



Report of Recommendations on Odours and Emissions in the Peace River Area

March 31, 2014

ALBERTA ENERGY REGULATOR

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EXECUTIVE SUMMARY

An Alberta Energy Regulator (AER) panel of Hearing Commissioners (the Panel) has conducted an inquiry into concerns from area residents about odours and emissions from heavy oil operations in the Peace River area. The Panel has prepared its report, which includes the following key findings and recommendations:

- Odours caused by heavy oil operations in the Peace River area need to be eliminated to the extent possible as they have the potential to cause some of the health symptoms of area residents.
- Operational changes must be implemented in the area to eliminate venting, reduce flaring and, ultimately, conserve all produced gas where feasible.
- The AER should establish a localized or “play-based” regulatory approach to heavy oil development in the area given the unique geology and the large volume of odour complaints from area residents related to heavy oil operations.
- A regional air quality monitoring program should be initiated to verify improved air quality and provide stakeholders with relevant data.
- The AER should approve its draft edition of *Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting* and begin taking enforcement action for off-lease hydrocarbon odours.
- The AER should continue to support stakeholder engagement activities and enhance its operational and enforcement presence in the Peace River area.

The AER’s mandate is to ensure the safe, efficient, orderly, and environmentally responsible development of Alberta’s hydrocarbon resources over their entire life cycle. This applies to the development of bitumen resources in the Peace River area.

Oil and gas development has been occurring in the Peace River area since the late 1950s; however, it hasn’t been until the last decade that technological advances have made development of the bitumen in the area economically feasible. Since then, industry activity has increased, as has the volume of odour complaints from area residents. Despite significant multistakeholder efforts to resolve odour and emission problems, the complaints continued.

In July 2013, the AER established the Panel of Hearing Commissioners to conduct an inquiry to examine these concerns and to make recommendations for solutions, including possible operational and regulatory changes. A public process (the Proceeding) was initiated to gather information from area stakeholders and subject matter experts, which included an organizational meeting and an eight-day hearing in Peace River, Alberta. This process is outlined in more detail in appendix 1.

The Panel carefully considered the information it received and has organized its report into the following topics: Geology, Health, Operations, Monitoring, Regulatory, and Stakeholder Engagement. Each topic section sets out the key information received, findings, a desired

outcome, and recommendations. Readers are encouraged to review each section in the report for a full description of the results of the Panel's deliberations.

- **Geology:** The Panel accepts that the bitumen deposits in the Peace River area are significant. The Panel finds that the geology in the Peace River area is unique in that the Gordondale-sourced bitumen deposits produce heavy oil that has higher levels of sulphur and aromatic compounds compared to other areas of the province. The Panel recommends that further study into the geochemistry of the produced heavy oil would be beneficial in more precisely identifying its chemical composition prior to processing.
- **Health:** The Panel's main finding in this section is that odours from heavy oil operations in the Peace River area have the potential to cause some of the symptoms experienced by residents; therefore, these odours should be eliminated. The Panel recommends that further study be conducted to examine linkages between odours and emissions and health effects. The Panel also recommends that Alberta Health ensure that appropriate avenues exist to link local physicians with specialists in environmental health.
- **Operations:** The Panel finds that practical operational measures should be implemented to capture and conserve gas. The Panel recommends that venting should be eliminated and that produced gas should be captured using vapour recovery units (VRUs) within four months in the Reno and Three Creeks areas. The Panel recommends that studies be conducted with respect to the installation of VRUs in the Walrus and Seal Lake areas, as well as into options and timelines for conserving all produced gas in the Peace River area. The Panel also recommends the implementation of measures to minimize odours from trucks, as well as practices to identify fugitive emissions and address them expeditiously.
- **Monitoring and Modelling:** The Panel recognizes that, despite significant efforts to monitor air quality in the Peace River area, there has been little correlation of the results of air monitoring with the odour events reported by residents in the area. There has also been a lack of communication of such results to area residents in a clear and understandable manner. The Panel's main recommendation in this area is to establish a comprehensive and credible regional air quality monitoring program for the Peace River area that will verify, through reliable and accessible data, that the recommended operational changes have improved air quality.
- **Regulatory:** The Panel finds that the current regulatory framework does not effectively manage hydrocarbon odours and emissions in the Peace River area. However, the Panel notes that the AER will soon have new regulatory tools to address hydrocarbon odours from oil and gas operations pursuant to section 116 of the *Environmental Protection and Enhancement Act* and the AER's draft edition of *Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting*, once released. These measures will address the "gap" identified in the current regulatory framework. The Panel recognizes the distinct geologic and geochemical aspects of the Gordondale-sourced bitumen deposits, and recommends a localized or "play-based" regulatory approach to heavy oil development in the Peace River area.
- **Stakeholder Engagement:** The Panel recognizes that although significant stakeholder engagement initiatives have occurred, these efforts were not seen by area residents as being successful in resolving their concerns. Nevertheless, there may be additional opportunities

for better information sharing and improved communications among stakeholders and the Panel recommends that the AER support these initiatives. The Panel also recommends an increased staff presence in the Peace River area to better allow the AER to respond to complaints and discuss concerns directly with residents.

The participation of stakeholders, including area residents, the AER, and industry, was fundamental to fulfilling the Panel's mandate in this Proceeding. Thousands of pages of information were provided and many of the participants took time away from their personal and work lives to participate in the hearing. Looking forward, the Panel is confident that the necessary work will be undertaken to address the recommendations in this report, and that the proposed measures will help resolve many of the concerns of the area residents.

INTRODUCTION

Purpose and Objective

[1] On July 17, 2013, the President and Chief Executive Officer of the Alberta Energy Regulator (AER) provided a written request to the Chief Hearing Commissioner to initiate an inquiry under section 17 of the *Responsible Energy Development Act (REDA)* because of the increasing industry activity and continuing concerns from residents in the Peace River area about odours and emissions from heavy oil operations. The purpose of the inquiry was to examine these concerns and to recommend solutions to address them, including possible operational and regulatory changes. A public process (the Proceeding) was initiated to gather information from area stakeholders and subject matter experts. This process is discussed below and outlined in appendix 1. A summary of the recommendations is in appendix 2.

Energy Development in the Peace River Area

[2] Oil and gas development has been occurring in the Peace River area since the late 1950s (see figure 1). Like other oil sands areas in Alberta, recent improvements in bitumen recovery technologies have opened up more of Alberta's oil sands for development, including oil sands in the Peace River area. A decade ago, using technologies available at that time, this area would have been considered too thin, too deep, or uneconomic for large-scale or long-term bitumen production. Since then, technological improvements have increased the development of oil sands in the Peace River area, increasing by about 20 percent annually. Development in other oil sands areas of Alberta has also grown at a similar annual rate.

[3] Development in the Peace River area primarily targets the Bluesky-Gething deposit, a reservoir found about 600–700 metres (m) below the surface, through vertical and horizontal wellbores. Although this area is referred to as an oil sands area, hydrocarbons are extracted through wells and not by mining, as is done in some other oil sands areas.

[4] Oil resources in the Peace River area are considered “heavy oil,”¹ which is a thick or highly viscous form of crude oil that does not flow easily. Different techniques are used to extract and process this heavy oil from bitumen deposits depending on the characteristics of underground reservoirs. Such techniques include those used in thermal operations that heat the bitumen in situ (in the ground). In the Peace River area, the primary technique used to extract this heavy oil is through cold heavy oil production (CHOP).

¹ Any liquid hydrocarbons produced in Peace River Oil Sands Area 1 from strata between the top of the Peace River Formation and the base of the Gething Formation and in Peace River Oil Sands Area 2 from the strata between the top of the Peace River Formation and the base of the Rundle Group are administratively designated as “crude bitumen.” Liquid hydrocarbons produced outside these strata are designated as “crude oil.” Throughout this report, the term “heavy oil” will be used to refer to both crude bitumen and crude oil.

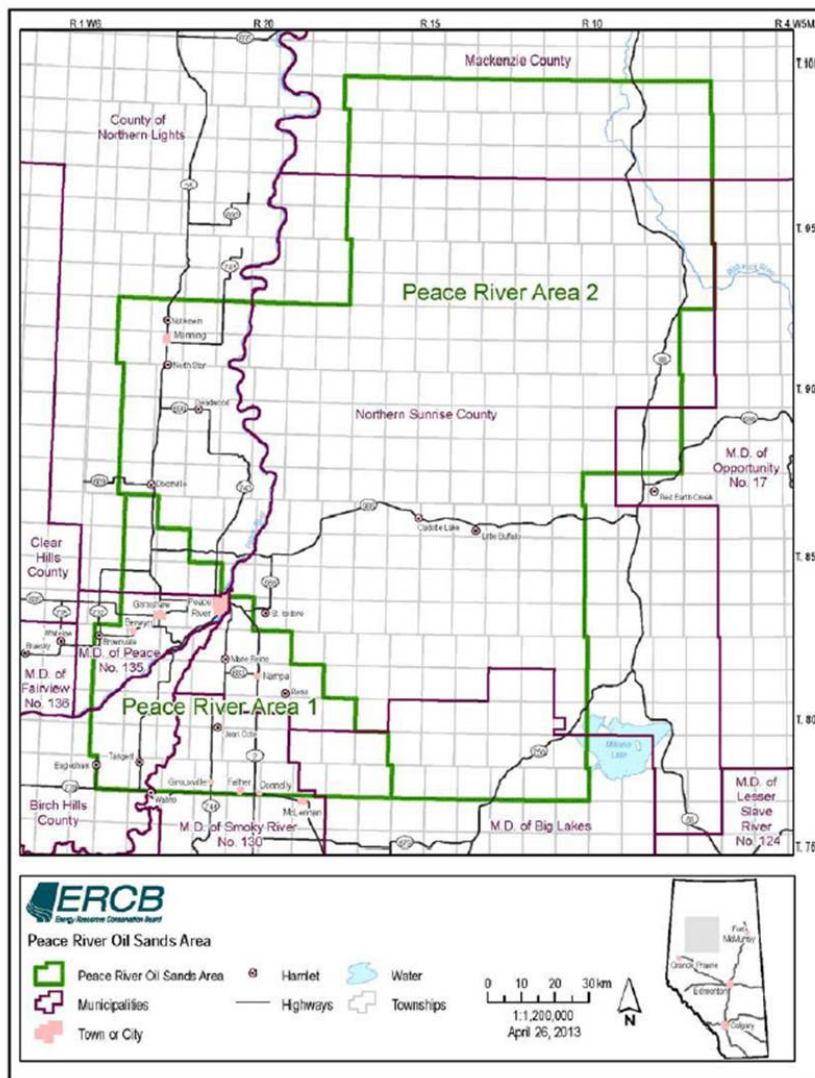


Figure 1. Peace River Oil Sands Areas 1 and 2.

[5] In CHOP operations, oil, gas, water, and sometimes sand are produced from an underground reservoir. The oil is then placed in heated production tanks at the surface before being transported by truck for further processing. Natural gas is also recovered and may either be conserved or be flared, incinerated, or vented. Gas produced from the well casing is referred to as casing gas and gas given off from the heavy oil while in production tanks is referred to as solution or tank top gas. As of November 2013, about 910 (five percent) of Alberta's 18 250 licensed CHOP wells and about 170 (four percent) of its 4325 licensed single- or multi-well batteries were located in the Peace River area. Figure 2 shows the significant increase in hydrocarbon production volumes from the area between 2002 and 2013. Figure 3 shows the specific areas that were considered in the Proceeding: Reno, Seal Lake, Three Creeks, and Walrus. Collectively, these areas are referred to as the Peace River area throughout this report. The facilities in each area are also shown.

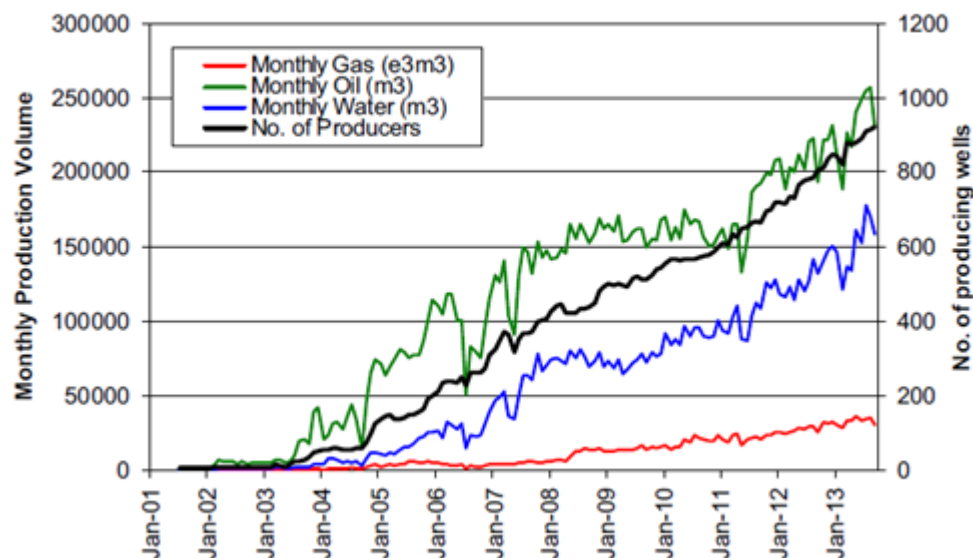


Figure 2. Production volumes from the Peace River area.

[6] Complaints from residents about hydrocarbon odours in the Three Creeks area began to increase in 2009. It was not until February 2010 that these complaints escalated to a high volume. Between January 1, 2009, and November 1, 2013, the AER (formerly the Energy Resources Conservation Board [ERCB])² received a total of 881 odour complaints, of which 715 came from 4 residences. Forty percent of the complaints included statements of human health impact. These 881 complaints represent 80 percent of all odour complaints from areas with CHOP operations in the province.

[7] The AER has also received odour complaints from residents in the Reno area and, to a lesser extent, the Seal Lake area. No complaints have been received from residents in the Walrus area. However, development in this area is primarily on Crown land and the nearest resident is about three kilometres away.

² In the information received in this proceeding, there are various references to the Energy Utilities Board (EUB) and the ERCB, both predecessors of the AER. On June 17, 2013, *REDA* came into force in Alberta. The *Energy Resources Conservation Act (ERCA)*, which established the ERCB, was repealed and the AER was created. In accordance with *REDA*, the AER assumed all of the ERCB's powers, duties, and functions under Alberta's energy resource enactments.

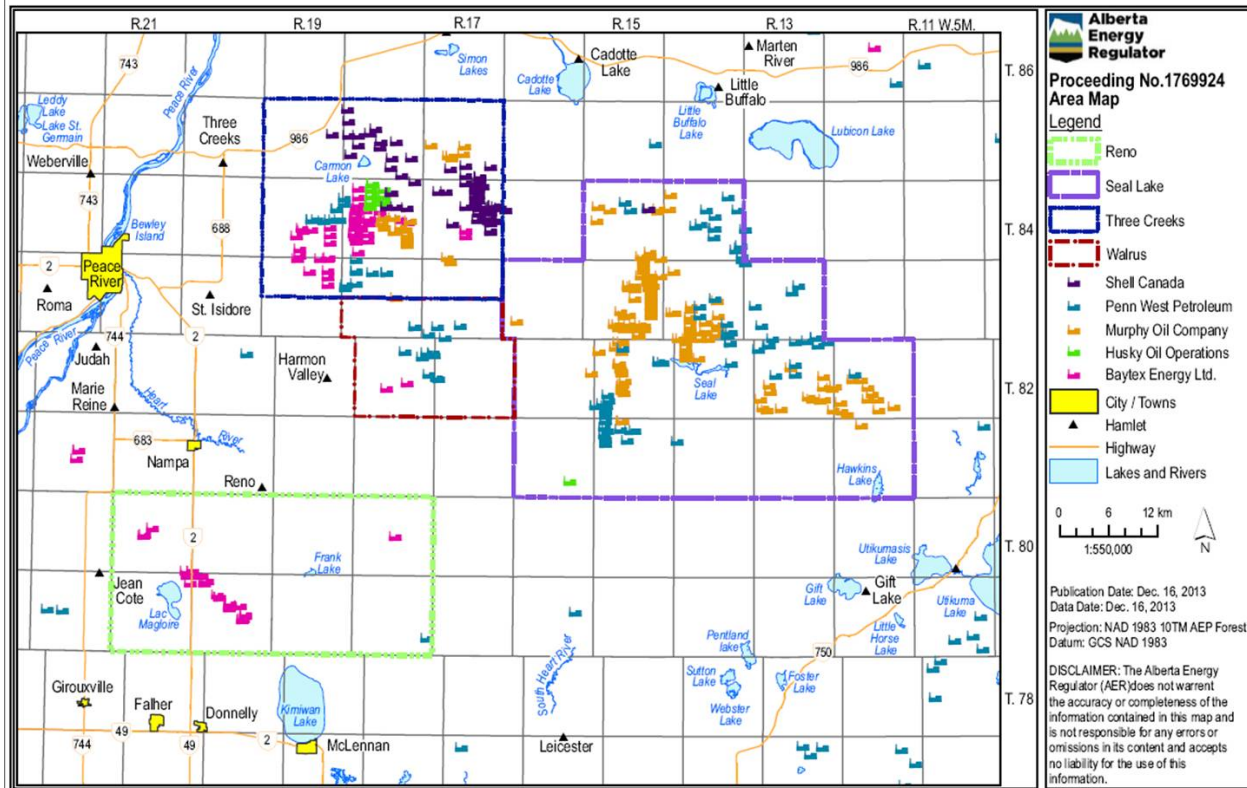


Figure 3. Map of the Peace River area considered in the Proceeding.³

Initiatives to Address Community Concerns

[8] In response to the increasing number of complaints from area residents, the AER began working with other government agencies, operators, and area residents to understand the basis of the concerns and to find and implement solutions. These efforts involved significant time and resources from all participants. While many of the efforts are discussed throughout this report, some are highlighted here to provide a sense of the level of effort and resources expended to pinpoint the cause of the problems and to find appropriate solutions.

- Environmental monitoring:
 - Three air quality monitoring studies were conducted by Alberta Environment and Sustainable Resource Development (ESRD). One of these was completed in collaboration with the Three Creeks Industry Steering Committee Air Quality Working Group.
 - ESRD conducted a soils, water, and snow sampling analysis.
 - Area operators set up four continuous air quality monitoring trailers, of which one was located near residences in Three Creeks. The Peace Airshed Zone Association’s (PAZA’s) mobile monitoring unit was moved into the area. More recently, two

³ For a larger version of the map, see appendix 3.

consulting companies have been engaged to conduct an emissions inventory and emissions characterization study in the Three Creeks area.

- In Reno, Baytex engaged outside consultants to examine emissions from their facilities and to recommend a mitigation program.
- Heavy oil operations:
 - An industry working group, which includes area residents and AER staff, has worked to identify ways to improve operational practices so as to prevent odours and emissions.
 - A road-use group developed a strategy to respond to complaints about the volume of tanker truck traffic.
- AER efforts:
 - Over 3000 investigations in response to complaints.
 - The development of a protocol to respond to odour complaints.
 - The establishment of the Focused Inspection Team to conduct audits and other surveys to pinpoint sources of emissions.
 - The hosting of and attendance at open houses.
 - Attendance at meetings with operators and area residents.
 - Participation on various committees.
 - Participation in provincial initiatives such as the Petroleum Technology Alliance of Canada's Heavy Oil Odour Management Technology and Best Management Practices, the Clean Air Strategic Alliance's *Comprehensive Provincial Framework for Odour Management*, and the AER's draft edition of *Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting*.

[9] As a result of these efforts, changes were made to operations to capture more of the vented gas and other emissions. However, although these changes resulted in significantly more gas being flared or conserved from CHOP operations in the Peace River area, concerns from area residents about odours and emissions persisted.

Process

[10] In response to the request from the AER's President and CEO, a panel of Hearing Commissioners (the Panel) was formed to conduct the Proceeding and provide a report and recommendations for solutions. The Panel members were B. T. McManus (presiding), C. Macken, T. Engen, and R. C. McManus. The Panel began its work by compiling relevant background information and issuing a draft terms of reference for matters that would be within the scope of the Proceeding. The Panel held an organizational meeting on October 7, 2013, in Peace River, Alberta, to hear from area residents, operators, and other stakeholders on both the

scope of and process for the Proceeding. Input from participants was used to finalize the scope, conduct, and timing of the Proceeding.

[11] On October 23, 2013, the AER released the Panel's decision on matters arising from the organizational meeting in *Decision 2013 ABAER 018: Proceeding into Odours and Emissions in the Peace River Area*. The Panel decided that the following matters were within the scope of the Proceeding:

- impacts from heavy oil operation emissions and odours, as expressed in the concerns of Peace River area residents and other local stakeholders;
- relevant expert scientific information about human and animal health impacts from emissions and odours related to heavy oil operations;
- the nature and sources of odours and emissions associated with heavy oil operations, including the transportation of energy resources from these operations, and the monitoring of those emissions in the area;
- existing Government of Alberta and AER policies, initiatives, and regulations relating to flaring, incinerating, venting, and air quality standards to determine if amendments are needed to address odours and emissions from heavy oil operations;
- possible technical and regulatory solutions that address short-term and long-term impacts of odours and emissions from present and future development of heavy oil operations in the area (including current stakeholder initiatives, potential regulation amendments, opportunities for solution gas gathering or conservation, and access to information regarding development in the area);
- potential impacts on licensees and operators of mandating the reduction of emissions from heavy oil operations; and
- specific geographic and geological information about the relevant play within the Peace River area, its reserves, and recovery potential. This would include consideration of potential economic, social, and environmental impacts of the recommendations made by the Panel to the Government of Alberta, local municipalities, the public, industry, and other stakeholders.

[12] The Panel set out a schedule for the Proceeding through which residents, industry, independent experts, and government agencies, including the AER through its staff submission group (SSG), could provide written and oral information on the issues identified within the scope of the Proceeding. The SSG was given its own counsel and functioned independently of the Panel and the AER staff assigned to the Panel to give background information on the record for the review of all the participants. Any party that provided a written submission could also participate in the oral hearing phase of the Proceeding to ask questions and respond to the written submissions. The oral hearing began on January 21, 2014, and concluded, after eight hearing days, on January 31, 2014. Those who appeared at the hearing are listed in appendix 4. Presentations on the issues within the scope of the Proceeding were organized according to topic areas.

[13] The hearing provided an important opportunity for participants and the Panel to hear and ask questions to aid in understanding the information necessary to achieve the Proceeding's objective. Many of the area residents took time away from work and personal lives to attend and participate in the hearing. Of the area operators, Baytex Energy Ltd. (Baytex) and Shell Canada (Shell) fully participated in the hearing. Murphy Oil Company Limited (Murphy), Penn West Exploration (Penn West), and Husky Oil Operations Limited (Husky), who also have operations in the area, did not provide oral evidence and did not make themselves available to respond to questions about their operations. Penn West provided final comments at the hearing. Alberta Health, Alberta Health Services (AHS), Alberta Transportation, Alberta Energy, and ESRD were also requested to participate and many of them filed submissions. However, no agency made itself available at the hearing for questions. The Panel acknowledges the critical contribution of all the participants, particularly that of area residents, Baytex, and Shell, who helped the Panel understand the concerns and operations in the area.

[14] In addition to the information provided by participants, the Panel also considered public reports that fell within the scope of the Proceeding, which were identified and made available to participants. The Panel also retained independent experts to prepare reports on the issues identified within the scope of the Proceeding. The experts were independent of the Panel and its staff and their reports were placed on the public record so that all participants could review and comment on them. This approach also negated the need for participants to retain and fund particular experts. Documents filed on the public record of the proceeding were made available on the AER's website www.aer.ca. Printed copies were also made available to participants at a local government office in the Town of Peace River, Alberta.

Report and Recommendations

[15] This report reviews the topic areas considered during the Proceeding and the Panel's recommendations for solutions to address the concerns of the area residents. The Panel has considered the information that it received during the written and hearing phases of the Proceeding, including the reports of independent experts retained by the Panel. Based on all of this information, the Panel made findings on the matters within the scope of the Proceeding, developed desired outcomes, and reached its recommendations.

[16] For clarity and ease of reading, the Panel has organized its report in accordance with the topic areas presented at the hearing. Each topic area begins with a background on central issues of the topic and a synopsis of what participants said about the topic in their written and oral submissions. This is followed by the Panel's findings for that topic area. In each section, the Panel has also provided a desired outcome on its vision of an ideal or desired, yet still practical, future state. It then makes recommendations about what specific actions are required to address that desired outcome.

[17] The order of topic areas presented in the report and a brief summary of each topic area are as follows:

- **Geology:** This topic describes the geologic and geographic focus of the Proceeding and, based on potential reserve estimates, provides information related to the magnitude and importance of this resource. The topic may also explain why there has been a uniquely high number of complaints and concerns in the Peace River area from residents compared to other areas of the province with similar development.

- **Health Effects:** A primary objective of the Proceeding was to listen to, understand, and find solutions to address residents' concerns. These concerns predominantly related to health effects. The Panel received information directly from area residents about their health concerns. The Panel also considered health studies, reports, and monitoring data relating to health effects observed in the area. This information, in the context of the unique characteristics of the area, helped the Panel understand the nature of the health effects and potential linkages with odours and emissions.
- **Operations:** The Panel considered the nature of the oil and gas operations currently underway in the Peace River area. Several participants made submissions about practices related to storage tanks, production, and transportation. The Panel also heard about future development plans in the area as well as potential operational solutions to reduce odours and emissions.
- **Monitoring:** The Panel also considered monitoring practices and data related to source emissions and ambient air quality in the area, not only to assess the potential impact of operations on human health, but, ultimately, to determine if improvements in air monitoring practices are required to provide confidence that air quality is improving and odours are being minimized as a result of operational and regulatory improvements.
- **Regulatory:** This topic considers the current requirements relating to odours and emissions from heavy oil operations. The Panel was tasked with providing recommendations that might include changes to the regulatory framework.
- **Stakeholder Engagement:** This topic considers the work that has been done to engage stakeholders and the potential for future engagement initiatives.

[18] During the hearing, the Panel also had a separate topic area in which it invited participants to provide information for solutions, including the potential social, economic, and environmental effects of the proposed solutions. Many participants gave detailed suggestions for solutions that were considered and, where deemed appropriate, are reflected in the Panel's own recommendations. This information did not lend itself to its own topic area, but has, instead, been addressed throughout the various sections of this report.

GEOLOGY

Background

[19] The Proceeding initially focused on evaluating the geology and geochemistry of the Peace River area to evaluate whether it differs from the geology and geochemistry of other areas of heavy oil and bitumen production in Alberta. This information assisted the Panel in determining the focus of the Panel's recommendations. Information was drawn from reports of the AER, SSG submissions, and the independent expert Dr. M. Fowler.

Peace River Oil Sands Area

[20] Heavy oil in the Peace River area is mainly produced from bitumen deposit (generally, referred to as Bluesky-Gething) in the clean estuarine reservoir sands of the Cretaceous-age Bluesky Formation, with secondary production from the Gething Formation. In areas where there is no bitumen development, the succession is mainly mudstone of the Gething Formation. Other secondary bitumen accumulations are also found in the deeper Paleozoic-age Belloy and Pekisko formations.

[21] The oil sands of the Bluesky-Gething were deposited during the Cretaceous Period within a transgressive system, with the lower fluvial to nonmarine Gething Formation at the base and the estuarine Bluesky Formation at the top. Deposition of the Bluesky-Gething reservoir and nonreservoir units was controlled by topography of the pre-Cretaceous unconformity. The Red Earth Highlands (see figure 4) separate the Bluesky-Gething into northeast and southwest accumulations and includes part of the Seal Lake area. In the Peace River oil sands areas, the Bluesky-Gething is overlain by the marine shales of the Wilrich Member.

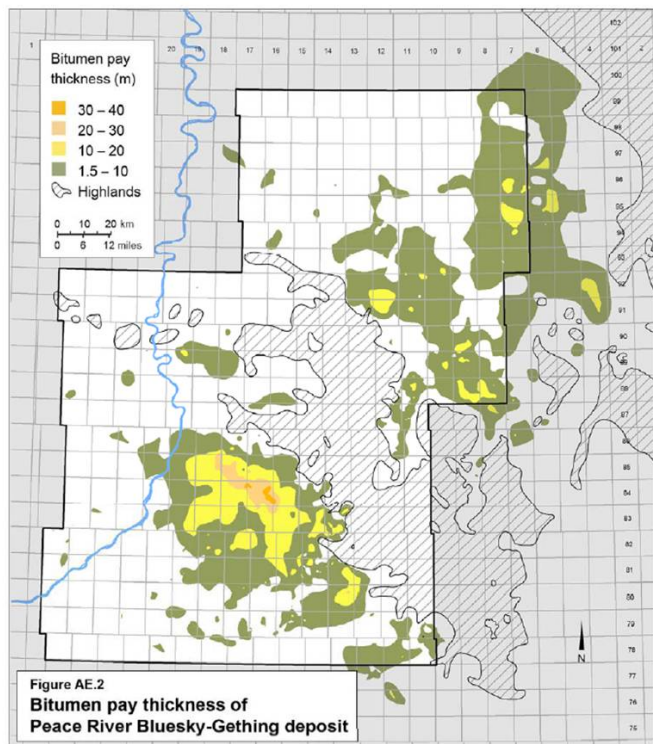


Figure 4. Bitumen pay thickness of the Peace River Bluesky-Gething deposit.

[22] The net bitumen pay in the Peace River Bluesky-Gething is up to 40 m thick (figure 4), with the subsurface reservoirs occurring at about 600–700 m below surface. Bitumen in the Peace River oil sands is less viscous than other oil sands deposits in Alberta. Portions of it can be produced largely through nonthermal, cold production technologies. This differs from other Alberta oil sands where bitumen is produced from deeper areas with thicker overburden by in situ thermal technologies or in areas of shallow overburden where production is by surface mining. Subsurface reservoir bitumen sands are accessed through both vertical and horizontal wellbores, some with multiple lateral extensions.

Reserve Estimates for Bitumen in the Peace River Area

[23] As previously noted, improvements to in situ recovery technologies for bitumen production have opened up more of Alberta's oil sands for development and, as a result, the EUB re-evaluated oil sands deposits in Alberta, including the Peace River Bluesky-Gething deposit in 2006. To more accurately reflect the total volume of bitumen that could reasonably be expected to be recovered, the minimum bitumen saturation was changed from 3 mass percent to 6 mass percent. The volume of the estimated recoverable bitumen in the Peace River oil sands areas increased from 9.93×10^9 cubic metres (m^3) to $10.97 \times 10^9 \text{ m}^3$ (from 62.458 to 68.999 billion barrels)—a net increase of $1.04 \times 10^9 \text{ m}^3$ (using a minimum bitumen saturation of 6 mass percent and a minimum thickness of 1.5 m of bitumen pay). The Bluesky-Gething Peace River oil sands represents about four percent of the total in place volumes of bitumen in the province. Maps of the Peace River oil sands were changed to show that the deposit was more aerially extensive than previously published.

Reservoir Geology

[24] In the Three Creeks area, Bluesky reservoirs are about 15 m thick, whereas in the Reno area they are 7 m thick. Permeabilities of the reservoir sands range from 50–6000 millidarcies (mD). Produced crude bitumen and heavy oil from the Bluesky reservoirs have viscosities between 8100 and 130 000 centipoise (cP) (9.9° – 11.2° API).

[25] The characteristics of the Bluesky reservoirs in the Three Creeks and Reno areas are well suited for horizontal well development. Horizontal well development includes primary production (cold development) and cyclic steam stimulation (CSS or thermal development). Bluesky intervals targeted for primary production generally have a permeability >500 mD and a viscosity $<50\,000$ cP, with primary production constituting most of the current production in the Three Creeks and Reno areas. Thermal development is currently ongoing in the eastern section of the Three Creeks area, where the Bluesky reservoir has a permeability <500 mD and a viscosity $>50\,000$ cP.

Petroleum Geology and Geochemistry

[26] Dr. Fowler, an independent expert, was retained by the Panel to assist in understanding the geology and geochemistry of the Peace River area. He assessed the petroleum geology and geochemistry of the region to

- gain a better understanding of the geological and geochemical characteristics of the Peace River oil sands and any differences between it and any other oil sands and heavy oil deposits in Alberta; and

- evaluate whether any of the geological and geochemical characteristics of the Peace River oil sands are a factor in the complaints of odours and emissions reported in the Peace River area.

[27] Dr. Fowler concluded that most of the hydrocarbons in the Alberta oil sands and heavy oil deposits were from the Devonian-Early Mississippian-aged Exshaw Formation, including those in the Cold Lake, Athabasca, and eastern Peace River oil sands deposits. The hydrocarbons in the western Peace River oil sands (including the Reno and Three Creeks areas) were from shale of the early Jurassic Gordondale Member, which is also known as the Nordegg Formation.

[28] He noted that the sulphur content of hydrocarbons from the Gordondale Member is the highest of all the Alberta oil sands. These high sulphur, Gordondale-sourced hydrocarbons are only found in the western part of the Peace River oil sands deposit, in areas north and east of thick Nordegg source rock facies and where the Poker Chip shale is absent (see figure 5). In deeper subsurface areas, Gordondale-source rocks are overlain by Poker Chip shale caprock, which is a very good seal to updip, lateral, and outward migration of hydrocarbons. In these deep subsurface areas, the Gordondale Member shale does not serve as a hydrocarbon source rock for overlying, younger reservoirs because it is trapped in lower strata by the Poker Chip shale. Only where the Poker Chip shale is absent are Gordondale-sourced hydrocarbons able to move updip and laterally with outward migration into overlying younger Bluesky reservoir sands.

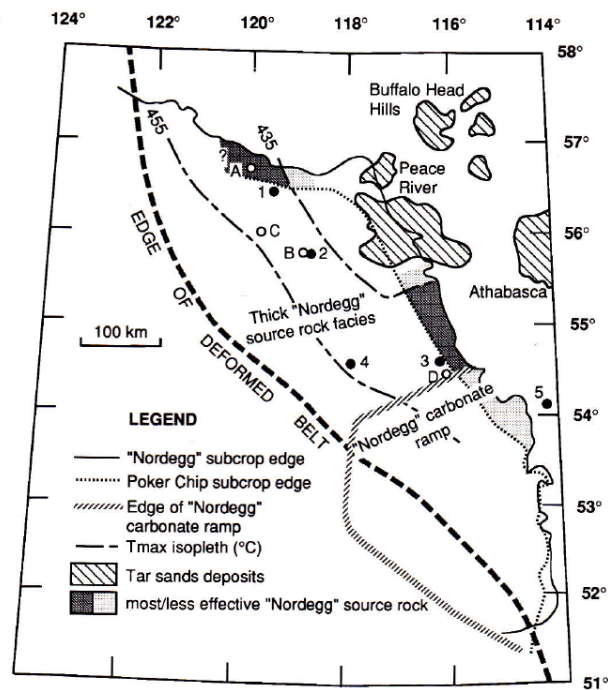


Figure 5. Regions of the most (dark shading) and less (light shading) effective source where the Nordegg (Gordondale) subcrops.

[29] Dr. Fowler confirmed that the bitumen in the Peace River area is unique because of its very high sulphur and aromatic hydrocarbon content, including volatile sulphur. This volatile sulphur would be expected to be present in oils as thiophenes and other similar compounds, many of which have an odour.

[30] Due to the lower viscosity of Gordondale-sourced bitumen in the western Peace River oil sands area, bitumen produced from the area may contain more volatile compounds than in bitumen produced from other Alberta oil sands areas. To date, no analyses have been completed on what volatile compounds may be present in the original bitumen or in the produced crude bitumen and heavy oil that are brought to surface.

Findings

[31] With respect to petroleum geology and geochemistry submissions, the Panel has determined that hydrocarbon resources in the Peace River oil sands areas are both significant and economically recoverable and that they represent an important source of royalty revenue for the province of Alberta and are a significant benefit to all Albertans.

[32] The Panel has been made aware that the Peace River oil sands is derived from both the Gordondale Member and Exshaw Formation and produced primarily from the Bluesky-Gething, and that other oil sands areas do not have hydrocarbons from the Gordondale-source rocks. The bitumen in the Peace River oil sands areas differs from bitumen in other oil sands areas of Alberta in that it is less viscous and is higher in sulphur and volatile components, which could result in increased odours. Therefore, the Panel finds that the characteristics of bitumen from the Peace River oil sands areas are likely a source of the ongoing odour and emissions complaints and symptoms reported by residents near Three Creeks and Reno bitumen production areas. As such, its recommendations should also apply to areas outside of the Peace River area where development of the Gordondale-sourced bitumen occurs.

[33] The Panel finds that the geochemistry of the bitumen in the Peace River area is known at reservoir conditions of higher pressure and temperature and understands that the composition of the bitumen may change as it is brought to surface. The Panel is of the opinion that additional geochemical analyses of Gordondale-sourced bitumen in the Peace River area that is brought to surface are needed to confirm what volatile compounds are in the produced heavy oil before it is heated or otherwise processed. In addition, it would be beneficial to know what volatile compounds remain in the produced heavy oil after being transferred and heated in tanks. This information would assist in developing appropriate regulations and requirements for the management of hydrocarbon compounds being extracted, produced, and stored in this area.

[34] The AER should take the unique characteristics of the Gordondale Member into account when developing regulations and requirements for bitumen production in the Peace River area.

Desired Outcome

[35] There is a significant economic benefit to the Peace River area and the province of Alberta from the development of the Peace River oil sands areas and this development would continue in a manner that ensures that its effects are appropriately mitigated. The unique geochemical characteristics of the Gordondale-sourced bitumen would be taken into account to ensure that the regulatory approach is appropriate.

Recommendations

[36] The Panel recommends that

- 1) the AER conduct or require operators in the Peace River area to submit a geochemical analysis of the volatile compounds from the heavy oil from the Gordondale-sourced bitumen
 - (a) at surface prior to processing and
 - (b) from the tank prior to transport.

HEALTH

Background

[37] To assist the Panel and the participants in the Proceeding in assessing the linkages between odours and emissions and possible health effects, the Panel retained independent specialists with expertise in this area. Early in the Proceeding, participants were invited to suggest experts that would be helpful to the Proceeding. Based on input from participants, the Panel engaged Dr. M. Sears and Dr. D. Davies to provide reports on potential human health effects and Dr. C. Waldner to provide an assessment on potential animal health effects.

[38] In 2010, the AER began receiving an increasing number of complaints about odours and emissions from cold heavy oil operations in the Peace River area. Some of the residents expressed concerns that the odours and emissions were having a negative effect on their health and well-being, causing symptoms such as sinus congestion, headaches, tiredness, coughs, diarrhea, loss of balance, dizziness, loss of sleep, and nausea, as well as illnesses such as asthma, heart disease, diabetes, and stroke.

[39] Some of the residents experienced varying degrees of the symptoms and not all of the residents reported being affected by the odours. According to a survey completed by AHS in 2011⁴ of residents in the Three Creeks area, 78 percent of respondents indicated that their general health was good to excellent. As outlined in Dr. Davies's report, some exceptions in the AHS survey were evident and may be attributed to a relatively poor lifestyle and traits such as being overweight (obesity), smoking, and a lack of physical activity. Based on the survey, it appears that some residents were satisfied with their health while others felt that their quality of life was affected by odours and emissions from heavy oil operations. Several residents chose to leave their properties.

[40] The residents described the odours as being “tar-like,” sharp, pungent, and acidic, or as smelling like rotten eggs, natural gas, chemicals, asphalt, and diesel—all odours that could be associated with the heavy oil process.

[41] Generally, emissions associated with heavy oil operations consist of the following compounds:

- Water, carbon dioxide, nitrogen, and oxygen.
- Reduced sulphur compounds (RSCs): a complex family of substances characterized by the presence of sulphur in a reduced state (e.g., hydrogen sulphide [H₂S] and mercaptans).
- Volatile organic compounds (VOCs): organic chemicals that are liquid and have a high vapour pressure at room temperature (e.g., natural gas components such as methane, ethane, and propane).
- Polycyclic aromatic hydrocarbons (PAHs): a group of hundreds of organic chemicals characterized by multiple fused aromatic (benzene) ring structures and alkylated substituted analogues.

⁴ Three Creeks Human Health Survey, AHS, December 2011.

[42] RSCs are naturally present in sour natural gas and many crude oils and are a major cause of offensive odours because of their low odour detection thresholds and potential to cause acute toxicity. They are usually measured as parts per billion (ppb) H₂S or as total reduced sulphur (TRS). Pulp mills and other industrial facilities may also emit RSCs.

[43] VOCs are of concern because of their potential to contribute to odours as well as their potential to cause health effects. Their high vapour pressure at room temperature causes large numbers of molecules to evaporate from the liquid form of the compound and enter the surrounding air. VOCs include and are often measured as total hydrocarbons (THCs), methane hydrocarbons (MHCs), and nonmethane hydrocarbons (NMHCs) and as benzene, toluene, ethylbenzene, and xylene (BTEX).

[44] PAHs are of concern primarily due to their potential carcinogenic properties. PAHs are formed when organic materials undergo combustion (e.g., coal, other fossil fuels, wood, municipal waste, tobacco). They also are present in crude oils and tars. PAHs are present as complex mixtures. When emitted to the air, they can be present in the gas phase, adsorbed to fine particulates, or can make up part of the structure of particulates (e.g., soot).

Reports submitted by Dr. Davies

[45] The review submitted by Dr. Davies, an independent expert, focused on the following two questions:

- Did the available evidence suggest or indicate that the health of residents in the Peace River area (more specifically the Three Creeks and Reno areas) may be adversely affected from exposure to emissions from heavy oil operations as a result of the direct toxic action of the chemicals in those emissions and do the effects align with the symptoms reported by the residents and landowners?
- Did the available evidence suggest or indicate that people's health in the same area could be adversely affected as a result of the odours associated with emissions from the heavy oil operations?

[46] For each question, Dr. Davies conducted a separate assessment: a screening-level human health impact assessment (SLHHIA) and a screening-level odour impact assessment (SLOIA). The assessments used maximum or near maximum concentrations of chemicals in the emissions measured or predicted (modelled) to occur in the area over short time intervals. The two assessments were treated separately for clarity and convenience, but also because of differences in the manner in which they were addressed and presented.

[47] Information on symptoms and other appropriate data were obtained by Dr. Davies from surveys (e.g., AHS), odour-event and symptom logs kept by residents and landowners, AER staff submissions on the frequency of odour complaints, reports from various published literature, information obtained from interviews with certain residents and landowners conducted jointly with Dr. Sears, and a personal site visit completed at both Reno and Three Creeks areas. Dr. Davies noted that there is no primary literature available describing how health may be affected by exposure to either odours or emissions from cold heavy oil operations in the Peace River area. The measured and predicted concentrations of the chemicals in the emissions were obtained from a variety of sources, including ambient air quality surveys conducted in the area by ESRD, a

report by Chemistry Matters Inc. (Chemistry Matters) on emissions from Baytex's facilities, and air quality dispersion modelling by RWDI Air Inc (RWDI) for Baytex in the Reno area. Dr. Davies acknowledged in his reviews that there are uncertainties and limitations with the available data and that these were addressed by incorporating conservatism (i.e., introducing a number of conservative assumptions or elements) into his assessments.

Screening-Level Human Health Impact Assessment

[48] The SLHHIA compared the maximum or near maximum concentrations of chemicals (measured or predicted) against two benchmarks: 1) the Alberta Ambient Air Quality Objectives (AAAQOs) and 2) health-based exposure limits (see table 1). These are values that both regulatory and scientific authorities believe can be tolerated by people on a short-term basis or would be protective of human health, including that of susceptible populations such as infants, children, the elderly, and people with compromised health.

[49] Dr. Davies also stated that people are rarely exposed to a single chemical, but are instead exposed to a mixture of chemicals. As mixtures, there could be interactions such that the toxic effects of the mixture could be enhanced (additive or synergistic), reduced (antagonistic), potentiated, or unchanged. In his opinion, the assessment of the health effects of chemical mixtures is challenging by virtue of the infinite number of possible combinations. He also discussed the possibility of alternate (or secondary) routes of exposure such as ingestion.

[50] Based on the measured and predicted values of the benchmark chemicals, Dr. Davies concluded that there was no obvious prospect for people's health to be affected by the direct toxic action of the chemicals in emissions from heavy oil operations. He noted that in many cases, the concentrations were well below the AAAQOs by large margins. Dr. Davies noted that the isolated exceedances for carbon disulphide (CS₂) and H₂S (table 1) are for AAAQO levels established based on odour perception and not health effects. Further, Dr. Davies noted that these exceedances occurred on lease or were predicted at distances close to heavy oil facilities—well removed from residences. Dr. Davies noted that the health-based exposure limits used by other regulatory authorities were not exceeded. He argued that this further supported his conclusion that there is no indication that the emissions from heavy oil operations will adversely affect the health of people in the area from the direct toxic action of the chemicals in those emissions.

[51] The Panel notes that Dr. B. Zelt, an independent expert retained by the Panel in the area of modelling, and Dr. C. Sandau, who conducted an assessment for Chemistry Matters, agreed that the predicted levels were well below the toxic thresholds.

Table 1. The maximum average concentrations (measured) of selected chemicals of potential concern from emissions compared to AAAQOs and health-based exposure limits in the Reno and Three Creeks areas.

Chemical	Maximum 1 hr average concentration (ppb), Reno area	Maximum 1 hr average concentration (ppb), Three Creeks area	Alberta AAAQOs concentration (ppb)	Health-based acute exposure concentration limits (ppb; 1 hr average unless specified otherwise)	Basis of exposure limits
acetone	30.0	51.3	2400	26 000 (<14 days)	neurotoxicity
benzene	2.4	0.90	9	180	immunological effects
carbon disulphide	39.4*	10.43*	10**	2000	developmental effects
ethyl benzene group	1.24	1.48	460**	5000 (<14 days)	neurological effects
hexane	4.17	3.21	5960		
hydrogen sulphide	16*	4.34	10**	70 (<14 days)	headaches, nausea
methyl ethyl ketone	2.4	0.836	-	4500	eye and respiratory irritation
sulphur dioxide	-	13	172		pulmonary function
styrene	-	0.327	52	5100	eye and throat irritation
toluene group	13.6	7.72	499**	4000	eye and nasal irritation, neurological effects
xylene group	6.46	2.15	530	1700	respiratory tract irritation, neurological effects

Note: Data within this table was obtained from reports submitted during the Proceeding.

* Exceeds AAAQOs.

** Based on odour perception.

Screening-Level Odour Impact Assessment

[52] The SLOIA compared the maximum near-peak concentrations of chemicals in the emissions against odour thresholds (i.e., published values at which the odour of the chemicals is first detected or noticed).

[53] Dr. Davis concluded that there was some prospect for odours to be noticed on occasion by the people in the area. He based this conclusion on his finding that there were certain chemicals and chemical groups for which the near-peak concentrations were above the minimum odour thresholds and even the mean odour thresholds (see table 2). These chemicals have very low odour thresholds and distinctive smells such as a skunk-like odour, a rotten cabbage odour, a sweet chloroform-like odour, and a rotten egg odour. Dr. Davies concluded that the odours described by residents are consistent with the presence of RSCs.

Table 2. Examples of detected maximum near-peak concentrations that exceeded odour thresholds in the Three Creeks and Reno areas.

Chemical	Near-peak three minute average concentration (ppb), Three Creeks area	Near-peak three minute average concentration (ppb), Reno area	Minimum odour threshold concentration (ppb)
Acetic acid	39.95	-	10
Acetone	423.66	-	396
Aliphatic aldehyde group	8.69	-	0.04
Aliphatic C ₅ -C ₈ group	370.13	-	359
Aliphatic C ₉ -C ₁₆ group	90.03	-	0.006
Carbon disulphide	21.12	71.7	16.1
Carbonyl sulphide	150.13	-	101.7
Decanal	0.38	-	0.04
Dimethyl disulphide	2.38	-	0.3
Dimethyl sulphide	0.27	-	0.1
Ethyl mercaptan	1.41	-	0.02
Hexanal	7.61	-	4.9
Hydrogen sulphide	7.90	29.1	0.04
Mercaptan group	9.89	-	0.02
Methyl mercaptan	4.61	-	0.0000000005
Nonanal	2.04	-	0.1
Sulphur compounds group	301.17	-	0.01
Thiophene group	2.88	-	1.7
Toluene	-	24.8	21
Trisulphide, dimethyl	0.37	-	0.01

Data were obtained primarily from Intrinsic's final report, dated November 29, 2013.
Original odour threshold source: L. Van Gemert, 1999, and other submissions.

[54] Dr. Davies referred to mounting evidence in the published literature of people experiencing physical and psychological and neurobehavioral symptoms in response to unpleasant odours. Dr. Davies reported that there is a difference between the irritant sensations that can be caused by odours and irritation that occurs as a toxicological effect. Based on this information, Dr. Davies noted that it appears that odours may cause certain symptoms at concentrations of the odourants well below those known to cause acute symptoms by recognized toxicological mechanisms. This means that people are not being "poisoned," but that the symptoms are a response to the odours associated with the emissions. Not all people are affected and the range of effects is very diverse, with some people not being affected at all. It will depend very much on the individual's circumstances, both personal and situational.

[55] Dr. Davies suggested that to further characterize odours from chemicals expected to be present in emissions and their possible effects on health, further assessment beyond the screening level is required. Dr. Davies also stated that he personally noticed odours within the Reno area during a site visit.

Reports submitted by Dr. Sears

[56] Dr. Sears prepared reports describing health effects related to anticipated exposures to emissions or odours from heavy oil operations in the Peace River area. Dr. Sears's reports discussed various chemicals associated with bitumen, but did not consider these chemicals in the context of toxicity or exposure levels where toxic effects would be expected to occur. Dr. Sears did not assess the likelihood of toxic effects occurring at exposure levels measured or predicted to occur in the Peace River area either. She presented general comments and suggested using

modern methods for scientific synthesis of evidence relating exposures to health outcomes and approaches to hazard identification and risk management.

[57] Dr. Sears expressed concern that there were gaps in the information available and that

- increased monitoring and data acquisition was needed,
- the measurement and identification of exposure levels were of single chemicals rather than complex mixtures,
- methods of laboratory analysis or emission samples were not utilizing proper laboratory analysis protocols,
- the traditional additive risk assessment approach was not an appropriate model to assess overall exposure toxicities, and
- practices in place to protect the health of people in the vicinity of heavy oil operations need to be improved.

[58] Dr. Sears emphasized that the exposures are chronic, but there are little or no data available to assess long term exposure effects. She stated that the symptoms reported by residents are not unique with respect to their response to oil and gas odours. However, she did not provide any specific research, analysis, or data to support this conclusion.

[59] She stated that based on her knowledge of typical emission components, mechanisms of toxicities, and modern medical toxicological considerations, it was very likely that the emissions are linked with symptoms. She also stated that the emissions have the potential to contribute to a number of morbidities (e.g., reproductive, developmental, metabolic, neurologic, autoimmune, and cancer) over the long term, and that the effects may be serious for susceptible populations (e.g., fetuses, children, the disadvantaged, and those with other health conditions), and this may be only the “tip of an iceberg” of citizens at increased risk of chronic disease. However, she did not compare toxicity information with measured or predicted exposure levels or provide any other specific research or analysis to support this conclusion.

[60] Dr. Sears discussed the bioaccumulative properties of sulphur compounds in bitumen and potential metabolism to H₂S. She also stated that there appeared to be a number of unknown RSCs. She noted in her second report that the measurement of many of these chemicals was not of sufficient sensitivity and, therefore, below detection limits. She had concerns with the quality of data in the environmental reports, stating that the data were of too poor quality to be useful and that the accuracy and precision of the data were insufficient for quantitative risk assessment. Dr. Sears also noted that the residents in the area contended that the data collected by Chemistry Matters—the company retained by Baytex to investigate emissions from its facilities—were not accurate and that Baytex took measures to minimize emissions during the time of sampling by closing the tank vents and reducing the number of vehicles. Dr. Sandau, the expert who conducted the assessment for Chemistry Matters, testified that no such measures were taken to reduce emissions during sampling for this analysis.

[61] Dr. Sears expressed the opinion that traditional additive risk assessment was not scientifically valid. However, she conceded that this was the approach used by regulators and an

alternative method was not provided. She maintained that the emissions from bitumen are mixtures of substances that include metals, carcinogens (such as aromatic hydrocarbons), bioaccumulative substances, and RSCs. She also stated that the details on exposure are extremely uncertain since data are lacking, existing data are of poor sensitivity, accuracy and precision are suspect, and sampling has not been conducted over longer (chronic) timeframes.

[62] Dr. Sears also reported that physicians are afraid to diagnose health conditions linked to the oil and gas industry. However, in her oral testimony, she confirmed that this was not based on her own investigations or on contact with those doctors, but that she was only reporting the information she had received from residents.

Health Interviews

[63] Dr. Davies and Dr. Sears conducted joint interviews with some of the residents. During the interviews, the health experts learned that other symptoms were experienced, such as feeling clumsy, problems with balance, eye twitching, feeling faint, nervousness, clumsiness (in children), constipation, leg cramps, sensitization to other odours, hot and cold flashes, weakness in arms, night sweats, and inflamed nasal passages. Odours were described as smelling like a burnt candle or tire, heavy solvents, and pesticides. Smells during the night continued to linger in their houses during the day. Several residents reported hay fever-like symptoms that cause grogginess and fatigue. In at least one instance, a resident reported being “knocked to his knees” when encountering strong odours in his home in the middle of the night. The effects seemed to occur at certain times of the day or year, perhaps related to factors that would affect the emissions, such as seasonal change, temperature, humidity, and wind speed. When the residents left their homes, the symptoms would subside or disappear and would return when they returned home.

Reports Submitted by Dr. Waldner

[64] Dr. Waldner, a veterinary expert, assessed the literature available on the effects of exposure to air emissions on beef cattle. No studies were available on the effects of such exposure on other kinds of livestock, such as horses, swine, or sheep.

[65] The most recent study that she found related to the concerns about emissions from heavy oil operations in the Peace River area was the Western Canada Beef Productivity Study of 2001 and 2002, both of which included a number of herds from Peace River region.⁵ The study measured potential exposures and outcomes from all types of oil and gas facilities, not just the heavy oil industry and the results of the study were expressed in terms of relative proximity to oil and gas well sites. The study concluded that there was no association between proximity or density of oil and gas well sites and reproductive performance measured by pregnancy rates, abortion rates, stillbirth rates, calf mortality, calf treatment, lesions in calves in nervous tissue or immune systems, or immune system structure or function.

[66] Using toluene and benzene to represent the VOCs, the study did not reveal any significant association between increasing cumulative VOC exposure and increasing risk of nonpregnancy

⁵ Waldner, C.L., 2008a. Western Canada study of animal health effects associated with exposure to emissions from oil and natural gas facilities. Study design and data collection I. Herd performance records and management. Archives of Environmental and Occupational Health, 63, 167-186.

or with increasing breeding-to-calving intervals. In addition, the results showed no association of the VOCs (benzene and toluene) with pregnancy rates, abortions, stillbirths, and calf mortality.

[67] There was, however, an estimated three day increase in the breeding-to-calving interval for mature cows at the highest levels of benzene, as well as significant associations between increased exposure to both benzene and toluene and the number of times calves were treated for illness after the first month of life (calf treatment rates). In addition, benzene exposure was associated with a higher risk of respiratory lesions as well as significantly lower counts of immune cells.

[68] Dr. Waldner's report provides evidence that low-level emissions from oil and gas facilities do not appear to significantly affect animal health. However, at the highest concentrations of the VOCs (e.g., benzene), breeding-to-calving intervals and calf treatment rates may be significantly affected as well as a higher risk of respiratory lesions and significantly lower counts of immune cells, such as T cells. She expressed some limitations to the study and stated that to address some of the identified gaps, it would be necessary to limit the analysis to the herds from the original study. This was not conducted in her reviews. Her review focused on the Western Canada Beef Productivity Study and did not address issues specific to the Peace River area.

Views of the Residents Relating to Health Effects

[69] Residents expressed many concerns related to the heavy oil industrial activities. In particular, the oral testimony of some residents described health effects that they attributed to exposure to odours and emissions from the oil and gas industry. These submissions were generally well organized, credible, and uncontested by other participants.

[70] Various residents submitted that their concerns were not being acknowledged by industry and that the medical profession did not want to become involved in their issues or concerns. They also expressed their frustration that they did not have input into the development of the AHS health survey in the Three Creeks area.

[71] Some residents believed there was a lack of regulations and guidelines to address odour and emission problems and that, in the past, regulatory agencies have focused on monitoring and evaluating current situations rather than on finding solutions. Health risks were being imposed on residents on an involuntary basis—without consent, without consultation, and sometimes without acknowledgement. The residents were concerned with future development and the realization that operations related to the heavy oil industry would increase, which may result in increased emissions, greater impacts, and increased risks.

[72] Residents were concerned that many of the emissions being released posed a health risk as they may be nonaromatic and, therefore, cannot be detected by smell (odour). They believed that it was necessary to better understand the composition, characteristics, and dispersion profiles of the emissions to better recognize their effects.

[73] It was suggested that there should be an increase and continuing combination of basic and applied research into the issue of health effects and odours and emissions. As noted by the residents, studies conducted in 2010 represented a narrow range of compounds and a short period of time. Therefore, they were not comprehensive enough to make conclusions of little or no adverse effect on health. Residents submitted that further research was required to gain a better

understanding of the effects of mixtures, different routes of exposure (other than inhalation), chronic exposure, long-term health effects, irreversible (permanent) damage, cumulative effects, potential changes in sensitivity, and potential loss of tolerance.

[74] In addition, it was felt that the effects on surface and groundwater, soil, and ecosystem health should be studied. A few people mentioned that they were concerned about the local springs in the area that may be affected by the emissions and questioned whether the water quality was changing. They believed that a cost analysis of ill health and reduced quality of life should also be conducted. Research should inform decision-making bodies on a regular basis. One resident stated that no level of economic gain could justify imposing negative and adverse health effects on Albertans.

Chemistry Matters Study

[75] Baytex engaged Chemistry Matters to investigate residents' complaints about odours and claims of health issues in the Reno area. Chemistry Matters collected ambient air samples, both upwind and downwind of facilities, to compare ambient chemical concentrations and patterns with those from potential production emissions. The results were as follows:

- the detection of one compound at very low concentrations out of all the RSC samples collected;
- the detection of H₂S at 16 ppb, which is above the 10 ppb 1-hour average AAAQO based on odour perception threshold; and
- of the VOC samples, with the exception of a single 4-hour sampling result for CS₂ (20 ppb; 40 ppb 1-hour equivalent) exceeding the 1-hour average AAAQO of 10 ppb, none of the concentrations exceeded AAAQOs or effects screening levels published by the Texas Commission on Environmental Quality.

[76] PAH concentrations did not exceed published objectives or screening levels. Chemistry Matters estimated the potential carcinogenic risks of exposure to PAHs via inhalation as being at least three orders of magnitude (1000 times) below Health Canada's acceptable level of cancer risk. When it compared the PAH concentrations in ambient air in Reno with those in other locations in Alberta, the mean benzo[a]pyrene total potency equivalent concentration was lower in Reno than in Edmonton, Calgary, Fort Saskatchewan, or Fort McMurray for years that similar data were collected for those cities.

[77] Chemistry Matters concluded that, from a human health perspective, none of the ambient air samples exceeded health-based objectives or screening levels. Only two compounds exceeded odour-based objectives in two separate samples.

Findings

[78] The Panel notes Dr. Davies's conclusions that, based on the available data and information, there appeared to be no obvious prospect, on a short-term basis, for the health of the people in the Peace River area to be adversely affected from the direct toxic effects of chemicals that were contained in the emissions from heavy oil. The Panel notes that the possible effects from long-term or chronic exposures were not addressed directly due to the lack of available data.

However, Dr. Davies did state that the results of the SLHHIA demonstrated an absence of risk for all chemicals of primary concern, including mixtures, and suggested that long-term exposure to the emissions would unlikely affect the health of these people. He acknowledged that this requires further study.

[79] The Panel also notes that Dr. Sears did not provide a conclusion on whether the specific emission levels, as detected in the Peace River area, were adversely affecting the health of residents. The Panel finds that the general approach taken by Dr. Sears to address the question of health-related effects was of limited assistance in this Proceeding.

[80] The Panel notes that Dr. Sears commented repeatedly on the lack of quality of data, procedures used in laboratories in Alberta, and what she believes is an inappropriate approach to risk assessment. Her criticism about Alberta's laboratories appeared to be based on general statements from unspecified studies and comments on a laboratory's website. With no credible evidence to support her views, the Panel is unable to draw any meaningful conclusions from her submissions and testimony.

[81] The Panel notes the statements by Dr. Sears regarding concerns about the willingness of the local medical community to provide medical treatment for health effects associated with oil and gas industry. The Panel finds that there was limited information to support this claim and that this issue is outside the scope of this Proceeding. The Panel notes that this matter has been raised in the media and the provincial legislature and, accordingly, is confident that, to the extent there is an issue, it will be dealt with in an appropriate manner. The Panel notes that concerns had been raised by local residents about the expertise of local physicians in diagnosing and treating symptoms associated with exposure to environmental factors, such as emissions from oil and gas activity. However, there was a lack of evidence from Alberta Health on this issue.

[82] As of the date of this report, the Panel notes that there is a general lack of pertinent data and research on the health effects of long-term exposure to chemicals in emissions. A confounding factor is the lack of information about exposures to mixtures of chemicals and the potential for adverse health effects. Notwithstanding these concerns, the Panel finds that the data available and the data used by other regulators, including ESRD, in determining the AAAQO, are sufficient to make initial findings on the potential for health effects from odours and emissions from heavy oil operations.

[83] The Panel acknowledges that both the residents and the health experts identified the need for further research on the relationship between odours and health effects. The Panel finds that it would be beneficial for further research into the potential health effects from long-term exposure to emissions from heavy oil operations, as well as for studies into the effects of exposure to mixtures of environmental chemicals. However, the Panel is challenged in making a specific recommendation in this regard, as none of the parties provided detailed recommendations on the research to be conducted, on who should conduct the research, or on how it should be funded.

[84] The Panel finds that based on the data available, there is no indication that health effects or toxicity are a result of exposure to chemicals in the emissions. The Panel agrees with Dr. Davies's conclusion that the weight of evidence indicates that there is no prospect for the health of residents to be adversely affected from the direct toxic effects of chemicals in the emissions when exposed on a short-term basis.

[85] Regarding the question of whether people's health could be adversely affected as a result of odours from heavy oil operations, both experts agreed that there was the potential for people to notice or detect odours and that these may be associated with symptoms. Dr. Davies referenced recent literature that suggests a link, be it broad, between odours and health symptoms. Dr. Davies referred to this as a result of odour or annoyance mechanisms rather than direct toxic mechanisms. He did state that further study was required to determine the intensity, frequency, and actual probability that odours could contribute to health effects. Later in the hearing, he clarified that it was possible that health effects could be related to the odours—a link, in the broadest sense, between odour and certain symptoms—but indicated that not everyone would be affected. The Panel understands that Dr. Sears, in essence, supported the notion that odours can contribute to health effects.

[86] The Panel notes from Dr. Fowler's report that the bitumen production in the area is uniquely high in sulphur and aromatic hydrocarbon content. The Panel accepts that many of these compounds are odiferous and some odour thresholds in the area have been exceeded as a result of bitumen production.

[87] The Panel accepts the residents' credible submissions that they are experiencing a variety of symptoms and health effects. These symptoms have interfered with the quality of life for many of the residents in the area.

[88] Accordingly, the Panel concludes that heavy oil operations are causing odours in the area and that these odours have the potential to cause some of the symptoms of area residents. Therefore, the Panel finds that odours need to be eliminated to the extent possible.

Desired Outcome

[89] The health of residents would not be affected by oil and gas activity in the Peace River area, either in the short term or long term. Symptoms associated with odours from oil and gas activity would be alleviated.

Recommendations

[90] The Panel recommends that

- 1) the Government of Alberta encourage the research community to conduct studies that would assist policy makers and regulators to better understand potential linkages between odours and emissions from heavy oil operations, including long-term exposures to individual chemicals and chemical mixtures, and health effects; and
- 2) Alberta Health ensure that appropriate avenues exist to link local physicians with specialists in environmental health to assist in diagnosing symptoms associated with odours and emissions from heavy oil operations and to enable physicians to provide appropriate treatment to residents.

OPERATIONS

Background

[91] To identify ways of mitigating and reducing any negative effect that odours and emissions may have on nearby residents in the Peace River area, it is important to understand the current state of heavy oil operations in the area and how those operations may be contributing to or addressing odours and emissions in the area.

Cold Heavy Oil Production

[92] As previously noted, CHOP is the primary method used to produce heavy oil from bitumen deposits in the Peace River area where the reservoir has a relatively high viscosity of between 8100 and 50 000 cP. CHOP operations use the energy in the reservoir to drive oil, water, and gas to the wellbore. Sand can also be produced along with these fluids. The fluids are then pumped to the surface and heated in production tanks to reduce their viscosity to make them easier to transport. The heating also allows for the separation of the oil, water, sand, and gas in the tanks.

[93] Gas produced through the well casing is typically collected and used as fuel on the well pad for various heaters and engines. The volume of gas that is given off from the heavy oil in the production tanks, commonly referred to as tank top gas, typically does not meet the economic test set out in *Directive 060*⁶ to require conservation. As a result, it is usually vented to the atmosphere or combusted in a flare stack. Figure 6 shows a typical setup for a battery.

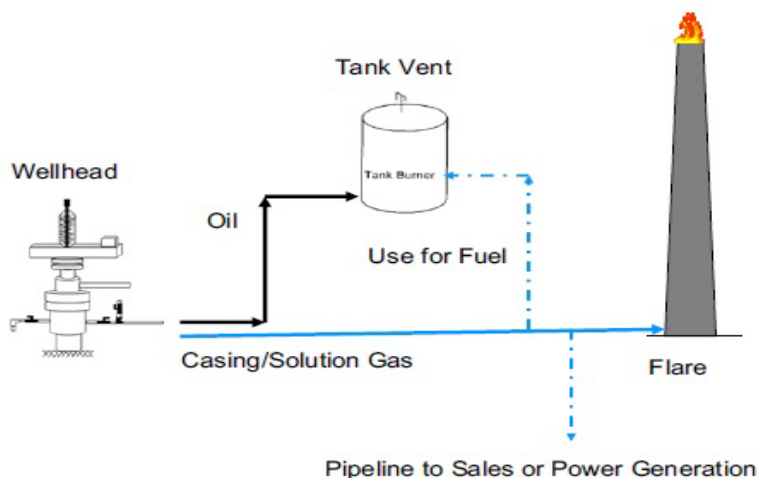


Figure 6. A typical bitumen battery.

Thermal Production

[94] Thermal production of heavy oil involves injecting steam into the reservoir to heat the bitumen. The heating reduces the viscosity and allows the bitumen to flow to the wellbore where it can be pumped to surface. Viscosity in this portion of the reservoir is high and can range from

⁶ See the Regulatory section for further details on this test.

50 000 to 130 000 cP. The produced emulsion of bitumen, water, sand, and gas is then treated to separate the components. Operations associated with thermal recovery schemes typically collect all of the produced gas and combust it either in boilers to generate steam or at a flare stack.

Operations in the Peace River Area

[95] The SSG gave a high-level overview on the operations in the Peace River area. The SSG advised that there were 34 approved CHOP schemes in the Peace River oil sands areas, and 5 approved thermal recovery schemes. The CHOP schemes were comprised of multiple facilities with a total of 923 producing wells. The SSG presented information on venting and flaring volumes in the Reno, Seal Lake, Three Creeks, and Walrus areas.

[96] Figure 7 illustrates the significant reduction in the volume of gas being vented in the area. These reductions appear to be from an increased use of vapour recovery units (VRUs) to capture and conserve produced gas, especially in the Three Creeks area where the volume of vented gas decreased from $9000 \times 10^3 \text{ m}^3$ per year in 2009 to nearly $0 \times 10^3 \text{ m}^3$ per year in 2012.

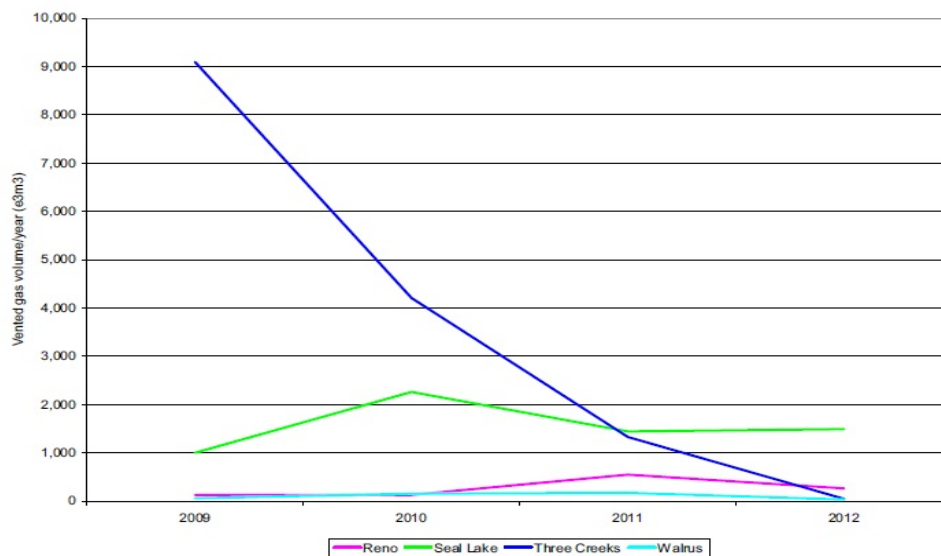


Figure 7. Vented gas volumes from CHOP operations in the Peace River area.

[97] Figure 8 illustrates the volume of produced gas being flared over the same 2009 to 2012 time period. As can be seen, other than the Three Creeks area, flaring volumes have increased over this time frame. This is likely because more gas was captured and any additional gas that hadn't been conserved was flared. The overall decrease in the Three Creeks area is likely the result of increased gas conservation efforts.

[98] The Panel received submissions from companies, area residents, and experts describing operational facilities and practices in the area at the time of the Proceeding.

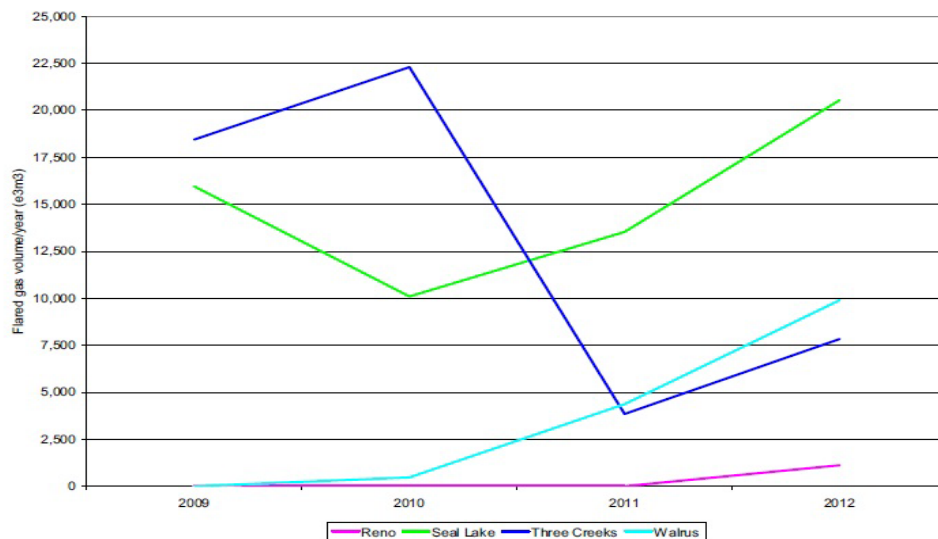


Figure 8. Flared gas volumes from CHOP operations in the Peace River area.

Husky Oil Operations Limited

[99] Husky began development in the Peace River area in 2006. Husky had 36 wells on CHOP operations, connected to eight well pads. Production from the area averaged 225 m³ per day (m³/d) of bitumen and was trucked from each pad to loading facilities out of the area. Casing gas was collected and used for lease fuel requirements in the tank and building heaters and compressors. Tank top vapours were collected and combined with the excess casing gas and sent via pipeline to the Genalta Power facility where it was used to generate electricity.

Murphy Oil Company Limited

[100] Murphy's operations in the Three Creeks and Seal Lake areas consisted of 146 bitumen battery facilities. Five facilities captured all produced gas for conservation and used flares in the event of an emergency. Seventy four facilities captured the casing gas for battery fuel use and conservation and vented the tank vapours to atmosphere. Seventeen facilities captured all produced gas for battery fuel use and flared the excess gas. Forty four facilities captured produced gas for battery fuel use and vented the excess to atmosphere. Six facilities were not categorized. Murphy used a mixture of trucks and pipelines to collect produced heavy oil and transport it to market. Murphy did not provide evidence on whether the vapours from the truck loading operations were treated in any way.

Penn West Petroleum Limited

[101] Penn West operated 40 bitumen batteries in the Three Creeks and western Seal Lake areas, Townships 81-84, Ranges 15-19, West of the 5th Meridian. Twenty facilities used casing gas as battery fuel and flared the excess casing gas, while the tank top gas was scrubbed using a SulfaTreat scrubber to remove odours. Eleven facilities conserved the produced gas for sale and nine facilities flared all excess casing gas and tank top gas.

Shell Canada Limited

[102] Shell had CHOP operations at its Cliffdale project and thermal operations at its Peace River complex. Shell advised that under normal operating conditions its emissions were approaching zero due to the fact it had fully enclosed systems from their tanks. Shell was

working on reducing odours during monthly maintenance operations. Shell acknowledged that it will continue to reduce odours and emissions in response to community complaints. Shell submitted that it thought all gas should be conserved and used for a useful purpose for the people of Alberta.

[103] Shell acquired the Cliffdale asset in 2006, at which 1800 m³/d was produced from 34 well pads. Production at each well pad was directed to a single tank and the tank temperatures averaged 65 to 70 degrees Celsius depending on the water cut in the well. The production was then trucked to the Cliffdale central battery where water and sand were separated from the heavy oil.

[104] All of the produced gas was collected at the well pads with casing gas being directed into the vapour space of the tanks to provide a gas blanket. The gas blanket prevented the ingress of air into the tank as the fluid was being pumped to the trucks. This allowed the VRU to operate in periods of low tank top gas production. The collected gas was used to fuel tank heaters, hydraulic pumps, and gas compression equipment. The remaining gas was sent to the Cliffdale battery. A flare stack was used to combust gas only in the event of an upset.

[105] Vapours emitted during the loading and unloading of trucks and during vacuum truck operations used to clean production tanks were scrubbed using a SulfaTreat solid media scavenger. The scavenger chemically reacts with sulphur compounds (hydrogen sulfide and mercaptans) to form a stable by-product and was intended to remove odours.

[106] The produced heavy oil from the Cliffdale field was trucked to the Cliffdale battery for treatment where gas was removed and collected with a VRU. H₂S and water were then removed from the gas before sending it to the Peace River complex to help generate steam. The heavy oil was shipped to market via pipeline from the Cliffdale battery.

[107] The Peace River complex was Shell's thermal recovery facility. Here, steam was injected into the reservoir to reduce the viscosity of the bitumen for production. The production was then transported to the central processing facility via pipeline where it was treated and then transported to market via pipeline. The gas was collected using a VRU and stored in an underground reservoir for future use. A flare system was used to combust gas in the event of an upset.

[108] Shell proposed a number of solutions to address issues with odours and emissions in the area. First, Shell proposed that approvals in the Peace River area for new developments should require that all gas produced during normal heavy oil operations be conserved, regardless of the economic test under *Directive 060*. Second, Shell proposed that industry continue to develop and implement best practices to prevent and control venting. If venting occurs because of upset conditions, then the production should be shut in until the situation is resolved. Third, Shell recommended that all vapours from truck loading be passed through a SulfaTreat scrubber.

Baytex Energy Ltd.

[109] Baytex presented a detailed overview of its operations in the Three Creeks and Reno areas. It advised that its involvement in the Reno field began in 2011 when it purchased wells and any associated bitumen battery facility infrastructure from Prosper Petroleum Ltd. When Baytex purchased the Reno assets, all produced gas (casing gas and tank top gas) was vented to

the atmosphere. Gas was also purchased from the local gas co-op to fuel tank heaters, hydraulic pumps, and gas compression equipment. Baytex advised that when it took ownership of the assets, it began to use some of the produced gas to fuel the equipment on the well pad. Baytex also purchased a gas compression and dehydration facility in the area and completed the construction of one gas pipeline to the facility, which allowed Baytex to conserve 34 000 m³/d of casing gas for sale to the TransCanada pipeline system. The current oil production volumes were about 270 m³/d.

[110] Baytex installed VRUs on five well pads in the Reno area, of which four were equipped with flare stacks and one with an incinerator. Baytex also indicated that the five well pads with vapour recovery accounted for fifty percent of the production from the Reno area. Tank top gas from the remaining ten well pads was vented to atmosphere through open thief hatches on the top of the tank. Since the vapours in the tank contained water, there was a risk of ice forming on the thief hatch during the cold winter months that would render it inoperable. As a result, the thief hatches were kept open. Baytex suggested that it was common practice in heavy oil operations in western Canada to prevent thief hatches from freezing in a closed position and eliminate the risk that tanks could explode or implode as fluid is added or removed.

[111] In 2004, Baytex began operating in the Three Creeks area. Production stood at 3800 m³/d from 155 wells on 42 well pads. Produced gas was used on site to fuel tank heaters, hydraulic pumps, and gas compression equipment. By June 2011, Baytex had installed vapour recovery on all of its production tanks. The captured gas was compressed into a gas gathering system or flared. Baytex submitted that it had taken measures to reduce fugitive emissions⁷ from equipment, such as gauge boards, to prevent emissions at a tank's gauge orifice.

[112] Baytex did not operate a central battery in the Three Creeks or Reno areas. Instead, it used the tanks at the well site to separate the produced heavy oil and water by heating the tanks to temperatures between 75 and 80 degrees Celsius. The heavy oil was then trucked off site. Baytex stated that it was looking for opportunities to improve truck loading and unloading at its facilities to reduce venting. Baytex also stated that it was pursuing opportunities to reduce flaring. Baytex committed to minimizing venting at its operations in the Peace River area and to installing tank top VRUs on all wells in the Reno area. It estimated that the cost of the VRUs would range from about 200 000 to 300 000 dollars per site.

[113] Finally, Baytex noted that to date, royalties paid to the Government of Alberta from their operations in the Peace River area were in excess of two hundred and fifty million dollars.

Altex Energy

[114] Altex Energy (Altex) was the operator of a transloading facility in Falher. It gave information on its operations and presented oral evidence at the Proceeding. Every day, about 15 trucks used the facility to transfer bitumen to rail cars. Gas from storage and rail car tanks was collected in a gas gathering system before it was sent to an incinerator. Altex also used a vapour balancing system when loading directly from the truck to the railcar. The vapour balancing system collected the vapours from the railcar as it was being loaded. The vapours were then directed back to the truck while it was being unloaded.

⁷ Fugitive emissions at oil and gas facilities are unintentional leaks to the atmosphere and arise due to normal wear and tear on seals, threaded or mechanical connections, covers, or other equipment components.

Dr. Ramsay

[115] The Panel retained Dr. S. Ramsay, an independent expert in process engineering, to comment on the submissions made during the Proceeding and to provide a report on operational practices that could be contributing to the odours and emissions in the area. He provided suggestions regarding technological improvements (including the cost of the improvements). Dr. Ramsay also reviewed the emissions sources identified in the report by Clearstone Engineering Ltd. (Clearstone). Dr. Ramsay submitted that lift pump and compressor engines, as well as tank heaters, were relatively low-priority contributors to the odours and emissions issues in the Reno and Three Creeks areas. Flares and incinerators significantly reduced the amount of odorous hydrocarbons. Tank vents, namely thief hatches, were identified as the most likely contributors to odours and emissions. Fugitive emissions were also identified as a likely source of odours and emissions. However, Dr. Ramsay was not able to recommend how fugitive emissions should be addressed as the information on sources and mitigation procedures filed during the Proceeding was insufficient.

[116] Dr. Ramsay advised that the obvious solution to reducing odours was the use of VRUs as part of a larger system to capture and dispose of the gas collected from the CHOP process. Gas could be disposed by flaring or injecting it into a pipeline for use at some other location. Due to the high water content in the vapour from heavy oil tanks, an inlet scrubber was necessary to prevent water from entering the compressor and affecting its operation. Other than for routine maintenance, VRUs can be expected to have very high operational dependability. Dr. Ramsay estimated that the cost of the VRUs would range from about 150 000 to 200 000 per site.

[117] Dr. Ramsay examined the concept of using a floating roof system in the production tanks. The purpose of a floating roof system is to limit the evaporative loss of a product from a tank. A floating roof system would be able to reduce emissions from bitumen tanks, but would have to be used as part of an overall control strategy to eliminate emissions with some certainty. Dr. Ramsay suggested that since bitumen was not a highly volatile material it would be difficult to justify the additional complexity of a floating roof as part of a larger emission control system.

[118] Dr. Ramsay examined the use of SulfaTreat scrubbers to treat vapours from the loading of trucks. He stated that the vast number of odour-causing substances were not RSCs and, therefore, would not be treated by the scrubbers.

[119] Dr. Ramsay examined the use of flares to dispose of gas on a site. He stated that the most efficient way of disposing of odorous compounds at a facility was to combust the gas in the tank heaters or engines. If there was excess gas at a facility with no infrastructure in place to dispose of that gas, a properly designed flare system would be an appropriate method of disposing it. Proper design of a flare system would include a knockout drum that would prevent liquids from entering the flare system and impairing the efficiency of the flare. However, Dr. Ramsay did raise concerns with the efficiency of combustion and whether the flares perform the way they are expected to, especially when looking at the very low levels of emissions associated with odour complaints.

[120] Dr. Ramsay examined the operational issues related to water vapour in the gas streams. Water vapour causes thief hatches and pressure vacuum relief valves to freeze, causing hatches to be propped open and gas to be vented to the atmosphere. Issues were also identified around conservation of the high water vapour gas stream from the tank tops. Dr. Ramsay stated that heat

tracing and insulation would address the freezing of process lines and valves. Dr. Ramsay also stated that dehydration of the gas would be required to meet the dew-point specifications of sales gas.

[121] Dr. Ramsay submitted that process engineers do not typically deal with odours as there is little guidance as to what the odour-detection levels are and how problems are to be handled. During the hearing, Dr. Ramsay was questioned on other various operational issues that may affect reducing emissions. In response, Dr. Ramsay stated that all of these problems have already been dealt with in other contexts and, therefore, could be managed. He referred to sour facilities in Alberta, which are required to have no sour emissions, as an example of where engineering solutions are found to similar issues that were mentioned during the Proceeding.

Area Residents

[122] In the Proceeding, the area residents provided information that identified concerns with odours and emissions from heavy oil operations, from the loading and transportation of the heavy oil, as well as with fugitive emissions. Reno area residents specifically raised issues with the practice of operating production tanks with the thief hatches propped open to vent gas to the atmosphere.

[123] The Panel heard submissions from Mr. D. Dallyn, a resident in the Three Creeks area, regarding a proposal to keep the truck loading as part of a closed process. The concept proposed would involve connecting the vapour space of the truck tank to the storage tank so that as the truck was loaded with liquid, the displaced gas would be routed back to the storage tank where it could be recovered in the VRU.

[124] The Panel received submissions from Mr. R. Glenn, another resident in the Three Creeks area, regarding potential engineering solutions to the odours and emissions issues. These detailed solutions included implementing blanket gas systems on the production tanks, using supervisory control and data acquisition (SCADA), capturing vapours from production tanks, and processing fluids in pressurized process vessels.

[125] The Panel received submissions from Ms. D. Dahm and Ms. D. Plowman, residents in the Three Creeks area, regarding concerns with high traffic volumes and road safety with the volume of trucks transporting heavy oil on Township Road 842. Mr. C. Langer, also a resident in the Three Creeks area, noted concerns about highway safety and truck drivers being “intoxicated” by emissions from bitumen loading operations.

Greatario Covers Inc.

[126] The Panel received a submission from Greatario Covers Inc. (Greatario), which manufactured a floating hexagonal segment that interlocked to form a barrier on top of the fluid in a tank. The barrier reduced the amount of volatile compounds and water vapour that was emitted from the fluid in a tank. Greatario has installed their covers in other parts of Alberta and Saskatchewan and expressed interest in deploying their product in the Peace River area.

Findings

[127] The Panel notes that operators in the Peace River area have already made a number of operational improvements that have significantly reduced the volume of gas that was vented, especially in the Three Creeks area. Shell is conserving all its produced gas under normal operations and Baytex is recovering casing and tank top gas in the Three Creeks area and from half of its production in the Reno area. However, despite improvements and commitments that have been made, odours are still present in the Peace River area and residents continue to report odours and associated effects.

[128] The Panel is of the view that most of the odours, at least in the Reno area, appear to be coming from tank top emissions at CHOP operations. The Panel finds that the most effective means of capturing such emissions from production tanks is through the use of VRUs. The Panel is aware that retrofitting existing infrastructure with VRUs may pose challenges. However, the Panel notes Shell's ability to find engineering solutions to these issues and that Baytex has already retrofitted many of its tanks. The Panel is confident that operators can resolve the issues related to retrofitting.

[129] The Panel is impressed with the operational dependability of the VRUs, as referenced in the evidence submitted by Dr. Ramsay, Shell, and Baytex during the Proceeding. The Panel expects that a reasonable target for VRU operational dependability would be 97 percent.

[130] Submissions from Dr. Ramsay and from Baytex indicated that the costs associated with the installation of VRUs on a pad is in the range of 150 000 to 300 000 dollars. The Panel finds that operators in the area have already installed or plan to install VRUs on many pads in the Three Creeks and Reno areas and, therefore, finds that the economic costs associated with purchasing, installing, and operating VRUs will not present an undue burden on bitumen producers in the area.

[131] The Panel also finds that emissions and odours can result from operational upsets, production tank cleaning and maintenance operations, the loading and unloading of trucks, and fugitive emissions. The fact that Three Creeks area residents continue to experience odours and emissions, despite the fact that tank top emissions are being captured in the area, demonstrates that these potential sources of emissions and odours are likely still significant, and continue to adversely impact some of the Three Creeks residents. Accordingly, the Panel finds that measures to identify and address fugitive and other sources of emissions are required.

[132] The Panel notes that studies commissioned by Baytex and conducted by Clearstone, RWDI and Chemistry Matters were of assistance in understanding the causes of the odours and emissions in the Reno area. Similar air quality studies are currently being done in the Three Creeks area by Stantec Consulting Ltd. (Stantec) and Clearstone, to be completed in 2014 (see appendix 5). The studies will identify emission sources and will correlate air monitoring data and meteorological data (Met data) with odour complaints. The Panel anticipates that these studies should assist operators to take appropriate corrective action to address these sources of emissions and odours and assist in further reducing odours and emissions concerns in the area.

[133] The Panel is of the view that the AER should review these studies and require operational changes, if necessary, to reduce odours and emissions from sources identified in those studies. Given that it is possible that odours may continue in the Reno area after the addition of VRUs

(similar to the situation that exists in the Three Creeks area), the Panel is of the view that any recommendations that come out of the Three Creeks studies be examined by the AER and area operators to determine the applicability to the other Peace River areas, especially Reno given the close proximity of residents to Baytex's Reno operations.

[134] As noted, fugitive emissions may be a contributor to the odour issues in the Peace River area. The Panel considers that it is important to ensure that these emissions are identified and addressed in a timely manner, pursuant to a comprehensive fugitive emissions plan. The Panel recognizes that some operators, such as Shell and Baytex, currently have fugitive emissions plans that include monthly checks with FLIR cameras to identify leaks. This would be an appropriate procedure for all operators to adopt. In addition, based on the SSG's comments regarding the lack of monitoring of fugitive emission plans by the AER, the Panel finds that the AER's practices to assess and ensure compliance with these plans should be improved.

[135] The Panel notes that Tervita Corporation (Tervita), who operates a waste facility in the Three Creeks area, did not participate in the Proceeding. There were concerns that Tervita stores some of the waste products from oil and gas activity in open pits. It appears reasonable that odours would be associated with those pits, but there was little information given about Tervita's operations during the Proceeding. The Panel notes that Tervita is part of the industry committee that is providing funding for the Stantec and Clearstone studies, and the Panel expects that the Tervita facility will be included in those studies. If the Tervita facility is identified as a source of odours, the Panel expects that the AER will take appropriate measures to ensure that Tervita is compliant with AER requirements.

[136] The Panel notes the work that has been done by Shell to reduce odours from the loading and unloading of trucks by using SulfaTreat scrubbers to capture sulphur odourants. The Panel also notes Shell's safety concerns with implementing a closed-loop system for truck vapours. However, the Panel also notes the evidence of Dr. Ramsay who believed that these operational issues could be addressed. In the hearing, Shell committed to continuing to look at the possibility of implementing a closed-loop system. The Panel encourages all operators to continue to find ways of reducing odours and emissions from trucking operations. At a minimum, operators in the area should use scrubbers to address emissions from sulphur compounds and mercaptans during truck loading operations.

[137] The Panel notes the concerns of the residents with trucking routes and the efforts to resolve these concerns by the 842 Road Use Strategy Group (appendix 5). In its oral submission to the Panel, Northern Sunrise County advised that it has approved funding to upgrade Township Road 840 to redirect industrial truck traffic from Township Road 842 to Township Road 840. The Panel expects that this change should reduce the effects of traffic relating to heavy oil operations on the residents along Township Road 842.

[138] The Panel acknowledges that eliminating all odours and emissions associated with heavy oil production is not feasible as there will be maintenance activity, occasional upsets, or fugitive emissions that could result in odours from time to time. However, the Panel is confident that operators can develop ways to ensure that these emissions are significantly reduced. The Panel notes that operators are currently sharing information about their operations through initiatives such as the Industry Best Practices Working Group, to improve the industry's environmental performance in the area. The Panel applauds industry operators for this approach.

[139] Further, the Panel notes the evidence of Greatario and from participants such as Mr. Glenn that suggested new technologies that might be appropriate to reduce odours. The Panel encourages the Industry Best Practices Working Group, to continue to explore new technologies to reduce odours and emissions.

[140] The Panel notes that Shell currently conserves most of the gas from its cold and thermal operations and that Baytex has committed to installing required pipelines for conservation purposes for the Reno area. Conservation of gas means that produced gas (casing and tank top gas) is captured and used for a useful purpose, preferably as fuel for on-site operations, or sent to a pipeline for sales or other use. Where the AER requires conservation, the ongoing flaring, incineration, or venting of gas is not permitted, except in emergency or upset conditions. Where flaring occurs, a properly engineered flare is preferable to venting as the chemicals that cause odours are destroyed.

[141] Based on this, the Panel finds that produced gas in the Peace River area should be conserved. At this time, the appropriate technology would be capturing this gas by way of a VRU. The gas should then be used on site or sent to a pipeline for some beneficial use. Where pipeline infrastructure is unavailable, the next best option in the short term is to combust the recovered gas in a flare or incinerator. Based on the evidence presented, the Panel believes it is advantageous to set out timelines for the capture and conservation of produced gas. However, the panel notes that some of the area operators did not present evidence or make themselves available for questioning at the hearing, so the Panel was unable to specifically inquire as to their views on these timelines. The Panel is confident that the AER will ensure that the implementation of the recommendations regarding conservation of gas is completed in a reasonable and timely manner.

[142] The Panel notes that the SSG submission identified 120 sites that are currently venting (tank top) in the Seal Lake and Walrus areas. The Panel did not receive any submissions that would allow it to determine the contribution of those facilities towards emissions and odours in the Peace River area. Further, the Panel did not receive any submissions regarding the impact of requiring companies in those fields of installing VRUs and/or conserving gas. As a result, the Panel considers that further information is required to appropriately deal with odours and emissions in those areas.

Desired Outcome

[143] To the extent reasonably practical, all gas would be conserved and zero odours or emissions would be released from heavy oil operations in the Peace River area during normal operations. Industry operators would continue to share learnings and develop best practices to enhance operations so as to move towards a zero emission aspirational goal.

Recommendations

[144] The Panel recommends that

- 1) the AER require that all produced gas be captured. Tank top gas will be captured using a VRU

- a) within four months from the issuance of this report in the Reno and Three Creeks areas, and
- b) immediately with respect to all new operations in the Peace River area.

The captured gas may be sent to a flare or incinerator until such time that the feasibility study (discussed in recommendation 5 of the Operations section) is implemented;

- 2) each operator in the Seal Lake and Walrus areas provide a report to the AER within two months of the issuance of this report outlining its plan to install VRUs to eliminate venting from existing facilities. The Panel expects the AER, after considering the information in such reports, to work with operators to implement an appropriate and timely plan to eliminate venting;
- 3) following implementation of gas capture measures contemplated in these recommendations, the AER prohibit venting from all facilities. In the event of an emergency or upset situation and where flaring infrastructure is not available (which results in venting), the well must be immediately shut in;
- 4) where gas conservation measures have been implemented, and where upsets and/or emergencies occur, the AER require that flaring be limited to a maximum of three percent of the annual operational time, with the duration of the flaring reported to the AER monthly;
- 5) toward the objective of conserving all captured gas, the AER require that, by October 31, 2014, operators, either collectively or independently, provide a feasibility study to the AER into options and timelines to conserve all gas at sites in the Peace River area. The Panel expects that the AER, after considering the information in the feasibility study, will require operators to implement an appropriate conservation plan;
- 6) the AER require that operators conduct monthly fugitive emission inspections using appropriate equipment (e.g., FLIR camera). The results of monthly fugitive emission inspections must be submitted to the AER for review and made available to area stakeholders;
- 7) the AER require that where sources of fugitive emissions are identified, these be repaired within 12 hours of being detected or the facility be shut down until such repairs are completed. Repair responses would be submitted to the AER for review and made available to area stakeholders;
- 8) the AER require that operators implement measures (such as scrubbing or recovering displaced truck tank emissions) to minimize odours from truck loading and unloading activities; and
- 9) the AER should review the results of the Stantec and Clearstone studies and
 - a) require operational changes in the Three Creeks area, if necessary, to reduce odours and emissions from sources identified in those studies; and

- b) determine the applicability of the results and operational changes to the other Peace River areas.

MONITORING AND MODELLING

Background

[145] Monitoring and modelling is an important aspect of this Proceeding as it permits stakeholders to identify and to understand any problems related to emissions affecting ambient air quality and where to focus efforts to address the problems. In this section, the Panel has included a brief description of some of the monitoring studies done to date to assess whether improvements are required. As mentioned above, some of these studies were considered in the previous section on health, as they provide the background data to the consideration of whether chemical levels were such that a potential for impacts existed.

[146] Residents in the Peace River area raised concerns with the ability of the air quality monitoring to detect odours. A number of air quality studies were undertaken in the Three Creeks and Reno areas with the intent of helping operators, the AER and residents gain a better understanding of the emissions, whether the emissions could be causing the odours, and whether the chemicals in the emissions or the odours exceeded any of the AAAQOs or odour thresholds.

[147] Between 2010 and 2013, ESRD conducted four air quality surveys in the Three Creeks area, one of these in conjunction with the Three Creeks Industry Steering Committee Air Quality Working Group.

[148] In the Reno area, Baytex engaged Clearstone, Chemistry Matters, and RWDI to sample and measure sources of emissions at its facilities and to conduct dispersion modelling and ambient modelling surveys. For this Proceeding, the Panel retained Dr. Zelt and Odotech as independent experts to provide their analysis of the situation.

Three Creeks Ambient Monitoring by ESRD

[149] According to the four studies conducted by ESRD, no AAAQO was exceeded, and the odour threshold for two compounds (hexanol and nonanal) was exceeded only once. However, it was observed that odours were perceived on occasions when the threshold value was not exceeded. VOC levels measured during odour events were substantially higher than background “natural” levels and yet did not exceed any AAAQO.

[150] The first study, done in 2010, concluded that, given the location of the sites, the compounds measured, and the wind direction, odours in the community were likely due to emissions from nearby oil and gas facilities.

[151] In the second study conducted with industry, a continuous monitoring station was placed near a local residence along Township Road 842 and monitored for sulphur dioxide (SO₂), TRS, THC and meteorological conditions between April and November 2010. Air samples were collected at the station and analyzed for individual VOCs. The study found periods of elevated hydrocarbon concentrations (above background levels of 2000 ppb). Concentrations greater than 2500 ppb were observed about 10 percent of the time when prevailing winds were from the east where heavy oil operations are located.

[152] The third study was conducted over eight days in 2011. Snow, surface water, and soil samples were analyzed to determine whether there was evidence that the surrounding

environment was being impacted by the oil and gas industry. ESRD concluded that it was not evident from the areas sampled that there was significant BTEX, lighter fractions of VOCs, or PAH deposition on snow, water, and, in particular, soil collected and analyzed.

[153] The fourth study was done over two days in 2012 when a mobile air monitoring unit was deployed in the Three Creeks area. None of the measurements taken exceeded the AAAQO screening exposure levels or odour perception thresholds.

Monitoring by Industry in Three Creeks

[154] Shell, on behalf of the Three Creeks Industry Steering Committee Air Quality Working Group, advised that the group used four continuous air quality monitoring stations. Two of the stations are owned and operated by Shell: one northeast of Shell's Peace River complex and one southeast of its Peace River complex, which began operating in December 2013. These stations measured SO₂, H₂S, TRS, THC_s (including MHC_s and NMHC_s), ambient temperature, wind speed, and wind direction. The other two stations were located near residents along Highway 986 (986 station) and Township Road 842 (842 station). These stations measured SO₂, TRS, THC_s (including MHC_s and NMHC_s), ambient temperature, atmospheric pressure, relative humidity, wind speed, and wind direction. Both of these stations had Summa canister systems to collect VOC samples.

[155] The most recent data available on THC_s from the three monitoring stations showed that elevated, one-hour average THC concentrations above typical rural background values tended to occur with southerly winds near the Peace River complex station, with east-southeast to southeast winds near the 986 station, and with east to east-northeast winds at the 842 station. The collected data pointed to the Three Creeks area heavy oil facilities as the source of emissions. At the 842 station, the elevated hydrocarbon levels were detected about 11 percent of the time. The maximum THC concentration was about 6000 ppb. Of interest in this study was the observation that the results correlated with odour events and health effects logs kept by residents in the area. Residents recorded that odours occurred on about 100 days and each day for about one-third of the day, or about 10 percent of the time.

Reno Field Air Quality Monitoring by Baytex

[156] As previously noted, Baytex engaged Chemistry Matters to investigate resident's complaints about odours and claims of health issues in the Reno area. Chemistry Matters concluded that, from a human health perspective, none of the ambient air samples exceeded health-based objectives or screening levels. Only two compounds exceeded odour-based objectives in two separate samples.

Reno Field Source Monitoring by Baytex

[157] Source monitoring field studies were conducted by Clearstone at the Baytex Reno Field to characterize atmospheric emissions and complete an emissions inventory for purposes of air quality modelling. The inventory of emission sources included lift pump engines, compressor engines, tank heaters, tank vents, flares and one incinerator. However, tanker truck loading emissions and fugitive emissions were not included. To characterize emissions, Clearstone conducted flow measurement of produced fluids and tank top gas vented to atmosphere or directed to flare. Casing gas, tank top gas, and combustion device flue gas samples were

collected and submitted for comprehensive analysis. Operational data was recorded or obtained from Baytex, the operator.

[158] In its studies, Clearstone assumed that all hydrocarbon gas emissions were released from the first production tank in the production train because, in Clearstone's view, the pressure drop to atmospheric pressure in the first tank would cause essentially all tank top gas to be released and only minor subsequent releases in adjoining tanks, with mostly water vapour emissions being visible.

[159] The Reno Landowners Group raised concerns with Clearstone's assumption that all the tank emissions would come from the first tank in the processing tank series. The Reno Landowner's Group reported visible emissions from tanks, which was supported by FLIR videos of Baytex's Three Creeks facility. Dr. Ramsay, an independent expert specializing in heavy oil operations, explained that he expected variability in the amount of gas to be released from each tank in a series with the predominant amount coming from the first tank and lesser amounts from subsequent tanks. He also stated that if all the emissions were simply assumed to come from the first tank, the calculation would be representative of the overall emissions.

[160] Odour measurement samples taken by RWDI were adjusted by Clearstone to be expressed as odour units per dry standard cubic metre, air-free vented gas. Clearstone assumed that operations are relatively consistent and that the cycle of tank filling and product removal from tanks was similar on both sample days. Notwithstanding this uncertainty, odour strength was adjusted and the maximum measured odour units were used to develop odour emission factors for tank top gas and mixed casing and tank top gas. It was found that tank top gas is about ten times more odourous than casing plus tank top gas.

[161] Odotech, one of the experts engaged by the Panel for odour issues, expressed concerns about sampling of tank emissions due to the reported condensation in sampling lines. Sulphur compounds readily dissolve in water so the reported concentrations may be low. H₂S and CS₂ (sulphur compounds) were measured by Chemistry Matters in ambient air, yet very little were measured by Clearstone in the source emissions. TRS compounds were found to be present in the casing and tank top gas, but not as H₂S and CS₂; however, both H₂S and CS₂ were detected in the ambient air. It appeared that the source monitoring missed the H₂S and CS₂, possibly due to the water condensation in the sampling lines, which absorbed the H₂S and CS₂.

Dispersion Modelling of Emissions in the Reno Field

[162] As noted above, to help predict the area where emissions and odours might be present, dispersion modelling was done by RWDI. The Panel retained an independent expert to review and report on the dispersion modelling information in the Proceeding.

[163] RWDI completed an air quality and odour assessment for emissions of twenty-eight chemicals selected by Chemistry Matters. The CALPUFF dispersion model was used to predict maximum concentrations and walking and mobile surveys were conducted. The modelled concentrations were all below the applicable AAAQO. Regarding odours, the model predicted odours from certain pads and, in some cases, the predicted odour concentrations were lower than the odour observations taken from the field surveys. RWDI concluded that emissions of tank top and casing gas from storage tanks are largely responsible for the off-site odours.

[164] Dr. Zelt evaluated results from the previous studies and used advanced dispersion modelling to demonstrate that flaring of vented gas was unlikely to be the sole cause of odours. He also submitted that the average tank emissions modelled by RWDI may have underestimated the predicted odour issues at residential locations. He argued that the gas venting rates as reported and estimated by industry following the requirements set out in AER *Directive 017: Measurement Requirements for Oil and Gas Operations* and *Directive 060* may systematically underestimate the amount of emissions vented. He also stated that data presented by Clearstone suggested that short-term variability of venting gas rates may result in emissions many times greater than the average values used in the modelling and may explain why a large number of residents experience frequent episodes of odours. Dr. Zelt concluded that short-term variability of emissions, even up to an order of magnitude, would remain lower than toxicity health end points and, although the period of monitoring was relatively short, these downwind measured concentrations provided a weight of evidence that short-term toxicity was not an issue from these emissions.

Residents' Monitoring Logs

[165] During the Proceeding, a group of Three Creeks area residents located on or near the east end of Township Road 842, filed detailed logs that recorded odours at their residences and related health symptoms. These residents stated that they began these logs in response to direction from the government, industry, and regulators in 2010 to provide more comprehensive data instead of verbally reporting concerns regarding health impacts. These documents provided a monthly summary of the dates, times, and nature of emissions incidents and health effects reported by these residents for the period January 1, 2011, up to and including December 31, 2013. The information in the logs was collected from seven households located on the east end of Township Road 842, with an average total population of eight to twelve residents. The logs showed that odours were detected about one third of the days, and a resident confirmed that it was about one third of the times on those days, which is about ten percent of the time.

Future Monitoring and Modelling Work

[166] Two studies have been initiated in the Three Creeks area and the approximate timing for initial draft results of both studies was anticipated to be in the first quarter of 2014. The final results of both studies were not anticipated until around mid-2014. The intent is that the studies will be publicly available.

[167] The first study is being conducted by Stantec and will provide a detailed analysis of historical air quality monitoring data collected in the Peace River region. The study will also evaluate correlations between air monitoring data and odour complaints from area residents and provide recommendations for potential improvements and/or modifications to the existing air quality monitoring regime. The second study is being conducted by Clearstone and involves the development of an inventory of emissions in the Three Creeks area. This study will identify the sources and the types of emissions being released to the air and will also address key questions regarding emission growth patterns and emissions from various typical well pad configurations.

Airdar

[168] Airdar Inc. (Airdar), an Alberta-based company, submitted a description of its methods for locating, quantifying, and measuring air contaminant concentrations. Airdar participated in the

Proceeding to inform participants of its technology to detect emissions and suggested that the AER award “credits” to industry for reducing emission rates of methane from heavy oil facilities in the Peace River area. According to an Airdar representative, this technology could identify emission plumes, map the variability of the emissions over time and track them back to their sources. Airdar submitted that its services have been used by operators in other parts of the province to identify and address fugitive emission sources.

Airshed Monitoring

[169] PAZA filed a brief submission advising that it was a multistakeholder group that operated continuous air quality stations through the Peace River area and that this information was available on the PAZA and ESRD websites. Shell confirmed that the boundaries of PAZA had not been extended from the Grande Prairie area to the Peace River oil sands areas. Shell and Baytex agreed that they would be supportive of the inclusion of the area into PAZA.

Findings

[170] The Panel notes that aromatic hydrocarbons such as BTEX and sulphur compounds, measured by Baytex and Clearstone, were identified in the casing and tank top gas. These results are consistent with the Panel’s findings in the Geology section that the bitumen in the Peace River area is uniquely high in sulphur and aromatic compounds.

[171] The Panel notes that the logs, the monitoring studies, the field surveys, and testimony all confirm that odour thresholds are exceeded for emissions from heavy oil operations in the area. The Panel notes that hydrocarbon odours identified in the residents monitoring logs at a frequency of about ten percent is similar to the data collected at the 842 station. The Panel finds that a robust monitoring program is critical to ensure that emission-related problems are identified, corrective measures are taken, and compliance with the requirements, including the recommendations in this report, are achieved.

[172] The Panel considers the concerns raised regarding the underestimation of emissions and is of the view that there is a need for a more comprehensive design of a monitoring system for odours and emissions in the Peace River area. In particular, the Panel is concerned that the predicted odour concentrations were lower than the concentrations observed during field surveys in the Reno field. The Panel notes that there was little information related to plans to detect and reduce fugitive emissions and is of the view that its recommendation in the Operations section regarding fugitive emission audits will help ensure that these emissions are addressed.

[173] The Panel is of the view that there have been significant efforts made to characterize air quality in the Reno and Three Creeks areas. However, there has been little if any analysis done to integrate the results of air quality measurements and meteorological data to better understand the odour events being reported by area residents and to communicate such analysis to area residents in a clear and understandable manner. The Panel recognizes that studies are currently underway in the Three Creeks area that might help address this issue.

[174] The Panel observes that many of the participants, operators, and residents voiced support for the establishment of an airshed zone. The Panel is aware of the success of airshed monitoring in other regions of Alberta and notes that there is a need in the Peace River area for a more comprehensive and transparent monitoring program than what currently exists.

[175] The Panel recognizes that recently, data from the air monitoring stations has been made available on the Northern Sunrise County's website. However, the Panel considers that more analysis and communication of results should be done to ensure that local residents can access and understand the air quality data.

Desired Outcome

[176] The Peace River area would have an air quality monitoring program that provides credible and comprehensive data to permit the identification and appropriate response to odour and emission related issues. The air quality monitoring program would

- assist in verifying that air quality is improving and odours are being minimized as a result of operational and regulatory improvements,
- operate transparently and give residents and stakeholders timely access to data and information in a manner that is readily understood,
- demonstrate that oil and gas operators have effective control mechanisms, and
- verify that air quality is at acceptable levels and that emissions residents are exposed to are below toxic thresholds.

[177] To accomplish these goals, the monitoring program would

- characterize emissions and odours associated with heavy oil operations,
- identify and measure dominant sources of emissions in the area,
- determine representative odour units for various sources, and
- give reliable real-time data on emissions and odours in the area.

Recommendations

[178] The Panel recommends that

- 1) the AER engage industry, residents, and stakeholders to establish a scientific and technically credible regional air quality monitoring program for the Peace River area that, to the extent possible,
 - a) builds on the efforts of the existing continuous monitoring program;
 - b) includes the Reno area;
 - c) considers the studies and monitoring surveys conducted to date by ESRD, industry, Stantec, RWDI, Clearstone, Chemistry Matters, Odotech, and Dr. Zelt;
 - d) provides greater geographic and spatial coverage by monitoring in areas of anticipated highest concentrations and where people might be exposed to emissions and odours;

- e) is operated collaboratively by industry, residents, the AER, and other government agencies (using a Clean Air Strategic Alliance [CASA] type model);
 - f) provides transparent and real-time data to residents and stakeholders; and
 - g) assesses innovative monitoring technologies to better understand odours and emissions sources, and use the technology where appropriate;
- 2) the AER require that holders of new approvals issued in the Peace River area join the regional monitoring program; and
- 3) the AER work with stakeholders engaged in the air quality monitoring program to provide a progress report to the Peace River area community within six months of the issuance of this report. The report should describe
- a) progress that has been made in establishing the governance framework for the monitoring program,
 - b) progress that has been made in modelling or in characterizing emissions and odours, and
 - c) other efforts made to address the monitoring recommendations above.

REGULATORY

Background

[179] This section of the report examines existing AER and Government of Alberta policies and regulations relating to flaring, incineration, venting and air quality standards to identify regulatory gaps, and determine if changes were required to address odours and emissions in the Peace River area. Several submissions from interested parties spoke of the need for stronger and more comprehensive regulations to address off-lease hydrocarbon odours from oil and gas operations.

[180] The AER's SSG presented information to the Panel and answered questions on the AER's emissions-related requirements. Flaring and venting regulations have been in place in Alberta since 1938. Current requirements can be found in the *Oil and Gas Conservation Rules* and the *Oil Sands Conservation Rules*. These regulations make specific reference to a number of AER directives containing emissions related requirements, including *Directive 060*.

[181] *Directive 060* provides that venting of tank top or casing gas is not an acceptable alternative to conservation or combustion (flaring or incinerating). As previously noted, the AER defines conservation as the recovery of produced gas for use as fuel for production facilities, for other useful purposes (e.g., power generation), for sale, or for beneficial injection into an oil or gas pool (e.g., pressure maintenance, enhanced oil recovery). If gas volumes and flow rates at a site are sufficient to support stable combustion, gas that is not conserved must be flared or incinerated. The rule of thumb flow rate to support stable combustion is 500 m³/d of gas per site. Generally speaking, if gas volumes are greater than about 500 m³/d and less than 900 m³/d, gas may be flared (but not vented). Gas may only be vented where volumes or flow rates are below 500 m³/d and stable combustion of the gas is not possible.

[182] If there is more than 900 m³/d of gas being flared at a site, a licensee must conduct an economic evaluation to determine if the gas must be conserved.⁸ If this economic test is met, measures must be taken to conserve the gas. Regardless of economics, gas must also be conserved where the gas-oil ratio at a well is greater than 3000 m³/d, and where flared volumes are greater than 900 m³/d per site and the flare is within 500 m of a residence.

[183] During the Proceeding, the Panel heard from residents that the AER currently does not have a regulatory tool to address off-lease hydrocarbon odours. The SSG's written submission indicates that the AER previously had authority to address both off-site H₂S odours and hydrocarbon odours under *AER Directive 064: Requirements and Procedures for Facilities*. However, that directive is no longer in force, and the AER's current authority to address off-site odours from compounds other than H₂S is restricted to natural gas processing plants and oilfield waste management facilities.

[184] The SSG also provided information to the Panel regarding the new edition of *Directive 060*, which is still in draft form and is not yet in force. The draft edition of *Directive 060*

⁸ Section 2.5(a) of *Directive 060* states that the licensee or operator must conserve solution gas at all sites where combined flaring and venting volumes are greater than 900 m³/d per site and the decision tree process and economic evaluation (see section 2.8) result in a net present value of greater than minus \$50 000Cdn.

contains two new requirements which are of significance to the issues raised in the Proceeding. Once in force, these new requirements will

- allow the AER to direct the licensee, operator, or approval holder to conserve all produced gas (tank top and casing gas) at a site, regardless of economics;⁹ and
- provide the AER with additional jurisdiction to respond to issues and concerns about off-lease non-H₂S hydrocarbon-sourced emissions and odours.¹⁰

[185] The SSG also stated that it has developed a new protocol, in conjunction with the draft edition of *Directive 060*, the intent of which is to standardize the investigation and enforcement with respect to off-lease hydrocarbon odours. This protocol will apply the FIDL principles of frequency, intensity, duration, and location. A number of hearing participants stated their support for the proposed amendments in draft edition of *Directive 060*, and some shared their view that the draft directive should be released immediately. Once in force, the draft directive would assist the AER in dealing with odour issues in the in Peace River area.

[186] Counsel to the SSG also advised that the AER will soon have jurisdiction to issue environmental protection orders under the *Environmental Protection and Enhancement Act (EPEA)* where a person is responsible for a substance or thing that has caused or is causing an offensive odour.¹¹ Under this section of *EPEA*, the AER can direct broad remedial action to be taken by the person responsible.

[187] *Directive 060* currently states that facility operators must develop and implement a program to detect and repair leaks.¹² The program must meet or exceed the Canadian Association of Petroleum Producers (CAPP) *Best Management Practice (BMP): Management of Fugitive Emissions at Upstream Oil and Gas Facilities*. The SSG advised that, in general, the AER does not monitor whether an operator is implementing its fugitive management plan to identify and remedy fugitive emissions. However, the AER has monitored operator's remediation of fugitive emissions in the Peace River area due to the high number of complaints from area residents. The SSG also advised that the Canadian Standards Association (CSA) is developing fugitive emissions standards for the upstream oil and gas industry. The AER is involved in the development of these requirements and the intention is that these new standards will be incorporated into the AER's fugitive emissions requirements.

[188] *Directive 060* requirements are designed to ensure compliance with the AAAQOs. The AAAQOs are developed by ESRD under the authority of the *EPEA*. Objectives are developed for all or part of the province to protect Alberta's air quality. The AAAQOs establish guidelines for ambient air limits for specific air contaminants. ESRD did not make itself available for questioning, nor did it present information on the AAAQOs or other ESRD requirements that might pertain to odours and emissions from heavy oil operations.

⁹ Section 2.6(d) of the draft edition of *Directive 060*.

¹⁰ Section 8.2(3) of the draft edition of *Directive 060* states that venting and/or fugitive emissions must not result in any hydrocarbon odours outside the lease boundary that, in the opinion of AER, are unreasonable either because of their frequency, their proximity to surface improvements and surface developments (as defined in *Directive 056: Energy Development Applications and Schedules*), their duration, or the strength of their odour.

¹¹ Section 116 of *EPEA*.

¹² Section 8.7(1) of the draft edition of *Directive 060*.

[189] Odotech and RWDI, independent experts retained by the AER for the Proceeding, provided information about air quality standards and odour regulation in Alberta and other jurisdictions. ESRD has developed AAAQOs for 48 chemicals, most of which are health-based. Only three chemicals in the AAAQOs have thresholds that are odour-based: H₂S, CS₂, and ammonia (NH₄). As some of the chemicals would be expected to be odourous at levels below the AAAQOs, it is possible for an operator to comply with the AAAQOs, even though there are distinct and noticeable odours in the ambient air. RWDI noted that Alberta's existing air quality objectives do not cover a wide enough range of potential odourants and that the potential odourants covered have objectives that are likely too high, resulting in the existing objectives not being appropriate for minimizing potential odour impacts.

[190] Odotech recommended that the AAAQOs should be expanded to include a sensory-based ambient limit similar to that established in Ontario, Quebec, Manitoba, and Saskatchewan. RWDI also was of the view that an ambient odour concentration-based system would be well suited to enforcement by a regulator because it uses a quantitative methodology. RWDI recommended that the detailed and comprehensive procedure for determining odour impacts outlined in the 2012 *Saskatchewan Air Quality Modelling Guideline* could be used as a template for Alberta. This procedure is based on the odour units, which in RWDI's view eliminates the difficulty in determining odour detection thresholds and setting ambient odour objectives for multiple chemicals.

[191] Altex provided a summary of the regulatory requirements under which the transloading industry operates. Altex's transloading operations are predominantly regulated by Transport Canada and by applicable railway regulation. Transloading facilities must also be permitted in accordance with the requirements of the local municipality. Northern Sunrise County indicated that transloading operations were permitted in its jurisdiction only after significant research, legal opinions, and deliberation by Council, and ultimately, an amendment to the County's Land Use Bylaw allowing for this type of development. Altex also indicated that it follows the requirements of *Directive 017* with regard to transfer of product to its facilities. Altex also indicated that it has an emergency response plan for each of its facilities, which has been developed in consultation with local authorities and emergency departments.

[192] Some residents expressed concerns about the lack of and immediate need for comprehensive regulation of the transportation of heavy oil to transloading facilities and called upon the Government of Alberta to review the need for further regulation. Some residents cited transportation related health and safety concerns and the need for total capture of emissions from all transportation vessels, including railcars.

Findings

[193] The current edition of *Directive 060* allows the AER to take enforcement action for off-lease H₂S odours. *Directive 060* also prohibits operators from exceeding the AAAQOs for specific compound such as H₂S and SO₂. Therefore, the AER can monitor and compare ambient concentrations of these compounds against the AAAQOs and take appropriate enforcement action if exceeded. However, there are no AAAQOs for total hydrocarbons and the AER does not currently have a regulatory tool to enforce against off-lease hydrocarbon odours from compounds other than H₂S. The Panel finds that this has created a regulatory gap that prevents the AER from enforcing against most hydrocarbon odours. A number of parties in the

Proceeding, including the SSG, identified the same gap in the current regulatory scheme. Accordingly, the current regulatory AER and ESRD framework is not sufficient to effectively manage hydrocarbon odours and emissions such as those in the Peace River area.

[194] The Panel notes the recommendations from the experts regarding regulatory approaches being developed in other provinces, such as Saskatchewan and Ontario, to regulate odours based on perception thresholds. These requirements apply across industries, but may be industry specific. The appropriateness and implementation of regulatory approaches that could be multi-industry and province-wide, is beyond the scope of this Proceeding. However, it may be a matter of interest to ESRD in managing odour issues in the province.

[195] In regards to the oil and gas industry, the Panel is of the view that the proposed changes to *Directive 060* would result in establishing enforcement authority for off-lease odours related to oil and gas activity. The Panel understands that this would be based in part, on the FIDL factors that were recommended by the independent experts.

[196] The Panel finds that the draft edition of *Directive 060* is a good improvement to address odours and encourages the AER to continue to ensure that enforcement of this requirement is applied consistently and as objectively as possible, recognizing that odours are a complex and subjective issue. The support expressed by parties in relation to the draft edition of *Directive 060* suggests to the Panel that the AER should approve and release the draft directive in its current form as soon as possible. It would also be beneficial for the AER to review this report and consider the need for any additional amendments to *Directive 060*. However, any identified need for future amendments should not delay the timely release of the current draft edition of *Directive 060*.

[197] In addition, by the end of March 2014, the AER will have authority under section 116 of the *EPEA* to enforce against odours and to direct operators to take remedial actions. Taken together, the AER is satisfied that these new regulatory measures, once available to the AER, will address the “regulatory gap” identified by RWDI and other parties to the Proceeding.

[198] As previously noted, the geologic and geochemical aspects of the Gordondale-sourced bitumen deposits, the number of complaints, and the inability to resolve these concerns are unique features of heavy oil operations in the Peace River area. The Panel has provided recommendations, some of which, at least at this time, would apply only to the Peace River area. Accordingly, the Panel encourages the AER to consider implementing a localized or “play-based” approach in the Peace River area to establish requirements to address the unique operating challenges of the area.

[199] In establishing play-based requirements, the AER should have regard for the findings and recommendations in the other sections of this report that address the unique features of the heavy oil produced in the Peace River area. The play-specific outcome would have the goal of eliminating concerns regarding health effects by focusing on reducing and ultimately eliminating exposure to odours and emissions.

[200] Regarding the concerns raised by residents in relation to transloading facilities, the Panel noted Altex’s evidence that it operates under various different regulatory requirements, and also in a manner that is consistent with AER requirements in anticipation of being regulated by the AER. With respect to the health and safety concerns raised by residents regarding transloading

operations, the Panel finds that Altex has implemented adequate safety measures and procedures at its facilities, including collaborating with local authorities on emergency response plans. Lastly, as noted in the Operations section of this report, Altex's transloading facilities are closed loop and designed to capture all vapours. The Panel is satisfied that Altex's transloading operations are subject to regulatory oversight at several different levels, and its practices regarding emissions and odours from its operations appear to meet or exceed many of the AER's current requirements.

Desired Outcome

[201] The AER and other regulatory authorities would administer a regulatory regime, enhanced by voluntary industry best operating practices, that supports the AER's vision of responsible energy development. The regime would, among other things, address, mitigate, and minimize odours and emissions from heavy oil operations in the Peace River area.

Recommendations

[202] The Panel recommends that

- 1) the AER establish localized, "play-based" regulatory requirements for all heavy oil operations in the Peace River area that are producing or will produce Gordondale-sourced bitumen;
- 2) the AER release the current draft edition of *Directive 060* as soon as possible, with any additional changes arising in response to the recommendations of this report to be developed in a timely manner; and
- 3) ESRD assess the feasibility of defining an ambient odour objective for Alberta based on a perception threshold.

STAKEHOLDER ENGAGEMENT

Background

[203] Stakeholder engagement is a process that brings together groups or individuals with diverse backgrounds and interests for the purpose of collaborative problem solving, building trust and maintaining relationships. For oil and gas developments, the stakeholder engagement process is usually initiated by an operator and involves area residents, local municipalities, other area operators, regulatory staff, and staff from relevant government agencies. This section of the report discusses some of the initiatives undertaken to date in the Three Creeks and Reno areas and the residents' views on the stakeholder engagement activities and considers opportunities for fruitful engagement in the future.

[204] Commencing in February 2010 and in response to the increased number of complaints from the area residents, a number of activities involving industry, the AER, and other government agencies, were initiated, including newsletters, open houses, community meetings, and technical working groups. A number of these stakeholder engagement activities were a part of the various initiatives implemented in the area and are described in further detail in appendix 5.

[205] Notwithstanding the efforts that began in 2010, some residents submitted that they remained frustrated at what they perceived to be the lack of meaningful, respectful, and successful opportunities that made progress in addressing their concerns. The Panel notes that there were a number of stakeholder engagement activities that attempted to establish working groups to bring together industry, the AER, and the area residents. However, those activities were unsuccessful. Further, the Panel notes that Synergy Alberta was consulted and that a third-party mediator was retained to try to facilitate stakeholder engagement activities. Neither initiative was successful.

[206] Some residents also cited their attempts to obtain data from area health studies and monitoring information without success and having to use the *Freedom of Information and Protection of Privacy Act* to access information they felt should be readily available from the AER or from operators. They stated that some processes were not very useful or were "one-way" and, for example, were used to inform them about a study or other course of action after the fact. Residents also spoke about their desire to obtain information about area development as opposed to hearing about development on a well-by-well basis, and a general lack of resources to facilitate meaningful communications with industry. This lack of information did not instill much confidence in CHOP operations, the various monitoring programs, or the AER's efforts to address concerns. Some residents stated that the onus should not be on them to have to go to great lengths to obtain information they believed they needed to determine whether they were being affected to be able to participate within the regulatory process. Instead, operators and the AER should be providing the information to them on a proactive basis and broadening opportunities for public engagement in the approval process.

[207] Some residents expressed dissatisfaction with the process for responding to their complaints about odours and emissions. The SSG explained that in March 2010, the AER worked with ESRD to initiate a hydrocarbon odour complaint protocol for the Three Creeks area. The process was for residents to phone their complaints to the field centre. AER staff then contacted the operators of the area facilities and requested that the company inspect its

operations for anything that may have been causing or contributing to the odours. Once the AER was in receipt of the inspection report, the information was reviewed, summarized, and then relayed back to the complainants by the AER. The AER followed up with the licensee if further information was required.

[208] Residents submitted that the protocol was not adequate as responses were not timely (given that odours were usually short-term events), that investigations should have been carried out by AER field personnel or third-party staff, and that the subsequent reports contained insufficient detail and were not meaningful. In 2012, the AER created the Hydrocarbon Emission Response Committee (HERC), which was a multistakeholder committee, to review the odour response protocol. The Panel understands that, at the time of this report, HERC was working on a new protocol for the Three Creeks area.

[209] Despite the frustrations and concerns noted above, the Panel heard that certain residents and operators were willing to work together in activities such as forming a regional airshed program to generate air quality data and analysis to characterize emissions and inform decision making. The local municipality expressed interest in using the Synergy Alberta model to start a synergy group in the region. Shell and Baytex spoke of their willingness to proactively engage with residents. Shell described the Comprehensive Regional Infrastructure Sustainability Plan (CRISP), a long-term, collaborative planning process that addresses regional infrastructure needs associated with the development of Alberta's oil sands. At the time of this report, a CRISP initiative was underway for the Peace River region.

[210] In summary, residents, along with other stakeholders, expressed their willingness to participate in future consultation processes that are respectful and have the objective of producing meaningful actions or plans aimed at mitigating resident concerns.

Findings

[211] The Panel notes the amount of time and effort that all stakeholders, including AER staff, invested in stakeholder engagement. However, a large amount of frustration appears to remain at the lack of progress in resolving concerns. The Panel finds that there are opportunities for better information sharing among stakeholders. The Panel is of the view that if another multistakeholder group is initiated and is successful, it will likely result in improving communication and dissemination of relevant information among the participants.

[212] The Panel also believes that local residents' dissatisfaction with the AER's protocol for responding to odour complaints was due in part to AER staff not being able to personally conduct an on-site inspection for each event. The Panel appreciates the high volume and the resource limitations involved in responding to these complaints. The Panel finds that, going forward, increased presence and availability of AER staff in the Peace River area to respond to complaints and discuss concerns directly with residents will enhance stakeholder confidence in the AER.

Desired Outcome

[213] Stakeholders, including residents, industry, and the AER, would work together in an atmosphere of trust and mutual respect, to share information, and cooperatively identify and implement effective and reasonable operational changes. The expectation is that this work would

begin with a focus on reducing odours and emissions, and monitoring the effects that these changes have on regional air quality.

Recommendations

[214] The Panel recommends that

- 1) the AER provide support to allow stakeholders to work together and determine what stakeholder engagement processes would meet their needs on a go-forward basis, and
- 2) the AER enhance its operational and enforcement presence in the Peace River area.

CONCLUSION AND ACKNOWLEDGMENTS

[215] This Proceeding was initiated to examine the issues and concerns of local resident about odours and emissions from heavy oil operations in the Peace River area, specifically those in the Three Creeks and Reno areas. The Proceeding was an important opportunity for all stakeholders, including the residents, to explain their concerns, present information, and suggest solutions for the Panel's consideration. The Panel received extensive written submissions and in response acknowledges the valuable and sincere contribution of residents, oil and gas operators, and various experts. The extensive information received from some area residents is affirmation of their desire to fully engage in the process and find solutions. The Panel also recognizes the commitment of oil and gas operators in attempting to pinpoint the source of the odours and emissions and in addressing the residents' concerns.

[216] In accordance with its mandate in this Proceeding and under *REDA*, the Panel has carefully considered all of the submissions. In developing its recommendations, the Panel has taken into account the concerns and interests of the area residents, the environmental and social impacts of heavy oil operations, as well as the economic benefits of this significant resource. Looking forward, the Panel is confident that the necessary work will be undertaken to implement the recommendations in this report and that the proposed measures will considerably reduce odours and emissions and resolve many of the concerns of the residents.

Dated in Calgary, Alberta, on March 31, 2014.

ALEBRTA ENERGY REGULATOR

<original signed by>

B. T. McManus, Q.C.
Presiding Hearing Commissioner

<original signed by>

C. Macken
Hearing Commissioner

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Hearing Commissioner

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T. C. Engen
Hearing Commissioner

APPENDIX 1 PROCEEDING PROCESS

The Panel decided to conduct the Proceeding in 4 distance phases, beginning with the organizational meeting as Phase 1. Phase 2 addressed expert selection and the gathering of background information through written comments from the parties. In Phase 3A, participants were invited to provide written comments on potential solutions and recommendations. In Phase 3B, parties had the opportunity to respond to any written comments, reports from experts, and potential recommendations received in earlier phases. Phase 4 was the hearing itself.

The AER participated in the Proceeding through a staff submission group (SSG) who provided information about current and past efforts by the AER to address the issues before the Panel. The SSG was independent of the Panel and the Panel's staff, and was provided its own counsel and did not have contact with the Panel during the Proceeding.

Phase 1: Organizational Meeting

The purpose of the organizational meeting was to receive comments from interested parties on the scope and process of the proceeding. Peace River area residents were also invited to provide preliminary comments on their concerns about odours and emissions from heavy oil operations in the area. On October 23, 2013, the organizational meeting decision (*Decision 2013 ABAER 018*) was issued, which set out the final purpose, mandate, and objective of the Proceeding, including a detailed schedule for the conduct of the Proceeding and submissions from participants. The decision also set out details of the public hearing portion to commence on January 21, 2014.

The Panel encouraged people that were interested in the Proceeding to register so that they could receive updates and information related to the Proceeding. Parties could choose to participate in the Proceeding by filing information and speaking at the hearing. All information considered by the Panel was made available to the public on the AER's website. The organizational meeting decision also set out a funding regime for participants who wished to apply for costs in order to support their participation in the Proceeding. Area residents were encouraged to consider participating as a group, where feasible, to minimize costs of participating.

The organizational meeting decision also set out the issues that the Panel determined would be within the scope of the Proceeding, which were as follows:

- 1) impacts from heavy oil operation emissions and odours, as expressed in the concerns of Peace River area residents and other local stakeholders;
- 2) relevant expert scientific information about human and animal health impacts from emissions and odours related to heavy oil operations;
- 3) the nature and sources of odours and emissions associated with heavy oil operations, including the transportation of energy resources from these operations, and the monitoring of those emissions in the area;
- 4) existing Government of Alberta and AER policies, initiatives, and regulations relating to flaring, incinerating, venting, and air quality standards to determine if amendments are needed to address odours and emissions from heavy oil operations;

- 5) possible technical and regulatory solutions that address short-term and long-term impacts of odours and emissions from present and future development of heavy oil operations in the area (including current stakeholder initiatives, potential regulation amendments, opportunities for solution gas gathering or conservation, and access to information regarding development in the area);
- 6) potential impacts on licensees/operators of mandating reduction of emissions from heavy oil operations; and
- 7) specific geographic and geological information about the relevant play within the Peace River area, its reserves, and recovery potential. This would include consideration of potential economic, social, and environmental impacts of recommendations made by the panel to the Government of Alberta, local municipalities, the public, industry, and other stakeholders.

Phase 2: Selection of Experts and Gathering of Information

The Panel retained independent experts to prepare reports on the areas within the scope of the Proceeding. The experts were independent of the Panel and its staff and their reports were placed on the public record so that all registered parties could review and comment on these reports. This approach also negated the need for parties to retain and fund particular experts. A list of proposed experts was posted to the AER's website and sent to registered parties who were invited to comment on the proposed experts or suggest their own experts and topics to be addressed in the experts' reports. The Panel received a number of submissions suggesting the names of individual experts. The Panel's final selection of experts was based on the comments received from parties, the experts' qualifications, and their availability to participate in the proceeding. The panel established statements of work for topics to be covered in the expert reports after considering the comments received from parties.

The independent experts had access to an online repository to facilitate access to and exchange of information between themselves. The Panel also required the experts to participate in the hearing in Phase 4 to present their reports and answer questions from other participants.

Experts were retained in the following areas:

- Human and Animal Health
- Geology and Geochemistry
- Emissions Dispersion Modeling
- Regulatory Framework in Alberta and Other Jurisdictions
- Odour and Emissions Characterization
- Process Engineering and Facility Design and Operation

Registered parties could also identify or provide additional reports and documents that were relevant to the issues within the scope of the proceeding. Many of these documents were added to the public record and available through the AER's website. The panel decided the information

gathering should begin with information to establish the factual background to the proceeding. Phase 2 invited participants, which included the independent experts, to provide information in order to understand the nature and extent of the development in the area, the concerns of the local residents, and initiatives that implemented to resolve these concerns. All received submissions were put onto the public record of the proceeding and available on the AER's website.

Phase 3A & 3B: Initial Solutions and Recommendations and Responses

After the information related to the factual background was provided in Phase 2, Phase 3A invited participants to review the factual background information and provided submissions on potential solutions and recommendations for possible technical and regulatory changes to address the residents' concerns. These submissions should have also addressed the potential impacts on licensees/operators as a result of these solutions. In Phase 3B, participants could provide final comments on the initial solutions and recommendations, including possible technical and regulatory changes, and the potential impacts of the proposed solutions.

Phase 4: Hearing

A hearing was held at the Belle Petroleum Conference and Business Centre in Peace River, Alberta, starting on January 21, 2014. The hearing was to provide participants who had filed written comments in the Proceeding with an opportunity to present information from their submissions and to ask questions of other participants about their submissions. The independent experts retained by the panel presented their information and were available for participants to question the experts about the submissions they had filed. The hearing was divided into the five topics set out in the organizational decision, namely:

- Geology
- Initiatives
- Operations
- Residents/Landowner' Concerns
- Impacts (including human and animal impacts)
- Solutions

Transcripts for the hearing were provided on the AER's website, as well as documents that were provided to the Panel at the hearing. After sitting for eight hearing days, the hearing closed on January 31, 2014.

APPENDIX 2 SUMMARY OF RECOMMENDATIONS

Geology

The Panel recommends that

- 1) The AER conduct or require operators in the Peace River area to submit a geochemical analysis of the volatile compounds from the heavy oil from the Gordondale-sourced bitumen
 - (a) at surface prior to processing and
 - (b) from the tank prior to transport.

Health

The Panel recommends that

- 1) the Government of Alberta encourage the research community to conduct studies that would assist policy makers and regulators to better understand potential linkages between odours and emissions from heavy oil operations, including long-term exposures to individual chemicals and chemical mixtures, and health effects; and
- 2) Alberta Health ensure that appropriate avenues exist to link local physicians with specialists in environmental health to assist in diagnosing symptoms associated with odours and emissions from heavy oil operations and to enable physicians to provide appropriate treatment to residents.

Operations

The Panel recommends that

- 1) the AER require that all produced gas be captured. Tank top gas will be captured using a VRU
 - a) within four months from the issuance of this report in the Reno and Three Creeks areas, and
 - b) immediately with respect to all new operations in the Peace River area.

The captured gas may be sent to a flare or incinerator until such time that the feasibility study (discussed in recommendation 5 of the Operations section) is implemented;

- 2) each operator in the Seal Lake and Walrus areas provide a report to the AER within two months of the issuance of this report outlining its plan to install VRUs to eliminate venting from existing facilities. The Panel expects the AER, after considering the information in such reports, to work with operators to implement an appropriate and timely plan to eliminate venting;
- 3) following implementation of gas capture measures contemplated in these recommendations, the AER prohibit venting from all facilities. In the event of an emergency or upset situation

and where flaring infrastructure is not available (which results in venting), the well must be immediately shut in;

- 4) where gas conservation measures have been implemented, and where upsets and/or emergencies occur, the AER require that flaring be limited to a maximum of three percent of the annual operational time, with the duration of the flaring reported to the AER monthly;
- 5) toward the objective of conserving all captured gas, the AER require that by October 31, 2014, operators, either collectively or independently, provide a feasibility study to the AER into options and timelines to conserve all gas at sites in the Peace River area. The Panel expects that the AER, after considering the information in the feasibility study, will require operators to implement an appropriate conservation plan;
- 6) the AER require that operators conduct monthly fugitive emission inspections using appropriate equipment (e.g., FLIR camera). The results of monthly fugitive emission inspections must be submitted to the AER for review and made available to area stakeholders;
- 7) the AER require that where sources of fugitive emissions are identified, these be repaired within 12 hours of being detected or the facility be shut down until such repairs are completed. Repair responses would be submitted to the AER for review and made available to area stakeholders;
- 8) the AER require that operators implement measures (such as scrubbing or recovering displaced truck tank emissions) to minimize odours from truck loading and unloading activities; and
- 9) the AER should review the results of the Stantec and Clearstone studies and
 - a) require operational changes in the Three Creeks area, if necessary, to reduce odours and emissions from sources identified in those studies;
 - b) determine the applicability of the results and operational changes to the other Peace River areas.

Monitoring and Modelling

The Panel recommends that

- 1) the AER engage industry, residents, and stakeholders to establish a scientific and technically credible regional air quality monitoring program for the Peace River area that, to the extent possible,
 - a) builds on the efforts of the existing continuous monitoring program;
 - b) includes the Reno area;
 - c) considers the studies and monitoring surveys conducted to date by ESRD, industry, Stantec, RWDI, Clearstone, Chemistry Matters, Odotech, and Dr. Zelt;

- d) provides greater geographic and spatial coverage by monitoring in areas of anticipated highest concentrations and where people might be exposed to emissions and odours;
 - e) is operated collaboratively by industry, residents, the AER, and other government agencies (using a Clean Air Strategic Alliance [CASA] type model);
 - f) provides transparent and real-time data to residents and stakeholders; and
 - g) assesses innovative monitoring technologies to better understand odours and emissions sources, and use the technology where appropriate;
- 2) the AER require that holders of new approvals issued in the Peace River area join the regional monitoring program; and
 - 3) the AER work with stakeholders engaged in the air quality monitoring program to provide a progress report to the Peace River area community within six months of the issuance of this report. The report should describe
 - a) progress that has been made in establishing the governance framework for the monitoring program,
 - b) progress that has been made in modelling or in characterizing emissions and odours, and
 - c) other efforts made to address the monitoring recommendations above.

Regulatory

The Panel recommends that

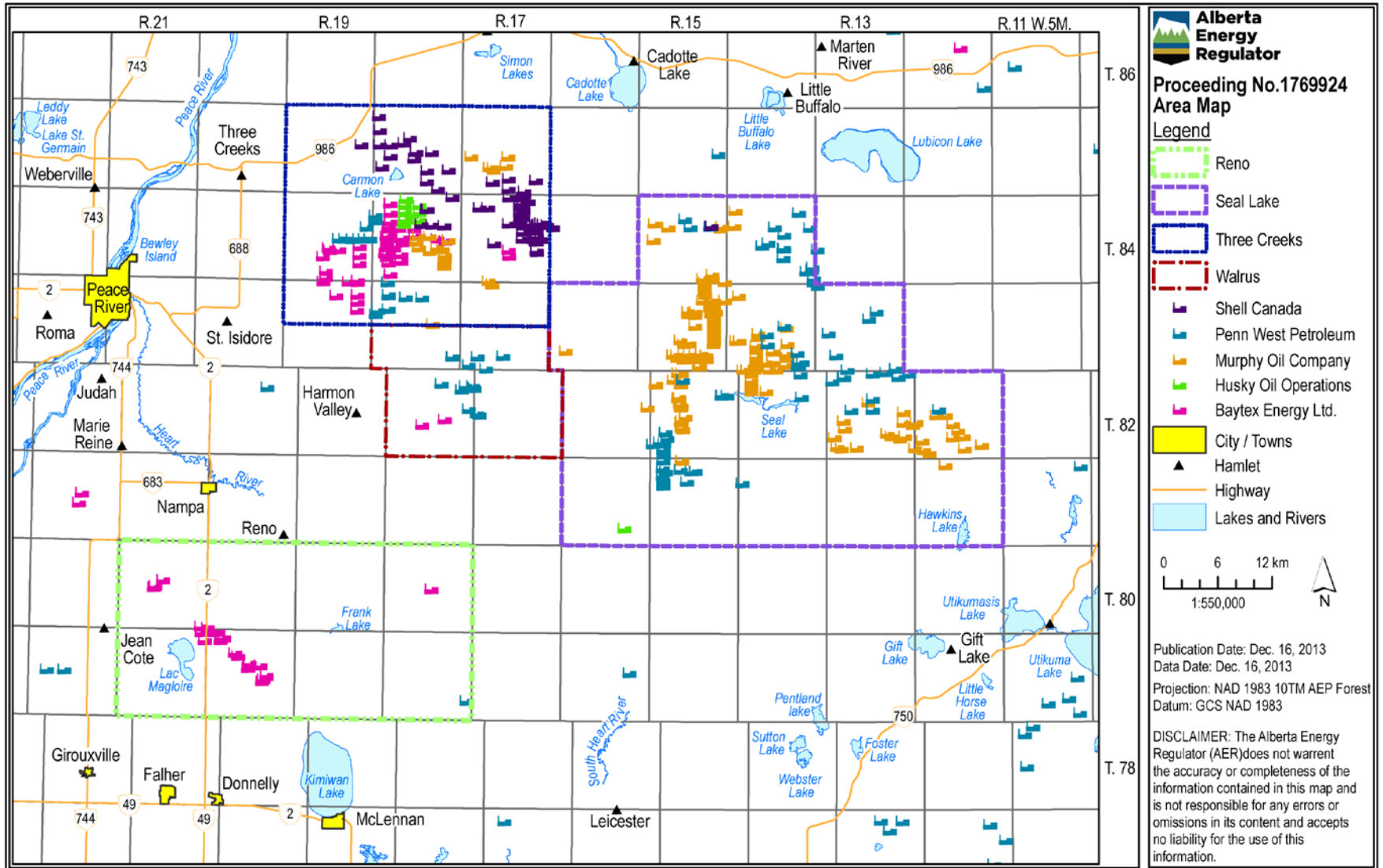
- 1) the AER establish localized, “play-based” regulatory requirements for all heavy oil operations in the Peace River area that are producing or will produce Gordondale-sourced bitumen;
- 2) the AER release the current draft edition of *Directive 060* as soon as possible, with any additional changes arising in response to the recommendations of this report to be developed in a timely manner; and
- 3) ESRD assess the feasibility of defining an ambient odour objective for Alberta based on a perception threshold.

Stakeholder Engagement

The Panel recommends that

- 1) the AER provide support to allow stakeholders to work together and determine what stakeholder engagement processes would meet their needs on a go-forward basis, and
- 2) the AER enhance its operational and enforcement presence in the Peace River area.

APPENDIX 3 MAP OF THE PEACE RIVER AREA CONSIDERED IN THE PROCEEDING



APPENDIX 4 HEARING PARTICIPANTS

Principals and Representatives (Abbreviations used in report)

Witnesses

Baytex Energy Ltd (Baytex)
K. Miller, Counsel

D. Colley, of
Clearstone Engineering
D. Dueck
C. Filek
M. Proctor
C. Sandau, of
Chemistry Matters
R. Ramsay

Altex Energy Ltd.

A. Bishop

Greatario Covers Inc.

T. Frank

Airdar Inc.

D. Prince

Landowners and Residents

D. Dahm
D. Dallyn
R. Glenn
C. Langer
M. Laliberte
V. Laliberte
W. Laurin
D. Plowman
K. Rich, of
Duncan's First Nation
M. Roberts

Northern Sunrise County
(unsworn)

C. Kolebaba
J. Sopko
P. Thomas

Penn West Exploration (Penn West)
S. Munro, Counsel

Reno Landowners' Group
K. Wilson

A. Labrecque
A. Labrecque
B. Labrecque
J. Labrecque
K. Labrecque

L. Labrecque
M. Labrecque

Shell Canada (Shell)
T. Grimoldby

R. Blachford
A. Fisher
J. Grant
M. Mayes

Independent Experts

D. Chadder, of
RWDI Air
D. Davies, of
Intrinsic Environmental Sciences
M. Fowler, of
Applied Petroleum Technology
R. Porter, of
Odotech
S. Ramsay
M. Sears (medical health researcher)
C. Waldner (veterinarian and professor)
B. Zelt (air quality dispersion modeler)

AER Staff Submission Group (SSG)
R. Marx, Counsel
B. Kapel Holden, Counsel

A. Duben
K. Fiakpui
J. Grant
C. MacDonald
G. McClenaghan
G. Palanca
S. Thomas

Alberta Energy Regulator staff

D. Burns, Counsel
S. Sexton, Counsel
R. Bartlett
L. Chartrand
B. Curran
D. Miles
L. Olsen
S. Power
S. Roth
J. Ryan
M. Schuster
J. Vaughan
M. Zelensky

APPENDIX 5 INITIATIVES

Current Initiatives

- Hydrocarbon Emission Response Committee (HERC)

A multistakeholder group initially created by the AER in November 2012 to review the existing odour response protocol, determine if a new response is required, and design a new response to manage odour and emission complaints in the Three Creeks area if necessary. HERC is currently hiring a third-party facilitator to help guide the group.

- Fugitive Emission Standards (Canadian Standards Association)

Developing fugitive emission standards for the upstream oil and gas industry. The AER participates in this committee and will consider the adoption of a Canadian Standards Association requirement for fugitive emissions management.

- Petroleum Alliance Technology of Canada (PTAC) Heavy Oil Odour Management Technology and Best Management Practice (BMP)

PTAC is developing a report on odour management and best practices relating to heavy oil. AER staff sits on the PTAC Air Research Planning Committee.

- Comprehensive Regional Infrastructure Sustainability Plan (CRISP)

Long-term, collaborative planning approaches to address infrastructure needs associated with Alberta's oil sands areas. A CRISP is currently underway for the Peace River region. This initiative is ongoing.

- Operator Meetings

The AER facilitated meetings with area licensees and government agency representatives to exchange information and technical collaboration. These meetings occurred monthly from February 2010 to May 2011. However, the AER still facilitates meetings with industry members when they determine a need.

- Area Specific Odour Complaint Protocol

In March 2010, the AER, in collaboration with ESRD, initiated a hydrocarbon odour complaint response for the Three Creeks area to ensure that the companies operating heavy oil production sites in the Three Creeks area immediately report to the heavy oil field outlined in a specific boundary and inspect their operations for anything that may be causing or contributing to the odours being detected by the complainants. Once the AER is in receipt of the inspections, the information is reviewed, summarized, and then relayed back to the complainants by the AER. The AER does communicate with the licensee if further information is required.

- Industry Air Quality Working Group (IAQWG)

This group consists of environmental experts from each of the five companies in the Three Creeks area who are working towards achieving the following objectives: implement credible, science-based air quality monitoring and emissions inventory related studies in the Three Creeks area; communicate the air quality data to all interested parties; and recommend changes to operating practices so that odours and emissions can be better managed. This group also supports the multistakeholder air quality committee. This group formed in May 2013.

- Industry Best Practices Working Group

Representatives from Husky, Shell, Baytex, Murphy, Penn West, and Tervita, along with road transport representatives in the Three Creeks area participate in this group. Collectively, they work to identify best operating practices and best equipment options, implementing efforts that support a minimum venting operating culture and efforts to reduce road-use impacts. The group formed in May 2013.

- Three Creeks Industry Steering Committee

Representation by senior operational management from each of the licensees involved in the area. This committee was formed May 2013 and promotes industry best practices, shares equipment design, establishes odour and emission monitoring systems, identifies and reduces sources of emissions and odours, coordinates industry efforts with government regulators and agencies, and reduces transportation impacts caused by heavy oil production traffic.

- Multistakeholder Air Monitoring Subcommittee

Created in 2011, this multistakeholder group's scope is to gain a better understanding of the emissions, air quality, and meteorological data in the Three Creeks area in order to strengthen future decision-making in the area.

This subcommittee awarded Stantec a contract to conduct an air monitoring and data review study and awarded Clearstone a contract to conduct an emissions inventory, both in the Three Creeks area. These studies are expected to be completed by mid-2014.

- 842 Road Use Strategy

Residents living along the Township Road 842, in the Three Creeks area have expressed concerns with the volume of traffic and other related road-use concerns since the road was opened up to the heavy oil field known as the Three Creeks field. In collaboration with Northern Sunrise County and the residents in the area, Baytex has led an industry-sanctioned effort to examine alternative access routes. This initiative looks at moving the main access road into the Three Creeks field to Township Road 840. Industry is willing to fund a portion of this cost, and Northern Sunrise County will need to finance the remainder.

- Peace Airshed Zone Association (PAZA)

The Reno area falls within the northern region of PAZA's monitoring boundary. In November 2013, PAZA moved their roving continuous air monitoring unit into the Reno area and will leave it in the area until May 2014. The unit was set up with a total hydrocarbon analyzer, and its data is available to the public on PAZA's website as well as housed in CASA's data warehouse. This is an ongoing but temporary initiative.

- Draft edition of *Directive 060*

Proposed revisions to *Directive 060* are intended to provide the AER with additional jurisdiction to respond to concerns about off-lease hydrocarbon odours and emissions. These proposed revisions are intended to bring hydrocarbon odour requirements in alignment with existing requirements for processing plants and waste management facilities. At the time of writing, this initiative is currently waiting for final release.

- Unconventional Regulatory Framework (URF)

Intended to deliver a new regulatory approach, designed to manage AER approvals and regulations based on a play instead of by the well.

- Draft Production Operation Directive

Draft AER directive which will focus on flame-type equipment, potentially addressing tank heater temperatures.

- Comprehensive provincial framework for odour management

CASA is developing a framework that will focus on odour complaints as well as the assessment, prevention, mitigation, enforcement, health, education, and continuous improvement for all adverse odours. CASA expects to have its work on the odour management initiative complete by either the end of 2014 or early 2015. The team will be working to develop a good practice guide for assessing and managing odour in Alberta and will include a toolkit with a variety of user-friendly tools that support odour assessment and management as well as an understanding of when it is appropriate to use each of the tools. By improving odour management and assessment in Alberta, the team aims to reduce the negative impacts of odour on ecosystem and community health. This toolkit would be available for communities, industry, and governments to use in addressing local odour concerns. The AER participates in the working groups.

Completed Initiatives

- Focused Inspection Team (FIT)

Organized by the AER in February 2013 with the purpose of increasing AER staff presence in the Peace River heavy oil area, identifying interdependencies between existing and future area development, increasing the AER's understanding of the resource and area operations, and conducting a technical field review of cold heavy oil production operations in the Peace River heavy oil area. This initiative is closed.

- Responsible Actions: A Plan for Alberta's Oil Sands

In 2009, the Oil Sands Sustainable Development Secretariat outlined an integrated approach for all levels of government, industry, and communities to address the economic, social, and environmental challenges and opportunities in the oil sands regions. The report is general in nature and does not specifically focus on cold heavy oil production.

- Cold Heavy Oil Production With Sand in the Canadian Heavy Oil Industry

This 2002 report explored technical, economic, and environmental issues related to cold heavy oil production with sand (CHOPS) at that time.

- Three Creeks Working Group (TCWG)

Multistakeholder group initially formed by the AER. The group met monthly to discuss the concerns and issues relating to the heavy oil production operations in the Three Creeks area and allowed for education and awareness presentations on various aspects, as determined by the group. The AER remained an active participant in the group. During its last year of operation, the group was facilitated by a third party that was selected by the residents. The group operated from July 2010 to September 2012.

- Monthly Newsletters

The AER sent out monthly newsletters that included summaries of the AER's, GoA's, and industry's efforts to address the Three Creeks community concerns. The newsletters were distributed to mainly Three Creek area residents. However, the distribution list was open to anyone who asked to receive the newsletter. The AER began distributing the newsletters in March 2010 and continued to do so until August 2011.

- Open Houses

The AER hosts open houses to give the public an opportunity to bring concerns forward and encourage the sharing of information between all stakeholders. In May 2010, the AER hosted one community open house in the Three Creeks area and participated in the second open house hosted by ESRD in July 2010.

- Reno Air and Health Quality Study

Proactive study initiated by Baytex in February 2013, specific to their Reno field. The study included Clearstone who completed an assessment and inventory of Baytex's Reno atmospheric emissions. RWDI Air Inc. completed an air quality and odour assessment as well as a letter with recommendations for Baytex to reduce off-site odours. Chemistry Matters completed an ambient air study, which included health impacts.

- Synergy Alberta Review of Operational Concerns in Three Creeks Area

Following the dissolution of the TCWG, Synergy Alberta was approached by stakeholders and was asked to study the Three Creeks situation and make recommendations for moving forward with a multistakeholder process. A report with recommendations was made available to the stakeholders in February 2013. This report was submitted as documentation for this Proceeding.

- Alberta Health and Agriculture Human and Animal Health Survey

A survey was carried out in the Three Creeks area in April 2011. Questions regarding human health as well as the health of companion and livestock animals were included in the survey. Results were presented to residents in December 2011. The purpose of this survey was solely to provide an opportunity for all residents in the Three Creeks area to provide feedback and information about local odour concerns.

- ESRD's Soil, Snow, and Water Sampling Report

Following public concerns relating to heavy oil operations in the Three Creeks region, ESRD led a study in spring 2010 on the potential hydrocarbon contamination due to emission deposition on the snow, soil, and water. This study was only to be considered as a preliminary sampling initiative.

- ESRD's Air Quality Monitoring reports

In May 2010, ESRD completed two phases of air quality monitoring in the Three Creeks area.