



Grizzly Resources Ltd. and Sinopec Daylight Energy Ltd.

Applications for Well, Pipeline, and Facility Licences
and a Regulatory Appeal of a Pipeline Licence
Pembina Field

October 31, 2013

ALBERTA ENERGY REGULATOR

Decision 2013 ABAER 019: Grizzly Resources Ltd. and Sinopec Daylight Energy Ltd.,
Applications for Well, Pipeline, and Facility Licences and a Regulatory Appeal of a Pipeline
Licence, Pembina Field

October 31, 2013

Published by

Alberta Energy Regulator
Suite 1000, 250 – 5 Street SW
Calgary, Alberta
T2P 0R4

Telephone: 403-297-8311
Toll free: 1-855-297-8311
E-mail: Hinfoservices@aer.ca
Website: [Hwww.aer.ca](http://www.aer.ca)

CONTENTS

Decision	1
Introduction.....	1
Applications	2
Background.....	4
Interventions	4
Prehearing.....	5
Hearing.....	5
Issues.....	6
The Need for the Projects	6
Grizzly’s Proposed Well.....	6
SDEL’s Proposed Pipelines and Facility Upgrades.....	7
Findings.....	7
The Adequacy of Public Notification and Consultation.....	8
Grizzly’s Proposed Well.....	8
SDEL’s Proposed Pipelines and Facility Upgrades.....	8
4-27 to 16-14 Pipeline.....	10
Findings.....	11
Project Design and Infrastructure Proliferation	12
Grizzly’s Proposed Well.....	12
SDEL’s Proposed Pipelines and Facility Upgrades.....	13
Findings.....	15
Emergency Planning and Response Capability	17
Grizzly’s Proposed Well.....	17
SDEL’s Proposed Pipelines and Facility Upgrades.....	19
4-27 to 16-14 Pipeline.....	21
Findings.....	22
The Risk of Human Health Effects.....	25
Human Health Outcomes of H ₂ S Endpoints.....	26
Findings.....	29
H ₂ S Risk Assessment.....	30
The Nature of Risk Assessment.....	30
The Panel’s Risk Assessment Requirements	31
Societal Tolerability of Risk Levels	32
Comparison of Methodologies.....	32
Release Frequency Data.....	33
Estimated Risks for the Three Endpoints.....	34
Lethality Endpoint	34
EPZ Endpoint.....	34
Evacuation Endpoint.....	35
Findings.....	35
Conclusion	36

Appendices

1	Hearing Participants.....	39
2	Summary of Conditions and Commitments.....	41

Figures

1	Area map with EPZs	42
2	Annual risk for the H ₂ S lethality endpoint during drilling	43
3	Annual risk for the H ₂ S lethality endpoint during production.....	44
4	Annual risk for the H ₂ S EPZ endpoint during production.....	45
5	Annual risk for the H ₂ S evacuation endpoint during production.....	46
6	MIACC's risk-based land use planning guideline	47

ALBERTA ENERGY REGULATOR

Calgary, Alberta

2013 ABAER 019

GRIZZLY RESOURCES LTD. AND SINOPEC DAYLIGHT ENERGY LTD.

APPLICATIONS FOR WELL,
PIPELINES, AND FACILITY LICENCES AND
A REGULATORY APPEAL OF A PIPELINE LICENCE
PEMBINA FIELD

APPLICATIONS NO. 1707770, 1723456,
1723458, 1723460, 1723486,
1723491, 1759037, 1759038,
1759044, 1759045, 1728964

DECISION

[1] Having carefully considered all of the evidence, the Alberta Energy Regulator (AER) approves Grizzly Resources Ltd.'s (Grizzly's) Application No. 1707770 and Sinopec Daylight Energy Ltd.'s (SDEL's) Applications No. 1723456, 1723458, 1723460, 1723486, 1723491, 1759037, 1759038, 1759044, and 1759045, subject to conditions outlined in the report and summarized in appendix 2.

[2] With respect to Regulatory Appeal Application No. 1728964, the AER confirms the approval of Application No. 1696239 to add Line No. 5 to Pipeline Licence No. P52607.

INTRODUCTION

[3] On June 17, 2013, the *Responsible Energy Development Act (REDA)* came into force in Alberta. The *Energy Resources Conservation Act (ERCA)*, which established the Energy Resources Conservation Board (ERCB/Board), was repealed and the AER was created. In accordance with the terms of the *REDA*, the AER assumed all of the ERCB's powers, duties, and functions under Alberta's energy resource enactments, which includes the *Oil and Gas Conservation Act* and the *Pipeline Act*. Throughout the transition from the ERCB to the AER, the authority of the hearing commissioners continued without interruption in accordance with the *REDA Transition Regulation*. As a result, the hearing commissioners assigned to this hearing will be referred to as the panel throughout this report. The ERCB/Board will be referred to as the AER regardless of whether the organization was known at the time as the ERCB.

[4] When the *REDA* came into force, review and variance proceedings, such as the review hearing, became regulatory appeals. Section 2(3)(e) of the *REDA Transition Regulation*, requires that every proceeding under section 40(1) of the former *ERCA* that had not been completed by the time the *REDA* came into force continues under Division 3, Part 2 of the *REDA*. Under this division, section 41 of the *REDA* requires the AER, after completing a regulatory appeal, to make a written decision, with reasons, on the regulatory appeal. In its decision, the AER may confirm, vary, suspend, or revoke the appealable decision.

Applications

Application No. 1707770

[5] Grizzly applied to the AER, pursuant to section 2.020 of the *Oil and Gas Conservation Rules*, for a licence to drill a directional well from a surface location in Legal Subdivision (LSD) 7, Section 5, Township 50, Range 6, West of the 5th Meridian (7-5 well site), to a projected bottomhole location in LSD 1-8-50-6W5M (1-8 well). The well would produce crude oil from the Pembina Nisku L2L pool with a maximum hydrogen sulphide (H₂S) concentration of 211.50 moles per kilomole (mol/kmol) (21.15 per cent) and have a cumulative drilling H₂S release rate of 1.51 cubic metres per second (m³/s). The corresponding emergency planning zone (EPZ) would be 1.02 kilometres (km). The proposed well would be located about 6.9 km east of Rocky Rapids, Alberta.

Application No. 1723456

[6] SDEL applied pursuant to part 4 of the *Pipeline Act* for a licence to construct and operate a pipeline to transport saltwater from an existing well site at LSD 6-3-50-6W5M to the 7-5 well site. The proposed pipeline would be about 4.32 km long with a maximum outside diameter of 112.5 millimetres (mm) and transport salt water with an H₂S concentration of 500.00 mol/kmol (50.00 per cent).

Application No. 1723458

[7] SDEL applied pursuant to part 4 of the *Pipeline Act* for an amendment to an existing pipeline to increase the H₂S concentration from 100.00 mol/kmol (10.00 per cent) to 220.00 mol/kmol (22.00 per cent). The pipeline transports oil effluent from an existing well site at LSD 6-3-50-6W5M to an existing multiwell battery at LSD 13-2-50-6W5M (13-2 battery). The pipeline is about 2.42 km long, has a maximum outside diameter of 114.3 mm, and would be operated as a level-1 pipeline.

Application No. 1723460

[8] SDEL applied pursuant to part 4 of the *Pipeline Act* for approval to construct and operate a pipeline to transport fuel gas from an existing well site at LSD 6-3-50-6W5M to the 7-5 well site. The proposed pipeline would be about 4.32 km long, have a maximum outside diameter of 60.3 mm, and transport fuel gas with no H₂S.

Application No. 1723486

[9] SDEL applied pursuant to part 4 of the *Pipeline Act* for approval to construct and operate pipelines to transport oil effluent from an existing multiwell pad site at the 7-5 well site to the 13-2 battery and an existing well site at LSD 6-3-50-6W5M. The proposed pipelines would be about 6.68 km and 4.32 km long and have maximum outside diameters of 168.3 mm and 114.3 mm, respectively. They would transport oil effluent with a maximum H₂S concentration of 220.00 mol/kmol (22.00 per cent) and be operated as level-1 pipelines.

Application No. 1723491

[10] SDEL applied pursuant to section 7.001 of the *Oil and Gas Conservation Rules* for an amendment to the 13-2 battery. The proposed amendment would increase the H₂S concentration from 100.00 mol/kmol (10.00 per cent) to 250.00 mol/kmol (25.00 per cent), change the

maximum licensed inlet rate of water from 2000 cubic metres per day (m^3/d) to 2500 m^3/d , increase compression from 149 kilowatts (kW) to 1193 kW, and include construction of a larger group separator.

Application No. 1759037

[11] SDEL applied pursuant to part 4 of the *Pipeline Act* for an amendment to an existing pipeline licence for a line split. The line split would divide a discontinued pipeline into two pipelines: the first extending from an existing pipeline tie-in at LSD 4-2-50-6W5M to an existing pipeline tie-in at LSD 4-2-50-6W5M and the second extending from an existing pipeline tie-in at LSD 4-2-50-6W5M to an existing pipeline tie-in at LSD 13-35-49-6W5M. The proposed pipelines would be about 0.08 km and 0.20 km long, respectively, have a maximum outside diameter of 124.0 mm, and transport crude oil with no H_2S .

Application No. 1759038

[12] SDEL applied pursuant to part 4 of the *Pipeline Act* for approval to construct and operate a pipeline to transport natural gas from an existing pipeline tie-in at LSD 3-2-50-6W5M to an existing pipeline tie-in at LSD 4-2-50-6W5M. The proposed pipeline would be about 0.10 km long, have a maximum outside diameter of 124.0 mm, and transport natural gas with no H_2S .

Application No. 1759044

[13] SDEL applied pursuant to part 4 of the *Pipeline Act* for an amendment to a licence for two existing pipelines to resume operation of the lines and reverse the flow of production. The pipelines would transport crude oil from an existing pipeline tie-in at LSD 4-2-50-6W5M to an existing pipeline tie-in at LSD 4-2-50-6W5M and from an existing pipeline tie-in at LSD 4-2-50-6W5M to the 13-2 battery. The pipelines are about 0.08 and 1.29 km long, respectively, have a maximum outside diameter of 124.0 mm, and transport crude oil with no H_2S .

Application No. 1759045

[14] SDEL applied pursuant to part 4 of the *Pipeline Act* for a substance change from crude oil to natural gas to move the two existing pipelines from existing Pipeline Licence No. P49489 to a new licence number. The pipelines would transport natural gas from an existing pipeline tie-in at LSD 4-2-50-6W5M to an existing pipeline tie-in at LSD 4-2-50-6W5M and from an existing pipeline tie-in at LSD 4-2-50-6W5M to the 13-2 battery. The pipelines are about 0.08 and 1.29 km long, respectively, have a maximum outside diameter of 124.0 mm, and would transport natural gas with no H_2S .

Application No. 1728964 (Regulatory Appeal)

[15] On October 20, 2011, the AER approved SDEL's Application No. 1696239 to add Line No. 5 to Pipeline Licence No. P52607. Line No. 5 was then constructed and has been operating since December 19, 2011. Line No. 5 is licensed to transport oil effluent with a maximum H_2S content of 90.00 mol/kmol (9.00 per cent) from a well at LSD 4-27-50-6W5M (4-27 well) to a pipeline tie-in at LSD 16-14-50-6W5M (4-27 to 16-14 pipeline). On October 21, 2011, the AER received a request from Dr. T. Losey and C. Kerpan to review its decision to approve Line No. 5 pursuant to sections 39 and 40 of the *ERCA*. In their submissions, Dr. Losey and Ms. Kerpan indicate that the southwest corner of their lands, which is within the EPZ, is

used for recreational purposes such as walking and snowshoeing. Dr. Losey and Ms. Kerpan expressed concerns that they could be affected by SDEL's pipeline in their area.

[16] On May 25, 2012, the AER granted the review hearing pursuant to section 40 of the *ERCA* and registered it as Proceeding No. 1728964. The purpose of the review hearing was to determine whether the AER should confirm, vary, or rescind its decision on Application No. 1696239 to issue an approval to add Line No. 5 to Pipeline Licence No. P52607 held by SDEL.

[17] This application was scheduled for a public hearing to start July 2, 2013, by a notice of rescheduling of hearing that was issued on May 6, 2013. It became a regulatory appeal when *REDA* came into force.

Background

[18] A notice of hearing for Grizzly's 1-8 well application was originally issued on March 13, 2012. An intervener's request to reschedule the hearing was granted and a notice of postponement of hearing was issued on May 2, 2012. A notice of rescheduling of hearing was issued on July 6, 2012. The AER received another request from interveners to postpone the public hearing and to add SDEL's applications to the hearing. On September 14, 2012, the AER granted the postponement request and issued a notice of postponement of hearing to fully consider the request to add additional applications.

[19] On February 8, 2013, the AER sent correspondence to all of the parties advising that the Grizzly and SDEL applications would be heard in a single, omnibus oral hearing. The AER considered that the applied for facilities and approval would form part of an integrated system that is already shared by Grizzly and SDEL, with production in the system being delivered to the 13-2 battery. Given the similarity of concerns expressed by the interveners, the AER decided that a single, omnibus hearing was an appropriate and efficient way to consider the applications and interventions.

[20] On February 15, 2013, the AER issued a notice of prehearing meeting. On May 6, 2013, a notice of rescheduling of hearing was issued to combine the applications from Grizzly and SDEL into one oral hearing commencing on July 2, 2013.

[21] All notices were distributed directly to interested and potentially affected parties and their counsel within the prescribed notification radius outlined in *Directive 056: Energy Development Applications and Schedules*. Notices were also distributed to the Alberta Department of Energy, Alberta Environment and Sustainable Resource Development, the MLA for the area Diana McQueen, and to Brazeau County, and advertised in the Drayton Valley Western Review.

Interventions

[22] The AER received objections to Grizzly's and SDEL's applications from S. Kelly, L. McGinn, L. Duperron, R. Domke, A. Warnock and D. Warnock, and Dr. Losey and Ms. Kerpan (collectively known as the interveners).

[23] The interveners were concerned with

- the consultation and notification process;
- health and safety issues (human and livestock health, pollutants, flaring, air and water quality, environmental sensitivity, and cumulative effects);
- the purpose of the applications, facilities proliferation, and pipeline integrity;
- emergency response planning and execution;
- AER's requirements for modelling of H₂S and sulphur dioxide (SO₂) releases for emergency planning; and
- the burden of proof, legal costs, and property values.

Prehearing

[24] The AER held a prehearing meeting concerning the applications at Causeway Bay Westwinds, 4225 – 50 Street, Drayton Valley, Alberta, on March 6, 2013, before panel members R. C. McManus, M.E.Des. (presiding), T. L. Watson, P.Eng., and G. Eynon, P.Geo., FGC. The purpose of the prehearing meeting was to

- identify the hearing participants and what their respective roles would be during the hearing;
- consider the issues in question and the respective positions of the participants, including any outstanding matters related to costs;
- decide on what procedures would be adopted for the hearing and whether participants would benefit from a settlement meeting to discuss the issues;
- set out the date, time, and place of the hearing and consider fixing the time allotted to each party to present evidence and argument; and
- consider any other matters that may simplify or aid the fair and most expeditious disposition of the hearing.

[25] The AER issued a written decision after the prehearing meeting on March 14, 2013. The decision contained the location of the hearing and details on the scope of the hearing. It also noted that it would include two independent risk assessments: one from the interveners and a second joint assessment from Grizzly and SDEL. A formal information request process would not be instituted. The AER was also open to receiving a reasonable advanced funding request to help the interveners retain qualified experts to provide an independent and credible risk assessment.

Hearing

[26] The AER held a public hearing in Drayton Valley, Alberta, beginning on July 2, 2013, and ending on July 5, 2013, before panel members R. C. McManus, M.E.Des. (presiding), and

A. H. Bolton, P.Geo., and G. Eynon, P.Geo., FGC. The panel completed a site visit of the area on July 1, 2013. Those who appeared at the hearing are listed in Appendix 1.

[27] The interveners sat two panels: an expert witness panel and the individual interveners.

[28] At the end of the hearing, Grizzly was required to complete one undertaking. The undertaking was completed on August 9, 2013. The AER considers the record to have closed on that date.

ISSUES

[29] The panel considers the issues of this proceeding to be

- the need for the projects,
- the adequacy of public notification and consultation,
- project design and infrastructure proliferation,
- emergency planning and response capability,
- the risk of human health effects, and
- H₂S risk assessment.

[30] In reaching the determinations in this decision, the panel considered all relevant materials constituting the record of this proceeding, including the evidence and argument provided by each party. References in this decision to specific parts of the record are intended to help the reader understand the panel's reasoning on a particular matter and should not be taken to mean that the panel did not consider all relevant parts of the record on that matter.

THE NEED FOR THE PROJECTS

Grizzly's Proposed Well

[31] Grizzly stated that there is a need for the 1-8 well and that it is in the public interest to have this well produce because it would allow access to additional reserves, extend the life of the Pembina Nisku L2L pool, and reduce water handling requirements. Grizzly submitted that

- based on simulation studies, reserves could be captured from the northeast portion of the Pembina Nisku L2L pool that could not otherwise be fully accessed by two existing wells at LSD 9-5-50-6W5M (9-5 well) and LSD 14-5-50-6W5M (14-5 well) increasing recovery of crude oil from the pool by about 80 000 m³ (500 000 barrels) or about 5.5 per cent;
- the proposed 1-8 well together with the existing 9-5 and 14-5 wells would defer water-coning effects and would extend the productive life of the Pembina Nisku L2L pool while shortening the end of the projected production period to 2026. With only the existing 9-5 and 14-5 wells the end of this production period would be in 2050;

- the total water handling requirement would be reduced by about 630 000 m³ (about 4 million barrels). Water would be injected via a well on the 7-5 well site at an existing well at LSD 10-5-50-6W5M (10-5 water injection well).

[32] Grizzly stated that because the 1-8 well would be on Freehold lands, there would be offset compensatory royalty payments should the 1-8 well be denied.

[33] The interveners questioned the need for the 1-8 well, submitting that Grizzly had previously objected to a similar well application¹ that also targeted the Pembina Nisku L2L pool because it was confident that the two existing 9-5 and 14-5 wells could safely, economically, and efficiently produce the hydrocarbons in the Pembina Nisku L2L pool.

SDEL's Proposed Pipelines and Facility Upgrades

[34] SDEL submitted that the proposed pipelines and facility upgrades are necessary to

- transport production from the 4-27 well, the existing 9-5 and 14-5 wells, and the proposed 1-8 well to the 13-2 battery and
- modify the existing 13-2 battery to increase the inlet H₂S concentration, increase compression, and add equipment to allow the handling of additional sour effluent production.

[35] To handle increased production, it applied to reconfigure the existing group separator and add a new group separator. To manage hydrate issues downstream in the pipeline, it applied to add a dehydrator to the 13-2 battery site.

[36] SDEL submitted that the pipeline blending scheme is required to bring sweet gas into the system to 1) reduce the H₂S content of the lines to 10 per cent, 2) stay within existing sales gas line licence parameters, 3) maintain existing setbacks, and 4) maintain the size of the current EPZ.

[37] SDEL stated that if the proposed pipelines and facility upgrades are approved the province of Alberta would receive about \$121 million in royalties.

Findings

[38] The panel notes its mandate to consider the efficient extraction of resources and acknowledges that a third well into the Pembina Nisku L2L pool will not only increase total recovery by more than 5 per cent but also reduce water handling significantly.

[39] The panel also finds that the pipeline amendments applied for will benefit the operation of the pipeline system by reducing the H₂S content of the lines with the addition of sweet gas, and by maintaining the other existing operating parameters of the projects.

[40] Further, the panel recognizes the benefits arising from additional royalty revenues paid to the province of Alberta as well as to the Freehold landowners.

¹ West Energy Ltd.'s Application No. 1623169. This application was withdrawn under *Decision 2012 ABERCB 006: Sinopec Daylight Energy Ltd., Application for a Well Licence, Pembina Field*.

[41] Accordingly, the panel finds the need for the projects is established.

THE ADEQUACY OF PUBLIC NOTIFICATION AND CONSULTATION

Grizzly's Proposed Well

[42] Grizzly submitted that its consultation was both extensive and exhaustive, including one-on-one meetings, community open house events (June 2008 and December 2010), and a series of project updates. In April 2008, it distributed its first project bulletin to stakeholders and an area development plan in June, both of which were sent to stakeholders as far as 15 km from the 7-5 well site. It distributed its most recent update in October 2011. Its participant involvement program involved consulting with all residents within the EPZ and with specific residents outside the EPZ, including the interveners. In a letter it sent in November 2011, Grizzly provided the interveners with opportunities for one-on-one meetings to discuss concerns about the proposed well.

[43] The interveners stated that neither Grizzly nor SDEL consulted with them directly about the well, pipelines, or facility upgrades, noting further that they did not have any face-to-face contact or telephone discussions with Grizzly on the proposed 1-8 well. The interveners also stated that Grizzly did not contact them to discuss their concerns with the project and that they had no reason to believe that Grizzly would be willing to take the time to discuss any further concerns with them about the project. Some of the interveners stated that if Grizzly were to compensate them for their time and legal counsel, they would be willing to meet with Grizzly to discuss their concerns.

[44] The interveners felt that the information Grizzly gave them about the applications was both confusing and inconsistent. The interveners noted errors and inaccurate information provided by Grizzly's contractor.

[45] The interveners also stated that there were no means of verifying the accuracy of personal information collected by a company. Intervenors also expressed concerns about the use and confidentiality of their personal information.

[46] In June 2013, Brazeau County expressed concerns to Grizzly and SDEL about the well, pipelines and facility upgrades. Grizzly and SDEL conducted a site tour for the Brazeau County safety coordinator and director of community services, and held a separate meeting to address specific concerns they may have had. Grizzly and SDEL stated that the Brazeau County officials acknowledged that their questions had been answered and their concerns addressed.

SDEL's Proposed Pipelines and Facility Upgrades

[47] SDEL submitted that overall, its relationship with the community is quite good and that it makes an effort to have an open door for communication, recognizing that some members of the community have longstanding objections to sour gas development in the area. SDEL noted that it began its consultation efforts in 2010 with the distribution of its first *Pembina Area Development Plan*. It followed this plan with project specific information packages and updates on the plan. These consultation materials were provided to members of the public and interveners that were both within and outside the prescribed consultation and notification distances. SDEL stated that

the consultation efforts it initiated in 2010 were proactive and met the requirements and intent of *Directive 056*.

[48] SDEL further submitted that its consultation efforts were comprehensive and proactive since it had obtained confirmation of nonobjection from all required parties. *Directive 056* requires personal consultation and confirmation of nonobjection from landowners and occupants of the right-of-way, and notification to 1) Crown disposition holders, 2) local authorities along the right-of-way, 3) landowners, occupants, and residents within 0.5 km of the proposed project, 4) urban authorities within 1.5 km of the proposed project, and 5) residents in the EPZ.

[49] SDEL further noted that *Directive 056* stipulates it is industry's responsibility to assess the area beyond the specified distance to determine if the notification radius should be expanded, and that it may be necessary to increase the radius to include public interest groups or others who have expressed an interest in development in the area. Therefore, SDEL filed the applications as nonroutine, given that a number of individuals objected to proposed sour oil and gas developments in the general area.

[50] SDEL submitted that, even though the interveners reside outside the formal notification and consultation radii outlined in *Directive 056*, it made considerable efforts to engage the interveners in meaningful dialogue. No concerns had been expressed to SDEL when it applied to the AER for the proposed pipelines and facility upgrades in March of 2012. It was not until after the AER published its notice of application on June 15, 2012, that SDEL became aware of concerns related to the proposed pipelines and facility upgrades. SDEL noted that ongoing communications with the interveners have occurred between SDEL counsel and the interveners' counsel.

[51] The interveners stated that SDEL has not consulted with them and have never proposed meetings with them. The interveners stated SDEL has maintained the view that it does not have any obligation to do so. SDEL stated its belief that the interveners preferred to communicate through other means, such as the hearing, rather than the consultation opportunities it offered.

[52] The interveners submitted that they did not have time to review and digest the information before responding to and engaging in consultation with Grizzly and SDEL. They added that it is overwhelming to receive so many documents on a piecemeal basis with contradictory information and changing rules. The interveners expressed concerns that information on the line lists may be inaccurate. The interveners submitted that the consultation process should be more than just the delivery of an information package and that simply having a conversation with someone could be misinterpreted as consultation. They viewed consultation as an active process—a conference or a meeting between parties.

[53] The interveners submitted that building a good relationship with Grizzly and SDEL is fundamental to their ability to feel safe and secure with activities that could affect their health and safety. The interveners noted the continually changing and sometimes conflicting nature of information provided by Grizzly, SDEL, and its predecessors concerning their development plans and stated that this contributes to a lack of confidence and trust.

[54] The interveners also expressed concern about the compliance history of SDEL and its predecessors (Highpine Oil and Gas Limited, West Energy Ltd., and Daylight Energy Ltd.) and the history of pipeline leaks and spills in the area. The interveners provided a list of 72

noncompliance events and releases attributed to SDEL and its predecessors between 2008 and 2012, compiled from FOIP requests and AER's noncompliance reporting system. The interveners noted that many of the noncompliance issues were related to corrosion-related pipeline leaks and a failure to document and follow a corrosion mitigation program. Their experience with Grizzly and SDEL and its predecessors has resulted in a lack of trust and an inability to rely on Grizzly and SDEL to ensure their safety.

[55] The interveners stated that they have been willing to engage with Grizzly and SDEL, but that only Grizzly was willing to meet in May 2012. SDEL has not met with them to date.

[56] In March 2013, SDEL issued an update on the pipelines and the 13-2 battery applications to all stakeholders, including the interveners, to inform them of the upcoming hearing, provide notice that additional applications associated with sweet gas blending scheme would be required, and to update the estimated schedule for construction, assuming regulatory approvals would be granted.

[57] Regardless of the extended consultation and notification distances, both Grizzly and SDEL commented they were unable to address the concerns of many of the residents outside the prescribed radii; several of the interveners stated there was nothing Grizzly or SDEL could do to allay their concerns or fears. SDEL stated that the interveners' submissions about its public consultation efforts are incorrect and reflect the interveners' lack of willingness to engage, rather than any failure on the part of SDEL. It argued that some of the interveners are opposed to all sour gas development in the area, which creates a barrier to meaningful, constructive dialogue.

4-27 to 16-14 Pipeline

[58] In 2011, SDEL conducted a participant involvement program for the proposed 4-27 to 16-14 pipeline with stakeholders inside the *Directive 056* consultation and notification radii, including Dr. Losey and Ms. Kerpan. Dr. Losey and Ms. Kerpan wrote to the AER objecting to the enlarged EPZ that crossed the southwest corner of their property, stating that they had other concerns that they were not prepared to share at that time. They reserved the right to address any additional concerns as they became aware of them. SDEL offered to meet at a time and place of Dr. Losey and Ms. Kerpan's choosing, and subsequently filed a nonroutine pipeline application based solely on their unresolved concerns.

[59] Dr. Losey and Ms. Kerpan stated that they initiated contact with SDEL about its application for the 4-27 to 16-14 pipeline when they became aware through the consultation and notification process that a part of their lands was in the EPZ. Dr. Losey and Ms. Kerpan further stated that they asked for a further opportunity for consultation, but they felt that SDEL's response created a barrier to the conversation they expected to have.

[60] Dr. Losey and Ms. Kerpan indicated that they might be willing to meet with SDEL staff if SDEL covered their costs, including the cost of counsel. SDEL requested details on how much would be requested, but did not hear back from them until they retained counsel. However, SDEL noted that there was no indication that Dr. Losey and Ms. Kerpan wished to meet to discuss their concerns. Dr. Losey and Ms. Kerpan said they interpreted SDEL's responses as a delay or stalling tactic or an unwillingness to meet with them. They stated that, while this may not have been a correct interpretation, their reaction should be understood largely in the context of their experiences with an SDEL predecessor, Highpine Oil and Gas Limited.

[61] On October 19, 2011, the AER advised Dr. Losey and Ms. Kerpan of its decision to dismiss their objection. On October 20, 2011, it added the 4-27 to 16-14 pipeline segment to Pipeline Licence No. P52607. SDEL constructed the pipeline, which has been operating since December 19, 2011. Dr. Losey and Ms. Kerpan filed submissions with the AER on October 21, 2011, November 23, 2011, and January 11, 2012, describing the use of their lands for recreational purposes. On May 25, 2012, the AER concluded that the test to trigger a review and variance under section 40 of the *ERCA* had been met, given that the pipeline EPZ extended onto the southwest corner of Dr. Losey and Ms. Kerpan's land.

Findings

[62] The panel acknowledges and emphasizes the requirement to consult with parties within the *Directive 056* consultation and notification radii, as well as the importance of consulting with other residents in the area, such as those outside the radii, who express an interest in the development of the proposed projects, or those who wish to object and intervene in the process.

[63] The panel notes conflicting submissions from Grizzly, SDEL, and the interveners about their willingness to meet and attempt to resolve issues. The panel finds that both Grizzly and SDEL have met the minimum requirements of *Directive 056* and have gone beyond those minimum requirements by contacting people outside the consultation and notification radii. Both SDEL and Grizzly described extensive and timely participant involvement that includes documented meetings and project information that they had provided to the parties.

[64] The panel recognizes that individuals may differ on what is considered appropriate notification and consultation. The panel notes that effective consultation takes time and effort of both company representatives and the public. Companies have an obligation to provide information about their activities that is clear and in plain language and to take enough time and effort to explain it. Similarly, concerned individuals have an obligation to try and understand the information given to them and to work with company representatives to resolve questions and concerns where possible.

[65] The panel understands the interveners' concerns about the compliance history of SDEL and its predecessors. It is difficult to be confident that companies are taking the steps necessary to protect the health and safety of their neighbours when they have not demonstrated an ability to comply with regulatory requirements. However, the panel notes that two thirds of the noncompliance issues happened before 2011 (48 of 72) and were associated with SDEL's predecessors. Since 2010, the number of noncompliance issues has been in decline (27 in 2010, 15 in 2011 and 7 in 2012).

[66] While the panel acknowledges that the noncompliance summary prepared by the interveners may not be a complete representation of SDEL's compliance record, the panel finds the improvement in compliance performance over the last few years to be encouraging. The panel expects that SDEL will continue to ensure that it sustains its improved compliance performance.

[67] The panel also notes that the AER has inspection and compliance programs in place to ensure that noncompliance issues are identified and corrected by licensees.

[68] Regarding the 4-27 to 16-14 pipeline, it appears to the panel that Dr. Losey and Ms. Kerpan were reluctant and suspicious of meeting with SDEL representatives, although both parties stated a willingness to do so even as late in the process as at the hearing. The panel notes that Dr. Losey and Ms. Kerpan's hesitations could be interpreted either as a lack of willingness to engage in discussions to resolve their objections or as an attempt to delay proceedings.

[69] The panel emphasizes that participant involvement and consultation should be a two-way process. The panel notes that the interveners appeared reluctant to meet with either Grizzly or SDEL representatives, even though both Grizzly and SDEL were willing to meet with them. The panel finds that statements made by some of the interveners' indicate that they are opposed to sour gas development and uninterested in resolving their concerns in any way other than not having development proceed. The panel recognizes that such opposition to sour gas development represents a significant barrier to effective consultation. It is also inconsistent with what the AER expects of all parties, which is to be open, engage in good faith discussions to address concerns and objections, and to resolve them where possible.

[70] The panel notes SDEL's view that the interveners preferred communicating through processes such as this proceeding. The panel considers hearings an appropriate forum for resolving disputes that cannot be resolved between the parties after other avenues, such as consultation and ADR, have been exhausted. Stakeholders should not see hearings as a venue for obtaining information, but rather as a last resort for resolving differences. Meeting both the spirit and intent of *Directive 056* is required to ensure that where possible, all parties work collaboratively to address issues and avoid the potentially adversarial hearing process.

[71] The panel finds that both Grizzly and SDEL made significant efforts to inform area residents of proposed activities and provide opportunities for consultation. The panel finds that Grizzly and SDEL have met, and in some instances exceeded, *Directive 056* consultation and notification requirements.

PROJECT DESIGN AND INFRASTRUCTURE PROLIFERATION

Grizzly's Proposed Well

[72] Grizzly stated that qualified and experienced drilling personnel oversee and direct all its drilling and completion operations, and that its primary responsibility is to ensure that operations are executed in a safe and technically correct manner.

[73] Grizzly submitted that this would be the fourth well on the 7-5 well site. The existing 9-5 and 14-5 wells were drilled in 2009. The 10-5 water injection well was drilled in 2011.

[74] Grizzly stated that all three existing wells were drilled into the sour Pembina Nisku L2L pool without incident—there were no releases or concerns. Grizzly stated that it would be able to drill and complete the 1-8 well in the Pembina Nisku L2L pool just as it did the existing wells. Grizzly stated that the 1-8 well would be drilled in a manner that would mitigate any risk to the public.

[75] Grizzly submitted that the 1-8 well would penetrate the gas cap and oil leg in the Pembina Nisku L2L pool. The AER reviewed and approved the H₂S release rate in Grizzly's

presubmission on September 26, 2011. In its approval, the AER specified that the H₂S release rate to be used in drilling the 1-8 well depended on the size of the wellbore. Grizzly stated that it would use a wellbore with an outside diameter of 139.7 mm to avoid having it classified as a critical sour well.

[76] Grizzly said that it would drill the 1-8 well under the same requirements as those for a critical sour well even though it is not classified as such. Grizzly stated that, if approved, it would meet regulatory requirements and industry best practices for critical-sour drilling. These include using intermediate casing, a class V blowout preventer, shear blind rams, dual well site supervision, dual ignition systems, and completion with the wellhead in place.

[77] The interveners questioned why Grizzly had not applied for a critical sour well if it was prepared to drill the 1-8 well using all the same precautions used in drilling critical sour wells.

[78] The interveners were concerned with future flaring activities on the 7-5 well site, particularly the uncertainty of the duration of flaring associated with drilling and completion since Grizzly had not provided it. The interveners also raised concerns about the adequacy of modelling and associated monitoring that Grizzly would undertake to verify flaring emissions, noting that Grizzly does not monitor emissions as far out as where they live. The interveners suggested that emissions where they live could exceed the acceptable levels defined by Alberta Environment and Sustainable Resource Development. They noted that in the event of a release, mobile air monitoring units would not be able to cover the whole area.

[79] Grizzly stated that it would apply for a permit to flare once it completed the 1-8 well and committed to flaring for no more than a single six-hour period during drilling and completion.

SDEL's Proposed Pipelines and Facility Upgrades

[80] SDEL considered a number of options for producing the Grizzly 9-5, 14-5, and 1-8 wells at the 7-5 well site and determined that the proposed pipelines and facility upgrades were the best option. SDEL considered transporting product to the Violet Grove battery, Easyford battery, and Tomahawk battery (13-2 battery). SDEL chose the 13-2 battery because, in doing so, it could construct a shorter pipeline, limit the number of pipeline emergency shutdown (ESD) stations, and eliminate water crossings. To minimize proliferation, SDEL submitted that it designed the proposed pipelines and facility upgrades by making use of existing infrastructure where possible.

[81] SDEL stated that the proposed pipelines from the 7-5 well site to the 13-2 battery and other existing pipelines in the area, including the pipeline leaving the 13-2 battery, are level-1 pipelines under AER regulations. SDEL noted that there are no level-2 pipelines in the area. SDEL also stated that it does not intend to expand its operations in the area.

[82] SDEL considered alternatives to the sweet gas blending scheme, such as injecting acid gas at the 13-2 battery through a new wellbore and amending the sales pipeline licence south of the 13-2 battery to 25.00 per cent H₂S. SDEL chose the 13-2 battery sweet gas blending scheme because it would be able to maintain the existing setbacks and EPZ associated with the sales line, reduce capital cost, eliminate third-party licence amendments, and minimize additional land disturbance. SDEL noted that a similar sweet gas blending scheme at the 4-27 well has been operating successfully since December 2011.

[83] The interveners submitted that SDEL's proposed sweet gas blending scheme was not adequately detailed in its applications and argued that blending was being used to avoid the need to license the lines as level-2 or level-3 pipelines with increased setbacks. The interveners submitted that the 4-27 to 16-14 pipeline should be licensed as a level-2 or level-3 pipeline. They also raised concerns that future increases in maximum operating pressure (MOP) and H₂S content could change the level designation of the sales line from the 13-2 battery.

[84] SDEL stated that it incorporated supervisory control and data acquisition (SCADA) systems on well sites, pipelines, and satellite facilities, which continuously monitor and control operations at all its sites. The SCADA system is monitored at SDEL's Paddy Creek facility (LSD 16-29-48-9W5M) 24 hours a day. SDEL stated that it also has H₂S and SO₂ monitors on pipeline ESD stations, which are checked by the SCADA system. SDEL stated that it also conducts pipeline right-of-way inspections on a regular basis and performs material balance checks daily to determine if there are any operational issues.

[85] SDEL submitted that the proposed facility upgrades would remove the need to flare at the 13-2 battery and, since there would be no separators at the 7-5 well site, the need for a flare stack. SDEL submitted that the proposed pipelines and facility upgrades eliminate emissions by using closed systems and removing flaring from everyday operations, and confirmed that there would be no continuous sour gas flaring at the 13-2 battery.

Pipeline Integrity

[86] The interveners initially expressed concern about SDEL's pipeline integrity and corrosion control. The interveners' pipeline expert, C. Duncan, noted that, in its initial application to the AER, SDEL did not submit a comprehensive corrosion control program or sufficient information on the type of pipe to be used or on the procedures that would ensure the pipe is fit for service. The interveners submitted that past performance is an indicator of future performance, noting a history of 26 failures in 3 years in the area by SDEL and its predecessor companies.

[87] SDEL provided a summary of pipeline releases in the area between the start of 2010 and mid-2013 attributed to SDEL and its predecessor companies. SDEL reported a total of 27 releases during this period, with 13 of the 27 releases related to pipeline corrosion. About half of the pipeline releases, or 13, occurred in 2010, with 5 occurring in 2011, 7 in 2012, and 2 in the first 6 months of 2013.

[88] The interveners were concerned about steel pipeline corrosion when the water cut is 40 to 50 per cent and suggested that pipe material testing and magnetic flux leakage inspection be performed.

[89] SDEL stated that it has engineering standards, a quality assurance programs, and a continuous learning philosophy in place—all of which would be applied to the design and construction activities of the proposed pipelines and their ongoing operations. SDEL noted that it has implemented a care, competency, management, and development system (CMDS), commonly used by industry, for its operations and facilities staff and contract pipeline inspectors. SDEL stated that its practices and procedures meet all current applicable *Canadian Standards Association* (CSA) Z662 standards for corrosion mitigation, monitoring, evaluation, and record keeping.

[90] SDEL stated that it has improved its corrosion control measures and mitigation programs by including pump checks, rate checks, and inventory and production balances to ensure the programs are performing on target. SDEL submitted that it documents these activities and does regular program reviews that involve operations and asset integrity personnel and its chemical vendor. SDEL stated that it has the resources to implement its long-term integrity management programs. This includes hiring or having a senior asset integrity manager with considerable experience and a Drayton Valley area asset integrity field coordinator on staff, as well as subject matter expert consultants to support the programs where required.

[91] SDEL stated that its existing well site headers and batteries are well-designed facilities with measures in place to manage corrosion, such as pigging, in-line inspection, corrosion inhibition, and monitoring. It stated that the proposed pipelines and facility upgrades would incorporate specific pipeline control measures and engineering assessments to properly evaluate how production changes would affect the proposed pipelines and facility.

[92] SDEL stated that it would install line heaters at the 7-5 well site and insulate the pipelines to help keep the production fluids warm before entering the 13-2 battery to prevent hydrates from forming. It stated that the removal of water vapour from the gas would assist in eliminating potential corrosion on the sales pipeline and that it would install a dehydrator on the discharge side of the battery.

[93] The interveners also expressed concern about using fibreglass pipe, noting a significant number of failures. SDEL indicated that either it or its predecessors had used spoolable fiberspar in the past. It acknowledged that there are some problems with it, but stated that it was not being used in the applications. SDEL indicated that it has used fibreglass stick pipe in its injection system since 2008/2009 with no issues and confirmed that it would use this kind of pipe for the sour water line.

[94] The interveners' expert, Mr. Duncan, stated that SDEL's supplemental information response addressed most of his concerns with corrosion control, and that SDEL's operation and maintenance manuals are well conceived and conform to CSA standards.

Findings

[95] The panel acknowledges that Grizzly has successfully drilled and completed the 9-5, 10-5, and 14-5 wells at the 7-5 well site. The panel further notes that these existing wells were drilled into the Pembina Nisku L2L pool without incident. The panel notes that Grizzly has committed to drilling the 1-8 well as a critical sour well even though it is not classified by the AER's criteria as one. The panel accepts this commitment and makes it a condition of the 1-8 well's approval. All equipment and practices used to drill the 1-8 well must meet or exceed the requirements for critical sour wells in *AER Directive 036: Drilling Blowout Prevention Requirements and Procedures* and the *Enform Industry Recommended Practice (IRP) Volume 1: Critical Sour Drilling*.

[96] The panel also acknowledges that Grizzly committed to restricting flaring to a single period that lasts no longer than six hours during drilling and completion. In the panel's view this is an important factor in addressing the interveners concerns and therefore the panel makes Grizzly's commitment a condition of the 1-8 well's approval.

[97] The panel notes the efforts that SDEL has undertaken to minimize the proliferation of pipelines and facilities in the area by designing systems that have the smallest surface footprints. The panel acknowledges that SDEL's design of the pipelines and facilities associated with the 1-8 well eliminates the need for flaring entirely, and commends SDEL for its responsiveness to residents' concerns about flaring.

[98] The panel also recognizes SDEL's responsiveness to the interveners' concerns with previous pipeline failures and spills in the area and its commitment to a pipeline integrity program that addresses their concerns. The panel notes that the interveners' corrosion control expert was satisfied with the operational controls and integrity management practices proposed by SDEL and the panel is satisfied that their concerns were addressed by the supplemental information provided by SDEL.

[99] The panel is satisfied with SDEL's pipeline design and integrity and corrosion programs as they adhere to CSA Z662 standards and procedures. The panel further notes SDEL's commitment to in-line inspection as part of its integrity management program.

[100] The panel notes the interveners' concern regarding fibreglass pipelines and their failure history. The panel acknowledges that SDEL has used fibreglass stick pipe successfully elsewhere and will be doing so for its proposed sour water line. The panel is satisfied that carefully following the manufacturer's specifications during pipeline installation will effectively mitigate the risk of failure.

[101] The panel notes the interveners' concerns about pipeline H₂S licence levels and the proposed sweet gas blending scheme at the 13-2 battery. The panel notes that SDEL has a similar blending scheme in place at the 4-27 well that has been operating successfully for 18 months. The panel finds that sweet gas blending is an appropriate way to manage H₂S content within approved pipeline licence levels. The panel is satisfied that the proposed blending scheme has appropriate monitoring and control devices capable of ensuring that the licensed H₂S limit for the sales line is not exceeded.

[102] The panel notes the interveners' concerns about future increases in MOP, H₂S content, or the level designation of the sales line from the 13-2 battery. However, the panel confirms that such changes would need to go through a *Directive 056* application process and would be subject to a thorough technical review by the AER. The panel notes SDEL's calculation regarding H₂S release volume and the level designation of the sales line and recognizes that the sales gas line will remain as a level-1 pipeline.

[103] The panel acknowledges the history of pipeline failures by SDEL and its predecessor companies in the area. While the panel believes that there is always room for improvement, it notes that the number of pipeline failures was highest in 2010 and has declined since then. It may be too early to conclude whether SDEL can sustain this improvement in operating performance. However, the panel acknowledges that this downward trend supports SDEL's contention that the controls it recently put in place and its increased emphasis on and commitment to managing corrosion and pipeline integrity are what's positively affecting operating performance and reducing pipeline failures. The panel is encouraged by recent changes SDEL has implemented and accepts that it may take some time to prove how effective a change to pipeline management practice might be once put in place.

EMERGENCY PLANNING AND RESPONSE CAPABILITY

Grizzly's Proposed Well

Drilling and Completion Emergency Planning

[104] Grizzly submitted that it based its H₂S release rates on the H₂S content of each formation considered, absolute open flow (AOF) estimates, and data from offset wells in the area in accordance with the AER's requirements. The AER approved a drilling release rate of 1.51 m³/s and a producing release rate of 0.29 m³/s. When it specified a release rate for the well in its approval, the AER noted that while Grizzly identified a higher H₂S concentration in the area, information available to the AER from offset wells showed pressures and gas-oil ratios (GOR) lower than what was predicted in the existing Grizzly wells.

[105] The interveners noted release rates for similar sour gas wells drilled in the area, and submitted that Grizzly should agree to use an H₂S release rate of 2.00 m³/s. The 1-8 well would then be classified as a critical sour well and would have to meet more stringent AER safety rules and regulations. The interveners also argued that since Grizzly had encountered a gas cap when drilling the existing Grizzly wells, it was possible that it could also encounter one when drilling the 1-8 well.

[106] As previously noted, Grizzly submitted that even though the 1-8 well is not classified as a critical sour well, it would meet all AER regulatory requirements and industry best practices for critical sour wells when drilling the well.

[107] Grizzly submitted that it had based the drilling EPZ (1.02 km) in its emergency response plan (ERP) on the 1.51 m³/s drilling release rate using ERCBH2S version 1.20. Grizzly stated that its ERP only addresses drilling, completion, and servicing the 1-8 well because the well would be operated by SDEL and included in SDEL's Tomahawk area operations ERP once on production. The producing EPZ of the well would be 0.26 km based on the estimated producing release rate of 0.29 m³/s.

[108] The interveners submitted that the 1.02 km drilling EPZ is much smaller than the value derived from either the nomograph previously used or earlier versions of ERCBH2S. They also pointed out that ERCBH2S version 1.20 no longer includes an emergency awareness zone beyond the EPZ. The interveners argued that they may need to shelter in place or evacuate because they would be in the emergency awareness zone. They noted previous incidents for which industry could not respond effectively or locate the source of odour releases.

Grizzly's Ability to Respond to a Drilling and Completion Emergency

[109] Grizzly stated that it included all the interveners in its ERP, as well as other residents outside the drilling and completion EPZs. Grizzly said that before the 1-8 well entered the first sour zone during drilling, it would erect signs indicating the extent of the EPZ and the locations of possible roadblocks.

[110] Grizzly further submitted that it would be able to detect and correct any abnormal conditions before they led to a sour gas release, given the additional equipment and processes for sour drilling and completion operations being applied for. Grizzly stated that the likelihood of sheltering in place or evacuation being necessary in the event of a release is extremely low.

[111] Grizzly said that it is prepared to respond to an incident and would implement its ERP at the first sign of well control problems, and that it would safely remove the public from the area before a sour gas release occurred. Grizzly submitted that if a release were to occur, it would use its decision tree to determine the best public protection measures to take. Grizzly would contact individuals identified in its ERP by telephone, and use its rovers to communicate directly with those it was unable to contact by telephone and with others beyond the EPZ.

[112] The interveners raised concerns about the ability of Grizzly and SDEL to identify and locate everyone within the area given the topography of the river valley. Grizzly's ERP expert stated that the topography in and around its EPZ is no more challenging than that for any other EPZs in this part of Alberta. It would be able to monitor all areas inside the EPZ, as well as areas beyond the EPZ that may be affected, such as the river valley and Eagle Point Provincial Park. It would do this with a combination of ground-, helicopter-, and river-based rovers and use roadblocks to isolate the EPZ.

[113] Grizzly stated that it provided the public with a *Sour Oil/Gas Self-Help Guide* on what to do if sheltering in place is unavailable and that it would continue to provide the public with similar educational materials.

[114] Grizzly submitted information about its table-top and full-scale emergency response exercises and other responder training it has been conducting since 2010 for earlier drilling at the 7-5 well site. It also stated that it would hold two meetings to review the 1-8 well ERP, one of which would include a communications exercise. The interveners stated that they had not been included in any exercises and were therefore unable to determine whether Grizzly would be prepared to respond effectively to an emergency.

[115] The interveners expressed concern that Grizzly may lack the personnel or resources to respond to an emergency. Grizzly stated that it would use consultants and contractors to respond to any emergency. Grizzly also submitted that it is a member of the Pembina Area Operators' Group (PAOG) mutual aid team, which is composed of oil and gas operators who pool resources and help each other during an emergency if necessary. Grizzly stated that it would not rely on Brazeau County or any other government agency for tactical "on the ground" resources to respond to any emergency at the 1-8 well. The interveners submitted that neither Grizzly nor SDEL had established to their satisfaction that the PAOG would be able to help in responding to an emergency.

[116] Grizzly submitted that it uses the incident command system (ICS) for incident response to establish simple pre-identified primary objectives and an incident action plan to which all responders are accountable. The ICS process is conducted by a local incident commander who is familiar with the area. Grizzly added that quick reference guides are given to all responders so that incident response is effective and complications are minimized.

[117] The interveners submitted that it is unclear in Grizzly's and the municipality's ERPs how the two will coordinate with each other. The interveners raised concerns about how they would be protected if an incident occurred. They noted that some people do not use cell phones and coverage in the area is unreliable. They also noted that buildings for sheltering in place are not always available and that evacuation might not be possible if the weather were bad or the road conditions on steep hills in the North Saskatchewan River valley were poor. They also noted that

there is no mechanism in place for Brazeau County to collect the interveners' relevant personal information and that it would have limited resources available to respond.

[118] The interveners also submitted that Brazeau County relies on public announcements (by television and radio) and door-to-door calls to contact residents. The interveners submitted that they do not believe that the municipality has the resources required to appropriately respond to emergencies at the proposed 1-8 well.

SDEL's Proposed Pipelines and Facility Upgrades

Emergency Planning for Pipeline and Facilities Operations

[119] SDEL submitted pipeline release volumes for each segment of pipeline between ESD stations. It noted that these valves close to isolate the failed section of a pipeline during an emergency to reduce the volume of gas released into the atmosphere. It calculated and submitted H₂S release volumes that ranged from 130 to 294 m³. All pipeline segments are classified as level-1 pipelines with a setback requirement from surface development equivalent to the width of the pipeline right-of-way.

[120] The interveners questioned why SDEL did not use an H₂S release volume of 300 m³ as its largest calculated H₂S release volume, as doing so would have had the 7-5 to 13-2 pipeline segment classified as a level-2 pipeline with a 100 m setback instead of a level-1 pipeline with only a right-of-way as a setback. SDEL responded that while the pipeline segments have a level-1 designation, it conducted the *Directive 056* notifications as though they were level-2 pipelines, communicating with residents well beyond the EPZ distance or the 500 m requirement to include all the interveners.

[121] SDEL noted that it added the applied-for pipelines to the *Tomahawk Area Emergency Response Plan Site-Specific Supplement* it had filed with the AER for approval. SDEL calculated an EPZ of 1.18 km for the 13-2 battery and 0.56 km for the 7-5 to 13-2 pipelines (see figure 1). SDEL stated that it would operate the 1-8 well and would therefore include it in its ERP. The EPZ for the 1-8 well, if approved, would be 0.26 km once it began producing.

[122] The interveners stated that they felt the same about SDEL's ERP as they did about Grizzly's—that it is complex, confusing, and difficult to implement. However, SDEL responded that its ERP is robust—not complex—and complies with all AER requirements. SDEL noted that its responders would use quick reference guides for effective response during an incident. It noted that the AER must review and approve each ERP in detail before sour operations begin, and that the AER approved its amended Tomahawk Area ERP on August 9, 2012.

[123] The interveners expressed concern that with each successive version of ERCBH2S, the calculated EPZs have decreased even though the volumes of sour gas that could be released have not changed and would still have the same effect on their health and safety.

SDEL's Ability to Respond to an Operational Emergency

[124] The information submitted by SDEL and the issues the interveners raised are similar to information and issues related to Grizzly's activities. While repetitive, they have been included here for completeness.

[125] SDEL submitted that it is fully capable of independently managing an emergency response, both within and outside the EPZ, and of protecting the public in the unlikely event of an emergency.

[126] SDEL acknowledged that many people use areas within and adjacent to the EPZs for recreation, including rivers and other water bodies; places where sheltering in place is not immediately available and cell phone coverage might not be reliable. It submitted that the topography in and around its EPZs is no more challenging to monitor than the topography for any other EPZ in this area of Alberta. SDEL further submitted that it would be able to monitor all areas inside and beyond the EPZs, including the river valley and parks, using roadblocks to isolate the EPZs, and ground-, helicopter-, and river-rovers to locate the public. SDEL further noted that a number of safe routes out of the river valley and park exist.

[127] SDEL indicated that it would continue to supply as much information as possible so that members of the public would be able to protect themselves in the event of a sour gas incident. SDEL noted that it had already provided all residents in the area with a *Sour Gas/Oil Self-Help Guide*.

[128] SDEL noted that its emergency and response training and exercises exceeded AER requirements and submitted a summary of them, including the tabletop and full-scale exercises it held in 2012 and 2013.

[129] The interveners did not believe they could rely on responders to be responsible for their safety. They referred to previous situations in the area where they felt that an operator's response times could have compromised their well-being. The interveners also noted that responders are trained to protect themselves first in an emergency and therefore questioned the degree to which they could rely on the responders to ensure their safety.

[130] The interveners stated that they lacked confidence in SDEL's ability to effectively respond to an emergency, referring to two of the AER's investigation reports on previous incidents involving Daylight Energy Ltd. that identified a number of deficiencies in its emergency response.

[131] The interveners stated that they are often outdoors on their properties and that it would be difficult for responders to locate them if it became necessary to shelter in place or evacuate. They stated that most of them do not carry their cell phones at all times and that cell phone coverage is limited. They also said that landlines and internet service are unreliable.

[132] The interveners expressed concerns and a lack of confidence in the concept of sheltering in place. Some interveners believed that sheltering in place is not an option because their homes are not suitable protection from sour gas exposure. One intervener also noted that in some circumstances, H₂S levels could become higher inside the home than what they are outside for brief periods.

[133] The interveners noted previous incidents where industry was unable to respond effectively or locate releases. The interveners considered the ERP too complex and felt that it would result in confusion and an ineffective response. They also felt that the ERPs were developed mainly to comply with the AER directives. The interveners submitted that municipalities are responsible for ensuring public health and safety. The interveners further submitted that if SDEL and Grizzly

were unable to respond, the Parkland and Brazeau counties would be responsible for protecting residents. The interveners stated that there is no link between the municipal plans and individual company plans, noting that county personnel are mostly volunteers not trained in H₂S response, and therefore might not be able to respond effectively.

[134] SDEL stated that because it is a member of the PAOG, it would not need the help of local municipalities to carry out its ERP within or beyond the EPZ. However, SDEL has memoranda of understanding with Brazeau, Parkland, the Wetaskiwin No. 10 counties and Alberta Health Services that define their roles and responsibilities. SDEL noted therefore that it would have municipal support, particularly with logistics, in the unlikely event that such help were to be required.

[135] SDEL submitted that it uses ICS when managing emergencies so that its emergency response is coordinated and effective. It noted that other local and provincial government groups (such as the Alberta Emergency Management Agency and Alberta Health Services) could play a role in emergency response and are familiar with ICS.

[136] The interveners expressed doubts that SDEL and the municipality have the resources to protect those who live outside the EPZ and felt that coordination between it and municipality is unclear. The interveners noted that Brazeau County would rely on public announcements on TV and radio and door-to-door calls to contact residents. The interveners submitted that because they live beyond the EPZ, the county does not have their contact information and that there is no mechanism in place for the county to collect it. SDEL responded that it has the manpower and equipment to implement the public protection measures if necessary, and that it is able to mobilize more than 80 responders, many of whom are full-time residents in the Tomahawk area.

4-27 to 16-14 Pipeline

[137] SDEL stated that the AER approved its application for a sweet gas blending scheme on the 4-27 to 16-14 pipeline, which decreased the licensed H₂S concentration from 12 to 9 per cent, increased the gas to liquid ratio, and increased the liquid production rate. With these changes, the release volume in the pipeline decreased from 219 to 182 m³. However, the EPZ increased from 0.22 to 0.24 km, extending onto the southwest corner of Dr. Losey and Ms. Kerpan's property (figure 1).

[138] SDEL indicated that the pipeline is still a level-1 pipeline, with a right-of-way setback. Dr. Losey and Ms. Kerpan submitted that the changes to the pipeline would result in the pipeline operating at a higher pressure. They argued that this would result in an increase in the area that could be affected by a rupture of the pipeline.

[139] SDEL submitted that the 13-2 battery and the 4-27 to 16-14 pipeline are built and operating and have been incorporated into its *Tomahawk Area Emergency Response Plan Site Specific Supplement*, which has been approved by the AER.

[140] Dr. Losey and Ms. Kerpan submitted that they use all their land year round for recreation, including the southwest corner, and were concerned a sour gas release could place them in danger, require them to evacuate, or affect their health. They argued that the EPZ calculation did not take into account the topography and that westerly winds could move sour gas along the stream course onto their property.

[141] Dr. Losey and Ms. Kerpan believed that neither SDEL nor Brazeau County have their contact information and might be unable to contact them in the event of an emergency. They stated that they do not use cell phones when they are out on their land. They stated that their residence has a landline, fax, and dial-up internet for communication, and that they do not have a voice messaging system.

[142] Dr. Losey and Ms. Kerpan are uncertain about whether they would need to shelter in place or evacuate. However, if they were to be asked to shelter in place, they do not believe their home would be able to protect them, adding that it could be difficult to evacuate from their land during the winter.

Findings

[143] The panel notes that the AER has several requirements that distinguish a critical sour well from a noncritical sour well. Some of the additional requirements for critical sour wells include the use of intermediate casing, dual ignition systems, blowout preventers with blind shear rams, and dual on-site supervision.

[144] The panel notes that the purpose of *Directive 071: Emergency Preparedness and Response Requirements for the Petroleum Industry* requirements is to ensure that licensees have identified potential hazards that could pose a risk to the public or the environment and have established a decision framework and action plans to quickly and effectively respond in the event of an emergency. Emergency preparedness means being able to respond to an emergency. This requires developing an ERP, building response capabilities, planning, and training with responders before an emergency occurs.

[145] The panel also notes that the AER requires companies to develop a site-specific ERP and have it approved by the AER for all operations with residences or other surface developments within the EPZ. ERPs are designed to address any situation that could be encountered in the event of an incident. ERPs must be updated and adjusted for operational changes. ERPs for on-going operations are required to be updated on an annual basis. Companies are required to conduct emergency response exercises, including an annual tabletop exercise and a full-scale exercise every three years. Objectives of the exercises include developing the competencies of response personnel, developing effective working relationships with internal and external responders including the local municipality, identifying potential gaps and areas for improvement in the plan, and demonstrating the company's ability to respond to emergencies.

[146] The panel notes the interveners' concerns about contacting residents who might be on their land outside their homes. The panel acknowledges that the required training and exercises prepare responders for these situations. The panel further notes that the responders are trained to maintain their own safety in order for them to be able to protect the public.

[147] The panel accepts that sheltering in place is a proven method of protecting people from exposure to unsafe levels of toxins, and is used by emergency response experts around the world. In cases where the emergency is of short duration, sheltering in place affords better protection than risking exposure by evacuating. Sheltering in place uses the fresh air supply in a house or other structure as a barrier from a hazardous substance in the outside air. Sheltering in place is effective because it protects people from limited-duration spikes in concentration of a toxic gas. Most homes contain enough fresh air to sustain a family for several hours before toxic levels can

build to unsafe levels inside the home. In the case of a short-duration release of a hazard, toxic levels would not reach the peak levels experienced outside. The panel accepts that even homes thought to be draughty provide an effective barrier from hazards outside the residence.

[148] The panel identified a need for better public understanding of sheltering in place as a protective measure, and supports efforts by industry and the AER to develop a program to build awareness that might include live exercises with public involvement.

[149] The panel confirms that the AER reviews and approves all required ERPs for compliance with *Directive 071* requirements before allowing the drilling, completion, servicing, or production of a well, or operation of a pipeline or facility. The AER also conducts audits to assess a company's knowledge of its plans and its capability to respond.

[150] The panel acknowledges that an EPZ is an area around a well, pipeline, or facility within which the operator must be prepared to respond in an emergency. The panel further acknowledges that the EPZ is not necessarily the response area, nor should it be assumed to be a dividing line between the responsibilities of the company and other responders, including the municipality. When an incident occurs the company determines the protective action zone, based on all the prevailing circumstances, within which it will focus its initial response and public protection actions on those most immediately at risk. During an incident, the company works closely with the AER and other responders to ensure appropriate actions are being taken to protect public safety.

Grizzly's Proposed Well

[151] The panel notes that Grizzly will be responsible for the drilling and completion of the proposed 1-8 well and these operations will be covered under Grizzly's ERP. SDEL will be responsible for ongoing operations, with the operations of the 1-8 well to be included within SDEL's emergency response plan.

[152] The panel acknowledges that Grizzly followed the approach required to determine an H₂S release rate based on H₂S content, AOF, and data from offset wells, and filed its release rate presubmission with the AER for review. The panel further acknowledges that the AER approved a drilling release rate of 1.51 m³/s and a producing release rate of 0.29 m³/s, which was lower than what Grizzly had initially applied for. The panel understands the interveners' concerns about H₂S release rates but finds that the AER has considered all available data in determining the appropriate inputs into ERCBH2S version 1.20.

[153] The panel also acknowledges the interveners' concerns about revisions to ERCBH2S, especially those noting that the EPZ area calculated using ERCBH2S version 1.20 is now smaller than using either previous versions or the original nomograph.

[154] The panel recognizes that the nomograph is an outdated tool with limited flexibility. The panel accepts that development and continuous improvement of the ERCBH2S model provides greater sophistication with the ability to input different assumptions. Therefore, the panel finds that ERCBH2S predictions become more accurate through continuously improving its predictive modelling program. The panel also notes that ERCBH2S version 1.20 is the current version of the model the AER has authorized for use.

[155] The panel acknowledges the interveners' concern that an emergency awareness zone extending beyond the EPZ is no longer required by the AER in emergency response planning. The panel recognizes that some of the interveners live or work in areas outside the EPZ where public protection measures might need to be taken. However, the current AER regulatory approach to emergency response requires defining a focused protective action zone at the time of an incident that is based on prevailing physical conditions. The panel finds this approach to be more protective of the public than the less focused emergency awareness zone used previously.

[156] The panel acknowledges that Grizzly has previously prepared ERPs for drilling and completing several wells at the 7-5 well site that were in compliance with AER requirements and has tested its plans through exercises. The panel finds that this previous experience demonstrates that Grizzly is capable of identifying the hazards and potential harm to the public, and mitigating these to an acceptable level, through the development and potential implementation of its drilling and completion ERP. The panel is satisfied that Grizzly has planned for and would have access to the necessary resources to respond to an emergency in the unlikely event that one occurs.

SDEL's Proposed Pipeline and Facility Operations

[157] Many of the panel's findings about Grizzly's ERP and its ability to respond also apply to SDEL and its ERP.

[158] The panel notes that SDEL will be responsible for the production operations of all Grizzly wells at the 7-5 well site and their associated pipelines and facilities. Similarly, SDEL operates and owns the 4-27 to 16-4 pipeline next to Dr. Losey and Ms. Kerpan's property. The panel also notes that SDEL has been operating pipelines in the area safely for some time and has improved compliance on those pipelines it has taken over and now operates.

[159] The panel notes the interveners' concern over why SDEL's various pipelines are classified as level-1. The panel understands that in the case of the 4-27 to 16-14 pipeline, the radius of the EPZ would be larger because of an increased gas to liquid ratio and increased liquid production rate, which are occurring within approved operating conditions.

[160] However, the panel acknowledges that SDEL has designed the applied-for pipelines to operate as level-1 since all its pipelines in the area are designated that way. The panel also accepts that the 4-27 to 16-14 pipeline meets the criteria for a level-1 pipeline and accepts that a level-1 designation is appropriate for its operation.

[161] The panel also acknowledges SDEL's decision to conduct a broader notification and consultation than what is required under *Directive 056* and *Directive 071* to include residents (including the interveners) well beyond the EPZ.

[162] The panel is concerned about the interveners' lack of knowledge and confidence in sheltering in place and the belief that their homes would not serve as adequate protection from exposure to H₂S. The panel emphasizes that in the case of a 15-minute unignited release from a well or a pipeline rupture, the H₂S plume will be of limited duration. The panel finds that sheltering in place is the most appropriate response and affords better immediate protection than evacuation since H₂S levels inside even a draughty a home would not reach the peak exposure levels outside.

[163] The panel notes the interveners' concern that responders are trained to protect themselves first, that the interveners are often outdoors without means to communicate, and ERPs are too complex, confusing, and difficult to implement. The panel accepts that the industry and its consultants and contractors have significant experience in developing and implementing ERPs and conducting training to ensure requirements are understood and effective. The panel also accepts that the AER is well qualified to assess how complete and effective an ERP may be and in determining how capable a party would be in implementing it.

[164] The panel acknowledges the interveners' concerns about SDEL's ability to effectively implement its ERP. The panel recognizes that Daylight Energy Ltd., an SDEL predecessor, had at least two sour gas incidents in the past that required an emergency response and that follow up investigations by the AER identified deficiencies in the company's response. The panel notes that both of these events were more than two years ago and SDEL has since improved its ERP and response capability. The panel also acknowledges that emergency response planning requires a continuous improvement approach and that one such purpose of an AER investigation is to identify areas where improvement is required.

[165] The panel finds that both Grizzly and SDEL's ERPs meet and in a number of aspects exceed AER requirements, and that their corresponding training, preparation, and ability to implement their plans are also appropriate.

THE RISK OF HUMAN HEALTH EFFECTS

[166] The interveners expressed concerns regarding the health effects of potential emissions associated with Grizzly and SDEL's proposed activities. The interveners provided evidence at the hearing regarding their health concerns, both in written submissions and in oral testimony. In their written submissions, the interveners also provided a number of publications on the health effects of exposure to H₂S and SO₂. One of the publications was the *Assessment of the Potential Human Health Impacts Associated with a Series of Hypothetical Sour Crude Oil Release Scenarios During Production Operations* (2008 Intrinsik report), which addressed the potential that the interveners' health could be affected by the wells, pipelines, and facility. The panel recognizes that the interveners' health concerns apply equally to the drilling and production of the 1-8 well and the existing and proposed SDEL pipelines and facility.

[167] Some of the interveners identified themselves as sensitive individuals who are at risk from emissions associated with sour oil and gas operations at exposure levels below those used as EPZ or evacuation criteria.

[168] The interveners also expressed concerns about livestock health and safety, as well as the effects of pollutants on soil acidification, crops, woodlands, and wild animals.

[169] Grizzly stated that no continuous emissions would occur during the drilling and completion of the proposed 1-8 well, and submitted that its project would meet environmental standards and regulations.

[170] SDEL also stated the proposed facility would not be a source of continuous emissions. SDEL stated that it would not be continuously flaring and that the gas dehydrator system would not emit any benzene since it would be a closed system.

[171] In its prehearing decision on the applications, the AER directed Grizzly and SDEL to complete a risk assessment for the applications. The AER invited the interveners to submit an independent risk assessment of the applications and subsequently provided the interveners with a prehearing cost award to ensure that they could retain qualified experts.

[172] The AER directed the parties to assess risks associated with three endpoints: an H₂S lethality endpoint, an EPZ endpoint (100 parts per million [ppm] for 60 minutes), and an evacuation endpoint (10 ppm for 3 minutes). At the prehearing, the AER made it clear that the appropriateness of the H₂S endpoints was not at issue. The AER requested independent quantitative risk assessments from the applicants and the interveners.

[173] In their reply submission, Grizzly and SDEL filed the *Report on Health Effects associated with Risk Assessment Endpoints* (2013 Intrinsik report), which was written by Dr. Davies. Subsequently, the interveners filed a motion to either exclude the report from the hearing record and prevent Dr. Davies from testifying, or to provide the interveners with an opportunity to review and respond to the report. The interveners expressed concern that they had not retained a human health expert since they believed the issue was out of scope for the hearing.

[174] In its June 26, 2013, decision letter on the interveners' motion, the AER stated that while it requested that the parties submit risk assessments for the three endpoints, it did not prevent the interveners from presenting evidence on health concerns at the hearing. In its decision letter, the AER stated that it regarded examination of that kind of evidence to be the very purpose of the hearing, that is, to assess the potential effects of the proposed well, pipelines, and facility on the interveners from the wells, pipelines, and facility, including the potential for health effects. The AER decision stated that the interveners' argument that they could not have anticipated that Grizzly and SDEL would address human health effects in their reply submission is unreasonable, given the interveners own written submissions and publications submitted, including the 2008 Intrinsik report.

[175] In its decision letter, the AER also found that sections 2.0 to 2.4 of the 2013 Intrinsik report contradicted its directions to all parties and could not be relied upon or addressed at the hearing by Grizzly and SDEL. However, the AER found that the remaining sections of the 2013 Intrinsik report did not contradict the instructions to the parties and that Grizzly and SDEL would be able to address those sections in their evidence.

Human Health Outcomes of H₂S Endpoints

[176] The interveners said that as part of its notification and consultation process, Grizzly provided residents with the Canadian Centre for Energy Information's (CCEI) pamphlet *Sour Gas: Questions + Answers* and charts referring to *Environmental Public Health Field Manual for Oil and Gas Activities in Alberta*. The interveners said that these documents showed that exposure to both SO₂ emissions and H₂S in the range of 1 to 1000 ppm could significantly affect health. The pamphlet stated that people who are more susceptible (those with certain pre-existing health concerns and small children) could be affected by lower H₂S concentrations over shorter exposure times than the general public.

[177] The interveners noted that the CCEI pamphlet also states that in addition to SO₂, inefficient combustion of sour gas can produce toxic substances such as carbonyl disulphide and carbonyl sulphide, and that, if inefficiently combusted, sour gas produces SO₂ and might produce volatile

organic compounds (VOC) such as benzene (a known carcinogen), toluene, and xylene. The interveners stated that SO₂ generated by flaring H₂S is a “choking” gas and is highly irritating, noting that flaring would release SO₂ and VOCs that might negatively affect the health of residents.

[178] One of the interveners stated that known carcinogenic chemicals may alter DNA and be taken up by fruit and garden plants that people consume. Although the intervener did not give any evidence to support this, she stated that this could result in life-altering diseases and death for humans.

[179] SDEL stated that other chemicals identified by the interveners as potential health hazards are the products of incomplete combustion during flaring, which for this project would be infrequent and short-term and conducted in compliance with *Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting*. SDEL stated that since it would not be flaring continuously, the interveners’ concerns with the effects of SO₂ on vegetation in the area are unfounded.

[180] SDEL argued that using the H₂S endpoints established by the AER provides adequate protection of the public and incorporate a high degree of conservatism. SDEL concluded that the likelihood of targeted health impacts, such as losing consciousness and sensory or irritant issues occurring at the H₂S concentrations and averaging times used to define the endpoints is low. SDEL concluded that, given the calculated potential volumes and release rates, it is unlikely the interveners would experience adverse health effects in the event of a release from the pipeline systems.

[181] SDEL submitted that it is highly unlikely the interveners would be exposed to concentrations capable of causing serious adverse effects near or in their homes given their distances from the wells, pipelines, and facility.

EPZ endpoint—Health Effects Above 100 ppm

[182] There was no disagreement among the parties that, depending on the duration, exposure to H₂S in the 100–1000 ppm range can cause significant adverse health effects, including the risk of lethality.

Evacuation Endpoint—Health Effects Above 10 ppm

[183] SDEL submitted that being exposed to H₂S concentrations less than 100 ppm may cause irritation but that systemic effects would be unlikely.

[184] SDEL noted that the concentration and exposure times used to determine the EPZ endpoint are based on systemic toxicity, while the evacuation endpoint is based on sensory and irritant effects. SDEL noted that the toxic load equation used for sensory and irritant effects is likely very conservative. SDEL stated that the EPZ endpoint H₂S concentration of 100 ppm is intended to protect against unconsciousness and is conservative by design.

[185] The interveners stated that people with existing health concerns and small children spend time in the areas where H₂S concentrations in the 10–100 ppm range might occur. Some of the interveners identified themselves as individuals who are more susceptible to the effects of H₂S exposure.

[186] The interveners also submitted a document from the Capital Health Region called *Health Effects of Short-Term Exposure to H₂S and Acute Exposure Health Effects of Sulphur Dioxide*, which indicated that health effects can occur at concentrations of 10 to 50 ppm. As concentrations increase, the moderate to strong odour can cause respiratory issues, eye irritation, irritability, headaches, dizziness, nausea, vomiting, and loss of sleep or appetite.

[187] The interveners also noted that Alberta's Occupational Health and Safety (OHS) legislation has specific requirements related to H₂S. The 8-hour occupational exposure limit (OEL) is 10 ppm. The OHS set a ceiling OEL of 15 ppm for unprotected workers.

Evacuation Endpoint—Health Effects Below 10 ppm

[188] SDEL submitted that normal healthy adults can be exposed to H₂S at a concentration of 10 ppm for 30 minutes without adverse effects according to a study commissioned by Alberta Health and Wellness.

[189] SDEL acknowledged that, in the event of a release, the interveners might detect an unpleasant H₂S odour. SDEL stated that it is unlikely that the interveners would be exposed to concentrations causing irritation, and that these effects are not considered clinically or toxicologically significant or adverse.

[190] SDEL stated that the evacuation endpoint is designed to protect against irritant effects and that systemic toxicity would not be expected at this level of exposure. Dr. Davies noted that although both the evacuation endpoint and OHS use the same 10 ppm H₂S concentration, the permitted exposure times are vastly different. The evacuation endpoint is based on a three-minute exposure while the OHS recommended OEL is eight hours. SDEL further submitted that the science behind the OHS recommended H₂S OEL would have supported a concentration of 20 ppm, but that OHS chose to be more conservative. SDEL noted that the evacuation endpoint is therefore highly conservative.

[191] SDEL also stated that if exposure were to be prolonged at H₂S concentrations less than 10 ppm, irritation could occur but would not be considered a significant adverse effect. It noted that these effects are likely the result of odours, not systemic toxicity, especially given that the odour of H₂S can be detected at concentrations of 0.05 ppm or less. It also stated that a “psycho-physiological” response could occur, but that this would not be considered a clinically adverse response. SDEL stated that adverse was considered to mean harmful, and having detrimental or injurious interference on bodily structure, processes, or function.

[192] The interveners noted that the CCEI pamphlet suggested some effects from exposure to 1 to 10 ppm concentrations “*appear to be reversible and not serious for the general population*” (emphasis added by interveners). However, some of the interveners identified themselves as people with pre-existing medical conditions who could be affected by lower H₂S concentrations over shorter exposure times than the general public.

[193] The interveners referred Dr. Davies to an Alberta Health and Wellness report called *Health Effects Associated with Short Term Exposure to Low Levels of Hydrogen Sulphide (H₂S)—A Technical Review* that he co-authored. The report referred to a study by Jappinen where 10 mild to moderate asthmatic subjects were subjected to a 2 ppm “whole body” exposure to H₂S for 30

minutes. This study reported that some asthmatic subjects complained of an unpleasant odour, dryness of the nose and throat, and headache during and after exposure.

[194] Dr. Davies noted that only two subjects showed reduced airway resistance after being exposed to the 2 ppm H₂S concentration for 30 minutes while four showed increased airway conductance. He also noted that, including the subjects that showed the reduced airway conductance, none of them showed any clinical evidence of respiratory discomfort or respiratory distress during the exposure or after the exposure. There was no evidence of coughing, wheezing, or shortness of breath. He noted that the investigators concluded that exposure to 2 ppm for 30 minutes did not noticeably affect respiratory function.

[195] While Dr. Davies acknowledged that some asthmatic individuals may show a heightened response to airborne irritants, he noted that the Jappinen study was only a single study, at 2 ppm for 30 minutes, and as such “one needs to proceed cautiously” when interpreting these results. He also acknowledged that children could be more sensitive to H₂S than adults. However, based on the risk assessments submitted by Grizzly and SDEL and the interveners, he stated that the potential for such health effects to the interveners would be virtually nonexistent.

Findings

[196] The panel acknowledges that in the event of an uncontrolled release, emissions could occur during drilling, completion, and production operations that may be harmful to human and animal health in high enough volumes and concentrations. The panel further acknowledges that this is a major concern of the interveners.

[197] In the prehearing, the panel requested that the parties focus on the risks of health effects occurring rather than the effects themselves. However, it acknowledges that it is necessary to discuss the nature of the effects on health and the environment to fully comprehend the issues.

[198] The panel recognizes that the purpose of the various pamphlets supplied by industry is to provide the public with basic information, and that this information is general and helpful. However, the panel notes that the pamphlets do not relate concentrations to exposure durations to determine potential toxicity.

[199] The panel acknowledges that although research on the effects of contaminants on individuals with severe respiratory health issues is lacking, it notes that the results of the risk assessments indicate that the chances of the interveners being exposed is extremely low.

[200] The panel notes that there will be no continuous flaring at either the 7-5 well site or the 13-2 battery, and therefore no continuous emissions of SO₂. The panel further notes that any short-term emergency flaring would be conducted in compliance with *Directive 060*, which requires that Alberta Ambient Air Quality Objectives be met. The panel therefore finds that there is no basis on which to expect health or environmental effects from SO₂ emissions from the proposed wells, pipelines, and facility.

[201] The panel notes SDEL’s statement that there would be no benzene emissions from the gas dehydrator system since it is a closed system. The panel also notes that while benzene and other VOCs may be emitted during flaring, flaring would be infrequent and of short duration. The

panel finds no basis on which to expect health or environmental effects from VOCs as there will be no continuous emissions from these facilities.

[202] The panel accepts that, depending on the duration of exposure, H₂S in the 100–1000 ppm range can cause significant adverse health effects, including the risk of lethality.

[203] The panel accepts that short-term exposures to concentrations of H₂S in the 10–100 ppm range (up to and including the EPZ endpoint) could be temporarily unpleasant, and that serious long-term effects on the general population are unlikely. However, the panel also accepts that individuals with heightened sensitivities could be adversely affected by H₂S in this range depending on the concentration and duration of exposure.

[204] The panel acknowledges the OHS guidelines that allow individuals to work in conditions of up to 10 ppm H₂S for up to 8 hours. The panel finds that it is unlikely short-term exposures to concentrations of H₂S up to 10 ppm (the evacuation endpoint) would adversely affect the health of members of the general population to a significant degree.

[205] The panel notes references to the Jappinen study, which showed some effects on mildly asthmatic individuals. The panel finds the Jappinen study to be inconclusive. The panel notes the small number of study subjects (10), the limited duration of exposure, and the contradictory responses of subjects. As such, the panel agrees that caution should be exercised in reading too much into the results of this study.

[206] The panel finds the evidence about the response of individuals with heightened sensitivities to low levels of H₂S (below 10 ppm) to be inconclusive. The panel notes there are very few studies that specifically examine the exposure of individuals with respiratory conditions to low levels of H₂S. Nevertheless, the panel accepts that some evidence suggests that individuals with heightened sensitivities could be affected by exposure to concentrations of H₂S lower than 10 ppm. However, it is not clear to the panel that these effects meet the clinical definition of an adverse health response.

H₂S RISK ASSESSMENT

The Nature of Risk Assessment

[207] Risk assessment is the overall process of identifying, analyzing, and evaluating risk (the chance of an adverse outcome). Something is considered safe if its risks are judged tolerable. There are degrees of risk, and therefore degrees of safety. Risk assessment helps decision makers and stakeholders understand public safety risks, and how adequate and effective controls are. As part of the risk management process, the AER monitors and reviews risks and controls on a regular basis.

[208] Risk identification is the process of finding, recognizing, and recording risks. Events that might happen that could affect the public are identified, such as hazards, the potential harms that those hazards represent, and the potential effects of those harms. The process allows numerical risk to be considered, along with other factors in determining whether or not a risk is tolerable.

[209] For wells, a blowout could occur during the drilling, servicing, or operating phase. A blowout is an identified hazard, and is defined by the AER as the loss of control of a well with a release of fluid to surface. The AER's statistics include the temporary loss of well control, but since no release occurs, they are not included in the AER's definition of a blowout.

[210] Pipelines can leak or rupture. The AER defines a pipeline leak as a failure where the line is losing product but might continue to operate until the leak is detected. A pipeline rupture is the failure of a line where it is shut down immediately. The frequency with which a pipeline fails is an important factor in assessing risk.

[211] For a sour gas release the primary concern (the potential harm) is the adverse effects (the potential impacts) of H₂S on human health at various levels of exposure. Exposure to H₂S can be a nuisance or cause irritation, adverse health effects, injury, or death, depending on the concentration and length of exposure. Exposure to SO₂ and heat (thermal radiation) in the event of ignition are also considered.

[212] Risk analysis is about developing an understanding of the risks. Risk analysis consists of determining the consequences and probabilities of the identified events, taking into account controls that can mitigate the risks. The consequences and probabilities are then combined to estimate the level of risk.

The Panel's Risk Assessment Requirements

[213] The panel, acknowledging that the interveners identified public safety as a primary concern, requested at the prehearing that Grizzly, SDEL, and the interveners prepare independent quantitative risk assessments of the proposed well, pipelines, and facility. The panel notes that a quantitative risk assessment determines a numerical value of risk related to an activity or situation. It requires that the consequence of an event and the probability that the event will occur be calculated. The panel specified three consequence endpoints for use in the risk assessments: an H₂S lethality endpoint, an EPZ endpoint, and the evacuation endpoint. The panel also established the context and scope of the risk assessments.

[214] The probability of lethality is calculated from a response curve. The curve is primarily defined by its median toxic load value of a 60-minute exposure to an H₂S concentration of 283 ppm.

[215] In ERCBH2S version 1.20, the EPZ endpoint is set at a 60-minute H₂S exposure to a concentration of 100 ppm as the toxic load. This provides a conservative margin of safety such that exposure to this EPZ endpoint would not result in unconsciousness that might prevent escape.

[216] The evacuation endpoint is based on a three-minute exposure to a concentration of 10 ppm H₂S, used in the event of a release to identify when and if sheltering in place or evacuation should be advised.

[217] The risk assessment determines the probability of these endpoints at distances from the source of the H₂S release. The endpoints from the Grizzly and SDEL risk assessment are shown on the maps as contours (figures 2, 3, 4 and 5) for the drilling of the 1-8 well and the operation of the wells and pipelines.

Societal Tolerability of Risk Levels

[218] Risk evaluation involves comparing estimated levels of risk to established risk criteria to determine the significance of the level and type of risk. Whether a risk is judged as small or large, or as tolerable or intolerable, depends on many factors. Risk tolerability criteria are set based on the premise that the risk being evaluated should not substantially increase the risks of everyday life. Risk tolerability criteria give decision makers a frame of reference for making value decisions and have been adopted by many jurisdictions.

[219] The risk analysis experts for Grizzly and SDEL and for the interveners referred to the modified *Risk-based Land Use Planning Guideline*² from the Major Industrial Accident Council of Canada (MIACC) for tolerable individual risk levels that change with the land use (figure 6). For the low density residential development of the interveners the tolerable annual individual risk of lethality is between 1 and 10 chances in a million. These criteria were developed for the risk of death occurring (lethality) and therefore incorporate an extremely low chance of occurrence.

[220] There are no similar risk-based land use planning criteria available for exposure to the EPZ toxic load or evacuation concentration endpoints. Given that the consequences of these two latter endpoints do not include lethality, the tolerable risk levels would be expected to be higher than those in the MIACC guidelines.

Comparison of Methodologies

[221] SDEL and Grizzly submitted a risk assessment as requested in the scoping direction from the prehearing decision. They modelled production activities, which include group, test, and salt-water pipelines, along with the continuous production and annual intermittent servicing of three producing wells and one produced-water injection well on the 7-5 wells site. They also modelled the drilling phase of the 1-8 well. The three endpoints were considered as requested.

[222] The interveners provided two independent reports: a refined (more rigorous) modelling assessment and a screening (more general) modelling assessment. Assuming that the 1-8 well would be tied in immediately, the interveners refined assessment combined the drilling and producing phases of the well (representative of the first year of operation). The interveners also provided refined modelling of the combined operation of the group, test, and salt-water pipelines.

[223] The interveners' screening risk assessment considered the consequences of a blowout during drilling and production, and of ruptures of individual pipelines. The screening modelling assessed the lethality endpoint and the EPZ endpoint. However, the H₂S releases were mistakenly modelled as liquids instead of gases; the resulting estimated distances of concern for gases were therefore higher than expected and cannot be compared to the refined modelling results.

[224] The interveners also modelled SO₂ dispersion of a blowout during drilling. Using CALPUFF software, the refined dispersion modelling predicted that the SO₂ evacuation endpoint

² MIACC risk-based land use planning guideline as modified by the process safety management division of the Chemical Institute of Canada/Canadian Society for Chemical Engineering (CSChE).

criteria would not be exceeded at the maximum H₂S release rate—except in a small area close to the well in specific dispersion conditions.

[225] The interveners also modelled H₂S dispersion from an unignited blowout of the 1-8 well during drilling. The worst-case distances to the evacuation endpoint (10 ppm H₂S) predicted with CALPUFF were almost identical to those predicted with ERCBH2S version 1.20, even though the two definitions of worst-case differ slightly.

[226] The interveners had their expert summarize the changes to the ERCBH2S model that have occurred, and compared the predictions made with the previous versions. They expressed concerns that the resulting smaller EPZs appear to provide less protection to the public.

[227] The interveners' risk assessment expert, Dr. Zelt, submitted that the current version of ERCBH2S (version 1.20), which uses province-wide weighted-average meteorological conditions to calculate the EPZ distance, is more appropriate for emergency planning and response than the previous versions that used worst-case distances of meteorological conditions.

Release Frequency Data

[228] The Grizzly and SDEL risk assessment and the interveners' refined risk assessment both used Alberta historical average failure frequencies. The average failure frequencies include the probability of failure to control both a kick (a pressure increase in the wellbore) and an associated failure to be able to control the well. Well failure data for drilling are expressed as blowouts per well drilled, while well failures during production, injection, or servicing are expressed as blowouts per well year of operation. Pipeline leaks and ruptures are expressed as releases per year per kilometre.

[229] SDEL and Grizzly used data from *ERCB Report 90-B (Volume 6): Risk Approach, An approach for Estimating Risk to Public Safety from Uncontrolled Sour Gas Releases* for wells from 1975 to 1988, whereas the interveners used Alberta's annual well blowout frequencies from *Risk Analysis Methods and Applications* by Dr. Frank Bercha (the Bercha report) with AER data for the years 1986 to 2001. The data on pipelines in *ERCB Report 90-B* and the Bercha report also differ, with data being from either 1975 to 1989 or from 1995 to 2001, respectively.

[230] Grizzly and SDEL's and the interveners' experts used the same frequency for drilling blowouts. However, Grizzly and SDEL's producing well blowout frequency was about 4 times greater than that used by the interveners. For oil pipelines, the frequencies are 40 times higher, and for salt-water pipelines they are 70 times higher. These differences led to differing orders of magnitude in risk predictions.

[231] The probabilities of meteorological conditions (defined by the stability class, wind speed, and wind direction) are from Alberta Environment and Sustainable Resource Development data (MET data) for the province and the specific area. These data and how they are used affect the predicted releases and their frequencies. The Grizzly and SDEL risk assessment and the interveners refined risk assessment both used the same MET data.

[232] The ERCBH2S version 1.20 model dispersion calculations for the EPZ are based on provincial average MET data. Grizzly and SDEL used the proprietary RELEASE/SLAB model with site-specific MET data. The interveners used the CALPUFF model and a modified version

of the ERCBH2S modelling methodology with site-specific MET data. Provincial average MET data are always used for EPZ endpoint calculations in formal applications using ERCBH2S version 1.20.

Estimated Risks for the Three Endpoints

[233] Grizzly and SDEL's risk assessment and the interveners' refined risk assessment used different proprietary consequence models that each gave a different prediction. In the 1-8 well drilling case (see figure 2), both applied a 15-minute H₂S release, which was then ignited, and used site-specific MET data.

[234] Grizzly and SDEL predicted individual risks for the producing operations. The contours in figures 3, 4, and 5 represent equal chances in a million per year (cpm) for each of the three endpoints. Since Grizzly and SDEL used larger frequencies of release events and different consequence inputs when estimating risk, their results were more conservative (i.e., showed a larger areal extent) than those of the interveners.

[235] Grizzly and SDEL submitted a comparison of the estimated risk levels at the individual intervener's residences, shown on the figures as receptor locations R1 to R6. The highest risks occur at R4 as it is closest to the wells and pipelines.

Lethality Endpoint

[236] Grizzly and SDEL estimated that during drilling, the 10 cpm lethality contour extends about 450 m and that the 1 cpm lethality contour extends about 1700 m from the well (see figure 2). For the pipelines associated with the 1-8 well, the 100 cpm lethality contour extends about 60 m from the centre of the pipeline right-of-way, the 10 cpm lethality contour about 240 m, and the 1 cpm lethality contour about 420 m (see figure 3).

[237] The lethality risk estimated by Grizzly and SDEL (see figures 2 and 3) is effectively zero at R1, R2, R3 and R5, and less than 0.1 cpm (1 in 10 000 000) at R4 and R6, well below the MIACC guideline for annual individual risk of 10 cpm (see figure 6).

[238] For the drilling and production phases of the 1-8 well, the interveners estimated that the 10 cpm lethality contour would be about 100 m from the well and that the 1 cpm lethality contour would be about 300 m. For the combined operation of the pipelines, they estimated that the 10 cpm lethality contour would not occur and that the 1 cpm lethality contour would be about 20 m from the pipeline.

[239] Grizzly and SDEL stated that the interveners reside far enough away from the wells and pipelines that the individual risk of lethality would be well below the MIACC tolerability criteria during all drilling and production. The risk of lethality would be well below 1 in 1 000 000, even for those interveners closest to the 7-5 well site.

EPZ Endpoint

[240] The interveners, using the ERCBH2S version 1.20 model with provincial-average MET data, calculated an EPZ radius of 1018 m for the drilling case.

[241] Grizzly and SDEL, using the RELEASE/SLAB model and the same provincial-average MET data, calculated an EPZ radius of 1443 m for the drilling case. Grizzly and SDEL also submitted evidence that showed using site-specific MET data resulted in EPZ endpoint calculations of 887 m with ERCBH2S version 1.20 and 1204 m with the RELEASE/SLAB model.

[242] Grizzly and SDEL's consequence predictions for the drilling case are 20 to 80 per cent greater than the interveners' estimates, and on average are 40 per cent greater. These higher consequence estimates result in the EPZ endpoint risk extending farther from the well than the interveners estimate.

[243] Grizzly and SDEL's EPZ endpoint risk does not occur at R1, R2, and R3, and is extremely low (less than 1 in 10 000 000) at R4, R5, and R6 (see figure 4).

Evacuation Endpoint

[244] The evacuation endpoint risk is greatest closest to the operations. It is about 100 cpm (or 1 in 10 000) at R4 and R5, about 10 cpm (1 in 100,000) at R3 and R6, and much less than 10 cpm at R1 and R2 during production (figure 5).

Findings

[245] The panel finds that the intervener's screening risk assessment expert made several input errors that could have been resolved by communicating with the other experts. However, the general conclusions of the screening assessment support the two refined risk assessments.

[246] The panel notes that the differences in the results obtained by the two sets of experts can be attributed in part to different data sets used for event frequency from *ERCB Report 90-B* and the Bercha report. The panel notes that although dated, the information in the Bercha report is more recent and therefore better represents current industry practices and outcomes. The panel acknowledges that due to these significant differences for both wells and pipelines, the interveners' failure frequency results are significantly lower than Grizzly and SDEL's in most areas.

[247] The panel notes that all the risk predictions are conservative as it is assumed that individuals are outdoors 100 per cent of the time. The panel finds this assumption to be unrealistic and overly conservative. The panel accepts that some individuals could be outdoors on their property for as much as eight hours a day on an annual basis (33 per cent of the time), which would reduce the risk estimation by a factor of three.

[248] The panel finds that the modified MIACC guideline for individual risk levels is an acceptable reference for determining tolerable levels of lethality risk in general, and to the interveners specifically with respect to the Grizzly and SDEL applications. The panel finds that risk of lethality to the interveners posed by the proposed well and pipelines is within the tolerable limits identified by the MIACC criteria.

[249] While it is difficult to compare risk predictions, given the different assumptions used and different presentations of the results, the panel notes that both sets of experts came to the same general conclusion: that the risks to the interveners are negligible given the MIACC tolerable lethality levels between 1 and 10 cpm for low density residential development. The panel finds

that the risk of lethality to the individual interveners is extremely low at the nearest residences and is near zero for more distant locations.

[250] With respect to the 1-8 well and associated pipelines and facility, the panel finds that the risk of lethality for all interveners is near zero (figures 2 and 3). Similarly, the risk of lethality associated with the 4-27 to 16-14 pipeline operations indicates that Dr. Losey and Ms. Kerpan's property is located far enough away that the individual risk to them is well below the MIACC tolerability criteria. The panel finds that the risk of lethality from a release would be less than 1 in 10 000 000, or effectively zero, on their property.

[251] The panel finds that the risk of being exposed to the H₂S EPZ endpoint of 100 ppm for a 60-minute period is negligible for all the interveners. At the interveners' residences, the chance of being exposed to the H₂S EPZ endpoint is less than 1 cpm.

[252] For the evacuation criteria, while the risk increases to about 100 cpm, the consequences of that exposure are much less. The panel finds that the risk associated with the evacuation endpoint concentration of 10 ppm for a three-minute period does not impose an unacceptable risk on the interveners and notes that OHS considers this concentration safe for workers to operate in for up to eight hours.

[253] The panel notes that the consequences of being in an area subject to the evacuation endpoint criteria are that the person may be advised to shelter in place or evacuate to avoid irritation or a potentially foul odour. However, the panel finds that even a 100 cpm (a chance of exposure of 1 in 10 000, or a 99.99 per cent chance of not being exposed) does not impose an unacceptable risk on the interveners. The panel notes that except for Dr. Losey and Ms. Kerpan's property, all the interveners' properties are well outside the 100 cpm contour (see figure 5).

[254] The panel acknowledges that regulators in many areas of public service are responsible for adopting risk criteria and determining a socially tolerable level of risk. The panel also acknowledges that this responsibility is carried out through sound scientific understanding and reasoning and principles of reasoning that link such decisions to reality through evidence and argument.

[255] The panel finds that applying the risk assessment process and its results provide a better understanding of the nature and magnitude of risks imposed on the public by these applications. The panel also finds that the risk assessments submitted confirm that the risks associated with the proposed activities are negligible, and that the local residents and the interveners specifically are adequately protected.

CONCLUSION

[256] Having carefully considered all the evidence, the panel finds that the proposed well, pipelines, and facility meet or exceed regulatory requirements, will not have a significant environmental effect, and that the risks to the interveners associated with these proposed well, pipelines, and facility are negligible. The panel also finds that there is a need for all of the facilities.

[257] The AER approves Grizzly's Application No. 1707770 and SDEL's Applications No. 1723456, 1723458, 1723460, 1723486, 1723491, 1759037, 1759038, 1759044, and 1759045, subject to the conditions outlined in the report and summarized in appendix 2.

[258] Having carefully considered all the evidence, the panel finds that the existing 4-27 to 16-14 pipeline meets the regulatory requirements and that the risks to Dr. Losey and Ms. Kerpan associated with this pipeline are negligible.

[259] The AER confirms the decision to approve Application No. 1696239 to add Line No. 5 to Pipeline Licence No. P52607.

Dated in Calgary, Alberta, on October 31, 2013.

ALBERTA ENERGY REGULATOR

<original signed by>

R. C. McManus, M.E.Des.
Presiding Hearing Commissioner

<original signed by>

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

<original signed by>

G. Eynon, P.Geo., FGC
Hearing Commissioner

APPENDIX 1 HEARING PARTICIPANTS

Principals and Representatives
 (Abbreviations used in report)

Witnesses

Grizzly Resources Ltd.

 D. Farmer
 A. Wong

 T. Benz
 P. Lubey
 L. Parks
 D. Long, of
 Barlon Engineering
 R. J. Brown, of
 Bissett Resource Consultants Ltd.
 I. Dowsett, of
 Skystone Engineering
 A. J. W. Springer, of
 Stantec

Sinopec Daylight Energy Ltd.

 B. Gilmour
 D. Naffin
 C. Prentice

 D. Baumgarten, P.Eng.
 D. McCoubrey, P.Eng.
 C. Venardos
 M. K. Wentworth, P.Eng.
 R. J. Brown, of
 Bissett Resource Consultants Ltd.
 I. Dowsett, of
 Skystone Engineering
 A. J. W. Springer, of
 Stantec
 D. B. Davies, Ph.D., DABT, of
 Intrinsic Environmental Sciences Inc.
 R. Goodfellow, P.Eng., of
 IRISNDT Corporation

 R. Domke, L. Duperron, S. Kelly, C. Kerpan,
 Dr. T. Losey, L. McGinn, A. Warnock,
 D. Warnock
 D. P. Bishop, P.Eng., LLB

 R. Domke
 C. Ehbrecht (in support of R. Domke)
 L. Duperron
 S. Kelly
 C. Kerpan
 Dr. T. Losey
 L. McGinn
 A. Warnock
 D. Warnock
 C. Duncan, P. Eng.
 D. McCutcheon, P.Eng., of
 Doug McCutcheon and Associates
 Consulting

G. Phillips, of
GC Phillips Consulting Ltd.
Dr. B. Zelt, of
Zelt Professional Services Inc.

T. Melnyk, of
Parkland County

J. Sweeney, of
Brazeau County

Alberta Energy Regulator staff
Gary Perkins, AER Counsel
Robert Mueller, AER Counsel
A. Allum
R. Ruddell
D. Miles
M. Craig
M. Zelensky
I. Mitchell
D. Barter

APPENDIX 2 SUMMARY OF CONDITIONS AND COMMITMENTS

Conditions generally are requirements in addition to or otherwise expanding upon existing regulations and guidelines. An applicant must comply with conditions or it is in breach of its approval and subject to enforcement action by the AER. Enforcement of an approval includes enforcement of the conditions attached to that licence. Sanctions imposed for the breach of such conditions may include the suspension of the approval, resulting in the shut-in of a facility. The conditions imposed on the licence are summarized below.

The AER notes that Grizzly has made certain undertakings, promises, and commitments (collectively referred to as commitments) to parties involving activities or operations that are not strictly required by the AER. These commitments are separate arrangements between the parties and do not constitute conditions of the AER's approval of the application. Those commitments that the AER has decided to make conditions of Grizzly's 1-8 well licence have been summarized below.

The AER expects the applicant to comply with commitments made to all parties. However, while the AER has considered these commitments in arriving at its decision, the AER cannot necessarily enforce them. If the applicant does not comply with commitments made, affected parties may request a review of the original approval. At that time, the AER will assess whether the circumstances regarding any failed commitment warrant a review of the original approval.

CONDITIONS

- Grizzly must drill the 1-8 well as a critical sour well even though it is not classified as one. All equipment and practices used to drill the 1-8 well must meet or exceed the requirements for critical sour wells in AER *Directive 036: Drilling Blowout Prevention Requirements and Procedures* and Enform's *Industry Recommended Practice (IRP) Volume 1: Critical Sour Drilling*.
- Grizzly must restrict flaring at the 1-8 well to no longer than a single period that lasts no longer than six hours during drilling and completion.

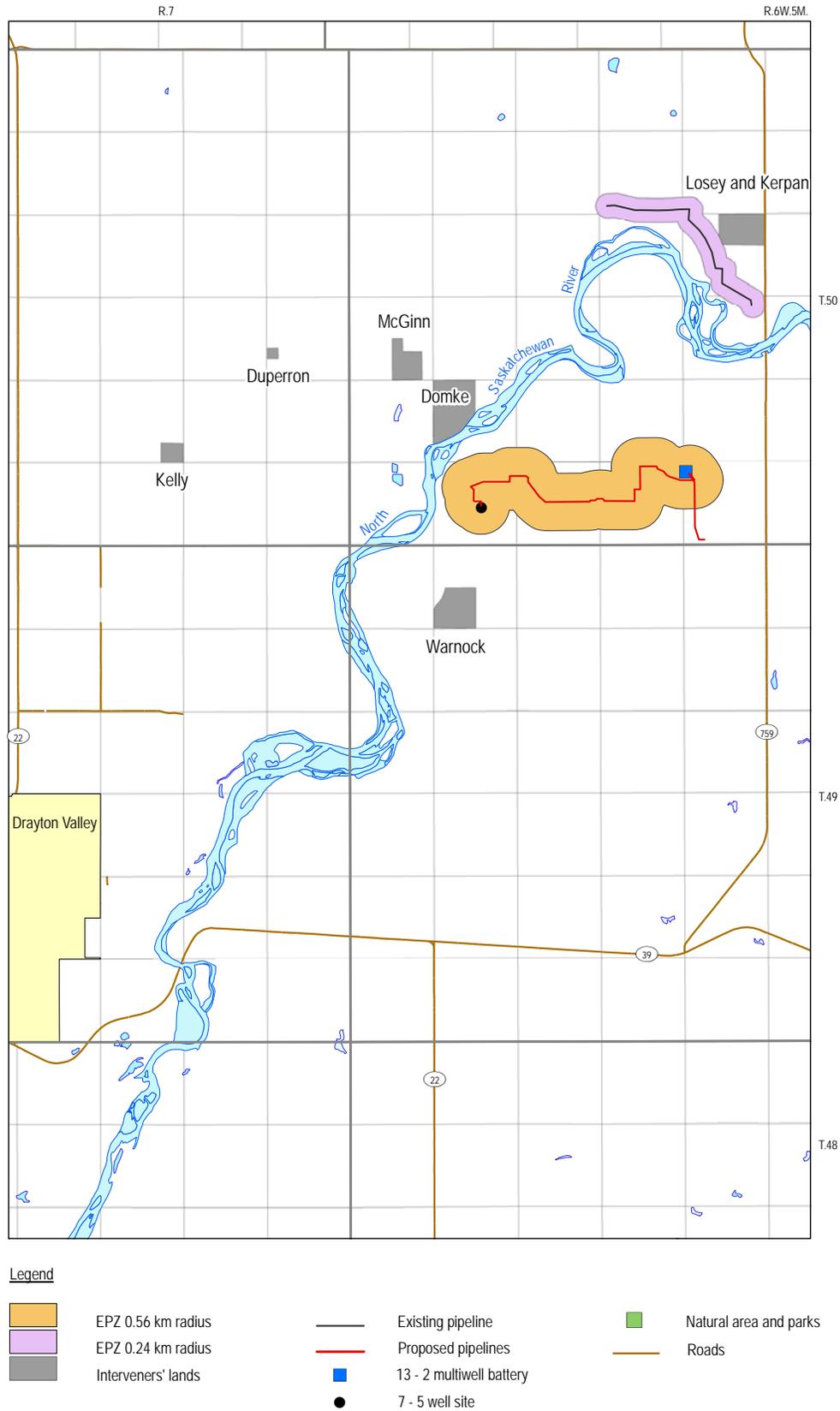
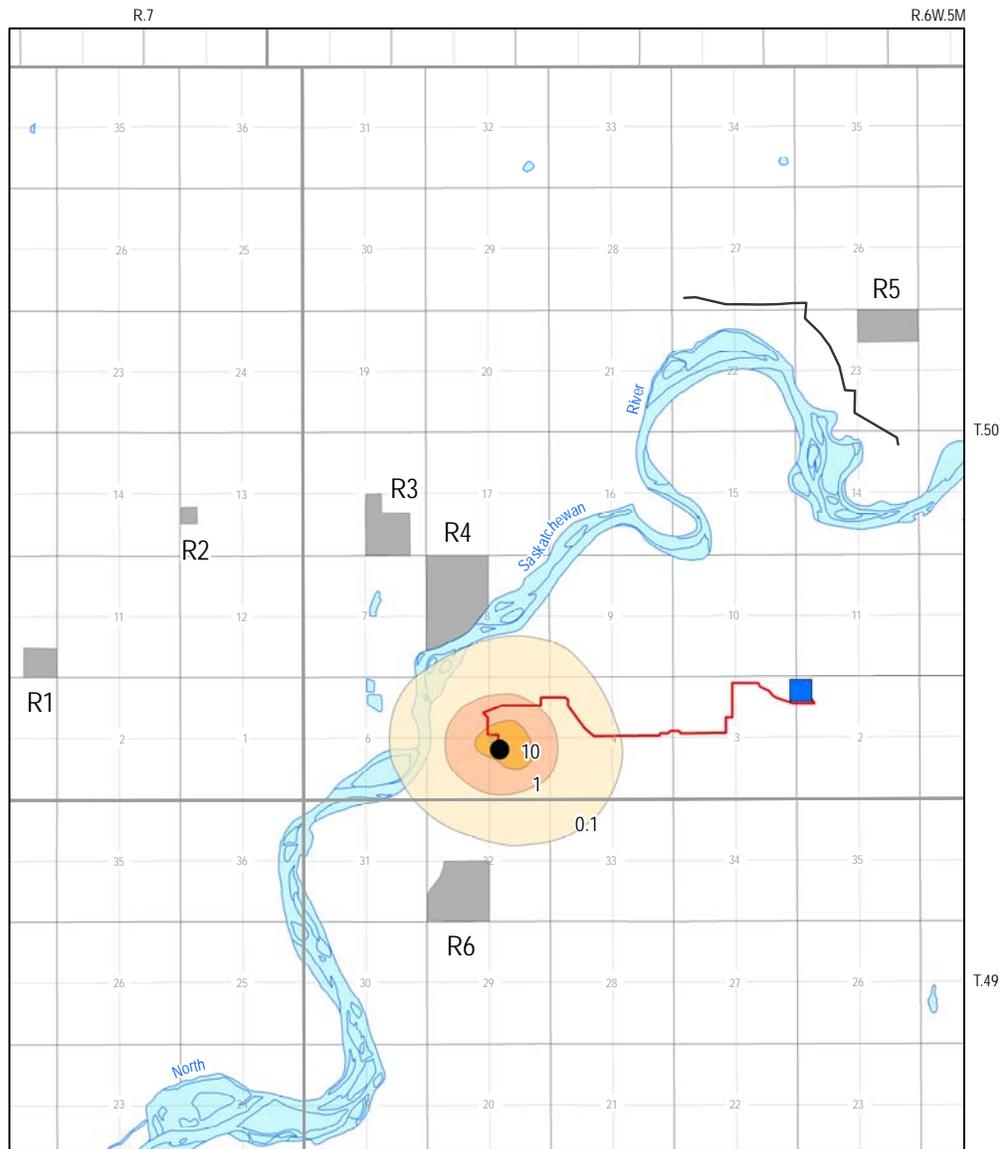


Figure 1. Area map with production EPZs



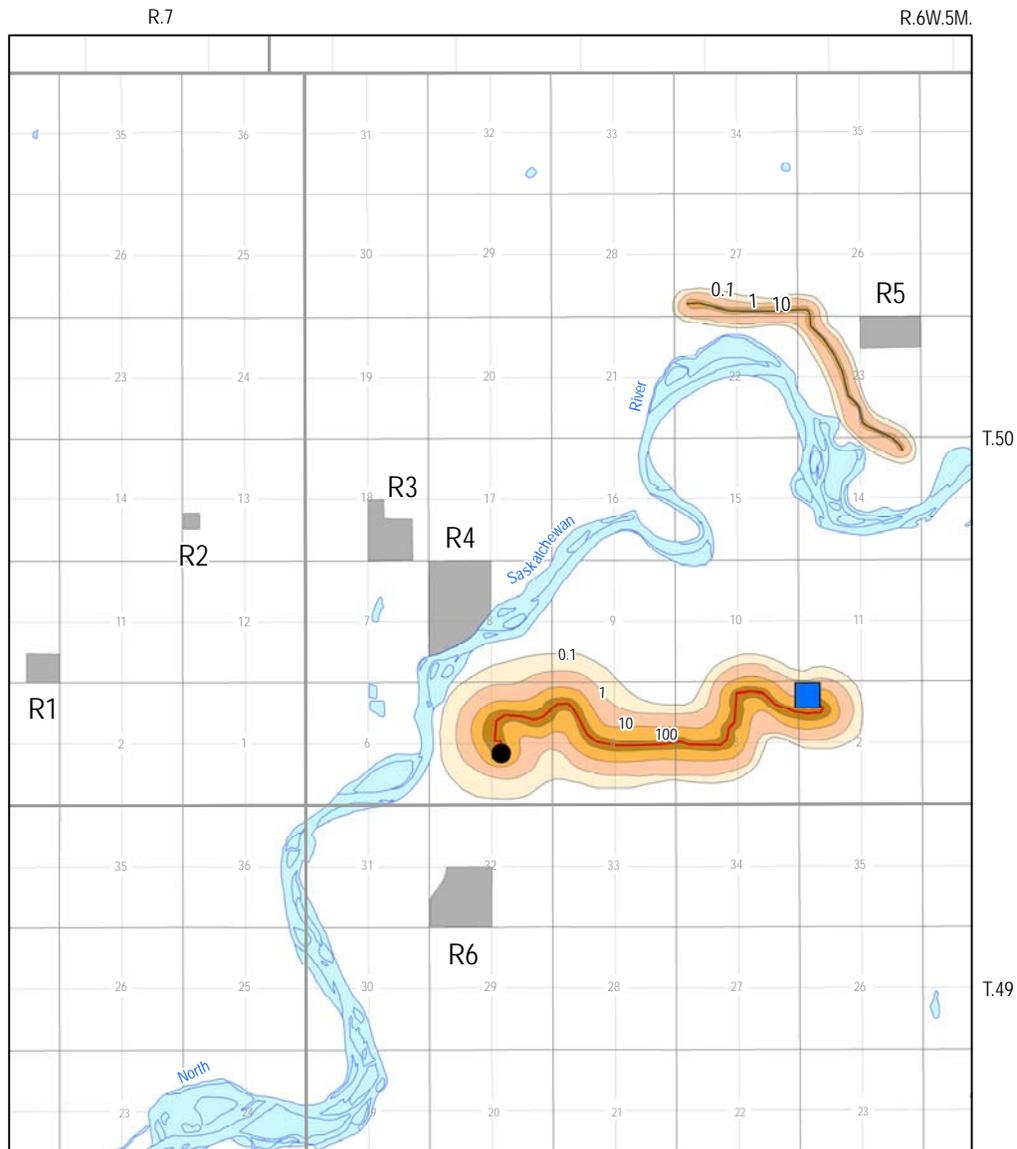
Legend

Chances in 1 million per year

- | | | | | | |
|---|----------|---|--------------------------|--|--------------------|
|  | 0.1 - 1 |  | Interveners' lands |  | Existing pipeline |
|  | 1 - 10 |  | 13 - 2 multiwell battery |  | Proposed pipelines |
|  | 10 - 100 |  | 7 - 5 well site | | |
|  | 100 | | | | |

(Source: Grizzly and SDEL joint risk assessment)

Figure 2. Annual risk for the H₂S lethality endpoint during drilling



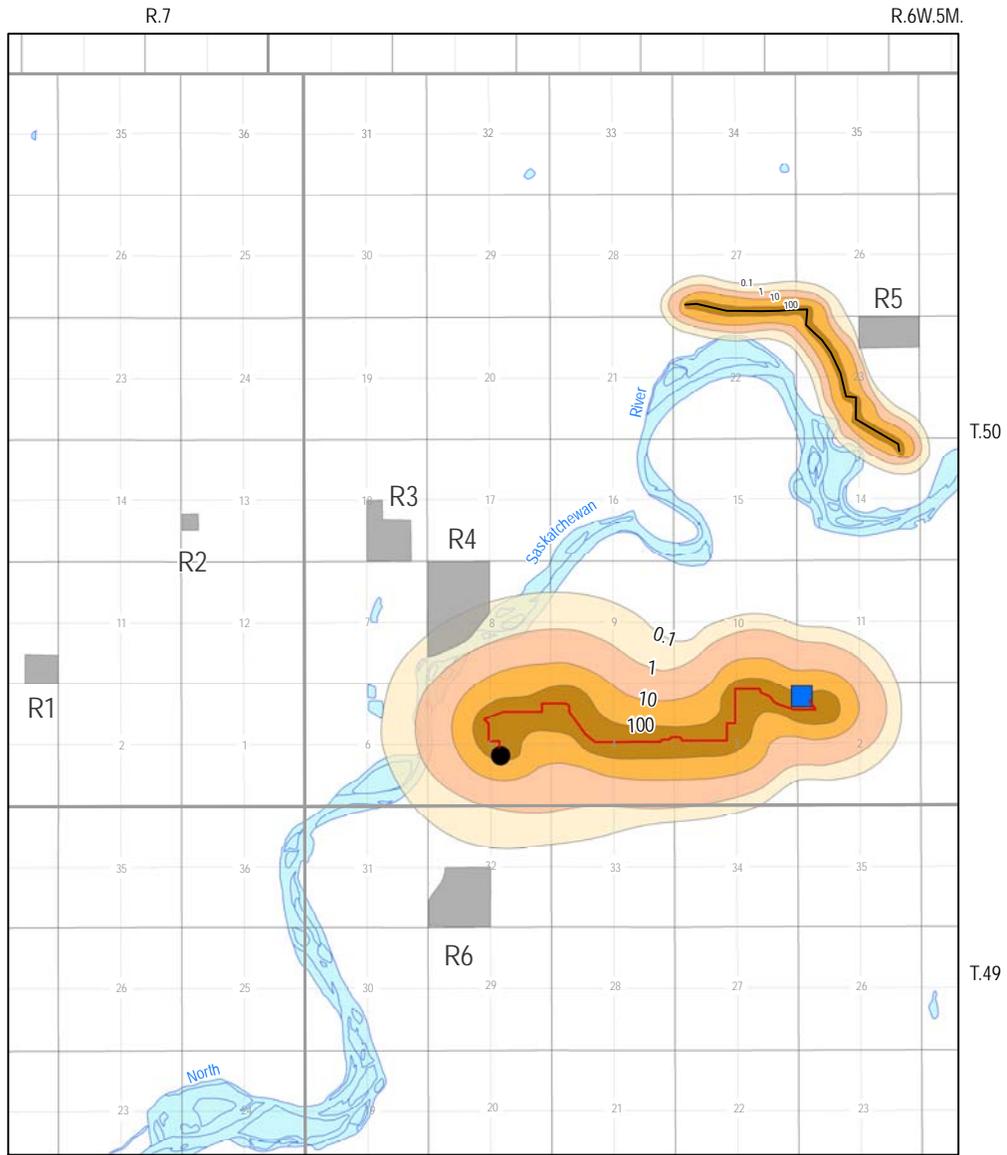
Legend

Chances in 1 million per year

- | | | | | | |
|---|----------|---|--------------------------|---|--------------------|
|  | 0.1 - 1 |  | Interveners' lands |  | Existing pipeline |
|  | 1 - 10 |  | 13 - 2 multiwell battery |  | Proposed pipelines |
|  | 10 - 100 |  | 7 - 5 well site | | |
|  | 100 | | | | |

(Source: Grizzly and SDEL joint risk assessment)

Figure 3. Annual risk for the H₂S lethality endpoint during production



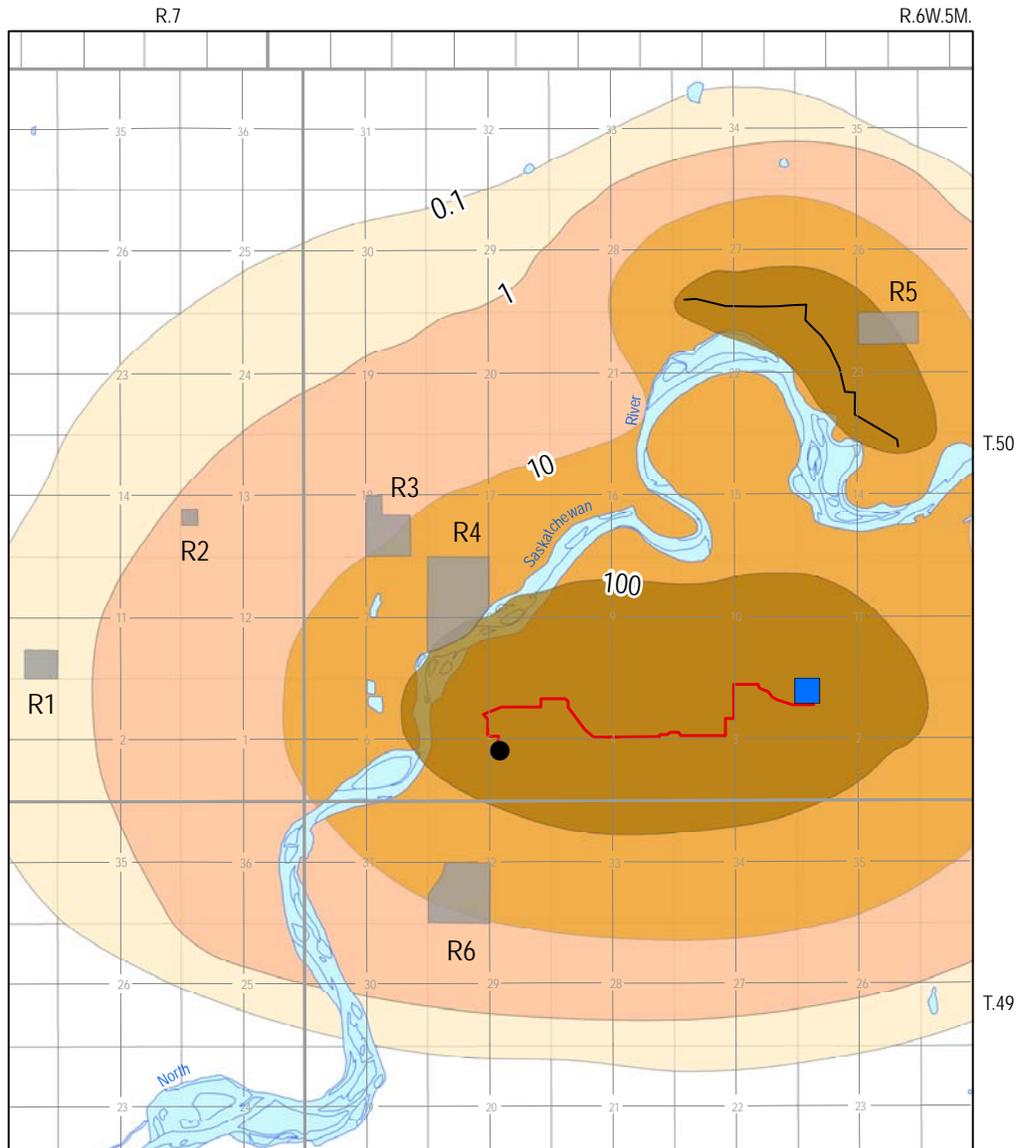
Legend

Chances in 1 million per year

- | | | | | | |
|---|----------|---|--------------------------|---|--------------------|
|  | 0.1 - 1 |  | Interveners' lands |  | Existing pipeline |
|  | 1 - 10 |  | 13 - 2 multiwell battery |  | Proposed pipelines |
|  | 10 - 100 |  | 7 - 5 well site | | |
|  | 100 | | | | |

(Source: Grizzly and SDEL joint risk assessment)

Figure 4. Annual risk for the H₂S EPZ endpoint during production



Legend

Chances in 1 million per year

- | | | | | | |
|---|----------|---|--------------------------|---|--------------------|
|  | 0.1 - 1 |  | Interveners' lands |  | Existing pipeline |
|  | 1 - 10 |  | 13 - 2 multiwell battery |  | Proposed pipelines |
|  | 10 - 100 |  | 7 - 5 well site | | |
|  | 100 | | | | |

(Source: Grizzly and SDEL joint risk assessment)

Figure 5. Annual risk for the H₂S evacuation endpoint during production

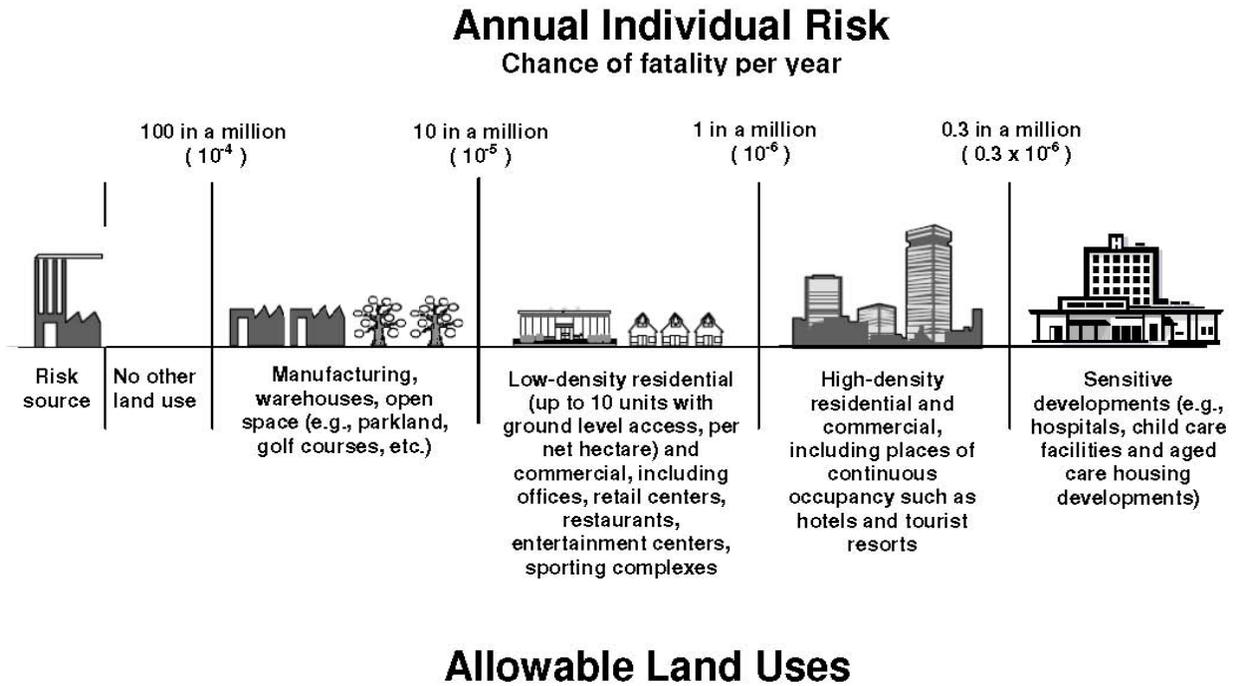


Figure 6. MIACC's risk-based land use planning guideline modified by CSChE