of application area.