June 27, 2007

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Dear Directors:

RE: Application for Approval of the Alberta Sulphur Terminals Ltd. Bruderheim Sulphur Forming and Shipping Facility

Alberta Sulphur Terminals Ltd. (AST), a division of HAZCO Environmental Services (HAZCO), which is a division of CCS Income Trust (CCS), hereby applies for approval to construct and operate a sulphur forming and shipping facility (the Project) in a portion of Section 35, Township 55, Range 20, west of the fourth meridian (the Site).

AST is a majority-owned subsidiary of HAZCO and specializes in the management of sulphur in western Canada. Activities and services provided by AST and HAZCO include sulphur remelting and recovery, sulphur forming and shipping of sulphur in both liquid and solid states to domestic and international customers.

AST, in accordance with the Terms of Reference issued by Alberta Environment on March 13, 2007, hereby applies to:

1. Alberta Environment (AENV) for approval,

    - under Chapters E-13.3, Part 2, Division 2, Section 63 and Regulations 113/93 Section 3(1) and 211/96, Schedule 1, Division 2, Section (b)(iii) of the *Environmental Protection and Enhancement Act*
    - pursuant to the Water Regulation of the *Water Act*, approval to:
        - divert water to provide up to 24,000 m^3 of cooling water per year to supply water during periods when the volume of water collected in the stormwater runoff collection pond is not sufficient to operate the sulphur forming cooling system

2. Natural Resources Conservation Board (NRCB) for approval,
    - under the requirements of Section 2 of the *Natural Resources Conservation Board Act*

AST believes the NRCB should grant the approval for the Project for the following reasons:

- sulphur production is expected to rise to approximately 2 million tonnes/year by 2008, and 3 million tonnes/year by 2013 as upgrading operations expand to accommodate the increased production associated with heavy oil
- AST will provide regional oil and gas producers with a state-of-the-art sulphur forming and shipping facility
- the Site is located within the Alberta Industrial Heartland in close proximity to existing and proposed oil refining and bitumen upgrading facilities
- the Site is located along major transportation corridors connecting the oil sands region of eastern Alberta to the municipal and industrial complex of central Alberta
- the Site is zoned for Heavy Industrial Use within Lamont County and the Alberta Industrial Heartland
- the Site possesses natural containment and alkaline buffering capacity which will effectively reduce the potential for environmental impacts associated with sulphur forming and shipping activities

In support of these applications, AST submits the enclosed documentation entitled *Application for Alberta Sulphur Terminals Ltd. Bruderheim Sulphur Forming and Shipping Facility (35-55-20 W4M)* to construct and operate the Bruderheim Sulphur Forming and Shipping Facility under the *Environmental Protection and Enhancement Act* and the *Natural Resources Conservation Board Act*.

The Applications to AENV and the NRCB consists of the following:

Application – Guide to Content which contains:

- the Application to AENV and NRCB
- Appendix I: Application for Approval to Divert Water
- Attachments A, B, C, D and G

Volume I: Project Description which contains:

- the formal Letter of Transmittal
- technical and other information required for the Application
- a summary of the Environmental and Socio-Economic Impact Assessment

Volume II: Environmental and Socio-Economic Impact Assessment which contains:

- descriptions of the existing conditions in the Project area
- identification and analysis of potential Project residual and cumulative effects
- presentation of mitigation measures and adaptive management strategies

Six printed copies of the Application – Guide to Content have been provided to AENV and NRCB. Twelve printed copies of Volume I and II and one digital copy of the Application – Guide to Content and Volume I and II have been provided to NRCB. Thirty printed copies of Volume I and II and thirty digital copies of the Application – Guide to Content and Volume I and II have been provided to AENV.

As part of the public consultation process, AST established the AST & Community Committee. AST will continue to work together with the local communities to develop mutually beneficial long-term relationships with its neighbours.

Please direct all communications regarding this Application to:

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Respectfully submitted on June 27, 2007.

Yours truly,

Alberta Sulphur Terminals Ltd.

Rob Mann
Project Manager

WorleyParsons Komex

resources & energy

Alberta Sulphur Terminals Ltd.
Bruderheim Sulphur Forming and Shipping Facility

Volume I: Project Description

Project Number 62720000
June 2007

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1. Project Description

1.1 Introduction

1.1.1 Purpose

The purpose of Volume I: Project Description and Volume II: Environmental Impact Assessment (EIA) is to examine the environmental and socio-economic effects of the construction, operation and reclamation of the sulphur forming and shipping facility proposed for the Bruderheim area (the Project) by Alberta Sulphur Terminals Ltd. (AST), a division of HAZCO Environmental Services (HAZCO), which is a division of CCS Income Trust (CCS). These volumes support the application to Alberta Environment (AENV) and the Natural Resources Conservation Board (NRCB) to construct and operate the proposed Project. Both volumes are intended to provide stakeholders with information about the Project and its potential effects to facilitate their participation in the review and permitting process. As well, the volumes contain information and guidance to assist AST in anticipating, mitigating, monitoring and managing potential environmental and socio-economic effects.

The Project will encompass construction and operation of a facility for sulphur forming, sulphur pastille storage and shipment for export. The facility is to be developed on a portion of Section 35, Township 55, Range 20, West of the 4th Meridian (35-55-20 W4M – the Site), approximately 2.2 km east of Bruderheim, Alberta, in the Industrial Heartland area of Lamont County. All infrastructure and activities will be confined to the lands owned by HAZCO. The Project includes:

- rail and road access for receiving and shipping sulphur
- molten sulphur unloading and transfer facilities
- sulphur forming facilities to produce sulphur pastilles
- loading and shipping facilities for formed sulphur
- sulphur pastilles temporary storage area

The Project will service oil and gas production and refining operations located in the Fort Saskatchewan area as well as northeastern Alberta. With increased applications, approvals and operation of bitumen upgraders and ongoing sulphur recovery initiatives, a shortage of sulphur forming facilities in Alberta is now apparent. AST will provide oil and gas producers in the area with a state-of-the-art sulphur forming, pastille storage and shipping facility with design elements and monitoring programs that focus on environmental protection.

1.1.2 Scope of Work

The EIA conforms with the approved Terms of Reference (TOR) (AENV 2007) and environmental information requirements prescribed under the *Environmental Protection and Enhancement Act* (EPEA), *Water Act* and federal legislation potentially applicable to the Project. The EIA was completed to support formal application for the facility under EPEA and to:

a) assist the public and government in understanding the environmental and socio-economic consequences of the Project's development and operation (Volume I) and reclamation plans (Volume IID, Section 2: Land Use and Reclamation) and will assist AST in its decision-making process

b) address:

- Project impacts
- mitigation options
- residual effects relevant to the assessment of the Project including, as appropriate, those related to other industrial operations. As appropriate for the various types of impacts, predictions shall be presented in terms of geographic extent, magnitude, direction, duration, reversibility and confidence.

c) discuss possible measures, including established measures and possible improvements based on research and development to:

- prevent or mitigate impacts
- assist in the monitoring of environmental protection measures
- identify residual environmental impacts and their significance including cumulative and regional development considerations

The Project Description and EIA form part of AST's application to AENV and the NRCB. An outline of the approved TOR (AENV 2007) is presented as Appendix I. The report conforms to the outline, order and numerical designations provided in the TOR. Where deviations from this outline occur, cross-reference tables are provided to allow the reader to readily access the relevant information, and verify that the EIA is complete. A glossary of terms and list of acronyms is provided in Appendix II.

1.1.3 Public Consultation

AST is committed to the implementation of an effective public consultation program both to support this application and EIA process, and complement ongoing operations of the facility. The fundamental objectives of the public consultation program are as follows:

- engage area residents and stakeholders to identify those who may be affected by the proposed Project
- communicate clearly and directly about the Project and each of its significant components
- develop an appreciation of the concerns of area residents and stakeholders, address those concerns within the context of this application, and communicate back to the concerned stakeholders the results of the assessment as it is relevant to their individual concerns
- communicate the results of the public consultation program to the relevant regulators so that these concerns and mitigating strategies can be accounted for in the regulatory review process
- establish a consultative approach that allows concerned stakeholders to provide meaningful input into the application process as well as the construction and operation of the facility if and when it is approved

Wherever possible, AST seeks to resolve stakeholder issues directly with those raising concerns. AST is committed to resolving issues wherever practical and possible to do so, and to preventing disagreements based on misunderstanding or lack of appropriate information.

The public consultation program was initiated as part of a stand-alone application, and has been continued to support the AENV and NRCB application process. The principle elements of the public consultation program are as follows:

- regular scheduling of open house forums to describe the Project, application status and obtain feedback from area residents and stakeholders
- direct meetings with individuals and groups that express concerns or require additional information regarding the Project
- feedback sessions with concerned stakeholders discussing how their concerns are being addressed in the application and assessment process
- posting of all application information on the HAZCO website as it becomes available
- distribution of information circulars at key times in the application process
- maintenance of a local office that is readily available to area residents during normal working hours

Documentation of the public consultation program is provided in Volume IID, Section 5 of the EIA report.

1.1.4 Proponent's Submission

The submission for approval to construct and operate the Project near Bruderheim, Alberta consists of the following documents:

- Volume I: Project Description which describes the proposed Project, location and processes and includes the EIA summary document
- Volume II: EIA is comprised of both environmental components and non-environmental components related to human health and socio-economic impacts in four volumes:
  - Volume IIA: Air, Noise and Human Health
  - Volume IIB: Water and Aquatic Ecology
  - Volume IIC: Terrestrial Ecosystems
  - Volume IID: Land, Historical, Socio-Ec and Consultation
- application to AENV for approval to construct and operate the facility under EPEA
- application to the NRCB for approval to construct and operate the facility under the *NRCB Act*

1.1.5 Sulphur Generation and Produced Sulphur

1.1.5.1 Sulphur Generation

The sulphur that will be accepted, formed and shipped by the proposed Project is generated primarily by bitumen upgrading facilities located near Fort Saskatchewan, Fort McMurray and Lloydminster. Amine units are part of the upgrading process and remove H_2S (hydrogen sulphide) from all upgrading gas streams, which produces sweet fuel gas (low sulphur content) and hydrogen plant feedstock. The upgrader sulphur plant consists of H_2S removal units (amine units) and sulphur recovery units, which convert H_2S to elemental sulphur.

The sulphur recovery units oxidize or burn part of the H_2S into sulphur dioxide (SO_2), which then reacts with H_2S to form liquid elemental sulphur and water. The initial reaction takes place in the burners of a reaction boiler and in-line burners before reaching the converters/condensers. These process components are known as sulphur "trains". First, second, and third stage converters contain a (bauxite) alumina catalyst to promote the reaction of H_2S with SO_2 at temperatures from 204–316°C. Modern processes reduce sulphur emissions and improve sulphur recovery.

Sulphur is recovered as a liquid by condensing sulphur vapour from the gases in the steam-generating heat exchangers of each sulphur train. The liquid sulphur is then gathered and stored, and entrained residual H_2S is removed from the stored sulphur.

Upgrading facilities near Lloydminster, Fort McMurray and Fort Saskatchewan currently generate sulphur at a rate of approximately 1 million tonnes/year (t/y). Sulphur production is expected to rise to approximately 2 million t/y by 2008, and 3 million t/y by 2013 as upgrading operations expand to accommodate the increased production associated with heavy oil.

1.1.6 Sulphur Properties

The produced sulphur will be delivered to the AST facility at a temperature slightly above its melting point of 115°C, generally between 130–140°C. Its specific gravity, both as a liquid and as a solid, will be roughly two, indicating that 1 m^3 of sulphur will weigh approximately 2 t. The vapour is relatively dense (8.8 times that of air); however, sulphur is not volatile at the delivery, forming and solidification temperatures that are expected. Strengths in excess of 200 kPa are typical when liquid sulphur is allowed to cool and solidify.

From a precautionary labelling point of view, hazards for health, fire and contact are considered slight (1 on a rating scale of 0–4 where 0 is minimal and 4 is a severe hazard, based on the Workplace Hazardous Materials Information System). Elemental sulphur oxidizes by combustion, requiring vigilant fire protection and monitoring procedures wherever sulphur is stored or formed. Notwithstanding these precautions, sulphur burns as a slow smoldering process; hence, there is generally ample time to respond to a fire once it is detected. Toxic fumes (SO_2) are generated by combustion and must be accounted for in any procedures associated with emergency response.

Solid and liquid sulphur is essentially insoluble in water. Soluble sulphur by-products can be generated by bacterial processes, which are discussed in greater detail in the underlying sections.

1.1.7 Environmental Concerns

1.1.7.1 Oxidation

Oxidation of sulphur, from either its elemental or reduced form, can occur chemically or as a result of aerobic bacterial activity. Combustion of elemental sulphur produces SO_2, which is odorous and acutely toxic at low concentrations. SO_2 will further oxidize in the atmosphere to form sulphuric acid. Sulphur is not prone to spontaneous combustion. Proper storage and management, as well as vigilant fire detection, are used to control the risk of combustion.

The bacterial oxidation process results in the direct formation of sulphuric acid and involves the following bacteria:

- *Thiobacillus ferrooxidans* (also referred to as *Ferrobacillus sulfooxidans* or *Ferrobacillus ferrooxidans*) is capable of oxidizing ferrous iron, thiosulfate, sulphur and metallic sulfides

- *Thiobacillus thiooxidans* has very similar characteristics but cannot oxidize iron or metallic sulphides other than sodium sulphide

The reaction may also occur abiotically; however, typically this would be at a much slower rate. Elemental sulphur is biologically oxidized to sulphate, which also produces excess protons (H^+) by the following reaction:

$$S^0 + {}^3/_2O_2 + H_2O \rightarrow SO_4^{2-} + 2H^+$$

By inspection, it can be seen that sulphur, oxygen and water are each required to enable the formation of acid. The acid is potentially toxic if released to the environment and can mobilize some metals which, in turn, results in increased bioavailability of these metals.

1.1.7.2 Reduction

Elemental sulphur also has the potential of being reduced to H_2S or a metal sulphide, again through bacterial transformation. Reduction of sulphate and elemental sulphur is reportedly possible when these compounds are present in saturated, anaerobic conditions. In the presence of only water and elemental sulphur, reduction would form H_2S through the following reaction:

$$2S^0 + 2H_2O \rightarrow 2H_2S + O_2$$

It is not clear whether sulphur reducing and oxidizing bacteria can be active at the same time, or whether the biological oxidation reaction would need to proceed prior to the biological reduction process. The fate of H_2S potentially generated by the reducing process is somewhat more certain. In the presence of dissolved metals such as iron, the sulphide will bind to form a metal sulphide. In the absence of available metals, the H_2S will stay in solution until the interstitial water becomes saturated with H_2S. At this point, the H_2S will become liberated as a gas and migrate to the atmosphere. In the presence of oxygen, H_2S quickly converts to SO_2 and ultimately to SO_4. Given that the proposed sulphur forming and shipping facilities are above ground and in an open environment, the possibility of developing anaerobic reducing conditions and H_2S is considered to be remote.

1.1.8 Acid Buffering

Buffering in groundwater and soil is provided by an equilibrium relationship involving carbonate alkalinity. The following equation illustrates this relationship:

$$2H_2O + CO_2 <=> H^+ + OH- + H_2CO_3 <=> 2H^+ + OH^- + HCO_3^- <=> 3H^+ + OH^- + CO_3^{2}$$

By observation of the above, it can be seen that the addition of acidity, which adds hydrogen ions, will be resisted, in accordance with Le Chatelier's Principle, by conversion of CO_3^{2-} to HCO_3^-, and HCO_3^- to H_2CO_3, and ultimately evolution of CO_2 gas from solution. Similarly, addition of calcium carbonate ($CaCO_3$), a source of CO_3^{2-}, will drive the reaction to the left, consuming hydrogen ions as long as excess CO_3^{2-} is present. Once buffered, the sulphuric acid generally combines with calcium to form gypsum, which precipitates out of solution, thus mitigating potential adverse environmental effects. Accordingly, it is advantageous to site the sulphur forming and shipping facilities in a location underlain by groundwater, soils and bedrock that have natural buffering properties.

2. Project Overview Information Requirements

AST is expected to provide: a corporate profile, an overview of the Project, the key environmental, resource management, and socio-economic issues that, from the proponent's perspective, are important for a public interest decision; and the results of the Environmental Assessment process.

2.1 Alberta Sulphur Terminals Ltd.

Present a corporate profile of the proponent and state who is responsible for the development, management, operation and reclamation of the Project.

Alberta Sulphur Terminals (AST) Ltd. is a division of HAZCO Environmental Services (HAZCO) which, in turn, is a division of CCS Income Trust (CCS). Based in Calgary, Alberta, CCS Income Trust employs over 1,000 people throughout its four business divisions: CCS Energy Services, CCS Energy Marketing, HAZCO Environmental Services and Concord Well Servicing. Since the Trust conversion in 2002, CCS has attained significant operating and financial growth due to continuous improvement and expansion of integrated services. CCS specializes in the management, recycling and safe disposal of by-products and wastes generated by petroleum production facilities.

HAZCO is a leading provider of environmental and decommissioning solutions. HAZCO's comprehensive services are backed by a strong corporate infrastructure, dedicated personnel, extensive project experience, and specialized equipment assets. HAZCO's commitment to safety and track record for professional and compliant operation of facilities make it a preferred contractor and service provider to major corporations and government agencies. HAZCO provides innovative and effective solutions to environmental and decommissioning challenges. HAZCO's core areas of service include site remediation, waste management, materials recycling, decommissioning, and soil treatment operations.

AST is a majority-owned subsidiary of HAZCO and specializes in the management of sulphur in western Canada. Activities and services provided by AST and HAZCO include sulphur remelting and recovery, sulphur forming and shipping of sulphur in both liquid and solid states to domestic and international customers.

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Overall responsibility for the Project within CCS reports through Don Friesen, Executive Vice President of HAZCO.

CCS confirms its commitment to environment, health and safety through:

- corporate mandate to meet or exceed industry standards
- board governance
- managerial commitment
- third-party and customer audits
- regulatory compliance

Protecting the environment and avoiding pollution by safely handling energy industry by-products and wastes form the core of CCS' businesses. CCS leads the industry in proven processes that meet or exceed regulatory standards.

Continuous performance improvement is the foundation for CCS' excellence in environment, health and safety stewardship. In offering premium waste management services, CCS protects both the environment and the financial interests of its unit-holders by ensuring compliance with all relevant environmental laws and regulations.

CCS implements a comprehensive internal and external audit program to meet the needs of customers, creditors, unit-holders and regulators. In addition to this program, CCS maintains a satisfactory-level compliance rating under the Alberta Energy & Utilities Board (EUB) enforcement ladder program.

CCS acknowledges its responsibility to respect and contribute to the communities in which it operates. CCS demonstrates this commitment year after year by contributing to numerous organizations that benefit these communities.

2.2 Project Need and Alternatives Considered

Discuss the need for the Project, the alternatives to the Project, including the potential alternative of not proceeding with the Project. Address the following:

2.2.1 Facility Market Analysis

a) an analysis of the alternative means of carrying out the Project that are technically and economically-feasible and indicate their potential environmental effects and impacts with the rationale for selecting the proposed option;

f) a market analysis of sulphur supply versus demand (e.g., 5yr, 10yr, and 10+ yrs).

Sulphur, a by-product of the oil and gas industry, is primarily used in the production of fertilizer. With increased activity in the heavy oil sector resulting in more produced sulphur, combined with an increase in demand for sulphur exports worldwide, there is a shortage of sulphur forming capacity in Alberta. The sulphur is produced in a molten form during oil and gas production and refining in Alberta, formed into a dry product (i.e., sulphur pellets) for handling, loaded onto rail car for transport to Vancouver, stockpiled and eventually loaded onto ships for further delivery to international markets.

The proposed Project will service oil and gas production and refining operations within three main areas: Fort Saskatchewan, Fort McMurray and Lloydminster. With increased applications, approvals and operation of bitumen upgraders, as well as improved sulphur recovery initiatives, a shortage of sulphur forming facilities is becoming apparent in Alberta. The proposed sulphur forming and shipping facility will provide area oil and gas producers with a state-of-the-art sulphur forming, storage and export facility that includes design

elements and monitoring programs that focus on environmental protection. The existing and future oil and gas activity, specifically heavy oil and oil sands production and upgrading, provide the strong demand for centralized sulphur forming that the proposed facility offers.

The following sulphur production, supply and demand information was obtained from the EUB (2004). In 2003, Alberta produced 6.8×10^6 t of sulphur, of which 5.7×10^6 t was derived from sour gas, 1.1×10^6 t from upgrading bitumen to synthetic crude oil, and just 2.0×10^3 t from oil refining. Sulphur production from these sources is depicted in Figure 2.2-1.

Sulphur production from sour gas is expected to decrease from 5.7×10^6 t in 2003 to 5.1×10^6 t in 2013, or by approximately 11%. During the same period, sulphur recovery associated with bitumen upgrading facilities is expected to increase to 3.2×10^6 t annually from 1.1×10^6 t/y. Alberta refineries are also expected to replace conventional crude and synthetic crude with bitumen as integration of bitumen upgrading and refining takes place in this forecast period. With this integration, the sulphur recovery from existing refineries will increase from 2.0×10^4 t in 2003 to 4.9×10^4 t by 2013. Total sulphur production is expected to reach 8.4×10^6 t by the end of the forecast period (EUB 2004). The location of sulphur generation is also expected to shift from the foothills area of the Western Sedimentary Basin, to the oil sands and Industrial Heartland areas, where currently no sulphur forming facilities are in place.

According to the EUB, annual demand for sulphur within the province in 2003 was about 2.5×10^5 t. It was used in production of phosphate fertilizer and kraft pulp, as well as in other chemical operations. Some 97% of the sulphur marketed by Alberta producers was exported outside the province, primarily to the United States, Asia Pacific and North Africa.

In the early 1990s, a number of traditionally sulphur-importing countries installed sulphur-recovery equipment in oil refineries and other sulphur-emitting facilities, largely for environmental reasons. Consequently, many of these countries became self-sufficient in sulphur and the price declined significantly. Under such low price conditions, many of Alberta's competitors ceased production of sulphur, enabling Alberta's market share to rise throughout the late 1990s. In 2002 and 2003, China increased sulphur imports from Canada substantially. Increased global demand resulted in a major price change, from Cdn$16/t in 2001 to $40/t in 2003. As of mid 2005, sulphur was being marketed at an approximate price of Cdn$60/t. Export demand is expected to increase over the next few years. Demand for Alberta sulphur, for both domestic use and export, is expected to rise slowly, reaching 7.5×10^6 t/y by the end of the forecast period. Figure 2.2-2 depicts the anticipated demand curve for Alberta relative to production rates and current storage volumes.

Based on current market information from oil and gas producers in the region, AST initially expects to process, form and export approximately 1×10^6 t of sulphur annually (3,000 t/d), increasing to 2×10^6 t of sulphur annually (6,000 t/d) as market conditions evolve. Actual quantities of sulphur processed will vary with market fluctuations, based on oil and gas production levels and sulphur demand. The technical, environmental and economic benefits associated with the proposed facility are summarized below.

Forecasts are currently available through 2013. A ten year forecast is considered to be less reliable but is expected to follow similar trends as Alberta production continues to move to heavy oil and world markets for sulphur gradually rise.

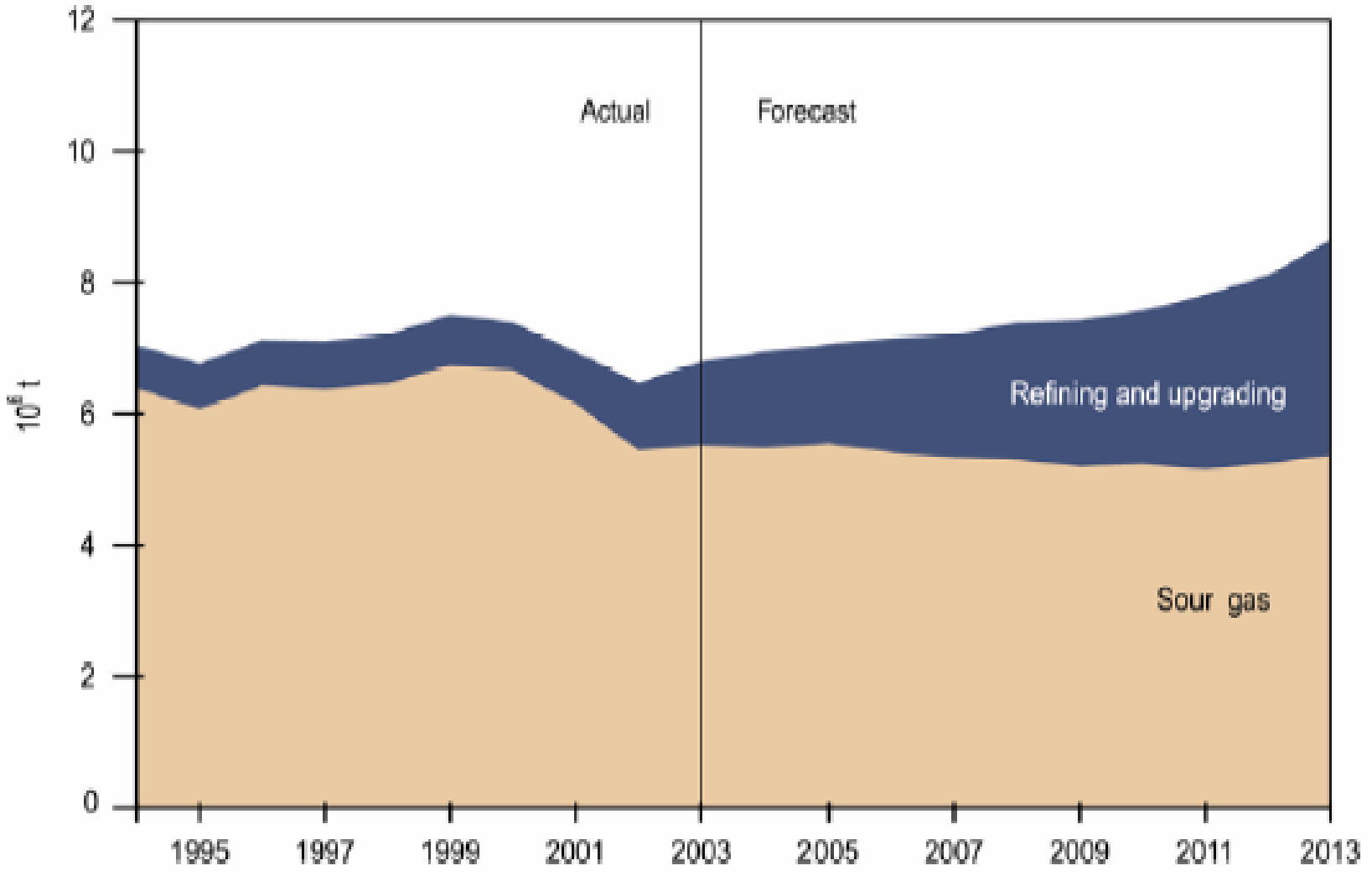


Figure 2.2-1: Alberta Sulphur Production

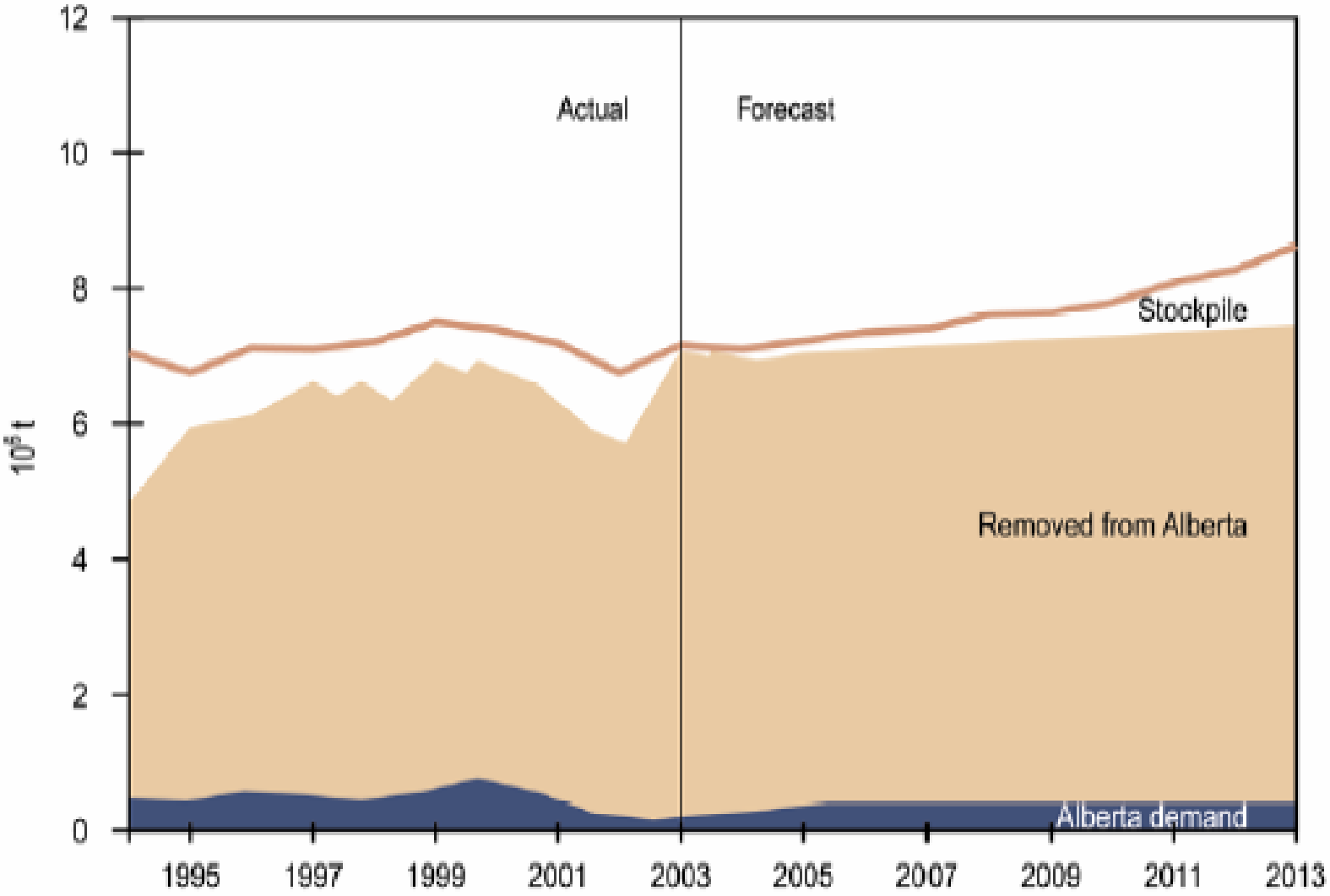


Figure 2.2-2: Sulphur Demand and Supply in Alberta

2.2.1.1 Technical

AST and its team of engineers, contractors and consultants have extensive experience in constructing and operating sulphur forming and dry storage facilities. As a result, AST brings expert knowledge and equipment to Lamont County and Alberta's Industrial Heartland to safely and effectively centralize and process sulphur produced from oil and gas production and refining/upgrading operations.

The HAZCO Division currently owns/operates 14 industrial landfills and the CCS Energy Services Division owns and operates 16 Treatment, Recovery and Disposal Facilities servicing the oil and gas industry. This experience demonstrates CCS' capabilities to own/operate a facility of this nature, safely and responsibly.

2.2.1.2 Environmental

The surface soils of the proposed Site possess naturally low hydraulic conductivity which decreases the potential for downward and outward migration of potential contamination (i.e., sulphur acidity). The existing soil and groundwater conditions at the Site also possess significant natural buffering capacity. The favorable site conditions will be further complemented by the proposed facility design that makes use of state-of-the-art dust controls, double containment systems, runoff control systems, environmental monitoring programs and reliable facility operation practices.

2.2.1.3 Economic

During facility construction, the local regional economy will benefit as a result of the work force. Construction activities over the proposed nine month period are expected to employ approximately 36,000 person-hours. Facility operations are expected to add approximately 40,500 person-hours annually to the regional economy (22 full-time positions). Preliminary cost estimates suggest the development will involve capital spending of over CDN $37 million.

2.2.2 Alternatives Considered

e) environmental performance of the technology and a comparison to the alternative technologies considered;

2.2.2.1 General

Alternative management options for new sulphur generated by oil sands upgrading and refining operations include the following:

- temporarily blocking the sulphur in above-ground blocks, and re-melting and forming this sulphur when market conditions allow
- indefinitely storing blocked sulphur below ground
- forming and shipping the sulphur from each of the upgrading and refining operations, individually
- shipping the sulphur directly to market in its liquid form
- shipping the liquid sulphur to existing forming facilities, primarily sour gas processing facilities associated with existing foothills production fields

Each of these options is discussed in greater detail, from both economic and environmental perspectives, in the following sections. This comparative assessment of sulphur management options demonstrates that a centralized sulphur forming and shipping facility located in the industrial area northeast of Edmonton is the preferred option for sulphur management from both the economic and environmental perspectives.

2.2.2.2 Above-ground Storage

Temporary storage of sulphur above-ground has typically been utilized to manage sulphur generated by existing production facilities in Alberta when there is no economic market for the sulphur or facilities are not available to form and/or transport it. For example, sulphur generated by Syncrude's existing upgrading operations is being blocked above-ground adjacent to the upgrading facilities, within completed portions of the original Syncrude oil sands mine. Temporary above-ground storage has also been utilized extensively at sour gas processing facilities, primarily to store sulphur during periods when sulphur prices and demand do not allow for economic sale of the sulphur.

Lack of facilities can result in lost sales and additional cost is incurred to ultimately form and market the blocked sulphur because both blocking and re-melting is involved. As a result, economic return associated with sale of the sulphur is delayed until the blocked sulphur is re-melted. In addition, the added costs associated with re-melting the sulphur blocks act as an impediment to sulphur recovery and sale. Finally, additional costs are incurred for the reclamation of block areas which are disturbed and impacted by long-term sulphur storage. Hence, this is not an attractive option from an economic perspective unless the sulphur cannot be marketed in a reasonable and economic manner.

The primary environmental issues related to temporary above-ground storage of sulphur are well understood from experience gained at existing facilities. They include acidification associated with runoff from the block area, fugitive sulphur emissions, and disturbance associated with the sulphur block development (typically greater than the area required for a facility to form and ship the sulphur). While each of these issues is manageable from an environmental perspective, the life-cycle impacts associated with temporary above-ground storage are in addition to those of the Project because the sulphur will eventually need to be re-melted, formed and delivered to market.

2.2.2.3 Indefinite Below-ground Storage

Indefinite storage of sulphur below ground has not yet been used to manage excess sulphur generated in Alberta, however, it has been considered by a joint industry/regulatory committee. This option may be considered if international sulphur markets deteriorate to the extent that marketing from Alberta becomes impractical over the long term. Technical issues associated with potential below-ground storage are well summarized in Potential Short and Long Term Sulphur Storage Options in Alberta (AMEC 2004). A pilot test cell for below-ground storage has been developed and monitored as part of Syncrude's existing upgrading operations. Class II landfills have also been used to dispose of large volumes of contaminated sulphur that do not meet quality requirements for sale. The technical study, pilot scale burial cell and landfill disposal indicate that sulphur may be safely and effectively stored below-ground, indefinitely.

The primary economic issue associated with this option is that it precludes economic gain associated with the sale of the sulphur. Further economic impacts include the restricted land use associated with the areas utilized for indefinite below-ground disposal. In addition, the added costs of unearthing and re-melting sulphur blocks act as an impediment to sulphur recovery and sale. Hence, this is not an attractive option unless the sulphur cannot be

marketed in a reasonable and economic manner, and unless the market outlook is for continued depressed conditions for an indefinite period of time.

The primary environmental issues related to indefinite below-ground storage of sulphur are associated with potential acidification, as well as potentially unknown impacts associated with extended burial. While each of these issues is manageable from an environmental perspective, the impacts associated with indefinite below-ground storage are often considered to be less desirable than those associated with forming sulphur. This may be a reflection of the general lack of experience with large-scale, long-term burial of sulphur.

2.2.2.4 Forming and Shipping Sulphur from Generating Facilities

New heavy oil upgrading and refining facilities could construct and operate their own sulphur forming facilities. However, at the present time, few of these facilities have elected to include sulphur forming as part of their core operations.

From an economic perspective, inclusion of individual sulphur forming facilities at each upgrader is hampered by the lack of processing scale, which in turn reduces forming efficiency. Appropriate transportation infrastructure, such as rail lines, might not be available requiring infrastructure construction and its related disturbance and cost. Building individual sulphur forming facilities at each upgrader is not as efficient as constructing a single, central, large-scale facility as proposed by AST.

From an environmental perspective, fugitive sulphur emission and overall disturbance would be greater from numerous facilities simply because of the multiple sources and facilities needed. AST's proposed sulphur forming and shipping facility represents a better environmental option because impacts and disturbance are focused in a single, smaller area.

2.2.2.5 Marketing Sulphur in its Liquid Form

Marketing sulphur in its liquid form is the preferred option for transport and delivery provided the sulphur can be used locally (within continental North America serviced by rail). Liquid sulphur produced by Suncor's existing upgrading operations is marketed to Agrium in Redwater, as is liquid sulphur produced in southern Alberta which is marketed to the United States. The market for liquid sulphur within the continental United States is currently completely supplied. Further, the oil sands area is located a relatively large distance from facilities that would typically accept liquid sulphur. Hence, the new upgrading facilities would not be price competitive with other potential sources, such as the sour gas processing facilities located in southwestern Alberta. The demand for liquid sulphur generated in Alberta currently totals approximately 1.0×10^6 t/y, or approximately 14% of the total sulphur produced by petroleum production and refining operations in Alberta.

From an economic perspective, direct marketing of liquid sulphur is preferred, provided a market exists. As shown in Figure 2.2-1, the rate of sulphur production in Alberta (estimated to exceed 8.0×10^6 t/y by 2011) easily exceeds current demand for liquid sulphur produced in Alberta (approximately 1.0×10^6 t/y). Accordingly, the direct marketing of liquid sulphur generated by new oil sands upgrading and refining facilities is not practically achievable.

The direct marketing of liquid sulphur is preferable from an environmental perspective primarily because sulphur emissions are minimized. This is only a valid environmental comparison if marketing liquid sulphur is an available option, which it currently is not.

2.2.2.6 Shipping to Existing Forming Facilities

Shipping to existing forming facilities in Alberta is the current management option employed for sulphur generated by Shell's upgrading facility at Scotford. Table 2.2-1 shows large scale sulphur forming and shipping facilities that are being operated in Western Canada.

Table 2.2-1: Existing Large-scale Sulphur Forming Facilities

Facility	Operator
Waterton	Shell
Shantz	Shell
Ram River	Husky
East Calgary	Nexen
Strachan	Keyera
Hanlan Robb	Petro-Canada
Kaybob I to III	SemCAMS
Edson	Suncor
Pine River	Duke Energy
Fort Nelson	Duke Energy

Each of these facilities is located either in western Alberta or northeastern British Columbia, a significant distance from the Fort Saskatchewan and Fort McMurray areas where most of the new sulphur associated with heavy oil upgrading will be generated. These facilities are also located significant distances from the main rail lines servicing the west coast of Canada. Hence, incremental transportation costs will be incurred to upgrade facilities utilizing these sulphur forming operations. In addition, many of these facilities are operating at or close to their capacity, precluding the large-scale transfer of sulphur from all or most of the facilities that would otherwise be serviced by the Project.

From an environmental perspective, most sulphur forming facilities associated with older sour gas processing plants utilize older technologies that tend to generate proportionally larger volumes of fugitive dust. Accordingly, the environmental impacts associated with the utilization of these older facilities will be higher than those associated with the Project. The major exception is Shell's Shantz facility, which utilizes the same technology and equipment that is proposed for the AST facility. The Shantz plant is currently operating at, or near its design capacity, and will not be available for most of the new sulphur anticipated from the new oil sands upgrading facilities.

Significant advances in sulphur forming technology have occurred in Alberta since sour gas processing operations were first required to recover and conserve sulphur. These advances have primarily been designed to either improve environmental performance by reducing fugitive dust, or improve the handling characteristics of the formed sulphur by optimizing the shape and hardness of the formed solids. Two sulphur forming technologies have evolved to represent the state-of-the-art technology for sulphur forming, as follows:

- Sandvik Rotoformer
- Enersul GX

Both processes are in common use for new sulphur forming facilities and can be considered comparable. Rotoformer uses non-contact cooling water to solidify sulphur pastilles with

depression of a rotating stainless steel belt. The Enersul GX uses a water-cooled cyclone to solidify the sulphur into small spheres.

2.2.3 Environmental Performance

b) how a balance between environmental, resource recovery or conservation and economic goals has been achieved through planning and preliminary design, highlighting any areas where planning focused on one goal in exclusion of others;

The proposed Project provides a balance between environmentally sound resource recovery and economic development. The Rotoform process represents a state-of-the-art technology that has been proven to be protective of the environment and operationally reliable. The Project's development will provide upgraders in the area with an opportunity to optimize the value and marketability of thelr sulphur. Finally, the ability to form and market sulphur will result in an economic benefit that is distributed, in part, into the communities that surround the facilities. These objectives and factors were given balanced consideration during the conception and planning of the proposed Project.

The Rotoform process (see Section 3.2) has been selected because it has a proven track-record of superior operational and environmental performance. WorleyParsons Komex has an extensive base of experience monitoring the environmental effects surrounding oil sands and sour gas processing facilities that separate, form and ship sulphur. Through this experience, it is evident that the Rotoform process is protective of the environment from the perspectives of control of emissions, odours and fugitive dust.

2.2.4 Contingency Plan

c) contingency plans, if major project components or methods prove to be unfeasible or do not perform as expected;

Contingency planning for the Rotoform technology is not required because the process has proven reliable in over 300 applications worldwide, including the largest sulphur forming and shipping facility in Alberta (Shell Shantz). Contingency programs will be needed in the event international sulphur markets deteriorate and it is not economically viable to form and market the new sulphur production. This will be the responsibility of the sulphur generators. The Project does not include facilities for storing excess sulphur in an above-ground block or otherwise. In the event that sulphur markets deteriorate to the extent that sulphur marketing is no longer viable, the Bruderheim facility will simply reduce its operations or become idle. AST has the financial and operational capability to operate, expand or idle the facility as market conditions demand.

2.2.5 Cooperative Development Opportunities

d) potential cooperative development opportunities and the implications of the Project for ongoing regional management and research initiatives;

Cooperative efforts associated with this Project are described in Section 3.10. In addition, AST will work with sulphur generating companies to ensure that activities associated with the Project are implemented efficiently and that opportunities to optimize the recovery, marketing and responsible export of elemental sulphur are realized. Further, AST will work closely with sulphur production and transportation service companies to coordinate sulphur shipment to and from the Site to operate safely and minimize, where possible, disruptions and nuisances to local residents.

2.3 Project Components and Development Timing

Provide an overview of the Project activities and physical components. Specifically, address the following:

a) a summary list, brief description and drawings of Project components and activities which are addressed in detail under Section 3.0;

The primary components of the proposed Project will be:

- infrastructure for the reception of liquid sulphur and shipment of formed sulphur
- storage facilities for liquid and formed sulphur
- sulphur forming facilities
- sulphur transfer and loading infrastructure

2.3.1 Sulphur Reception

Liquid sulphur will be received at the Project by rail car, truck or (in future) pipeline. Only liquid sulphur that has been degassed to a maximum of 10 ppm H_2S will be accepted. Upon arrival at the facility, the tankers will unload via a pumping station into insulated and heated tanks. Liquid sulphur will then be pumped from the receiving tanks to a feed tank. The sulphur will then be filtered and temperature conditioned prior to being formed.

2.3.2 Sulphur Storage

Storage will be provided for sulphur in its liquid form, prior to being formed, as well as in its pastille form, prior to being shipped. The sole purpose of the storage facilities is to allow efficient operation of the forming facilities, while accommodating sulphur delivery and shipping functions. Liquid sulphur will be stored in 3,000 t, insulated and clad, steel tanks designed to comply with the requirements of EUB Directive 55 (EUB 2001, Internet site) and API 650 modified (API 1998). The initial development will include three 3,000 t tanks, and six 3,000 t tanks at ultimate capacity. Formed sulphur will be stored on a double-lined asphalt pad equipped with run-on and runoff controls. This pad will have a capacity to store 90,000 t of finished product, half of which will be established as part of initial construction.

2.3.3 Sulphur Forming

The forming process first will involve pumping sulphur from receiving tanks to a feed tank. It will then be pumped from the feed tank through a duplex filter and conditioning unit which will cool it to an optimal forming temperature of 125°C. The sulphur will then enter a recirculation loop that feeds the Rotoform HS® Drop forming equipment. The feed to the Rotoformer will use metering equipment and nozzles specifically designed to provide a continuous sulphur feed across a rotating stainless steel belt. The belt will be cooled by cold water jets sprayed against the underside of the rotating belt, causing the pastilles to cool and solidify above.

2.3.4 Transfer and Shipping Infrastructure

The solid pastilles will be deposited into a collection hopper, conveyed to a radial stacking conveyor and the asphalt bulk sulphur storage pad. A wind screen will be built upwind of the sulphur pastille stockpile. Initially, a front-end loader will transfer the stockpiled sulphur to a surge bin equipped with a dust suppression package. The dust treated product will then be deposited on a load out conveyor equipped with weight scale and totalizer, and onto rail or

trucks for shipment. An automated loading system will be introduced as part of future expansion to full production. In this instance, the formed sulphur will be transferred into vertical holding bins used to directly load rail cars. The EIA is based on a forming capacity of 6,000 t/d, half of which is associated with initial construction.

Water utilized by the Rotoform HS® will be sent through a closed loop cooling tower which provides filtration and temperature reduction. Make-up water for the cooling tower will be supplied from a runoff pond which will be designed to collect surface water from the Site and also serve as the source of fire protection water. Additional make-up water will be provided by a groundwater supply well.

Each of these components is described in detail in Section 3 of this report which also includes appropriate drawings.

2.3.5 Development Schedule

b) proposed activity stages or phases and a likely development schedule, explaining:

i) the timing of key construction, operation and reclamation activities;

ii) the expected duration of each for the life of the Project;

iii) the key factors controlling the schedule and uncertainties; and

iv) the implications of a delay in the Project and include the regulatory process as a consideration in the likely development schedule.

The proposed facilities will be developed in stages to accommodate the rate of sulphur production generated by existing and proposed oil sands development programs as well as market conditions. The initial stage will include the development of all Project components with sufficient capacity to process approximately 3,000 t/d of sulphur. Subsequent expansions will occur to process approximately 6,000 t/d of sulphur. The anticipated timing for the initial stage of development is summarized in Table 2.3-1 and is dependent on the pace and outcome of the regulatory process.

Table 2.3-1: Initial Development Timing

Task	Anticipated Timeframe
Project disclosure	2005
EIA scoping	Early 2006
EIA implementation	2006
Application submission	Mid 2007
Detailed design	Late 2007
Construction	Early 2008
First operations	Mid 2008
Project lifespan	25 years

The receipt, forming, temporary storage and shipping of formed sulphur will occur continuously over the lifespan of the facility (estimated to be 25 years), assuming there is a viable international market for the sulphur produced in Alberta.

Failure to meet the proposed timeline, or approve the Project in general, will result in the blocking of incremental volumes of sulphur produced by oil sands upgrading facilities, either in new locations or at existing facilities. For example, sulphur produced by Syncrude is currently being stored in above-ground blocks, and Suncor is considering this option for

sulphur generated by its Voyageur upgrader. Sulphur forming facilities are currently not available to the independent upgraders scheduled to come on-line in the next few years.

2.4 Regulatory and Planning Framework

Identify the legislation, policies, approvals, and current multi-stakeholder planning initiatives applicable to the review of this Project. List the major components of the Project that will be applied for and constructed within the duration of any potential approvals under the EPEA and WA (Water Act) and address the following:

2.4.1 Primary and Secondary Regulatory Requirements

a) other regulatory approvals that are required and any approvals that have already been issued including provincial, municipal, and applicable federal government requirements;

b) the primary focus of each regulatory requirement, such as resource allocation, environmental protection, land use/development, and the element(s) of the Project subject to the regulation;

c) any regulatory classification systems which apply to the Project, such as solid waste or air pollution classifications and land use zones; and

d) summary of the objectives, standards, or guidelines that have been used by AST to assist in the evaluation of the significance of effects.

This EIA is completed in accordance with the requirements of *Environmental Protection and Enhancement Act* Part 2, Division 1 Environmental Assessment Process, Approvals and Registrations, as well as the supporting Environmental Assessment Regulation 112/93. The construction and operation of a sulphur forming and shipping facility is not listed as a Mandatory or an Exempt activity in accordance with the Environmental Assessment (Mandatory and Exempt Activities) Regulation. The EIA is required at the discretion of the Director, in accordance with these regulations, in response to the nature and extent of concerns raised by local stakeholders. The EIA complies with the requirements of the final authorized TOR for the EIA (Appendix I), as published by AENV.

The EIA is prepared to support an application to construct and operate a sulphur forming and shipping facility in accordance with the requirements of the Approvals and Registrations Procedure Regulation (113/93) of EPEA. Sulphur processing is listed in the Activities Designation Regulation (211/96) of EPEA, Schedule 1, Division 2, Section (b)(iii) as requiring formal approval under EPEA. The primary focus of the Project Description, EIA and AENV Approval is environmental protection.

This EIA is also prepared to support an application to the NRCB under the requirements of the *Natural Resources Conservation Board Act*. The primary focus of the NRCB application and approval is the responsible use of the sulphur resource.

Additional approvals are required through other regulatory instruments and jurisdictions to allow for construction and the operation of the proposed Project. These include the following:

- Permit to Divert Water issued by AENV under the Water Regulation of the *Water Act*, to provide up to 24,000 m^3 of cooling water per year to supply water during periods when the volume of water collected in the stormwater runoff control pond is not sufficient to operate the sulphur forming cooling system

- Development Permit issued by Lamont County under the *Municipal Government Act* (Government of Alberta 2000a) to allow construction of surface facilities associated with the Project
- authorization under the *Historical Resources Act* (Government of Alberta 2000b) for clearance to construct the Project – clearance was granted April 11, 2007

The primary focus of the *Water Act* approval is the responsible diversion and use of water as a resource. The primary focus of the municipal approval process is to scrutinize the Project as a viable land use. No other regulatory classification systems have been applied and to the best knowledge of the proponent, none are required. Standard guidelines for the evaluation of potential environmental effects have been used throughout the assessment of EIA components. The guidelines applied, and their supporting rationale, are described in the respective component reports (see Volume II).

2.5 Principal Development Area and EIA Study Area

The Principal Development Area (PDA) includes all lands subject to direct disturbance from the Project and associated infrastructure, including access and utility corridors. For the PDA, provide:

a) the legal land description;

b) the boundaries of the PDA;

c) a map that identifies the locations of all proposed development activities; and

d) a map and photo mosaic showing the area proposed to be disturbed in relation to existing topographic features, township grids, wetlands and water bodies.

Study Areas for the EIA report include the PDA and other areas based on individual environmental components where an effect from the proposed development can reasonably be expected. Provide:

e) the rationale used to define Local and Regional Study Areas (see also Section 4.5), considering the location and range of probable Project and cumulative effects including those related to regional or local developments; and

f) illustrate boundaries, and identify Local and Regional Study Areas chosen to assess impacts on maps of appropriate scale.

The Principle Development Area (PDA), located within Section 35-55-20 W4M (the Site), comprises the area of disturbance and development (see Figure 2.5-1). The PDA contains the sulphur forming and shipping facility, located in the west-central portion of the Site, and rail transfer loops used to receive and ship sulphur. The plot plan for the sulphur forming and shipping facility PDA is shown in Figure 2.5-2.

The Local Study Area (LSA) for the majority of disciplines assessed in the EIA is the Site (groundwater, historical resources, surface water quantity and surface water quality) or the Site plus a 200 m buffer zone (aquatics, biodiversity and fragmentation, land use and reclamation, soil, vegetation and wildlife). The Regional Study Area (RSA) for the majority of disciplines is the Site plus a 500 m buffer zone (surface water quantity and surface water quality) or the Site plus a 1,000 m buffer zone (aquatics, biodiversity and fragmentation, soil, vegetation and wildlife). Specific LSAs and RSAs for the individual EIA components are defined in each respective component report. Figure 2.5-3 illustrates major geographic features in the area as well as the boundaries of counties and municipal districts that will be affected by the Project.

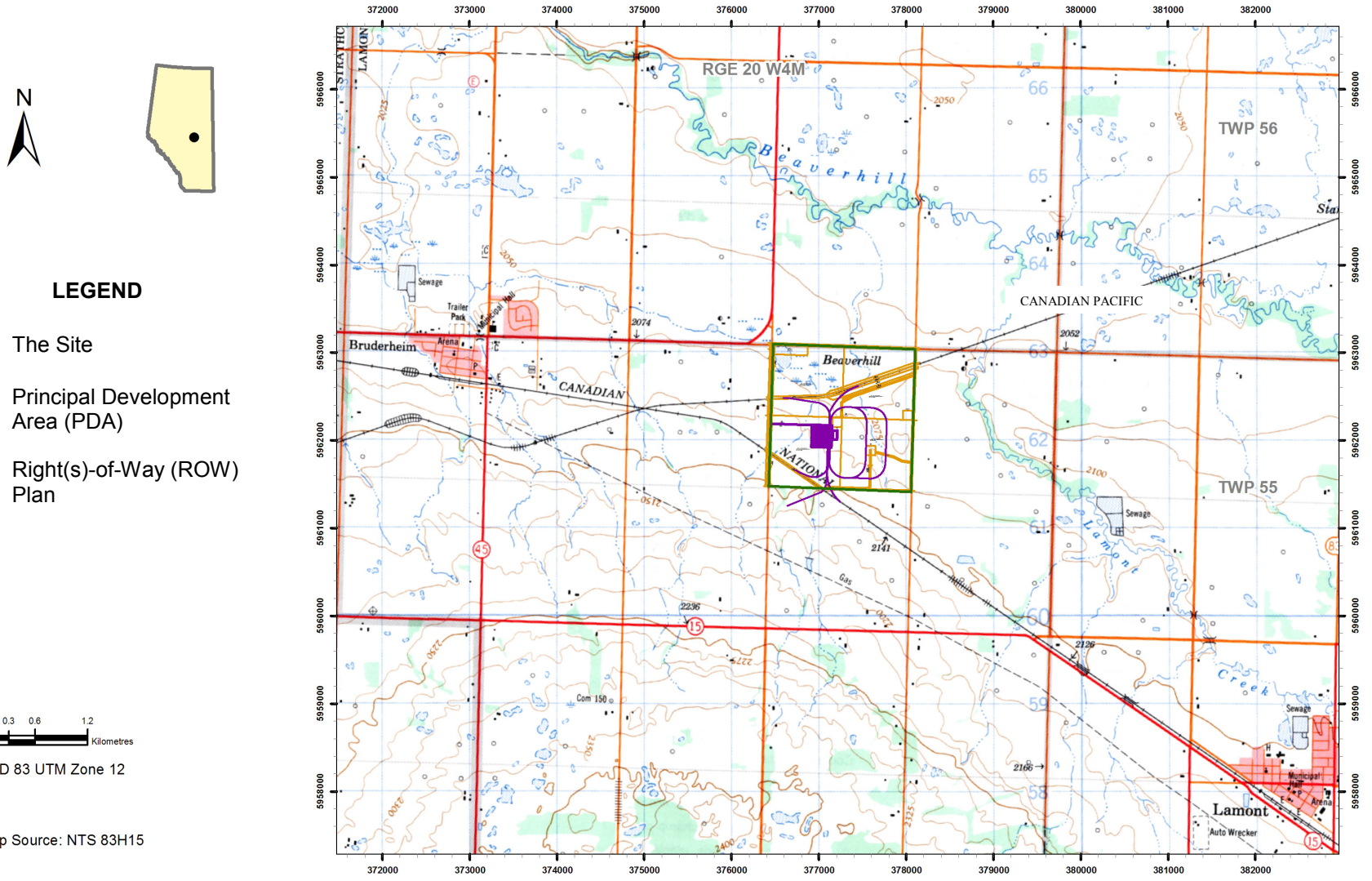


Figure 2.5-1: Site Plan for Section 35-55-20 W4M and PDA

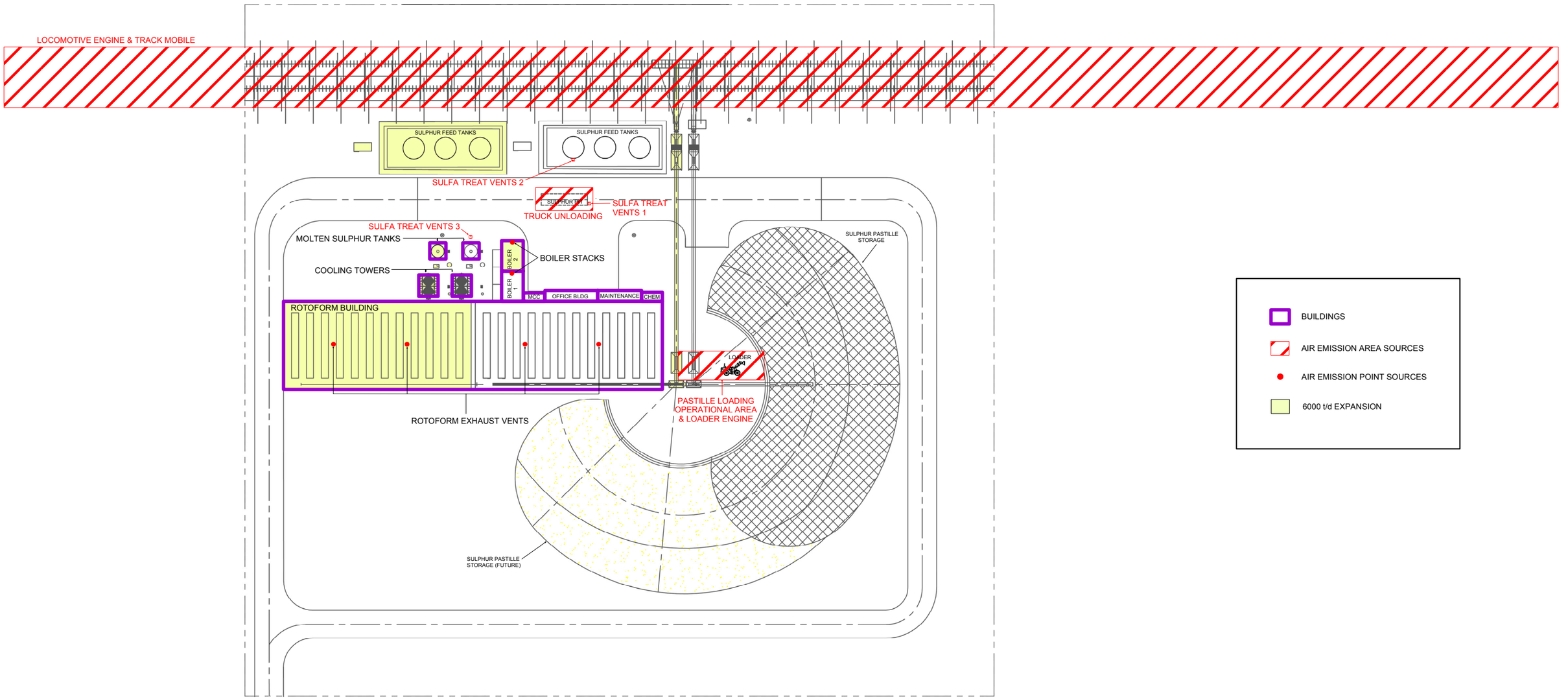


Figure 2.5-2: Plot Plan for Sulphur Forming and Shipping Operations in the PDA

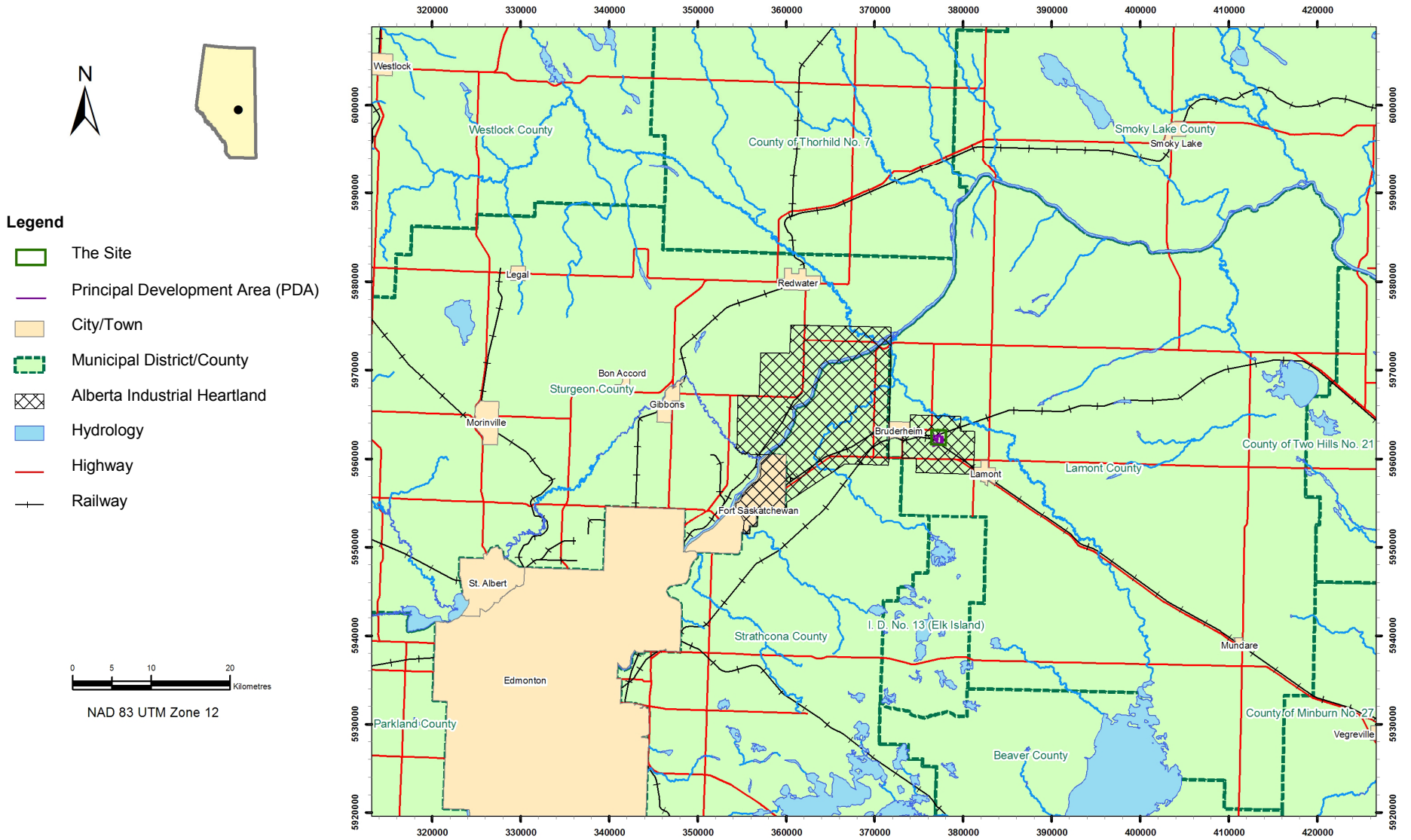


Figure 2.5.3: Section 35-55-20 W4M and Geographic Features

The RSA for the purpose of evaluating all but socio-economic issues is contained within a 3 km radius of the Site boundary. This is reasonable given the low levels of impacts to the environment associated with the proposed Project.

The RSA for the socio-economic component was assumed to be the Alberta Industrial Heartland and the counties associated with the Alberta Industrial Heartland. Given the small size of the proposed Project in comparison with other facilities in the Fort Saskatchewan area, socio-economic influences are not expected to extend into the metropolitan area of Edmonton. However, the proposed Project will have significant influences on major industrial facilities in the Alberta Industrial Heartland that generate sulphur as a by-product. Hence, the entire Alberta Industrial Heartland was included in the RSA for the socio-economic component of the EIA. The socio-economic impact to Lamont County proper was also evaluated separately to address concerns raised by local residents.

2.6 EIA Summary

2.6.1 Synopsis

This section distills the primary findings of the EIA into a summary format that is intended to augment, and not repeat, the findings of the EIA as highlighted in the individual components of the EIA as well as within the executive summaries of those components. This section is intended to provide a concise, non-technical overview of the approach and findings of the EIA for readers to quickly learn the key issues and mitigation measures proposed regarding the Project.

Provide a summary of the EIA report addressing:

a) environmental and land use conditions in the EIA Study Area without the Project;

The Site and lands surrounding the Site are located within the Alberta Industrial Heartland within Lamont County, in an area specifically zoned for heavy industrial use. Lamont County is located at the eastern extreme of the Alberta Industrial Heartland and as such is some distance from the more concentrated industrial developments, which are typical of eastern Edmonton and the Fort Saskatchewan area. Accordingly, relatively little industrial development has occurred in the EIA study area, with significant industries in the immediate vicinity of the Project being limited to the Canexus chlorate plant, the ERCO chlorate plant, and the Triton Fabrication facility. These are relatively small industrial developments, with relatively small environmental and land use impacts. Chlorate manufacturers appear to be concentrating their operations within areas offering relatively low electricity prices, such as Manitoba. The ERCO chlorate plant is in the process of being decommissioned and it is very possible that the Canexus Bruderheim plant will meet the same fate, leaving only Triton Fabrication as the remaining current industrial business in the area.

Most of the lands situated within Alberta's Industrial Heartland within Lamont County are currently utilized for agricultural purposes and have not been developed for industrial use. For example, based on an air photo interpretation of the EIA study area, less than 4% of the lands currently zoned for heavy industrial use have actually been converted to this use. Hence, the land-use, income and lifestyle base in the EIA study area remains essentially agricultural.

Notwithstanding the above, it is reasonable to conclude that increased industrial development will occur in Lamont County. New industrial operations in Alberta's Industrial Heartland are commonplace and it is likely only a matter of time before the lands

designated for industrial use are developed. Several new industries, in addition to the proposed Project, have expressed interest in the EIA study area, though to the knowledge of the authors no other industrial projects have been formally announced. Lamont County is also consulting with its residents regarding potential expansion of the area designated for industrial use.

The proposed Project has been the subject of active debate, and significant concern, within the County. The attitude and positions of the residents in Lamont County, including those who have actively participated in the public consultation program completed for this Project, are shaped by the agricultural and rural land uses that predominate the EIA study area. In the opinion of the author, these positions reflect the following perspectives or opinions:

- those that are accepting of the pending industrial development and the proposed Project
- those that are opposed to industrial development in the EIA study area, and do not feel that the current land zonings and land use plans fairly reflect their personal interests and situation
- those that are concerned about the safety and potential environmental impacts associated with the proposed Project
- those that believe that the Site can be used more effectively, and/or that believe that the proposed Project will result in a negative socio-economic outcome.

The public opinion is relevant to the current 'environment and land use condition' because it was the primary motivating factor that resulted in the Director's decision to order this EIA.

b) activities and components of the Project that are anticipated to influence environmental and land use conditions;

The proposed Project is small in scale in comparison to industrial developments that are typical of Alberta's Industrial Heartland, and those that are listed as 'mandatory activities' within EPEA and its Regulations. The PDA results in a disturbance of approximately 24 hectares, which represents only a small proportion of the agricultural lands within Section 35. Hence, land use in the EIA study area is not significantly affected by Project development. The primary impact relates to the loss of agricultural lands, which is an expected outcome of zoning this area for heavy industrial use. The development of a facility which supports petroleum processing and the petrochemical industry conforms with Alberta's Industrial Heartland Area Structure Plan.

Because the scale of the Project is small, and industrial developments in its immediate vicinity are small, there are few environmental impacts associated with the Project that are expected to impact adjacent industries, and vice versa. The primary concern associated with the adjacent industries is the compatibility of chlorate and elemental sulphur, because chlorate is a strong oxidizer and the oxidation of sulphur is an exothermic reaction. Testing is underway to compare the potential reactivity of sulphur and chlorate to that of other common organic particulates. Results will be reported to the NRCB and AENV independently, and communicated to interested stakeholders.

c) the anticipated environmental effects, with emphasis on regional and cumulative considerations;

Further, there are few issues of regional significance, and few Project impacts that are of concern from a cumulative impacts perspective. The proposed Site is a considerable

distance from the main industrial operations of the Industrial Heartland, hence emissions from these facilities have little effect on the Project of the Site and surrounding lands. The following text summarizes the most significant issues, their respective causes, and mitigating and monitoring measures that will be taken.

2.6.1.1 Air, Light, Climate and Noise

The primary concern of local stakeholders relates to Project air emissions during normal, upset and emergency (worst case) operating conditions. Potential increase in noise and light levels was also expressed as a concern of some of the nearby residents. The conclusions reached in the EIA for these issues were:

- air emissions related to normal operations are not expected to have significant effect outside of the primary operating area. Emissions concerns are related to potential release of hydrogen sulphide entrained within the liquid sulphur, sulphur dioxide emissions associated with accidental sulphur combustion, and fugitive sulphur dust. During normal and upset operating conditions, air emissions associated with each of these chemicals of concern are well within acceptable limits. Hydrogen sulphide emissions are effectively mitigated by accepting only degassed sulphur, and by treating off-gases from all liquid sulphur storage and transfer facilities. Sulphur dioxide emissions are potentially a concern only during emergency (worst case) conditions during a large sulphur file. The potential impacts associated with emergency conditions are mitigated by effective emergency response capability, which includes emergency call out and procedures for nearby residents. The potential acidifying effects of fugitive sulphur deposition are expected to be limited to the areas immediately surrounding the sulphur processing and handling area. These impacts are minimized by implementing best management practices for sulphur handling, utilization of specialty equipment and dust suppressants, and by employing the Rotoformer process which is recognized as 'best available technology' from the perspective of environmental protection.
- light impacts to nearby residents are low because the processing facilities are a significant distance (greater than 500 m) from the nearest resident. Directional lighting will be used to optimize lighting of the process area, and to minimize the potential nuisance to nearby residents.
- the activities related to sulphur processing do not contribute significantly to greenhouse gas (GHG) emissions, and are not expected to be effected by climate change. The availability of water from on site sources may diminish if the climate becomes warmer and drier. This potential effect can be effectively overcome by either constructing greater on site storage of water or by obtaining cooling water from the Lamont County Water Utility.
- the noise levels associated with the proposed Project comply with the intent of relevant EUB guidance documents. Noise levels at most residences increase to levels compliant with EUB requirements or to levels only marginally higher than current noise levels.

2.6.1.2 Water

Many residents expressed concern regarding water quality and the potential effects of the Projects on the availability and quantity of surface and groundwater. The conclusions reached in the EIA for these issues were:

- groundwater quality impacts are not anticipated, primarily because all sulphur and potentially impacted water will be contained in lined, engineered facilities that are compliant with Provincial guidelines. It is uncertain whether there is sufficient groundwater to provide make-up water for process cooling when runoff water is not

available for this use. Mitigation options for this possible occurrence include obtaining water from the Lamont County Water Utility, or increasing the volume of runoff water storage.

- potential impacts to surface water quantity were concluded to be insignificant as only approximately 3% of the runoff from the local surface water catchment area would be collected and contained by the Project. Impacts to surface water quality are not anticipated because water will be collected and contained on site during all but extreme runoff events. Further, any water that is discharged will be tested and neutralized prior to release. Notwithstanding these factors, regular monitoring of water quality in the adjacent wetlands has been recommended as a precautionary measure.
- no impacts to aquatic life are anticipated. Water quality and quantity monitoring of the adjacent wetlands will be completed as part of standard facility operations.

2.6.1.3 Terrestrial

The potential acidifying effects of sulphur on the surrounding soils and vegetation was raised as a concern by the some of the stakeholders in the area. The conclusions reached in the EIA for these issues were:

- soils are not expected to be adversely effected by Project operations because potential acidifying effects are low relative to the ability of the soils to buffer potential acidification. Acidifying effects associated with sulphur deposition are expected to be confined to the area immediately surrounding the sulphur handling area. Soil monitoring and lime treatment (if necessary) will be implemented on a regular basis to mitigate these potential impacts.
- no significant impacts to vegetation or adjacent crop are anticipated. The primary vegetation concern involves the potential encroachment of weeds in disturbed areas. This will be effectively addressed through regular monitoring and spraying.
- no significant impacts to wildlife or biodiversity and fragmentation are anticipated as a result of Project development, primarily because all wetlands and non-agricultural areas will remain undisturbed. It was recognized that facility development may restrict some of the movement of wildlife in the area.

2.6.1.4 Historical Resources and Traditional Land Use

No issues regarding historical resources or traditional land uses were revealed by the assessment. Alberta Tourism, Parks, Recreation and Culture issued *Historical Resources Act* clearance on April 12, 2007, indicating that a Historical Resources Impact Assessment is not required.

2.6.1.5 Public Health and Safety

A large number of stakeholders expressed concerns regarding human health, either through normal air emissions, or because of emergency situations. The conclusions reached in the EIA for these issues were:

- no significant health effects are anticipated as a result of normal plant operations. The potential evacuation zone associated with an emergency (the worst case scenario) extends approximately 1.5 km from the processing facility but does not encroach on the towns of Bruderheim and Lamont. An appropriate Emergency Response Plan has been established to effectively mitigate this risk, which includes equipping and training site

personnel, familiarizing local response personnel with facility risk and appropriate response, and full membership and participation in NR CAER.

2.6.1.6 Public Consultation

A Public Consultation Committee has been established to receive and respond to stakeholder concerns and to provide a forum for keeping people informed. This committee will be continued through the operational phase of the Project if and when approved. Most of the public concerns have been addressed by the technical components of this EIA (Table 2.6-1).

Table 2.6-1: AST Measures to Address Stakeholder Issues

Stated Issues	AST Measures to Address Issues: EIA Section Cross-reference
Negative impacts on water in terms of quality and/or quantity	Detailed evaluations of potential impacts to surface and ground water are provided in Volume IIB, Section 2: Groundwater Quantity and Quality; Section 3: Surface Water Quantity; and Section 4: Surface Water Quality. Potential for impacts to surface water quality will be effectively mitigated by collecting, containing and using runoff from the sulphur processing area that could be impacted by elemental sulphur. The runoff water collected and used in this manner represents only a minor proportion of runoff in the catchment area; hence, the potential impact to surface water quantity is insignificant. Potential impacts to groundwater quality will be effectively mitigated by double-lining all sulphur and chemical storage, and water containment facilities. These facilities will also be equipped with leak detection capability. Groundwater will be used to provide make-up water for cooling. The yield of the aquifer beneath the Site is marginal relative to the Project's needs. Detailed monitoring of groundwater withdrawal will be implemented to identify potential impacts to adjacent groundwater users. If unacceptable impacts are observed, groundwater diversion will be stopped and an alternative water supply (Lamont County Water Utility) will be used.
Air contamination and sulphur dust	Potential air quality impacts are evaluated in Volume IIA, Section 2: Climate and Air Quality. Analysis included assessment of H_2S, SO_2, NO_x, particulate, etc. under normal and emergency operating conditions. These evaluations concluded that all parameter concentrations remain below 10% of the AAAQO at the fence line of the Site. Potential impacts to soil pH associated with elemental sulphur dust are predicted to be confined to the area immediately surrounding the process facilities, and to the Site proper. Potential impacts related to fugitive sulphur dust will be effectively mitigated by implementing best management practices, using sulphur dust suppressants, and selecting forming technology that minimizes the generation of dust. Potential for air emissions is mitigated by treating air vented from liquid sulphur storage tanks and transfer points, and implementing best safety and site management practices, including reliable emergency response capability.
Increased road traffic	A traffic study completed to support the Project (Volume I: Project Description – Appendix III) concludes that impacts to traffic volume are relatively minor in comparison to current and predicted traffic volumes. An upgrade to the intersection of Highway 15 and R.R. 202 was recommended and will be implemented as part of Project construction.

Table 2.6-1: AST Measures to Address Stakeholder Issues (Cont'd)

Stated Issues	AST Measures to Address Issues: EIA Section Cross-reference
Impact on land values	Potential impacts to land values were evaluated as part of Volume IID, Section 4: Socio-Economic Assessment. This evaluation found that the Project is not expected to decrease land values in the area already zoned for heavy industrial use. It was not possible to project land values in the buffer zone or within the Towns of Bruderheim and Lamont. Some interviewees voiced concerns about the potential for a decrease in land values, especially for areas in the buffer zone. Land in the buffer zone may be subject to the Alberta Industrial Heartland's Voluntary Property Purchase Program and landowners in the area may receive fair value for their land where appropriate if they choose to move based on the Project.
Sulphur fires/Emergency Response Plan (ERP)	Potential for sulphur fires and related emergency response planning is addressed in Volume I: Project Description – Appendix V, Emergency Response Plan. While the risk of sulphur fires exists, sulphur burns very slowly and sulphur fires can be easily extinguished. The consequences of typical sulphur fires are not significant. The potential impacts of sulphur fires are best managed by developing and maintaining vigilant fire monitoring and response capability. AST will belong to NR CAER, the emergency response cooperative of industries operating in the Industrial Heartland.
Impact on human health	Public Health and Safety (Volume IIA, Section 4: Public Health and Safety) concludes that no unacceptable risks to human health will occur during either normal operating conditions. The primary human health risk occurs during sulphur fires (see above) and is associated with SO_2 emissions. These risks will be mitigated by diligently monitoring for fires, H_2S and SO_2; implementing an effective Health and Safety Plan (see Volume I: Project Description – Appendix IV); and by the implementation and maintenance of effective fire detection and response capabilities (see Sulphur fires/Emergency Response Plan above).
Soil contamination	The primary risk of soil contamination is associated with deposition of fugitive sulphur dust. Volume IIC, Section 2: Soil concludes that significant impacts to soil quality will be limited to the Site and area immediately surrounding the facility. Mitigation will include minimizing fugitive sulphur dust emissions (see Air contamination and sulphur dust above), monitoring and, if necessary, neutralizing potential soil acidity.
Impact on health of livestock	No impacts to domestic livestock are anticipated. According to Volume IIA, Section 2: Climate and Air Quality, all air emission concentrations of chemicals of potential concern are well below the threshold of concern for human health. Therefore, the concentrations are not expected to harm domestic stock. Sulphur compounds do not bioaccumulate and are not a concern from the perspective of ingestion by livestock. As well, no significant impacts to water quality are anticipated and, therefore, no ingestion concerns related to water are anticipated. Past studies at sour gas processing facilities commissioned by AENV also concluded that the level of sulphur emissions associated with these facilities were not harmful to livestock (Alberta Health and Wellness. 2006).

Table 2.6-1: AST Measures to Address Stakeholder Issues (Cont'd)

Stated Issues	AST Measures to Address Issues: EIA Section Cross-reference
Increased rail traffic and decreased safety	According to Volume I: Project Description – Appendix III, Traffic Impact Assessment, the increase in rail traffic outside of the Site and the potential for safety issues related to rail traffic is not significant. During peak operations, one daily liquid sulphur train and one formed sulphur train every two days are anticipated.
Sulphur blocking will happen in the future	In response to this public concern, AST's initial intention to block sulphur was removed from the Project design. Sulphur blocking is not included in this application and it is not AST's intention to implement sulphur blocking at this Site now, or in the future. Any plans to block sulphur would require a separate application, public consultation and approval under EPEA (see Volume I: Project Description – Section 3.1.1). Should sulphur markets deteriorate to the extent that sulphur marketing is no longer viable, the Bruderheim facility could reduce its operations or become idle. AST has the financial and operational capability to operate, expand or idle the facility as market conditions demand (see Volume I: Project Description – Section 2.4.4).
Sulphur smells	Potential for odours associated with the Project were evaluated in Volume IIA, Section 2: Climate and Air Quality. It concluded no unusual or obnoxious sulphur odours are expected outside of the boundaries of the Site.
Inadequate Emergency Response Plan (ERP)/Project proximity to Bruderheim and Lamont	The ERP (Volume I: Project Description – Appendix V) was reviewed and approved by a local emergency response expert, and complies with the requirements of EUB Directive 071: Emergency Preparedness and Response Requirements for the Upstream Petroleum Industry. Further, AST will become an active member of NR CAER, an emergency response cooperative of industrial operators in the Industrial Heartland.
Lack of trust in AST	AST continues to implement its public consultation program as detailed in Volume I and Volume IID, Section 5: Public Consultation. A public consultation committee has been established to improve communication, establish trust with the local community and facilitate public input into the Project's design and operation.
Impact on wildlife	Volume IIC, Section 4: Wildlife and Section 5: Biodiversity addresses potential impacts to wildlife, which are expected to be minor. The area's primary natural feature, the wetland in the northwest corner of the Site, will be conserved as part of the Project.
Negative visual impact	According to Volume IIA, Section 3: Noise and Light, the proposed facilities are relatively low lying (maximum height 15 m) and set back a considerable distance from access roads and rural residences (500 m from the nearest residence). They occupy a maximum of 3% of the field of vision above the horizon (assuming flat ground and unimpeded view). Visibility of the facility is also reduced by shrubs and trees surrounding the Site. Further development of trees and natural visual buffers is possible if specific views are compromised.

Table 2.6-1: AST Measures to Address Stakeholder Issues (Cont'd)

Stated Issues	AST Measures to Address Issues: EIA Section Cross-reference
Light pollution	The facility will operate 24 hours/day and will be lit to allow nighttime operation, resulting in a light impact similar in nature to the Canexus chlorate plant located to the southwest of the Project. Light associated with the Project will diminish with distance through adsorption and dissipation, and will be directed into the process area (rather than the surrounding ground). Vegetation and buildings will also act as barriers to light travel.
Lamont County will become a hazardous waste area	No hazardous wastes will be generated by the Project. Construction and operation of a sulphur forming facility is unrelated to the development of a hazardous waste treatment or disposal area.
Increased noise	The predicted sound levels of the Project alone are well below EUB permissible sound levels (PSLs) and will remain below the PSLs even when transportation sources are added. AST will investigate any noise concerns expressed by surrounding residents.
Overall loss of farmland to industry in the area	Volume IID, Section 2: Land Use and Reclamation assesses land use in the area, and the Project's impacts on land use. The Project will result in a small reduction in agricultural land in the area, but the reduction is limited to lands zoned for industrial use and farmland that, on balance, is rated as poor quality.
Impedes future economic development	The socio-economic and social impacts associated with the Project are assessed in Volume IID, Section 4: Socio-Economic Assessment. There is no evidence the Project's development has the potential to impede future economic development.
Negative impact on vegetation	Potential impacts to vegetation are addressed in Volume IIC, Section 3: Vegetation. Vegetation in the potentially impacted area surrounding the PDA will be subject to a proposed soil monitoring and mitigation program described in Vegetation and in Air contamination and sulphur dust and Soil contamination above. The results of the monitoring programs will be evaluated to determine if modifications to mitigation plans are required to reduce impacts. Additional mitigation steps will be taken to reduce the potential for establishment of noxious weeds that may occur as part of the industrial development.
Ensure AST complies with regulatory standards, including highest Safety and Environmental Stewardship standards	AST/HAZCO intends to comply with all regulatory standards and has demonstrated its commitment through the compliant operation of more than 30 industrial facilities in Alberta
Possible hazardous effects of mixing sulphur with chlorate	Testing is underway to compare the potential reactivity of sulphur and chlorate to that of other common organic particulates. Results will be reported to the NRCB and AENV independently, and communicated to interested stakeholders.
Concern over AST's public relations in the area	AST continues to implement its public consultation program as detailed in Volume I and Volume IID, Section 5: Public Consultation. A public consultation committee has been established to improve communication, establish trust with the local community and facilitate public input into the Project's design and operation.

Table 2.6-1: AST Measures to Address Stakeholder Issues (Cont'd)

Stated Issues	AST Measures to Address Issues: EIA Section Cross-reference
Adequate use of local labour	The Project will employ an estimated 21 people during the operations phase. AST has stated that local labour is preferred and will be given primary consideration for employment as long as work quality and safety are not compromised.
Construction quality	AST will follow standard engineering practices.
Tax revenue and benefits for the County	Projected taxes on AST assets are approximately $460,000 with an estimated $388,128 in municipal taxes, $62,387 to the Alberta School Foundation, and $9,562 to the County of Lamont Foundation.
Plant location not appropriate due to its proximity to two towns and rural populations; should be a remote area	Although Lamont County is largely an agricultural area and the proposed AST facility is near the Towns of Lamont and Bruderheim, the facility will be located in a zone approved by the County for heavy industrial use. The facility's proximity to the Towns of Lamont and Bruderheim and the rural population is addressed in AST's ERP (Volume I: Project Description – Appendix V) and Sulphur fires/Emergency Response Plan above.

d) proposed mitigation measures, monitoring, and management plans; and

The mitigation measures AST plans to implement for the Project are based on best operating practices at other sulphur forming and shipping facilities and adaptive management.

AST will implement a number of mitigation measures to reduce or eliminate the effects of the Project on various environmental indicators. The planned mitigation measures will meet applicable provincial and federal regulatory requirements. Additional environmental protection and mitigation measures are described in the Conceptual Conservation and Reclamation Plan in EIA Volume IID, Section 2: Land Use and Reclamation – Appendix I, C&R Plan. The mitigation measures recommended but not limited to in the EIA are summarized below.

Water supply, water management and wastewater management plans are detailed in Section 3.5 of this volume. A 100 m setback from waterbodies, where practicable, will be maintained during construction of the Project. Erosion and sediment control will be implemented during construction and operation of the Project. A stormwater retention pond will be constructed equipped with a leak detection system described in detail in Section 3.5. Discharge from the retention pond will only be required during extreme runoff events and will be subject to monitoring and release criteria.

Air emissions management plans are described in detail in Section 3.6 of this volume. Dust suppression will be implemented using a wind screen and proprietary dust suppression agents. Air emissions will be minimized by accepting only degassed sulphur and using the SulphaTreat process at point sources on the Site. Acid deposition will be mitigated as required by liming.

Chemical and waste management is described in Section 3.7 of this volume. Chemicals will be stored in accordance with appropriate regulatory guidance documents and leak detection systems will be installed to monitor any potential releases. Chemical spills will be addressed immediately and the appropriate action will be implemented to mitigate the

spills. An Emergency Response Plan has been developed and is included as Appendix V in this Volume.

Surface disturbance will be minimized at the Site as existing rights-of-way and disturbed areas will be incorporated into the Project. Reclamation to equivalent land capacity will occur when the Project is no longer operational.

Wildlife mortality associated with the Project will be tracked. Planting of trees and shrubs and installation of fencing along wildlife movement corridors can be implemented if necessary, to provide travel routes to deer or to deter deer from crossing along certain sections of the roads.

Detailed mitigation measures are stated in each section of Volume II.

2.6.2 Monitoring Recommendations

Section 5 of this volume documents the detailed environmental effects monitoring for surface water, groundwater, soil and air. Additional monitoring recommended in Volume II of the EIA is summarized below. Detailed monitoring plans are described in each component of the EIA.

2.6.2.1 VOL IIA: Air, Noise and Human Health

Continuous measurements of wind, H_2S and fine particulates ($PM_{2.5}$) will be evaluated by AST through an air monitoring program at the boundary of the Site. A monitoring program designed to ascertain the degree of acidification on soils and water from current operations will be conducted within the localized area. AST will maintain observational programs with respect to fine particulates and H_2S. Furthermore, AST will continue to participate in regional initiatives relative to air quality issues.

AST will investigate any noise and light concerns expressed by the surrounding residents.

Management and monitoring plans applicable to human health will be consistent with those described in the groundwater, surface water and air quality assessments.

2.6.2.2 VOL IIB: Water and Aquatic Ecology

With respect to groundwater and aquatic resources, monitoring measures should be initiated to address the following:

- sediment control and water quality during construction
- water quality of discharges leaving the facility during operation
- water quality of surface waters (outside the facility) entering aquatic environments
- groundwater quality and water table level

Planned monitoring activities with respect to surface water and groundwater include:

- monitoring water that is potentially discharged from the Site for:
  - visible sheen
  - 6<pH<9
  - COD<50 mg/L

  - chloride<500 mg/L
  - TSS<50 mg/L

- grab samples will be conducted immediately prior to discharge
- monitoring groundwater twice annually for:
  - water table level
  - temperature, pH and electrical conductivity
  - potability

In addition to the planned monitoring activities, it is recommended that:

- surface water in northwest wetland be monitored for turbidity during construction
- surface water in northwest wetland be sampled twice annually for temperature, pH and dissolved oxygen during operations

2.6.2.3 VOL IIC: Terrestrial Ecosystems

A periodic soil monitoring program that complies with Guideline for Monitoring and Management of Soil Contamination under EPEA Approvals (AENV 1996) will be established to assess the rate and locations of any increases in soil acidity compared to baseline data within the Site using established guidelines (AENV Air Monitoring Directive Appendix A–7: Soil Monitoring Guidelines; AENV 1989).

Vegetation monitoring will be conducted if deemed necessary by the soil monitoring program to quantify the potential effects of dust deposition on native vegetation and croplands. The potential introduction of non-native and invasive species into the LSA will be monitored annually. The PDA, including stockpiled soil, should be monitored by AST over the operational lifespan of the sulphur forming and shipping facility for non-native and invasive species.

Wetlands, waterbodies and soils will be monitored for changes in acidity as part of the Surface Water and Soils monitoring program. Data from these studies are essential to evaluate the potential effects of increased acidity on amphibians and waterbirds. If pH levels in wetlands and waterbodies become acidic (less than 7.0), actions to reverse this will be implemented to protect species that are water-dependent.

e) any project-related residual effects, their contribution to regional cumulative effects and their implications for the future management of regional cumulative effects.

Table 2.6-2 summarizes the conclusions of the assessments completed for each component of the EIA, in terms of the common fundamental criteria used to assess each of the potential impacts (extent, magnitude, direction, duration, reversibility, confidence, and rating).

Table 2.6-2: Final Impact Summary Table for Each Component of the EIA

Potential Impact	Geographic Extent	Magnitude	Direction	Duration	Reversibility	Confidence	Rating
AIR QUALITY							
Criteria pollutants	Local	Negligible	Negative	Long term	Reversible	High	4
Non-Criteria substances	Local	Negligible	Negative	Long term	Reversible	High	4
Ozone	Local	Negligible	Uncertain	Long term	Reversible	High	4
Acid deposition	Local	Negligible	Negative	Long term	Reversible	High	4
NOISE							
Noise from normal operations	Local	Low to moderate	Negative	Mid-term	Reversible	High	3
Construction noise	Local	Low to moderate	Negative	Short-term	Reversible	High	3
Transportation noise	Local	Low to moderate	Negative	Mid-term	Reversible	High	3
Non-routine operations (e.g., blowdown of steam, emergency power generators)	Local	Low to moderate	Negative	Short-term	Reversible	Moderate	3
PUBLIC HEALTH AND SAFETY							
Acute health risks	Local	Low	Negative	Short term	Reversible	High	3
Chronic health risks	Local	Negligible	Negative	Long term	Reversible	High	4
GROUNDWATER QUALITY AND QUANTITY							
Decreased water levels and flows	Regional	Negligible to low	Negative	Medium-term	Reversible	Moderate	3
Interaction between groundwater and surface water	Local	Negligible	Negative	Medium-term	Reversible	Moderate	3
Groundwater available to existing users	Regional	Low	Negative	Medium-term	Reversible	Moderate	3
Potential effects to Groundwater Quality	Local	Low to moderate	Negative	Short-term	Reversible	High	3
SURFACE WATER QUALITY							
Potential Impact from Surface Disturbances							
Increased erosion and basin sediment yield and altering runoff patterns	Local	Low to Moderate	Negative	Short-term	Reversible	Moderate to High	3
Impact of groundwater withdrawal on local water quality	Local	Negligible	Negative	Mid-term	Reversible	High	3
Potential Impact from the Deposition of Acidifying Compounds on Waterbodies							
Project contribution to acid deposition on local waterbodies	Local	Low to Moderate	Negative	Mid-term	Reversible	Moderate to High	3
Potential impact from Upset Conditions							
Accidental spillages or leaks	Local	Low to Moderate	Negative	Short-term	Reversible	Moderate to High	3
Uncontrolled release from runoff collection pond	Local	Low to Moderate	Negative	Short-term	Reversible	Moderate to High	3

Table 2.6-2: Final Impact Summary Table for Each Component of the EIA (Cont'd)

Potential Impact	Geographic Extent	Magnitude	Direction	Duration	Reversibility	Confidence	Rating
SURFACE WATER QUANTITY							
Changes to flow, water level and drainage patterns	Local	Low to Moderate	Negative	Mid-term	Reversible	High	3
Impact to channel regime and channel alterations	Local	Low to Moderate	Negative	Mid-term	Reversible	High	3
Impact to sediment yield	Local	Negligible to Low	Negative	Short-term	Reversible	Moderate	3
Potential impact from Upset Conditions							
Changes to water level and drainage patterns	Local	Negligible	Negative	Mid-term	Reversible	High	3
AQUATIC RESOURCES							
Surface disturbance (siting)	-	-	Neutral	-	-	High	4
Surface disturbance (construction)	Local	Negligible	Negative	-	Reversible	High	4
During Operation							
Dust deposition	Local	Low to Moderate	Negative	Short-term	Reversible	Moderate	3
Air emissions	Local	Low to Moderate	Negative	Mid-term	Reversible	Moderate	3
Wastewater and stormwater discharge	Local	Low to Moderate	Negative	Mid-term	Reversible	Moderate	3
Groundwater drawdown	Local	Negligible	Negative	Mid-term	Reversible	Moderate	3
Contaminant spills	Local	Low to Moderate	Negative	Mid-term	Reversible	Moderate	3
SOIL							
Changes to Agricultural Land Capability							
Project impacts to agricultural land capability	Local	Low	Neutral to positive	Mid-Term	Reversible	High	3
Potential Effects on Soil Quality							
Soil admixing	Local – Confined to PDA	Low to moderate	Negative	Mid-Term	Reversible	High	3
Soil compaction	Local	Low to moderate	Negative	Mid-Term	Reversible	High	3
Soil erosion	Local	Low	Negative	Long-Term	Reversible	High	2
Soil contamination	Local	Moderate to high	Negative	Mid-Term	Reversible	High	2
Alteration of Soil Moisture Regime							
Project impacts to surface hydrology and shallow groundwater quantity	Local	Low	Negative	Mid-Term	Reversible	High	3
Soil Suitability for Reclamation							
Project impacts resulting in changes to soil reclamation suitability	Local	Low to moderate	Neutral to positive	Long-Term	Reversible	High	3

Table 2.6-2: Final Impact Summary Table for Each Component of the EIA (Cont'd)

Potential Impact	Geographic Extent	Magnitude	Direction	Duration	Reversibility	Confidence	Rating
Project impacts to soil resulting from dry and wet deposition of acidic compounds	Local	Moderate to high	Negative	Long-term	Reversible	Moderate	2
VEGETATION							
Surface disturbance	Local	Low to Moderate	Negative	Mid-term	Reversible	High	3
Dust deposition	Local	Low to Moderate	Negative	Mid-term	Reversible	Moderate	3
Contaminant spills	Local	Low to Moderate	Negative	Mid-term	Reversible	Moderate	3
Introduction of non-native and invasive species	Local	Negligible	Negative	Short-term	Reversible	High	3
Air emissions	Local	Low to Moderate	Negative	Mid-term	Reversible	Moderate	3
WILDLIFE							
Potential acid input: air emissions	Local and Regional	Low to Moderate	Negative	Mid-term	Reversible	Moderate	3
Potential acid input: Waterbodies	Local and Regional	Low to Moderate	Negative	Mid-term	Reversible	Moderate	3
Potential acid input: Soils	Local and Regional	Low to Moderate	Negative	Long-term	Reversible	Moderate	3
Direct mortality	Local and Regional	Low to Moderate	Negative	Mid-term	Reversible	Moderate	3
Habitat availability	Local	-	Neutral	-	-	Moderate	4
Fragmentation and wildlife movements	Local	Moderate	Negative	Mid-term	Reversible	Moderate	3
Noise	Local and Regional	Low to Moderate	Negative	Mid-term	Reversible	Moderate	3
Final Impact Rating Summary Table for the Cumulative Effects Case							
Habitat availability	Regional	-	Neutral	-	-	Moderate	4
BIODIVERSITY AND FRAGMENTATION							
Impacts to Biodiversity Indicators in the LSA at Project Application							
Landscape Diversity							
Patch area	Local	Low	Negative	Mid-term	Reversible	Moderate	3
Patch size	Local	Low	Negative	Mid-term	Reversible	Moderate	3
Anthropogenic edge	Local	-	Neutral	-	-	High	4
Linear features	Local	Moderate	Negative	Mid-term	Reversible	Moderate	3
Species Diversity							
Vegetation species diversity	Local	Low	Negative	Mid-term	Reversible	Moderate	3
Wildlife species diversity	Local	Low	Negative	Mid-term	Reversible	Moderate	3

Table 2.6-2: Final Impact Summary Table for Each Component of the EIA (Cont'd)

Potential Impact	Geographic Extent	Magnitude	Direction	Duration	Reversibility	Confidence	Rating
Impacts to Biodiversity Indicators in the RSA at Project Application							
Landscape Diversity							
Patch area	Regional	Low	Negative	Mid-term	Reversible	Moderate	3
Patch size	Regional	Moderate	Negative	Mid-term	Reversible	Low	3
Anthropogenic edge	Regional	-	Neutral	-	-	High	4
Linear features	Regional	Moderate	Negative	Mid-term	Reversible	Moderate	3
Species Diversity							
Vegetation species diversity	Regional	Low	Negative	Mid-term	Reversible	Moderate	3
Wildlife Species diversity	Regional	Low	Negative	Mid-term	Reversible	Moderate	3
LAND USE & RECLAMATION							
Agriculture	Local	Low to Moderate	Negative	Mid-term	Reversible	High	3
Hunting and wildlife	Regional	Low to moderate	Negative	Mid-term	Reversible	Moderate	3
Birdwatching	Local	Low to Moderate	Negative	Mid-term	Reversible	Moderate	3
SOCIO-ECONOMIC ASSESSMENT							
Construction Phase							
Population	Regional	Low to moderate	Neutral	Short-term	Reversible	High	4
Economic	Regional	Not applicable	Positive	Short-term	Permanent	Moderate	4
Employment	Regional	Negligible	Positive	Short-term	Not applicable	Moderate	4
Emergency services	Regional	Negligible	Negative	Short-term	Permanent	Moderate	3
Infrastructure	Local	Negligible	Neutral	Short-term	Not applicable	High	4
Housing	Regional	Negligible	Neutral	Short-term	Reversible	High	4
Community services	Regional	Negligible	Negative	Short-term	Reversible	High	4
Operations Phase							
Population	Regional	Negligible	Neutral	Mid-term	Permanent	Moderate	4
Employment	Regional	Negligible	Positive	Mid-term	Permanent	High	4
Housing	Regional	Negligible	Neutral	Long-term	Permanent	Moderate	4
Potential negative impacts to existing businesses	Local	Low to Moderate – Moderate to High	Negative	Mid-term	Permanent	Low	3

List and discuss the key environmental issues and the issues that are important for the achievement of sustainable environmental and resource management that were identified during the preparation of the EIA report and public consultation. Differentiate between emerging issues (with ongoing uncertainties) with quantifiable and significant environmental effects, and issues that can be resolved through available technology and existing management approaches.

Provide a matrix or summary chart to describe this section."

The summary is provided in the Concordance Table (Table 2.6-3). The key issues identified in the TOR are addressed in the sections indicated in the Concordance Table.

Table 2.6-3: Concordance Table

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
1.	**INTRODUCTION**		
1.1	**Purpose**		
	The purpose of this document is to identify for Alberta Sulphur Terminals (AST), a division of HAZCO Environmental Services (HAZCO) and CCS Income Trust (CCS), and appropriate stakeholders the information required by government agencies for an Environmental Impact Assessment (EIA) report. AST will prepare and submit an EIA report that examines the environmental and socio-economic effects of the construction, operation and reclamation of the proposed sulphur forming and shipping facility (the Project). The Project includes the construction and operation of facilities for sulphur forming, sulphur pastille storage and shipment for export. The proposed facility is to be developed on a portion of Section 35, Township 55, Range 20, West of the 4th Meridian (the Site), which is located approximately 2.2 km east of Bruderheim, Alberta. The Project is located within the Industrial Heartland area of Lamont County. The Project includes the development of rail and road access for receiving and shipping sulphur, liquid sulphur unloading and transfer facilities, sulphur forming facilities to produce sulphur pastilles and loading and shipping facilities for formed sulphur. Finished product will be stored on a storage pad with a capacity of 90,000 tonnes. The forming capacity for the proposed Project will be 6,000 t/d, with approximately half of that being associated with initial construction. All Project infrastructure and activities will be confined to and occupy the lands (35-55-20 W4M) owned by the Project proponent. AST will service oil and gas production and refining operations located in the Fort Saskatchewan area as well as northeastern Alberta. With increased applications, approvals and operation of bitumen upgraders and ongoing sulphur recovery initiatives, a shortage of sulphur forming facilities in Alberta has become apparent. AST will provide area oil and gas producers with a state of the art sulphur forming, pastille storage and shipping facility that will include design elements and monitoring programs that focus on environmental protection.	Sec 1.1	Vol IIA: Sec 1 Vol IIB: Sec 1 Vol IIC: Sec 1 Vol IID: Sec 1
1.2	**Scope of Environmental Impact Assessment Report**		
	The EIA report shall be prepared in accordance with these Terms of Reference and the environmental information requirements prescribed under the *Environmental Protection and Enhancement Act* (EPEA), *Water Act* (WA) and any other legislation which may apply to the Project. The EIA report will:		Vol IIA: Sec 1 to 4 Vol IIB: Sec 1 to 5 Vol IIC: Sec 1 to 5 Vol IID: Sec 1 to 5
	a) assist the public and government in understanding the environmental and socioeconomic consequences of the Project's development, operation, and reclamation plans and will assist AST in its decision-making process;		
	b) address:		
	i) Project impacts;		
	ii) mitigation options;		
	iii) residual effects relevant to the assessment of the Project including, as appropriate, those related to other industrial operations. As appropriate for the various types of impacts, predictions shall be presented in terms of magnitude, frequency, duration, seasonal timing, reversibility and geographic extent;		
	c) discuss possible measures, including established measures and possible improvements based on research and development to:		
	i) prevent or mitigate impacts;		
	ii) assist in the monitoring of environmental protection measures;	Sec 3.8	
	iii) identify residual environmental impacts and their significance including cumulative and regional development considerations;		

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
	d) include tables that cross-reference the report (subsections) to the EIA Terms of Reference; and	Sec 2.6	
	e) include a glossary of terms and a list of abbreviations to assist the reader in understanding the material presented.	Appendix II	Vol IIA: Sec 1 Vol IIB: Sec 1 Vol IIC: Sec 1 Vol IID: Sec 1
	The EIA report will form part of AST's EPEA and WA applications to Alberta Environment and part of AST's application to the Natural Resources Conservation Board (NRCB).		
1.3	**Public Consultation**		
	The preparation of the EIA report will include a public consultation program to assist with Project scoping and issue identification, and documentation of the results of these consultations (see Section 9.0). The public consultation program is to communicate with those members of the public who may be affected by the Project and to provide them with an opportunity to participate in the Environmental Assessment process.	Sec 1.1	Vol IID: Sec 5.4, 5.5, 5.6, 5.7
1.4	**Proponent's Submission**		
	AST is responsible for the preparation of the EIA report and related applications. The final submission will be based upon these Terms of Reference and issues raised during the public consultation process.	Sec 1.1	
2.	**PROJECT OVERVIEW INFORMATION REQUIRMENTS**		
	AST is expected to provide: a corporate profile, an overview of the Project, the key environmental, resource management, and socio-economic issues that, from the proponent's perspective, are important for a public interest decision; and the results of the Environmental Assessment process.	Sec 2	
2.1	**Alberta Sulphur Terminals Ltd.**		
	Present a corporate profile of the proponent and state who is responsible for the development, management, operation and reclamation of the Project.	Sec 2.1	
2.2	**Project Need and Alternatives Considered**		
	Discuss the need for the Project, the alternatives to the Project, including the potential alternative of not proceeding with the Project. Address the following:	Sec 2.2	
	a) an analysis of the alternative means of carrying out the Project that are technically and economically-feasible and indicate their potential environmental effects and impacts with the rationale for selecting the proposed option;		
	b) how a balance between environmental, resource recovery or conservation and economic goals has been achieved through planning and preliminary design, highlighting any areas where planning focused on one goal in exclusion of others;		
	c) contingency plans, if major Project components or methods prove to be unfeasible or do not perform as expected;		
	d) potential cooperative development opportunities and the implications of the Project for ongoing regional management and research initiatives;		
	e) environmental performance of the technology and a comparison to the alternative technologies considered;		
	f) a market analysis of sulphur supply versus demand (e.g. 5yr, 10yr, and 10 + yrs).		
2.3	**Project Components and Development Timing**		
	Provide an overview of the Project activities and physical components. Specifically, address the following:	Sec 2.3	
	a) a summary list, brief description and drawings of Project components and activities which are addressed in detail under Section 3.0;		

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
	b) proposed activity stages or phases and a likely development schedule, explaining:		
	i) the timing of key construction, operation and reclamation activities;		
	ii) the expected duration of each for the life of the Project;		
	iii) the key factors controlling the schedule and uncertainties;		
	iv) the implications of a delay in the Project and include the regulatory process as a consideration in the likely development schedule.		
2.4	**Regulatory and Planning Framework and Classifications**		
	Identify the legislation, policies, approvals, and current multi-stakeholder planning initiatives applicable to the review of this Project. List the major components of the Project that will be applied for and constructed within the duration of any potential approvals under the EPEA and WA and address the following:	Sec 2.4	
	a) other regulatory approvals that are required and any approvals that have already been issued including provincial, municipal, and applicable federal government requirements;		
	b) the primary focus of each regulatory requirement, such as resource allocation, environmental protection, land use/development, and the element(s) of the Project subject to the regulation;		
	c) any regulatory classification systems which apply to the Project, such as solid waste or air pollution classifications and land use zones; and		
	d) summary of the objectives, standards, or guidelines that have been used by AST to assist in the evaluation of the significance of effects.		
2.5	**Principal Development Area and EIA Study Area**		
	The Principal Development Area (PDA) includes all lands subject to direct disturbance from the Project and associated infrastructure, including access and utility corridors. For the PDA, provide:	Sec 2.5	
	a) the legal land description;		
	b) the boundaries of the PDA;		
	c) a map that identifies the locations of all proposed development activities; and		
	d) a map and photo mosaic showing the area proposed to be disturbed in relation to existing topographic features, township grids, wetlands and water bodies.		
	Study Areas for the EIA report include the PDA and other areas based on individual environmental components where an effect from the proposed development can reasonably be expected. Provide:	Sec 2.5	Vol IIA: Sec 1.2 Vol IIB: Sec 1.2 Vol IIC: Sec 1.2 Vol IID: Sec 1.2
	e) the rationale used to define Local and Regional Study Areas (see also Section 4.5), considering the location and range of probable Project and cumulative effects including those related to regional or local developments; and		
	f) illustrate boundaries, and identify Local and Regional Study Areas chosen to assess impacts on maps of appropriate scale.		
2.6	**EIA Summary**		
	Provide a summary of the EIA report addressing:		Vol IIA: Sec 1 Vol IIB: Sec 1 Vol IIC: Sec 1 Vol IID: Sec 1

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
	a) environmental and land use conditions in the EIA Study Area without the Project;		
	b) activities and components of the Project that are anticipated to influence environmental and land use conditions;		
	c) the anticipated environmental effects, with emphasis on regional and cumulative considerations;		
	d) proposed mitigation measures, monitoring, and management plans; and		
	e) any Project-related residual effects, their contribution to regional cumulative effects and their implications for the future management of regional cumulative effects.		
	List and discuss the key environmental issues and the issues that are important for the achievement of sustainable environmental and resource management that were identified during the preparation of the EIA report and public consultation. Differentiate between emerging issues (with ongoing uncertainties) with quantifiable and significant environmental effects, and issues that can be resolved through available technology and existing management approaches.	Sec 1.1, 3.8	Vol IID: Sec 5.7
	Provide a matrix or summary chart to describe this section.	Sec 2.6	
3.	**PROJECT DESCRIPTION AND MANAGEMENT PLANS**		
	Describe activities and components of the Project and relevant management plans. Provide sufficient scope and detail in the Project description information to allow quantitative assessment of the environmental consequences. If the scope of information varies among components or phases of the Project, provide rationale demonstrating that the information is sufficient for assessment purposes. Technical information required in this section may also be required for an EPEA and WA approval application. Information required in this section may be provided in other parts of AST's submission(s) provided that the location of the information is referenced in the EIA report. AST should ensure consistency in the information provided whenever it is discussed in more than one section of the submission.	Sec 3.1, 3.2	
3.1	**Project Components and Site Selection**		
3.1.1	**Project Components**		
	Describe the nature, size, location and duration of the significant components of the Project including, but not limited to, the following:	Sec 3.1	
	a) the plant site and any chemical/fluids storage locations;		
	b) design capacities of the Project and the changes in design capacities;		
	c) temporary structures, dewatering, water control facilities, and processing/treatment facilities;		
	d) buildings and infrastructure, transportation, utilities, access routes, and storage areas;	Appendix III	Vol IID: Sec 4.4
	e) the location of groundwater supply well(s);		Vol IIB: Sec 2.6
	f) the types and amounts of waste materials, and locations of waste storage, and disposal sites;		
	g) a site development plan to illustrate the locations of components including an outline of the proposed phasing and sequencing of components (include pre-construction, construction, operation, reclamation, decommissioning, and end land use);		Vol IID: Sec 2.7, 2.8
	h) how AST has used community input for Project design and development; and		Vol IID: Sec 5.4, 5.5, 5.6, 5.7
	i) potential cooperative ventures to minimize environmental impacts.		

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
3.1.2	**Site Selection**		
	Discuss the site selection process including, but not limited to, the following:	Sec 3.1	
	a) factors that were considered in determining the preferred plant site and associated processing facilities;		Vol IIB: Sec 5.5 Vol IIC: Sec 2.5
	b) the site selection process for the proposed location of the Project components;		
	c) the rationale for choosing the proposed sites instead of alternative sites;		
	d) the technical, economical, and environmental criteria considered;		
	e) potential impacts on environmental and land use conditions; and		Vol IIA: Sec 1 to 4 Vol IIB: Sec 1 to 5 Vol IIC: Sec 1 to 5 Vol IID: Sec 1 to 5
	f) suitable maps showing the location of proposed facilities.		
3.2	**Process Description**		
	Provide material balances, energy balances, flow diagrams, and descriptions of the processes including:	Sec 3.2	
	a) energy efficiency and process efficiency of the technologies chosen;		
	b) alternate technologies considered;		
	c) shared facilities and utilities associated with the Project;		
	d) chemicals needed for sulphur forming and storage processes included in the Project;		
	e) Project inputs such as energy and water, and outputs such as emissions and wastes;		
	f) Effect of technology on waste generation and storage requirements, air and water discharges, water requirements, waste streams, and effects to reclamation programs; and		
	g) sources of major feed materials for the sulphur forming process.		
3.3	**Project Handling**		
	Identify the location and amount of all on site storage associated with sulphur forming including storage of chemicals, products, by-products, intermediates and wastes (additional detail can be found in Section 3.7). Explain containment and environmental protection measures to be used.	Sec 3.3	
3.4	**Utilities and Transportation**		
	Describe and discuss the Project energy requirements, and associated infrastructure and other infrastructure requirements including, but not limited to, the following:	Sec 3.4, Appendix III	
	a) the amount and source of energy required for the Project;		
	b) the options considered for supplying the thermal energy and electrical power required for the Project and their environmental implications;		
	c) worker accommodations and travel routes to the plant site during construction and operation phases, including:		Vol IID: Sec 4.4, 4.5
	i) desired traffic routing;		
	ii) control methods; and		
	iii) road use agreements;		
	d) any expected changes and impacts in traffic volume by Average Annual Daily Traffic (AADT) and any seasonal variability in traffic volume, from the Project;		
	e) the result of consultation with the local transportation authorities including transportation studies that are underway or planned;		

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
	f) cumulative impacts on the transportation network including information regarding the upgrading requirement for Highway 15 and effect on Highway 45 and Range Road 202 due to the increase of traffic as a result of the Project;		
	g) the adequacy in design and upgrades required of all utility lines, roads, railways and pipeline crossings of roads, rivers and streams with respect to the construction;		
	h) design features to prevent spills, contingencies for spill response and environmental risks associated with spills; and		
	i) plans to minimize and mitigate the impacts of the Project's energy and infrastructure requirements and associated infrastructure on area residents.		
3.5	**Water Supply, Water Management and Wastewater Management**		
3.5.1	**Water Supply**		
	Describe the Project's water supply requirements including, but not limited to, the following:	Sec 3.5	
	a) the overall water balance(s);		
	b) the water requirements for construction, start-up, normal conditions, peak demand conditions, emergency operating situations, decommissioning and reclamation;		
	c) the variability in the amount of water required on an annual and seasonal basis as the Project is implemented;		
	d) the supply options including on site storage;		
	e) the location of existing sources/intakes and associated infrastructure (pipelines); and		Vol IIB: Sec 2 - Appendix V
	f) potential modifications to the Project.		
3.5.2	**Water Management**		
	Provide a Water Management Plan including, but not limited to, the following:	Sec 3.5	
	a) measures for ensuring efficient use of water throughout the Project life including alternatives to reduce freshwater consumption such as water minimization, recycling, and conservation in accordance with the Water for Life strategy objective;		
	b) permanent or temporary alterations or diversions to watercourses and water bodies;		Vol IIB: Sec 3.6, 3.8, 4.6, 4.8
	c) factors used in the design of water management facilities including expected flood levels and flood protection;		
	d) options considered for water management strategies and reasons for selecting the preferred options; and		Vol IIB: Sec 3.7, 4.7
	e) an explanation of how these plans will be incorporated into Project design.		
3.5.3	**Wastewater Management**		
	Provide a Wastewater Management Plan to address site runoff, groundwater protection, deep well disposal, and wastewater discharge including, but not limited to, the following:	Sec 3.5	
	a) source, quantity and composition of each wastewater stream from the proposed Project facilities;		
	b) those waste substances produced by the Project in sufficient quantities to be reportable under National Pollutants Release Inventory (NPRI) requirements;		
	c) design of facilities that will handle, treat, and store wastewater streams;		
	d) options considered for wastewater treatment and management strategies, and reasons (including water quality and environmental considerations) for selecting the preferred options;		Vol IIB: Sec 4.6

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
	e) type (chemical names) and quantity of chemicals used in wastewater treatment;		
	f) potable water and sewage treatment systems that will be installed as components of the Project for both the construction and operation stages;		
	g) the discharge of aqueous contaminants (quantity, quality, and timing) beyond plant site boundaries and the potential environmental effects of such releases;		
	h) design parameters for managing site runoff during precipitation or snowmelt events;		
	i) programs to monitor the effects of Project operations on local surface and groundwater quantity and quality;	Sec 3.8	Vol IIB: Sec 2.7, 3.7, 4.7
	j) options for wastewater disposal (including zero liquid discharge) as well as the rationale for choosing the preferred options; and		Vol IIB: Sec 4.6
	k) description of how the Wastewater Management Plan will be incorporated into Project design.		
3.6	**Air Emissions Management**		
	Develop an emissions profile (type, rate and source) for each component of the Project including point sources, fugitive emissions and vehicle emissions. Consider both normal operating conditions and upset conditions. Include definitions for these conditions. Discuss the following:	Sec 3.6	
	a) any emissions produced by the Project in sufficient quantities to be reportable under NPRI requirements;		Vol IIA: Sec 2.5
	b) any odorous or visual emissions from the proposed facilities;		Vol IIA: Sec 2.5
	c) the amount and nature of any acidifying emission, probable deposition patterns and rates, and programs AST may implement to monitor the effects of this deposition;		Vol IIA: Sec 2.3, 2.5
	d) control technologies used to minimize air emissions such as sulphur dioxide (SO_2), hydrogen sulphide (H_2S), oxides of nitrogen (NOx), volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAH) and particulate matter (specifically including, but not limited to sulphur compounds);		Vol IIA: Sec 2.5
	e) the emission control technologies proposed for the Project in the context of best-available technologies, and the applicability of Canadian Council of Ministers of the Environment (CCME) emission control technology guidelines;		
	f) fugitive emissions control program to detect, measure and control emissions and odours from equipment leaks and the applicability of the CCME Code of Practice for Measurement and Control of Fugitive Emissions from Equipment Leaks and the CCME Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Above Ground Storage Tanks;	Sec 3.8	
	g) technology or management programs to minimize emissions which lead to formation of particulate matter and ozone (O^3) having regard to the provisions of the Canada Wide Standard for particulate matter and O^3;		Vol IIA: Sec 2.4, 2.6
	h) the incremental contribution of the Project to regional emissions of $PM_{2.5}$ and PM_{10} and ground-level ozone precursors including NO_x and sulphur oxides (SO_x);		Vol IIA: Sec 2.5
	i) gas collection, conservation and applicability of technology for vapour recovery for the Project; and		Vol IIA: Sec 2.4, 2.5
	j) monitoring programs AST will implement to assess air quality and the effectiveness of mitigation, during the Project's development and operation. Discuss how these monitoring programs are compatible with those in use by regional multi-stakeholder air initiatives.	Sec 3.8	

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
3.6.1	**Greenhouse Gas Emissions**		
	Provide the following:	Sec 3.6	
	a) the expected annual and total greenhouse gas (GHG) emissions over the construction, operation and decommissioning phases of the Project;		
	b) the Project's marginal contribution to total provincial and national GHG emissions on an annual basis;		
	c) the intensity of GHG emissions per unit of production and discuss how it compares with similar projects and technology performance;		
	d) how the Project design and GHG management plans have taken into account the need for continuous improvement with respect to GHG emissions and their consideration of Alberta's Climate Change Action Plan; and		
	e) AST's overall GHG management plans and the expected results of implementing the plans.		
3.7	**Hydrocarbon, Chemical and Waste Management**		
	Characterize and quantify the anticipated hazardous, non-hazardous, recyclable and dangerous goods wastes generated or used by the Project. Demonstrate that the selected management options are consistent with the current regulatory requirements and industry practices. Describe and address the following:	Sec 3.7	
	a) the composition and volume of specific waste streams generated by the Project, and identify how each stream will be managed. Demonstrate that the selected practices comply with provincial and federal regulations including EPEA's Waste Control Regulation and Alberta Environment's Hazardous Waste Storage Guidelines;		
	b) a listing of chemical products to be used for the Project. Identify products containing substances that are:		
	i) Canadian Environmental Protection Act (CEPA) toxics;		
	ii) on the PSL2, and Accelerated Reduction/Elimination of Toxics (ARET), and those defined as dangerous goods pursuant to the federal Transportation of Dangerous Goods Act. Classify the wastes generated and characterize each stream under Alberta Environment User's Guide for Waste Managers;		
	iii) on the National Pollutant Release Inventory (NPRI);		
	iv) on Track 1 substances targeted under Environment Canada's Toxic Substances Management Policy for virtual elimination from the environment due to their persistent, bio-accumulative and toxic nature;		
	c) how feedstocks and products will be stored and managed to ensure safety and environmental protection;		
	d) the strategy for on site waste disposal versus off site waste disposal and identify:		
	i) the location of on site waste disposal, including landfills, if applicable;		
	ii) the suitability of the site(s) from a groundwater protection perspective (provide geo-technical information to support the siting of disposal facilities);		
	iii) the site suitability with regard to existing and potential human activities in the area;		
	iv) potential effects on the environment; and		
	e) plans for waste minimization, recycling, and management over the life of the Project. Discuss methods and technologies to reduce waste quantities to the lowest practical levels.		

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
3.8	**Environmental Management System and Contingency Plans**		
	Summarize key elements of AST's existing and proposed environmental, health, and safety management system and discuss how it will be integrated into the Project, addressing the following:	Sec 3.8	
	a) corporate policies and procedures, operator competency training, spill and air emission reporting procedures, emergency response plans, public notification protocol and safety procedures;		
	b) plans to minimize the production or release into the environment of substances that may have an adverse effect;		
	c) a conceptual contingency plan that considers environmental effects associated with operational upset conditions such as serious malfunctions, fires or accidents; and		
	d) the emergency response plan's capability to deal with unpredicted negative effects.		
3.9	**Adaptation Planning**		
	Describe the flexibility built into the plant design and layout to accommodate future modifications required by any change in emission standards, limits and guidelines. Discuss any follow-up programs and adaptive management considerations.	Sec 3.9	
3.10	**Participation in Regional Cooperative Efforts**		
	Document AST's involvement in regional cooperative efforts to address environmental and socio-economic issues associated with regional industrial development during the life of the Project, including:	Sec 3.10	
	a) AST's current and planned participation in regional monitoring and management activities such as the Fort Air Partnership to address environmental, health and socio-economic issues;		
	b) AST's current and planned cooperative ventures with other operators to minimize the environmental impact of the Project or the environmental impact of regional industrial development;		
	c) how AST will work to develop and implement such cooperative opportunities;		
	d) monitoring activities that will be undertaken to assist in managing environmental protection strategies. Discuss how any result will contribute to AST's participation in the regional efforts;		
	e) how AST will use information from regional cooperative efforts to design and implement mitigation measures (to mitigate Project-specific effects and cumulative effects), monitoring programs (Project-specific and regional monitoring), and research programs; and		
	f) how AST would design and implement mitigation measures (to mitigate specific effects and cumulative effects), monitoring programs (Project-specific monitoring and regional monitoring), and research programs outside of these initiatives where necessary.		
4.	**ENVIRONMENTAL INFORMATION AND CUMULATIVE EFFECTS ASSESSMENT INFORAMTION REQIREMENTS**		
4.1	**Assessment Scenarios**		
	Define assessment scenarios including:		Vol IIA: Sec 1.5 Vol IIB: Sec 1.5 Vol IIC: Sec 1.5 Vol IID: Sec 1.5
	a) a baseline case, which includes existing environmental conditions and existing and approved projects or activities;		
	b) an application case, which includes the baseline case plus the Project; and		

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
	c) a cumulative effects assessment (CEA) case, which includes past studies, existing and anticipated future environmental conditions, existing and approved projects or activities, plus other planned projects or activities.		
	Note: For the purposes of defining assessment scenarios, "approved" means approved by any federal, provincial or municipal regulatory authority. "Planned" is considered any project or activity that has been publicly disclosed prior to the issuance of the Terms of Reference or up to six months prior to the submission of the Project application and EIA report, whichever is submitted sooner.		
4.2	**Information Requirements for the Environmental Assessment**		
	Basic environmental information requirements for AST's EIA report include for each relevant section:		
	a) quantitative and qualitative information about the existing environmental and ecological processes in the EIA Study Area;		Vol IIA: Sec 2.4, 3.7 Vol IIB: Sec 2.5, 3.5, 4.5, 5.4 Vol IIC: Sec 2.5, 3.4, 4.6, 5.4 Vol IID: Sec 2.6, 3.4, 3.5, 4.3
	b) information about the existing and planned human activities in the EIA Study Area, and the nature, size, location and duration of their potential interactions with the environment, sometimes described as stressors (e.g., land disturbance, discharges of pollutants, changes to access status, consumption of renewable resources);		Vol IIA: Sec 2.4, 3.7, 4.4 Vol IIB: Sec 2.5, 3.5, 4.5, 5.4 Vol IIC: Sec 2.5, 3.4, 4.6, 5.4 Vol IID: Sec 2.5, 2.6, 3.4, 3.5, 4.3
	c) information about ecological processes and natural forces which are expected to produce changes in environmental conditions (e.g., climate change, forest fires, flood or drought conditions, predator-prey population cycles), and which are relevant to the Project;		Vol IIA: Sec 2.4 Vol IIB: Sec 2.5, 3.5, 4.5, 5.4 Vol IIC: Sec 2.5, 3.4, 4.6, 5.4
	d) the demonstrated use of appropriate predictive tools and methods, enabling quantitative estimates of future conditions with the highest possible degree of certainty;		Vol IIA: Sec 2.3, 3.5, 4.3 Vol IIB: Sec 2.4, 3.4, 4.4, 5.5 Vol IIC: Sec 2.3, 3.3, 4.4, 5.3 Vol IID: Sec 2.4, 3.3, 4.2
	e) quantitative and qualitative descriptions of the effects;		Vol IIA: Sec 2.5, 3.8, 4.8 Vol IIB: Sec 2.6, 3.6, 4.6, 5.5 Vol IIC: Sec 2.6, 3.5, 4.7, 5.5 Vol IID: Sec 2.7, 4.4

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
	f) evaluation of the significance of the effects, including the probability of the effect occurring and the importance of the consequences (measured quantitatively against management objectives and guidelines or baseline conditions and described qualitatively with respect to the views of AST and stakeholders);		Vol IIA: Sec 2.5, 3.10, 4.10 Vol IIB: Sec 2.12, 3.8, 4.8, 5.8 Vol IIC: Sec 2.8, 3.8, 4.9, 5.7 Vol IID: Sec 2.7, 3.7 4.4
	g) a description of air quality impact assessment as it relates to the Alberta Ambient Air Quality Guidelines;		Vol IIA: Sec 2.3, 2.5, 2.6
	h) management plans to prevent, minimize or mitigate adverse effects and to monitor and respond to expected or unanticipated conditions, including any follow-up plans to verify the accuracy of predictions or determine the effectiveness of mitigation plans;		Vol IIA: Sec 2.7, 3.11, 4.9 Vol IIB: Sec 2.10, 3.7, 4.7, 5.7 Vol IIC: 2.6, 3.5, 3.7, 4.7, 4.9, 5.5, 5.8 Vol IID: Sec 2 - Appendix I
	i) a record of all assumptions, including an evaluation of impact prediction confidence in data and analysis to support conclusions; and		Vol IIA: Sec 1.4 Vol IIB: Sec 1.4 Vol IIC: Sec 1.4 Vol IID: Sec 1.4
	j) a description of residual effects and their consequences for the environment as well as for regional management initiatives that are underway or in development.		Vol IIA: Sec 2.5, 3.8 Vol IIB: Sec 2.6, 3.6, 4.6, 5.5 Vol IIC: Sec 2.6, 3.5, 4.7, 5.5 Vol IID: Sec 2.7, 4.4
4.3	**Modelling**		
	Document any assumptions used to obtain modelling predictions submitted as part of the EIA report. Clearly identify the limitations of the model(s) including sources of input data, as well as error and relative accuracy in predicated results.		Vol IIA: Sec 2.3, 2 - Appendix I, 3.7 Vol IIB: Sec 2 - Appendix VI Vol IIC: Sec 3.5, 3 - Appendix IV, 4.6, 4 - Appendix II Vol IID: 4.3
4.4	**Cumulative Environmental Effects**		
	Assessment of cumulative effects will be an integral component of the EIA report. AST will conduct a cumulative environmental effects assessment of the Project based on the EUB/AENV/NRCB Information Letter "Cumulative Effects Assessment in Environmental Impact Assessment Reports under the Alberta Environmental Protection and Enhancement Act," June 2000. This will include a summary of all proposed monitoring, research and other strategies or plans to minimize mitigate and manage potential adverse effects. The identification and assessment of the likely cumulative environmental effects of the Project will:		Vol IIA: Sec 2.6, 3.9 Vol IIB: Sec 2.8, 3.6, 4.6, 5.6 Vol IIC: Sec 2.7, 3.6, 4.8, 5.6 Vol IID: Sec 2.8, 4.5
	a) define the spatial and temporal Study Area boundaries and provide the rationale for assumptions used to define those boundaries for each environmental component examined;		Vol IIA: Sec 1.2, 1.3 Vol IIB: Sec 1.2, 1.3 Vol IIC: Sec 1.2, 1.3 Vol IID: Sec 1.2, 1.3
	b) describe the current (baseline) state of the environment in the Regional Study Area (used for the cumulative effects assessment);		

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
	c) assess the incremental consequences that are likely to result from the Project in combination with other existing, approved and planned projects in the region;		
	d) demonstrate that relevant information or data used from other development projects is appropriate for use in this EIA report;		
	e) consider and describe deficiencies or limitations in the existing database for relevant components of the environment; and		
	f) explain the approach and methods used to identify and assess cumulative effects, including cooperative opportunities and initiatives undertaken to further the collective understanding of cumulative effects, and provide a record of relevant assumptions, confidence in data and analysis to support conclusions.		
4.5	**EIA Study Area**		
	The EIA Study Area shall include the PDA and associated infrastructure, as well as the spatial and temporal areas of individual environmental components outside the PDA boundaries where an effect can be reasonably expected. The EIA Study Area includes both Regional and Local Study Areas. Illustrate boundaries and identify the Study Areas chosen to assess effects. Define temporal and spatial boundaries for the Study Areas. Maps of these areas shall include township and range lines for easy identification and comparisons with other information within the EIA report. Describe the rationale and assumptions used in establishing the Study Area boundaries, including those related to cumulative effects.		Vol IIA: Sec 1.2, 1.3, 2.3, 3.4, 4.4 Vol IIB: Sec 1.2, 1.3, 2.4, 3.4, 4.4, 5.3 Vol IIC: Sec 1.2, 1.3, 2.3, 3.3, 4.4, 5.3 Vol IID: Sec 1.2, 1.3, 2.4, 3.3, 4.2
4.6	**Climate and Air Quality**		
	Discuss baseline climatic and air quality conditions. Review emission sources and discuss emissions from industrial development within the EIA Study Areas. Consider emission point sources as well as fugitive emissions. Identify components of the Project that will affect air quality from a local and regional perspective, and:		Vol IIA: Sec 2.4, 2.4, 2.5 Sec 2 - Appendix II
	a) identify any regional air monitoring in the area and describe AST's participation in regional forums (e.g., Northeast Capital Industrial Association, Fort Air Partnership);		Vol IIA: Sec 2.4
	b) discuss appropriate air quality parameters such as SO_2, carbon monoxide (CO), H_2S, NO_x and particulates ($PM_{2.5/10}$) (specifically including, but not limited to, sulphur compounds), and O_3, volatile organic compounds (VOC), and polycyclic aromatic hydrocarbons (PAH);		Vol IIA: Sec 2.3, 2.4, 2.5, 2.6
	c) estimate ground-level concentrations of appropriate air quality parameters. Discuss any expected changes to particulate deposition or acidic deposition (PAI) patterns. Justify the selection of models used and identify any model shortcomings or constraints on findings. Complete modeling in accordance with Alberta Environment's Air Quality Model Guideline. Include model input files;		Vol IIA: Sec 2.3, 2.4, 2.5, 2.6
	d) identify the potential for reduced air quality (including odors and visibility) resulting from the Project and discuss any implications of the expected air quality for environmental protection and public health;		Vol IIA: Sec 2.5, 2.6
	e) discuss interactive effects that may occur as a result of co-exposure of a receptor to all emissions and discuss limitations in the present understanding of this subject;		Vol IIA: Sec 4.5, 4.7, 4.8
	f) describe how air quality impacts resulting from the Project will be mitigated;		Vol IIA: Sec 2.5
	g) identify ambient air quality monitoring and receptor monitoring that will be conducted during operation of the Project to assess air quality and the effectiveness of mitigation;		Vol IIA: Sec 2.6

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
	h) assess Project specific air quality and cumulative air quality impacts, and implications for other environmental resources, including habitat diversity and quantity, vegetation resources, water quality and soil conservation. Discuss the relative contribution of the Project (e.g., after mitigation) to regional cumulative effects;		Vol IIA: Sec 2.5, 2.6
	i) assess the cumulative effects on the air quality of the EIA Study Area and include any related emissions increases from the Project; and		Vol IIA: Sec 2.6
	j) describe the monitoring programs AST will implement to assess air quality and the effectiveness of mitigation during the Project's development operation.		Vol IIA: Sec 2.6
4.6.1	**Climate Change**		
	Discuss the following:		
	a) review and discuss climate change and the local and/or regional, inter-provincial/territorial changes to environmental conditions resulting from climate conditions, including trends and projections where available;		Vol IIA: Sec 2.7
	b) identify stages or elements of the Project that are sensitive to changes or variability in climate parameters. Discuss what impacts the change to climate parameters may have on elements of the Project that are sensitive to climate parameters; and		Vol IIA: Sec 2.7
	c) comment on the adaptability of the Project in the event the region's climate changes. Discuss any follow-up programs and adaptive management considerations.		Vol IIA: Sec 2.7
4.7	**Noise and Light**		
	Discuss baseline noise and light level conditions. Identify components of the Project that will affect noise and light level, and:		Vol IIA: Sec 3.7, Sec 3 - Appendix I
	a) present the results of a noise assessment based on existing conditions as specified by EUB ID 98-08, Noise Control Directive, including:		
	i) an estimate of the potential for increased noise resulting from the Project;		Vol IIA: Sec 3.7
	ii) the identification of potentially-affected people and wildlife;		Vol IIA: Sec 3.4, 3.6 Vol IIC: Sec 4.6
	iii) the implications of any increased noise levels;		Vol IIA: Sec 3.7
	b) identify facilities that will affect light levels at night and evaluate the potential effects of increased light on affected residents; and		Vol IIA: Sec 3.4
	c) discuss the effects and mitigative measures to be utilized to minimize the production of noise and light.		Vol IIA: Sec 3.8, 3.9, 3.10
4.8	**Land Use and Reclamation**		
	Review current land use issues and identify the anticipated changes in nature, location and duration of land use as a result of the Project. Discuss:		
	a) conformity with land use objectives and planning parameters for the Lamont County, Alberta's Industrial Heartland Area Structure Plan;		Vol IID: Sec 2.7
	b) potential Project impact on local and regional land use management, residential areas, agricultural development, areas with native vegetation, wildlife habitat, recreation uses, and other industrial uses in the region;		Vol IID: Sec 2.7
	c) mitigation plans to minimize these effects; and		Vol IID: Sec 2.7
	d) reclamation concepts and objectives. Develop a conceptual reclamation/closure plan for the (PDA) considering regulatory requirements, stakeholder input, land use objectives and other factors necessary for a reclamation plan to be implemented.		Vol IID: Sec 2: Appendix I – Sec 3.3

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
	Discuss how the reclamation/closure plan design will:		
	e) assess for and mitigate/remediate on site contamination;		Vol IID: Sec 2: Appendix I – Sec 3.2
	f) return equivalent land capability as compared to pre-disturbance conditions;		Vol IID: Sec 2: Appendix I – Sec 3.3
	g) integrate the proposed landscape with the surrounding landscapes including inter-connectivity to the surrounding landscapes;		Vol IID: Sec 2: Appendix I – Sec 3.3
	h) integrate surface- and near-surface drainage within the PDA; and		Vol IID: Sec 2: Appendix I – Sec 3.3
	i) be incorporated into planning and development of the Project.		Vol IID: Sec 2: Appendix I – Sec 3.3
	Provide and discuss:		
	j) the anticipated timeframes for completion of reclamation activities;		Vol IID: Sec 2: Appendix I – Sec 3.3
	k) the applicable parameters that should be used to monitor and evaluate the reclaimed land;		Vol IID: Sec 2: Appendix I – Sec 3.3
	l) any constraints to reclamation such as timing of activities, availability of materials and influence of natural processes and cycles;		Vol IID: Sec 2: Appendix I – Sec 3.3
	m) any soil-related constraints or limitations that may affect reclamation; and		Vol IID: Sec 2: Appendix I – Sec 3.3
	n) specifically discuss the feasibility of the methods prescribed for reclamation (i.e., their proven success in trials or other locations).		Vol IID: Sec 2: Appendix I – Sec 3.3
4.9	**Terrestrial**		
4.9.1	**General Terrestrial Considerations**		
	Review current biophysical conditions and identify the nature, location and duration of changes anticipated as a result of the Project. Provide and discuss the following:		
	a) maps indicating the pre-disturbance landscape, elevation and drainage patterns of the Study Areas;		Vol IIC: Sec 2.5
	b) an assessment of the anticipated changes to the pre-disturbed topography, elevation and drainage patterns of the Study Areas;		Vol IIC: Sec 2.6

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
	c) baseline biophysical conditions, including topography, soil and vegetation characteristics and wildlife capability within the Study Area. Conduct the necessary surveys to characterize the biophysical resources in the Study Area and to assist in reclamation planning;		Vol IIC: Sec 2.5, 3.4, 4.6, 5.4
	d) components of the Project that will potentially affect these biophysical resources including soils, vegetation, wildlife and biodiversity;		Vol IIC: Sec 2.6, 3.5, 4.7, 5.5
	e) mitigation plans to minimize these effects; and		Vol IIC: Sec 2.6, 3.5, 4.7, 5.5
	f) an assessment of the relative contribution of the Project (after mitigation) to regional cumulative pressures on biophysical resources (e.g., Project contributions to cumulative potential acid input [PAI]).		Vol IIC: Sec 2.7, 3.6, 4.8, 5.6
4.9.2	**Soil**		
	Provide the following:		
	a) describe and map the soil types and their distribution according to the Soil Survey Handbook, Vol. 1 (Agriculture Canada, 1987) and The Canadian System of Soil Classification Third Edition (Agriculture and Agri-Food Canada, 1998) including the following soil survey intensity levels;		Vol IIC: Sec 2.5
	i) SIL (survey intensity level) 1 for the PDA area and any areas that may be subject to future disturbance by the Project such as burrows, rail spurs, access roads etc.;		
	ii) SIL 2 for the Local Study Area; and		
	iii) appropriate level of detail to determine the effect of the Project on soil types and quality in the Regional Study Area.		
	b) characterize the pre-disturbance morphological, physical and chemical properties of the soil types and assess the pre-disturbance soil capability classes;		Vol IIC: Sec 2.5
	c) develop a soil conservation and reclamation plan for the PDA including revegetation and weed management plans. Describe the suitability and availability of soil materials within the Study Areas for reclamation. Outline the criteria to be used in salvaging and storing soils. Describe the procedures for soil handling storage and long-term management of soil intended for reclamation within the PDA. Provide siting criteria for and location of soil stockpiles and describe how they will be managed;		Vol IIC: Sec 2.5, Vol IID: Sec 2 - Appendix I
	d) assess the sensitivity of local and regional soils to acidic deposition by: including baseline information as outlined in Appendix A-7 (Soil Monitoring Guidelines) of AENV's Air Monitoring Directive (1996);		
	i) discuss sensitivity of soils to wet and dry acidic deposition in the local and regional study areas for baseline, application and cumulative cases;		Vol IIC: Sec 2.5, 2.6
	ii) explain the methods used to assess sensitive soils and include information from grid cell sensitivity assessments that may be available for the study area;		Vol IIC: Sec 2.4, 2.5, 2.6
	iii) using modeled PAI for the baseline, application and cumulative cases, describe the soils that would exceed CASA's recommended critical loads in the Local and Regional Study areas, including maps showing their spatial distribution;		Vol IIC: Sec 2.5, 2.6
	iv) outline any existing monitoring information such as AENV's long term soil acidification study and any regional initiatives (NCIA) for acidic deposition.		Vol IIC: Sec 2.5
	e) identify any activities associated with the Project, which may cause soil contamination or soil deterioration at the local and regional scale including acid deposition and discuss mitigation strategies to reduce potential impact; and		Vol IIC: Sec 2.6
	f) discuss the regulatory requirements for soil monitoring or soil management for potential impacts of the Project to soils in the development area and areas that may be potentially affected.		Vol IIC: Sec 2.6

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
4.9.3	**Vegetation**		
	Provide the following:		
	a) conduct an inventory, map and describe the existing terrestrial, wetland and aquatic vegetation. Include any rare vascular and non-vascular plant species and rare plant communities in the Study Areas, including data from historical records as well as any surveys for the purpose of this EIA;		Vol IIC: Sec 3.4, 3.5, 3.6
	b) describe and assess potential impacts of the Project construction and operation on vegetation (abundance, diversity, health, rare species and rare plant communities in the Study Areas) including cumulative impacts of acidifying and other air emissions;		Vol IIC: Sec 3.5, 3.7
	c) describe and discuss measures to be implemented to mitigate and monitor potential impacts of the Project on vegetation in the Study Areas; and		Vol IIC: Sec 3.7
	d) discuss how vegetation monitoring programs will be used to adaptively manage the mitigation measures and monitoring programs.		Vol IIC: Sec 3.7
4.9.4	**Wildlife**		
	Describe existing wildlife resources (amphibians, reptiles, birds and terrestrial and aquatic mammals), their use and potential use of habitats in the Study Areas. Document the anticipated changes to wildlife in the Study Areas. Specifically:		
	a) document and describe species of conservation concern found within the Study Area, using recognized survey protocols;		Vol IIC: Sec 4.5, 4.6
	b) describe and assess potential impacts of the Project on wildlife species found in the Study Areas, including impacts on critical habitat, habitat availability and quality, and habitat fragmentation and loss. These impacts should be described for the various phases of the Project both locally and cumulatively with other activities in the Study Areas;		Vol IIC: Sec 4.6, 4.7, 4.8
	c) proposed strategies to minimize and/or mitigate impacts on the species and their habitats that are found in the Study Areas. These strategies should be tailored to the various phases of the Project and meet the expectations of relevant wildlife legislation;		Vol IIC: Sec 4.7
	d) identify and discuss proposed monitoring programs that will be implemented during various phases of the Project to evaluate the effectiveness of mitigative strategies to reduce impacts to the species and their habitats that are found in the Study Areas. Describe how the results from the monitoring programs will also be used to evaluate the effectiveness of the programs themselves; and		Vol IIC: Sec 4.9
	e) discuss any existing wildlife studies that may be occurring in the Study Areas and how AST plans to integrate its operational and mitigation activities with those studies.		Vol IIC: Sec 4.9
4.9.5	**Biodiversity and Fragmentation**		
	Provide the following:		
	a) discuss how the impacts defined in the EIA report could affect local and regional biodiversity and habitat fragmentation, both Project specific and cumulatively. Use quantitative data where possible to describe the potential effects on biodiversity and habitat;		Vol IIC: Sec 5.5, 5.6, 5.7
	b) discuss the contribution of the Project to any anticipated changes in regional biodiversity, including measures to minimize such changes;		Vol IIC: Sec 5.5, 5.6, 5.8
	c) discuss how AST's plans for mitigation and monitoring will meet the expectations of Sustaining Alberta's Biodiversity An Overview of Government of Alberta Initiatives Supporting the Canadian Biodiversity Strategy (Alberta Environmental Protection 1998);		Vol IIC: Sec 5.5, 5.6, 5.8
	d) determine the current and proposed level of habitat fragmentation for the Study Areas;		Vol IIC: Sec 5.4, 5.5
	e) describe the techniques used in the fragmentation analysis;		Vol IIC: Sec 5.3

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
	f) identify and evaluate the extent of potential effects from fragmentation (e.g., disruption of movement corridors) that may result from the Project; and		Vol IIC: Sec 5.5, 5.6
	g) discuss measures to mitigate, monitor and reclaim impacts from fragmentation.		Vol IIC: Sec 5.5, 5.6, 5.8 Vol IID: Sec 2 – Appendix I
4.10	**Surface Water and Groundwater**		
4.10.1	**Surface Water Hydrology and Quality**		
	Discuss baseline surface hydrology conditions. Identify components of the Project that will affect these conditions from a local and regional perspective. Discuss:		
	a) existing drainage patterns, surface water bodies, and wetlands within local and regional Study Areas, and the seasonal flow/water level characteristics of these water bodies;		Vol IIB: Sec 3.5
	b) Project-related temporary and permanent alterations to these drainage patterns, water bodies and wetlands;		Vol IIB: Sec 3.6
	c) possible water diversions from and return flows to these drainage channels, water bodies and wetlands under a variety of operating conditions and scenarios including, emergency conditions, low flow, or drought conditions;		Vol IIB: Sec 3.6
	d) effects of site runoff management on flow/level characteristics and aquatic functions in these drainage channels, water bodies and wetlands;		Vol IIB: Sec 3.6
	e) mitigation plans to minimize these effects;		Vol IIB: Sec 3.6
	f) the relative contribution by the Project (after mitigation) to regional cumulative pressures on surface water resources;		Vol IIB: Sec 3.6
	g) a monitoring program to assess hydrological impacts and assess performance of mitigation plans and water management systems;		Vol IIB: Sec 3.7
	h) baseline surface water quality;		Vol IIB: Sec 4.5
	i) water quality of watercourses and water bodies in the Study Areas before and after Project development and operation. The description of water quality will consider all appropriate water quality parameters, (e.g., temperature, pH, conductivity, cations and anions, metals, dissolved oxygen, suspended sediment, dissolved solids, nutrients and other water contaminants) their seasonal variations and relationships to flow and other controlling factors, and a summary of existing water quality data including necessary surveys to characterize water quality of watercourses and water bodies in the Study Areas;		Vol IIB: Sec 4.5, 4.6
	j) the significant and potential impacts to surface water quality within the Study Areas resulting from the Project, including site runoff and Project-related wastewater discharges, that may indicate a potential adverse effect or exceedance of the Surface Water Quality Guidelines for Use in Alberta (November 1999) or Canadian Water Quality Guidelines;		Vol IIB: Sec 4.6
	k) the potential Project related and cumulative impacts of acidifying and other air emissions on surface water quality;		Vol IIB: Sec 4.6
	l) effects of site runoff on water quality in surface waterbodies within the Study Area;		Vol IIB: Sec 4.6
	m) the impacts to surface water quality within the Study Areas due to the change in groundwater movement, spills and contaminated groundwater resulting from spills;		Vol IIB: Sec 4.6
	n) mitigation plans to minimize these effects during the construction, operation and reclamation phases of the Project;		Vol IIB: Sec 4.6

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
	o) a plan and implementation program for the protection of surface water quality, addressing the following:		
	i) surface water monitoring program for early detection of potential contamination and assistance in remediation planning;		Vol IIB: Sec 4.7
	ii) surface water remediation options to be considered for implementation in the event that adverse effects are detected; and		Vol IIB: Sec 4.6
	iii) the relative contribution of the Project (after mitigation) to regional cumulative effects on surface water quality of watercourses and water bodies in the Study Areas (e.g., Project contributions to lake acidification).		Vol IIB: Sec 4.6
4.10.2	**Groundwater Quantity and Quality**		
	Discuss baseline groundwater conditions and identify components (e.g., dewatering, well supply) of the Project that will affect groundwater from a local and regional perspective. Provide the following:		
	a) a discussion of the characteristics of major geological units and their function as potential aquifers, aquitards, and aquicludes in the Study Area;		Vol IIB: Sec 2.5
	b) lithologic and stratigraphic continuity of the geologic units in the Study Area;		Vol IIB: Sec 2.5
	c) hydrogeologic information including hydraulic properties, hydraulic heads, flow direction, velocity and connectivity with surface water bodies of the geologic units;		Vol IIB: Sec 2.5
	d) baseline groundwater quantity and quality information of the hydrogeologic units in the Study Area;		Vol IIB: Sec 2.5
	e) maps and cross-sections that include the water table and piezometric surfaces based on identifiable hydrogeologic units and accurate data sources, such as drill holes;		Vol IIB: Sec 2.5
	f) results of any new hydrogeological investigations, including methodology;		Vol IIB: Sec 2.4, 2.5
	g) an inventory of groundwater users in the Study Area. Identify potential groundwater use conflicts and possible means to resolve these conflicts;		Vol IIB: Sec 2.5, 2.6, Sec 2 – Appendix V
	h) an assessment of potential effects of water withdrawal on groundwater levels, effects on local and regional groundwater regimes, including vertical gradients and discharge areas;		Vol IIB: Sec 2.6
	i) an assessment of the effects of groundwater withdrawal/dewatering and its implications for other environmental resources, including flows and water levels in local streams, water wells, wetlands, vegetation and soil saturation;		Vol IIB: Sec 2.6
	j) an assessment of potential effects of Project-related activities and surface releases (e.g., accidental contaminant spills) and down-hole wastewater on groundwater quality;		Vol IIB: Sec 2.7
	k) justification for the selection of hydrogeologic models used, including identifying any model shortcomings or constraints on findings, and any surrogate parameters that were used as indicators of potential aquifer contamination due to the Project;		Vol IIB: Sec 2.6
	l) a plan and implementation program for the protection of groundwater resources, addressing the following:		
	i) groundwater monitoring program for early detection of potential contamination and assistance in remediation planning;		Vol IIB: Sec 2.10
	ii) groundwater remediation options to be considered for implementation in the event that adverse effects are detected; and		Vol IIB: Sec 2.10
	iii) monitoring the sustainability of groundwater production and dewatering effects.		Vol IIB: Sec 2.10

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
4.11	**Aquatic Resources**		
	Identify components of the Project that will affect baseline conditions from a local and regional perspective. Discuss:		
	a) baseline aquatic resource conditions, including fish and benthic invertebrate habitat capability and their characteristics in water bodies within the Study Area. Conduct the necessary surveys to characterize the aquatic resources in the PDA and any potential changes that could occur in this component of the aquatic ecosystem in the Study Area(s) as a result of the Project;		Vol IIB: Sec 5.4
	b) components of the Project that will potentially affect aquatic resources within the Study Area, potential impacts of these components and their significance;		Vol IIB: Sec 5.5
	c) cumulative effects of the impacts that already exist and potential Project-related impacts on the aquatic resources in relevant water bodies;		Vol IIB: Sec 5.6
	d) mitigation plans to minimize these effects;		Vol IIB: Sec 5.5, 5.8
	e) an assessment of the relative contribution of the Project (after mitigation) to regional cumulative effects on aquatic resources (e.g., Project contributions to lake acidification);		Vol IIB Sec 5.6
	f) the potential for contamination of fish by wastewater discharges relative to fish consumption guidelines; and		Vol IIB: Sec 5.4, 5.5
	g) programs to monitor aquatic habitat quality and the effectiveness of mitigation strategies.		Vol IIB: Sec 5.7, 5.8
5.	**ENVIRONMENTAL EFFECTS MONITORING**		
	Describe environmental effects monitoring (EEM) activities that AST will undertake to manage effects, and confirm the performance of mitigative measures. Specifically addressing:	Sec 5	
	a) monitoring activities and initiatives that AST is proposing to conduct independently of other stakeholder activities in the region;		Vol IIA: Sec 2.6, 3.11, 4.9 Vol IIB: Sec 2.10, 3.7, 4.7, 5.7 Vol IIC: 2.6, 3.7, 4.9, 5.8 Vol IID: Sec 2 - Appendix I
	b) monitoring activities that AST is proposing to conduct collaboratively with other stakeholders. Include in this discussion the role that AST anticipates taking in each of the programs. With respect to groundwater monitoring, discuss AST's participation in the Regional Groundwater Quality Study of the Beverly Channel in the Fort Saskatchewan area managed by the Northeast Capital Industrial Association (NCIA);	Sec 3.10	
	c) mechanisms for sharing results, reviewing findings, and adjusting programs should monitoring identify unanticipated consequences of AST's operations or mitigation plans, including:	Sec 3.10	
	i) corporate adaptive management strategies; and	Sec 3.9	
	ii) consultation with regulators, public stakeholders, and, if necessary, regional management forums.	Sec 1.1	
6.	**PUBLIC HEALTH AND SAFTEY**		
	Describe those aspects of the Project that may have implications for public health or the delivery of health care services. Determine whether there may be implications for public health arising from the Project. Specifically:		
	a) identify and discuss the data and methods used by AST to assess the impacts of the Project on human health and safety;		Vol IIA: Sec 4.3

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
	b) assess the potential health implications of the compounds that will be released to the environment from the proposed operation in relation to exposure limits established to prevent acute and chronic adverse effects on human health;		Vol IIA: Sec 4.3, 4.4, 4.5, 4.6, 4.8, Sec 4 - Appendix I
	c) identify the human health impact of potential contamination of country foods and natural food sources taking into consideration all Project activities;		Vol IIA: Sec 4.4
	d) provide information on samples of selected species of vegetation known to be consumed by humans;		Vol IIA: Sec 4.4
	e) discuss the potential to increase human exposure to contaminants from changes to water quality, air quality and soil quality taking into consideration all Project activities;		Vol IIA: Sec 4.4
	f) document health concerns identified by Aboriginal stakeholders;		Vol IID: Sec 2.1
	g) assess cumulative health effects to receptors, that are likely to result from the Project in combination with other existing, approved, and planned projects;		Vol IIA: Sec 4.8, 4.10
	h) as appropriate, identify anticipated follow-up work, including regional cooperative studies. Identify how such work will be implemented and coordinated with ongoing air, soil and water quality initiatives;		Vol IIA: Sec 4.9
	i) identify and discuss potential health and safety impacts due to higher regional traffic volumes and the increased risk of accidental leaks and spills;	Sec 3.4	
	j) document health and safety concerns raised by stakeholders during the consultation on the Project;		Vol IID: Sec 5.7
	k) provide a summary of AST's emergency response plan and discuss mitigation plans that will be implemented to ensure workforce and public safety during pre-construction, construction, operation and reclamation of the Project. Include prevention and safety measures for wildfire occurrences, accidental release or spill of chemicals to the environment and failures of structures retaining water or fluid wastes;	Appendix V	
	l) describe how local residents will be contacted during an emergency and what type of information will be communicated to them;	Appendix V	
	m) describe existing agreements with area municipalities or industry groups such as, safety co-operatives, emergency response associations and municipal emergency response agencies; and	Sec 3.10	Vol IID: Sec 2.7
	n) describe and discuss the impacts of the proposed Project on potential shortages of affordable housing and the quality of health care services. Identify and discuss the mitigation plans that will be undertaken to address these issues. Provide a summary of any discussions that have taken place with the Municipality and the Regional Health Authority concerning potential housing shortages and health care services respectively.		Vol IID: Sec 4.6, 5.5
7.	**HISTORICAL RESOURCES**		
	Provide the following:		
	a) evidence of consultation with and clearance from Alberta Community Development; and		Vol IID: Sec 3.7
	b) a general overview of the results of any previous historical resource studies that have been conducted in the historical resources Study Area, including archaeological resources, palaeontological resources, historic period sites, and any other historical resources as defined within the *Historical Resources Act*.		Vol IID: Sec 3.4, 3.5, 3.6
8.	**SOCIO-ECONOMIC FACTORS**		
	Provide information on the economic effects of the Project. Specifically, provide and address the following:		
	a) the number and distribution of people who may be affected by the Project;		Vol IID: Sec 4.2, 4.3

Table 2.6-3: Concordance Table (Cont'd)

TOR Section	Environmental Assessment or Topic	Volume I	Volume II
	b) information on the economic status of the area and the contribution of the proposed development		Vol IID: Sec 4.3. 4.4.
	c) information on the social impacts of the Project on the Study Area and on Alberta including:		
	i) local employment and training;		Vol IID: Sec 4.3, 4.4
	ii) local procurement;		Vol IID: Sec 4.4
	iii) population changes;		Vol IID: Sec 4.3, 4.4
	iv) demands on local services and infrastructure; and		Vol IID: Sec 4.4
	v) regional and provincial economic benefits;		Vol IID: Sec 4.4
	d) identify components of the Project that may be considered a nuisance and negatively impact to individuals identified in a) and AST's plans to mitigate these nuisances;		Vol IID: Sec 5.7
	e) the impacts of the Project during construction and operation phases, to transportation planning, traffic and local services;	Appendix III	Vol IID: Sec 4.4
	f) the economic impacts of the Project on the Study Area and on Alberta, having regard for capital, labor, and other operating costs and revenue from services;		Vol IID: Sec 4.4
	g) AST's policies and programs respecting the use of local, Alberta, and Canadian goods and services;		Vol IID: Sec 4.4
	h) an estimated breakdown of Alberta, other Canadian and non-Canadian industrial benefits for Project management/engineering; equipment and materials; construction labor, and total overall Project;		Vol IID: Sec 4.4
	i) the employment and business development opportunities the Project may create for local communities and the region;		Vol IID: Sec 4.4
	j) any existing employment and business opportunities that may be *negatively* affected as a result of the Project;		Vol IID: Sec 4.4
	k) a breakdown of the labor force, type of employment, and number of employees with respect for the construction and operational workforces. Identify when the peaks in labor requirements will occur, the extent of the peaks and the source of labor for the Project; and		Vol IID: Sec 4.4
	l) impacts of the proposed Project on potential shortages of affordable housing and the quality of health care services. Identify and discuss the mitigation plans to address these issues. Provide a summary of any discussions that have taken place with the Municipality and the Regional Health Authority concerning potential housing shortages and health care services respectively.		Vol IID: Sec 4.4, 5.7
9.	**PUBLIC CONSULTATION REQUIRMENTS**		
	AST shall undertake a consultation program during the preparation of the EIA report and within all of the communities, in the Study Area.		Vol IID: Sec 5.4, 5.5, 5.6
	Describe and document in detail the public consultation program implemented with respect to the Project, record any concerns or suggestions made by the public, and demonstrate how these concerns have been addressed, including:		Vol IID: Sec 5.4, 5.5
	a) the type of information provided and the issues discussed, differentiating between those which have been resolved and any outstanding issues;		Vol IID: Sec 5.4, 5.5, 5.6
	b) the key alternatives which have been identified by AST and stakeholders in the consideration of unresolved issues; and,		Vol IID: Sec 5.7
	c) any plans for ongoing consultations.		Vol IID: Sec 5.6

3. Project Description and Management Plans

Describe activities and components of the Project and relevant management plans. Provide sufficient scope and detail in the project description information to allow quantitative assessment of the environmental consequences. If the scope of information varies among components or phases of the Project, provide rationale demonstrating that the information is sufficient for assessment purposes.

Technical information required in this section may also be required for an EPEA and WA approval application. Information required in this section may be provided in other parts of AST's submission(s) provided that the location of the information is referenced in the EIA report. AST should ensure consistency in the information provided, whenever it is discussed in more than one section of the submission.

3.1 Project Components and Site Selection

3.1.1 Project Components

Describe the nature, size, location and duration of the significant components of the Project including, but not limited to, the following:

a) the plant site and any chemical/fluids storage locations;

b) design capacities of the Project and the potential changes in design capacities;

c) temporary structures, dewatering, water control facilities, and processing/treatment facilities;

d) buildings and infrastructure, transportation, utilities, access routes, and storage areas;

e) the location of groundwater supply well(s);

f) the types and amounts of waste materials, and locations of waste storage, and disposal sites;

g) a site development plan to illustrate the locations of components including an outline of the proposed phasing and sequencing of components (include pre-construction, construction, operation, reclamation, decommissioning, and end land use);

h) how AST has used community input for project design and development; and

i) potential cooperative ventures to minimize environmental impacts.

The primary components of the sulphur forming and shipping facility are:

- infrastructure for the reception of liquid sulphur and shipment of formed sulphur
- storage facilities for liquid and formed sulphur
- sulphur forming facilities
- sulphur transfer and loading infrastructure

An illustration of the overall Site development is presented in Figure 2.5-1. Table 3.3-1 summarizes the initial and ultimate capacities of the proposed Project.

Table 3.1-1: Principle Design Capacities

Component	Initial Capacity	Ultimate Capacity
Liquid storage	9,000 t	18,000 t
Sulphur forming	3,000 t/d	6,000 t/d
Pastilles stockpile	45,000 t	90,000 t
Water consumption	22.8 L/min	45.6 L/min
Principle development area	20.09 ha	24.8 ha

The facilities associated with the Project are described in the underlying text. Each component of the Project will be constructed and operated as part of initial development. The ultimate development will be constructed in response to market conditions and will consist of the approximate doubling of initial capacity.

The community has been involved in the evaluation and permitting process of this facility through the Public Consultation program that is described in Section 1.3 of this Volume and in Volume IID, Section 5: Public Consultation. This group has had meaningful input into the design and scope of the proposed Project. For example, the temporary sulphur block component was removed in response to public and stakeholder concern regarding its presence.

AST participates in the Northeast Capital Industrial Association (NCIA) cooperative ventures and initiatives (see Section 3.10) and is committed to continuing its public consultation effort, throughout the operations phase of the Project, to ensure that the public concerns and priorities are understood, and factored into operational decisions.

3.1.2 Site Selection

Discuss the site selection process including, but not limited to, the following:

a) factors that were considered in determining the preferred plant site and associated processing facilities;

b) the site selection process for the proposed location of the Project components;

c) the rationale for choosing the proposed sites instead of alternative sites;

d) the technical, economical, and environmental criteria considered;

e) potential impacts on environmental and land use conditions; and

f) suitable maps showing the location of proposed facilities.

The proposed sulphur forming and shipping facility is located in a portion of Section 35-55-20 W4M (the Site). The preferred Site was selected based on the following economic, environmental and Project criteria:

- it is located within the Alberta Industrial Heartland, in close proximity to existing and proposed oil refining and bitumen upgrading facilities that will generate increasing volumes of sulphur as part of Alberta's planned oil sands production operations. To date, none of these facilities have included the capabilities to form and ship sulphur suitable for export.
- it is located along the major transportation corridor connecting the oil sands regions of eastern Alberta, to the municipal and industrial complex of central Alberta. Significant quantities of sulphur are generated in the source areas of eastern Alberta that do not presently have sulphur forming capabilities.

- both Canadian Pacific (CPR) and Canadian National (CN) rail lines run through the Site, providing efficient delivery of liquid sulphur and shipment of formed sulphur, while minimizing disturbance that would otherwise be required to establish rail access to the Site
- the Site is zoned for Heavy Industrial Use within Lamont County and the Alberta Industrial Heartland
- the Site possesses natural containment and alkaline buffering capacity which will effectively reduce the potential for environmental impacts associated with sulphur forming and shipping activities
- the Site was commercially available at the time that the sulphur forming and shipping facility project was conceived by AST. Purchase and potential subsequent development of the Site do not involve the relocation of any permanent residents. In the interim, the Site continues to be used for agricultural purposes.

The Site location, in aerial photograph format, is illustrated on Figure 3.2-1.

Volume IIB, Section 2: Groundwater Quantity and Quality and Volume IIC, Section 2: Soil describe the characteristics of the Site, and their relevant properties with respect to sulphur handling.

3.2 Process Description

Provide material balances, energy balances, flow diagrams, and descriptions of the processes including:

a) energy efficiency and process efficiency of the technologies chosen;

b) alternate technologies considered;

c) shared facilities and utilities associated with the Project;

d) chemicals needed for sulphur forming and storage processes included in the Project;

e) Project inputs such as energy and water, and outputs such as emissions and wastes;

f) effect of technology on waste generation and storage requirements, air and water discharges, water requirements, waste streams, and effects to reclamation programs; and

g) sources of major feed materials for the sulphur forming process.

3.2.1 General

For the purpose of this Project, AST has chosen to utilize a third generation drop forming sulphur solidification technology from Sandvik Process Systems named Rotoform 'HS'®. Each unit has a minimum guaranteed capacity of 12.0 t/h. Up to 22 units will be implemented at full scale operation, providing a sulphur forming capacity of approximately 6,000 t/d. However, initial construction will include only half of these units, providing an initial forming capacity of approximately 3,000 t/d.

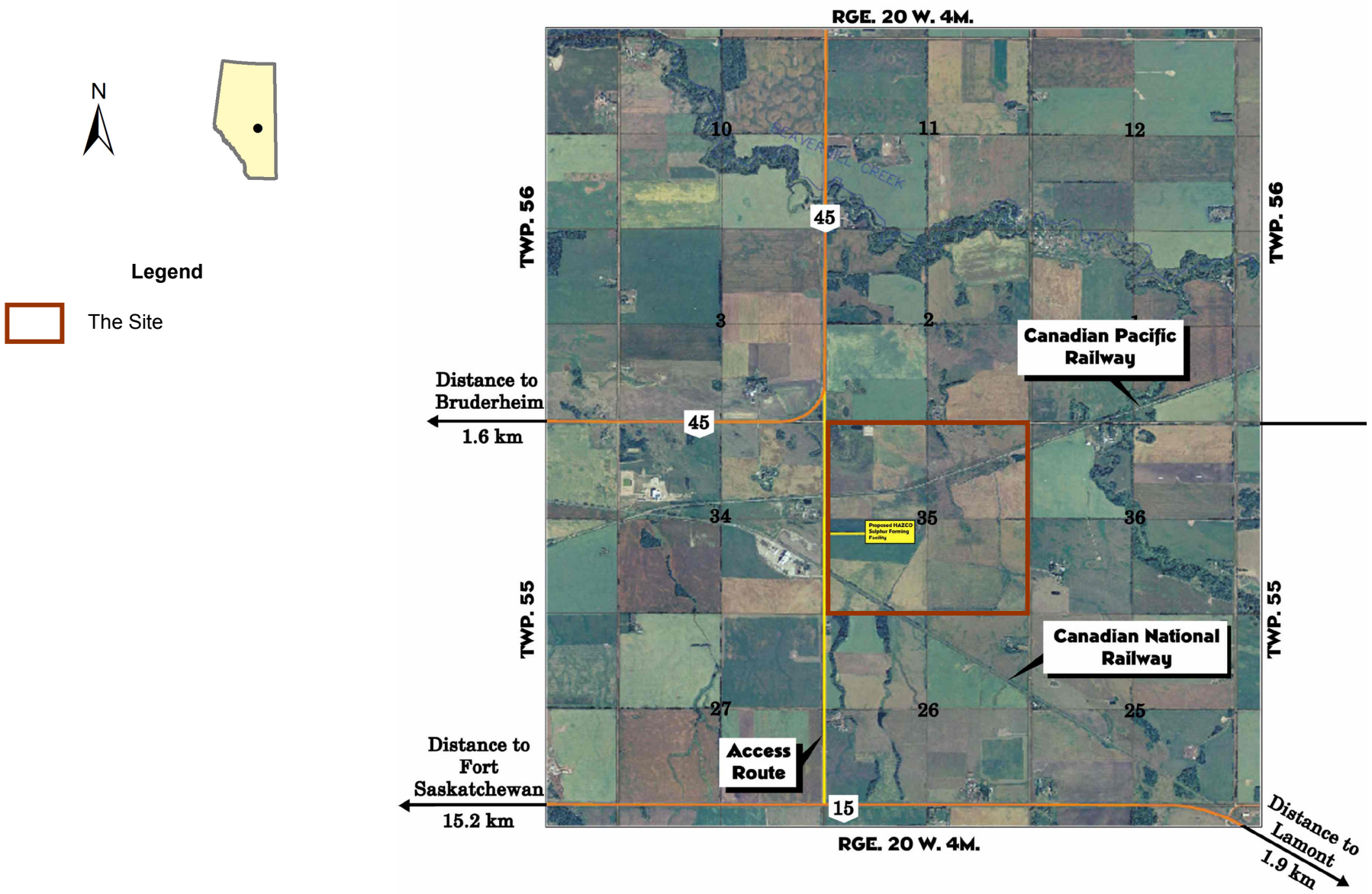


Figure 3.2-1: Aerial Photograph Depicting Site Location

The equipment is modular in design and flexible in that any number of machines can be used at any given time. The process is exceptionally clean without any sulphur contact with water, steam, or air surges during the forming process. The elimination of direct contact with water, steam or air currents effectively minimizes major environmental concerns, namely dust emissions as well as water contamination through sulphur acidification. The process does not require specialized personal protective equipment including artificial breathing air or confined space entry. A detailed process flow diagram is provided in Figure 3.2-2. Principle Project components are described in the following subsections.

The process consumes water and energy efficiently as the modular design operates the appropriate number of forming units relative to the volume of sulphur being formed. Further, the Rotoform HS® Drop forming equipment represents the best available technology from the perspective of operating efficiency and environmental protection.

AST considered the Enersul GX forming technology which would also be considered a state-of-the-art process which is protective of the environment. AST selected the Rotoformer HS process because of its operational track record and because of its excellent emissions performance.

Utilities and infrastructure that will be utilized as part of the Project include:

- existing onsite CN and CPR rail lines for transporting liquid sulphur to the Site and formed sulphur away from the Site
- existing Highways 45 and 15, as well as R.R. 202
- electrical supply obtained from the regional grid and local supplier
- natural gas supply obtained from the regional network and local supplier

The only chemicals that will be added to the process are those used for dust suppression (see Section 3.6) as well as lime that may be used, if and as required, for acid water neutralization. All chemicals will be stored in accordance with provincial standards for containment of potentially hazardous materials which will include double containment and leak detection.

Water use for non-contact cooling is described in Section 3.5. The estimated maximum rate of electricity consumption will be 700 MWH/mon (power flux per month). The maximum natural gas consumption will be approximately 20,000 gigajoules per month for the full development. Emissions from the forming system will include air emissions from the Rotoform HS® Drop forming equipment, described in Section 3.6, and excess stormwater runoff described in Section 3.5.2. Emissions will also occur from the natural gas fired boilers and mobile equipment. There will be no significant waste streams generated by the process; however, over the operating lifespan of the Project, minor volumes of off-specification sulphur and water neutralization precipitates (primarily gypsum) are expected to be generated from time to time. These materials will be disposed off site at approved facilities in accordance with Section 3.7.

Sources of sulphur for the proposed Project are described in Section 2.2 and are primarily associated with new heavy oil upgrading operations.

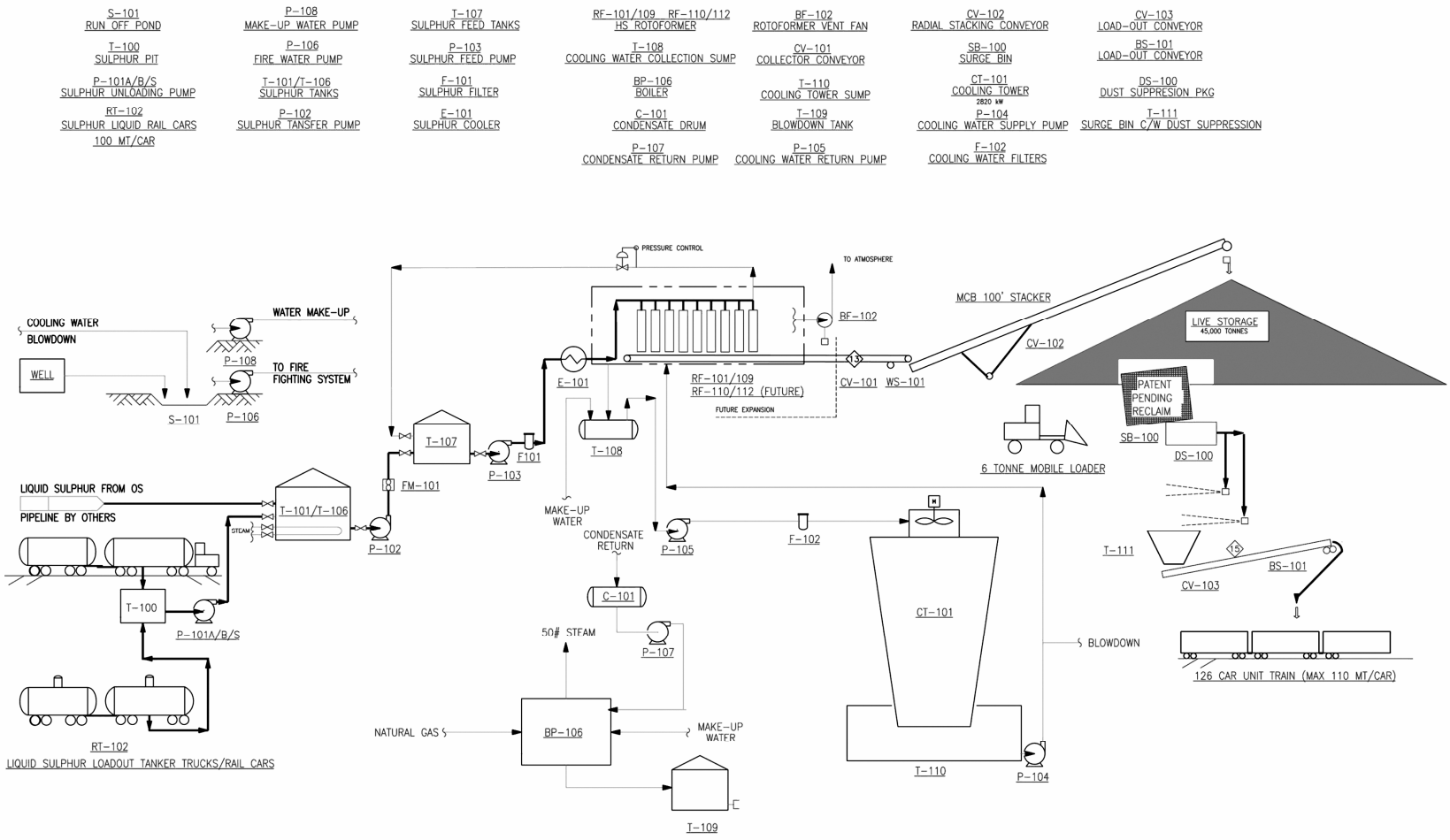


Figure 3.2-2: Process Flow Diagram

3.2.2 Sulphur Reception and Preparation

Liquid sulphur will be received at the facility by either rail car or truck. Future delivery may possibly occur by pipeline. Only sulphur that has been degassed to a maximum of 10 ppm H_2S will be accepted. Upon arrival, the pipeline or tankers will unload via a pumping station into insulated and heated tanks ($T\text{-}10^1$ – $T\text{-}10^6$), each having a holding capacity of 3,000 t of liquid sulphur. All liquid sulphur storage tanks will be vented to atmosphere following treatment to reduce entrained H_2S, should it be present in the tank vapours.

3.2.3 Sulphur Forming

The forming process will first involve pumping sulphur from receiving tanks to a feed tank. It is next pumped through a duplex filter and conditioning unit in order to cool to an optimal forming temperature of 125°C. The sulphur will then enter a recirculation loop fed by the Rotoform HS® drop forming equipment. The feed to the Rotoformer will use metering equipment and nozzles specifically designed to provide a continuous sulphur feed across a rotating stainless steel belt. The belt will be cooled by cold water jets sprayed against the under side of the rotating belt, causing the pastilles to cool and solidify above.

The solid pastilles will gather into a collection hopper and be conveyed to a radial stacking conveyor, as described in Section 2.3.4. The EIA is based on a forming capacity of 6,000 t/d, with approximately half of this capacity being associated with initial construction.

The water utilized by the Rotoform HS® will be sent through a closed loop cooling tower to provide filtration and temperature reduction. Make-up water for the cooling tower will be supplied from the runoff collection pond which will be designed to collect surface water from the Site and provide fire protection water. Additional make-up water will be provided by a groundwater supply well. Figure 3.2-3 is a schematic illustration of the Rotoform process.

3.2.4 Sulphur Transfer and Shipping

The solid pastilles will fall onto a collection conveyor (CV101), be transferred outside to a radial stacking conveyor (CV102) and onto an asphalt bulk sulphur storage pad. At full capacity, the facility is designed to store up to 90,000 t of formed pastilles; 45,000 t of storage capacity will be established as part of initial construction. Sulphur pad design details are provided in Figure 3.2-4.

Initially, a front end loader will transfer stockpiled sulphur to a surge bin equipped with a dust suppression package. The dust treated product will be deposited on a loadout conveyor (CV103) equipped with weight measurements and totalizer, and onto rail or trucks for shipment. An automated loading system may be introduced as part of future expansion to transfer formed sulphur into vertical holding bins used to directly load rail cars.

3.2.5 Product Storage

Liquid sulphur storage will occur at two locations within the Site and process, as follows:

- initial sulphur load-out and transfer tank
- liquid sulphur storage tanks

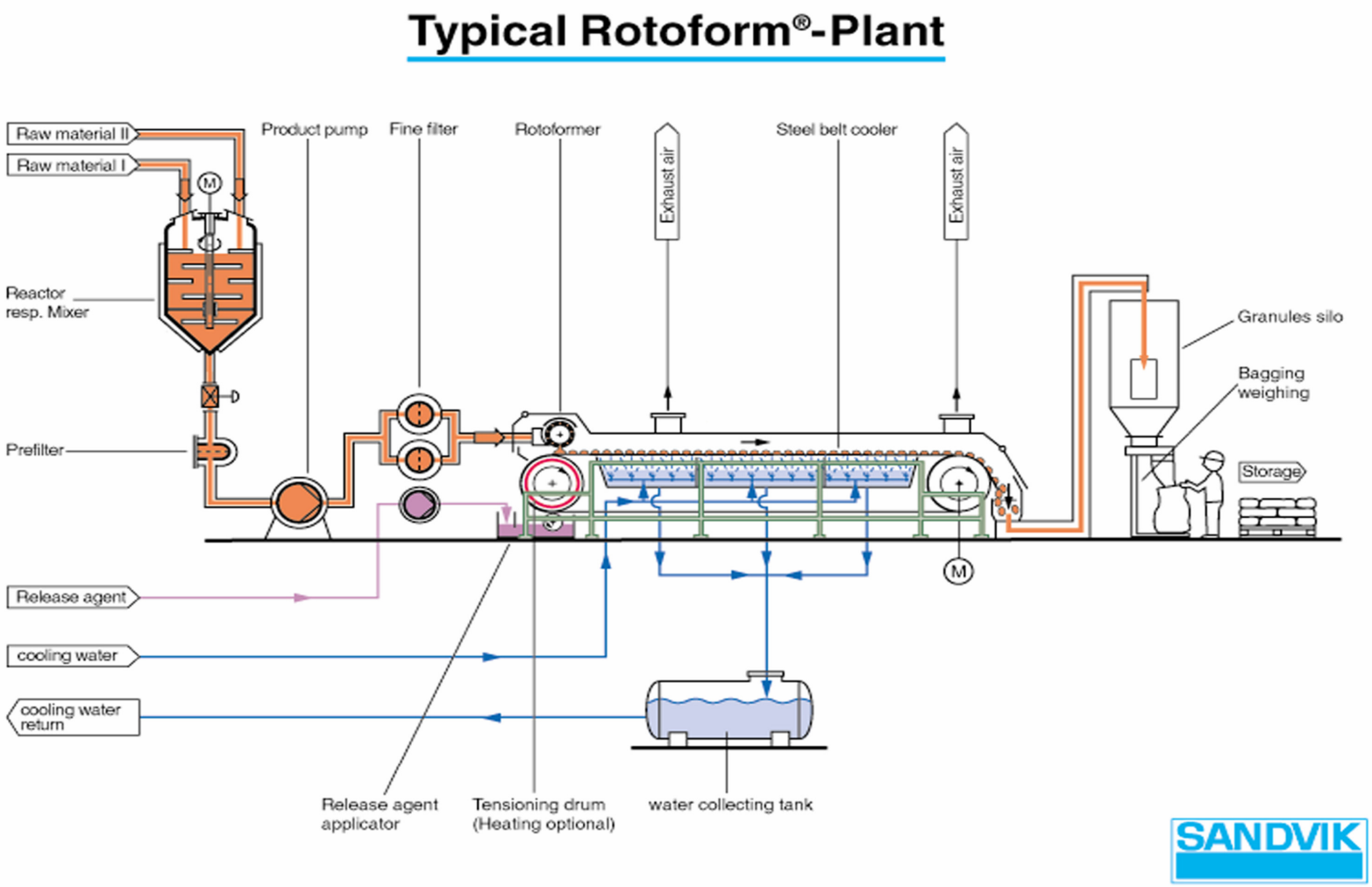


Figure 3.2-3: Schematic Illustration of the Sandvik Rotoform Process

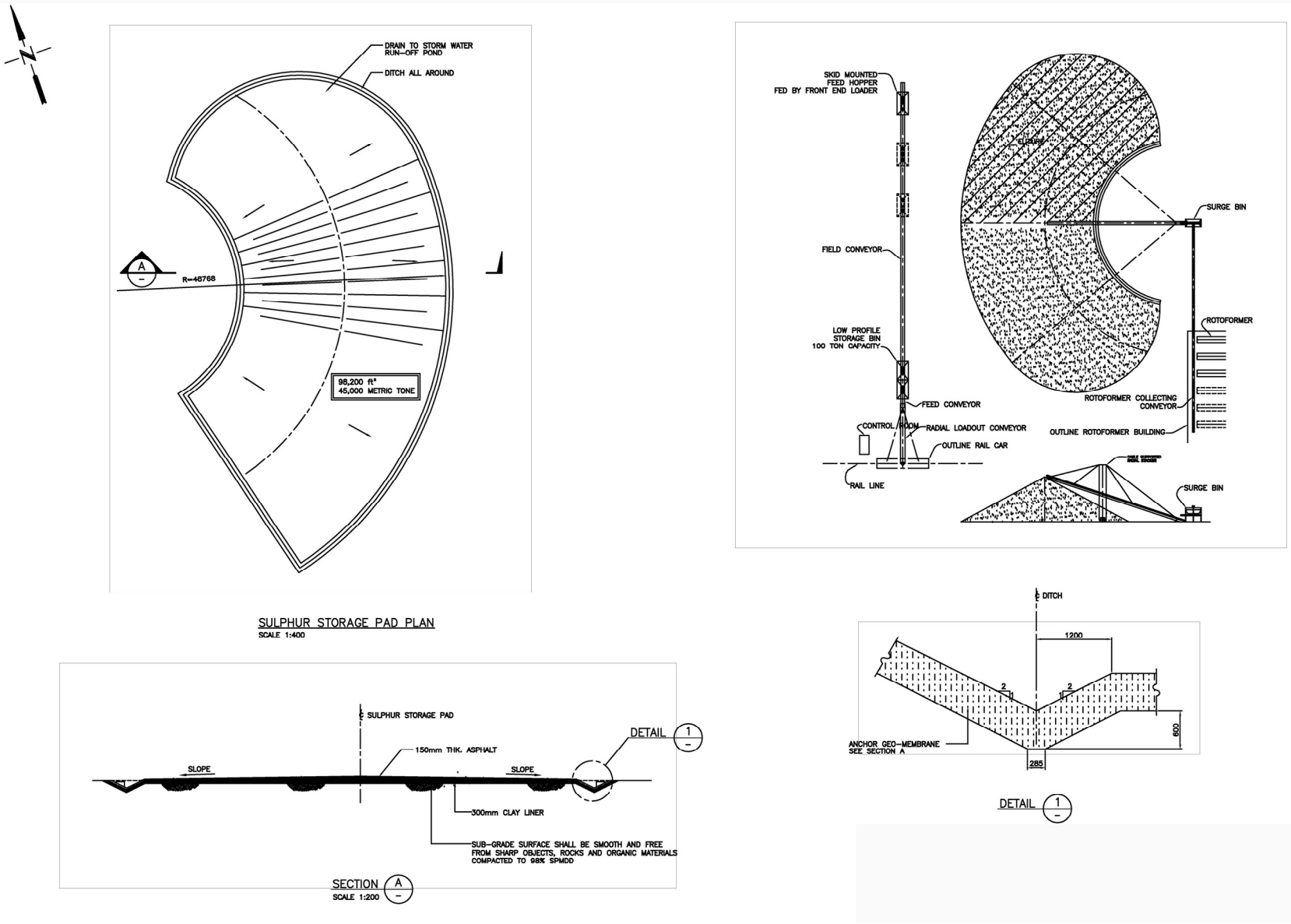


Figure 3.2-4: Sulphur Pad Design Details

The initial sulphur load-out and transfer tank will consist of an in-ground concrete tank surrounded by a permeable leak detection system and a secondary compacted clay soil liner. The tank will be fitted with steam-coils to maintain the sulphur in its liquid state, and will be vented to atmosphere through an H_2S removal system. The concrete walls of the tank provide primary containment, and the secondary clay soil liner will provide secondary containment. Because any liquid sulphur that may potentially permeate the concrete will quickly solidify, the primary containment system is self-annealing. The vent stack will be situated above the breathing zone to protect workers from any potential H_2S vapours that may accumulate in the tank.

Liquid sulphur will be transferred into one of six, 3,000 t heated, insulated and vented tanks used to store liquid inlet sulphur. These tanks will include leak detection and will be vented to the atmosphere following treatment to remove residual H_2S. Initial development will include only three of these tanks. The sulphur pastille storage area has the following environmental protection measures incorporated into its design: run-on and runoff controls; 150 mm thick asphalt surface for primary containment and working; 300 mm clay secondary containment liner; and, prepared sub-grade.

3.3 Product Handling

Identify the location and amount of all on site storage associated with sulphur forming including storage of chemicals, products, by-products, intermediates and wastes (additional detail can be found in Section 3.7). Explain containment and environmental protection measures to be used.

Sulphur handling procedures are described in Section 3.2. Additional products that will require storage include dust suppression agents, as described in Section 3.6, and lime, which may be required to neutralize acidic surface water runoff. Volumes of these compounds will be small relative to the volume of liquid and formed sulphur that may be stored on site. Up to 50 t of each product could be stored on site at any given point in time. Products will be stored in containers provided by the respective suppliers and all storage areas will comply with AENV requirements for storage of potentially hazardous materials. Handling of these materials will also be in accordance with manufacturers' recommendations and any requirements of the applicable Material Safety Data Sheets (MSDS).

3.4 Utilities and Transportation

Describe and discuss the Project energy requirements, and associated infrastructure and other infrastructure requirements including, but not limited to, the following:

a) the amount and source of energy required for the Project;

b) the options considered for supplying the thermal energy and electrical power required for the Project and their environmental implications;

c) worker accommodations and travel routes to the plant site during construction and operation phases, including:

  i) desired traffic routing;

  ii) control methods; and

  iii) road use agreements.

d) any expected changes and impacts in traffic volume by Average Annual Daily Traffic (AADT) and any seasonal variability in traffic volume, from the Project;

e) the result of consultation with the local transportation authorities including transportation studies that are underway or planned;

f) cumulative impacts on the transportation network including information regarding the upgrading requirement for Highway 15 and effect on Highway 45 and Range Road 202 due to the increase of traffic as a result of the Project;

g) the adequacy in design and upgrades required of all utility lines, roads, railways and pipeline crossings of roads, rivers and streams with respect to the construction;

h) design features to prevent spills, contingencies for spill response and environmental risks associated with spills; and

i) plans to minimize and mitigate the impacts of the Project's energy and infrastructure requirements and associated infrastructure on area residents.

The anticipated maximum electrical consumption for the Project is 298.3 kW. Approximately half of this power is associated with sulphur forming process, and the remaining half is associated with the support facilities and sulphur handling infrastructure. The electrical power will be provided by the general electrical supply grid, which is appropriate given the relatively small size of the proposed Project. No other electrical supply options have been considered.

The number of workers anticipated for the construction and operational phases is low relative to most of the large industrial expansion projects planned or being implemented in the region. Workers for both phases of the Project are expected to come from the residential areas of the Industrial Heartland counties. The primary roadways to and from the Site are Highways 15 and 45, with local access from R.R. 202. The anticipated level of road use associated with the construction phase is insignificant relative to the capacities of these routes. Traffic volumes associated with the operating phase of the Project could increase by approximately 75 trucks per day, assuming that half of the sulphur is delivered to the Site by truck. An evaluation of impacts associated with this level of traffic is provided as Appendix III.

All public and private infrastructure associated with the Project is adequate to serve its needs without interfering with other users. Upgrade of the intersection of Highway 15 and R.R. 202 has been recommended (see Appendix III: Traffic Impact Assessment) and will be implemented as part of Project construction.

All sulphur handling and forming facilities will be within the contained area described in Section 3.5.2. Hence, any liquid sulphur that may be spilled will not be released to the environment. Further, sulphur solidifies almost immediately when released to the ground under ambient conditions. The response involves simply collecting and disposing of the solidified sulphur, which is yellow and clearly visible.

Plans and modifications to reduce potential impacts to area residents include:

- elimination of the temporary, above-ground storage block
- scheduling sulphur deliveries and shipments to avoid peak or sensitive road use times, such as when children are going to and returning from school
- limiting Site activities to sulphur forming and shipping, which are relatively innocuous activities
- implementing and maintaining a public consultation program to incorporate the concerns of residents and stakeholders in decision making

3.5 Water Supply, Water Management and Wastewater Management

3.5.1 Water Supply

Describe the Project's water supply requirements including, but not limited to, the following:

a) the overall water balance(s);

b) the water requirements for construction, start-up, normal conditions, peak demand conditions, emergency operating situations, decommissioning and reclamation;

c) the variability in the amount of water required on an annual and seasonal basis as the Project is implemented;

d) the supply options including on site storage,

e) the location of existing sources/intakes and associated infrastructure (pipelines); and

f) potential modifications to the Project.

Water usage will be approximately 22.8 L/min during initial operation, and will increase to approximately 45.6 L/min during full scale operation. This water will either evaporate during the cooling process or be recycled. Water for sulphur cooling will be obtained from two sources; the surface runoff collection pond and a groundwater supply well. Water collected in the surface runoff collection pond will be used as a first choice. Groundwater will be utilized whenever there is insufficient surface water available to operate the cooling system. The groundwater quality and quantity component of the EIA includes assessment of the groundwater supply and verifies that groundwater yield is marginal. A long-term pump test will be completed in the spring of 2007 to quantify the adequacy of the water supply. Back-up water supplies are available if groundwater production is not adequate. Monitoring the aquifer being used to supply groundwater to the Project is proposed on a twice yearly basis to verify these conclusions.

Therefore, water supply for fire fighting under emergency conditions will also be obtained from the surface runoff collection pond. A minimum volume of water (approximately 6,000 m^3) is maintained in this pond for fire fighting.

Alternate water supplies were considered but are inappropriate given the relatively low consumption rates of water for this Project. Specifically, a water reservoir being considered by Lamont County was evaluated, but is considerably more expensive relative to the cost of a groundwater supply well**.** AST is in the process of applying for water allotment from the Lamont County Water Utility which would be a suitable alternate supply if an adequate groundwater supply is not confirmed.

The location of the groundwater supply well is illustrated in the groundwater assessment component. The location of the surface runoff collection pond is shown in Figure 3.5-1.

3.5.2 Surface Water Management

Provide a Water Management Plan including, but not limited to, the following:

a) measures for ensuring efficient use of water throughout the project life including alternatives to reduce freshwater consumption such as water minimization, recycling, and conservation in accordance with the Water for Life strategy objective;

b) permanent or temporary alterations or diversions to watercourses and water bodies;

c) factors used in the design of water management facilities including expected flood levels and flood protection.;

d) options considered for water management strategies and reasons for selecting the preferred options; and

e) an explanation of how these plans will be incorporated into Project design.

All surface water that comes in contact with the sulphur handling and pastille storage areas will be collected and stored in a surface water runoff collection pond. This pond will be double-lined and equipped with leak detection monitoring to ensure that potentially acidic water is not released to the ground or to the surrounding watershed. The water contained within the lined pond will be used as cooling water within the sulphur forming process. Excess water will be neutralized and monitored prior to being released to the surrounding watershed. Design details for the surface water runoff pond and ditching details are illustrated in Figure 3.5-2.

The following design features were included to mitigate the risk of contaminating surface and groundwater as a result of operating the proposed facilities:

- areas surrounding the sulphur handling areas will be sloped away from the facility to prevent surface water run-on
- runoff from the sulphur forming and storage areas will be collected in a perimeter ditch lined with high density polyethylene (HDPE)
- the capacity of the surface water runoff pond will exceed the volume of runoff generated by the 1 in 25 years, 24-hour rainfall event. The pond will be double-lined (60 mil HDPE liner over compacted clay soil) and include a leak detection system to ensure that potentially impacted surface water is not released to the underlying aquifers.
- capacity will be 10,980 m^3, allowing for 300 mm of freeboard
- the pastille storage area will be lined with asphalt pavement and is underlain by compacted clay soil minimizing seepage of surface water into the surrounding ground
- water collected in the surface water runoff collection pond may be neutralized by adding free lime on a batch-basis, as needed

Freshwater consumption will be minimized by utilizing surface water in the process, and by recycling water used in the cooling process. The water diversions will be limited to the area of sulphur handling and will be temporary. These plans are consistent with standard design and operating practices for sulphur management facilities.

3.5.3 Wastewater Management

Provide a Wastewater Management Plan to address site runoff, groundwater protection, deep well disposal, and wastewater discharge including, but not limited to, the following:

a) source, quantity and composition of each wastewater stream from the proposed Project facilities;

b) those waste substances produced by the Project in sufficient quantities to be reportable under National Pollutants Release Inventory (NPRI) requirements;

c) design of facilities that will handle, treat, and store wastewater streams;

d) options considered for wastewater treatment and management strategies, and reasons (including water quality and environmental considerations) for selecting the preferred options;

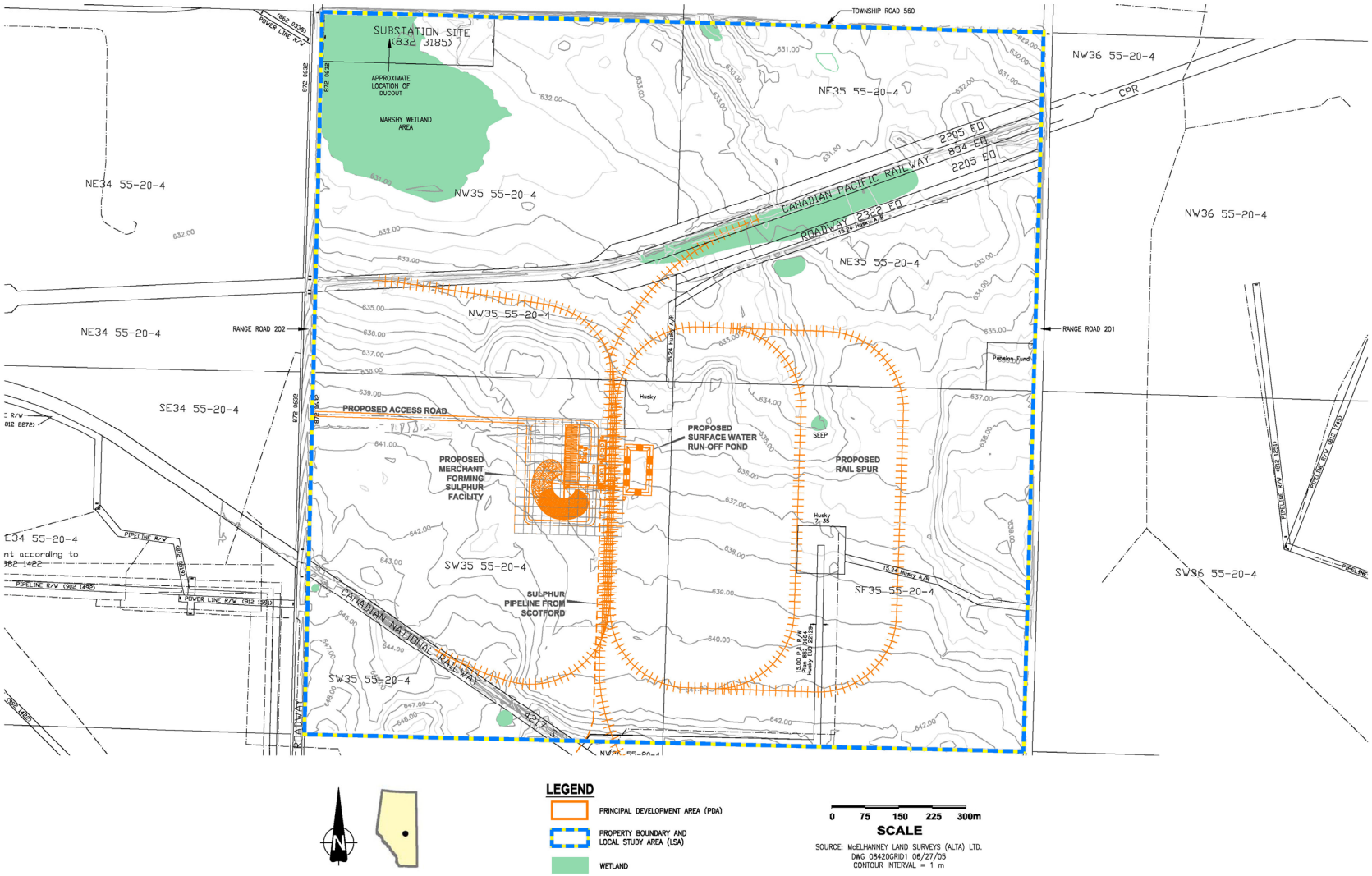
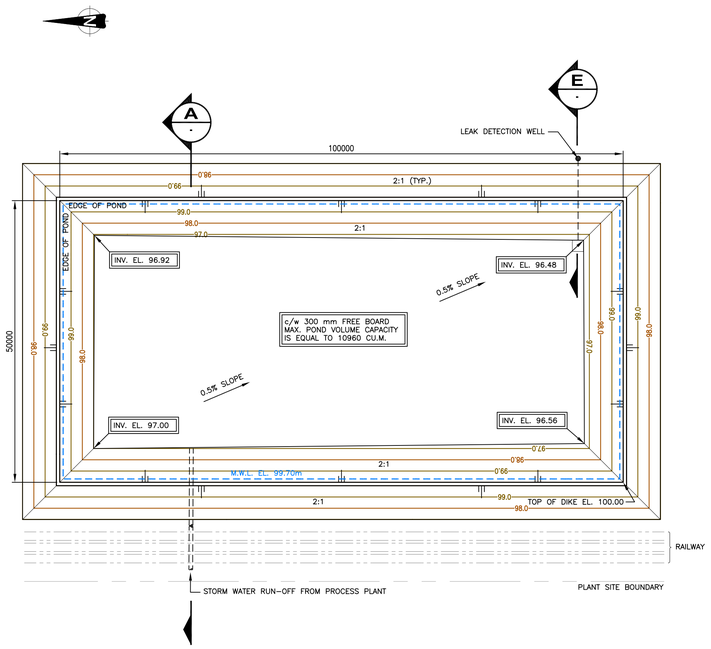
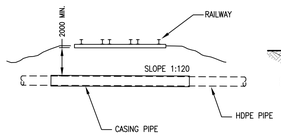
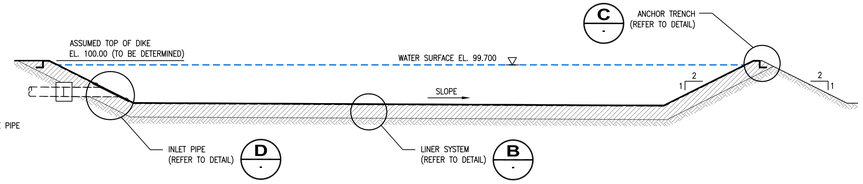


Figure 3.5-1: Location of Surface Water Collection Pond



PLAN
1 : 500





A **POND SECTION**
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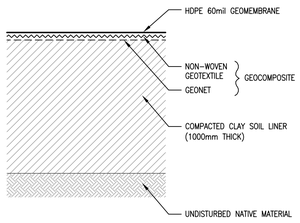

B **LINER SYSTEM DETAIL**
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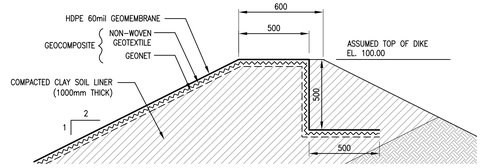

C **ANCHOR TRENCH DETAIL**
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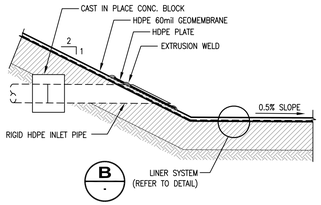

D **INLET PIPE DETAIL**
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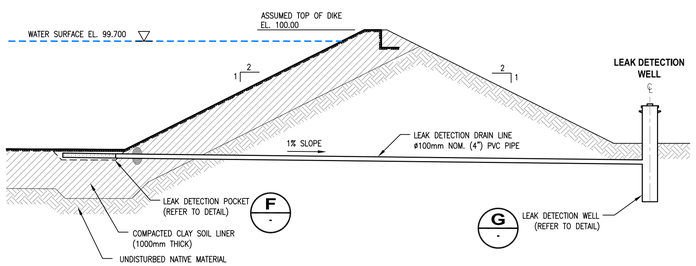
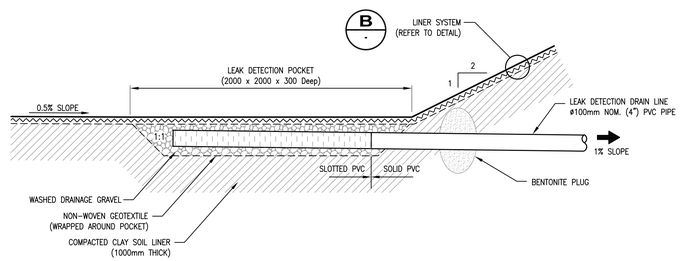
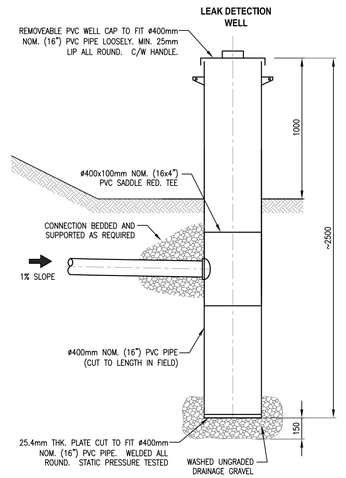


E **LEAK DETECTION - SECTION**
1 : 75



F **LEAK DETECTION - POCKET**
1 : 20



G **LEAK DETECTION - WELL**
1 : 20

Figure 3.5-2: Design of Surface Water Collection Pond

e) type (chemical names) and quantity of chemicals used in wastewater treatment;

f) potable water and sewage treatment systems that will be installed as components of the Project for both the construction and operation stages;

g) the discharge of aqueous contaminants (quantity, quality, and timing) beyond plant site boundaries and the potential environmental effects of such releases;

h) design parameters for managing site runoff during precipitation or snowmelt events;

i) programs to monitor the effects of Project operations on local surface and groundwater quantity and quality;

j) options for wastewater disposal (including zero liquid discharge) as well as the rationale for choosing the preferred options; and

k) description of how the Wastewater Management Plan will be incorporated into Project design.

Surface water management systems are described in Section 3.5.2. The sulphur forming and shipping operations will not generate wastewater that requires releases to the environment. Cooling water is the only water that will be used in the process. The cooling system will include a non-contact spray system, filtering and conditioning, a cooling tower for temperature conditioning and water reuse.

3.6 Air Emissions Management

Develop an emissions profile (type, rate and source) for each component of the Project including point sources, fugitive emissions and vehicle emissions. Consider both normal operating conditions and upset conditions. Include definitions for these conditions. Discuss the following:

a) any emissions produced by the Project in sufficient quantities to be reportable under NPRI requirements;

b) any odorous or visual emissions from the proposed facilities;

c) the amount and nature of any acidifying emission, probable deposition patterns and rates, and programs AST may implement to monitor the effects of this deposition;

d) control technologies used to minimize air emissions such as sulphur dioxide (SO_2), hydrogen sulphide (H_2S), oxides of nitrogen (NO_x), volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAH) and particulate matter (specifically including, but not limited to sulphur compounds);

e) the emission control technologies proposed for the Project in the context of best-available technologies, and the applicability of Canadian Council of Ministers of the Environment (CCME) emission control technology guidelines;

f) fugitive emissions control program to detect, measure and control emissions and odours from equipment leaks and the applicability of the CCME Code of Practice for Measurement and Control of Fugitive Emissions from Equipment Leaks and the CCME Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Above Ground Storage Tanks;

g) technology or management programs to minimize emissions which lead to formation of particulate matter and ozone (O_3) having regard to the provisions of the Canada Wide Standard for particulate matter and O_3;

h) the incremental contribution of the Project to regional emissions of $PM_{2.5}$ and PM_{10} and ground-level ozone precursors including NO_x and sulphur oxides (SO_x);

i) gas collection, conservation and applicability of technology for vapour recovery for the Project; and

j) monitoring programs AST will implement to assess air quality and the effectiveness of mitigation, during the Project's development and operation. Discuss how these monitoring programs are compatible with those in use by regional multi-stakeholder air initiatives.

$PM_{2.5}$ and PM_{10} are the only air emissions expected to be of sufficient quantity to be reportable under NPRI requirements.

Potentially odourous emissions include the potential liberation of resident H_2S gas that is retained within the liquid sulphur, as well as any SO_2 that may be formed by the oxidation of H_2S. The amount and nature of acidifying emissions is essentially limited to fugitive elemental sulphur dust. Estimated quantities of these emissions are summarized below.

Emission control systems are described in greater detail in Volume IIA, Section 2: Climate and Air Quality component of the EIA. Principals of air quality controls include the following:

- H_2S adsorption of gases vented from liquid sulphur tanks and transfer points using the SULFATREAT® process (see below)
- utilization of the Sandvik Rotoform process to minimize process emissions
- dust suppression as described below
- implementation of appropriate management and operating practices

SULFATREAT® is a non-corrosive, non-toxic, dry material that reacts with H_2S to form pyrite, a safe and stable compound. Reacted SULFATREAT® has passed every stringent environmental test and EPA regulation, and testing by a major California university found it to be beneficial to plant growth without changes in pH or detrimental effects to the soil. Chemically, the product has a different molecular structure than iron sponge which allows it to remove approximately two to three times more sulphur. The uniform shape and size of the granular material does not allow gas to channel (i.e., rat hole) through the bed, as commonly occurs with iron sponge.

Dust suppression on the sulphur pastille storage pad, transfer points and rail load-out area will use a proprietary dust suppression agent and release aid, as well as water. Dust suppression agents will be applied at the load-out hopper at the rail load-out. The agents will be stored in make-up tanks and delivered via pump.

Dust suppression agents currently selected for the Project include a proprietary dust suppression agent, Dustbind S5, and a proprietary sulphur release aid, IPAC SRB Plus. The Dustbind S5 and IPAC SRB Plus usage rates are estimated to be less than 100 kg/d (respectively) during initial operations, increasing to less than 200 kg/d for full-scale operations. The actual amounts used will depend on the size of the trains being loaded and the conveyor size. Dustbind S5 is applied at the transfer points and IPAC SRB Plus is applied at each individual Rotoformer. Product data sheets for sulphur and hydrated lime are provided with Appendix IV: Health and Safety Plan.

Dust suppression equipment will include a metering pump assembly capable of delivering a maximum of 102 mL/min at 150 psi; 2" camlock, draw down tube; and a stainless steel pump hanger.

Project emissions with respect to criteria air pollutants (CO, H_2S, NO_2, $PM_{2.5}$, SO_2), acid deposition and O_3 creation were predicted for the application and cumulative effects cases in Volume IIA, Section 2: Climate and Air Quality. No exceedances of air quality objectives or standards were predicted.

Technologies for the reduction or minimization of ozone precursors are not applicable to the Project given the very low levels of NO_x and SO_x that are anticipated. Air quality monitoring that is incorporated into the development plan is summarized in Section 3.8.

3.6.1 Greenhouse Gas Emissions

Provide the following:

a) the expected annual and total greenhouse gas (GHG) emissions over the construction, operation and decommissioning phases of the Project;

b) the Project's marginal contribution to total provincial and national GHG emissions on an annual basis;

c) the intensity of GHG emissions per unit of production and discuss how it compares with similar projects and technology performance;

d) how the project design and GHG management plans have taken into account the need for continuous improvement with respect to GHG emissions and their consideration of Alberta's Climate Change Action Plan; and

e) AST's overall GHG management plans, and the expected results of implementing the plans.

The proposed Project will not contribute significantly to GHG emissions as there are no combustion or separation processes that will result in the release of GHG. Intermittent operation of the loader for delivering sulphur to rail cars and trucks will result in the emission of very small volumes of greenhouse gases. Electricity that will be used to power the forming and transfer facilities will be generated from coal-powered systems that also emit GHG (700 t per month at maximum operating capacity (David Suzuki Foundation 2006, Internet site). However, the Project's electricity consumption is insignificant relative to total emissions of the power generation facilities. Operation of the natural gas fired boilers will also result in the release of carbon dioxide to atmosphere (300 t per month at maximum operating capacity, (CREST 2007, Internet site). The total incremental emissions of carbon dioxide to the atmosphere as a result of the Project are estimated to be 5 kg of carbon dioxide per tonne of formed sulphur. This corresponds to a maximum monthly carbon dioxide emissions rate of 1,000 t, which is insignificant relative to the total provincial and national emissions of GHGs.

The transportation of sulphur to and from the facility will occur in any event and hence does not add to the overall emissions of GHG.

There are no stand-alone sulphur forming facilities in the province, hence, it is not possible to directly compare emissions intensity. Because the proposed facilities are modern and include state-of-the-art technology, the emissions intensity is expected to be low relative to existing forming systems.

3.7 Hydrocarbon, Chemical and Waste Management

Characterize and quantify the anticipated hazardous, non-hazardous, recyclable and dangerous goods wastes generated or used by the Project. Demonstrate that the selected management options are consistent with the current regulatory requirements and industry practices. Describe and address the following:

3.7.1 Chemical Management

a) the composition and volume of specific waste streams generated by the Project, and identify how each stream will be managed. Demonstrate that the selected practices comply with provincial and federal regulations including EPEA's Waste Control Regulation and Alberta Environment's Hazardous Waste Storage Guidelines;

b) a listing of chemical products to be used for the Project. Identify products containing substances that are:

i) Canadian Environmental Protection Act (CEPA) toxics;

ii) on the PSL2, and Accelerated Reduction/Elimination of Toxics (ARET), and those defined as dangerous goods pursuant to the federal Transportation of Dangerous Goods Act. Classify the wastes generated and characterize each stream under Alberta Environment User's Guide for Waste Managers;

iii) on the National Pollutant Release Inventory (NPRI); and

iv) on Track 1 substances targeted under Environment Canada's Toxic Substances Management Policy for virtual elimination from the environment due to their persistent, bio-accumulative and toxic nature;

c) how feedstocks and products will be stored and managed to ensure safety and environmental protection;

Chemicals to be managed and stored as part of routine operations include:

- degassed liquid sulphur
- formed sulphur pastilles
- lime
- dust suppression agents Dustbind S5 and IPAC SRB Plus

All storage facilities are designed to comply with AENV guidelines for the containment of potentially hazardous materials. All liquid products will be stored in steel tanks that include double-containment and leak detection monitoring. Liquid products will be managed and applied in enclosed systems with minimum opportunity for accidental release to the environment. None of these products are expected to contain substances that are CEPA toxics, ARET, Track 1, or on the NPRI.

The asphalt storage pad for sulphur pastilles will include primary asphalt containment, a secondary clay soil liner, runoff and run-on controls, and a leak detection layer.

3.7.2 Waste Management

d) the strategy for on site waste disposal versus off site waste disposal and identify:

i) the location of on site waste disposal, including landfills, if applicable;

ii) the suitability of the site(s) from a groundwater protection perspective (provide geo-technical and hydrogeological information to support the siting of disposal facilities);

iii) the site suitability with regard to existing and potential human activities in the area;

iv) potential effects on the environment; and

e) plans for waste minimization, recycling, and management over the life of the Project. Discuss methods and technologies to reduce waste quantities to the lowest practical levels.

Based on the facility design and operation, AST is striving to be a "zero discharge" facility with respect to generation of wastes. The facility is designed to minimize wastes and by-products. All dust that is collected in the process will be recycled and placed back in the sulphur feed tanks to be formed. During operations, there may potentially be some waste or contaminated sulphur (sulphur that does not meet saleable product specifications) collected as part of equipment maintenance and on-going operations. Any waste sulphur that is collected will be stored on the pastille storage pad until sufficient volumes are present to allow for efficient disposal. Disposal will occur at an approved Class II waste disposal facility and will be managed and neutralized in accordance with that facility's operational requirements.

Neutralization sludge may also be generated by the surface water neutralization facility. This sludge will be solidified and stockpiled pursuant to disposal at an approved Class II waste disposal facility. Appropriate testing of representative samples of the sludge will be completed to verify these materials are solid and non-hazardous in accordance with provincial regulations. Removal of accumulated sediments from the pond is expected to occur very infrequently given the pond's size and the controls that will be put in place to minimize potential acidification of runoff water.

The volumes of industrial wastes, as described above, are anticipated to be below 10 t/y for each waste stream. Each waste stream would be classified as non-hazardous in accordance with the Waste Control Regulation of EPEA.

All domestic garbage will be disposed at an authorized municipal solid waste landfill. To minimize domestic wastes generated at the Site, a recycling program will collect and recycle plastics, cardboard and beverage containers.

Domestic wastewaters generated at the Site will be collected in a septic tank and subsequently hauled off site for disposal at an approved sewage treatment facility.

3.8 Environmental Management System and Contingency Plans

Summarize key elements of AST's existing and proposed environmental, health, and safety management system and discuss how it will be integrated into the Project, addressing the following:

a) corporate policies and procedures, operator competency training, spill and air emission reporting procedures, emergency response plans, public notification protocol and safety procedures;

b) plans to minimize the production or release into the environment of substances that may have an adverse effect;

The Health and Safety plan in Appendix IV details safe work procedures and the Emergency Response Plan in Appendix V outlines procedures to follow under emergency conditions. Sections 3.5, 3.6 and 3.7 detail the Water Management, Air Management and Chemical and Waste Management plans for the proposed Project.

3.8.1 Contingency Plans

c) a conceptual contingency plan that considers environmental effects associated with operational upset conditions such as serious malfunctions, fires or accidents;

The following contingency measures are available for each of the following circumstances:

Surface Water Quality Exceedances

- treatment of impacted water to comply with release criteria
- utilization of impacted water in the water cooling system
- off site disposal at an approved facility

Groundwater Quality Issues

- modify operating practices to address potential release
- detailed review of containment systems for sulphur
- additional soil and/or groundwater quality monitoring
- implementation of groundwater remediation measures

Soil Quality Issues

- lime or calcium carbonate treatment of impacted soils
- excavation and disposal of impacted soils
- additional soil monitoring

Air Quality Issues – Elemental Sulphur

- modify forming operations and controls to reduce sulphur emissions
- modify sulphur handling operations and dust controls to reduce fugitive sulphur emissions
- modify or reduce forming operations to reduce sulphur emissions

Air Quality Issues – Hydrogen Sulphide or Sulphur Dioxide

- stop operations until the source of hydrogen sulphide is identified
- evaluate sulphur sources and suppliers for potential hydrogen sulphide exceedances
- evaluate liquid sulphur in storage to identify hydrogen sulphide exceedances

Leak Detection Monitoring

- inspect and repair primary containment systems
- automated extraction of water from the leak detection layer(s)
- repair or re-design containment systems

3.8.2 Emergency Response Planning

d) the emergency response plan's capability to deal with unpredicted negative effects.

An ERP for the Project is provided as Appendix V and will be implemented to accomplish the following:

- provide a safe work environment for Site workers

- protect the health and safety of workers and members of the public that could potentially be effected by the facility operations
- evaluate emergency scenarios with the goal of establishing what individuals could be at risk as a result of an emergency, and to what degree those individuals may be put at risk
- prepare for emergencies and put in place the necessary personnel, training and equipment to appropriately respond to emergency situations that can be reasonably anticipated

The ERP consists of the following general elements:

- appropriate staffing, training and equipment to respond to the vast majority of incidents on site by workers. This includes first aid response to injuries, identification and response to small fires, on site and off site spill response, response to air quality alerts and odour complaints, and the containment and response to most industrial accidents.
- notification and utilization of municipal services (police, ambulance, fire, paramedic, etc.) for accidents and incidents that are beyond the ability of on site personnel to manage. The proponent will ensure that all emergency response personnel are made familiar with the Site operations, the nature of risks present, appropriate emergency response procedures, and protective equipment and protective measures put in place to safeguard response personnel.
- membership and participation in the NR CAER, which provides assistance during emergency situations beyond the capabilities of municipal response services. NR CAER also provides training of emergency response personnel as well as training drills, community awareness programs, and automated notifications to individuals, businesses and government agencies that could be effected by an emergency.

This ERP has been reviewed by a local professional experienced in providing emergency response services in the Industrial Heartland area of Alberta. The Plan includes the following procedures and guidelines for the following:

- communications (external and internal)
- gas detection system for H_2S and SO_2. If a gas alarm is received, operations personnel should check the area using the following guidelines:
    - a minimum of two people are required to check alarmed areas. One person is to operate the portable gas detector and test the area. The second is to serve as a safety person and must be equipped to maintain radio contact with the control room incident commander at all times.
    - when checking for H_2S, either a Self-contained Breathing Apparatus (SCBA) or Supplied Air Breathing Apparatus (SABA) must be worn until the area has been proven safe
    - all personnel are to be evacuated from the affected area
    - all doors are to be opened prior to entering affected buildings
    - H_2S and SO_2 testing is to be conducted
    - if a leak is detected, remedial action will be determined by operators as dictated and in accordance with the severity of the leak
    - once the situation has been corrected, the detector is to be reset at the monitoring location

- emergency horn alarm system. Reasons for this system are:
  - toxic gas release (unknown, uncontrolled)
  - personnel potentially overcome by toxic gas
  - fire or explosions
  - rescue assistance is required
  - other (i.e., approaching severe weather (tornado) or transportation incident (train derailment) in the proximity to the facility)
- odour complaint
- hazardous material spills; actions for minor and major spills
- fires and explosions
- AST specific coverage areas
- public notification
- injuries
- natural hazards
- post incident analysis and debriefing

The Health and Safety Plan, which is included as Appendix IV, includes fire prevention and emergency response procedures as follows:

- if a fire or explosion occurs, all staff must immediately evacuate danger area
- if fires occur in closed tanks, they can be smothered by closing the vents
- if fires occur in open tanks, they can be extinguished with fine water spray
- shut off all sources of fuel and ignition
- in the event of a small fire, suppress fire with dry chemical, CO_2, water spray or foam extinguishing media
- in the event of a large fire, the fire department will wear full bunker gear including NIOSH approved positive pressure SCBA. Fires must be suppressed with water spray, fog or regular foam.
- in the event of fires involving tanks, storage container cars and trailer loads, leave area immediately and contact Emergency Response. Do not spray water directly into a storage container to avoid boil overs. Tanks may be sprayed to cool them after a fire.

3.8.3 Health and Safety Plans

Summarize key elements of AST's existing and proposed environmental, health, and safety management system and discuss how it will be integrated into the Project, addressing the following:

a) corporate policies and procedures, operator competency training, spill and air emission reporting procedures, emergency response plans, public notification protocol and safety procedures;

A Project-Specific Safety Plan is provided as Appendix IV and was prepared to communicate guidelines developed to ensure work activities are conducted in a manner that safeguards the

health and safety of employees, contractors, subcontractors, and all members of the public that may be affected by the operations.

The Health and Safety Plan for this project includes the following responsibilities:

Facility Operator

- control of the designated work area
- ensuring employers are aware of their responsibilities to their employees
- making sure that all relevant regulations are followed
- coordinating the work of the various employers on Site

AST

- arrange for a safety orientation for all workers on the Site
- review the safety manual, and distribute field copies to all personnel and one representative of each contractor working on Site
- provide resources for personal protective equipment for personnel
- ensure that company safety policies, government acts and regulations are followed by all workers
- ensure that hazards associated with all tasks are identified, discussed with on Site personnel, and minimized using appropriate controls
- conduct and document a facility indoctrination, and daily safety meetings for the duration of construction activities
- conduct regular safety inspections, and correct unsafe conditions and acts promptly
- ensure that workers are wearing the appropriate personal protective equipment
- take the appropriate disciplinary action when a worker does not comply with safety regulations and/or policies
- review and investigate all incident and accident reports
- ensure that all injuries that may become lost-time incidents or fatality claims are reported to the Workers' Compensation Board (WCB)
- report all incidents and accidents that cause or have the potential to cause serious injuries or fatalities to an AST representative, as well as an Alberta Workplace Health & Safety Director or Inspector, as appropriate

Workers, Contractors and Subcontractors

All Site workers, contractors and subcontractors are required to:

- report to the Site each day, physically and mentally competent to perform their specified work
- sign in and out of the Site
- follow all Site safety policies
- keep a copy of the safety manual on hand in the field for reference

- provide feedback on safety policies and procedures
- inspect and maintain all equipment during the services
- report any incidents, accidents, near misses or unsafe conditions to the Site supervisor
- wear personal protective equipment, as directed by AST procedures and policies
- comply with all safety policies, government acts, regulations and codes

All workers, contractors and sub-contractors will be required to be familiar with the specifications included in the Health and Safety Plan and indicate their willingness to comply with all procedures and protocols by completing and returning the Acknowledgement Form in Attachment IV-I.

Contractors and subcontractors must submit the following documentation prior to commencement of the project:

- safety certificates for all personnel; which will include:
  - Alberta Standard First Aid
  - H_2S Alive
  - Workplace Hazardous Materials Information System (WHMIS)
  - Confined Space Entry Awareness
- appropriate certification for any personnel operating heavy equipment
- appropriate journeyman tickets
- fit test documentation for personnel required to use respirators
- proof of Worker's Compensation Board coverage
- valid insurance coverage
- certificate of recognition (COR) from Alberta Partnerships in Health and Safety
- Contractors and subcontractors will identify Short Service Workers at the daily safety meeting

Visitors

- visitors must be authorized by an AST representative before entering the Site
- visitors will be required to sign in and out of the Site
- visitors are expected to supply and wear basic personal protective equipment (e.g., hard hat, boots, safety glasses, high-visibility vest or striped coveralls) unless AST has agreed to provide it for them
- visitors must remain with a designated representative during their visit to the Site

3.8.3.1 Safety Procedures

Safety procedures will be incorporated into every phase of facility operations. Such safety procedures include:

General Safe Work Procedures:

- clean wash water will be available at the Site
- ignition sources from vehicles, pumps, static pressure build-up and sparks generated from rubbing or scraping will be minimized by:
  - turning vehicles off around flammable sources (where possible)
  - smoking in designated areas only
  - discarding cigarette butts appropriately
  - ensuring that equipment is properly grounded when appropriate
  - using materials that are non-sparking
- manual lifting will be minimized where ever possible and any lifting should involve bending at the knees and lifting with the legs
- all work areas will be clutter-free and be accessible to emergency vehicles
- minimizing excessive dust generated from activities on the Site. If the amount of dust generated significantly reduces visibility, or the dust clouds generated are opaque, then dust suppressing agents should be incorporated into the Site activities
- workers should be clean-shaven and have long hair tied back in order to facilitate the wearing of respiratory devices and ensure that hair does not get tangled in equipment

Noise Management and Hearing Protection Procedures

Noise exposure will be managed, where possible, by engineering and administrative controls. All workers who are or who may be exposed to noise in excess of the Occupational Exposure Limits (OEL) will wear hearing protection that meets CSA requirements for the level of noise exposure of the worker.

Driving Procedures

When operating any vehicle during this project, workers will:

- complete a Vehicle Inspection Checklist (see Attachment IV-I) to document the vehicle walk-around and inspection for unsafe conditions before driving
- carry a vehicle safety kit containing a minimum of an Alberta #1 first aid kit
- observe all rules of the road, including posted speed limits
- adjust speed to accommodate road and weather conditions
- ensure all loads are properly secured to prevent them from shifting or falling off the vehicle
- avoid parking or stopping on slopes of hilly terrain, or on obscured sections of roads or trails

- use the park brake when vehicle is parked or left standing (standing refers to a vehicle with the engine running and the vehicle in a parked position)
- practice defensive driving at all times
- use turn signals whenever appropriate
- drive with headlights on
- keep the vehicle and associated equipment neat, clean, and free from fluid leaks
- do not smoke while fuelling vehicles
- never leave fuel line unattended

Confined Space Procedures

It is the responsibility of the lead operator to:

- determine if confined space entry is necessary
- identify and classify confined spaces on a Confined Space Entry Decision Chart
- assess hazards associated with entry
- implement appropriate procedures for eliminating/minimizing entry hazards
- ensure atmospheric monitoring is completed by competent personnel
- ensure personnel are trained in confined space entry (including emergency response)
- ensure personnel are equipped with the appropriate equipment

Sulphur Containment, Storage and Handling Procedures

Chemicals that are managed and stored as part of routine operations include:

- degassed liquid sulphur
- formed sulphur pastilles
- lime
- dust suppression agents Dustbind S5 and IPAC SRB Plus

Safe Equipment Operation to Sulphur Procedures:

- equipment
- loading/hauling
- hand tools, power tools, welding

Potential hazards and associated safety precautions are summarized in Table 3.8-1.

Table 3.8-1: Hazard Control Inventory

Hazard	Hazard Control
Physical	
Driving	• properly licensed, experienced drivers • obey all road rules and speed limits • no cell phones or eating while driving • use of vehicle safety kits • complete Vehicle Inspection Checklist • drive with caution, watching for wildlife and potential hazards • prior to backing up do a walk around and use a spotter • follow AST procedures and safe work practices
Fire potential	• open flames, spark inducing items and smoking are prohibited on Site • ensure that air monitoring and fire-fighting equipment is in good operating condition • be aware of all emergency response requirements on Site
Excessive noise	• wear CSA standard hearing protection in high noise areas • post warnings signs around perimeter of work area when noise >85 dB
Workplace violence	• strictly prohibited and not tolerated • disciplinary measures may include an apology, referral to an employee assistance program, reporting to a professional body, possible legal/criminal charges, and/or termination • a full investigation will be required
Drugs and alcohol	• strictly prohibited and not tolerated • disciplinary measures will be taken in the form of a warning, a formal warning or termination • a significant incident may require post-incident testing • a full investigation will be required
Confined space	• use Confined Space Entry Safe Operating Procedures
Working around rail yard	• wear visibility vest or coveralls with visibility striping • stay out of the blind spot of the trains and vehicles, stand in line of Site of the operator and maintain eye contact, wait for hand signals
Tripping, falling	• wear CSA approved work boots with ankle support • keep Site organized and free of clutter
Handling materials	• use proper lifting techniques • use mechanical lifting where appropriate • wear work gloves (and prescribed personal protective equipment)
Toxicological	
Elemental sulphur	• modify or reduce forming operations and controls to reduce sulphur emissions • modify sulphur handling operations and dust controls to reduce fugitive sulphur emissions • implement best management practices to reduce fugitive dust • have appropriate MSDS available (Attachment IV-II)

Table 3.8-1: Hazard Control Inventory (Cont'd)

Hazard	Hazard Control
H_2S	• stop operations until the source of hydrogen sulphide is identified • evaluate sulphur sources and suppliers for potential hydrogen sulphide exceedances • evaluate liquid sulphur in storage to identify hydrogen sulphide exceedances • personal and Site air monitoring • have appropriate MSDS available (Attachment IV-II)
SO_2 (Toxic Fumes)	• stop operations until the source of sulphur dioxide is identified • evaluate sulphur sources and suppliers for potential sulphur dioxide exceedances • evaluate liquid sulphur in storage to identify sulphur dioxide exceedances • personal and Site air monitoring • have appropriate MSDS available (Attachment IV-II)
Dust suppression agents (including lime and gypsum)	• product data sheets are provided in Attachment IV-II • proper storage and handling procedures – refer to MSDS (Attachment IV-II)

Hazardous Analysis and Control Procedures

Control measures for potential hazards will be implemented throughout the duration of operations. These include:

- safety meetings
- incident reporting:
  - notify an AST representative of the accident
  - notify Alberta Workplace Health and Safety as to the time, place and nature of serious injuries or accidents
  - carry out an investigation into the circumstances surrounding serious injuries or accidents
  - prepare a report in accordance with the regulations, outlining the circumstances of the serious injury or accident and the corrective actions, if any, undertaken to prevent a recurrence of the serious injury or accident
  - ensure that a copy of the report is readily available for inspection by Alberta Workplace Health and Safety

Safety Training

All on Site personnel will possess the following safety certification:

- standard first-aid (minimum 1 person for every 9 field personnel on Site)
- Site indoctrination
- H_2S Alive
- WHMIS
- confined space entry awareness

Disciplinary Action:

- verbal warning: Worker will be informed of a minor safety violation (i.e., not wearing the required Personal Protective Equipment (PPE)) and than a written warning will be issued if the offence is not corrected or is repeated
- written warning: Worker will be issued a written warning of a potentially serious safety violation or repeated offences of a minor safety violation. A written warning report will be kept on file and a copy will be presented to the worker's employer. Also, a verbal warning will be issued to the worker that a more severe action will be taken if the violation is ignored or repeated.
- dismissal from the Site: This action will be used only for very serious safety violations or where the worker refuses to follow and obey safety rules. This action is the final step and good judgment should be used when administering this action.

Air Monitoring:

The proposed air monitoring program consists of three primary components, as follows:

- H_2S and SO_2 monitoring in the work area as a health and safety precaution for workers
- Compliance Source Emissions Testing on Rotoform emissions
- ambient air monitoring once per year to evaluate potential fugitive emissions of elemental sulphur

The monitoring program for hydrogen sulphide and sulphur dioxide includes:

- personal monitors on all personnel working in the sulphur forming and processing areas
- continuous monitors in the vicinity of the liquid sulphur storage tanks, sulphur reception area and inside of the forming building

In addition, the air monitoring program will include:

- building alarm levels
- personal monitor alarm levels
- respiratory protection

First Aid Measures

Sulphur handling first aid measures will include:

- first aid equipment. All on Site personnel will have Standard level First Aid training.
- first aid measures. These include information and response actions for acute and chronic exposure to sulphur, taking in consideration different entry routes: eyes, skin, ingestion, and inhalation. It also includes PPE:
  - CSA approved hard hat
  - visibility vest or coveralls with visibility stripping
  - CSA approved hearing protection

- half-mask respirators (equipped with p100/HEPA filters and organic vapour cartridges)
- safety glasses with side shields, goggles or full-face shield
- CSA approved steel toed work boots and/or chemical resistant rubber boots
- heat-resistant neoprene work gloves
- fire resistant neoprene coveralls as indicated by the Site supervisor
- Tyvek disposable coveralls with boots

3.9 Adaptive Planning

Describe the flexibility built into the plant design and layout to accommodate future modifications required by any change in emission standards, limits and guidelines. Discuss any follow-up programs and adaptive management considerations.

The need for adaptive planning is somewhat limited in the case of the proposed Project because the facilities are intended to process only one material (degassed, liquid elemental sulphur) and produce only one output (solid elemental sulphur pastilles). Further, the forming technology that has been selected represents a modern, environmentally responsible and proven technology that is readily available to AST. Modifications may be implemented in one of the following circumstances:

- if improved forming technology becomes available
- if and when the forming process is expanded
- when improved dust control and emission control technologies become available

Critical evaluations of emerging technologies will be completed whenever these technologies are developed. A similar review will be completed if the processing facilities are expanded, as part of the amending application to allow expansion of the forming facilities. Finally, review of dust management and mitigation measures will be completed a minimum of every three years, in conjunction with the soil monitoring program. This review will be based on the results of both the soil monitoring and air monitoring programs.

3.10 Participation in Regional Cooperative Efforts

Document AST's involvement in regional cooperative efforts to address environmental and socio-economic issues associated with regional industrial development during the life of the Project, including:

a) AST's current and planned participation in regional monitoring and management activities such as the Fort Air Partnership to address environmental, health and socio-economic issues;

b) AST's current and planned cooperative ventures with other operators to minimize the environmental impact of the Project or the environmental impact of regional industrial development;

c) how AST will work to develop and implement such cooperative opportunities;

d) monitoring activities that will be undertaken to assist in managing environmental protection strategies. Discuss how any result will contribute to AST's participation in the regional efforts;

e) how AST will use information from regional cooperative efforts to design and implement mitigation measures (to mitigate project-specific effects and cumulative effects), monitoring programs (Project-specific and regional monitoring), and research programs; and

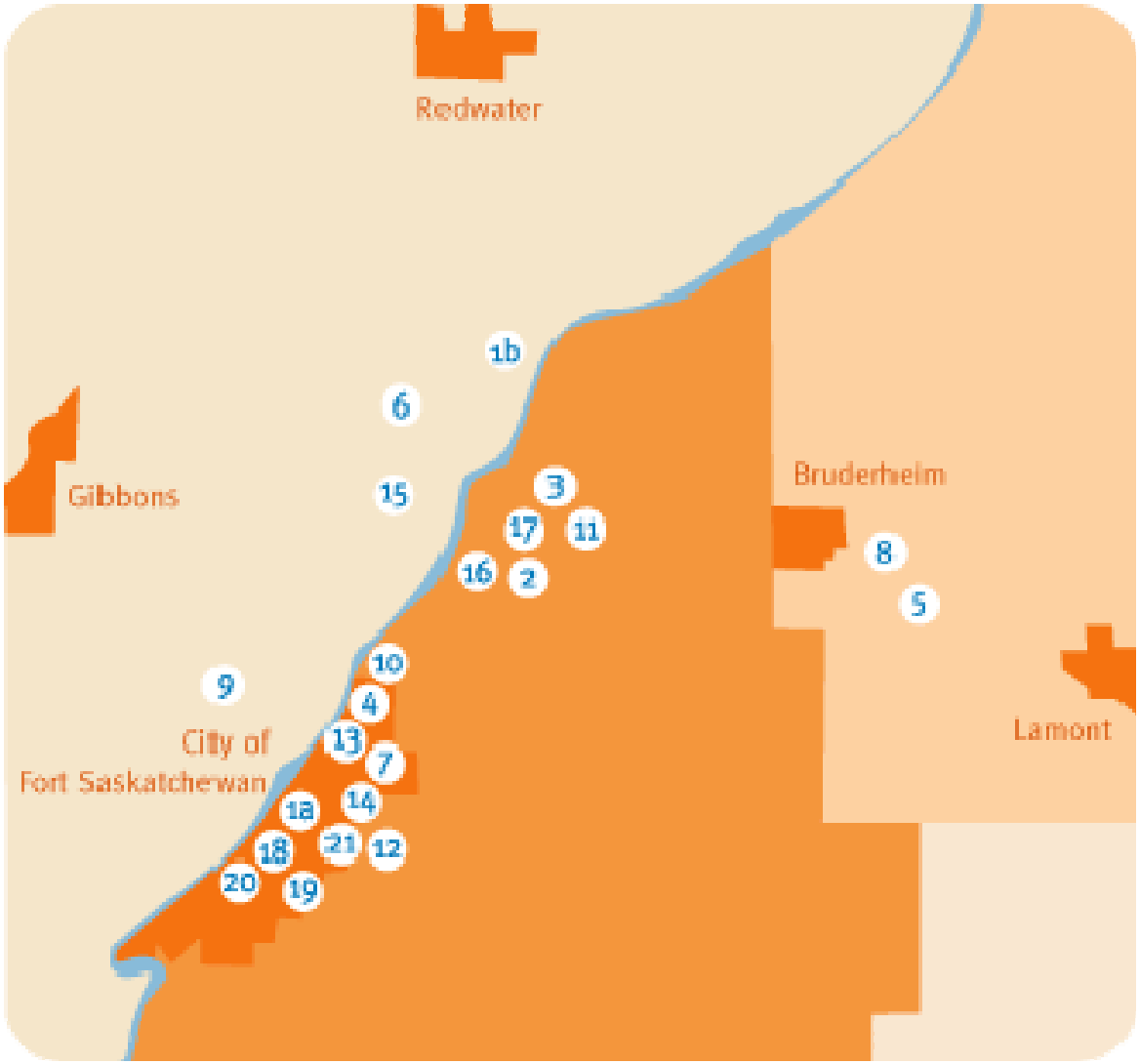
f) how AST would design and implement mitigation measures (to mitigate specific effects and cumulative effects), monitoring programs (Project-specific monitoring and regional monitoring), and research programs outside of these initiatives where necessary.

AST is an Associate Member of the NCIA which automatically involves partnership and participation in the Fort Air Partnership. The NCIA is a not-for-profit cooperative in northeast Alberta that seeks to understand and reduce the environmental impacts of member industries through collaborative efforts with the community and all levels of government while supporting sustainable industrial growth. A summary of participants and a map illustrating NCIA operating locations are provided in Figure 3.10-1. It is AST's intention to work through NCIA to address environmental and socio-economic issues that are common to industrial operators in the area.

Monitoring information that will be shared with the public and NCIA members is summarized in Section 5. It is expected this information is sufficient to evaluate and react to potential environmental impacts that could result from the Project.

AST will also join NR CAER once an operating approval is obtained and construction program is initiated. It is AST's intent to participate fully in all activities and initiatives of NR CAER.

HAZCO and AST are also industrial sponsors and members of Alberta Sulphur Research Ltd. (ASRL), a non-profit sulphur research organization. More than 90% of Alberta's sulphur producing industries are active members of ASRL, as well as other organizations with sulphur related interests in Canada, United States, United Kingdom, France, Germany, Italy, Netherlands, Norway and Saudi Arabia. ASRL fosters research in the chemistry and technology of sulphur and its compounds with particular emphasis on recovery of sour natural gas, Claus plant operations, handling and transportation of elemental sulphur, and environmental aspects of the gas and sulphur industries. ASRL serves as a contact point between industry and academia (at the University of Calgary) and strives to provide an expert level of technological support for both producers and users of this essential resource.



Sturgeon County

Strathcona County

Lamont County

Elk Island National Park

Legend

1a	Agrium Fort Saskatchewan
1b	Agrium Redwater
2	Air Liquide Canada Inc.
3	BA Energy Inc.
4	BP Canada Energy Company
5	Canexus
6	Degussa Canada Inc.
7	Dow Chemicals Canada Inc.
8	ERCO Worldwide
9	Guardian Chemicals
10	Keyera Energy
11	KinderMorgan (Terasen) Heartland Terminal
12	Marsulex Inc.
13	MEGlobal Canada Inc.
14	Praxair Canada Inc.
15	Provident Energy Inc.
16	Shell Canada
17	Shell Chemicals Canada Ltd.
18	Sherritt International Corp.
19	Sulzer Metco (Canada) Inc.
20	The Westaim Corporation and Nucryst Pharmaceuticals Corporation
21	Umicore
*	North West Upgrading Inc.
*	Petro-Canada Oil Sands Inc.
*	Synenco Energy

Figure 3.10-1: Northeast Capital Industrial Association

4. Environmental Information and Cumulative Effects Assessment Information Requirements

Section 4 of the TOR is presented in the following volumes of the Environmental Impact Assessment:

- Volume IIA – Air, Noise and Human Health
- Volume IIB – Water and Aquatic Ecology
- Volume IIC – Terrestrial Ecosystems
- Volume IID – Land Use, Historical, Socio-Economics, and Public Consultation.

5. Environmental Effects Monitoring

Describe environmental effects monitoring (EEM) activities that AST will undertake to manage effects, and confirm the performance of mitigative measures. Specifically addressing:

a) monitoring activities and initiatives that AST is proposing to conduct independently of other stakeholder activities in the region;

5.1 Surface Water Monitoring

All surface water that comes in contact with the sulphur handling and pastille storage areas will be collected and stored in a surface water runoff collection pond. This pond will be double-lined and equipped with leak detection monitoring to ensure that potentially acidic water is not released to the ground or to the surrounding watershed. Water contained within the lined pond will be used as cooling water in the sulphur forming process. Excess water will be neutralized and monitored prior to being released to the surrounding watershed. Design details for the surface water runoff pond and ditching details are illustrated in Figure 3.5-1.

The following design features are included to mitigate the risk of contaminating surface and groundwater as a result of operating the proposed facilities:

- areas surrounding the sulphur handling areas are sloped away from the facility to prevent surface water run-on
- runoff from the sulphur forming and storage areas is collected in a perimeter ditch lined with high density polyethylene (HDPE)
- the capacity of the surface water runoff pond exceeds the volume of runoff generated by the 1 in 25 years, 24 hour rainfall event. The pond is double-lined (60 mil HDPE liner over compacted clay soil) and includes a leak detection system to ensure that potentially impacted surface water is not released to the underlying aquifers.
- capacity is 10,980 m^3, allowing for 300 mm of freeboard
- the pastille storage area is lined with asphalt pavement and is underlain by compacted clay soil minimizing seepage of surface water into the surrounding ground
- water collected in the surface water runoff collection pond may be neutralized by adding free lime on a batch-basis, as needed

Freshwater consumption will be minimized by utilizing surface water in the process, and by recycling water used in the cooling process. The water diversions will be limited to the area of sulphur handling and will be temporary. All plans are consistent with standard design and operating practices for sulphur management facilities.

Monitoring of surface water quality will be implemented to preclude accidental release of acidic water from the surface water runoff collection pond. Grab samples will be collected immediately prior to release of any water to the environment. Any water that is potentially discharged from the Site will be sampled and tested to comply with the following generic criteria:

- no visible sheen
- 6<pH<9

- COD<50 mg/L
- chloride <500 mg/L
- TSS<50 mg/L

Samples will be collected and sampled on a batch basis prior to releasing treated water to the environment. Discharge limits for specific contaminants (if and when suspected) will be determined in accordance with the Water Quality Based Effluent Limits Procedures Manual (AEP 1995). Monitoring of water quality in the adjacent wetlands will be completed twice annually as an extension of the groundwater monitoring program (below).

5.2 Groundwater Monitoring

Groundwater monitoring wells completed in the uppermost groundwater bearing formations, around the perimeter of the sulphur forming and storage facilities will be monitored twice annually to evaluate potential impacts to groundwater quality. Piezometer nests have been installed at selected locations to evaluate the vertical groundwater flow direction and monitor potential impacts to deeper water bearing formations. Baseline conditions have been established as part of the groundwater component of the EIA. Groundwater samples are collected using standard methodologies, preservation, containment, and transport techniques. The analytical schedule for ongoing monitoring of the sulphur facility is expected to include the following parameters:

- temperature, pH and electrical conductivity
- routine potability parameters

The leak detection systems for the surface water runoff collection pond and the pastille storage pad will be sampled and analyzed for the same parameters and at the same time as the groundwater monitoring wells.

Monitoring the effects of groundwater withdrawal will be completed twice per year, at the same time as quality monitoring.

5.3 Soil Monitoring

The emission and subsequent deposition of fugitive dust may present a risk to soil quality in and around the development area associated with the facility. Soil monitoring around the facility will be completed a minimum of once every three years, allowing identification and characterization of any impacts to surrounding surface soils. Soil monitoring will be completed in accordance with the requirements of the Soil Monitoring Directive (AENV 2000), as well as a soil monitoring proposal which is submitted to AENV for formal approval.

Soil monitoring will also be implemented in any one of the following instances:

- if there are any spills or accidental releases from the sulphur forming and shipping activities
- if there is significant impact to groundwater quality as determined by the groundwater monitoring program described in Section 5.2
- when portions of the PDA are decommissioned and reclaimed
- at the time the facilities are decommissioned to identify any potential adverse effects from the facility operations

Analytes for soil monitoring will include elemental sulphur, calcium carbonate equivalency, total sulphur and soluble main ions.

5.4 Air Monitoring

The proposed air monitoring program consists of three primary components, as follows:

- H_2S and SO_2 monitoring in the work area as a health and safety precaution for workers
- Compliance Source Emissions Testing on Rotoform emissions
- ambient air monitoring once per year to evaluate potential fugitive emissions of elemental sulphur

The monitoring program for H_2S and SO_2 includes:

- personal monitors on all personnel working in the sulphur forming and processing areas
- continuous monitors in the vicinity of the liquid sulphur storage tanks, sulphur reception area and inside of the forming building

The H_2S monitors will be set to alarm at a measured concentration exceeding 8 ppm. The SO_2 monitors will be set to alarm at a measured concentration of 4 ppm. Personal monitors will alarm at a level audible to the individual; whereas, continuous monitors will alarm at the monitoring location and within the control room.

Annual ambient air and compliance source monitoring programs will be designed and implemented as a condition of the EPEA operating approval to be issued by AENV.

5.5 Leak Detection Monitoring

Leak detection monitoring will be implemented for the surface water runoff collection pond and asphalt stockpile pad to assess potential leakage relative to an action leakage rate (ALR), which is defined as the leakage expected to occur through a synthetic impermeable liner having two holes of 2 mm diameter every 1 ha of area. The ALR is calculated as follows:

$Q = CDa\ (2ghw)1/2$

where Q = ALR

a = hole area (m^2 – assume two – 2 mm diameter holes per ha)

CD = dimensionless coefficient (0.6 default value)

hw = liquid depth (m)

g = gravity constant (9.8 m/s^2)

The potential for leakage will be determined by considering relative water levels in the leak detection and primary containment systems, water chemistry and potential flow into the leak detection layer. Leak detection monitoring will be implemented monthly until the integrity of the primary liners is confirmed, after which the monitoring frequency will be reduced to twice yearly.

Describe environmental effects monitoring (EEM) activities that AST will undertake to manage effects, and confirm the performance of mitigative measures. Specifically addressing:

b) monitoring activities that AST is proposing to conduct collaboratively with other stakeholders. Include in this discussion the role that AST anticipates taking in each of the programs. With respect to groundwater monitoring, discuss AST's participation in the Regional Groundwater Quality Study of the Beverly Channel in the Fort Saskatchewan area managed by the Northeast Capital Industrial Association (NCIA); and

c) *mechanisms for sharing results, reviewing findings, and adjusting programs should monitoring identify unanticipated consequences of AST's operations or mitigation plans, including:*

i. corporate adaptive management strategies; and

ii. consultation with regulators, public stakeholders, and, if necessary, regional management forums.

The above TOR is addressed under Sections 3.9 (Adaptive Planning) and 3.10 (Participation in Regional Corporative Efforts).

6. References

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Volume I: Project Description

Appendix I: Final Terms of Reference
Environmental Impact Assessment (EIA) Report

FINAL TERMS OF REFERENCE
ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT

FOR THE

ALBERTA SULPHUR TERMINALS

SULPHUR FORMING AND SHIPPING FACILITY

(formerly referred to as the Bruderheim Sulphur Forming & Pastille Storage Facility)

located
at 35-55-20 W4M, approximately 2.2km East of Bruderheim, Alberta
within Lamont County's Industrial Heartland

ISSUED BY: ALBERTA ENVIRONMENT
DATE: March 13, 2007

Table of Contents

1. INTRODUCTION

1.1 Purpose

The purpose of this document is to identify for Alberta Sulphur Terminals (AST), a division of Hazco Environmental Services (Hazco) and CCS Income Trust (CCS), and appropriate stakeholders the information required by government agencies for an Environmental Impact Assessment (EIA) report. AST will prepare and submit an EIA report that examines the environmental and socio-economic effects of the construction, operation and reclamation of the proposed sulphur forming and shipping facility (the Project).

The Project includes the construction and operation of facilities for sulphur forming, sulphur pastille storage and shipment for export. The proposed facility is to be developed on a portion of Section 35, Township 55, Range 20, West of the 4th Meridian (the Site), which is located approximately 2.2 km east of Bruderheim, Alberta. The Project is located within the Industrial Heartland area of Lamont County. The Project includes the development of rail and road access for receiving and shipping sulphur, liquid sulphur unloading and transfer facilities, sulphur forming facilities to produce sulphur pastilles and loading and shipping facilities for formed sulphur. Finished product will be stored on a storage pad with a capacity of 90,000 tonnes. The forming capacity for the proposed Project will be 6,000 tonnes per day, with approximately half of that being associated with initial construction. All Project infrastructure and activities will be confined to and occupy the lands (35-55-20 W4M) owned by the Project proponent.

AST will service oil and gas production and refining operations located in the Fort Saskatchewan area as well as northeastern Alberta. With increased applications, approvals and operation of bitumen upgraders and ongoing sulphur recovery initiatives, a shortage of sulphur forming facilities in Alberta has become apparent. AST will provide area oil and gas producers with a state of the art sulphur forming, pastille storage and shipping facility that will include design elements and monitoring programs that focus on environmental protection.

1.2 Scope of Environmental Impact Assessment Report

The EIA report shall be prepared in accordance with these Terms of Reference and the environmental information requirements prescribed under the *Environmental Protection and Enhancement Act* (EPEA), *Water Act* (WA) and any other legislation which may apply to the Project. The EIA report will:

a) assist the public and government in understanding the environmental and socio-economic consequences of the Project's development, operation, and reclamation plans and will assist AST in its decision-making process;
b) address:
    i. Project impacts;
    ii. mitigation options; and
    iii. residual effects relevant to the assessment of the Project including, as appropriate, those related to other industrial operations. As appropriate for the various types of impacts, predictions shall be presented in terms of magnitude, frequency, duration, seasonal timing, reversibility and geographic extent;

c) discuss possible measures, including established measures and possible improvements based on research and development to:
   i. prevent or mitigate impacts;
   ii. assist in the monitoring of environmental protection measures; and
   iii. identify residual environmental impacts and their significance including cumulative and regional development considerations.
d) include tables that cross-reference the report (subsections) to the EIA Terms of Reference; and
e) include a glossary of terms and a list of abbreviations to assist the reader in understanding the material presented.

The EIA report will form part of AST's EPEA and WA Applications to Alberta Environment and part of AST's Application to the Natural Resources Conservation Board (NRCB).

1.3 Public Consultation

The preparation of the EIA report will include a public consultation program to assist with Project scoping and issue identification, and documentation of the results of these consultations (see Section 9.0). The public consultation program is to communicate with those members of the public who may be affected by the Project and to provide them with an opportunity to participate in the Environmental Assessment process.

1.4 Proponent's Submission

AST is responsible for the preparation of the EIA report and related applications. The final submission will be based upon these Terms of Reference and issues raised during the public consultation process.

2. PROJECT OVERVIEW INFORMATION REQUIREMENTS

AST is expected to provide: a corporate profile, an overview of the Project, the key environmental, resource management, and socio-economic issues that, from the proponent's perspective, are important for a public interest decision; and the results of the Environmental Assessment process.

2.1 Alberta Sulphur Terminals Ltd.

Present a corporate profile of the proponent and state who is responsible for the development, management, operation and reclamation of the Project.

2.2 Project Need and Alternatives Considered

Discuss the need for the Project, the alternatives to the Project, including the potential alternative of not proceeding with the Project. Address the following:

a) an analysis of the alternative means of carrying out the Project that are technically and economically-feasible and indicate their potential environmental effects and impacts with the rationale for selecting the proposed option;
b) how a balance between environmental, resource recovery or conservation and economic goals has been achieved through planning and preliminary design, highlighting any areas where planning focused on one goal in exclusion of others;
c) contingency plans, if major Project components or methods prove to be unfeasible or do not perform as expected;
d) potential cooperative development opportunities and the implications of the Project for ongoing regional management and research initiatives; and
e) environmental performance of the technology and a comparison to the alternative technologies considered; and
f) a market analysis of sulphur supply versus demand (e.g. 5yr, 10yr, and 10 + yrs).

2.3 Project Components and Development Timing

Provide an overview of the Project activities and physical components. Specifically, address the following:

a) a summary list, brief description and drawings of Project components and activities which are addressed in detail under Section 3.0; and,
b) proposed activity stages or phases and a likely development schedule, explaining:
    i. the timing of key construction, operation and reclamation activities;
    ii. the expected duration of each for the life of the Project;
    iii. the key factors controlling the schedule and uncertainties; and
    iv. the implications of a delay in the Project and include the regulatory process as a consideration in the likely development schedule.

2.4 Regulatory and Planning Framework and Classifications

Identify the legislation, policies, approvals, and current multi-stakeholder planning initiatives applicable to the review of this Project. List the major components of the Project that will be applied for and constructed within the duration of any potential approvals under the EPEA and WA and address the following:

a) other regulatory approvals that are required and any approvals that have already been issued including provincial, municipal, and applicable federal government requirements;
b) the primary focus of each regulatory requirement, such as resource allocation, environmental protection, land use/development, and the element(s) of the Project subject to the regulation;
c) any regulatory classification systems which apply to the Project, such as solid waste or air pollution classifications and land use zones; and

d) summary of the objectives, standards, or guidelines that have been used by AST to assist in the evaluation of the significance of effects.

2.5 Principal Development Area and EIA Study Area

The Principal Development Area (PDA) includes all lands subject to direct disturbance from the Project and associated infrastructure, including access and utility corridors. For the PDA, provide:

a) the legal land description;
b) the boundaries of the PDA;
c) a map that identifies the locations of all proposed development activities; and
d) a map and photo mosaic showing the area proposed to be disturbed in relation to existing topographic features, township grids, wetlands and water bodies.

Study Areas for the EIA report include the PDA and other areas based on individual environmental components where an effect from the proposed development can reasonably be expected. Provide:

e) the rationale used to define Local and Regional Study Areas (see also Section 4.5), considering the location and range of probable Project and cumulative effects including those related to regional or local developments; and
f) illustrate boundaries, and identify Local and Regional Study Areas chosen to assess impacts on maps of appropriate scale.

2.6 EIA Summary

Provide a summary of the EIA report addressing:

a) environmental and land use conditions in the EIA Study Area without the Project;
b) activities and components of the Project that are anticipated to influence environmental and land use conditions;
c) the anticipated environmental effects, with emphasis on regional and cumulative considerations;
d) proposed mitigation measures, monitoring, and management plans; and
e) any Project-related residual effects, their contribution to regional cumulative effects and their implications for the future management of regional cumulative effects.

List and discuss the key environmental issues and the issues that are important for the achievement of sustainable environmental and resource management that were identified during the preparation of the EIA report and public consultation. Differentiate between emerging issues (with ongoing uncertainties) with quantifiable and significant environmental effects, and issues that can be resolved through available technology and existing management approaches.

Provide a matrix or summary chart to describe this section.

3. PROJECT DESCRIPTION AND MANAGEMENT PLANS

Describe activities and components of the Project and relevant management plans. Provide sufficient scope and detail in the Project description information to allow quantitative assessment of the environmental consequences. If the scope of information varies among components or phases of the Project, provide rationale demonstrating that the information is sufficient for assessment purposes.

Technical information required in this section may also be required for an EPEA and WA approval application. Information required in this section may be provided in other parts of AST's submission(s) provided that the location of the information is referenced in the EIA report. AST should ensure consistency in the information provided whenever it is discussed in more than one section of the submission.

3.1 Project Components and Site Selection

3.1.1 Project Components

Describe the nature, size, location and duration of the significant components of the Project including, but not limited to, the following:

a) the plant site and any chemical/fluids storage locations;
b) design capacities of the Project and the potential changes in design capacities;
c) temporary structures, dewatering, water control facilities, and processing/treatment facilities;
d) buildings and infrastructure, transportation, utilities, access routes, and storage areas;
e) the location of groundwater supply well(s);
f) the types and amounts of waste materials, and locations of waste storage, and disposal sites;
g) a site development plan to illustrate the locations of components including an outline of the proposed phasing and sequencing of components (include pre-construction, construction, operation, reclamation, decommissioning, and end land use);
h) how AST has used community input for Project design and development; and
i) potential cooperative ventures to minimize environmental impacts.

3.1.2 Site Selection

Discuss the site selection process including, but not limited to, the following:

a) factors that were considered in determining the preferred plant site and associated processing facilities;
b) the site selection process for the proposed location of the Project components;
c) the rationale for choosing the proposed sites instead of alternative sites;
d) the technical, economical, and environmental criteria considered;
e) potential impacts on environmental and land use conditions; and
f) suitable maps showing the location of proposed facilities.

3.2 Process Description

Provide material balances, energy balances, flow diagrams, and descriptions of the processes including:

a) energy efficiency and process efficiency of the technologies chosen;
b) alternate technologies considered;
c) shared facilities and utilities associated with the Project;
d) chemicals needed for sulphur forming and storage processes included in the Project;
e) Project inputs such as energy and water, and outputs such as emissions and wastes;
f) effect of technology on waste generation and storage requirements, air and water discharges, water requirements, waste streams, and effects to reclamation programs; and
g) sources of major feed materials for the sulphur forming process.

3.3 Product Handling

Identify the location and amount of all on-site storage associated with sulphur forming including storage of chemicals, products, by-products, intermediates and wastes (additional detail can be found in Section 3.7). Explain containment and environmental protection measures to be used.

3.4 Utilities and Transportation

Describe and discuss the Project energy requirements, and associated infrastructure and other infrastructure requirements including, but not limited to, the following:

a) the amount and source of energy required for the Project;
b) the options considered for supplying the thermal energy and electrical power required for the Project and their environmental implications;
c) worker accommodations and travel routes to the plant site during construction and operation phases, including:
    i. desired traffic routing;
    ii. control methods; and
    iii. road use agreements.
d) any expected changes and impacts in traffic volume by Average Annual Daily Traffic (AADT) and any seasonal variability in traffic volume, from the Project;
e) the result of consultation with the local transportation authorities including transportation studies that are underway or planned;
f) cumulative impacts on the transportation network including information regarding the upgrading requirement for Highway 15 and effect on Highway 45 and Range Road 202 due to the increase of traffic as a result of the Project;
g) the adequacy in design and upgrades required of all utility lines, roads, railways and pipeline crossings of roads, rivers and streams with respect to the construction;
h) design features to prevent spills, contingencies for spill response and environmental risks associated with spills; and
i) plans to minimize and mitigate the impacts of the Project's energy and infrastructure requirements and associated infrastructure on area residents.

3.5 Water Supply, Water Management and Wastewater Management

3.5.1 Water Supply

Describe the Project's water supply requirements including, but not limited to, the following:

a) the overall water balance(s);
b) the water requirements for construction, start-up, normal conditions, peak demand conditions, emergency operating situations, decommissioning and reclamation;
c) the variability in the amount of water required on an annual and seasonal basis as the Project is implemented;
d) the supply options including on-site storage,
e) the location of existing sources/intakes and associated infrastructure (pipelines); and
f) potential modifications to the Project.

3.5.2 Water Management

Provide a Water Management Plan including, but not limited to, the following:

a) measures for ensuring efficient use of water throughout the Project life including alternatives to reduce freshwater consumption such as water minimization, recycling, and conservation in accordance with the Water for Life strategy objective;
b) permanent or temporary alterations or diversions to watercourses and water bodies;
c) factors used in the design of water management facilities including expected flood levels and flood protection.;
d) Options considered for water management strategies and reasons for selecting the preferred options; and
e) an explanation of how these plans will be incorporated into Project design.

3.5.3 Wastewater Management

Provide a Wastewater Management Plan to address site runoff, groundwater protection, deep well disposal, and wastewater discharge including, but not limited to, the following:

a) source, quantity and composition of each wastewater stream from the proposed Project facilities;
b) those waste substances produced by the Project in sufficient quantities to be reportable under National Pollutants Release Inventory (NPRI) requirements;
c) design of facilities that will handle, treat, and store wastewater streams;
d) options considered for wastewater treatment and management strategies, and reasons (including water quality and environmental considerations) for selecting the preferred options;
e) type (chemical names) and quantity of chemicals used in wastewater treatment;

f) potable water and sewage treatment systems that will be installed as components of the Project for both the construction and operation stages;
g) the discharge of aqueous contaminants (quantity, quality, and timing) beyond plant site boundaries and the potential environmental effects of such releases;
h) design parameters for managing site runoff during precipitation and snowmelt events;
i) programs to monitor the effects of Project operations on local surface and groundwater quantity and quality;
j) options for wastewater disposal (including zero liquid discharge) as well as the rationale for choosing the preferred options; and
k) description of how the Wastewater Management Plan will be incorporated into Project design.

3.6 Air Emissions Management

Develop an emissions profile (type, rate and source) for each component of the Project including point sources, fugitive emissions and vehicle emissions. Consider both normal operating conditions and upset conditions. Include definitions for these conditions. Discuss the following:

a) any emissions produced by the Project in sufficient quantities to be reportable under NPRI requirements;
b) any odorous or visual emissions from the proposed facilities;
c) the amount and nature of any acidifying emission, probable deposition patterns and rates, and programs AST may implement to monitor the effects of this deposition;
d) control technologies used to minimize air emissions such as sulphur dioxide (SO_2), hydrogen sulphide (H_2S), oxides of nitrogen (NO_x), volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAH) and particulate matter (specifically including, but not limited to sulphur compounds);
e) the emission control technologies proposed for the Project in the context of best-available technologies, and the applicability of Canadian Council of Ministers of the Environment (CCME) emission control technology guidelines;
f) fugitive emissions control program to detect, measure and control emissions and odours from equipment leaks and the applicability of the CCME Code of Practice for Measurement and Control of Fugitive Emissions from Equipment Leaks and the CCME Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Above Ground Storage Tanks;
g) technology or management programs to minimize emissions which lead to formation of particulate matter and ozone (O_3) having regard to the provisions of the Canada Wide Standard for particulate matter and O_3;
h) the incremental contribution of the Project to regional emissions of $PM_{2.5}$ and PM_{10} and ground-level ozone precursors including NO_x and sulphur oxides (SO_x);
i) gas collection, conservation and applicability of technology for vapour recovery for the Project; and
j) monitoring programs AST will implement to assess air quality and the effectiveness of mitigation, during the Project's development and operation. Discuss how these

monitoring programs are compatible with those in use by regional multi-stakeholder air initiatives.

3.6.1 Greenhouse Gas Emissions

Provide the following:

a) the expected annual and total greenhouse gas (GHG) emissions over the construction, operation and decommissioning phases of the Project;
b) the Project's marginal contribution to total provincial and national GHG emissions on an annual basis;
c) the intensity of GHG emissions per unit of production and discuss how it compares with similar projects and technology performance;
d) how the Project design and GHG management plans have taken into account the need for continuous improvement with respect to GHG emissions and their consideration of Alberta's Climate Change Action Plan; and
e) AST's overall GHG management plans, and the expected results of implementing the plans.

3.7 Hydrocarbon, Chemical and Waste Management

Characterize and quantify the anticipated hazardous, non-hazardous, recyclable and dangerous goods wastes generated or used by the Project. Demonstrate that the selected management options are consistent with the current regulatory requirements and industry practices. Describe and address the following:

a) the composition and volume of specific waste streams generated by the Project, and identify how each stream will be managed. Demonstrate that the selected practices comply with provincial and federal regulations including EPEA's Waste Control Regulation and Alberta Environment's Hazardous Waste Storage Guidelines;
b) a listing of chemical products to be used for the Project. Identify products containing substances that are:
    i. Canadian Environmental Protection Act (CEPA) toxics;
    ii. on the PSL2, and Accelerated Reduction/Elimination of Toxics (ARET), and those defined as dangerous goods pursuant to the federal Transportation of Dangerous Goods Act. Classify the wastes generated and characterize each stream under Alberta Environment User's Guide for Waste Managers;
    iii. on the National Pollutant Release Inventory (NPRI); and
    iv. on Track 1 substances targeted under Environment Canada's Toxic Substances Management Policy for virtual elimination from the environment due to their persistent, bio-accumulative and toxic nature;
c) how feedstocks and products will be stored and managed to ensure safety and environmental protection;
d) the strategy for on-site waste disposal versus off-site waste disposal and identify:
    i. the location of on-site waste disposal, including landfills, if applicable;
    ii. the suitability of the site(s) from a groundwater protection perspective (provide geo-technical and hydrogeological information to support the siting of disposal facilities);

iii. the site suitability with regard to existing and potential human activities in the area;
iv. potential effects on the environment; and

e) plans for waste minimization, recycling, and management over the life of the Project. Discuss methods and technologies to reduce waste quantities to the lowest practical levels.

3.8 Environmental Management System and Contingency Plans

Summarize key elements of AST's existing and proposed environmental, health, and safety management system and discuss how it will be integrated into the Project, addressing the following:

a) corporate policies and procedures, operator competency training, spill and air emission reporting procedures, emergency response plans, public notification protocol and safety procedures;
b) plans to minimize the production or release into the environment of substances that may have an adverse effect;
c) a conceptual contingency plan that considers environmental effects associated with operational upset conditions such as serious malfunctions, fires or accidents; and
d) the emergency response plan's capability to deal with unpredicted negative effects.

3.9 Adaptation Planning

Describe the flexibility built into the plant design and layout to accommodate future modifications required by any change in emission standards, limits and guidelines. Discuss any follow-up programs and adaptive management considerations.

3.10 Participation in Regional Cooperative Efforts

Document AST's involvement in regional cooperative efforts to address environmental and socio-economic issues associated with regional industrial development during the life of the Project, including:

a) AST's current and planned participation in regional monitoring and management activities such as the Fort Air Partnership to address environmental, health and socio-economic issues;
b) AST's current and planned cooperative ventures with other operators to minimize the environmental impact of the Project or the environmental impact of regional industrial development;
c) how AST will work to develop and implement such cooperative opportunities;
d) monitoring activities that will be undertaken to assist in managing environmental protection strategies. Discuss how any result will contribute to AST's participation in the regional efforts;
e) how AST will use information from regional cooperative efforts to design and implement mitigation measures (to mitigate Project-specific effects and cumulative effects), monitoring programs (Project-specific and regional monitoring), and research programs; and

f) how AST would design and implement mitigation measures (to mitigate specific effects and cumulative effects), monitoring programs (Project-specific monitoring and regional monitoring), and research programs outside of these initiatives where necessary.

4. ENVIRONMENTAL INFORMATION AND CUMULATIVE EFFECTS ASSESSMENT INFORMATION REQUIREMENTS

4.1 Assessment Scenarios

Define assessment scenarios including:

a) a Baseline Case, which includes existing environmental conditions and existing and approved projects or activities;
b) an Application Case, which includes the Baseline Case plus the Project; and
c) a Cumulative Effects Assessment (CEA) Case, which includes past studies, existing and anticipated future environmental conditions, existing and approved projects or activities, plus other planned projects or activities.

Note: For the purposes of defining assessment scenarios, "approved" means approved by any federal, provincial or municipal regulatory authority. "Planned" is considered any project or activity that has been publicly disclosed prior to the issuance of the Terms of Reference or up to six months prior to the submission of the Project Application and EIA report, whichever is submitted sooner.

4.2 Information Requirements for the Environmental Assessment

Basic environmental information requirements for AST's EIA report include for each relevant section:

a) quantitative and qualitative information about the existing environmental, and ecological processes in the EIA Study Area;
b) information about the existing and planned human activities in the EIA Study Area, and the nature, size, location and duration of their potential interactions with the environment, sometimes described as stressors (e.g., land disturbance, discharges of pollutants, changes to access status, consumption of renewable resources);
c) information about ecological processes and natural forces which are expected to produce changes in environmental conditions (e.g., climate change, forest fires, flood or drought conditions, predator-prey population cycles), and which are relevant to the Project;
d) the demonstrated use of appropriate predictive tools and methods, enabling quantitative estimates of future conditions with the highest possible degree of certainty;
e) quantitative and qualitative descriptions of the effects;
f) evaluation of the significance of the effects, including the probability of the effect occurring and the importance of the consequences (measured quantitatively against management objectives and guidelines or baseline conditions and described qualitatively with respect to the views of AST and stakeholders);

g) a description of air quality impact assessment as it relates to the Alberta Ambient Air Quality Guidelines;
h) management plans to prevent, minimize or mitigate adverse effects and to monitor and respond to expected or unanticipated conditions, including any follow-up plans to verify the accuracy of predictions or determine the effectiveness of mitigation plans;
i) a record of all assumptions, including an evaluation of impact prediction confidence in data and analysis to support conclusions; and
j) a description of residual effects and their consequences for the environment as well as for regional management initiatives that are underway or in development.

4.3 Modeling

Document any assumptions used to obtain modeling predictions submitted as part of the EIA report. Clearly identify the limitations of the model(s) including sources of input data, as well as error and relative accuracy in predicated results.

4.4 Cumulative Environmental Effects

Assessment of cumulative effects will be an integral component of the EIA report. AST will conduct a cumulative environmental effects assessment of the Project based on the EUB/AENV/NRCB Information Letter "Cumulative Effects Assessment in Environmental Impact Assessment Reports under the Alberta Environmental Protection and Enhancement Act," June 2000. This will include a summary of all proposed monitoring, research and other strategies or plans to minimize, mitigate and manage potential adverse effects. The identification and assessment of the likely cumulative environmental effects of the Project will:

a) define the spatial and temporal Study Area boundaries and provide the rationale for assumptions used to define those boundaries for each environmental component examined;
b) describe the current (baseline) state of the environment in the Regional Study Area (used for the cumulative effects assessment);
c) assess the incremental consequences that are likely to result from the Project in combination with other existing, approved and planned projects in the region;
d) demonstrate that relevant information or data used from other development projects is appropriate for use in this EIA report;
e) consider and describe deficiencies or limitations in the existing database for relevant components of the environment; and
f) explain the approach and methods used to identify and assess cumulative effects, including cooperative opportunities and initiatives undertaken to further the collective understanding of cumulative effects, and provide a record of relevant assumptions, confidence in data and analysis to support conclusions.

4.5 EIA Study Area

The EIA Study Area shall include the PDA and associated infrastructure, as well as the spatial and temporal areas of individual environmental components outside the PDA boundaries where an effect can be reasonably expected. The EIA Study Area includes both Regional and Local Study Areas.

Illustrate boundaries and identify the Study Areas chosen to assess effects. Define temporal and spatial boundaries for the Study Areas. Maps of these areas shall include township and range lines for easy identification and comparisons with other information within the EIA report. Describe the rationale and assumptions used in establishing the Study Area boundaries, including those related to cumulative effects.

4.6 Climate and Air Quality

Discuss baseline climatic and air quality conditions. Review emission sources and discuss emissions from industrial development within the EIA Study Areas. Consider emission point sources as well as fugitive and mobile emissions. Identify components of the Project that will affect air quality from a local and regional perspective, and:

a) identify any regional air monitoring in the area and describe AST's participation in regional forums (e.g., Northeast Capital Industrial Association, Fort Air Partnership);
b) discuss appropriate air quality parameters such as SO_2, carbon monoxide (CO), H_2S, NO_x and particulates ($PM_{2.5}/_{10}$) (specifically including, but not limited to, sulphur compounds), and O_3, volatile organic compounds (VOC), and polycyclic aromatic hydrocarbons (PAH);
c) estimate ground-level concentrations of appropriate air quality parameters. Discuss any expected changes to particulate deposition or acidic deposition (PAI) patterns. Justify the selection of models used and identify any model shortcomings or constraints on findings. Complete modeling in accordance with Alberta Environment's Air Quality Model Guideline. Include model input files;
d) identify the potential for reduced air quality (including odors and visibility) resulting from the Project and discuss any implications of the expected air quality for environmental protection and public health;
e) discuss interactive effects that may occur as a result of co-exposure of a receptor to all emissions and discuss limitations in the present understanding of this subject;
f) describe how air quality impacts resulting from the Project will be mitigated;
g) identify ambient air quality monitoring and receptor monitoring that will be conducted during operation of the Project to assess air quality and the effectiveness of mitigation;
h) assess Project specific air quality and cumulative air quality impacts, and implications for other environmental resources, including habitat diversity and quantity, vegetation resources, water quality and soil conservation. Discuss the relative contribution of the Project (e.g., after mitigation) to regional cumulative effects.
i) Assess the cumulative effects on the air quality of the EIA Study Area and include any related emissions increases from the Project; and
j) Describe the monitoring programs AST will implement to assess air quality and the effectiveness of mitigation during the Project's development operation.

4.6.1 Climate Change

Discuss the following:

a) review and discuss climate change and the local and/or regional, inter-provincial/territorial changes to environmental conditions resulting from climate conditions, including trends and projections where available;
b) identify stages or elements of the Project that are sensitive to changes or variability in climate parameters. Discuss what impacts the change to climate parameters may have on elements of the Project that are sensitive to climate parameters; and
c) comment on the adaptability of the Project in the event the region's climate changes. Discuss any follow-up programs and adaptive management considerations.

4.7 Noise and Light

Discuss baseline noise and light level conditions. Identify components of the Project that will affect noise and light level, and:

a) present the results of a noise assessment based on existing conditions as specified by EUB ID 98-08, Noise Control Directive, including:
    i. an estimate of the potential for increased noise resulting from the Project;
    ii. the identification of potentially-affected people and wildlife, and
    iii. the implications of any increased noise levels;
b) identify facilities that will affect light levels at night and evaluate the potential effects of increased light on affected residents; and
c) discuss the effects and mitigative measures to be utilized to minimize the production of noise and light.

4.8 Land Use and Reclamation

Review current land use issues and identify the anticipated changes in nature, location and duration of land use as a result of the Project. Discuss:

a) conformity with land use objectives and planning parameters for the Lamont County, Alberta's Industrial Heartland Area Structure Plan;
b) potential Project impact on local and regional land use management, residential areas, agricultural development, areas with native vegetation, wildlife habitat, recreation uses, and other industrial uses in the region;
c) mitigation plans to minimize these effects; and
d) reclamation concepts and objectives. Develop a conceptual reclamation/closure plan for the PDA considering regulatory requirements, stakeholder input, land use objectives and other factors necessary for a reclamation plan to be implemented.

Discuss how the reclamation/closure plan design will:

e) assess for and mitigate/remediate on-site contamination;
f) return equivalent land capability as compared to pre-disturbance conditions;
g) integrate the proposed landscape with the surrounding landscapes including inter-connectivity to the surrounding landscapes;

h) integrate surface- and near-surface drainage within the PDA; and
i) be incorporated into planning and development of the Project.

Provide and discuss:

j) the anticipated timeframes for completion of reclamation activities;
k) the applicable parameters that should be used to monitor and evaluate the reclaimed land;
l) any constraints to reclamation such as timing of activities, availability of materials and influence of natural processes and cycles;
m) any soil-related constraints or limitations that may affect reclamation; and
n) specifically discuss the feasibility of the methods prescribed for reclamation (i.e., their proven success in trials or other locations).

4.9 Terrestrial

4.9.1 General Terrestrial Considerations

Review current biophysical conditions and identify the nature, location and duration of changes anticipated as a result of the Project. Provide and discuss the following:

a) maps indicating the pre-disturbance landscape, elevation and drainage patterns of the Study Areas;
b) an assessment of the anticipated changes to the pre-disturbed topography, elevation and drainage patterns of the Study Areas;
c) baseline biophysical conditions, including topography, soil and vegetation characteristics and wildlife capability within the Study Area. Conduct the necessary surveys to characterize the biophysical resources in the Study Area and to assist in reclamation planning;
d) components of the Project that will potentially affect these biophysical resources including soils, vegetation, wildlife and biodiversity;
e) mitigation plans to minimize these effects; and
f) an assessment of the relative contribution of the Project (after mitigation) to regional cumulative pressures on biophysical resources (e.g., Project contributions to cumulative potential acid input [PAI]);

4.9.2 Soil

Provide the following:

a) Describe and map the soil types and their distribution according to the Soil Survey Handbook, Vol. 1 (Agriculture Canada, 1987) and The Canadian System of Soil Classification Third Edition (Agriculture and Agri-Food Canada, 1998) including the following soil survey intensity levels;
    i. SIL (survey intensity level) 1 for the PDA area and any areas that may be subject to future disturbance by the Project such as borrows, rail spurs, access roads etc;
    ii. SIL 2 for the Local Study Area; and
    iii. Appropriate level of detail to determine the effect of the Project on soil types and quality in the Regional Study Area.

b) characterize the pre-disturbance morphological, physical and chemical properties of the soil types and assess the pre-disturbance soil capability classes;
c) develop a soil conservation and reclamation plan for the PDA including re-vegetation and weed management plans. Describe the suitability and availability of soil materials within the Study Areas for reclamation. Outline the criteria to be used in salvaging and storing soils. Describe the procedures for soil handling storage and long-term management of soil intended for reclamation within the PDA. Provide siting criteria for and location of soil stockpiles and describe how they will be managed;
d) assess the sensitivity of local and regional soils to acidic deposition by: including baseline information as outlined in Appendix A-7 (Soil Monitoring Guidelines) of AENV's Air Monitoring Directive (1996);
    i. Discussing sensitivity of soils to wet and dry acidic deposition in the local and regional study areas for baseline, application and cumulative scenarios;
    ii. Explaining the methods used to assess sensitive soils and include information from grid cell sensitivity assessments that may be available for the study area;
    iii. Using modeled PAI for the baseline, application and cumulative scenarios, describe the soils that would exceed CASA's recommended critical loads in the Local and Regional Study areas, including maps showing their spatial distribution;
    iv. Outlining any existing monitoring information such as AENV's long term soil acidification study and any regional initiatives (NCIA) for acidic deposition.
e) identify any activities associated with the Project, which may cause soil contamination or soil deterioration at the local and regional scale including acid deposition and discuss mitigation strategies to reduce potential impact; and
f) discuss the regulatory requirements for soil monitoring or soil management for potential impacts of the Project to soils in the development area and areas that may be potentially affected.

4.9.3 Vegetation

Provide the following:
a) Conduct an inventory, map and describe the existing terrestrial, wetland and aquatic vegetation. Include any rare vascular and non-vascular plant species and rare plant communities in the Study Areas, including data from historical records as well as any surveys for the purpose of this EIA;
b) describe and assess potential impacts of the Project construction and operation on vegetation (abundance, diversity, health, rare species and rare plant communities in the Study Areas) including cumulative impacts of acidifying and other air emissions;
c) describe and discuss measures to be implemented to mitigate and monitor potential impacts of the Project on vegetation in the Study Areas; and

d) discuss how vegetation monitoring programs will be used to adaptively manage the mitigation measures and monitoring programs.

4.9.4 Wildlife

Describe existing wildlife resources (amphibians, reptiles, birds and terrestrial and aquatic mammals), their use and potential use of habitats in the Study Areas. Document the anticipated changes to wildlife in the Study Areas. Specifically:

a) document and describe species of conservation concern found within the Study Area, using recognized survey protocols;
b) describe and assess potential impacts of the Project on wildlife species found in the Study Areas, including impacts on critical habitat, habitat availability and quality, and habitat fragmentation and loss. These impacts should be described for the various phases of the Project both locally and cumulatively with other activities in the Study Areas;
c) proposed strategies to minimize and/or mitigate impacts on the species and their habitats that are found in the Study Areas. These strategies should be tailored to the various phases of the Project and meet the expectations of relevant wildlife legislation;
d) identify and discuss proposed monitoring programs that will be implemented during various phases of the Project to evaluate the effectiveness of mitigative strategies to reduce impacts to the species and their habitats that are found in the Study Areas. Describe how the results from the monitoring programs will also be used to evaluate the effectiveness of the programs themselves; and
e) discuss any existing wildlife studies that may be occurring in the Study Areas and how AST plans to integrate its operational and mitigation activities with those studies.

4.9.5 Biodiversity and Fragmentation

Provide the following:

a) Discuss how the impacts defined in the EIA report could affect local and regional biodiversity and habitat fragmentation, both Project specific and cumulatively. Use quantitative data where possible to describe the potential effects on biodiversity and habitat;
b) discuss the contribution of the Project to any anticipated changes in regional biodiversity, including measures to minimize such changes;
c) discuss how AST's plans for mitigation and monitoring will meet the expectations of Sustaining Alberta's Biodiversity An Overview of Government of Alberta Initiatives Supporting the Canadian Biodiversity Strategy (Alberta Environmental Protection, 1998);
d) determine the current and proposed level of habitat fragmentation for the Study Areas;
e) describe the techniques used in the fragmentation analysis;
f) identify and evaluate the extent of potential effects from fragmentation (e.g., disruption of movement corridors) that may result from the Project; and

g) discuss measures to mitigate, monitor and reclaim impacts from fragmentation.

4.10 Surface Water and Groundwater

4.10.1 Surface Water Hydrology and Quality

Discuss baseline surface hydrology conditions. Identify components of the Project that will affect these conditions from a local and regional perspective. Discuss:

a) existing drainage patterns, surface water bodies, and wetlands within local and regional Study Areas, and the seasonal flow/water level characteristics of these water bodies;
b) Project-related temporary and permanent alterations to these drainage patterns, water bodies and wetlands;
c) possible water diversions from and return flows to these drainage channels, water bodies and wetlands under a variety of operating conditions and scenarios including, emergency conditions, low flow, or drought conditions;
d) effects of site runoff management on flow/level characteristics and aquatic functions in these drainage channels, water bodies and wetlands;
e) mitigation plans to minimize these effects;
f) the relative contribution by the Project (after mitigation) to regional cumulative pressures on surface water resources; and
g) a monitoring program to assess hydrological impacts and assess performance of mitigation plans and water management systems.
h) baseline surface water quality;
i) water quality of watercourses and water bodies in the Study Areas before and after Project development and operation. The description of water quality will consider all appropriate water quality parameters, (e.g., temperature, pH, conductivity, cations and anions, metals, dissolved oxygen, suspended sediment, dissolved solids, nutrients and other water contaminants) their seasonal variations and relationships to flow and other controlling factors, and a summary of existing water quality data including necessary surveys to characterize water quality of watercourses and water bodies in the Study Areas;
j) the significant and potential impacts to surface water quality within the Study Areas resulting from the Project, including site runoff and Project-related wastewater discharges, that may indicate a potential adverse effect or exceedance of the Surface Water Quality Guidelines for Use in Alberta (November 1999) or Canadian Water Quality Guidelines;
k) the potential Project related and cumulative impacts of acidifying and other air emissions on surface water quality;
l) effects of site runoff on water quality in surface waterbodies within the Study Area;
m) the impacts to surface water quality within the Study Areas due to the change in groundwater movement, spills and contaminated groundwater resulting from spills;
n) mitigation plans to minimize these effects during the construction, operation and reclamation phases of the Project;

o) a plan and implementation program for the protection of surface water quality, addressing the following:
    i. surface water monitoring program for early detection of potential contamination and assistance in remediation planning;
    ii. surface water remediation options to be considered for implementation in the event that adverse effects are detected; and
    iii. the relative contribution of the Project (after mitigation) to regional cumulative effects on surface water quality of watercourses and water bodies in the Study Areas (e.g., Project contributions to lake acidification).

4.10.2 Groundwater Quantity and Quality

Discuss baseline groundwater conditions and identify components (e.g., dewatering, well supply) of the Project that will affect groundwater from a local and regional perspective. Provide the following:

a) a discussion of the characteristics of major geological units and their function as potential aquifers, aquitards, and aquicludes in the Study Area;
b) lithologic and stratigraphic continuity of the geologic units in the Study Area;
c) hydrogeologic information including hydraulic properties, hydraulic heads, flow direction, velocity and connectivity with surface water bodies of the geologic units;
d) baseline groundwater quantity and quality information of the hydrogeologic units in the Study Area;
e) maps and cross-sections that include the water table and piezometric surfaces based on identifiable hydrogeologic units and accurate data sources, such as drill holes;
f) results of any new hydrogeological investigations, including methodology;
g) an inventory of groundwater users in the Study Area. Identify potential groundwater use conflicts and possible means to resolve these conflicts;
h) an assessment of potential effects of water withdrawal on groundwater levels, effects on local and regional groundwater regimes, including vertical gradients and discharge areas;
i) an assessment of the effects of groundwater withdrawal/dewatering and its implications for other environmental resources, including flows and water levels in local streams, water wells, wetlands, vegetation and soil saturation;
j) an assessment of potential effects of Project-related activities and surface releases (e.g., accidental contaminant spills) and down-hole wastewater on groundwater quality;
k) justification for the selection of hydrogeologic models used, including identifying any model shortcomings or constraints on findings, and any surrogate parameters that were used as indicators of potential aquifer contamination due to the Project;
l) a plan and implementation program for the protection of groundwater resources, addressing the following:

i. groundwater monitoring program for early detection of potential contamination and assistance in remediation planning;
ii. groundwater remediation options to be considered for implementation in the event that adverse effects are detected; and
iii. monitoring the sustainability of groundwater production and dewatering effects.

4.11 Aquatic Resources

Identify components of the Project that will affect baseline conditions from a local and regional perspective. Discuss:

a) baseline aquatic resource conditions, including fish and benthic invertebrate habitat capability and their characteristics in water bodies within the Study Area. Conduct the necessary surveys to characterize the aquatic resources in the PDA and any potential changes that could occur in this component of the aquatic ecosystem in the Study Area(s) as a result of the Project;
b) components of the Project that will potentially affect aquatic resources within the Study Area, potential impacts of these components and their significance;
c) cumulative effects of the impacts that already exist and potential Project-related impacts on the aquatic resources in relevant water bodies;
d) mitigation plans to minimize these effects;
e) an assessment of the relative contribution of the Project (after mitigation) to regional cumulative effects on aquatic resources (e.g., Project contributions to lake acidification);
f) the potential for contamination of fish by wastewater discharges relative to fish consumption guidelines; and
g) programs to monitor aquatic habitat quality and the effectiveness of mitigation strategies.

5. ENVIRONMENTAL EFFECTS MONITORING

Describe environmental effects monitoring (EEM) activities that AST will undertake to manage effects, and confirm the performance of mitigative measures. Specifically addressing:

a) monitoring activities and initiatives that AST is proposing to conduct independently of other stakeholder activities in the region;
b) monitoring activities that AST is proposing to conduct collaboratively with other stakeholders. Include in this discussion the role that AST anticipates taking in each of the programs. With respect to groundwater monitoring, discuss AST's participation in the Regional Groundwater Quality Study of the Beverly Channel in the Fort Saskatchewan area managed by the Northeast Capital Industrial Association (NCIA); and
c) mechanisms for sharing results, reviewing findings, and adjusting programs should monitoring identify unanticipated consequences of AST's operations or mitigation plans, including:
    i. corporate adaptive management strategies; and
    ii. consultation with regulators, public stakeholders, and, if necessary, regional management forums.

6. PUBLIC HEALTH AND SAFETY

Describe those aspects of the Project that may have implications for public health or the delivery of health care services. Determine whether there may be implications for public health arising from the Project. Specifically:

a) identify and discuss the data and methods used by AST to assess the impacts of the Project on human health and safety;
b) assess the potential health implications of the compounds that will be released to the environment from the proposed operation in relation to exposure limits established to prevent acute and chronic adverse effects on human health;
c) identify the human health impact of potential contamination of country foods and natural food sources taking into consideration all Project activities;
d) provide information on samples of selected species of vegetation known to be consumed by humans;
e) discuss the potential to increase human exposure to contaminants from changes to water quality, air quality and soil quality taking into consideration all Project activities;
f) document health concerns identified by Aboriginal stakeholders;
g) assess cumulative health effects to receptors, that are likely to result from the Project in combination with other existing, approved, and planned projects;
h) as appropriate, identify anticipated follow-up work, including regional cooperative studies. Identify how such work will be implemented and coordinated with ongoing air, soil and water quality initiatives;
i) identify and discuss potential health and safety impacts due to higher regional traffic volumes and the increased risk of accidental leaks and spills;
j) document health and safety concerns raised by stakeholders during the consultation on the Project;
k) provide a summary of AST's emergency response plan and discuss mitigation plans that will be implemented to ensure workforce and public safety during pre-construction, construction, operation and reclamation of the Project. Include prevention and safety measures for wildfire occurrences, accidental release or spill of chemicals to the environment and failures of structures retaining water or fluid wastes;
l) describe how local residents will be contacted during an emergency and what type of information will be communicated to them;
m) describe existing agreements with area municipalities or industry groups such as, safety co-operatives, emergency response associations and municipal emergency response agencies;
n) describe and discuss the impacts of the proposed Project on potential shortages of affordable housing and the quality of health care services. Identify and discuss the mitigation plans that will be undertaken to address these issues. Provide a summary of any discussions that have taken place with the Municipality and the Regional Health Authority concerning potential housing shortages and health care services respectively.

7. HISTORICAL RESOURCES

Provide the following:

a) evidence of consultation with and clearance from Alberta Community Development; and

b) a general overview of the results of any previous historical resource studies that have been conducted in the historical resources Study Area, including archaeological resources, palaeontological resources, historic period sites, and any other historical resources as defined within the *Historical Resources Act*.

8. SOCIO-ECONOMIC FACTORS

Provide information on the economic effects of the Project. Specifically, provide and address the following:

a) the number and distribution of people who may be affected by the Project;

b) information on the economic status of the area and the contribution of the proposed development;

c) information on the social impacts of the Project on the Study Area and on Alberta including:
   i. local employment and training;
   ii. local procurement;
   iii. population changes;
   iv. demands on local services and infrastructure; and
   v. regional and provincial economic benefits;

d) identify components of the Project that may be considered a nuisance and negatively impact to individuals identified in a) and AST's plans to mitigate these nuisances;

e) the impacts of the Project during construction and operation phases, to transportation planning, traffic and local services;

f) the economic impacts of the Project on the Study Area and on Alberta, having regard for capital, labor, and other operating costs and revenue from services;

g) AST's policies and programs respecting the use of local, Alberta, and Canadian goods and services;

h) an estimated breakdown of Alberta, other Canadian and non-Canadian industrial benefits for Project management/engineering; equipment and materials; construction labor, and total overall Project;

i) the employment and business development opportunities the Project may create for local communities and the region;

j) any existing employment and business opportunities that may be *negatively* affected as a result of the Project;

k) a breakdown of the labor force, type of employment, and number of employees with respect for the construction and operational workforces. Identify when the peaks in labor requirements will occur, the extent of the peaks and the source of labor for the Project; and

l) impacts of the proposed Project on potential shortages of affordable housing and the quality of health care services. Identify and discuss the mitigation plans to address these issues. Provide a summary of any discussions that have taken place with the Municipality and the Regional Health Authority concerning potential housing shortages and health care services respectively.

9. PUBLIC CONSULTATION REQUIREMENTS

AST shall undertake a consultation program during the preparation of the EIA report and within all of the communities, in the Study Area.

Describe and document in detail the public consultation program implemented with respect to the Project, record any concerns or suggestions made by the public, and demonstrate how these concerns have been addressed, including:

a) the type of information provided and the issues discussed, differentiating between those which have been resolved and any outstanding issues;
b) the key alternatives which have been identified by AST and stakeholders in the consideration of unresolved issues; and,
c) any plans for ongoing consultations.

Volume I: Project Description

Appendix II: Glossary and Acronym List

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1. Glossary and Acronym List

Acronym	Definition
$(NH_4)_2SO_4$	ammonium sulphate
35-55-20-W4M	Section 35, Township 55, Range 20, West of the 4th Meridian (the Site)
A	symbol for hole area from the action leakage rate formula
A	cross-sectional area available for flow
A1	Agricultural Use Area 1
A2	Agricultural Use Area 2
AAAQO	Alberta Ambient Air Quality Objectives
AADT	average annual daily traffic
AAF	Alberta Agriculture and Food
AAFRD	Alberta Agriculture Food and Rural Development
abiotic	not biological; not involving or produced by organisms
ACD	Alberta Community Development
acid	molecule that is able to give up a proton (H^+) to, or accept electrons from, a base; gives a solution with a pH of less than 7
acidification	reduction of the pH of soil, waterways and lakes
adaptive planning	flexibility built into design and layout to accommodate future modifications required by changed standards, limits and guidelines
AENV	Alberta Environment
aerobic bacteria	bacteria that require oxygen to survive and grow
AET	areal evapotranspiration
AFSC	Agricultural Financial Services Corporation
AIH	Alberta Industrial Heartland: a large industrial centre in central Alberta including Edmonton, Fort Saskatchewan, Strathcona County, Sturgeon County and Lamont County
AII	industrial total
ALF	available labour force
ALR	action leakage rate – leakage expected to occur through a synthetic impermeable liner having 2 holes of 2 mm in diameter every 1-ha of area
alumina catalyst	medium used to regenerate and recycle amines used to adsorb hydrogen sulphide gas
amine units	process units used to remove hydrogen sulphide from a gaseous process stream using amine compounds
anaerobic bacteria	bacteria that do not require oxygen to survive and grow
ANC	acid-neutralizing capacity
ANHIC	Alberta Natural Heritage Information Centre
ANPC	Alberta Native Plant Council
AO	aesthetic objectives

Acronym	Definition
APA	Agricultural Policy Area
API	American Petroleum Institute
aquatics	aquatic resource conditions, including fish and benthic invertebrate habitat capability and their characteristics in waterbodies
aquifer	an underground porous geological formation that stores or carries water
ARET	accelerated reduction/elimination of toxics
ASIC	Alberta Soil Information Centre
ASL	ambient sound level
ASP	Alberta's Industrial Heartland Area Structure Plan/Lamont County
asphalt bulk sulphur storage pad	storage pad used to stockpile formed sulphur pastilles in preparation for shipment
ASRD	Alberta Sustainable Resource Development
ASRL	Alberta Sulphur Research Ltd.
AST	Alberta Sulphur Terminals Ltd.
ASWQ	Alberta Surface Water Quality
AVI	Alberta Vegetation Inventory
AWI	Alberta Wetland Inventory
BC MWLAP	British Columbia Ministry of Environment, Lands and Parks
bioavailability	the degree to which toxic substances or other pollutants present in the environment are available to potentially biodegradative microorganisms
bitumen upgrader	term used for a refining facility that converts bitumen (heavy oil) into a lighter grade synthetic oil that can be further refined to make useable products such as gasoline and diesel
BSL	basic sound level
BTEX	benzene, toluene, ethylbenzene and xylenes
buffer	a solution or liquid with a chemical constitution allowing it to neutralize acids or bases without a great change in pH
^{o}C	degrees Celsius
CA	annual crop total
Ca^{2+}	calcium ion
$CaCO_3$	calcium carbonate
CALPUFF	California Puff Model
camlock	fitting used to quick-connect pipes and hoses
CanSIS	Canadian Soil Information System
capital spending	expenditures by a company for plant and equipment
carbonate alkalinity	carbonate alkalinity is a measure of the amount of negative carbonate and bicarbonate ions in solution

Acronym	Definition
CASA	Clean Air Strategic Alliance
CCME	Canadian Council of Ministers of the Environment
CCS	CCS Income Trust
CCS	Canadian Crude Separators
CDWQG	Canadian Drinking Water Quality Guidelines
CEA	cumulative effects assessment
CEPA	Canadian Environmental Protection Act
CGCM3	Coupled Global Climate Model 3
Class II waste disposal facility	landfill facility that is designed and permitted to dispose of non-hazardous solid wastes in the Province of Alberta
clay soil liner	low permeability containment layer constructed using compacted clay soil
CLU	contemporary land use
cm	centimetre
cm y^{-1}	centimetres per year
CN	Canadian National Railway
CNR	Command Notification System
CO	carbon monoxide
CO_2	carbon dioxide
CO_3^{2-}	carbonate ion
COD	chemical oxygen demand – used to indirectly measure the amount of organic compounds in water
collection hopper	receptacle that collects formed sulphur pastilles and directs those pastilles onto a conveyor belt
Compliance Source Emissions Testing	testing implemented on sources of air emissions, such as combustion stacks, to verify that those emissions comply with regulated standards
conditioning unit	unit in the sulphur forming process that regulates the rate and temperature of the liquid sulphur that is fed into the process
COPC	chemicals of potential concern
COSEWIC	Committee on the Status of Endangered Wildlife
CP	perennial crop total
CPNVI	Central Parkland Native Vegetation Inventory
CPR	Canadian Pacific Railway
CPR1	cardiopulmonary resuscitation
CPR2	uncultivated pasture total
CPUE	catch per unit effort
CR	concentration ratio
CSA	Canada Standards Association

Acronym	Definition
CSL	comprehensive sound level
CWQ	Canadian Water Quality
CWS	Canada-wide Standards
dBA	A-weighted decibel
dBC	C-weighted sound levels
degassed sulphur	sulphur that contains less than 10 ppm by weight of hydrogen sulphide
DFO	Department of Fisheries and Oceans
DO	dissolved oxygen
DOC	dissolved organic carbon
double containment system	containment system for storing potentially hazardous liquids that includes two independent containment layers
draw down tube	tube used to control (reduce) fluid levels in a containment vessel
duplex filter	filter designed to remove two types of impurities, such as particulate and organic matter
dust suppression package	process component that suppresses dust that may be emitted to atmosphere at a material transfer point
EC	electrical conductivity
EC20	concentration that affects 20% of text organisms
EC50	concentration that affects 50% of test organisms
EIA	Environmental Impact Assessment
elemental	a pure substance that cannot be broken down into different kinds of matter
emergency response	the action taken after an event to minimize the consequences of an emergency
EMS	environmental management system
EMS	Emergency Medical Services
EOC	Emergency Operations System
EPEA	*Environmental Protection and Enhancement Act*
ER	exposure ratio
ERP	Emergency Response Plan
ESA	Environmental Significant Areas
EUB	Alberta Energy and Utilities Board
FAP	Fort Air Partnership
feed tank	tank at the beginning of the sulphur processing system that is used to control the rate of sulphur feed to the forming process
ferrous iron	iron with an oxidation number of +2
fish/trap-hour	fish catch rate; fish caught per hour
FMZ	Fur Management Zone
FOLC	The Friends of Lamont County for Responsible Industrial and Community Development
FONG	open, non-patterned graminoid dominated fen

Acronym	Definition
formed sulphur	sulphur that has been formed into solid pastilles using the Rotoformer process
fugitive dust	dust that is not emitted from definable point sources
fugitive sulphur emissions	sulphur emissions that are not emitted from definable point sources
FWHIS	Fish and Wildlife Historical Information System
g	the gravitational constant (9.8 m/s^2)
g s^{-1}	grams per second
GHG	greenhouse gases
GIS	geographic information system
GJ/mon	gigajoules per month
gm/t	grams per tonne
groundwater	water beneath the earth's surface in underground streams and aquifers
gypsum	a soft white mineral composed of hydrous sulfate of lime
H	Hour
H&S	Health and safety
H^+	hydrogen ion; the symbol for a proton
H_2CO_3	carbonic acid
H_2O	Water
H_2S	hydrogen sulphide
H_2SO_4	hydrogen sulphate
ha	hectare
HADD	harmful alteration, disruption, or destruction of fish habitat
HAZCO	HAZCO Environmental Services
HCO_3	bicarbonate
HDPE	high density polyethylene
HEC	human equivalent condition
HHRA	Human Health Risk Assessment
HNO_3	nitric acid
HP	horsepower
HRIA	Historical Resources Impact Assessment
HRV	historical resources value
hw	the symbol for liquid depth from the action leakage rate formula
hydraulic conductivity	the extent to which a given substance allows water to flow through it
hydrogen plant feedstock	plant that is used to generated hydrogen gas, which is in turn used in the heavy oil upgrading and/or oil refining process
hydrogeological	pertaining to the geology of ground water with emphasis on its chemistry and movement

Acronym	Definition
i	hydraulic gradient in the surficial deposits
I/C	Industrial/Commercial District
ICS	Incident Command System
infrastructure	basic facilities, such as transportation, communications, power supplies and buildings, that enable an organization, project or community to function
interstitial water	subsurface water contained in pore spaces between grains of rock and sediment
IPCC	Intergovernmental Panel on Climate Change
ISQG	Interim Freshwater Sediment Quality Guidelines
ITE	Institute of Transportation Engineers
K	hydraulic conductivity
K	degrees Kelvin
K^+	potassium ion
keq H^+/(ha•y)	kiloequivalents of hydrogen ions per hectare per year
kg	kilogram
kg s^{-1}	kilograms per second
kg/d	kilograms per day
kg/ha/y	kilograms per hectare per year
kg/t	kilograms per tonne
km	kilometres
km/h^{-1}	kilometres per hour
km^2	square kilometre
kPa	kiloPascals
kraft pulp	pulp produced by a process where the active cooking agent is a mixture of sodium hydroxide and sodium sulphide
Kw	kilowatt
L/min	litres per minute
L/s	litres per second
LCC	Lamont County Council
Le Chatelier's Principal	used to predict the effect of changing the amount of reactants, products, temperature or system volume on the composition of a chemical system at equilibrium
leak detection layer	layer located between the primary and secondary containment layers that is used to monitor the integrity of the primary containment layer
LEK	local environmental knowledge
L_{eq}	energy equivalent sound level
Level I fire	minor fire that can be isolated or controlled and is not of a serious nature
Level II fire	fire that cannot be isolated or controlled, but can be managed by local fire and emergency response service

Acronym	Definition
Level III fire	fire that cannot be isolated or controlled and cannot be managed by local fire and emergency response service
L_{max}	maximum sound level for a given time period
load out conveyor	conveyor used to transfer formed sulphur onto rail cars
LOAEL	lowest observed adverse effect level
LOS	level of service
LSA	Local Study Area
LST	local standard time
LUB	Land Use Bylaw
LZ	landing zone
m	metre
m/m	metres per minute
m/s^{-1}	metres per second
m/y	metres per year
m^2	metres squared
m^2/day	metres squared per day
m^3	cubic metres
m^3 h^{-1}	cubic metres per hour
m^3/day	metres cubed per day
m^3/s	metres cubed per second
m^3/y	metres cubed per year
MAC	maximum acceptable concentrations
Man-hours	number of workers multiplied by hours worked
masl	metres above sea level
mbgs	metres below ground surface
MDBP	Municipal Development Plan Bylaw
meq	milliequivalents
meq/L	milliequivalents per litre
metallic sulfides	compounds formed by metal elements bonding to sulphides
metering pump assembly	process unit that measures flow volumes and rates through a pump
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mg/m^3	milligrams per cubic metre
Mg^{2+}	magnesium ion
mitigation	any action taken to permanently eliminate or reduce the long-term risk to human life, property and function from hazards

Acronym	Definition
mL	millilitre
mL/minute	millilitres per minute
mm	millimetre
mm day^{-1}	millimetres per day
mm/y	millimetres per year
MP	McElroy-Pooler dispersion coefficient
MPC	Municipal Planning Commission
MPOI	maximum points of infringement
MRL	minimal risk limit
MSDS	Material Safety Data Sheets
MVC	motor-vehicle collisions
MWH/mon	power flux per month
N	Nitrogen
n	number of individuals
n.d.	not defined
n/a	not applicable
Na^+	sodium ion
NAAQO	National Ambient Air Quality Objectives
$NaHCO_3$	sodium bicarbonate
NCIA	Northeast Capital Industrial Association
Ne	effective porosity
neutralization sludge	sludge formed by the neutralization of sulphuric acid using either caustic soda or lime
NGO	non-governmental organizations
NH_4NO_3	ammonium nitrate
NIA	noise impact assessment
NO	nitric oxide
NO_2	nitrogen dioxide
NO_2^-	nitrite ion
NO_3^-	nitrate ion
NOAEL	no observed adverse effect level
NO_x	nitrogen oxides
NPRI	National Pollutants Release Inventory
NR CAER	Northeast Region Community Awareness and Emergency Response
NRC	Natural Regions Committee
NRCB	Natural Resources Conservation Board
NTU	nephelometric turbidity unit

Acronym	Definition
O_2	oxygen
O_3	ozone
OEL	Occupational Exposure Limit
off-specification sulphur	sulphur that does not comply with shipping specifications either because of excessive mineral or organic content
OH^-	hydroxide ion
OM	organic matter
oxidation	the removal of electrons from an element or compound
ozone precursors	chemical compounds, such as carbon monoxide, methane, non-methane hydrocarbons and nitrogen oxides, which in the presence of solar radiation react with other chemical compounds to form ozone
PAH	polycyclic aromatic hydrocarbons
PAI	potential acid input
PDA	Principal Development Area
PEL	probable effect levels
PEMS	Prairie Emergency Medical Systems
PET	potential evapotranspiration
PFRA	Prairie Farm Rehabilitation Administration
PG	Pasquill-Gifford dispersion coefficient or atmospheric stability class
pH	measure of the acidity or basicity (alkalinity) of a material when dissolved in water
piezometer	instrument which measures hydraulic pressures
PM_{10}	particulate matter with mean aerodynamical diameter less than 10 µm
$PM_{2.5}$	particulate matter with mean aerodynamical diameter less than 2.5 µm
PPE	personal protective equipment
ppb	parts per billion
ppm	parts per million
precipitate	separate as a fine suspension of solid particles
protons	positively charged particles forming part of atomic nuclei
psi	pounds per square inch
PSL	permissible sound level
pump hanger	device for vertically positioning a pump
PW	pumping well
Q	symbol for action leakage rate from the action leakage rate formula; groundwater contributions
QA	quality assurance
QC	quality control
R.R.	Range Road

Acronym	Definition
radial stacking conveyor	conveyor that places formed sulphur in a radial pattern
rail transfer loop	rail line placed in an approximately circular pattern
RCMP	Royal Canadian Mounted Police
Rd	road
Receiving tank	tank used to receive liquid sulphur delivered by rail or truck
recirculation loop	water circulation loop that returns spent cooling water to the start of the cooling water circuit
reduction	addition of electrons to an element or compound
RELAD	Regional Lagrangian Acid Deposition
RfC	reference condition
RGDR	regional gas dosimetry ratio
Rotoform emissions	particulate sulphur emissions for the Rotoform process
ROW	right(s) of way
RSA	Regional Study Area
runoff control system	system of ditches and culverts used to collect runoff from the sulphur processing area to the stormwater collection pond
S	Sulphur
s^{-1}	per second
S_2O_3	thiosulfate
SABA	supplied air breathing apparatus
Sandvik Rotoform process	sulphur forming process developed and patented by Sandvik and referred to as the Rotoform process
SAR	sodium adsorption ratio
SAR	species at risk
SARA	*Species at Risk Act*
saturated	most concentrated solution possible at a given temperature
SCA	soil correlation area
SCBA	self-contained breathing apparatus
SEIA	Socio-Economic Impact Assessment
SIL	survey intensity level
Site	Section 35-55-20 W4M
S^o	symbol for elemental sulphur
SO_2	sulphur dioxide
SO_4^{2-}	sulphate ion
sour gas	hydrogen sulfide gas; H_2S
SO_x	sulphur oxides
specific gravity	the ratio of the density of a material to the density of water

Acronym	Definition
spontaneous combustion	self-ignition of combustible material through the chemical action of its parts
stakeholders	people or organizations with an interest or share in an undertaking, such as a commercial venture
sulphur acidification	lowering of pH in soils or water by sulphur dioxide
sulphur forming	process of converting liquid sulphur into solid sulphur particles
sulphur pastille	sulphur pastilles of uniform shape, stability and quality formed by the Sandvik Rotoform process
sulphur recovery	separation and recovery of sulphur from a hydrocarbon refining process
sulphur train	a train used to convey liquid or solid sulphur
sulphuric acid	a strong acid; H_2SO_4
surface water	water that flows in streams and rivers, natural lakes, in wetlands, and in reservoirs constructed by humans
surface water runoff collection pond	pond used to collect and contain surface runoff from the sulphur forming and handling area
surge bin	bin used to collect and store surges in solid sulphur pastilles
sweet fuel gas	methane that is used as fuel and does not contain hydrogen sulphide
t/d	tonnes per day
t/y	tonnes per year
TDS	total dissolved solids
THE	total exactable hydrocarbons
temperature conditioned	sulphur that is conditioned and controlled to be in a specific temperature range
TIA	traffic impact assessment
TKN	total Kjeldahl nitrogen
TOC	total organic carbon
TOR	Terms of Reference
totalizer	metering device that totals the volume of liquid passed through that meter
TP	total phosphorus
TPH	total petroleum hydrocarbons
TRV	toxicological reference values
TSS	total suspended solids; the weight of particles suspended in water
Twp	Township
UF	urban fringe
USEPA	United States Environmental Protection Agency
USGPM	US gallons per minute
USLE	universal soil loss equation
UTM	universal transverse mercator

Acronym	Definition
V	Velocity
visible sheen	collection of hydrocarbons that is visible on the surface of a waterbody
VOC	volatile organic compounds
W4M	West of the 4th Meridian
vpd	vehicles per day
WA	*Water Act*
WCB	Workers' Compensation Board
wetland	area regularly saturated by surface water or groundwater and characterized by a prevalence of vegetation adapted for life in saturated soil conditions (e.g., swamps, bogs, fens, marshes and estuaries)
WHMIS	Workplace Hazardous Materials Information System – national chemical hazard communication system for regulation of information pertaining to hazardous materials
WMU	Wildlife Management Unit
WVC	wildlife-vehicle collisions
y	year
µeq/L	microequivalents per litre
µg m^{-3}	micrograms per cubic metre
µm	microns (micrometres)
µS/cm	Microsiemens per centimetre

Volume I: Project Description

Appendix III: Traffic Impact Assessment

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1. Introduction

1.1 Background

Alberta Sulphur Terminals Ltd. (AST) is seeking approvals for the construction and operation of a sulphur forming facility (the Project) east of Range Road (R.R.) 202 between Highway 45 and Highway 15 east of Bruderheim. AST has selected a preferred site plan in which access is obtained from the existing R.R. 202 that connects with Highway 15 approximately 3.2 km east of the intersection of Highway 45 and Highway 15.

1.2 Study Context and Scope

Given the proposed location of the Project, and the existing access relative to Highway 45 and Highway 15, Alberta Infrastructure and Transportation requested that a Transportation Impact Assessment (TIA) be completed and submitted for review prior to allowing construction of the Project. To fully understand the traffic and transportation issues, and determine an access management strategy to support the Project, AST retained Bunt and Associates to complete a TIA. The impacts of the Project on the adjacent roadway infrastructure and traffic operations are documented in this study. An original study was completed in September of 2005 and was revised this spring to reflect the latest highway traffic volumes and revised vehicular access projections for the Project.

1.3 Study Purpose

Careful consideration must be given to the incremental increase in traffic on roads accessing the highways to ensure that the function and integrity of the highway system and key intersections are maintained. The primary purpose for completing this TIA was to:

- assess anticipated travel characteristics of traffic generated by the Project
- evaluate traffic activity along Highways 45 and 15, and evaluate intersection traffic operations at key area intersections
- provide reliable guidance on the location and function of site accesses and identify any off-site improvements needed to permit the adjacent street system to satisfactorily accommodate site and off-site generated traffic

In general, the report should provide regulators with a clear appreciation of the Project's traffic characteristics including traffic generation and adjacent roadway impacts.

1.4 Study Methodology

The TIA was completed using the following methodology:

- an examination of the area around the Project with respect to existing conditions: land use, roadways, traffic conditions, peak flows and operational characteristics
- an examination of the proposed future roadway network around the Project and forecasted traffic conditions
- trip generation: estimate of future vehicular trip patterns generated to and from the Project based on the fully developed employment and manufacturing opportunities provided

- trip distribution and assignment: estimate of vehicular demands on adjacent corridors based on the proposed access management strategy, relative location of supply routes and an assignment of trip origin/destination based on the company's shipping forecasts and existing traffic flow patterns

- overall analysis and assessment of the roadway volumes within the study area to identify lane requirements, capacity restrictions and traffic impacts of the Project

2. Site Context – Area Conditions

2.1 Site Location

The Principal Development Area (PDA) and location of the proposed sulphur forming and shipping facility is on a portion of Section 35-55-20 W4M (the Site) on the north/south extension of Highway 45 (R.R. 202) approximately 2.2 km east of Bruderheim in Lamont County. The PDA is situated between two railway crossings – Canadian National (CN) to the south and the Canadian Pacific Railway (CPR) to the north. Directly west is the Town of Bruderheim. Figure III-1 illustrates the location of the Site and PDA within this sector of Lamont County. The lands surrounding the Site are largely agricultural with the exception of two active manufacturing plants:

- Triton Fabrication Services and modular assembly yard on the east side of R.R. 202 south of the Site
- Canexus Chemicals on the west side of R.R. 202 adjacent to the CN track

2.2 Existing Transportation System

2.2.1 Existing Roadway Network

The following roadways provide access to the Site via a local roadway connection (R.R. 202):

- Highway 15 runs east/west and is located south of the Site. It is a two-lane paved highway and provides direct connection to the City of Fort Saskatchewan for the Towns of Lamont and Mundare. The intersection with R.R. 202 providing access to the Project is approximately 3.2 km east of the Highway 45 intersection with Highway 15. The speed limit on this highway is 100 km/h.
- Highway 45 is a two-lane paved highway, running north/south from Highway 15 to provide access to Bruderheim. It turns and runs east/west into Bruderheim and proceeds approximately 2.2 km east of town where it curves to run north/south again and connect with Highway 38. R.R. 202 and Township Road 560 (north/south and east/west respectively) connect at the curve with the two intersections forming a triangle as shown on Figure III-1. The speed limit on Highway 45 is 100 km/h with a speed reduction to 80 km/h for the curve.
- R.R. 202 connects Highway 15 and Highway 45 crossing two railways and providing direct access to the Project. The road is a two-lane gravel roadway with a non-posted speed limit of 80 km/h.

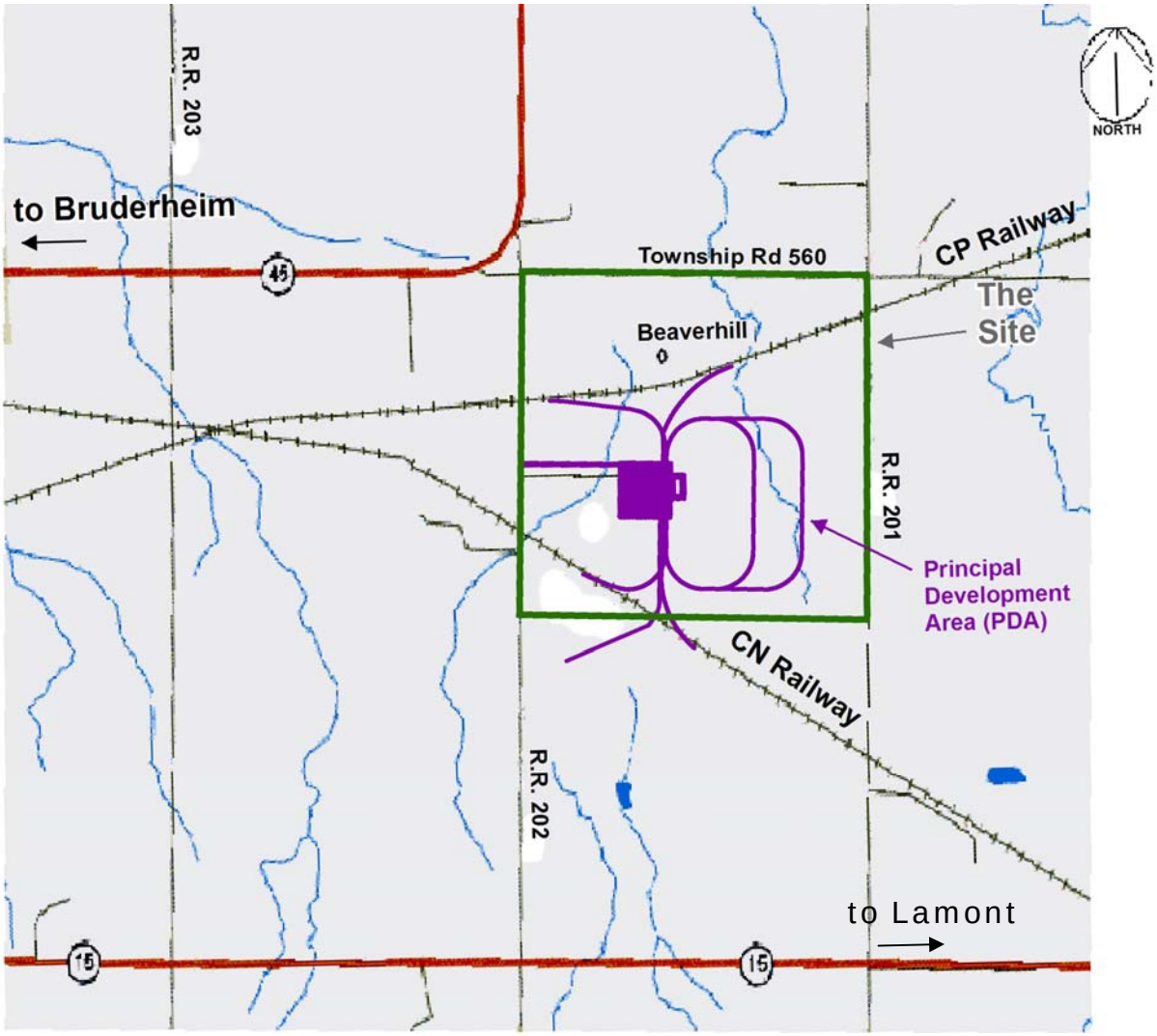


Figure III-1: Project Location and Surrounding Roadways

2.2.2 Key Intersections

This study included the intersections adjacent to or within the immediate vicinity of the Project. The key intersections are:

- R.R. 202 and Highway 45 intersection
- R.R. 202 and Highway 15 intersection

2.2.3 Existing Daily and Peak Hour Traffic Volumes

The AM and PM peak hour traffic data and intersection turning movement data used to assess transportation impacts associated with the Project's construction and operation were obtained from the Alberta Infrastructure and Transportation Traffic Count Database (Alberta Infrastructure and Transportation 2006). Historical weekday average traffic volumes were reviewed in addition to turning movement count information for the Highway 45/Highway 15 intersection. The most current information available was from 2006. Table III-1 presents the most current weekday average traffic volumes on the roadway network.

Table III–1: 2006 Average Annual Daily Traffic Volume

Roadway Link	Date	Volume (vpd)[1]
Highway 15 W of 45 S of Bruderheim	2006 AADT	5,580
Highway 15 E of 45 S of Bruderheim	2006 AADT	4,330
Highway 45 N of 15 S of Bruderheim	2006 AADT	1,800
Highway 45 10.7 km S of 38 and 45	2005 AADT	730
Highway 45 S of 38 SW of Deerland	2006 AADT	620

Note:
[1] vpd – vehicles per day.

It should be noted that volumes on both highways have fluctuated over the last ten years but have remained relatively constant. Highway 45 volumes are low with less than 800 vehicles traveling past the R.R. 202 intersection on a daily basis. Traffic volumes on Highway 15 are more significant in the vicinity of the R.R. 202 access but have remained fairly constant at about 5,000 vehicles per day over the last five years. In 2005 a more marked increase in daily traffic flow was noted to the level identified in Table III-1.

The weekday AM and PM peak hour traffic flows on Highway 15 were reviewed in conjunction with the intersection turning volumes obtained from the Alberta Infrastructure and Transportation Traffic Count Database for the intersections of Highway 15 and Highway 45 as well as Highway 15 and Highway 29 (formerly Highway 637), and are considered to reflect similar operating conditions as the key study intersection of R.R. 202 and Highway 15.

3. Project Characteristics

3.1 Proposed Project Plan

The Project is located between Highway 45 and Highway 15, between the CPR and CN rail tracks east of R.R. 202.

3.2 Design Vehicle

The Project will process molten sulphur carried to the facility by B train and Super B train trucks. On this basis, a WB23 vehicle (large semi-trailer and long combination vehicle) should be considered as the design vehicle for access development including turning radius, acceleration and deceleration lanes.

3.3 Proposed Project Access Management Plans

All directional access is proposed to be provided from R.R. 202 to the Site.

This assessment analyzes the Project's impact on access to R.R. 202 from both Highway 15 and Highway 45. The dual access provides alternative approaches to the Site and will allow customer servicing from all directions.

4. Project Traffic Characteristics

4.1 Assessment Time Period Selection

The Project is expected to generate traffic dispersed over a major portion (7:00 am–10:00 pm) of the day including AM and PM peak hours. However, it is noted that the facility will operate on a 24-hour basis with two shifts throughout the day, and that the start and end of these shifts will not necessarily coincide with the peak hours of nearby traffic. It was determined that the combination of both Site generated and surrounding peak hour traffic would provide the highest traffic flow rates and thus, the weekday AM and PM peak hours were selected for analysis.

4.2 Trip Generation

To estimate the volume of additional traffic generated by the proposed Project, Bunt and Associates reviewed an operations and staffing summary provided by AST and evaluated the trip generating potential from an operations perspective. In addition, a review of trip generation information presented by the Institute of Transportation Engineers (ITE 2003) Trip Generation Handbook 7th Edition for manufacturing land uses was completed.

The ITE handbook defines the trip generation for a manufacturing facility by either employee or gross acre of developable land. AST indicated that, upon full development, they will have approximately 22 employees (maximum 11 per shift) and that the PDA will be approximately 24.8 ha (61.28 acres). Based on the rates quoted in ITE, at full build out the Project could generate between 8 two-way trips during the PM peak hour based on the per-employee trip generation rate and 513 two-way trips during the PM peak hour based on the per-acre trip generation rate. It is noted there is a large discrepancy between to the two rates and thus a third method for trip generation was evaluated.

The operational and staffing information provided by AST was evaluated from a trip generating perspective. This included the number of employees per-shift, the start and finish time of the shifts, as well as daily molten sulphur delivery operations. The trips were generated assuming each employee generated one inbound and one outbound trip during the day and that each shipment or delivery generated one inbound and one outbound trip. The trips were then adjusted to reflect the likelihood of the trip occurring during the peak hour of surrounding road traffic.

For employee trips associated with work shifts beginning or ending outside of the AM and PM peak hours, influence was assumed to be zero whereas shifts with beginnings or endings during the AM and PM peak hours were assumed to have an influence factor of 0.5, with one trip occurring during the AM peak and one during the PM peak. The receiving characteristics described by the developer were used to determine the potential for receiving trips to occur during the AM and PM peak hours. AST indicated that the majority of receiving trips are completed outside the AM and PM peak hours and the influence factors reflect this fact. In addition, an auto-occupancy of 1.0 was assumed for the trips associated with employees and for all delivery trips.

This calculation indicated that the Project has the potential to generate 35 trips during the AM peak hour and 24 trips during the PM peak hour. As this information directly relates to the Project and is within the trip generation range projected by the ITE trip per employee rate, this is the trip generation used in this assessment. Table III-2 and Table III-3 summarize the trip generation calculation used to determine projected vehicle trips anticipated to be generated for the AM and PM weekday peak hours, respectively.

4.3 Trip Distribution and Assignment

Distribution of trips was based on the location of the Project relative to the location of supply of raw materials in and around the greater Edmonton area. From information supplied by AST, it has been assumed that about 90% of the trips are to and from the west and will access the Site from Highway 15. The remaining 10% of trips will be travel to and from the north, and will access the Site via Highway 45. The trip assignment was completed for the AM and PM peak hours. Site-generated trips anticipated to be generated by the Project are illustrated in Figure III-3.

4.4 Total Traffic

Background traffic is the traffic on surrounding roads that would be present regardless of the Project. A general growth rate is normally applied to existing traffic to reflect on-going growth caused by new development and general population increases in the area. Based on a review of historical average annual daily traffic (AADT) data available on the Province's website, the last ten years have seen little growth; however a linear growth factor of 2.5% per year was assumed to be representative of ongoing traffic growth along Highway 15 while a linear growth factor of 0.5% per year was assumed on Highway 45.

For the purpose of the assessment, two time horizons were used; a 2007 horizon was selected as the time line for the Project build-out scenario while a 2022 horizon was selected as the future time period for review. Growth was applied to the eastbound and westbound through movements on Highway 15 as well as the eastbound and southbound movements on Highway 45 at the intersection of R.R. 202. Figure III-4 and Figure III-5 present the 2007 and 2022 background volumes estimated for the weekday peaks hours respectively.

Total traffic forecasts were prepared by adding the background traffic to the predicted Site traffic generated by the Project. Figure III-6 and Figure III-7 illustrate the total peak hour traffic volumes for the two time period scenarios.

As presented in Table III-2 and Table III-3, it is anticipated that the Project could generate in the order of 35 two-way trips during a typical weekday AM Peak Hour and in the order of 24 two-way trips during a typical weekday PM peak hour.

Table III–2: Total Trip Generation – Weekday AM Peak Hour (6:45–7:45)

Shift	Trip Generator	Time of Influence	Number of Employees/Deliveries	Number of Daily Trips	AM Peak Influence Factor	Adjusted Number of Peak hour Trips	% In	In	% Out	Out
1	Staff	7:00 AM - 7:00 PM	11	22	0.40	9	100%	9	0%	0
	Receiving	Daily	60	120	0.10	12	70%	8	30%	4
2	Staff	7:00 PM- 7:00 AM	11	22	0.50	11	0%	0	100%	11
	Receiving	Daily	15	30	0.10	3	30%	1	70%	2
Total			**97**	**194**		**35**		**18**		**17**

Table III–3: Total Trip Generation – Weekday PM Peak Hour (5:30–6:30)

Shift	Trip Generator	Time of Influence	Number of Employees/Deliveries	Number of Daily Trips	PM Peak Influence Factor	Adjusted Number of Peak hour Trips	% In	In	% Out	Out
1	Staff	7:00 AM – 7:00 PM	11	22	0.00	0	0%	0	0%	0
	Receiving	Daily	60	120	0.20	24	50%	12	50%	12
2	Staff	7:00PM - 7:00 AM	11	22	0.00	0	0%	0	0%	0
	Receiving	Daily	15	30	0.00	0	0%	0	0%	0
Total			**97**	**194**		**24**		**12**		**12**

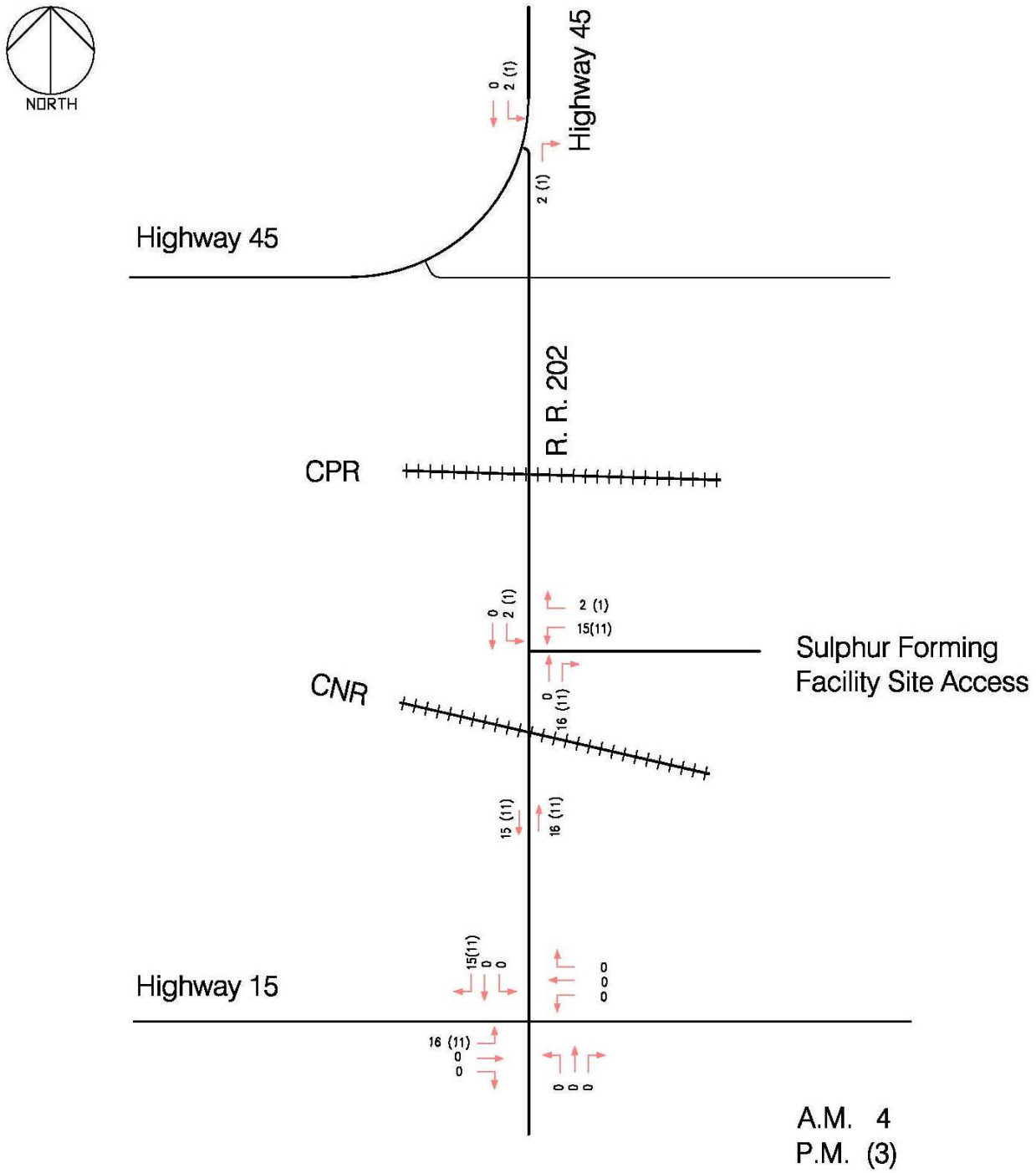


Figure III-2: 2007 Project Generated Peak Hour Volumes

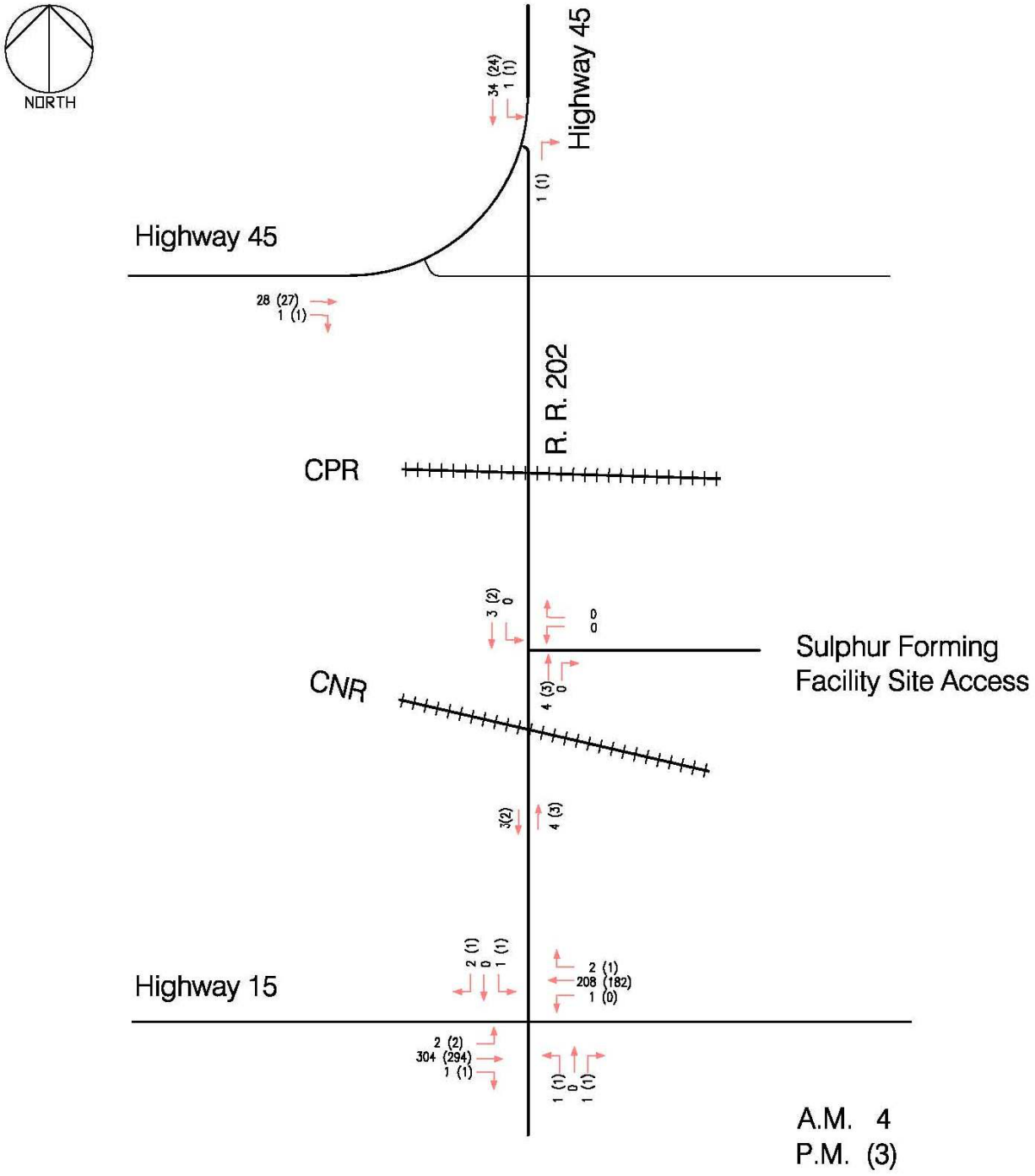


Figure III-3: 2007 Background Peak Hour Volumes

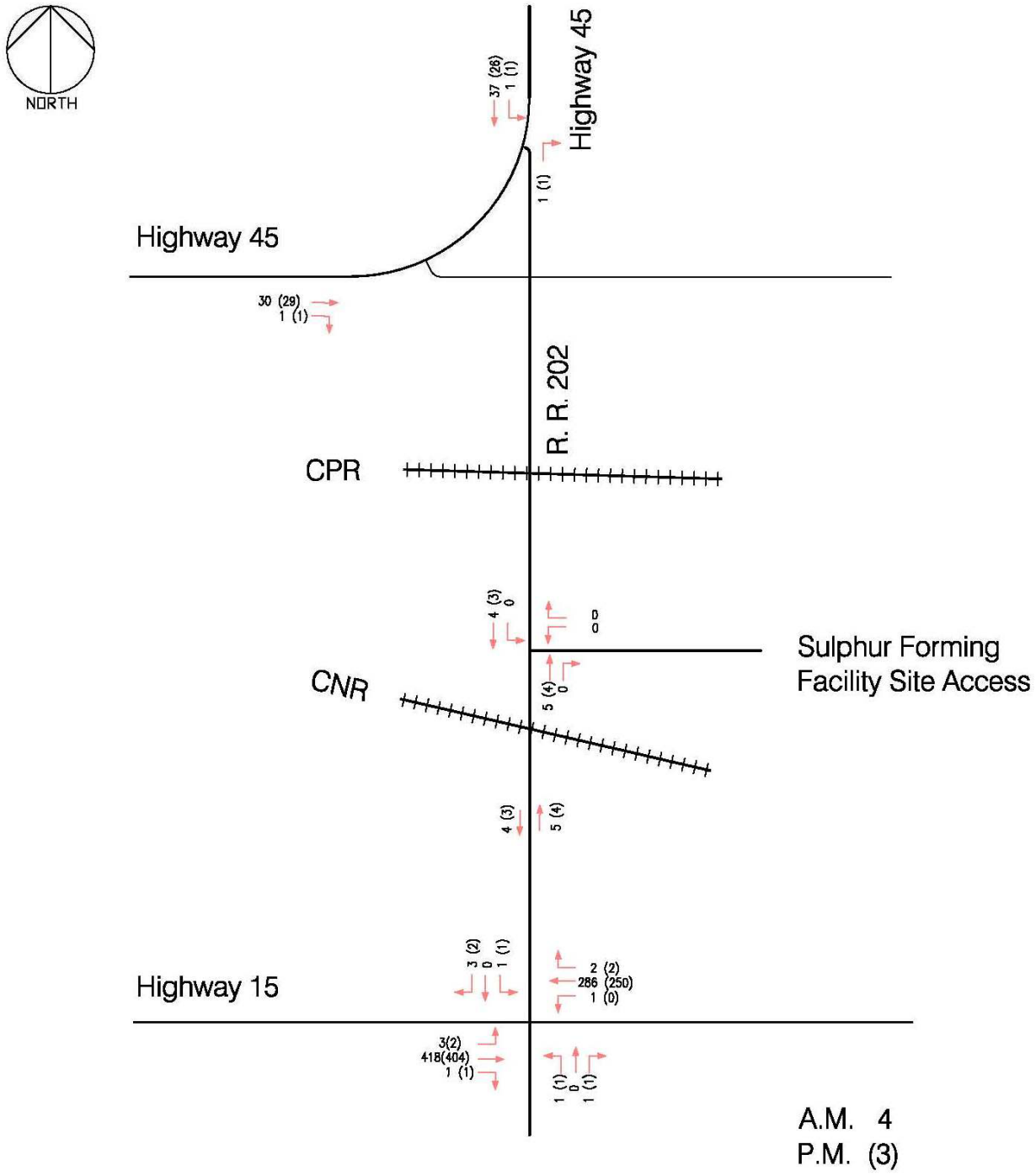


Figure III-4: 2022 Background Peak Hour Volumes

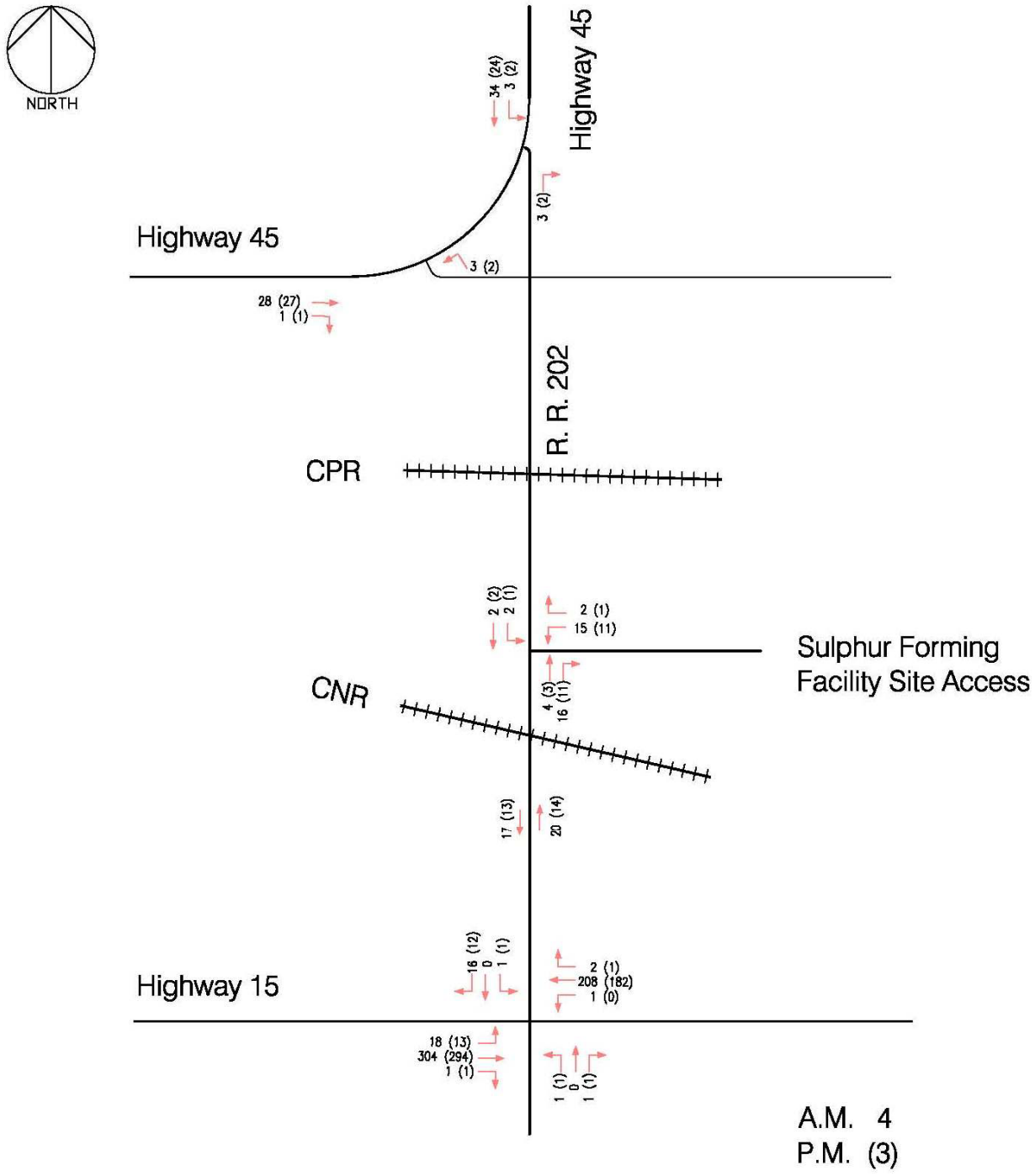


Figure III-5: 2007 Total Background and Project Peak Hour Volumes

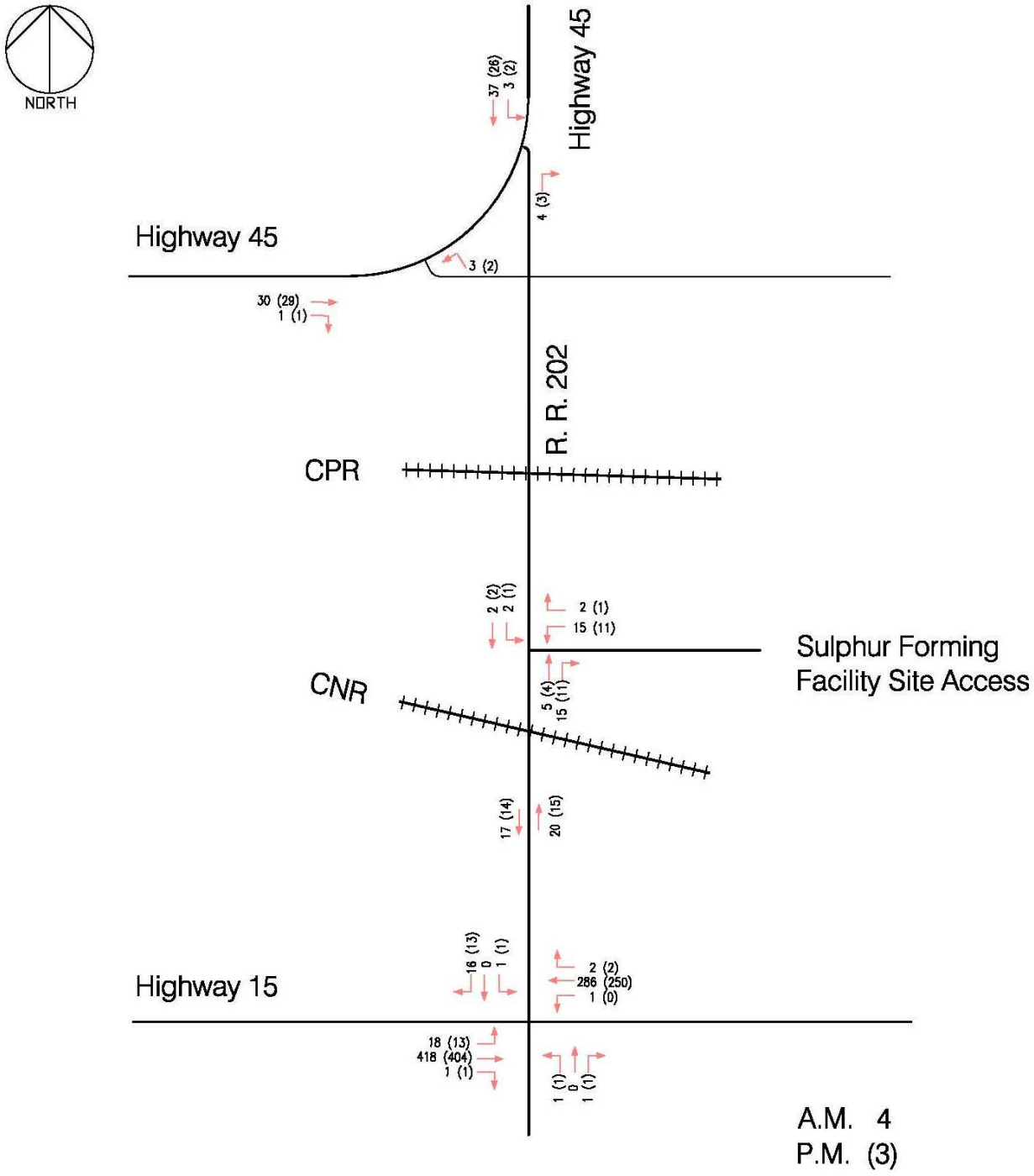


Figure III-6: 2022 Total Background and Project Peak Hour Volumes

5. Transportation Assessment

5.1 Analysis Methodology

To evaluate traffic conditions during the peak periods, a capacity analysis was conducted at key intersections for accessing the Project. The capacity analysis is based on the methods outlined in the Highway Capacity Manual (Transportation Research Board 2000), using High Capacity Software 2000 analysis.

Intersection operations are typically rated by two measures. The volume-to-capacity (v/c) ratio describes the extent to which traffic volumes can be accommodated by the physical capacity of the road configuration and signal control. A value (measured during the peak hour) less than 0.90 indicates that generally there is ample capacity and good traffic condition. A value between 0.90 and 1.0 suggests unstable operations may occur and volumes are nearing capacity. A calculated value over 1.0 indicates that traffic volumes are theoretically exceeding capacity. The second measure of performance, Level of Service (LOS), is based on the estimated average delay per vehicle among all traffic passing through the intersection. A low average delay merits a LOS A rating whereas a high average delay merits a LOS rating of F.

An unsignalized intersection assessment was completed at the R.R. 202/Highway 45 intersection. The assessment was based on existing roadway geometry and assumes the intersection continues to operate under stop control for R.R. 202.

The Highway 15/ R.R. 202 intersection analysis was also based on existing roadway geometry and assumes that this intersection continues to operate under stop control for R.R. 202.

A peak hour factor of 0.92 has been assumed for all intersection movements. Based on a review of historical count information, a heavy vehicle factor of 20% has been applied to Highway 15 and Highway 45 through volumes during the AM peak hour and a heavy vehicle factor of 10% has been applied during the PM peak hour.

5.2 Assessment

5.2.1 Highway 45/R.R. 202

Table III-4 presents the results of the analysis for the Highway 45/R.R. 202 intersection for the two time periods assessed (2007 and 2022) with the addition of Project generated traffic. This intersection was analyzed for the weekday AM and PM peak hours.

Table III–4: Highway 45/R.R. 202 – Weekday AM and PM Peak Hours

Movement	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
2007 Background AM Peak Hour												
Volume		28	1	1	34		1		1			
v/c		0.02	0.02	0.0	0.0		0.0		0.0			
LOS		A	A	A	A		A		A			
Delay		0.0	0.0	0.0	0.2		8.7		8.7			
95% queue		0.0	0.0	0.0	0.0		0.1		0.1			
2007 Background & Site AM Peak Hour												
Volume		28	1	3	34		2		3			
v/c		0.02	0.02	0.0	0.0		0.01		0.01			
LOS		A	A	A	A		A		A			
Delay		0.0	0.0	0.0	0.6		8.9		8.9			
95% queue		0.0	0.0	0.1	0.1		0.1		0.1			
2007 Background PM Peak Hour												
Volume		27	1	1	24		1		1			
v/c		0.02	0.02	0.0	0.0		0.0		0.0			
LOS		A	A	A	A		A		A			
Delay		0.0	0.0	0.0	0.3		8.9		8.9			
95% queue		0.0	0.0	0.0	0.0		0.1		0.1			
2007 Background & Site PM Peak Hour												
Volume		27	1	2	24		1		2			
v/c		0.02	0.02	0.0	0.0		0.0		0.0			
LOS		A	A	A	A		A		A			
Delay		0.0	0.0	0.0	0.3		8.9		8.9			
95% queue		0.0	0.0	0.0	0.0		0.1		0.1			
2022 Background AM Peak Hour												
Volume		30	1	1	37		1		1			
v/c		0.02	0.02	0.0	0.0		0.0		0.0			
LOS		A	A	A	A		A		A			
Delay		0.0	0.0	0.0	0.2		8.7		8.7			
95% queue		0.0	0.0	0.0	0.0		0.1		0.1			
2022 Background & Site AM Peak Hour												
Volume		30	1	3	37		3		4			
v/c		0.02	0.02	0.0	0.0		0.01		0.01			
LOS		A	A	A	A		A		A			
Delay		0.0	0.0	0.0	0.6		8.9		8.9			
95% queue		0.0	0.0	0.1	0.1		0.2		0.2			
2022 Background PM Peak Hour												
Volume		29	1	1	26		1		1			
v/c		0.02	0.02	0.0	0.0		0.0		0.0			
LOS		A	A	A	A		A		A			
Delay		0.0	0.0	0.0	0.3		8.6		8.6			
95% queue		0.0	0.0	0.0	0.0		0.1		0.1			
2022 Background & Site PM Peak Hour												
Volume		29	1	2	26		2		3			
v/c		0.02	0.02	0.0	0.0		0.01		0.01			
LOS		A	A	A	A		A		A			
Delay		0.0	0.0	0.0	0.6		8.9		8.9			
95% queue		0.0	0.0	0.0	0.0		0.1		0.1			

Notes:

L=left turn, T= through traffic, R=right turn. Delay refers to the average wait time at the intersection during peak hour of operation and is measured in seconds. 95% queue is the mathematical calculated queue length of vehicles waiting to advance measured in meters. A typical passenger vehicle is assumed to occupy 7 m of space.

As presented in Table III-4, the Highway 45 intersection with R.R. 202 is anticipated to continue to operate at Level of Service A upon the addition of Project generated traffic in the 2007 and 2022 scenarios during both the AM and PM peak hours.

5.2.2 Highway 15/R.R. 202

Table III-5 presents the results of the analysis for the Highway 15/R.R. 202 intersection for the two time periods assessed upon the addition of Project generated traffic. This intersection was also assessed for the weekday AM and PM peak hours.

Table III–5: Highway 15/R.R. 202 – Weekday AM and PM Peak Hours

Movement	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
2007 Background AM Peak Hour												
Volume	2	304	1	1	208	2	1	0	1	1	0	2
v/c	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	0.01	-	0.01
LOS	A	A	A	A	A	A	B	-	B	B	-	B
Delay	0.0	0.1	0.1	0.0	0.0	0.0	11.7	-	11.7	10.8	-	10.8
95% queue	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-	0.1	0.1	-	0.1
2007 Background & Site AM Peak Hour												
Volume	18	304	1	1	208	2	1	0	1	1	0	17
v/c	0.02	0.20	0.20	0.0	0.0	0.0	0.0	-	0.0	0.03	-	0.03
LOS	A	A	A	A	A	A	B	-	B	B	-	B
Delay	8.8	0.0	0.0	0.0	0.0	0.0	12.2	-	12.2	11.0	-	11.0
95% queue	0.5	0.0	0.0	0.0	0.0	0.0	0.1	-	0.1	0.7	-	0.7
2007 Background PM Peak Hour												
Volume	2	294	1	0	182	1	1	0	1	1	0	1
v/c	0.0	0.0	0.0	-	0.0	0.0	0.0	-	0.0	0.0	-	0.0
LOS	A	A	A	-	A	A	B	-	B	B	-	B
Delay	0.0	0.1	0.1	-	0.0	0.0	11.4	-	11.4	11.0	-	11.0
95% queue	0	0	0	-	0	0	0.1	-	0.1	0.1	-	0.1
2007 Background & Site PM Peak Hour												
Volume	13	294	1	0	182	1	1	0	1	1	0	1
v/c	0.01	0.19	0.19	-	0.0	0.0	0.0	-	0.0	0.02	-	0.02
LOS	A	A	A	-	A	A	B	-	B	B	-	B
Delay	8.5	0.0	0.0	-	0.0	0.0	11.7	-	11.7	10.8	-	10.8
95% queue	0.3	0.0	0.0	-	0.0	0.0	0.1	-	0.1	0.5	-	0.5
2022 Background AM Peak Hour												
Volume	3	418	1	1	286	2	1	0	1	1	0	3
v/c	0.0	0.0	0.0	0.0	0.0	0.0	0.01	-	0.01	0.01	-	0.01
LOS	A	A	A	A	A	A	B	-	B	B	-	B
Delay	0.0	0.1	0.1	0.0	0.0	0.0	13.8	-	13.8	11.6	-	11.6
95% queue	0.1	0.1	0.1	0.0	0.0	0.0	0.1	-	0.1	0.2	-	0.2
2022 Background & Site AM Peak Hour												
Volume	18	418	1	1	286	2	1	0	1	1	0	16
v/c	0.02	0.27	0.27	0.0	0.0	0.0	0.01	-	0.01	0.03	-	0.03
LOS	A	A	A	A	A	A	B	-	B	B	-	B
Delay	9.1	0.0	0.0	0.0	0.0	0.0	14.5	-	14.5	11.9	-	11.9
95% queue	0.5	0.0	0.0	0.0	0.0	0.0	0.1	-	0.1	0.8	-	0.8
2022 Background PM Peak Hour												
Volume	2	404	1	0	250	2	1	0	1	1	0	2
v/c	0.0	0.0	0.0	-	0.0	0.0	0.0	-	0.0	0.01	-	0.01
LOS	A	A	A	-	A	A	B	-	B	B	-	B
Delay	0.0	0.1	0.1	-	0.0	0.0	13.2	-	13.2	11.7	-	11.7
95% queue	0.0	0.0	0.0	-	0.0	0.0	0.1	-	0.1	0.1	-	0.1
2022 Background & Site PM Peak Hour												
Volume	13	404	1	0	250	2	1	0	1	1	0	13
v/c	0.01	0.26	0.26	-	0.0	0.0	0.01	-	0.01	0.03	-	0.03
LOS	A	A	A	-	A	A	B	-	B	B	-	B
Delay	8.8	0.0	0.0	-	0.0	0.0	13.7	-	13.7	11.6	-	11.6
95% queue	0.3	0.0	0.0	-	0.0	0.0	0.1	-	0.1	0.6	-	0.6

Note:
L=left turn, T= through traffic, R=right turn

As presented in the above table, the Highway 15 intersection with R.R. 202 is anticipated to continue to operate at acceptable levels of service upon the addition of Project generated traffic in the 2007 and 2022 scenario during both the AM and PM peak hour.

5.2.3 Highway Geometric Design Guide – Intersection Analysis

A preliminary assessment based on Figure D-7.4 in the Highway Geometric Design Guide (see Attachment 1) was completed for both intersections of R.R. 202 and Highways 45 and 15.

The Highway 45 intersection based on a calculated growth from 2005 existing volumes with Project generated volumes added, will warrant only a Type I intersection in both the 2007 and 2022 time periods. Average annual daily traffic volumes for Highway 45 are anticipated to grow from 730 vehicles per day in 2006 to less than 760 in 2022. The intersecting R.R. 202 volumes may grow with Project generation to about 40 vehicles per day. These types of volumes warrant a Type I intersection. A field review of this site indicates that existing access to Highway 45 will continue to operate as it presently does. While the highway curves through this intersecting area, as shown in Figure III-8, the clear site lines exceed 600 m and a reduced speed limit posted on the curve provides continued safe operation of the intersection. The existing intersection radii of 15 m will accommodate the design vehicle used for the Project.

Highway 15's AADT of 4,330 in 2006 could expand to 6,042 by 2022 with growth at a linear rate of 2.5% per year. With Project generated volumes on R.R. 202 growing to about 350 vehicles per day, a Type IVb intersection is warranted by interpretation of Table D-7.4 (see Attachment 1). Further review of the left turn requirements as identified in Figure D-7.6-7a (see Attachment 1) indicate that a left turn lane is not required at present but with the anticipated growth on Highway 15, it would be warranted in 2022. A standard Type IVb intersection would be required to meet this criterion (see Attachment 1). Clear sightlines of greater than 800 m prevail at this intersection. Attachment 1 shows the work charts used to confirm this rationale.

5.3 Transportation Assessment Synopsis

Based on the assessment completed, it has been determined that the access management scheme requires improvement to the intersection of Highway 15 and R.R. 202 to a standard Type IVb Alberta Infrastructure and Transportation intersection. The intersection of Highway 45 and R.R. 202 can remain in its constructed state and continue to provide the operational character required. Based on the analysis, the road system surrounding the Project will be able to support an increase in vehicle traffic and still maintain acceptable Level of Service and Volume to Capacity standards.

As presented, the access strategy includes improvements to the intersection at Highway 15 and R.R. 202 to provide a left turn lane and acceleration lane. Traffic stop control will remain in effect on R.R. 202 on either side of Highway 15 as well as the Highway 45 intersection with R.R. 202.

Figure III-7: Intersection of Highway 45 and R.R. 202

6. Conclusions and Recommendations

6.1 Summary of Study Findings

Based upon the TIA, it has been determined that turning movement delay on the Highway 15/R.R. 202 intersection will be high enough in future to warrant a left turn lane. It was also determined that the volume of traffic anticipated at this intersection with Project traffic does not warrant traffic control changes to serve the Project's access requirements.

The lesser use of access from the north and the predicted minor change in traffic flows does not warrant changes to the existing intersection of Highway 45 and R.R. 202.

It is anticipated that the Project will operate well with this access management plan. The analysis indicates that under the following operations the proposed Project could be accommodated with minor infrastructure improvements to the Highway 15 access:

- all inbound and outbound trips to the east, south and the majority of outbound trips to the west utilize the Highway 15/RR 202 intersection
- inbound and outbound trips from the north and a minority of the westerly trips utilize the Highway 45/R.R. 202 intersection

6.2 Recommendations

It is recommended that the Project implement the aforementioned access management plan. Under this plan, the operational characteristics of the Highway 15/R.R. 202 and the Highway 45/RR 202 intersections are expected to operate at good levels of service when the Project is in full operation.

It is anticipated that this report provides Lamont County, Alberta Infrastructure and Transportation, and other regulators with the information required for the Project to proceed.

7. References

7.1 Literature Cited

Institute of Traffic Engineers (ITE). 2003. *Trip Generation Handbook*. 7th Edition. Institute of Transportation Engineers, Washington, DC 20005-3438 USA. Publication No. IR-016E Fourth Printing. December 2003.

Transportation Research Board. 2000. Highway Capacity Manual. Transportation Research Board, National Research Council, Washington, D.C.

7.2 Internet Sites

Alberta Infrastructure and Transportation. 2006. Traffic Count Database. www.infratrans.gov.ab.ca/Roads_%26_Highways/Traffic_Counts/index.htm. Accessed December 2006.

Attachment III-1

TABLE D.7.4

PROJECT: HAZCO E/BRUDERHEI

INTERSECTION ANALYSIS PROCEDURE

Intersection at Hwy 15 and R.R. 202
Main (or through) Road Classification PRIMARY Intersecting Road Classification LOCAL
Main (or through) Road AADT/ASDT/AWDT Current 4240 (Year 2005) Future 6042 (design year 2022)
Intersecting Road AADT/ASDT/AWDT Current < 100 (Year 2005) Future < 200 (design year 2022)
Design Speed 110 km/hr. Posted Speed 100 km/hr.
Type of Treatment (preliminary assessment)
(refer to Figure D-7.4, Traffic Volume Warrant Chart for At-Grade Intersection Treatment)

FUNCTIONAL CHARACTERISTICS

PART I (General Information for all treatment types)
Collision Analysis N/A
Access Requirements N/A
Access Control N/A
Future Development N/A
Type of Vehicles for Design WB 23
Percentage of Trucks 14%

PART II (Specific Information for main (or through) and intersecting road with daily traffic volumes greater than 1800)
Turning Movement Diagram N/A ASSUMED SIMILAR TO HWY 15 & 637
Warrant for Exclusive Left Turn Lane YES BEYOND 2007
Warrant for Exclusive Right Turn Lane volume too low
Any Proposed Improvement to Other Highways that would impact the traffic movement at this intersection (evaluate network)? No

GEOMETRIC CHARACTERISTICS

Intersection Sight Distances

	Available		*Required
	left (m)	right(m)	(m)
WB21			
WB15			
SU			
P			
Other (WB 23)	750 - 1000 m	750 - 1000 m	

*Adjust length for gradient if necessary (see Table D.6.2.6)

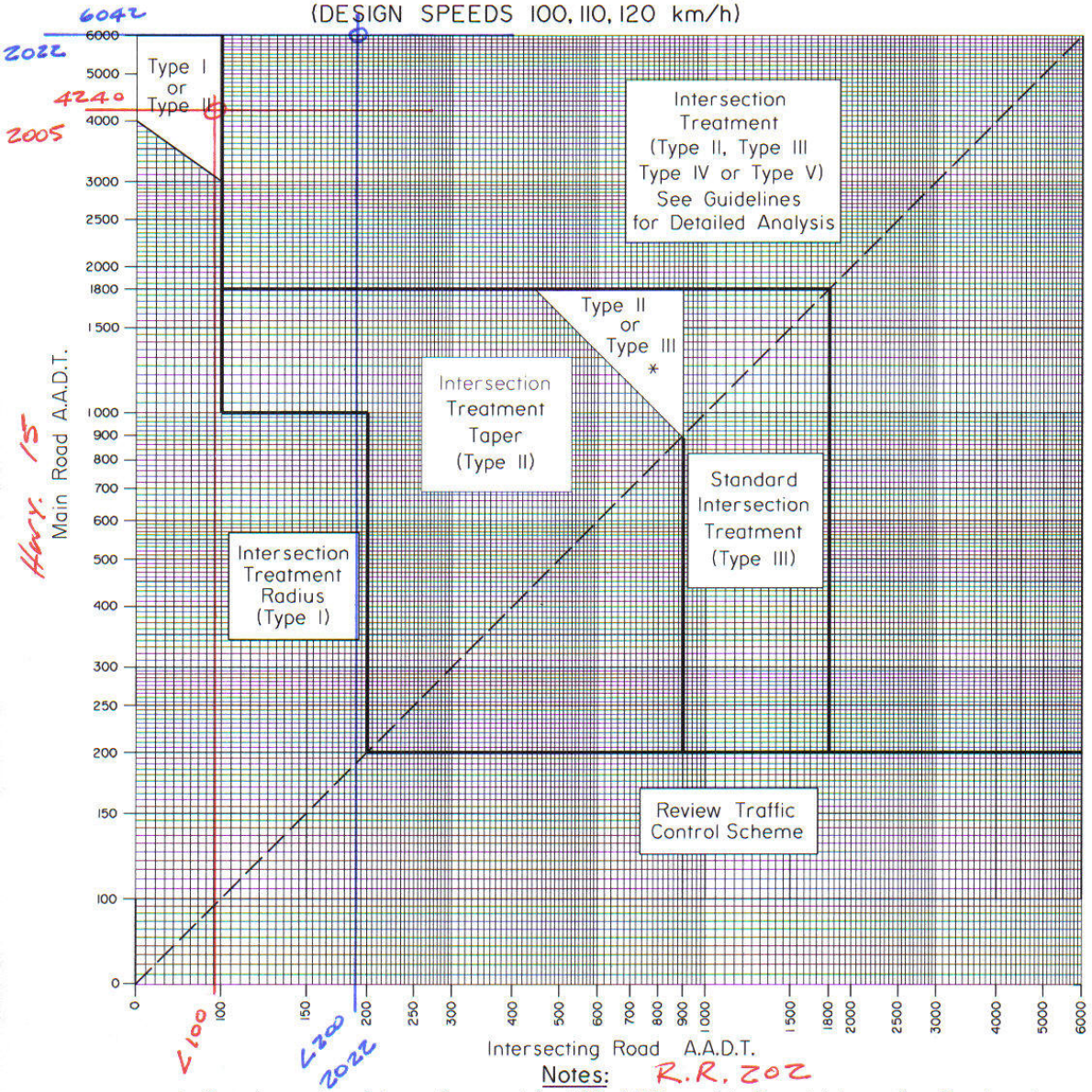
Decision Sight Distance:
Skew Angle: 90°
Intersection on Horizontal Curve Yes ____ No X If yes, superelevation rate = ____ m/m
Profile grade of Main Road 1.0 % ± ____ % Intersecting Roadway ____ %

OTHER CHARACTERISTICS

Utility Impact
Right-of-Way Impact
Warrant for Future Signalization
(Check with Traffic Operations Branch if necessary)
Warrant for Illumination
(Check with Traffic Operations Branch if necessary)
Recommendation of Type of Intersection Treatment based on Functional, Geometric and Other Characteristics:
TYPE IVb

Designer: [signature] Date: Feb 22/07
Approved: ____ Date: ____

FIGURE D-7.4 TRAFFIC VOLUME WARRANT CHART FOR AT-GRADE INTERSECTION TREATMENT ON TWO-LANE RURAL HIGHWAYS (DESIGN SPEEDS 100, 110, 120 km/h)

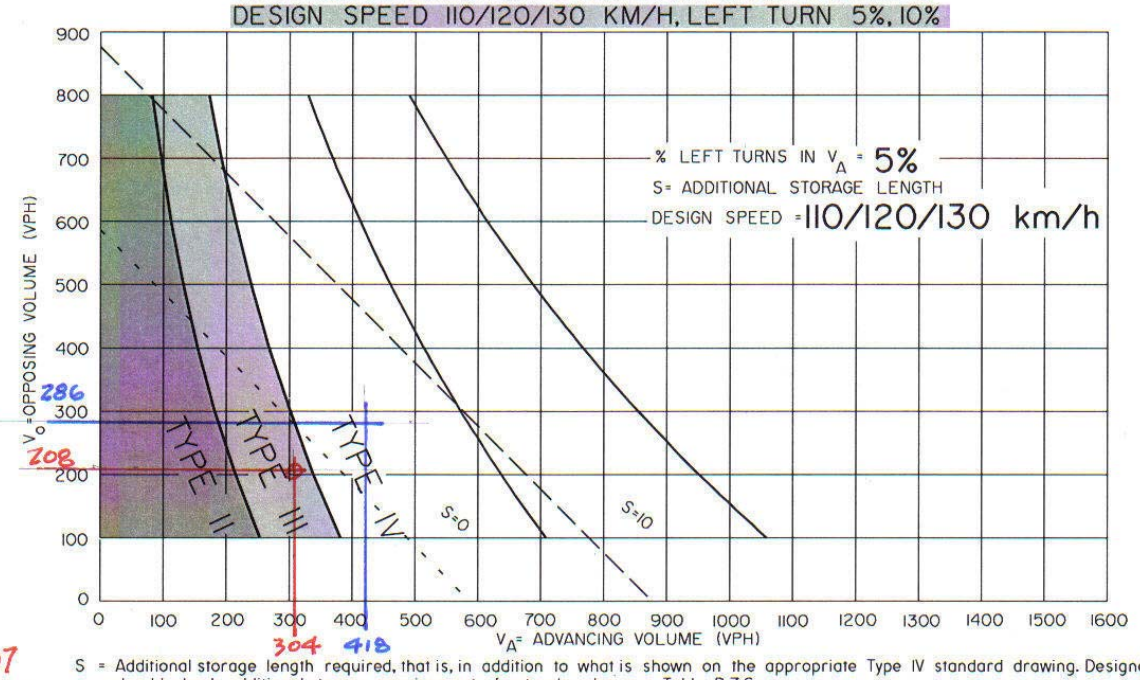


Notes:

1. If main road, or intersecting road, is <100 AADT provide Type I Intersection Treatment (15m radius), except as shown for the higher volume main roads on this chart (Type I or II zone) where engineering judgement may be used to select the appropriate treatment.
2. If main road is >4000 AADT Review Access Management
   - — — If Intersecting Road AADT is > Main Road AADT: Review Traffic Control Scheme
3. Use projected traffic volumes for design
   Sloping line is defined by Main Road AADT x Intersecting Road AADT = 800,000

GRAPHICS FILE: TIGSFSOI\REB\MANUAL\CHAPTERS\CHAP-D\DEBD74.MAN

FIGURE D-7.6-7a WARRANTS FOR LEFT TURN LANES AND STORAGE REQUIREMENTS FOR TWO-LANE HIGHWAYS DESIGN SPEED 110/120/130 KM/H, LEFT TURN 5%, 10%



2007
2022

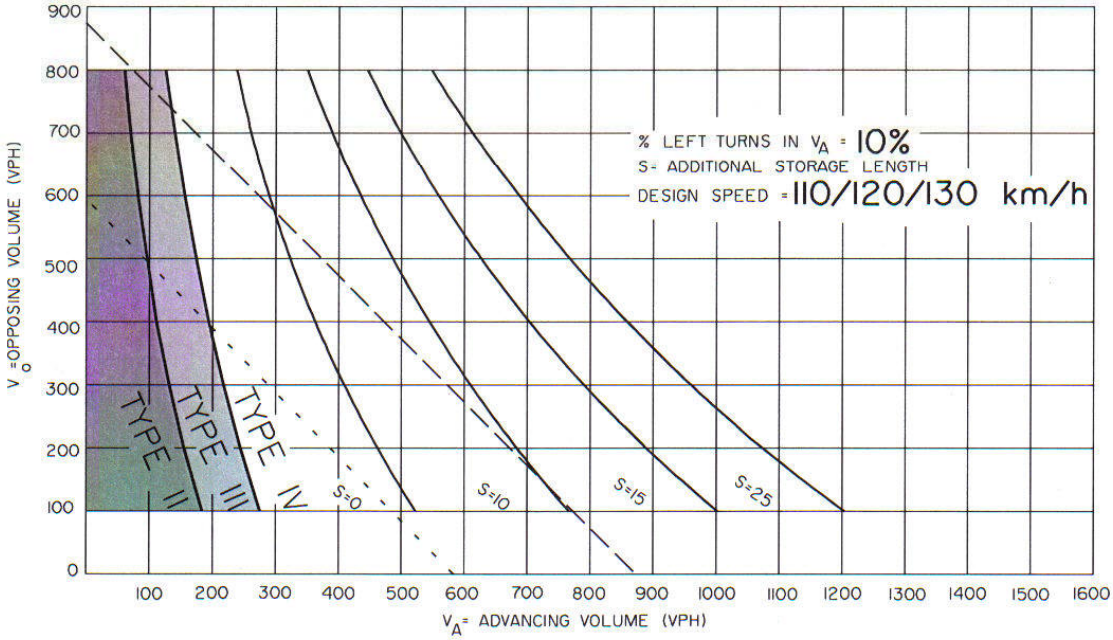
S = Additional storage length required, that is, in addition to what is shown on the appropriate Type IV standard drawing. Designers should check additional storage requirements for trucks, also see Table D.7.6a.

- - - - Traffic signals may be warranted in rural areas, or urban areas, with restricted flow.

— — — Traffic signals may be warranted in "free flow" urban areas.

Notes:

1. The traffic signal warrant lines are provided for reference only. For detailed analysis of the requirements for signals, contact Roadway Engineering Branch.
2. Warrant for Type I treatment is shown in Figure D-7.4.



GRAPHICS FILE: debd767a.man

ALBERTA HIGHWAYS 1 TO 986
TRAFFIC VOLUME HISTORY 1996 - 2005

Alberta Infrastructure and Transportation
Program Management Branch
Highway Asset Management Section

Produced: 03-Mar-2006 By CornerStone Solutions Inc.

Hwy	CS	TCS	Muni	From	1996 AADT	1997 AADT	1998 AADT	1999 AADT	2000 AADT	2001 AADT	2002 AADT	2003 AADT	2004 AADT	2005 AADT	2005 ASDT
14	16	4	Wain	E OF 41 E OF WAINWRIGHT	1980	2100	2110	2110	2080	2230	2310	2310	2330	2350	2570
14	16	4	Wain	W OF 610 NW OF HEATH	1710	1800	1560	1560	1540	1660	1680	1680	1700	1710	1870
14	16	8	Wain	E OF 610 NW OF HEATH	1590	1510	1310	1310	1290	1390	1260	1260	1280	1290	1410
14	16	8	Wain	W OF 894 E OF WAINWRIGHT WJ	1290	1470	1280	1170	1170	1270	1250	1250	1280	1300	1420
14	16	12	Wain	E OF 894 E OF WAINWRIGHT WJ	1260	1440	1250	1150	1130	1230	1210	1210	1240	1240	1360
14	16	12	Wain	W OF 894 N OF EDGERTON EJ	1120	1280	1120	1130	1130	1230	1210	1210	1240	1240	1360
14	16	16	Wain	E OF 894 N OF EDGERTON EJ	820	940	820	840	840	890	940	940	980	990	1080
14	16	16	Wain	W OF 897 NE OF EDGERTON	750	850	730	810	830	830	880	880	890	960	1050
14	16	20	Wain	E OF 897 NE OF EDGERTON	680	760	660	730	700	700	740	740	750	730	800
14	16	20	Wain	W OF 17 SASK BORDER WJ	730	820	700	680	700	680	710	710	720	720	790
14	16	24	Wain	E OF 17 SASK BORDER WJ	1370	1530	1310	1400	1470	1450	1520	1630	1630	1660	1820
14	16	24	Wain	W OF 17 SASK BORDER EJ	1370	1530	1160	1240	1360	1450	1520	1630	1630	1660	1820
14	16	28	Wain	E OF 17 SASK BORDER EJ	840	940	590	630	700	940	1050	1140	1150	1150	1260
14	16	28	Prov	ALTA - SASK BORDER	840	940	810	870	910	1000	1070	1160	1140	1150	1260
15	4	8	Stur	S OF 37 W OF FT SASK	7010	7360	7850	7460	7540	7930	8400	8130	8010	8490	9280
15	4	12	Stur	N OF 37 W OF FT SASK	10590	11120	11870	12110	12260	12830	13600	12800	12670	12970	14170
15	4	12	Stur	W OF LAMOUREAUX DR 32-54-22-412700750					12470	13040	13800	13000	12880	13180	14400
15	4	12	Stur	E OF LAMOUREAUX DR 32-54-22-412700750					12790	13380	14170	13350	13210	13510	14760
15	4	12	Stur	2.0 KM W 15 & 21 FORT SASKATCHEWAN	11630	12210	13030	12630	12790	13380	14330	13050	13200	13730	14760
15	5	99	CoFS	W OF RGE RD 220 12-55-22-400000220	6400	6910	7130	7170	6690	7080	7850	8070	8040	8400	9310
15	6	8	Strc	E OF RGE RD 220 12-55-22-400000220	6300	6800	7030	7030	6560	6940	7710	7990	7920	8280	9180
15	6	8	Strc	W OF RGE RD 215A WJ 18-55-21-406000880	6310	6780	7010	7300	6820	7210	7690	7970	7900	8260	9160
15	6	8	Strc	E OF RGE RD 215A WJ 18-55-21-406000880	6220	6670	6930	7220	6740	7130	7680	7960	7880	8240	9140
15	6	8	Strc	W OF RGE RD 215 EJ 17-55-21-412000400							7680	7960	7880	8240	9140
15	6	8	Strc	E OF RGE RD 215 EJ 17-55-21-412000400							7640	7920	7840	8200	9090
15	6	8	Strc	W OF 830 N OF JOSEPHBURG WJ	6220	6670	6930	7240	6770	7160	7640	7920	7840	8200	9090
15	6	12	Strc	E OF 830 N OF JOSEPHBURG WJ	5480	5880	6110	6130	5730	6070	6510	6570	6870	7190	7970
15	6	12	Strc	W OF RGE RD 212 22-55-21-400000000	5460	5880	6020	6040	5640	5960	6570	6570	6870	7190	7970
15	6	12	Strc	E OF RGE RD 212 22-55-21-400000000	5380	5730	5870	5890	5490	5810	6520	6560	6860	7180	7960
15	6	12	Strc	6.7 KM W OF 15 & 45 SCOTFORD	5440	5800	5950	6520	6090	6440	6610	6760	6960	7390	8050
15	6	12	Strc	W OF RGE RD 211 23-55-21-400000000	5420	5690	5690	5690	5320	5620	6450	6500	6790	7090	7860
15	6	12	Strc	E OF RGE RD 211 23-55-21-400000000	5410	5680	5680	5680	5310	5610	6410	6460	6750	7050	7820
15	6	12	Strc	W OF 830 NE OF FT SASK EJ	5080	5300	5390	5240	5020	5310	5900	5940	6200	6490	7200
15	6	20	Strc	E OF 830 NE OF FT SASK EJ	4650	4850	4820	4690	4510	4780	4900	4940	5160	5320	5900
15	6	20	Lamo	W OF 45 S OF BRUDERHEIM	4590	4820	4820	4670	4470	4720	4850	4870	5090	5240	5810
15	8	4	Lamo	E OF 45 S OF BRUDERHEIM	3550	3750	4070	3940	3770	3960	4070	4100	4190	4240	4660
15	8	4	Lamo	W OF 637 NW OF LAMONT	3520	3720	3740	5980	5920	6220	4100	4060	4090	4140	4550
15	8	8	Lamo	E OF 637 NW OF LAMONT	2080	2200	2220	3540	3500	3680	2420	2400	2730	2760	3030
15	8	8	Lamo	W OF 831 W OF LAMONT WJ	2130	2250	2270	2290	2270	2370	2450	2430	2770	2800	3080
15	8	12	Lamo	E OF 831 W OF LAMONT WJ	2100	2220	2220	2240	2230	2330	2390	2370	2560	2820	3100
15	8	12	Lamo	W OF 831 W OF LAMONT EJ			1110	1110	1110	1190	1100	1090	1170	1190	1310

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TRAFFIC VOLUME HISTORY 1996 - 2005

Alberta Infrastructure and Transportation
Program Management Branch
Highway Asset Management Section

Produced: 03-Mar-2006 By CornerStone Solutions Inc.

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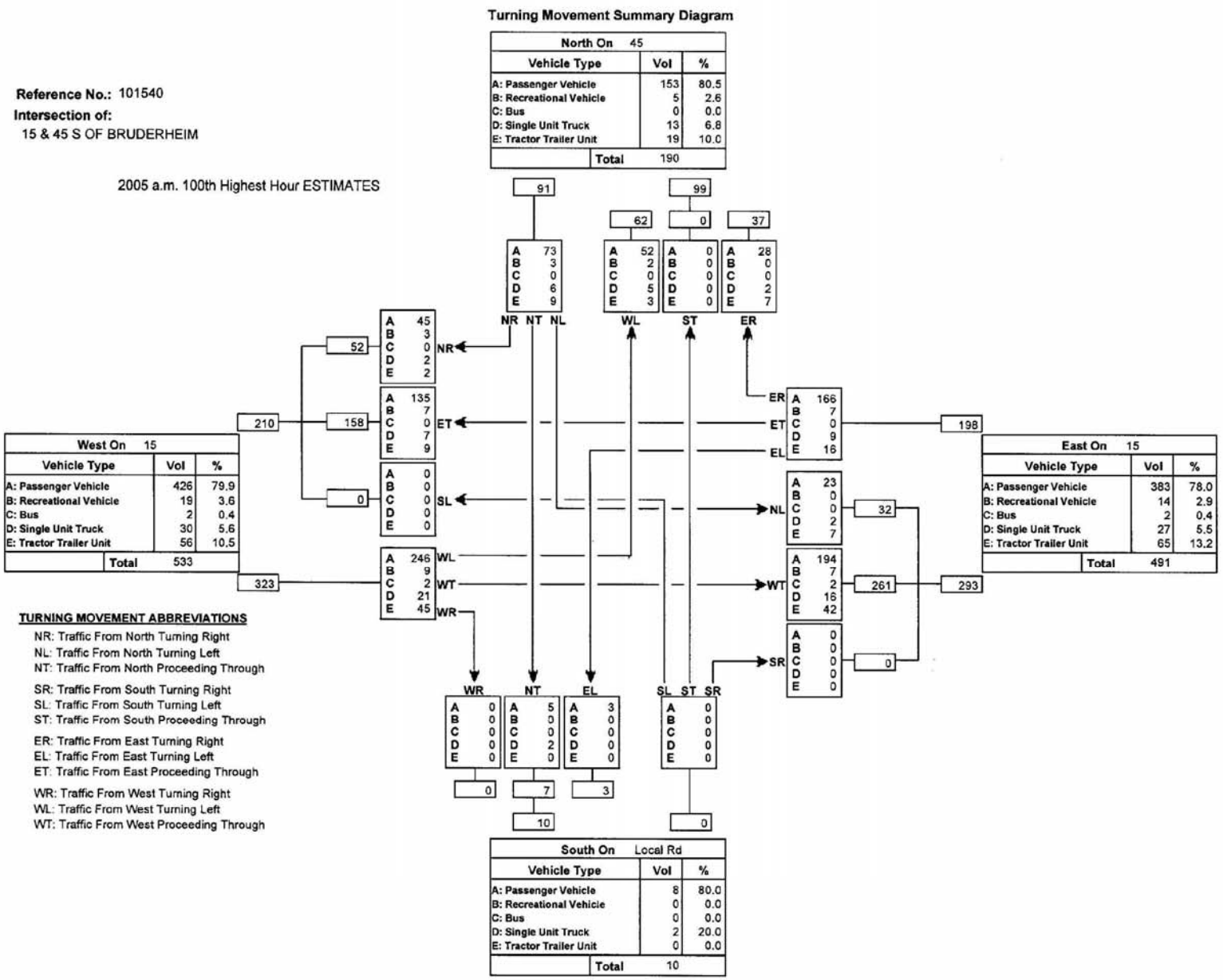
44	0	20	Wstl	N OF TWP 585 (PICKARDVILLE ACC) 30-58-26-400000000										3140	3490
44	0	20	Wstl	S OF TWP RD 590 31-58-26-400000000		2470	2570	2560	2690	2800	2840	2970	3100	3220	3580
44	0	20	Wstl	N OF TWP RD 590 31-58-26-400000000		2510	2610	2600	2730	2850	2890	3020	3150	3270	3640
44	0	20	Wstl	2.6 KM S OF 18 & 44 WESTLOCK	2800	2890	3010	3000	3100	3280	3360	3530	3640	3840	4180
44	0	24	Wstl	S OF 18 IN WESTLOCK		7280	7430	7410	7500	7540	7440	7600	7760	8040	8940
44	2	4	Wstl	N OF 18 IN WESTLOCK		8080	8240	8040	8050	8080	8180	8340	8500	8630	9750
44	2	4	Wstl	S OF 106A ST IN WESTLOCK 5-60-26-400000830		4490	4180	4080	4100	4100	5140	5250	5340	5400	6100
44	2	4	Wstl	N OF 106A ST IN WESTLOCK 5-60-26-400000830		4100	4570	4460	4480	4480	4010	3990	4060	4120	4660
44	2	6	Wstl	7.0 KM N OF 18 & 44 WESTLOCK	3330	3480	3540	3360	3380	3390	3340	3300	3340	3440	3830
44	2	6	Wstl	S OF TWP RD 611 (PIBROCH ACC) 5-61-26-400000000										3260	3680
44	2	6	Wstl	N OF TWP RD 611 (PIBROCH ACC) 5-61-26-400000000										3100	3500
44	2	6	Wstl	S OF SUNNIEBEND RD 8-61-26-400000000	3080	3210	3270	3100	3070	3090	3050	3010	3070	3110	3510
44	2	6	Wstl	N OF SUNNIEBEND RD 8-61-26-400000000	2880	3010	3070	2910	2930	2950	2910	2840	2900	2940	3320
44	2	6	Wstl	S OF 661 E OF DAPP SJ	2520	2640	2680	2540	2820	2660	2640	2600	2640	2780	3140
44	2	8	Wstl	N OF 661 E OF DAPP SJ	2470	2570	2610	2490	2620	2480	2460	2420	2460	2720	3070
44	2	8	Wstl	S OF 661 NE OF DAPP NJ	2370	2480	2520	2400	2620	2480	2460	2420	2460	2720	3070
44	2	12	Wstl	N OF 661 NE OF DAPP NJ	2130	2220	2260	2160	2360	2080	2060	2030	2030	2200	2490
44	2	12	Wstl	E OF JARVIE NORTH ACC 27-63-27-400000625	1700	1920	1920	1830	2000	2020	2060	2030	2030	2080	2310
44	2	12	Wstl	W OF JARVIE NORTH ACC 27-63-27-400000625	1790	1940	1940	1850	2020	2040	2110	2070	2070	2120	2350
44	2	12	Wstl	S OF 663 E OF FAWCETT	1770	1890	1890	1800	1970	1990	1970	1930	1930	2080	2310
44	2	16	Wstl	N OF 663 E OF FAWCETT	1770	1890	1890	1800	1950	1970	1950	1890	1890	2040	2270
44	4	4	Less	S OF CROSS LAKE PP ACC 32-65-1-500000000	1710	2040	2040	1900	2030	2050	1940	1810	1810	1850	2050
44	4	4	Less	N OF CROSS LAKE PP ACC 32-65-1-500000000	1640	2030	2030	1890	2020	2040	1870	1730	1730	1770	1970
44	4	4	Less	3.5 KM S OF 2 & 44 HONDO	1630	1740	1740	1620	1730	1750	1700	1580	1590	1670	1810
44	4	4	Less	S OF 2 S OF HONDO	1630	1740	1830	1800	1730	1760	1730	1590	1590	1630	1810
45	4	4	Lamo	N OF 15 S OF BRUDERHEIM	1740	1810	1760	1710	1640	1720	1700	1670	1800	1820	1990
45	4	6	Lamo	10.7 KM S OF 38 & 45 BRUDERHEIM	640	650	650	620	600	630	610	610	780	700	800
45	4	6	Lamo	S OF 38 SW OF DEERLAND	560	570	510	490	480	520	480	470	580	600	660
45	4	8	Lamo	E OF 38 SW OF DEERLAND	1120	1130	1280	1270	1250	1330	1280	1240	1300	1380	1600
45	4	8	Lamo	W OF 831 S OF SKARO	1130	1140	1200	1160	1120	1340	1340	1300	1340	1400	1630
45	4	12	Lamo	E OF 831 S OF SKARO	930	940	1000	980	950	1080	1080	1040	1080	1100	1280
45	4	12	Lamo	W OF 855 S OF UKALTA WJ	840	850	850	820	790	790	850	830	840	850	990
45	4	16	Lamo	E OF 855 S OF UKALTA WJ	620	720	720	700	680	680	840	820	830	830	960
45	4	16	Lamo	W OF 855 N OF ANDREW EJ	650	750	750	730	690	690	860	840	850	850	990
45	6	4	Lamo	E OF 855 N OF ANDREW EJ	910	970	970	930	890	900	1040	1000	1010	1030	1200
45	6	4	Lamo	W OF 645 SE OF WHITFORD	920	980	980	940	900	1060	1060	1030	1040	1060	1230
45	6	8	Lamo	E OF 645 SE OF WHITFORD	420	440	440	420	400	390	390	380	390	410	480
45	6	8	TwoH	W OF 857 NW OF WILLINGDON WJ	480	480	460	440	370	370	370	360	370	390	450
45	6	12	TwoH	E OF 857 NW OF WILLINGDON WJ	590	590	570	550	590	590	590	550	560	600	700
45	6	12	TwoH	W OF 857 SE OF WILLINGDON EJ	560	560	520	520	560	580	580	540	550	590	690
45	6	16	TwoH	E OF 857 SE OF WILLINGDON EJ	320	320	300	300	320	340	340	320	330	350	410

Turning Movement Summary Diagram

Reference No.: 101540
Intersection of:
15 & 45 S OF BRUDERHEIM

2005 a.m. 100th Highest Hour ESTIMATES



TURNING MOVEMENT ABBREVIATIONS

NR: Traffic From North Turning Right
NL: Traffic From North Turning Left
NT: Traffic From North Proceeding Through

SR: Traffic From South Turning Right
SL: Traffic From South Turning Left
ST: Traffic From South Proceeding Through

ER: Traffic From East Turning Right
EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Turning Movement Summary Diagram

Reference No.: 101540

Intersection of:
15 & 45 S OF BRUDERHEIM

2005 AADT / ASDT ESTIMATES

North On 45		
Vehicle Type	Vol	%
A: Passenger Vehicle	1591	87.4
B: Recreational Vehicle	22	1.2
C: Bus	20	1.1
D: Single Unit Truck	101	5.5
E: Tractor Trailer Unit	86	4.7
ASDT 1990	AADT 1820	

West On 15		
Vehicle Type	Vol	%
A: Passenger Vehicle	4498	85.8
B: Recreational Vehicle	109	2.1
C: Bus	20	0.4
D: Single Unit Truck	246	4.7
E: Tractor Trailer Unit	367	7.0
ASDT 5810	AADT 5240	

East On 15		
Vehicle Type	Vol	%
A: Passenger Vehicle	3563	84.0
B: Recreational Vehicle	101	2.4
C: Bus	18	0.4
D: Single Unit Truck	212	5.0
E: Tractor Trailer Unit	346	8.2
ASDT 4660	AADT 4240	

South On Local Rd		
Vehicle Type	Vol	%
A: Passenger Vehicle	126	90.0
B: Recreational Vehicle	0	0.0
C: Bus	2	1.4
D: Single Unit Truck	11	7.9
E: Tractor Trailer Unit	1	0.7
ASDT 160	AADT 140	

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WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

TURNING MOVEMENT ABBREVIATIONS

AADT: Average Annual Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of January 1 to December 31 (365 days)

ASDT: Average Summer Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of May 1 to September 30 (153 days)

Turning Movement Summary Diagram

Reference No.: 101540

Intersection of:
15 & 45 S OF BRUDERHEIM

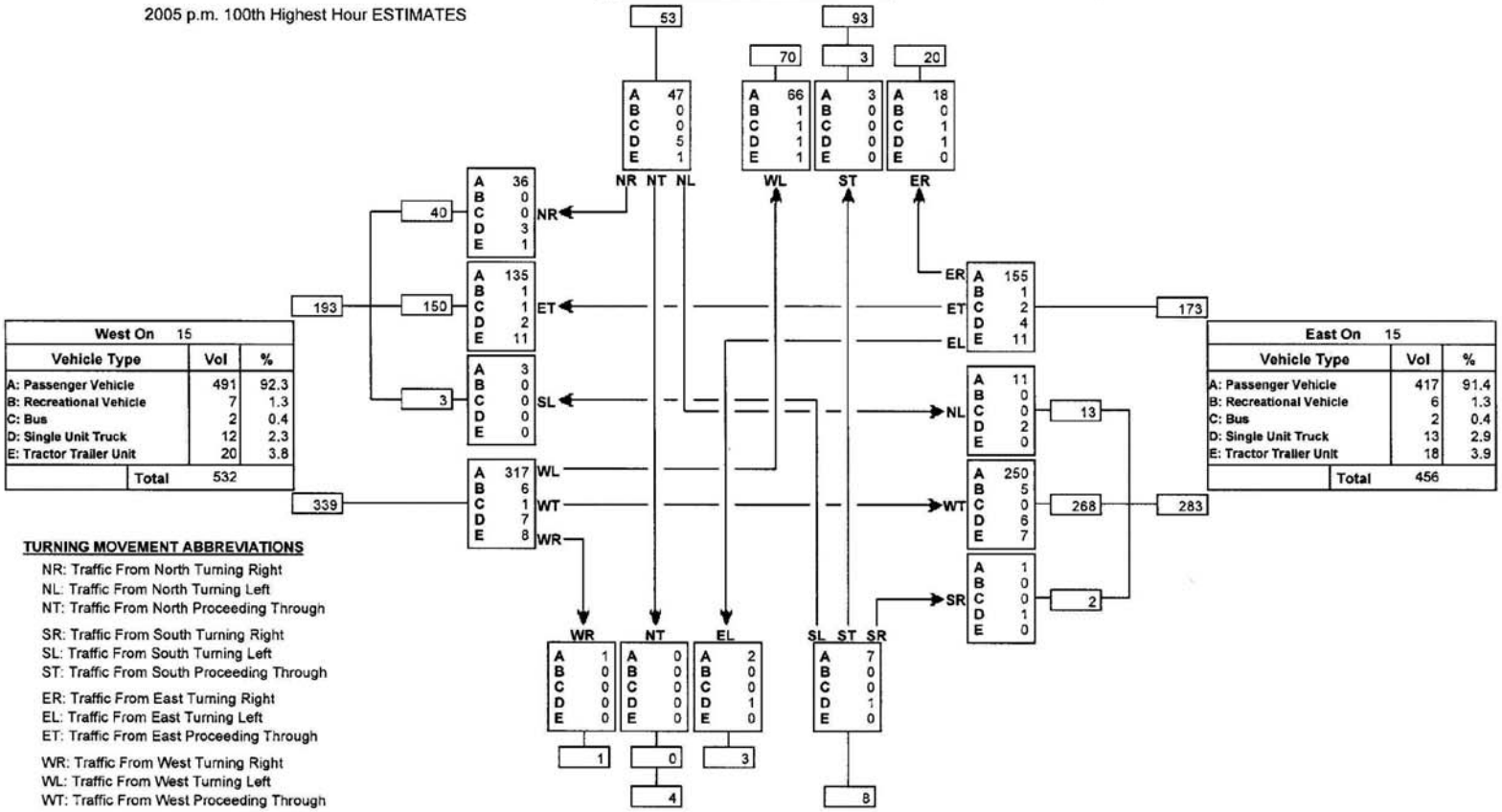
2005 p.m. 100th Highest Hour ESTIMATES

North On 45		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	134	91.8
B: Recreational Vehicle	1	0.7
C: Bus	2	1.4
D: Single Unit Truck	7	4.8
E: Tractor Trailer Unit	2	1.4
Total	146	

West On 15		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	491	92.3
B: Recreational Vehicle	7	1.3
C: Bus	2	0.4
D: Single Unit Truck	12	2.3
E: Tractor Trailer Unit	20	3.8
Total	532	

East On 15		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	417	91.4
B: Recreational Vehicle	6	1.3
C: Bus	2	0.4
D: Single Unit Truck	13	2.9
E: Tractor Trailer Unit	18	3.9
Total	456	

South On Local Rd		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	10	83.3
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	2	16.7
E: Tractor Trailer Unit	0	0.0
Total	12	



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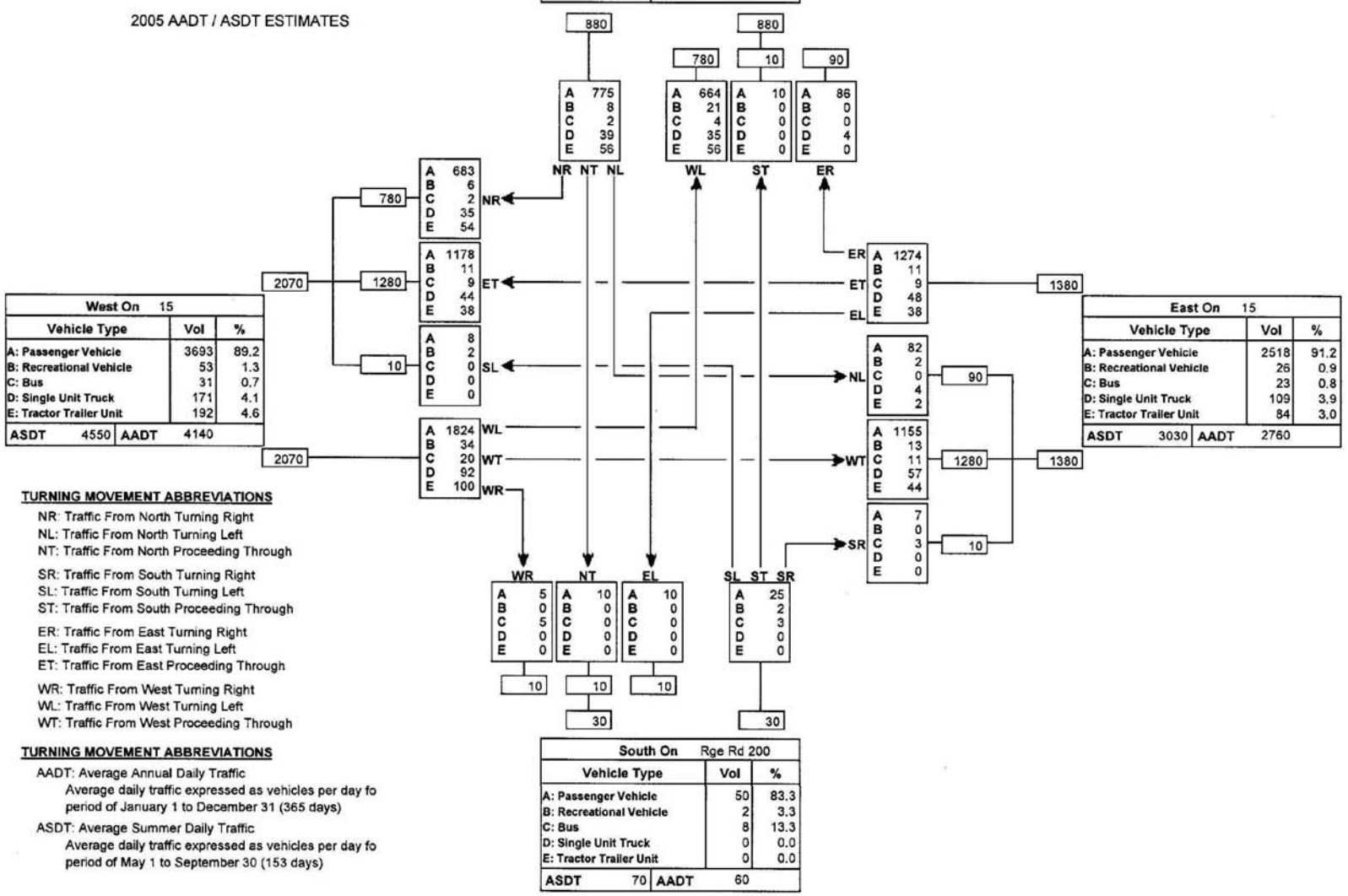
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Reference No.: 104550

Intersection of:
15 & 637 NW OF LAMONT

2005 AADT / ASDT ESTIMATES

Turning Movement Summary Diagram



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ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

TURNING MOVEMENT ABBREVIATIONS

AADT: Average Annual Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of January 1 to December 31 (365 days)

ASDT: Average Summer Daily Traffic
Average daily traffic expressed as vehicles per day fo
period of May 1 to September 30 (153 days)

Turning Movement Summary Diagram

Reference No.: 104550

Intersection of:
15 & 637 NW OF LAMONT

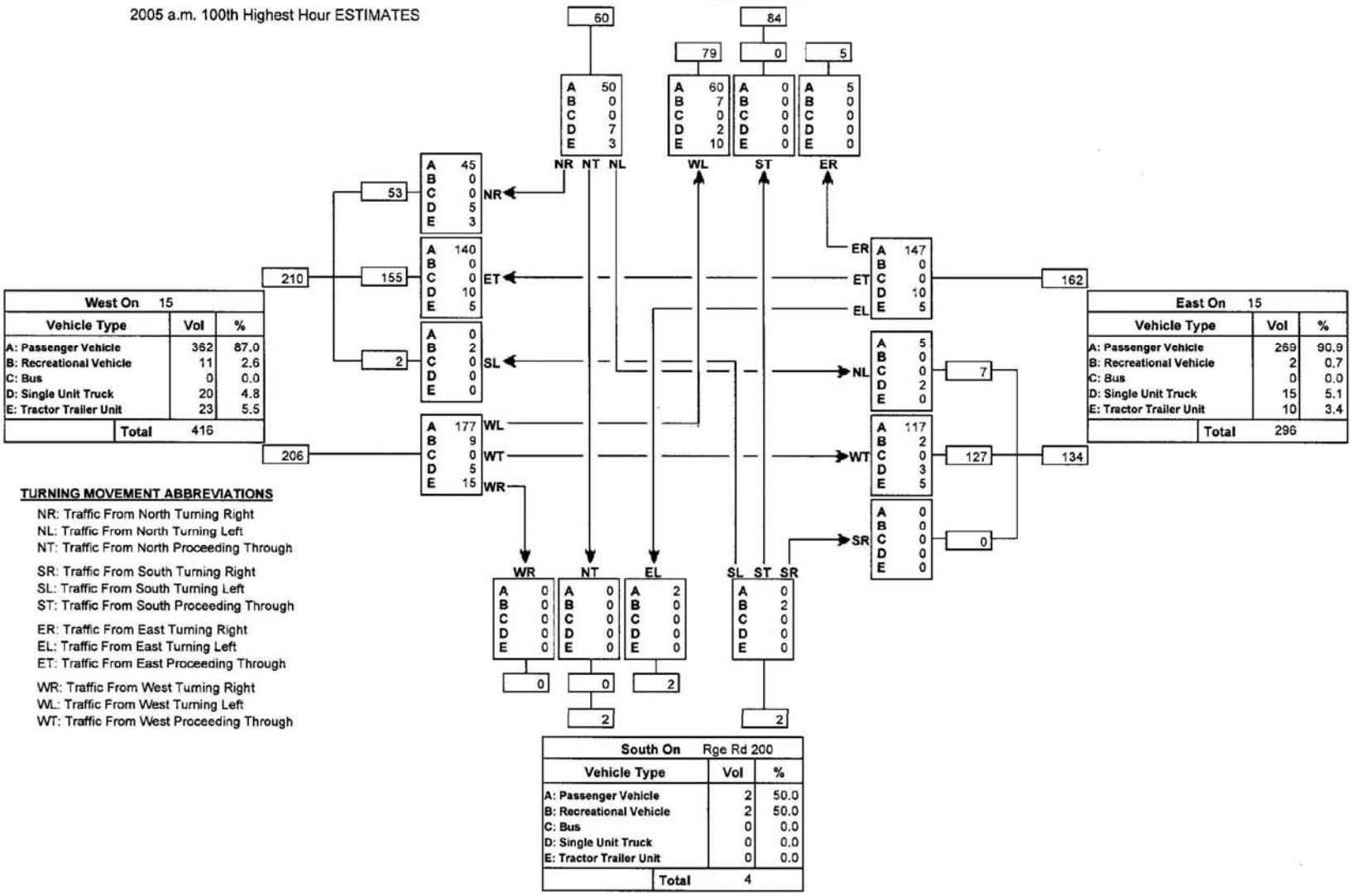
2005 a.m. 100th Highest Hour ESTIMATES

North On 637		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	115	79.9
B: Recreational Vehicle	7	4.9
C: Bus	0	0.0
D: Single Unit Truck	9	6.3
E: Tractor Trailer Unit	13	9.0
Total	144	

West On 15		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	362	87.0
B: Recreational Vehicle	11	2.6
C: Bus	0	0.0
D: Single Unit Truck	20	4.8
E: Tractor Trailer Unit	23	5.5
Total	416	

East On 15		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	269	90.9
B: Recreational Vehicle	2	0.7
C: Bus	0	0.0
D: Single Unit Truck	15	5.1
E: Tractor Trailer Unit	10	3.4
Total	296	

South On Rge Rd 200		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	2	50.0
B: Recreational Vehicle	2	50.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	4	



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WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

Turning Movement Summary Diagram

Reference No.: 104550

Intersection of:
15 & 637 NW OF LAMONT

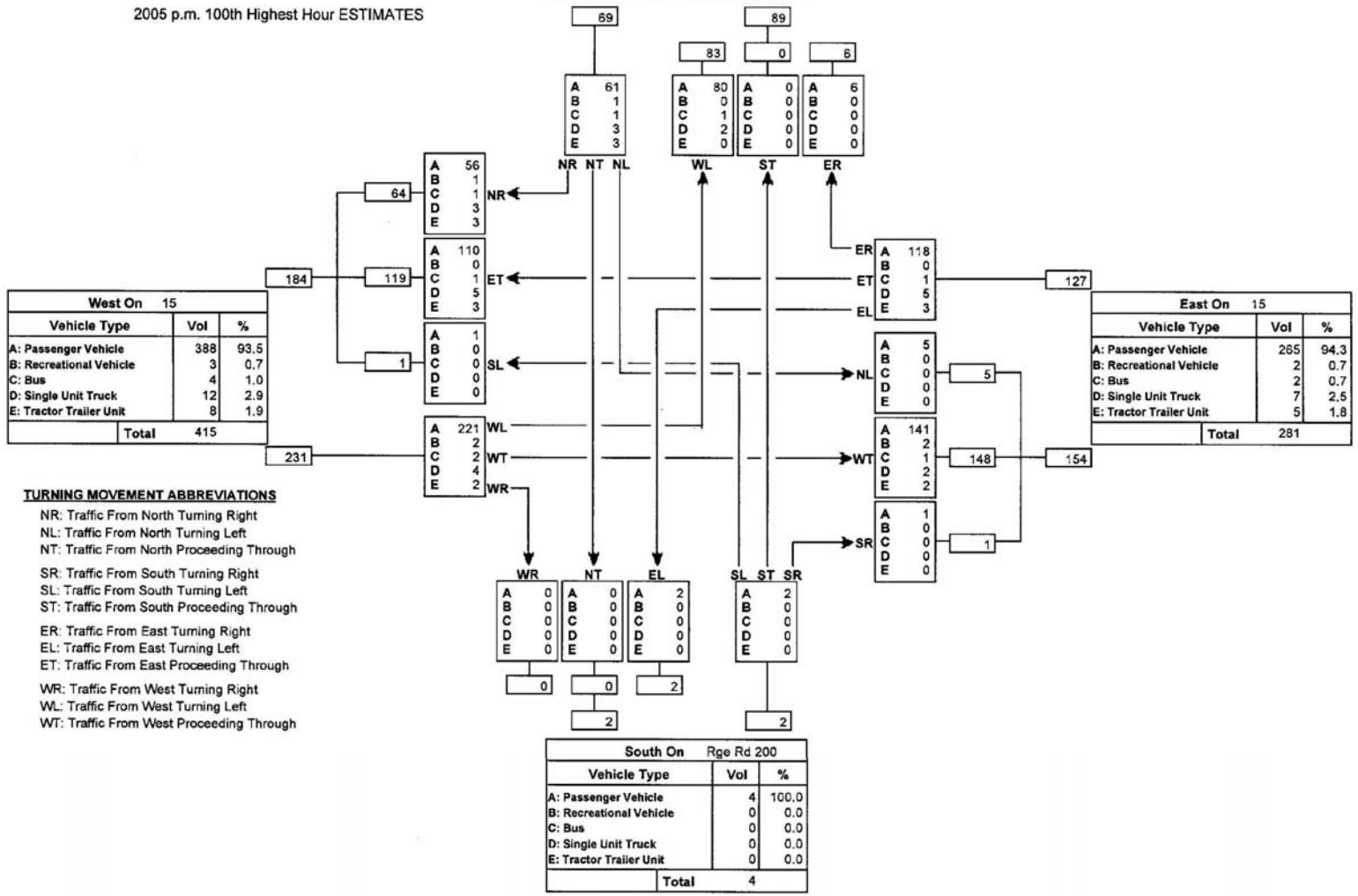
2005 p.m. 100th Highest Hour ESTIMATES

North On 637		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	147	93.0
B: Recreational Vehicle	1	0.6
C: Bus	2	1.3
D: Single Unit Truck	5	3.2
E: Tractor Trailer Unit	3	1.9
Total	158	

West On 15		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	388	93.5
B: Recreational Vehicle	3	0.7
C: Bus	4	1.0
D: Single Unit Truck	12	2.9
E: Tractor Trailer Unit	8	1.9
Total	415	

East On 15		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	265	94.3
B: Recreational Vehicle	2	0.7
C: Bus	2	0.7
D: Single Unit Truck	7	2.5
E: Tractor Trailer Unit	5	1.8
Total	281	

South On Rge Rd 200		
Vehicle Type	**Vol**	**%**
A: Passenger Vehicle	4	100.0
B: Recreational Vehicle	0	0.0
C: Bus	0	0.0
D: Single Unit Truck	0	0.0
E: Tractor Trailer Unit	0	0.0
Total	4	



TURNING MOVEMENT ABBREVIATIONS

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EL: Traffic From East Turning Left
ET: Traffic From East Proceeding Through

WR: Traffic From West Turning Right
WL: Traffic From West Turning Left
WT: Traffic From West Proceeding Through

TABLE 1

HIGHWAY DESIGNATION	LANE*/SHOULDER WIDTHS (m)	SHOULDER WIDTH "W" AT INTERSECTION (m)
RAU-213.4	3.7/3.0	1.5
RAU-21.8	3.7/2.2	1.5
RAU-210.0	3.5/1.5	1.5
RAU-209.0	3.5/1.0	1.0
RAU-208.0	3.5/0.5	0.5

* AUXILIARY LANE WILL BE 3.5m
BYPASS LANE WIDTH WILL BE THE SAME AS THROUGH LANE.

NOTES
1. DIMENSIONS SHOWN ARE FINISHED SURFACE PAVEMENT WIDTHS. ADDITIONAL SUBGRADE WIDTHS TO BE PROVIDED TO ALLOW FOR DEPTH OF BASE COURSE AND PAVEMENT.
2. THE DESIGNER MUST COMPLETE "INTERSECTION ANALYSIS" PROCEDURE TO JUSTIFY THE TYPE V TREATMENT.

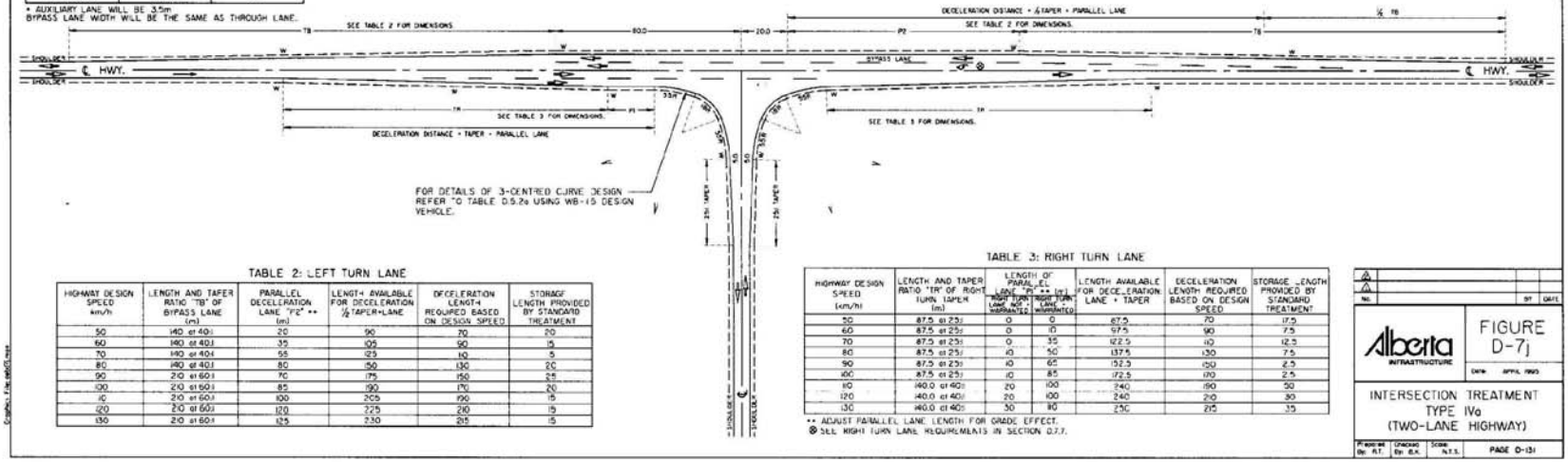

TABLE 2: LEFT TURN LANE

HIGHWAY DESIGN SPEED km/h	LENGTH AND TAPER RATIO "TB" OF BYPASS LANE (m)	PARALLEL DECELERATION LANE "P2" ** (m)	LENGTH AVAILABLE FOR DECELERATION ½TAPER+LANE	DECELERATION LENGTH REQUIRED BASED ON DESIGN SPEED	STORAGE LENGTH PROVIDED BY STANDARD TREATMENT
50	140 at 40:1	20	90	70	20
60	140 at 40:1	35	105	90	15
70	140 at 40:1	55	125	110	5
80	140 at 40:1	80	150	130	20
90	210 at 60:1	70	175	150	25
100	210 at 60:1	85	190	170	20
110	210 at 60:1	100	205	190	15
120	210 at 60:1	120	225	210	15
130	210 at 60:1	135	230	215	15

TABLE 3: RIGHT TURN LANE

HIGHWAY DESIGN SPEED (km/h)	LENGTH AND TAPER RATIO "TR" OF RIGHT TURN TAPER (m)	LENGTH OF PARALLEL LANE "P1" ** (m)		LENGTH AVAILABLE FOR DECELERATION LANE + TAPER	DECELERATION LENGTH REQUIRED BASED ON DESIGN SPEED	STORAGE LENGTH PROVIDED BY STANDARD TREATMENT
		RIGHT TURN LANE NOT WARRANTED	RIGHT TURN LANE WARRANTED			
50	87.5 at 25:1	0	0	87.5	70	17.5
60	87.5 at 25:1	0	10	97.5	90	7.5
70	87.5 at 25:1	0	35	122.5	110	12.5
80	87.5 at 25:1	10	50	137.5	130	7.5
90	87.5 at 25:1	10	65	152.5	150	2.5
100	87.5 at 25:1	10	85	172.5	170	2.5
110	140.0 at 40:1	20	100	240	190	50
120	140.0 at 40:1	20	100	240	210	30
130	140.0 at 40:1	30	80	230	215	15

** ADJUST PARALLEL LANE LENGTH FOR GRADE EFFECT.
⊗ SEE RIGHT TURN LANE REQUIREMENTS IN SECTION D.7.7.

No.		BY	DATE

Alberta INFRASTRUCTURE

FIGURE D-7j

INTERSECTION TREATMENT TYPE IVa (TWO-LANE HIGHWAY)

Prepared by: A.T. | Checked by: B.K. | Scale: N.T.S.

Volume I: Project Description

Appendix IV: Health and Safety Plan

TABLE OF CONTENTS

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LIST OF TABLES

LIST OF ATTACHMENTS

1. Background

Volume I: Project Description and Volume II: Environmental Impact Assessment (EIA) examines the environmental and socio-economic effects of construction, operation and reclamation of the sulphur forming and shipping facility proposed for the Bruderheim area (the Project). The proponent is Alberta Sulphur Terminals Ltd. (AST), a division of HAZCO Environmental Services (HAZCO), which is a division of CCS Income Trust (CCS). These volumes support applications to Alberta Environment (AENV) and the Natural Resources Conservation Board (NRCB) to construct and operate the proposed facility. They provide stakeholders with information about the Project and its potential effects so they can participate in the review and permit process. As well, they contain information and guidance to assist AST in anticipating, mitigating, monitoring and managing potential environmental and socio-economic effects.

The Project encompasses construction and operation of a facility for sulphur forming, temporary sulphur pastille storage and shipment for export. The facility is to be developed on a portion of Section 35, Township 55, Range 20, West of the 4th Meridian (35-55-20 W4M – the Site), approximately 2.2 km east of Bruderheim, Alberta, in the Industrial Heartland area of Lamont County. All infrastructure and activities will be confined to the lands owned by HAZCO.

The Project includes:

- development of rail and road access for shipping and receiving sulphur
- liquid sulphur receiving and transfer facility
- sulphur forming facility to produce sulphur pastilles
- storage of liquid and formed sulphur
- loading and shipping facility for formed sulphur

The facility will service oil and gas production and refining operations located in the Fort Saskatchewan area as well as northeastern Alberta. With increased applications, approvals and operation of bitumen upgraders and ongoing sulphur recovery initiatives, a shortage of sulphur forming facilities in Alberta is now apparent. AST will provide oil and gas producers in the area with a state-of-the-art sulphur forming, pastille storage and shipping facility with design elements and monitoring programs that focus on environmental protection.

2. Introduction

This Health and Safety Plan was prepared to communicate guidelines developed to ensure work activities are conducted in a manner that safeguards the health and safety of employees, contractors, subcontractors and all members of the public that may be affected by the operations. CCS procedures and policies together with this Plan are considered to be the designated health and safety plan for this Project.

The information in this document is applicable to employees, contractors and sub-contractors completing Project work. Requirements outlined in this document are compatible with CCS policies and procedures, and do not replace the specifications described therein.

The health and safety requirements outlined within this report comply with the *Occupational Health and Safety Act, Regulation and Code* (Province of Alberta 2006a).

During all Project activities, health and safety requirements will be evaluated and appropriate modifications to procedures shall be made where necessary. AST is responsible for the safety and well-being of their employees and subcontractors. The site supervisor is responsible for ensuring that all contracted employees comply with all health and safety policies on site. All personnel must be familiar with this manual and must indicate their willingness to follow procedures and protocols described in this manual by completing and returning the Acknowledgement Form in Attachment IV-1.

Should any member(s) of the Project team feel their safety of the safety of others is at risk at any time, they will be encouraged to stop work and discuss their concerns with the Project manager, Project safety representative or their own H&S advisor. Under OH&S regulations, all workers have the right and duty to refuse unsafe work.

3. Safety Responsibilities

3.1 Facility Operator

It is important for all personnel on the work site to be aware of the operator to ensure that all responsibilities are fulfilled. The operator is responsible for:

- control of the designated work area
- ensuring that the employer is aware of its responsibilities to their employees
- making sure that all relevant regulations are followed
- coordinating the work of the various employers on site

3.2 Alberta Sulphur Terminals

AST is responsible for the protection of employees, contractors and subcontractors, the public and the environment from potential incidents or accidents. AST must identify safety hazards and implement appropriate control measures. Workers must be made aware of these hazards and instructed in safety precautions.

Specifically, AST will:

- arrange for a safety orientation for all workers on the work site
- review this manual and distribute field copies to all personnel and one representative of each contractor working on site
- provide resources for personal protective equipment for personnel
- ensure that company safety policies, government acts and regulations are followed by all workers
- ensure that hazards associated with all tasks are identified, discussed with on-site personnel and minimized using appropriate controls
- conduct and document a facility indoctrination and daily safety meetings for the duration of construction activities
- conduct regular safety inspections and correct unsafe conditions and acts promptly
- ensure that workers are wearing the appropriate personal protective equipment

- take the appropriate disciplinary action when a worker does not comply with safety regulations and/or policies
- review and investigate all incident and accident reports
- ensure that all injuries that may become lost-time incidents or fatality claims are reported to the Workers' Compensation Board (WCB)
- report all incidents and accidents that cause or have the potential to cause serious injuries or fatalities to an AST representative, as well as an Alberta Workplace Health & Safety Director or Inspector, as appropriate

3.3 Worker's, Contractors and Subcontractors

All site workers, contractors and subcontractors are required to:

- report to the site each day, physically and mentally competent to perform their specified work
- sign in and out of the site
- follow all site safety policies
- keep a copy of this safety manual on hand in the field for reference
- provide feedback on safety policies and procedures
- inspect and maintain all equipment during the services
- report any incidents, accidents, near misses or unsafe conditions to the site supervisor
- wear personal protective equipment, as directed by AST procedures and policies
- comply with all safety policies, government acts, regulations and codes

All workers, contractors and sub-contractors are required to be familiar with the specifications included in this manual and indicate their willingness to comply with all procedures and protocols by completing and returning the Acknowledgement Form in Attachment IV-1.

Contractors and subcontractors must submit the following documentation prior to commencement of the Project:

- safety certificates for all personnel which will include:
  - Alberta Standard First Aid
  - H_2S Alive
  - Workplace Hazardous Materials Information System (WHMIS)
  - Confined Space Entry Awareness
- appropriate certification for any personnel operating heavy equipment
- appropriate journeyman tickets
- fit test documentation for personnel required to use respirators
- proof of Worker's Compensation Board coverage
- valid insurance coverage
- certificate of recognition from Alberta Partnerships in Health and Safety

Contractors and subcontractors will identify short service workers at daily safety meeting.

3.4 Visitors

Visitors must be authorized by an AST representative before entering the site. Visitors are required to sign in and out of the site and are expected to supply and wear basic personal protective equipment (e.g., hard hat, boots, safety glasses, high-visibility vest or striped coveralls) unless AST has agreed to provide it for them. Visitors must remain with a designated representative during their visit to the site.

4. General Safety

4.1 Hazard Control Inventory

Safety procedures will be incorporated into every phase of facility operations. Potential hazards and associated safety precautions are summarized below and consist of a combination of procedural controls and personal protective equipment (PPE).

Table IV-1: Hazard Control Inventory

Hazard	Hazard Control
Physical	
Driving	• properly licensed, experienced drivers • obey all road rules and speed limits • no cell phones or eating while driving • use of vehicle safety kits • complete Vehicle Inspection Checklist (see Attachment IV-2) • drive with caution, watching for wildlife and potential hazards • prior to backing up, do a walk around and use a spotter • follow AST procedures and safe work practices
Fire potential	• open flames, spark inducing items and smoking are prohibited on site • ensure that air monitoring and fire-fighting equipment is in good operating condition • be aware of all emergency response requirements on site
Excessive noise	• wear CSA standard hearing protection in high noise areas • post warning signs around perimeter of work area when noise >85 dB
Workplace violence	• strictly prohibited and not tolerated • disciplinary measures may include an apology, referral to an employee assistance program, reporting to a professional body, possible legal/criminal charges and/or termination • a full investigation will be required
Drugs and alcohol	• strictly prohibited and not tolerated • disciplinary measures will be taken in the form of a warning, a formal warning or termination • a significant incident may require post-incident testing • a full investigation will be required

Table IV-1: Hazard Control Inventory (Cont'd)

Hazard	Hazard Control
Physical (continued)	
Confined space	• use Confined Space Entry Safe Operating Procedures (see Attachment IV-3 and Attachment IV-4)
Working around rail yard	• wear visibility vest or coveralls with visibility striping • stay out of the blind spot of the trains and vehicles, stand in line of site of the operator and maintain eye contact, wait for hand signals
Tripping, falling	• wear CSA approved work boots with ankle support • keep site organized and free of clutter
Handling materials	• use proper lifting techniques • use mechanical lifting where appropriate • wear work gloves (and prescribed personal protective equipment)
Toxicological	
Elemental sulphur	• modify forming operations and controls to reduce sulphur emissions • modify sulphur handling operations and dust controls to reduce fugitive sulphur emissions • implement best management practices to reduce fugitive dust • have appropriate MSDS available (Attachment IV-5)
Hydrogen Sulphide (H_2S)	• stop operations until the source of hydrogen sulphide is identified • evaluate sulphur sources and suppliers for potential hydrogen sulphide exceedances • evaluate liquid sulphur in storage to identify hydrogen sulphide exceedances • personal and site air monitoring • have appropriate MSDS available (Attachment IV-6)
Sulphur Dioxide ($S0_2$) (toxic fumes)	• stop operations until the source of sulphur dioxide is identified • evaluate sulphur sources and suppliers for potential hydrogen sulphide exceedances • evaluate liquid sulphur in storage to identify hydrogen sulphide exceedances • personal and site air monitoring • have appropriate MSDS available (Attachment IV-7)
Dust suppression agents (including lime and gypsum)	• product data sheets are provided in Attachments IV-8 through IV–12 • proper storage and handling procedures - refer to MSDS (Attachments IV-8 through IV–12)

For this work, the most likely pathway of toxicological exposure is inhalation of the contaminant, followed by ingestion. Occupational exposure limits (OELs), including acute and chronic effects, for substances expected to be encountered at the site are summarized in the hazard control inventory. For more detailed information, refer to the Material Safety Data Sheets (MSDS) in Attachments IV-5 through IV–12.

5. Hazardous Analysis and Control Procedures

This Health and Safety Plan was developed to assist in identifying and controlling hazards associated with plant operations. Control measures for potential hazards shall be implemented throughout the duration of operations.

5.1 Safety Meetings

All on-site personnel will be required to attend a facility operations indoctrination conducted by AST site supervisors. The meeting is intended to inform all workers of the potential hazards associated with site activities and outline the scope of site activities, health and safety protocols, and emergency response procedures. All site personnel will sign a site safety indoctrination form prior to the initiation of plant operations.

Daily safety meetings will be held and documented on separate safety meeting forms throughout the construction phase.

5.2 Incident Reporting

Incidents and near misses must be reported to an operations manager or site supervisor and an HSE representative, and the appropriate Incident report form must be completed and submitted as soon as possible. Incident reporting allows workers to learn from potentially hazardous mistakes and prevent them from recurring. In accordance with the *Workers Compensation Act*, an injured worker must fill out appropriate WCB forms. To minimize loss, all incidents are recorded and corrective action taken to prevent any recurrences.

If a serious injury or an accident that has the potential of causing serious injury occurs at the site, AST shall:

- notify an AST representative of the accident
- notify Alberta Workplace Health and Safety as to the time, place and nature of serious injuries or accidents
- carry out an investigation into the circumstances surrounding serious injuries or accidents
- prepare a report in accordance with the regulations, outlining the circumstances of the serious injury or accident and the corrective actions, if any, undertaken to prevent a recurrence of the serious injury or accident
- ensure that a copy of the report is readily available for inspection by Alberta Workplace Health and Safety

The AST H&S representative and facility manager will be responsible for investigating incidents. The investigators will review the cause(s) of the event and make appropriate recommendations. The report will be sent to AST senior management for review.

5.3 Safety Training

All on-site personnel shall possess the following safety certification:

- standard first-aid (minimum 1 person for every 9 field personnel on site)
- site indoctrination

- H_2S Alive
- WHMIS
- confined space entry awareness

5.4 Disciplinary Action

The AST facility manager has the responsibility to ensure safe work practices and discipline a worker who does not comply with company safety policies and/or applicable government acts and regulations. Disciplinary actions will be used to prevent safety violations from recurring. Disciplinary action can be initiated by the AST facility manager.

The following disciplinary actions are listed from minor to severe and in the order that they would be used. If a verbal warning is issued to the non-compliant worker and the safety violation is not corrected, the supervisor should follow through with a written warning.

- verbal warning
    - worker will be informed of a minor safety violation (i.e., not wearing the required PPE) and that a written warning will be issued if the offence is not corrected or is repeated
- written warning
    - worker will be issued a written warning of a potentially serious safety violation or repeated offences of a minor safety violation. A written warning report will be kept on file and a copy will be presented to the worker's employer. Also, a verbal warning will be issued to the worker that a more severe action will be taken if the violation is ignored or repeated.
- dismissal from the site
    - this action will be used only for very serious safety violations or where the worker refuses to follow and obey safety rules. This action is the final step and good judgment should be used when administering this action.
    - an automatic dismissal will be issued for any drug, alcohol or firearm offence. Drugs, alcohol and firearms will not be permitted on the work site; impairment by illegal drugs or alcohol will not be tolerated.
    - individuals suspected to be under the influence of drugs and/or alcohol will not be allowed to remain on site. If it has been determined that the individual was indeed under the influence of drugs and/or alcohol, they will not be allowed back on site.
    - if personnel require medication that could impair their work performance, they should inform their supervisor before starting work. Workers who fail to notify their supervisor of prescription drugs that may impair their judgment or physical skills may be considered for discharge from the site.
    - AST is committed to maintaining a violence-free workplace. Workplace violence includes the threatened, attempted or actual conduct of an individual that causes or is likely to cause physical injury. Workplace violence (including implied or actual violence) is considered a serious offence, which will not be tolerated on site. Any incidents must be reported immediately and offenders will be subject to disciplinary action and may be dismissed from the facility.

5.5 Air Monitoring

The MSDS for chemicals of concern are provided in Attachments IV-5 through IV-12. At all times, contaminant exposures will be as low as reasonably achievable and within established occupational exposure limits. The proposed air monitoring program consists of three primary components, as follows:

- H_2S and SO_2 monitoring in the work area as a health and safety precaution for workers
- Compliance Source Emissions Testing on Rotoform emissions
- ambient air monitoring once per year to evaluate potential fugitive emissions of elemental sulphur

Annual ambient air and compliance source monitoring programs will be designed and implemented as a condition of the *Environmental Protection and Enhancement Act* (EPEA) with operating approval to be issued by AENV.

5.6 Building Alarm Levels

Automatic gas detection systems for H_2S and SO_2 monitor the ambient air and supply data indicating the level of H_2S and SO_2 present in parts per million (ppm). Should the amount of gas in the process or sulphur handling areas reach 5 ppm H_2S or SO_2, a panel light will illuminate in the control room and an audible alarm will sound in both the control room and contaminated area. This will warn operators that the atmosphere is contaminated and where the release has occurred.

H_2S and SO_2 gas detection systems are located as follows:

- rail car sulphur reception area – one
- truck sulphur reception area – one
- sulphur forming building– two
- sulphur load out area – two

5.6.1 Personal Monitor Alarm Levels

All personnel working in the sulphur forming and processing areas are required to wear personal monitors. Personal monitors alarm at a level audible to the individual. Under warning circumstances, the worker should stop work immediately and exit the building or risk area. The building or risk area should then be ventilated and attempts made to reduce or eliminate the potential source of the hazardous atmosphere. Workers shall not re-enter the building or risk area until it has been cleared to do so.

5.6.2 Respiratory Protection

All personnel are responsible for ensuring that they are competent to use the type of respiratory protection that is required for the work being conducted and voice any concerns they may have to the site supervisor. Site personnel must check the condition of the respiratory device, ensure that it is appropriate for the situation and store, maintain and clean respiratory protective devices properly. Self contained breathing apparatus (SCBA) will be available in designated areas for emergency response situations where safe exit of the building is required.

6. Safe Work Procedures

6.1 General Safety

The following general work area health and safety measures shall be followed at the operations facility:

- clean wash water will be available at the work site
- ignition sources from vehicles, pumps, static pressure build-up and sparks generated from rubbing or scraping will be minimized by:
    - turning vehicles off around flammable sources (where possible)
    - smoking in designated areas only
    - discarding cigarette butts appropriately
    - ensuring that equipment is properly grounded when appropriate
    - using materials that are non-sparking
- manual lifting will be minimized wherever possible and any lifting should involve bending at the knees and lifting with the legs
- all work areas will be clutter-free and accessible to emergency vehicles
- minimize excessive dust generated from activities on the site: if dust significantly reduces visibility or the dust clouds are opaque, dust suppressing agents shall be incorporated into the site activities
- workers should be clean-shaven and tie back long hair to facilitate wearing respiratory devices and prevent it from becoming tangled in equipment

6.2 Noise Management and Hearing Protection

Noise exposure will be managed, where possible, by engineering and administrative controls (e.g., equipment maintenance, minimizing exposure duration). Exposure limits are presented in Table IV-2. Where noise exceeds 85 dBA, signs will be posted at the perimeter of the area, warning that hearing protection must be worn. All workers who are or who may be exposed to noise in excess of the OEL will wear hearing protection (see Table IV-3). Hearing protection worn must meet CSA requirements for the level of noise exposure of the worker. Disposable hearing protection will be available on site. In general, if you must raise your voice to be heard by a person standing beside you, hearing protection should be worn. In order for hearing protection to be effective it must be used and maintained according to the manufacturers recommendations. In general, the protector must make a seal with the ear canal or the side of the head (Province of Alberta 2006b).

Table IV-2: Occupational Exposure Limits for Noise

Exposure Level dBA	Exposure Level Limits (hours)
82	16 hours
83	12 hours and 41 minutes
84	10 hour and 4 minutes
85	8 hours
88	4 hours
91	2 hours
94	1 hour
97	30 minutes
100	15 minutes
103	8 minutes
106	4 minutes
109	2 minutes
112	56 seconds

Table IV-3: Selection of Hearing Protection Devices

Maximum Equivalent Noise Level (dBA L_{eq})	CSA Class of Hearing Protection	CSA Grade of Hearing Protection
<90	C, B or A	1, 2, 3 or 4
<95	B or A	2, 3 or 4
<100	A	3 or 4
<105	A	4
<110	An earplug + A or B earmuff	3 or 4 earplug + 2, 3 or 4 earmuff
>110	A earplug + A or B earmuff and limited exposure time to keep sound reaching the worker's ear drum below 85 dBA L_{eq}	3 or 4 ear plug + 2, 3 or 4 earmuff and limited exposure time to keep sound reaching the worker's ear drum below 85 dBA L_{eq}

6.3 Driving

All on-site workers must have a valid driver's license. All workers who drive on site, including those that use their personal vehicle on site, must have the vehicle insured for business use with a minimum of $2 million liability insurance. Personal vehicles must be inspected by a licensed mechanic annually and maintained in a roadworthy condition. Documentation of vehicle repairs and inspections should be readily available for confirmation by AST.

When operating any vehicle during this Project, workers must:

- complete a Vehicle Inspection Checklist (see Attachment IV-2) to document the vehicle walk-around and inspection for unsafe conditions before driving
- carry a vehicle safety kit containing a minimum of an Alberta #1 first aid kit
- observe all rules of the road including posted speed limits
- adjust speed to accommodate road and weather conditions

- ensure all loads are properly secured to prevent them from shifting or falling off the vehicle
- avoid parking or stopping on slopes of hilly terrain or on obscured sections of roads or trails
- use the park brake when vehicle is parked or left standing (standing refers to a vehicle with the engine running and the vehicle in a parked position)
- practice defensive driving at all times
- use turn signals whenever appropriate
- drive with headlights on
- keep the vehicle and associated equipment neat, clean and free from fluid leaks
- do not smoke while fuelling vehicles
- never leave a fuel line unattended

6.4 Confined Space

AST is responsible for arranging the appropriate level of confined space entry training for all personnel working in the vicinity of confined spaces. A representative will track this training and arrange refresher training, as required.

It is the responsibility of the lead operator to:

- determine if confined space entry is necessary
- identify and classify confined spaces on a Confined Space Entry Decision Chart (see Attachment IV-3)
- assess hazards associated with Confined Space Entry Checklist (see Attachment IV-4)
- implement appropriate procedures for eliminating/minimizing entry hazards
- ensure atmospheric monitoring is completed by competent personnel
- ensure personnel are trained in confined space entry (including emergency response)
- ensure personnel are equipped with the appropriate equipment

6.5 Sulphur Containment, Storage and Handling

Products are stored in containers provided by the respective suppliers and all storage areas will comply with the requirements of the EUB Guide 55 (EUB 2001). Liquid sulphur storage occurs at two locations within the facility and process:

- initial sulphur load-out and transfer tank
- liquid sulphur storage tanks

The initial sulphur load-out and transfer tank comprises an in-ground concrete tank surrounded by a permeable leak detection system and secondary compacted clay soil liner. The tank is fitted with steam-coils to maintain the sulphur in its liquid state and vented to the atmosphere through a vertical vent stack. Vapours are treated to remove residual H_2S. The concrete walls of the tank provide primary containment and the secondary clay soil liner provides secondary containment. Because any liquid sulphur that permeates the concrete will

quickly solidify, the primary containment system is self-annealing. The vent stack is situated above the breathing zone to protect workers from any potential hydrogen sulphide vapours that may accumulate in the tank.

The liquid sulphur is transferred into one of six, 3,000 m^3 heated, insulated and vented tanks used to store liquid inlet sulphur. These tanks include leak detection and are vented to the atmosphere. Vapours emitted to the atmosphere are subject to H_2S treatment.

6.6 Chemical Management

Chemicals that are managed and stored as part of routine operations include:

- degassed liquid sulphur
- formed sulphur pastilles
- lime
- dust suppression agents Dustbind S5 and IPAC SRB Plus

The chemicals that require storage such as lime or dust suppression agents must be done in accordance with manufacturers' recommendations and any requirements of the applicable MSDS (see Attachments IV-8 through IV–12).

6.7 Safe Equipment Operation for Sulphur

6.7.1 Equipment

Sulphur packs in the pins and bushings of the track type undercarriage can cause severe stretching of the links. Links must be visually inspected and cleaned out after each shift.

6.7.2 Loading/Hauling

Sparks from loading/excavating can cause fires. A fire can occur while the load is being transported. All loads should be transferred as soon as possible. Be aware of the odour of SO_2.

6.7.3 Hand Tools, Power Tools, Welding

Before any repair work can be undertaken on any machinery or equipment, the area must be cleared of all sulphur dust and debris. If this is impractical, other prevention measures should be taken (i.e., cover, wetting down of area). Be familiar with "Hot Work" permit procedures prior to starting any repair. Assure that all permits are in place and all conditions of the permit have been met prior to work starting.

7. Sulphur Handling and First Aid Measures

7.1 First Aid Equipment

All on-site personnel will have Standard Level First Aid training (First Aider I, under the OH&S Regulations). A first aid station will be maintained on the site, clearly marked and contain a minimum of the following (Province of Alberta 2006a):

- an Alberta #3 first-aid kit
- an eye-wash station
- a list of qualified first-aid attendants
- hygiene facilities to include a portable toilet, site trailer and wash station
- sufficient clean water to cleanse wounds

The location of the first aid station will be clearly marked and identified during facility indoctrination. The site supervisor will replace any supplies used from this station within 24 hours. A minimum of one – 30 pound multi-purpose (Class A, B and C) fire extinguisher will be located by the first-aid station for emergency use.

7.2 First Aid Measures

It is important to protect all possible routes of entry when working with and handling all types of sulphur. Table IV-4 and Table IV-5 outline the effects of both acute and chronic exposures through each possible route of entry.

Table IV-4: Effects of Acute Exposure to Sulphur

Route of Entry	Effects
Eyes	May cause irritation of the inner surface of the eyelid
Skin	Sulphur dust may cause skin irritation and liquid sulphur will burn on contact
Ingestion	Metabolic acidosis (lowered pH of bodily fluids) has been observed following ingestion
Inhalation	Inhaled dust may cause respiratory tract irritation; exposure to sulphur particulates may produce tracheobronchitis characterized by cough, sore throat, chest pain and light headedness

Hydrogen sulphide may be fatal if inhaled and can cause respiratory paralysis by depression of central nervous system activity. Effects of overexposure include headaches, dizziness, vertigo, giddiness, confusion, chest pains, olfactory fatigue, unconsciousness and death. Rhinitis, pharynggitis, bronchitis, pneumonitis, pulmonary edema and cyanosis may occur.

Table IV-5: Effects of Chronic Exposure to Sulphur

Route of Entry	Effects
Eyes	Repeated contact can cause permanent eye damage (clouding of the lens and chronic irritation)
Skin	May cause contact dermatitis and is a possible skin sensitizer
Ingestion	Not normally required; obtain medical attention if large amounts have been ingested
Inhalation	Repeated exposure may cause irritation of the mucous membrane and bronchitis with cough, phlegm and/or shortness of breath

Table IV-6 presents first aid measures for all possible routes of entry.

Table IV-6: First Aid Response

Route of Entry	Response
Eyes	Immediately flush eyes with water for at least 15 minutes holding eyelids open to ensure effective cleaning; if irritation persists, seek medical attention
Skin	In case of contact with sulphur dust, wash affected area with soap and water. If irritation occurs and persists, seek medical attention. In case of contact with molten sulphur, wash exposed area with cool running water. Do not remove the sulphur crust - it serves as a sterile dressing. Seek medical attention immediately.
Ingestion	If conscious, wash out mouth with water and seek medical attention if large amounts have been ingested
Inhalation	Move victim to uncontaminated area. If affected by decomposition products, remove immediately to fresh air and seek medical attention. If breathing has stopped, trained personnel should begin artificial respiration or, if the heart has stopped, cardiopulmonary resuscitation (CPR) immediately. Apply oxygen if available. Seek medical attention. Consult medical personnel for chronic respiratory distress (pulmonary edema).

In all cases, seek medical attention immediately.

7.2.1 Personal Protective Equipment

All on-site personnel may be required to bring or be supplied with the following personal PPE at site based on the nature of the activities and handling as designated by the site supervisor:

- CSA approved hard hat
- visibility vest or coveralls with visibility stripping
- CSA approved hearing protection
- half-mask respirators (equipped with p100/HEPA filters and organic vapour cartridges)
- safety glasses with side shields, goggles or full-face shield
- CSA approved steel toed work boots and/or chemical resistant rubber boots
- heat-resistant neoprene work gloves
- fire resistant neoprene coveralls as indicated by the site supervisor
- Tyvek disposable coveralls with boots

Sulphur impregnated clothing could result in serious burns and therefore coveralls must remain as dust free as possible and be cleaned regularly. Safety showers should be available for emergency use.

8. Emergency Response Plan

The Emergency Response Plan (ERP), contained in Appendix V of Volume I, was completed to accomplish the following:

- provide a safe work environment for site workers
- protect the health and safety of workers and members of the public that could potentially be affected by the facility operations
- evaluate emergency scenarios with the goal of establishing what individuals could be at risk as a result of an emergency and to what degree those individuals may be put at risk
- prepare for emergencies and put in place the necessary personnel, training and equipment to appropriately respond to emergency situations that can be reasonably anticipated

9. References

9.1 Literature Sited

Alberta Energy and Utilities Board (EUB). 2001. *Guide 55: Storage Requirements for the Upstream Petroleum Industry*. December 2001.

Province of Alberta. 2006a. *Occupational Health and Safety Act and Regulation*. Queen's Printer for Alberta.

Province of Alberta. 2006b. *Occupational Health and Safety Code.* Queen's Printer for Alberta.

Attachment IV-1: Safety Manual Acknowledgement Form

SAFETY MANUAL ACKNOWLEDGEMENT FORM

I have read the Bruderheim Sulphur Facility Safety Manual (March 2007). I have a thorough knowledge of the safety policies and Occupational Health and Safety Acts Regulations and Codes governing the type of work I am to perform for Alberta Sulphur Terminals Ltd.

AND

I commit to conduct myself in a safe and professional manner and adhere to all OH&S and site safety policies.

Date: _____ /_____ /_____ (YY/MM/DD)

_____ _____
Employee Name (printed) *Employee Signature*

***COMPLETE AND SUBMIT TO AN HSE ADVISOR**

Attachment IV-2: Vehicle Inspection Checklist

Vehicle Inspection Checklist

VEHICLE INSPECTION CHECKLIST

Date: _____
Supervisor: _____
Task: _____
Location: _____
Description of Work: _____

WALK AROUND

- ☐ Ensure Vehicle is not diesel
- ☐ Perform pre-driving inspection of vehicle.
- ☐ Check for obstacles.

VISIBILITY

- ☐ Check condition of windshield to ensure cracks do not obscure driver's vision.
- ☐ Check windshield wipers to ensure that they are in good condition.
- ☐ Ensure that windows and mirrors are clear and properly adjusted. Ensure that headlights (including high beams and indicator), tail lights, turn signals, running lights, hazards, and brake lights are all functional on vehicle.

TIRES

- ☐ Look for excessive wear or damaged areas on tread and sidewalls.
- ☐ Check for proper jack, tire wrench and spare tire.
- ☐ Check and use vehicle manufacturer recommended tire pressure.
- ☐ Make sure wheel wells are unimpeded by mud, ice or snow.

BODY

- ☐ Check for vehicle body damage and record any findings.

ENGINE/ELECTICAL

- ☐ Check oil, coolant and windshield washer fluid levels.
- ☐ Check condition of hoses and belts.
- ☐ Check for leaks and puddles of oil or anti-freeze.
- ☐ Make sure horn and all gauges are working.
- ☐ Ensure that trailer lights are working (if applicable).
- ☐ Check integrity of hood latch and prop bar.

BRAKES

- ☐ Test foot brake before commencing driving by testing during a slow roll.
- ☐ Test emergency brake by engaging and then gently applying acceleration.

INTERIOR

- ☐ Check emergency road kit.
- ☐ Ensure seat belts are in working condition and not frayed.
- ☐ Check fuses and indicator lights.
- ☐ Check secondary attachments and ensure load is secured properly.

VERIFICATION

I verify that the above stated inspection has been performed to the best of my knowledge.

Signature: _____ Date: _____ / _____ / _____ (yy/mm/dd)

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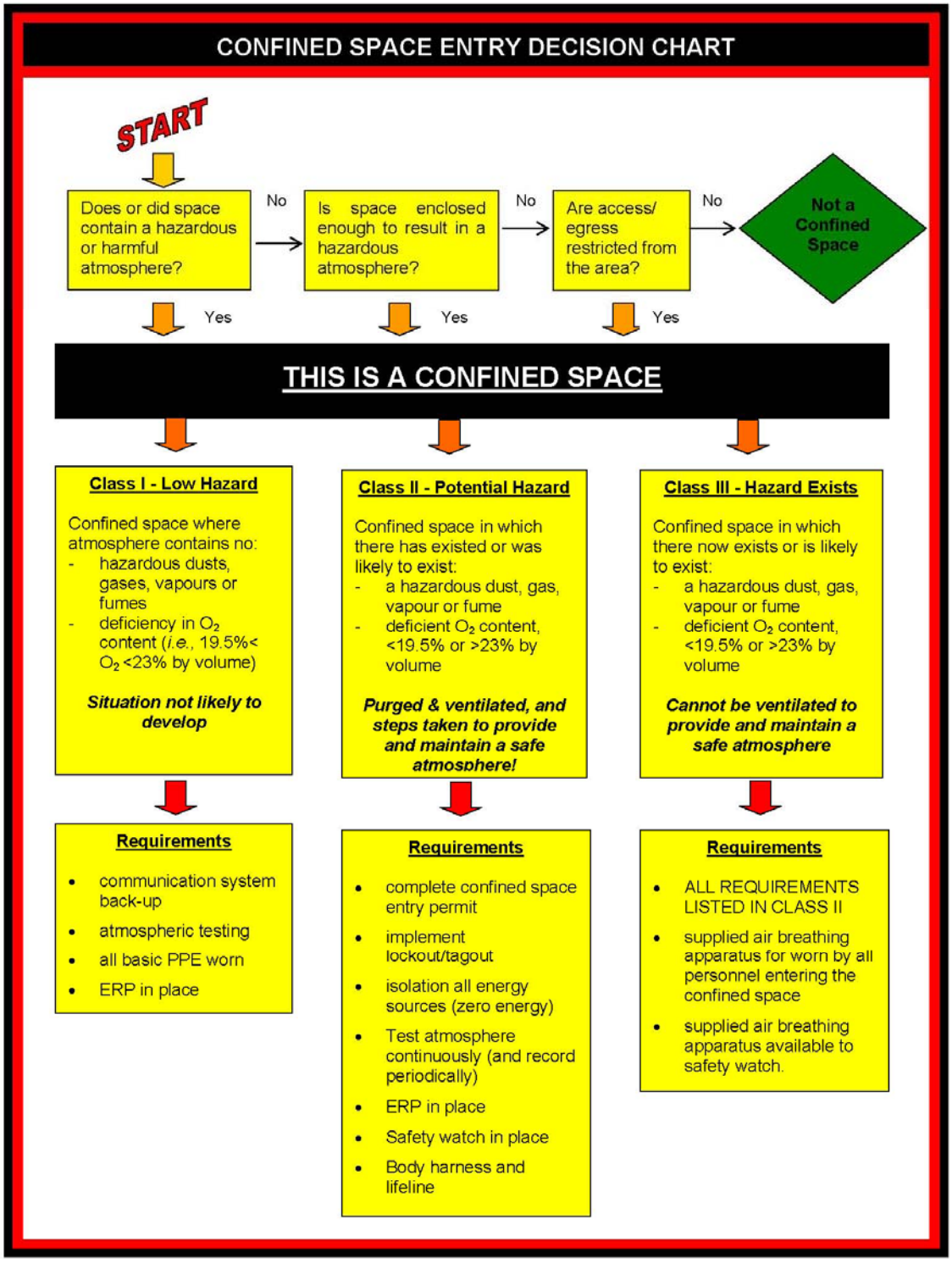
Attachment IV-3: Confined Space Entry Decision Chart



Attachment IV-4: Confined Space Entry Checklist

CONFINED SPACE ENTRY CHECKLIST

Facility Location .....
Required Task .....
Supervisor .....
Date: ..... / ..... / ..... (yy/mm/dd)
Employee Name: .....
General Description of Work: .....
.....

PERSONNEL LOG

Personnel Entering Confined Space	Entry Time:	Exit Time:	Standby Personnel	Start time:	Finish Time:
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....

PRE-ENTRY CHECKLIST

DO NOT ENTER A CONFINED SPACE UNLESS YOU HAVE CONSIDERED EVERY OPTION

Is entry absolutely required? ☐ Yes ☐ No
If yes, address ALL of the following issues.

TRAINING	YES	NO
Have you been trained in the use of a respirator or supplied-air breathing appartus, if required?	☐	☐
Have you received first-aid training?	☐	☐
Have you been trained on entry into a confined space?	☐	☐
Have you read and understood the procedures on entry into a confined space?	☐	☐

CLEANING	YES	NO
Have all liquids or free flowing solids been removed and/or prevented from entering the confined space?	☐	☐
	☐	☐

RESPIRATORY PROTECTION	YES	NO
Is respiratory protection required?	☐	☐
Have appropriate respirators & cartridges been supplied?	☐	☐
Do the respirators meet prescribed standards?	☐	☐

STANDBY RESCUE	YES	NO
Are at least 2 standby persons available near the confined space when required?	☐	☐
Are standby personnel in direct communication with workers inside the confined space?	☐	☐
Is there a suitable device available to call for help?	☐	☐
Is safety harness securely attached to life line?	☐	☐
Are standby personnel supplied with protective and emergency equipment for use in a possible rescue?	☐	☐
Do standby personnel have first-aid training?	☐	☐
Is at least one standby person trained in emergency procedures?	☐	☐

ISOLATION	YES	NO
Is isolation required?	☐	☐
Has the space been isolated? (i.e. have pipes, pressure lines, etc. been blanked off?)	☐	☐
Has all electrical and mechanical equipment in the space been disconnected and locked out?	☐	☐
Is the opening for entry or exit large enough to allow a person who is wearing protective equipment to go through?	☐	☐

WRITTEN PROCEDURES	YES	NO
Have the written procedures been established and attached to this checklist?	☐	☐
Has personal protective equipment been specified?	☐	☐
Have the written procedures been explained to all personnel involved?	☐	☐
Have emergency procedures been established	☐	☐

ATMOSPHERE MONITORING	YES	NO
Has a qualified person been appointed to carry out the required testing?	☐	☐
Is the testing equipment correctly calibrated?	☐	☐
Have all areas of the confined space been tested?	☐	☐
Is the oxygen level not less than 18% and not more than 23%, by volume? _____% O_2	☐	☐
Are toxic, flammable, or oxygen-displacing gas vapours present? _____% LEL	☐	☐
Have assessments been made and reviewed for chemicals of concern?	☐	☐
Does the concentration of any airborne chemical agent exceed regulated levels (OEL)? _____ppm	☐	☐
Will the quality of the air be monitored in the confined space while workers are inside?	☐	☐
Have all atmospheric tests been documented (attach)?	☐	☐

VENTILATION	YES	NO
Is ventilation required?	☐	☐
Has the space been ventilated just before entry?	☐	☐
Will the ventilation equipment be kept running while workers are in the confined space?	☐	☐
Does the ventilation equipment have an audible or visible alarm that will be activated if the equipment fails?	☐	☐
Will the ventilation equipment be monitored constantly?	☐	☐

CLOTHING & EQUIPMENT	YES	NO
Is special clothing required (*e.g.,* chemical resistant)?	☐	☐
Are safety boots an hard hat required?	☐	☐
Is eye or hearing protection required?	☐	☐
Is a safety harness available?	☐	☐
Is a suitable lifting device required and available?	☐	☐
Is any other special equipment required?	☐	☐
Are special tools required?	☐	☐
Are the above supplied and in good working order?	☐	☐

Attachment IV-5: Sulphur MSDS Sheet

Syncrude
Securing Canada's Energy Future

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT & COMPANY IDENTIFICATION

PRODUCT: **Sulphur** **SAN 4263**

MANUFACTURER:
Syncrude Canada Ltd.
P.O. Bag 4009
Fort McMurray, AB
Canada T9H 3L1
Emergency Telephone No. (780) 790-5094

SYNONYMS: Sulfur, Elemental Sulphur, Liquid Sulphur
Syncrude Sample Tag # 12x001

PRODUCT USE: By-product of Oil Sands Treatment

PREPARED BY: Nathalie Bérubé
(780) 790-4544

DATE OF PREPARATION/REVISION: March 7, 2006

2. COMPOSITION, INFORMATION ON INGREDIENTS

Sulphur	100 %	CAS #: 7704-34-9
Hydrogen Sulphide	< 100 ppm (mg/Kg)	CAS #: 7783-06-4

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

Yellow crystals, powder, or heated liquid. Sulphur dust is explosive when exposed to flame. Liquid sulphur can cause burns on contact. Hydrogen sulphide (H2S) may be released as liquid sulphur cools and solidifies. Hydrogen sulphide may also be released from excessive heating, agitation, or from contact with acids or acid salts. Inhaled H2S may cause central nervous system depression resulting in headache, dizziness, nausea, unconsciousness, and death. Exposure to elemental sulphur may cause irritation to the eyes, skin, and respiratory tract.

ROUTE OF ENTRY: Eye contact, Skin contact, Inhalation, Ingestion

EFFECTS OF ACUTE EXPOSURE:
EYES: May cause irritation of the inner surface of the eyelid.

SKIN: Sulphur dust may cause skin irritation. Liquid sulphur will burn.

INGESTION:
Metabolic acidosis (lowered pH of bodily fluids) has been observed following ingestion.

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INHALATION: Inhaled dust may cause respiratory tract irritation. Exposure to sulphur particulates may produce tracheobronchitis, characterized by cough, sore throat, chest pain, and lightheadedness.

Hydrogen sulphide may be fatal if inhaled; causes respiratory paralysis by depression of central nervous system activity. Effects of overexposure include headache, dizziness, vertigo, giddiness, confusion, chest pains, olfactory fatigue, unconsciousness, and death. Rhinitis, pharyngitis, bronchitis, pneumonitis, pulmonary edema and cyanosis may occur.

EFFECTS OF CHRONIC EXPOSURE:
EYES: Repeated contact can cause permanent eye damage (clouding of the lens and chronic irritation).

SKIN: May cause contact dermatitis and is a possible skin sensitizer.

INGESTION: Not normally required; obtain medical attention if large amounts have been ingested.

INHALATION: Repeated exposure may cause irritation of the mucous membrane and bronchitis with cough, phlegm and/or shortness of breath.

4. FIRST AID MEASURES

EYES: Immediately flush eyes with water for a least 15 minutes holding eyelids open to ensure effective cleaning. If irritation persists, seek medical attention.

SKIN: In case of contact with sulphur dust, wash affected area with soap and water. If irritation occurs and persists, obtain medical attention. In case of contact with molten sulphur, wash exposed area with cool running water. The sulphur crust should not be removed because it serves as a sterile dressing. Seek medical attention immediately.

INGESTION: If conscious wash out mouth with water. Obtain medical attention if large amounts have been ingested.

INHALATION: Move victim to uncontaminated area. If a person is affected by decomposition products, remove immediately to fresh air and obtain medical attention. if breathing has stopped, trained personnel should begin artificial respiration, or, if the heart has stopped, cardiopulmonary resuscitation (CPR) immediately. Apply oxygen if available. Obtain medical attention. Consult medical personnel for chronic respiratory distress (pulmonary edema).

GENERAL: In all cases, seek medical attention.

5. FIRE FIGHTING MEASURES

FLASH POINT (PMCC):	207 °C	
AUTO-IGNITION TEMPERATURE:	232 °C	
FLAMMABLE LIMITS IN AIR:	LEL: 35 g/m3	UEL: 1400 g/m3

FIRE & EXPLOSION HAZARDS:
May burn at or above the flashpoint; material in the form of dust is subject to explosion.

Decomposes; flammable/toxic gases will form at elevated temperatures (thermal decomposition). Toxic gases will form upon combustion.

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Warning: In enclosed containers or confined spaces, hazardous concentrations of hydrogen sulphide can build up in the headspace which can form explosive mixtures with air.

EXTINGUISHING MEDIA:
Class A fire extinguishers, water foam, dry chemical, carbon dioxide. Do not direct straight stream to molten sulphur.

FIRE FIGHTING PROCEDURES:
Evacuate all personnel from danger area. Exposed firefighters must wear full bunker gear, including a NIOSH approved positive pressure self-contained breathing apparatus with full-face mask. Shut off sources of fuel and ignition. Use water spray to cool fire-exposed surfaces and to protect personnel. Use foam, dry chemical or water spray to extinguish fire. Avoid spraying water directly into storage containers due to danger of boil over. Liquid sulphur in open containers may be extinguished with a fine water spray. Use of high-pressure hose streams shall be avoided due to the risk of splattering or causing a steam explosion. Quantity of water used shall be kept to a minimum.
When fighting sulphur block fires, beware of the risk of the block collapsing.

HAZARDOUS COMBUSTION PRODUCTS:
Hydrogen Sulphide (H2S) (Toxic and Explosive) and Oxides of Sulphur (Toxic)

6. ACCIDENTAL RELEASE MEASURES

LEAK AND SPILL PROCEDURE:
Contain spill, remove sources of ignition. Keep public away. If molten, allow to solidify and cool. Clean solid spill to two or more inches below soil line, and place in suitable containers for recycle or disposal. If in agricultural area or landscaped ditch, etc. roto-till with a light coating of powdered limestone.

7. HANDLING AND STORAGE

HANDLING PROCEDURES AND EQUIPMENT:
Keep containers closed. Handle and open containers with care. Open containers only in a well-ventilated area. Store in a cool, well-ventilated place away from incompatible materials. DO NOT handle or store near an open flame, heat, or other sources of ignition. Protect material from direct sunlight.

The vapour space over solid sulphur in enclosed containers or other confined spaces may contain concentrations of toxic and flammable hydrogen sulphide gas, which can be rapidly lethal and which can form an explosive mixture with air. Exercise caution and wear a positive pressure air mask when opening or closing a hatch. Use non-ferrous tools to reduce sparking. Solid sulphur should not be put into any container that contains trace quantities of hydrocarbons. Contact with hydrocarbons can generate toxic and flammable hydrogen sulphide gas.

Do not breathe dust or fumes. Minimize dust generation during handling. Empty containers may contain product residue. Do not pressurize, cut, heat, or weld empty containers. Do not reuse empty containers without commercial cleaning or reconditioning.

STORAGE REQUIREMENTS:
Vented storage tanks, grounded and diked. Solid sulphur stored in blocks.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

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ENGINEERING CONTROLS: Adequate ventilation to ensure that atmospheric concentrations of H_2S and $S0_2$ do not exceed OEL, LEL.

PERSONAL PROTECTIVE EQUIPMENT:
Eyes And Face: Chemical safety goggles and/or full-face shield to protect eyes and face, if product is handled such that it could be splashed into eyes. Provide an eyewash station in the area.

Skin (Hands, Arms And Body): Insulated, impervious gloves (neoprene) should be worn at all times when handling liquid sulphur. Impervious clothing (apron, coveralls, boots) should also be worn in confined workspaces or where the risk of skin exposure is much higher. Safety showers should be available for emergency use.

Respiratory: In dusty conditions, use a dust mask. Under conditions of fire or high heat, use self-contained breathing apparatus.

EXPOSURE LIMITS: 8-hour OEL = 10 mg/m^3 (as total dust)

9. PHYSICAL AND CHEMICAL PROPERTIES

	Solid Sulphur	**Liquid Sulphur**
APPEARANCE:	Crystalline yellow solid.	Light yellow to amber liquid
ODOUR:	May have odour of H2S.	May have odour of H2S.
VAPOUR PRESSURE:	< 1 kPa	136 kPa @ 119 °C
VAPOUR DENSITY (Air = 1):	Not applicable	8.9
MELTING/FREEZING POINT:	113 - 122 °C	113 - 122 °C
BOILING POINT:	Not applicable	444.6 °C
SPECIFIC GRAVITY:	1.96 - 2.06	1.8 @ 130 °C
pH:	Not applicable	
EVAPORATION RATE (n-Butyl Acetate = 1):	Not available	
COEFFICIENT OF WATER/OIL DISTRIBUTION:	Water insoluble, oil insoluble	
ODOUR THRESHOLD:	Not available.	

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10. STABILITY AND REACTIVITY

STABILITY: Stable

CONDITIONS TO AVOID: Avoid excessive heat, open flames and all ignition sources.

MATERIALS TO AVOID: Avoid contact with strong oxidizing agents and acids.

HAZARDOUS COMBUSTION PRODUCTS: Emits highly toxic fumes of sulphur dioxide and sulphur trioxide.

11. TOXICOLOGICAL INFORMATION

LD50: = 8 mg/kg (intravenous-rat)
LC50: Studies reporting the LC50 for sulphur were not located in the literature.

ACUTE:
A man who ingested 60g of sulphur over a period of 24 hours survived.
(Reference 1)

CHRONIC:
Studies describing the adverse health effects from chronic exposure to sulphur were not located in the literature.

CARCINOGENICITY:
No evidence

REPRODUCTION:
Studies describing the reproductive effects from exposure to sulphur were not located in the literature.

TERATOLOGY:
Studies describing the teratogenic effects exposure to sulphur were not located in the literature.

MUTAGENICITY:
Salmonella typhrimurium with and without activation was negative. (Reference 2)

TOXICOLOGICALLY SYNERGISTIC PRODUCTS:
Studies describing potentially synergistic products with sulphur were not located in the literature.

12. ECOLOGICAL INFORMATION

Not available.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL: Allow spills of liquid sulphur to cool and solidify before removing. Recycle and reuse material if possible. Off-site spills should be dealt with according to relevant legislation. Bury in approved landfill if acceptable.

14. TRANSPORT INFORMATION:

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:
MOLTEN SULPHUR: Class 4.1, Packing Group III
PRODUCT IDENTIFICATION NUMBER (PIN): UN2448
PROPER SHIPPING NAME: Sulphur, molten

SOLID SULPHUR: Class 4.1, Packing Group III
PRODUCT IDENTIFICATION NUMBER (PIN): UN1350
PROPER SHIPPING NAME: Sulphur

15. REGULATORY INFORMATION

WHMIS CLASS: Liquid Sulphur: D-1A
Solid Sulphur: B4; D-1B

This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

All compounds in this product are listed in the Canada Domestic Substances List (DSL) and the United States Toxic Substances Control Act (TSCA) Chemical Substance Inventory (1985).

16. OTHER INFORMATION

REFERENCES:

1. Gosselin, R. E., H. C. Hodge, R. P. Smith and M. N. Gleason. Clinical Toxicology of Commercial Products: Acute Poisoning. Fourth Edition. The Williams & Wilkins Co. Baltimore. 1976.

2. Royal Society of Chemistry. The Dictionary of Substances and Their Effects. Ed. M. L. Richardson and S. Gangolli. Royal Society of Chemistry. 1994.

DISCLAIMER

The information and recommendations contained in this MSDS are believed to be accurate as at the date of its preparation. Syncrude Canada Ltd. makes no representations or warranties, express or implied, with respect to the accuracy or completeness of the information contained herein. Syncrude Canada Ltd. assumes no responsibility for incorrect handling or use of the product or the inherent hazards involved in the nature of the product itself.

Attachment IV-6: Hydrogen Sulphide (H_2S) MSDS Sheet

Material Safety Data Sheet - MSDS

Hydrogen Sulfide

Section 1. Chemical Product and Company Identification

Trade name : Hydrogen Sulfide

Material Uses : Purification of acids, and wastewater and in the manufacture of sulfur and organosulfur compounds.

Headquarters : Marsulex Inc.
111 Gordon Baker Road
Suite 300
North York, ON
M2H 3R1
(416) 496-9655
www.marsulex.com

Validation Date : **2004-11-13.**

In Case of Emergency : Canada : CANUTEC 1-613-996-6666
US : CHEMTREC: 1-800-424-9300

Section 2. Composition, Information on Ingredients

Name	CAS #	% by Weight
Hydrogen Sulfide	7783-06-4	99.9

This material is classified hazardous under OSHA regulations in the United States and the WHMIS Controlled Product Regulation in Canada.

See Section 8 for Exposure Limits.
See Section 11 for Toxicological Data.

Section 3. Hazards Identification

Physical State and Appearance : Gas.

Emergency Overview : DANGER!
MAY BE FATAL IF INHALED.
VERY TOXIC TO AQUATIC ORGANISMS.
FLAMMABLE GAS.
MAY CAUSE FLASH FIRE.
CONTENTS UNDER PRESSURE.
CAUSES DAMAGE TO THE FOLLOWING ORGANS: LUNGS, RESPIRATORY TRACT, EYES, CENTRAL NERVOUS SYSTEM, EYE, LENS OR CORNEA.
MAY CAUSE RESPIRATORY TRACT AND EYE IRRITATION.
Extremely hazardous liquid and vapor under pressure. Keep away from heat, sparks and flame. Avoid contact with eyes. Do not puncture or incinerate container. Do not breathe gas/fumes/ vapor/spray. Keep container closed. Use only with adequate ventilation. Wash thoroughly after handling. Avoid contact of spilled material and runoff with soil and surface waterways.

Routes of Entry : Eye contact. Inhalation.

Potential Acute Health Effects

Eyes : Inflammation and irritation of the eyes can occur at very low airborne concentrations (sometimes less than 10 ppm). Exposure over several hours or days may result in "gas eyes" or "sore eyes" with symptoms of scratchiness, irritation, tearing and burning. Above 50 ppm, there is intense tearing, blurring of vision and pain when looking at light. The victim may see rings around bright lights. Most symptoms disappear when exposure ceases. However, in serious cases the eye may be permanently damaged. Contact with liquid H_2S may freeze the eye and cause severe damage or blindness.

Skin : Rarely, the gas may irritate the skin. Contact with liquid H_2S can cause frostbite (freezing of the tissue).

Inhalation : At concentrations of 0.13 to 30 ppm, the odor is obvious and unpleasant. At 50 ppm, marked dryness and irritation of the nose and throat occurs. Prolonged exposure may cause a runny nose, cough, hoarseness, shortness of breath and pneumonia. At 100-150 ppm, there is a temporary loss of smell. At 200 to 250 ppm, H2S causes severe irritation as well as symptoms such as headache, nausea, vomiting and dizziness. Prolonged exposure may cause lung damage (build-up of fluid in the lungs). Exposure for 4 to 8 hours can cause death. Concentrations of 300-500 ppm cause these same effects sooner and more severely. Death can occur in 1 to 4 hours. At 500 ppm, excitement, headache, dizziness, staggering, unconsciousness and respiratory failure occur in 5 minutes to 1 hour. Death can occur in 30 minutes to 1 hour. Exposures above 500 ppm rapidly cause unconsciousness and death. Severe

Continued on Next Page

exposures, which do not result in death, may cause long-term symptoms such as memory loss, paralysis of facial muscles or nerve tissue damage.

Ingestion : Since the product is a gas it is more probable that it will be inhaled rather than ingested. The first action is to look at treating and/or preventing inhalation of the material.

Potential Chronic Health Effects : **CARCINOGENIC EFFECTS:** Not classified or listed by IARC, NTP, OSHA, EU and ACGIH.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.

Medical Conditions Aggravated by Overexposure: : Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Over-exposure signs/symptoms : Breathing of vapors may aggravate neurological, eye and respiratory conditions .

See Section 11 for Toxicological Data.

Section 4. First Aid Measures

Eye Contact : If irritation occurs, immediately flush eyes with running water for a minimum of 20 minutes. Hold eyelids open during flushing. Obtain medical attention IMMEDIATELY.

Skin Contact : If the liquid is splashed on the skin, flush contaminated area with lukewarm, gently running water for at least 20 minutes. Under running water, carefully cut around clothing that sticks to damaged skin and remove rest of garment. Obtain medical attention immediately. Completely decontaminate clothing, shoes and leather goods before re-use, or discard.

Inhalation : Remove source of contamination or move victim to fresh air. Give artificial respiration ONLY if breathing has stopped. Give Cardiopulmonary Resuscitation (CPR) only if there is no pulse AND no breathing. Oxygen may be beneficial if administered by a person trained in its use, preferably on a physician's advice. Obtain medical attention IMMEDIATELY.

Ingestion : Not a typical route of exposure. Refer to the above 'Inhalation' sub-section.

Notes to Physician : Not available.

Section 5. Fire Fighting Measures

Flammability of the Product : Flammable.

Auto-ignition Temperature : 259.9°C (499.8°F)

Flash Points : Not available.

Flammable Limits : LOWER: 4% UPPER: 44%

Products of Combustion : These products are sulfur oxides (SO_2, SO_3).

Fire Hazards in Presence of Various Substances : Extremely flammable in presence of open flames, sparks and static discharge.
Highly flammable in presence of heat.

Explosion Hazards in Presence of Various Substances : Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions : SMALL FIRE: Use dry chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet. Move vessels containing H_2S from fire area if without risk. Cool H_2S containing vessels with flooding quantities of water until well after fire is out. Cool H_2S containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion. Do not extinguish a leaking gas flame unless leak can be stopped. Extinguish secondary fire. Handle damaged cylinders with extreme care. Use extinguishing media suitable for surrounding materials.

Protective Clothing (Fire) : H_2S is extremely toxic. Fight fires from safe distance or protected location. Stay upwind. Wear full protective equipment. H_2S may travel some distance along the ground to a source of ignition and flash back. It may collect in lower, poorly ventilated areas. Water or foam may cause frothing. Use water to keep fire-exposed containers cool, to flush spills away from populated areas and to dilute spills to non-combustible mixtures. Stop escaping flow of gas rather than extinguish the fire. If fire is extinguished and gas continues to escape, an explosive mixture could form. If necessary to extinguish the fire, use carbon dioxide or dry chemical extinguishers.

Continued on Next Page

Hydrogen Sulfide *Page: 3/6*

Section 6. Accidental Release Measures

Small Spill and Leak : See instructions below.

Large Spill and Leak : Evacuate area immediately. Restrict access to area until completion of clean up. Ensure clean up is conducted by trained personnel only. Remove all ignition sources (no smoking, flares, sparks or flames). All equipment should be grounded. Ventilate area and stay upwind. Use appropriate Personal Protection Equipment. Stop or reduce leak if safe to do so.
Liquid H_2S: Do not touch spilled material. Prevent material from entering sewers or confined spaces. Stop or reduce leak if safe to do so. If not, allow liquid to vaporize.
Gaseous H_2S: Stop or reduce leak if safe to do so. If source of the leak is a cylinder and the leak cannot be stopped safely, move the cylinder to a safe place in the open air. If possible, repair the leak or allow the cylinder to empty.
In the case of a large spill, evacuation of populated areas downwind may have to be considered. Deliberate ignition and controlled burn of escaping hydrogen sulfide should be considered in order to reduce the risk to adjacent areas.
Comply with Federal, Provincial/State and local regulations on reporting releases.

Section 7. Handling and Storage

Handling : Keep away from heat, sparks and flame. Do not puncture or incinerate. Keep container closed. Use only with adequate ventilation. To avoid fire, minimize ignition sources. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Never work alone when handling H_2S. Someone must be in communication at all times and be equipped and trained to rescue. If H_2S is released, immediately put on a respirator and leave the area until the severity of the release is determined. If necessary to enter an area contaminated with H_2S, follow precautions for confined space entry including use of a supplied-air respirator with full facepiece, adequate communication, safety belts and lifelines. People working with this chemical should be properly trained regarding its hazards and its safe use.

Storage : Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Segregate from oxidizing materials. Avoid all possible sources of ignition (spark or flame). Outside or detached storage is preferred. Store away from heat and ignition sources, incompatible materials, and cylinders or other containers under high pressure. Use grounded, non-sparking ventilation systems and electrical equipment that does not provide a source of ignition. Use corrosion-resistant structural materials, lighting and ventilation systems in storage area. Store cylinders at or above ground level, upright on a level, fireproof floor. Keep cylinders secured in position and protected from damage.
Keep cylinder valve cover on. Label empty cylinders. Store full cylinders separately from empty ones. Consider leak detection and alarm systems, as required. Limit quantity in storage. Restrict access to storage area and post warning signs. Keep storage area separate from populated work areas. Inspect periodically for deficiencies such as damage or leaks. Have fire extinguishers available in and near the storage area. Comply with all applicable regulations for the storage and handling of compressed gases and flammable material.

Section 8. Exposure Controls, Personal Protection

Engineering Controls : Engineering control methods to reduce hazardous exposures are preferred. Methods include mechanical ventilation (dilution and local exhaust) and process or personnel enclosure. Administrative controls and personal protective equipment may also be required. Because of the high potential hazard associated with this substance, stringent control measures such as enclosure or isolation may be necessary. A continuous monitoring system with alarm is recommended in areas where H_2S is used. Use a non-sparking, grounded, corrosion-resistant ventilation system separate from other exhaust ventilation systems. Exhaust through a scrubber directly to the outside. Supply sufficient replacement air to make up for air removed by exhaust systems.

Personal Protection

Eyes : Tight-fitting chemical safety goggles. A face shield may also be necessary if there is potential for contact with liquid H_2S.

Body : Recommendations are valid for permeation rates reaching 0.1 ug/cm^2/min or 1 mg/m^2/min and over. Resistance of specific materials can vary from product to product. Breakthrough times are obtained under conditions of continuous contact, generally at room temperature. Evaluate resistance under conditions of use and maintain clothing carefully.

Continued on Next Page

Hydrogen Sulfide *Page: 4/6*

Respiratory : NIOSH recommendations for hydrogen sulfide concentrations in air.
·Up to 100 ppm: Powered air-purifying respirator with cartridge(s) to protect against hydrogen sulfide; or gas mask with canister to protect against hydrogen sulfide; or SAR*; or full-facepiece SCBA.
·Emergency or planned entry into unknown concentrations or IDLH conditions: Positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.
·ESCAPE: Gas mask with canister to protect against hydrogen sulfide; or escape-type SCBA.
·NOTE: The IDLH concentration for hydrogen sulfide is 100 ppm.
*NOTE: Substance reported to cause eye irritation or damage; may require eye protection.
ABBREVIATIONS: SAR = supplied-air respirator; SCBA = self-contained breathing apparatus. IDLH = Immediately Dangerous to Life or Health.

Hands : Gloves: Neoprene, PVC, vinyl or rubber.

Feet : Boots.

Protective Clothing (Pictograms) :

Personal Protection in Case of a Large Spill : Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self-contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist before handling this product.Resistance of materials for protective clothing : Guidelines for hydrogen sulfide:
RECOMMENDED (resistance to breakthrough longer than 8 hours): Tychem 10000(TM).
RECOMMENDED (resistance to breakthrough longer than 4 hours): Teflon(TM).(8)
RECOMMENDED (estimated resistance to breakthrough longer than 4 hours): Responder(TM).
NOT RECOMMENDED for use (resistance to breakthrough less than 1 hour): CPF3(TM).

Exposure Limits

Product Name	**Exposure Limits**
Hydrogen Sulfide	**ACGIH TLV (United States, 2003).** STEL: 21 mg/m³ 15 minute(s). Form: All forms STEL: 15 ppm 15 minute(s). Form: All forms TWA: 14 mg/m³ 8 hour(s). Form: All forms TWA: 10 ppm 8 hour(s). Form: All forms **NIOSH REL (United States, 2001).** CEIL: 15 mg/m³ 10 minute(s). Form: All forms CEIL: 10 ppm 10 minute(s). Form: All forms **OSHA PEL Z2 (United States, 2002).** AMP: 50 ppm 10 minute(s). Form: All forms CEIL: 20 ppm Form: All forms

Consult local authorities for acceptable exposure limits.

Section 9. Physical and Chemical Properties

Physical State and Appearance : Gas.

Color : Colorless.

Odor : Rotten eggs. (Strong.)

Molecular Weight : 34.08 g/mole

Molecular Formula : H_2S

pH : Not available.

Boiling/Condensation Point : -59.94°C (-75.9°F)

Melting/Freezing Point : -82.72°C (-116.9°F)

Specific Gravity : Not available.

Vapor Pressure : Not applicable.

Vapor Density : Not available.

Odor Threshold : 0.13 ppm

Evaporation Rate : Not available.

$LogK_{ow}$: Not available.

Solubility : 437 mL of gas in 100 mL of water at 0°C; 186 mL of gas in 100 mL of water at 40°C. Soluble in hydrocarbon solvents, ether, alcohol, glycerol and carbon disulfide.

Continued on Next Page

Hydrogen Sulfide *Page: 5/6*

Section 10. Stability and Reactivity

Stability and Reactivity : The product is stable.

Conditions of Instability : Keep away from heat and sources of ignition.

Incompatibility with Various Substances : Reactive with oxidizing agents, acids, alkalis.

Hazardous Decomposition Products : Toxic oxides of sulfur.

Hazardous Polymerization : Will not occur.

Section 11. Toxicological Information

Toxicity Data

Ingredient Name	Test	Result	Route	Species
Hydrogen Sulfide	LC50	444 ppm (4 hour(s))	Inhalation	Rat
	LC50	673 ppm (1 hour(s))	Inhalation	Mouse

Chronic Effects on Humans : Causes damage to the following organs: lungs, upper respiratory tract, eyes, central nervous system (CNS), eye, lens or cornea.

Other Toxic Effects on Humans : Hazardous in case of eye contact (irritant), of inhalation (lung irritant).

Section 12. Ecological Information

Ecotoxicity Data

Ingredient Name	Species	Period	Result
Hydrogen Sulfide	Pimephales promelas (LC50)	96 hour(s)	0.007 mg/l
	Oncorhynchus mykiss (LC50)	96 hour(s)	0.007 mg/l
	Pimephales promelas (LC50)	96 hour(s)	0.0071 mg/l
	Lepomis macrochirus (LC50)	96 hour(s)	0.009 mg/l
	Pimephales promelas (LC50)	96 hour(s)	0.0107 mg/l
	Oncorhynchus mykiss (LC50)	96 hour(s)	0.012 mg/l

Mobility : When it is spilled onto soil, much will evaporate. However, since it is very soluble in water, the presence of water in soil or falling as precipitation at the time of the spill may contribute to movement in the soil. If the soil surface is saturated with moisture at the time of the spill as might be the case after a rainfall, the spilled chemical will run off and/or evaporate away.

Products of Degradation : These products are sulfur oxides (SO_2, SO_3).

Toxicity of the Products of Biodegradation : The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation : Microorganisms in soil and water are involved in oxidation-reduction reactions, which oxidize hydrogen sulfide to elemental sulfur. Abiotic Degradation: Hydrogen sulfide does not absorb solar radiation reaching the tropsphere. It does not, therefore, undergo photolysis or react photochemically with oxygen. The primary chemical transformation of hydrogen sulfide in the atmosphere is oxidation by oxygen containing radicals to sulfur dioxide and sulfates.

Section 13. Disposal Considerations

Waste Information : Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Consult your local or regional authorities.

Section 14. Transport Information

Canada (TDG) : RQ, HYDROGEN SULFIDE, 2.3(2.1), UN1053.

United States (DOT) : RQ, HYDROGEN SULFIDE, 2.3(2.1), UN1053.

ERG : 117

Continued on Next Page

Section 15. Regulatory Information

WHMIS (Canada) : A: Compressed gas.
B-1: Flammable gas.
D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
D-2B: Material causing other toxic effects (TOXIC).

CEPA DSL: Hydrogen sulfide

This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

HCS Classification : Highly toxic
Flammable gas
Irritating material
Target organ effects

U.S. Federal Regulations : TSCA 8(b) inventory: Hydrogen sulfide
Clean air act (CAA) 112 accidental release prevention: Hydrogen sulfide

Clean air act (CAA) 112 regulated toxic substances: Hydrogen sulfide
SARA 302/304/311/312 extremely hazardous substances: Hydrogen sulfide
SARA 302/304 emergency planning and notification: Hydrogen sulfide
SARA 302/304/311/312 hazardous chemicals: Hydrogen sulfide
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: Hydrogen sulfide: Fire Hazard, Sudden Release of Pressure, Immediate (Acute) Health Hazard, Delayed (Chronic) Health Hazard

SARA 313	Ingredient Name	% by Weight
Form R - Reporting Requirements	: Hydrogen sulfide	70-100
Supplier Notification	: Hydrogen sulfide	70-100

State Regulations : Pennsylvania RTK: Hydrogen sulfide: (environmental hazard, generic environmental hazard)
Massachusetts RTK: Hydrogen sulfide
New Jersey: Hydrogen sulfide

California prop. 65: No products were found.

Section 16. Other Information

Hazardous Material Information System (U.S.A.)

Health	* 4
Fire Hazard	4
Reactivity	0
Personal Protection	C

National Fire Protection Association (U.S.A.)

References : - 29CFR Part1910.1200 OSHA MSDS Requirements. - 49CFR Table List of Hazardous Materials, UN#, Proper Shipping Names, PG. ANSI Z400.1, MSDS Standard, 2001. -Canada Gazette Part II, Vol. 122, No. 2 Registration SOR/88-64 31 December, 1987 Hazardous Products Act "Ingredient Disclosure List". - Canadian Transport of Dangerous Goods, Regulations and Schedules, Clear Language version 2002. -Manufacturer's Material Safety Data Sheet.

Responsible Name : **Kemika XXI Inc. +1-450-435-7475**

Date of Previous Issue : **No Previous Validation.**

Version : **1**

Notice to Reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Attachment IV-7: Sulphur Dioxide (SO_2) MSDS Sheet

Material Safety Data Sheet

Printing date 04/16/2007 Version 1 Reviewed on 04/13/2007

*

1 Identification of substance

· **Product details**

· **Trade name: Sulphur Dioxide**

· **Article number:** 007-01-0009BOC

· **Creation date:** 05/19/2006

· **Manufacturer/Supplier:**
BOC Canada Limited
5860 Chedworth Way
Mississauga, Ontario L5R 0A2
www.bocgases.ca

TELEPHONE NUMBER: (905) 501-1700
24-HOUR EMERGENCY TELEPHONE NUMBER: (905) 501-0802
EMERGENCY RESPONSE PLAN NO: 2-0101

Please ensure that this MSDS is received by the appropriate person

· **Information department:** Customer Service Centre: 1-866-385-5349

2 Composition/Data on components

· **Chemical characterization:**
· **CAS No. Description**
7446-09-5 Sulphur Dioxide
· **Identification number(s)**
· **EINECS Number:** 231-195-2
· **EU Number:** 016-011-00-9

*

3 Hazards identification

· **Hazard description:**

Toxic

· **WHMIS-symbols:**
A - Compressed gas
D1B - Toxic material causing immediate and serious toxic effects

· **HMIS-ratings (scale 0 - 4)**

Health = 3
Fire = 0
Reactivity = 0

(Contd. on page 2)

Material Safety Data Sheet

Printing date 04/16/2007 Version 1 Reviewed on 04/13/2007

Trade name: Sulphur Dioxide

(Contd. of page 1)

· **NFPA ratings (scale 0 - 4)**

Health = 3
Fire = 0
Reactivity = 0

· **Information pertaining to particular dangers for man and environment:**
Toxic by inhalation.
Causes burns.
· **Classification system:**
The classification is in line with internationally approved calculation standards. It is expanded, however, by information from technical literature and by information furnished by supplier companies.

*

4 First aid measures

· **General information:**
Immediately remove any clothing soiled by the product.
Remove breathing apparatus only after contaminated clothing have been completely removed.
In case of irregular breathing or respiratory arrest provide artificial respiration.
· **After inhalation:**
Supply fresh air or oxygen; call for doctor.
In case of unconsciousness place patient stably on the body side position.
· **After skin contact:** Immediately wash with water and soap and rinse thoroughly.
· **After eye contact:** Rinse opened eye for several minutes under running water. Then consult a doctor.
· **After swallowing:** Not applicable

*

5 Fire fighting measures

· **Suitable extinguishing agents:**
CO2, powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
· **Protective equipment:** Wear self-contained respiratory protective device.

*

6 Accidental release measures

· **Person-related safety precautions:**
Wear protective equipment. Keep unprotected persons away.
Ensure adequate ventillation.
Stop leak - ONLY if possible to do so without risk.
· **Measures for environmental protection:**
Prevent seepage into sewage system, workpits and/or cellars.
In case of gas release or seepage into the ground inform responsible authorities.
· **Measures for cleaning/collecting:**
Use neutralizing agent.
Dispose contaminated material as waste according to item 13.
Ensure adequate ventillation.

CDN

(Contd. on page 3)

Material Safety Data Sheet

Printing date 04/16/2007 Version 1 Reviewed on 04/13/2007

Trade name: Sulphur Dioxide

(Contd. of page 2)

*

7 Handling and storage

· **Handling:**
· **Information for safe handling:**
Ensure good ventilation/exhaustion at the workplace.
Open and handle cylinder with care.
Handle with care. Avoid jolting, friction, and impact.
Use only in well ventilated areas.
Store cylinders upright with valve protection cap in place and firmly secured to prevent falling or being knocked over.
If difficulty with operating cylinder valve is experienced discontinue use and contact supplier.
· **Information about protection against explosions and fires:**
Keep ignition sources away - Do not smoke.
Keep respiratory protective device available.
Pressurized container: protect from sunlight and do not expose to temperatures exceeding 50°C. Do not pierce or burn, even after use.

· **Storage:**
· **Requirements to be met by storerooms and receptacles:**
Do not expose cylinder to temperatures higher than 50°C (122 °F)
· **Information about storage in one common storage facility:**
Sources of ignition should be removed from storage area.
· **Further information about storage conditions:**
Keep cylinder valve tightly closed.
Store cylinder in a well ventilated area.
Store in accordance with local fire code and/or building code or any pertaining regulations.

*

8 Exposure controls and personal protection

· **Additional information about design of technical systems:**
Adequate local ventillation.
Safety showers and eyewash stations should be nearby.

· **Components with limit values that require monitoring at the workplace:**	
7446-09-5 Sulphur Dioxide (23-100%)	
EL	Short-term value: 5 ppm Long-term value: 2 ppm

· **Additional information:** The lists that were valid during the creation were used as basis.

· **Personal protective equipment:**
· **General protective and hygienic measures:**
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Store protective clothing separately.
Avoid contact with the eyes and skin.
Protective clothing should be kept free of oil and grease.
PPE should be inspected and maintained regularly to retain it's effectiveness.
· **Breathing equipment:**
Use atmosphere-supplying respirators (e.g. supplied-air: demand, pressure-demand, or continuous-flow or self-contained breathing apparatus: demand or pressure-demand or combination supplied-air with auxiliary self-contained air supply atmosphere-supplying respirator) in case of insufficient ventilation.

(Contd. on page 4)

Material Safety Data Sheet

Printing date 04/16/2007 Version 1 Reviewed on 04/13/2007

Trade name: Sulphur Dioxide

(Contd. of page 3)

· **Protection of hands:**

Protective gloves.

· **Material of gloves**
- (Resistance to breakthrough longer than 8 hours): Saranex (TM), Barricade (TM), Responder (TM).
- (Resistance to breakthrough longer than 4 hours): Teflon (TM).

· **Not suitable are gloves made of the following materials:**
Resistance to breakthrough less than 1 hour: Polyethylene
· **Eye protection:** Splash resistant safety goggles and face shield.
· **Body protection:**
Acid resistant protective clothing, heavy weight coveralls, safety boots, and insulated impervious (ie. neoprene, PVC) gloves.

9 Physical and chemical properties

· **General Information**	
Form:	Gaseous.
Color:	Colorless
Odor:	Pungent
· **Change in condition**	
Melting point/Melting range:	-75.5°C
Boiling point/Boiling range:	-10°C
· **Flash point:**	Not applicable.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Solubility in / Miscibility with**	
Water at 20°C:	1.000 g/l

*

10 Stability and reactivity

· **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
· **Dangerous reactions** No dangerous reactions known.
· **Dangerous products of decomposition:** No dangerous decomposition products known.

*

11 Toxicological information

· **Acute toxicity:**

· **LD/LC50 values that are relevant for classification:**		
7446-09-5 Sulphur Dioxide		
Inhalative	LC50/1hr	2520 ppm (rat)

· **Primary irritant effect:**
· **on the skin:** Caustic effect on skin and mucous membranes.

(Contd. on page 5)

Material Safety Data Sheet

Printing date 04/16/2007 Version 1 Reviewed on 04/13/2007

Trade name: Sulphur Dioxide

(Contd. of page 4)

· **on the eye:** Strong caustic effect.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

*
12 Ecological information

· **General notes:** Must not reach bodies of water or drainage ditch undiluted or unneutralized.

*
13 Disposal considerations

· **Product:**
· **Recommendation:**
Cylinder and unused product should be returned to vendor. Disposable cylinder must be disposed of in accordance with local regulations.

· **Uncleaned packagings:**
· **Recommendation:**
Cylinder and unused product should be returned to vendor. Disposable cylinder must be disposed of in accordance with local regulations.
· **Recommended cleansing agent:** None applicable.

*
14 Transport information

· **TDG and DOT regulations:**

· **Hazard class:**	2
· **Identification number:**	UN1079
· **Packing group:**	-
· **Proper shipping name (technical name):**	SULPHUR DIOXIDE
· **Label**	2.3+8
· **Packaging group:**	-

· **Maritime transport IMDG:**

· **IMDG Class:**	2.3
· **UN Number:**	1079
· **Label**	2.3+8
· **Packaging group:**	-
· **EMS Number:**	F-C,S-U

(Contd. on page 6)

Material Safety Data Sheet

Printing date 04/16/2007 Version 1 Reviewed on 04/13/2007

Trade name: Sulphur Dioxide

(Contd. of page 5)

· **Marine pollutant:**	No
· **Proper shipping name:**	SULPHUR DIOXIDE

· **Air transport ICAO-TI and IATA-DGR:**

· **ICAO/IATA Class:**	2
· **UN/ID Number:**	1079
· **Label**	2.3+8
· **Packaging group:**	-
· **Proper shipping name:**	SULPHUR DIOXIDE

*

15 Regulations

· **Sara**

· **Section 355 (extremely hazardous substances):**

Substance is listed.

· **Section 313 (Specific toxic chemical listings):**

Substance is not listed.

· **TSCA (Toxic Substances Control Act):**

Substance is listed.

· **Proposition 65**

· **Chemicals known to cause cancer:**

Substance is not listed.

· **Chemicals known to cause reproductive toxicity for females:**

Substance is not listed.

· **Chemicals known to cause reproductive toxicity for males:**

Substance is not listed.

· **Chemicals known to cause developmental toxicity:**

Substance is not listed.

· **Cancerogenity categories**

· **EPA (Environmental Protection Agency)**

Substance is not listed.

· **IARC (International Agency for Research on Cancer)**

Group 2B: The agent (mixture) is possibly carcinogenic to humans. The exposure circumstance entails exposures that are possibly carcinogenic to humans.

· **NTP (National Toxicology Program)**

Substance is not listed.

· **TLV (Threshold Limit Value established by ACGIH)**

A4

(Contd. on page 7)

Material Safety Data Sheet

Printing date 04/16/2007 Version 1 Reviewed on 04/13/2007

Trade name: Sulphur Dioxide

(Contd. of page 6)

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**
Substance is not listed.

· **OSHA-Ca (Occupational Safety & Health Administration)**
Substance is not listed.

· **Canadian substance listings:**

· **Canadian Domestic Substances List (DSL)**
Substance is listed.

· **Canadian Ingredient Disclosure list (limit 0.1%)**
Substance is not listed.

· **Canadian Ingredient Disclosure list (limit 1%)**
Substance is listed.

· **Product related hazard informations:**
The product has been classified and marked in accordance with directives on hazardous materials.

· **Hazard symbols:**
Toxic

· **Risk phrases:**
Toxic by inhalation.
Causes burns.

· **Safety phrases:**
Keep container in a well-ventilated place.
In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
Wear suitable protective clothing, gloves and eye/face protection.
In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Department issuing MSDS:** Customer Service Centre: 1-866-385-5349
· **Contact:** Canada Technical Services: 1-866-385-5349
· *** Data compared to the previous version altered.**

CDN

Attachment IV-8: Hydrated Lime MSDS Sheet

Material Safety Data Sheet
May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910 1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY *(as Used on Label and List)*
HYDRATED LIME

Note: Blank spaces are not permitted. If any item is not applicable or no information is available, the space must be marked to indicate that.

Section I

Manufacturer's name	Emergency Telephone Number
CHENEY LIME & CEMENT COMPANY	205-625-3031
Address *(Number, Street, City, State and ZIP Code)*	Telephone Number for Information
478 GRAYSTONE ROAD	205-625-3031
	Date Prepared
ALLGOOD, ALABAMA 35013	
	Signature of Preparer *(optional)*

Section II—Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity, Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
CALCIUM HYDROXIDE (EPA #A349-3522)	10 mg/M^3	5 mg/M^3		
$Ca(OH)_2$				

Section III—Physical/Chemical Characteristics

Boiling Point	5162°F (CaO)	Specific Gravity (H_20 = 1) TRUE	2.3 – 2.6
Vapor Pressure (mm Hg)	NA	Melting Point DEHYDRATES TO CaO AT 580°C (1076°F) AT 1 ATM.	
Vapor Density (AIR = 1)	NA	Evaporation Rate (Butyl Acetate = 1)	

Solubility in Water NEGLIGIBLE 0.185-0.070% AT 25°C

Appearance and Odor WHITE POWDER NO ODOR

Section IV—Fire and Explosion Hazard Data

Flash Point (Method Used)	NA	Flammable Limits NA	LEL	UEL

Extinguishing Media NA

Special Fire Fighting Procedures

HYDRATED LIME IS INCOMBUSTIBLE AND, UNLIKE QUICKLIME, IT WILL NOT GENERATE HEAT WHEN IT COMES IN CONTACT WITH WATER.

Unusual Fire and Explosion Hazards

NA

(Reproduce locally) OSHA 174 Sept. 1985

Hydrated Lime MSDS – Pg. 1

Section V—Reactivity Data

Stability	Unstable		Conditions to Avoid
		YES	IF SUBJECTED TO CARBON DIOXIDE IN MOIST AIR AND ACIDS
	Stable		
		YES	IF CONFINED IN WATER-TIGHT CONTAINER.

Incompatibility *(Materials to Avoid)*

CONTACT WITH ACIDS.

Hazardous Decomposition or Byproducts NA

Hazardous Polymerization	May Occur		Conditions to Avoid NA
	Will Not Occur	X	

Section VI—Health Hazard Data

Route(s) of Entry Inhalation? X Skin? X Ingestion?

Health Hazards *(Acute and Chronic)* TLV 5mg/M^3

Carcinogenicity NA NTP? IARC Monographs? OSHA Regulated?

Signs and Symptoms of Exposure UNDER DUSTY CONDITIONS IT CAN CAUSE EXCESSIVE DRYING OF SKIN AND POSSIBLE SKIN IRRITATION AND OPEN CUTS ARE PARTICULARLY VULNERABLE.

Medical Conditions Generally Aggravated by Exposure OPEN CUTS

Emergency and First Aid Procedures

WASH OFF ALL LIME DUST FROM SKIN WITH CLEAN WATER; THEN OPTIONALLY RINSE SKIN WITH VINEGAR; APPLY BURN OINTMENT TO AFFECTED AREAS. FOR EYES FLUSH OUT IMMEDIATELY WITH WATER & SEE PHYSICIAN.

Section VII—Precautions for Safe Handling and Use

Steps to Be Taken in Case Material Is Released or Spilled

CLEAN UP BY NORMAL PHYSICAL METHODS.

Waste Disposal Method

CAN BE SALVAGED FOR USE OR EMPTIED IN SEWER OR REMOVED TO DUMP.

Precautions to Be Taken in Handling and Storing

KEEP PRODUCT DRY AND AVOID DUSTING.

Other Precautions NONE

Section VII—Control Measures

Respiratory Protection *(Specify Type)* PROTECT (FILTER) MASK IN DUSTY ENVIRONMENT.

Ventilation	Local Exhaust	NA	Special	NA
	Mechanical *(General*	APPLY ADEQUATE VENTILATION TO KEEP DUST CONC. BELOW TLV.	Other	VENT DUST TO A COLLECTOR.

Protective Gloves	Eye Protection
WORK GLOVES IN MANUAL HANDLING	TIGHT FITTING SAFETY GOGGLES.

Other Protective Clothing or Equipment LONG SLEEVED SHIRT WITH BUTTONED COLLAR. LONG PANTS EXTENDING OVER WORK SHOES. PROTECTIVE CREAM MAY BE USED ON EXPOSED SKIN IF NEEDED

Work/Hygienic Practices HYDRATED LIME DUST SHOULD BE WASHED FROM SKIN & HAIR.

Hydrated Lime MSDS – Pg. 2

Attachment IV-9: Dustbind S5 MSDS Sheet

IPAC MATERIAL SAFETY DATA SHEET

PRODUCT NAME IPAC DUSTBIND S5

EFFECTIVE DATE January 1, 2007 **PAGE 1 OF 3**

SECTION 1 - PRODUCT IDENTIFICATION AND USE

PRODUCT NAME IPAC DUSTBIND S5 **PRODUCT USE** Dust Suppressant **MANUFACTURER** IPAC CHEMICALS LTD. 1620 West 75th Avenue Vancouver, B.C. V6P 6G2	**TDG SHIPPING NAME** Not Regulated **TDG CLASS** Non-Hazardous **UN/PIN NUMBER** Not applicable	**HMIS RATINGS** Health 2 Flammability 0 Reactivity 0 Personal Protection x **WHMIS CLASS** D2B

EMERGENCY TELEPHONE NUMBER (CANUTEC 24 HOURS) (613) 996-6666

SECTION 2 - HAZARDOUS INGREDIENTS

HAZARDOUS INGREDIENTS	APPROX. CONC %	C.A.S. NUMBER	EXPOSURE LIMITS	LD_{50}/LC_{50} - SPECIES AND ROUTE
Propylene glycol ether DPM	3 – 7	34590-94-8	TLV-TWA = 100 ppm	LD_{50} (oral, rat) = 5135 mg/kg
Ethoxylated alcohol	5 – 10	68439-46-3	Not established	LD_{50} (dermal, rabbit) = >2,000 mg/kg
Alkyl aryl sulfonate	10 – 30	27177-77-1	Not established	LD_{50} (oral, rat) = 0.8-3.0 g/kg

SECTION 3 - PHYSICAL DATA

PHYSICAL STATE Liquid	**APPEARANCE** Clear, light straw coloured		**ODOUR** Mild
ODOUR THRESHOLD (ppm) No applicable	**VAPOUR PRESSURE (mm Hg)** Not available	**VAPOUR DENSITY (Air =1)** Not available	**EVAPORATION RATE** Slow
BOILING POINT (•C) 100	**FREEZING POINT (•C)** -2	**SOLUBILITY IN WATER (20•C)** Appreciable	**% VOLATILE (by weight)** Not available
pH 7 - 9	**DENSITY (g/mL)** 1.02	**COEFFICIENT OF WATER/OIL DISTRIBUTION** Not available	

SECTION 4 - REACTIVITY DATA

CHEMICAL STABILITY
This compound is stable at ambient conditions.

INCOMPATIBILITY WITH OTHER SUBSTANCES
Avoid contact or contamination with strong oxidizing and reducing agents.

HAZARDOUS DECOMPOSITION PRODUCTS
In case of a fire, oxides of carbon, hydrocarbons, fumes, smoke, and other traces may be produced. Avoid temperature greater than 100 Celsius.

IPAC MATERIAL SAFETY DATA SHEET

PRODUCT NAME **IPAC DUSTBIND S5**

EFFECTIVE DATE **January 1, 2007** **PAGE 2 OF 3**

SECTION 5 - FIRE AND EXPLOSION HAZARDS

FLAMMABILITY/COMBUSTIBILITY Not flammable or combustible according to WHMIS.

MEANS OF EXTINCTION Water spray, carbon dioxide, foam or dry chemical.

SPECIAL FIRE-FIGHTING PROCEDURES
Evacuate non-emergency personnel to a safe area. Contact emergency personnel as necessary. Avoid breathing smoke, fumes, and decomposition products. As in any fire, wear self-contained breathing apparatus pressure-demand MSHA/NIOSH (approved or equivalent) and full protective gear.

HAZARDOUS COMBUSTION PRODUCTS
During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

FLASH POINT (•C) & METHOD	UPPER EXPLOSION LIMIT (% BY VOLUME)	LOWER EXPLOSION LIMIT (% BY VOLUME)
>93.3°C TCC	Not established	Not established

AUTO IGNITION TEMP. (•C)	TDG FLAMMABILITY CLASS	SENSITIVITY TO STATIC DISCHARGE	SENSITIVITY TO MECHANICAL IMPACT
Not applicable	Not classified	None	None

SECTION 6 - TOXICOLOGICAL PROPERTIES

ROUTE OF ENTRY

Skin Contact	Skin Absorption	Eye Contact	Inhalation Acute	Inhalation Chronic	Ingestion
[X]	[X]	[X]	[X]	[ ]	[X]

EFFECTS OF ACUTE EXPOSURE TO PRODUCT
Inhalation: Headache, nausea, dizziness, drowsiness, confusion, loss of consciousness.
Skin: Reddening, swelling, rash, scaling, or blistering.

EFFECTS OF CHRONIC EXPOSURE TO PRODUCT No reported chronic health effects.

LD_{50}	LC_{50}	EXPOSURE LIMITS
Not available	Not available	Not available

Carcinogen Effects	Reproductive	Teratogen	Mutagen	Irritant	Sensitizer
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

SECTION 7 - PREVENTIVE MEASURES

PROTECTIVE GLOVES Wear solvent resistant gloves to avoid skin contact.	**RESPIRATORY PROTECTION** When there is potential for airborne exposures in excess of applicable limits, wear NIOSH/MSHA approved respiratory protection.
EYE PROTECTION Chemical goggles are recommended to avoid contact with Eyes. When splashing of the material may occur, chemical Goggles and a face shield are recommended.	**PROTECTIVE FOOTWEAR**
PROTECTIVE CLOTHING Wear solvent resistant clothing to avoid skin contact.	**OTHER PROTECTIVE EQUIPMENT** Wear appropriate personal protective equipment.

IPAC	**MATERIAL SAFETY DATA SHEET**	
PRODUCT NAME	**IPAC DUSTBIND S5**	
EFFECTIVE DATE	**January 1, 2007**	**PAGE 3 OF 3**

SECTION 7 - PREVENTIVE MEASURES (Continued)

ENGINEERING CONTROLS Good general ventilation should be sufficient to control airborne levels. If operations generate dusts, fumes or mists, use ventilation as necessary to keep exposure to airborne contaminants below the exposure limits. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower.

LEAK AND SPILL PROCEDURES LARGE SPILLS – Shut off leak if safe to do so. Contain spilled material. Do not flush to sewer. Absorb spill with inert material (e.g., dry sand or earth), then place in a chemical waste container. Treat or dispose of waste material in accordance with all local, state/provincial, and federal requirements.
SMALL SPILLS – Floor may become slippery. Absorb spills with inert material. Treat or dispose of waste material in accordance with all local, provincial, and federal requirements. Avoid contact with spilled material.

WASTE DISPOSAL Dispose of in accordance with Federal, Provincial, and Municipal regulations. Do not flush to sewer. Uncleaned empty containers should be disposed of in the same manner as the contents.

HANDLING PROCEDURES AND EQUIPMENT Avoid breathing (dust, vapour, mist, gas). Avoid contact with eyes, skin, and clothing. Wash thoroughly after handling. Close container after each use. Avoid mixing with incompatible materials (refer to Section 4). Provide appropriate ventilation. Store in secure area.

STORAGE REQUIREMENTS
Keep container closed when not in use. Keep away from heat, sparks, and flame. Keep from freezing.

SPECIAL SHIPPING INFORMATION Keep from freezing.

SECTION 8 - FIRST AID MEASURES

SKIN Immediately flush skin with plenty of water for at least 15 minutes. Get medical attention if irritation develops or persists. Launder contaminated clothing before reuse.

EYE Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for 15 minutes. Get immediate medical attention.

INHALATION Remove to fresh air. Rest victim in half-upright position. If breathing is difficult, give oxygen by trained personnel and get immediate medical attention.

INGESTION Never give anything by mouth to an unconscious person. Exposure by ingestion is not likely during normal industrial use of product. If ingested, immediately rinse mouth and give large quantities of water and seek immediate attention.

GENERAL ADVICE – WARNING: Harmful by inhalation. May irritate eyes, nose and throat. Avoid inhalation. Avoid eye and skin contact. Overexposure may cause kidney and liver damage.

SECTION 9 - PREPARATION OF M.S.D.S.

PREPARED BY	**PHONE NUMBER**	**DATE**
Regulatory Affairs Department	(604) 261-3019	January 1, 2007

ADDITIONAL INFORMATION AND COMMENTS

Every effort is made to ensure that the data presented herein is current and factual; however, no warranty nor any other legal responsibility is to be construed from this document. Numerical values reported represent nominal and/or typical properties and do not constitute specifications. Any use of the information presented herein must be determined by the user to be in accordance with applicable Federal, Provincial and local laws and regulations.

Attachment IV-10: IPAC SRB+ MSDS Sheet

IPAC MATERIAL SAFETY DATA SHEET

PRODUCT NAME IPAC SRB PLUS

EFFECTIVE DATE January 1, 2007 PAGE 1 OF 3

SECTION 1 - PRODUCT IDENTIFICATION AND USE

PRODUCT NAME IPAC SRB PLUS **PRODUCT USE** Release Aid **MANUFACTURER** IPAC CHEMICALS LTD. 1620 West 75th Avenue Vancouver, B.C. V6P 6G2	**TDG SHIPPING NAME** Not regulated **TDG CLASS** Not regulated **UN/PIN NUMBER** Not applicable	**HMIS RATINGS** Health 1 Flammability 1 Reactivity 0 Personal Protection X **WHMIS CLASS** Not controlled

EMERGENCY TELEPHONE NUMBER (CANUTEC 24 HOURS) (613) 996-6666

SECTION 2 - HAZARDOUS INGREDIENTS

HAZARDOUS INGREDIENTS	APPROX. CONC %	C.A.S. NUMBER	EXPOSURE LIMITS	LD_{50}/LC_{50} - SPECIES AND ROUTE
This product contains no controlled ingredients at disclosable concentrations.				

SECTION 3 - PHYSICAL DATA

PHYSICAL STATE Liquid	**APPEARANCE** Opaque thin white liquid		**ODOUR** Faint odour
ODOUR THRESHOLD (ppm) Not available	**VAPOUR PRESSURE (mm Hg)** Not available	**VAPOUR DENSITY (Air =1)** < 1	**EVAPORATION RATE** Slow
BOILING POINT (•C) Approximately 100	**FREEZING POINT (•C)** Approximately 0	**SOLUBILITY IN WATER (20•C)** Miscible	**% VOLATILE (by weight)** Approximately 84
pH 6 - 8	**DENSITY (g/mL)** 1.0	**COEFFICIENT OF WATER/OIL DISTRIBUTION** > 1	

SECTION 4 - REACTIVITY DATA

CHEMICAL STABILITY
Stable

INCOMPATIBILITY WITH OTHER SUBSTANCES
Avoid contact with oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS
Burning can produce oxides of carbon and silicon.

IPAC MATERIAL SAFETY DATA SHEET

PRODUCT NAME IPAC SRB PLUS

EFFECTIVE DATE January 1, 2007 **PAGE 2 OF 3**

SECTION 5 - FIRE AND EXPLOSION HAZARDS

FLAMMABILITY/COMBUSTIBILITY
This product is not classified as flammable or combustible according to WHMIS.

MEANS OF EXTINCTION
As required for surrounding fire. Use water spray, carbon dioxide, dry chemical, or foam.

SPECIAL FIRE-FIGHTING PROCEDURES
Firefighters should wear protective clothing and self-contained breathing apparatus when fighting fires involving chemicals.

HAZARDOUS COMBUSTION PRODUCTS
Burning can produce oxides of carbon and silicon.

FLASH POINT (•C) & METHOD	UPPER EXPLOSION LIMIT (% BY VOLUME)	LOWER EXPLOSION LIMIT (% BY VOLUME)
> 93.3 (COC)	Not applicable	Not applicable

AUTO IGNITION TEMP. (•C)	TDG FLAMMABILITY CLASS	SENSITIVITY TO STATIC DISCHARGE	SENSITIVITY TO MECHANICAL IMPACT
Not available	Not applicable	Not sensitive	Not sensitive

SECTION 6 - TOXICOLOGICAL PROPERTIES

ROUTE OF ENTRY

Skin Contact [ ]	Skin Absorption [ ]	Eye Contact [ ]	Inhalation Acute [ ]	Inhalation Chronic [ ]	Ingestion [ ]

EFFECTS OF ACUTE EXPOSURE TO PRODUCT
Contact with eyes may produce an oil film causing a brief reversible dimness of sight. May cause allergic skin reactions in susceptible individuals.

EFFECTS OF CHRONIC EXPOSURE TO PRODUCT
No chronic effects expected.

LD_{50}	LC_{50}	EXPOSURE LIMITS
Not available	Not available	Not available

Carcinogen [ ]	Reproductive Effects [ ]	Teratogen [ ]	Mutagen [ ]	Irritant [ ]	Sensitizer [ ]

SECTION 7 - PREVENTIVE MEASURES

PROTECTIVE GLOVES	RESPIRATORY PROTECTION
Rubber gloves recommended.	Generally not required. Wear a respirator equipped with cartridge for organic gases/vapour if exposed to aerosol mists.
EYE PROTECTION Chemical goggles or safety glasses recommended.	**PROTECTIVE FOOTWEAR** No special requirements.
PROTECTIVE CLOTHING As required to prevent skin contact.	**OTHER PROTECTIVE EQUIPMENT**

IPAC	**MATERIAL SAFETY DATA SHEET**	
PRODUCT NAME	**IPAC SRB PLUS**	
EFFECTIVE DATE	**January 1, 2007**	**PAGE 3 OF 3**

SECTION 7 - PREVENTIVE MEASURES (Continued)

ENGINEERING CONTROLS
General ventilation usually adequate.

LEAK AND SPILL PROCEDURES
Do not flush to sewer. Dike or contain. Absorb irrecoverable material onto inert medium, package, and label for legal disposal.

WASTE DISPOSAL
Dispose of in accordance with Federal, Provincial, and Municipal regulations. Do not flush to sewer.

HANDLING PROCEDURES AND EQUIPMENT
Handle in accordance with good industrial hygiene practice. Wash thoroughly after handling.

STORAGE REQUIREMENTS
Store container in a cool room and keep closed.

SPECIAL SHIPPING INFORMATION
Prevent from freezing.

SECTION 8 - FIRST AID MEASURES

SKIN Thoroughly wash affected area with soap and water. Remove contaminated clothing and launder before reuse. Seek medical attention if irritation occurs and persists.

EYE Immediately and thoroughly flush eyes, holding the eyelids open, with lukewarm, gently flowing water for at least 20 minutes. Seek medical attention.

INHALATION
Remove victim from hazard. Apply artificial respiration if indicated. Seek medical attention.

INGESTION
Do not induce vomiting. Give conscious patients fluids. Call a physician.

GENERAL ADVICE

SECTION 9 - PREPARATION OF M.S.D.S.

PREPARED BY	**PHONE NUMBER**	**DATE**
Regulatory Affairs Department	(604) 261-3019	January 1, 2007

ADDITIONAL INFORMATION AND COMMENTS

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Attachment IV-11: Calcium Oxide MSDS Sheet

ScienceLab.com
Chemicals & Laboratory Equipment

Health	3
Fire	0
Reactivity	2
Personal Protection	J

Material Safety Data Sheet
Calcium oxide MSDS

Section 1: Chemical Product and Company Identification

Product Name: Calcium oxide

Catalog Codes: SLC5248, SLC4246, SLC1453

CAS#: 1305-78-8

RTECS: EW3100000

TSCA: TSCA 8(b) inventory: Calcium oxide

CI#: Not applicable.

Synonym: Quicklime; Lime

Chemical Name: Calcium oxide

Chemical Formula: CaO

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Calcium oxide	1305-78-8	100

Toxicological Data on Ingredients: Calcium oxide LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive). The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastro-intestinal or respiratory tract, characterized by burning, sneezing and coughing. Severe over-exposure can produce lung damage, choking, unconsciousness or death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can

produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Chlorine Trifluoride reacts violently with calcium oxide producing flame.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. If necessary: Neutralize the residue with a dilute solution of acetic acid.

Large Spill:
Corrosive solid.
Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of acetic acid. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep container dry. Do not breathe dust. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes. Keep away from incompatibles such as organic materials, acids, moisture.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 24°C (75.2°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor and dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 2 (mg/m3) from ACGIH (TLV) [United States]
TWA: 2 (mg/m3) [Canada]
TWA: 5 (mg/m3) from OSHA (PEL) [United States]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Crystalline solid.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 56.08 g/mole

Color: White.

pH (1% soln/water): 10 [Basic.]

Boiling Point: 2850°C (5162°F)

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Melting Point: 2572°C (4661.6°F)

Critical Temperature: Not available.

Specific Gravity: 3.33 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Soluble in acids, glycerol, sugar solution.
Practically insoluble in alcohol.
Very slightly soluble in cold water, hot water.
Insoluble in methanol, diethyl ether, n-octanol.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with organic materials, acids, moisture.

Corrosivity: Not available.

Special Remarks on Reactivity:
Absorbs CO2 from air. Reacts with fluorine to evolve much heat and some light.
Reacts with water. Addition of water to Quicklime has generated temperatures as high as 800 C. Some reports describe the reaction as violent.
In water, calcium oxde forms calcium hydroxide generating a large quanity of heat.
Ignition of sulfur, gunpowder, wood, and straw by heat of Quicklime-water reaction has been reported.
Liquid hydrofluoric acid and calcium oxide react very violently.
Calcium reacts with phosphorous pentoxide extremely violently when initiated by local heating.
Lime becomes incandescent when heated to near its melting point (2500 C).

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

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Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion, of inhalation.
Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Causes skin irritation and burns.
Eyes: Causes eye irritation and burns.
Inhalation: Material is irritating to respiratory tract and mucous membranes and upper respiratory tract.
Ingestion: May be harmful if swallowed. Irritates gastrointestinal tract with possbile burns. Swallowing may become painful, and difficult. A burning pain extends down the esophagus to the stomach. May affect respiration. Vomitous is thick and slimy due to mucous. Later is may contain blood shred of mucous membrane due to necrosis.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Calcium Oxide UNNA: 1910 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Calcium oxide
Illinois toxic substances disclosure to employee act: Calcium oxide
Rhode Island RTK hazardous substances: Calcium oxide
Pennsylvania RTK: Calcium oxide
Minnesota: Calcium oxide
Massachusetts RTK: Calcium oxide

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California Director's List of Hazardous Substances: Calcium oxide
TSCA 8(b) inventory: Calcium oxide
TSCA 8(a) chemical risk rules: Calcium oxide

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS E: Corrosive solid.

DSCL (EEC):
R38- Irritating to skin.
R41- Risk of serious damage to eyes.
S2- Keep out of the reach of children.
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S39- Wear eye/face protection.
S46- If swallowed, seek medical advice immediately and show this container or label.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 2

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves.
Synthetic apron.
Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-The Sigma-Aldrich Library of Chemical Safety Data, Edition II.
-Guide de la loi et du rÃ¨glement sur le transport des marchandises dangeureuses au canada. Centre de conformitÃ© internatinal LtÃ©e. 1986.

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Other Special Considerations: Not available.

Created: 10/11/2005 11:31 AM

Last Updated: 10/11/2005 11:31 AM

Attachment IV-12: Glass Mat Faced Gypsum Panels MSDS Sheet

Georgia-Pacific

Material Safety Data Sheet

Material Name: GLASS MAT FACED GYPSUM PANELS **ID: GP-072**

*** Section 1 - Chemical Product and Company Identification ***

Chemical Name: GLASS MAT FACED GYPSUM PANELS

Trade Name: See Product List Found in Section 16

Product Use: Patented water-resistant boards for exterior and interior walls and ceilings, interior floors, countertops, roof decks, elevator shafts and stairwells. FIREGUARD® panels can be used in fire-rated assemblies and area separation walls.

Manufacturer Information

G-P Gypsum Corporation
A wholly owned subsidiary of
Georgia Pacific Corporation
133 Peachtree Street NE
Atlanta, GA 30303

800-225-6119 (Technical Information)
404-652-5119 (MSDS Request)

Georgia Pacific Canada, Inc.
A wholly owned subsidiary of
Georgia Pacific Corporation
319 Allanburg Road
Thorold, Ontario
L2V 3ZB, Canada

800-424-9300 (CHEMTREC Emergency)

Description

Gray, gold, green, tan, blue, silver, or white glass mat faced panels

*** Section 2 - Composition / Information on Hazardous Ingredients ***

CAS #	Component	Percent
7778-18-9	Calcium sulfate*	85-98
65997-17-3	Continuous Filament Glass Fibers	1-5

Component Related Regulatory Information

*This product may be regulated, have exposure limits or other information identified as the following: Crystalline silica, (quartz), Glass filaments. See Section 8 for exposure information.

Component Information/Information on Non-Hazardous Components

Gypsum contains naturally occurring crystalline silica (quartz). Due to its natural occurrence, the exact percentage of crystalline silica is unknown.

*** Section 3 - Hazards Identification ***

Emergency Overview

CAUTION! Cutting, sanding or otherwise working with this product may generate large amounts of dust. Dust may cause respiratory tract, eye and skin irritation. This product also contains naturally occurring crystalline silica (quartz), which is listed as a lung carcinogen.

Potential Health Effects: Eyes

Dust may cause mechanical eye irritation. Good housekeeping practices are recommended.

Potential Health Effects: Skin

Handling can cause dry skin. Dust and glass fibers may produce itching, rash and redness.

Material Safety Data Sheet

Material Name: GLASS MAT FACED GYPSUM PANELS **ID: GP-072**

Potential Health Effects: Ingestion

Not applicable under normal conditions of use. May result in obstruction and temporary irritation of the digestive tract.

Potential Health Effects: Inhalation

Dust can cause irritation to the respiratory tract. Good housekeeping practices are recommended.

HMIS Ratings: Health: 1 **Fire:** 0 **Physical Hazard:** 0
Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic hazard

* * * Section 4 - First Aid Measures * * *

First Aid: Eyes

Immediately rinse with water. Remove contact lenses. Hold eyelids apart and flush eyes with water for at least 15 minutes. If irritation persists, get medical attention.

First Aid: Skin

Wash affected areas gently with soap and water. Rubbing or scratching may force fibers into skin. If irritation persists, get medical attention. Launder contaminated clothing separately before reuse or dispose of properly.

First Aid: Ingestion

Ingestion may result in obstruction and/or irritation to the digestive tract. Get medical attention, if needed.

First Aid: Inhalation

Remove to fresh air immediately. If persistent irritation, severe coughing or breathing difficulty occurs, get medical attention.

* * * Section 5 - Fire Fighting Measures * * *

Flash Point

Not Applicable

Auto Ignition

Not Applicable

General Fire Hazards

This product is fire resistant and has the following surface burning characteristics as reported by nationally recognized laboratories: Flame Spread: 0 - 25.

Hazardous Combustion Products

None Known

Extinguishing Media

Not Applicable

NFPA Ratings: Health: 1 **Fire:** 0 **Reactivity:** 0
Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

* * * Section 6 - Accidental Release Measures * * *

Containment Procedures

Not applicable for product in purchased form. Pick up large pieces. To prevent obstruction, do not wash down drain. Sweep or vacuum material into a waste container for disposal. If needed, use water spray to wet down and minimize dust generation. Wear approved respirator, if necessary.

Material Safety Data Sheet

Material Name: GLASS MAT FACED GYPSUM PANELS **ID: GP-072**

* * * Section 7 - Handling and Storage * * *

Handling Procedures

Avoid contact with eyes, skin and clothing. Always test air prior to entry to ensure atmosphere is below the permissible exposure limit.

Storage Procedures

Store level and keep dry. Dew point or other conditions causing the presence of moisture can damage the product during storage.

* * * Section 8 - Exposure Controls / Personal Protection * * *

Exposure Guidelines

Component Exposure Limits

Calcium sulfate (7778-18-9)

ACGIH: 10 mg/m3 TWA (particulate matter containing no asbestos and < 1% crystalline silica)
OSHA: 15 mg/m3 TWA; 5 mg/m3 TWA (respirable fraction)

Continuous Filament Glass Fibers (65997-17-3)

ACGIH: 1 f/cc TWA (respirable fibers: length > 5 µm, aspect ratio equal to or greater than 3:1, as determined by the membrane filter method at 400-450X magnification (4-mm objective), using phase-contrast illumination.); 5 mg/m3 TWA (inhalable fraction) (related to Continuous filament glass fibers)

Silica, crystalline, quartz (14808-60-7)

ACGIH: 0.05 mg/m3 TWA (respirable fraction)
OSHA: 10 mg/m3 / %SiO2 + 2 TWA (respirable)

Engineering Controls

Provide local and general exhaust ventilation to keep airborne concentrations below exposure limits. Use wet methods, if appropriate, to reduce generation of dust.

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment: Eyes/Face

Wear eye goggles or safety glasses for nuisance dust. Ensure compliance with OSHA's PPE standards (29 CFR 1910.132 and 133) for eye and face protection.

Personal Protective Equipment: Skin

Protective gloves recommended to prevent drying or irritation of hands. Ensure compliance with OSHA's PPE standards 29 CFR 1910.132 (general) and 138 (hand protection).

Personal Protective Equipment: Respiratory

Wear NIOSH approved respirator when permissible exposure limit to dust may be exceeded. Respirators should be selected by and used under the direction of a trained health and safety professional following requirements found in OSHA's respirator standard (29 CFR 1910.134) and ANSI's standard for respiratory protection (Z88.2).

Material Safety Data Sheet

Material Name: GLASS MAT FACED GYPSUM PANELS **ID: GP-072**

*** Section 9 - Physical & Chemical Properties ***

Appearance:	Gray, gold, green, tan, blue, silver or white glass mat faced boards	**Odor:**	Odorless
Physical State:	Solid	**pH:**	6-8
Vapor Pressure:	Not Applicable	**Vapor Density:**	Not Applicable
Boiling Point:	Not Applicable	**Melting Point:**	Not Applicable
Solubility (H2O):	<0.2% @ 22°C	**Specific Gravity:**	2.3

*** Section 10 - Chemical Stability & Reactivity Information ***

Chemical Stability
Stable material

Chemical Stability: Conditions to Avoid
Reaction with strong acids will generate carbon dioxide.

Incompatibility
None Identified

Hazardous Polymerization
Will not occur

*** Section 11 - Toxicological Information ***

Acute and Chronic Toxicity

Crystalline Silica: Respirable crystalline silica in the form of quartz or cristobalite from occupational sources is listed by the International Agency for Research on Cancer (IARC) and National Toxicology Program (NTP) as a lung carcinogen.

Prolonged exposure to respirable crystalline silica has been known to cause silicosis, a lung disease, which may be disabling. While there may be a factor of individual susceptibility to a given exposure to respirable silica dust, the risk of contracting silicosis and the severity of the disease is clearly related to the amount of dust exposure and the length of time (usually years) of exposure.

Continuous Filament Glass Fibers: In 1987, IARC classified continuous filament glass fibers as a Group 3 substance, "not classifiable as to its carcinogenicity to humans". In 2001, IARC re-affirmed this designation. Continuous filament glass fibers are not considered respirable due to its large diameter.

Component Analysis - LD50/LC50
No LD50/LC50's are available for this product's components.

Carcinogenicity

Component Carcinogenicity

Calcium sulfate (7778-18-9)

ACGIH	A2 – Suspected Human Carcinogen (related to Silica, crystalline – Quartz)
NTP:	Known Carcinogen (related to Silica, crystalline (respirable size)
IARC:	Monograph 68, 1997 (related to Silica, crystalline (general form)) (Group 1 (carcinogenic to humans))

Material Safety Data Sheet

Material Name: GLASS MAT FACED GYPSUM PANELS **ID: GP-072**

Continuous Filament Glass Fibers (65997-17-3)
ACGIH: A4 - Not Classifiable as a Human Carcinogen (related to Continuous filament glass fibers)
IARC: Monograph 43, 1988; Monograph 81, 2002 (related to Continuous glass filaments) (Group 3 (not classifiable))

*** Section 12 - Ecological Information ***

Ecotoxicity
A: General Product Information
No information found.
B: Component Analysis - Ecotoxicity - Aquatic Toxicity
No ecotoxicity data are available for this product's components.

Environmental Fate
No information is found.

*** Section 13 - Disposal Considerations ***

US EPA Waste Number & Descriptions
A: General Product Information
This product, if discarded as supplied, is not considered a hazardous waste under Federal Hazardous Waste Regulations 40 CFR 261. If processing, use, or contamination alters the material, the waste must be tested using methods described in 40 CFR 261 to determine if it meets applicable definitions of hazardous wastes.
B: Component Waste Numbers
No EPA Waste Numbers are applicable for this product's components.

Disposal Instructions
Dispose of as inert solid in landfill. Dispose of waste material according to local, state, federal and provincial environmental regulations.

*** Section 14 - Transportation Information ***

International Transportation Regulations
This material is not a DOT hazardous material.

*** Section 15 - Regulatory Information ***

US Federal Regulations
A: General Product Information
Dust and potential respirable crystalline silica generated from cutting, sanding or otherwise machining this product may be hazardous.
B: Component Analysis
None of this products components are listed under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65), or CERCLA (40 CFR 302.4).

State Regulations
A: General Product Information
Airborne particles of respirable size crystalline silica are known to the State of California to cause cancer. Worker exposure testing conducted by Georgia Pacific on various industrial gypsum products did not demonstrate an exposure to respirable crystalline silica.

Material Safety Data Sheet

Material Name: GLASS MAT FACED GYPSUM PANELS **ID: GP-072**

B: Component Analysis - State

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
Calcium sulfate	7778-18-9	No	Yes	Yes	Yes	Yes	No
Continuous filament glass fibers	65997-17-3	No	No	Yes	No	No	No

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):

WARNING! This product contains a chemical known to the state of California to cause cancer.

Canadian WHMIS Information

General Product Information

This product is not a controlled product.

Additional Regulatory Information

Component Analysis - Inventory

Component	CAS #	TSCA	CAN	EEC
Calcium sulfate	7778-18-9	Yes	DSL	EINECS
Continuous filament glass fibers	65997-17-3	Yes	DSL	EINECS

*** Section 16 - Other Information ***

Other Information

Trade Names of Products

DensArmor™
DensArmor™ FIREGUARD®
DensArmor™ Plus Interior Panel
DensArmor™ Plus FIREGUARD® Interior Panel
Dens-Core®
DensDeck DuraGuard™ Roof Board
DensDeck® Roof Board
DensDeck® FIREGUARD® Roof Board
DensDeck Prime™ Roof Board
DensGlass Gold® Exterior Sheathing
DensGlass Gold® FIREGUARD® Exterior Sheathing
DensGlass Silver™ Residential Sheathing
DensGlass® Ultra Shaftliner™ Guard
DensMarine™ Board
DensShield® FIREGUARD® Tile Guard
DensShield® Tile Backer

MSDS History

Effective Date: 01/14/2005
Supercedes Date: 01/01/2004
Section(s) Changed Since Last Revision:
Section 1 Description Updated
Section 2 Crystalline Silica (Quartz) Language Updated
Section 8 Crystalline Silica (Quartz) Language Updated
Section 9 Appearance Updated
Section 16 Product Name Updated

Material Safety Data Sheet

Material Name: GLASS MAT FACED GYPSUM PANELS **ID: GP-072**

Disclaimer

IMPORTANT: The information and data herein are believed to be accurate and have been compiled from sources believed to be reliable. It is offered for your consideration, investigation and verification. Buyer assumes all risk of use, storage and handling of the product in compliance with applicable federal, state and local laws and regulations. Georgia Pacific and its subsidiaries make no warranty of any kind, expressed or implied, concerning the accuracy or completeness of the information and data herein. The implied warranties of merchantability and fitness for a particular purpose are specifically excluded. Georgia Pacific and its subsidiaries will not be liable for claims relating to any party's use of or reliance on information and data contained herein regardless of whether it is claimed that the information and data are inaccurate, incomplete or otherwise misleading.

Key/Legend

ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
C	Ceiling Limit
CAS	Chemical Abstract Services Number
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
DOT	Department of Transportation
DSL	Domestic Substance List
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
HCS	Hazard Communication Standard
HEPA	High Efficiency Particulate Air
HMIS	Hazardous Material Identification System
IARC	International Agency for Research on Cancer
LCLO	Lowest lethal concentration of a substance
LC50	Concentration of a material expected to kill 50% of an animal text group
LDLO	Lowest lethal does of a material
LD50	Dose of a material expected to kill 50% of an animal text group
NA	Not Available or Not Applicable
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NJTSR	New Jersey Trade Secret Registry
N O S	Not Otherwise Specified
NSL	Non-Domestic Substance List
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment
SARA	Superfund Amendments and Reauthorization Act
STEL	Short Term Exposure Limit
TCLo	Lowest Concentration in Air Resulting in a Toxic Effect
TDLo	Lowest Dose Resulting in a Toxic Effect
TDG	Canadian Transportation of Dangerous Goods
TLV	Threshold Limit Value
TSCA	Toxic Substance Control Act
TWA	Time Weighted Average

This is the end of MSDS # GP-072

Volume I: Project Description

Appendix V: Preliminary Emergency Response Plan

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Scope and Intent

This Preliminary Emergency Response Plan (ERP) will be customized upon completion of the Project design as a facility-specific policy and procedure manual that meets all applicable regulatory requirements.

The ERP was designed to simplify the decision making process for all those responding to an emergency at the Alberta Sulphur Terminal Ltd. (AST) Bruderheim Sulphur Forming and Shipping Facility. It was created to protect both on-site personnel and members of the public who may be impacted by an incident at the Bruderheim Sulphur Forming and Shipping Facility. The ERP is intended to work in conjunction with the CCS corporate ERP and, therefore, its focus remains on practical operational considerations and not on elements such as business continuity or hazard mitigation. The core elements of the Plan are formed around Northeast Region Community Awareness and Emergency Response Guide (NR CAER) Emergency Response Plan, CAN/ CSA-Z731-03 Emergency Preparedness and Response, and the Alberta Energy and Utilities Board (EUB) Directive 071: Emergency Preparedness and Response Requirements for the Petroleum Industry.

The Plan was developed to accomplish the following:

- ensure access to information utilizing an Incident Command System (ICS)
- promote communications with all persons involved or potentially affected by a plant emergency
- coordinate activities among other mutual aid industry responders, emergency services, local authorities, governments and others who have an operational role
- identify response organizations, and command and control structures as laid out in the ICS
- identify resources, personnel, equipment and services required to manage an incident

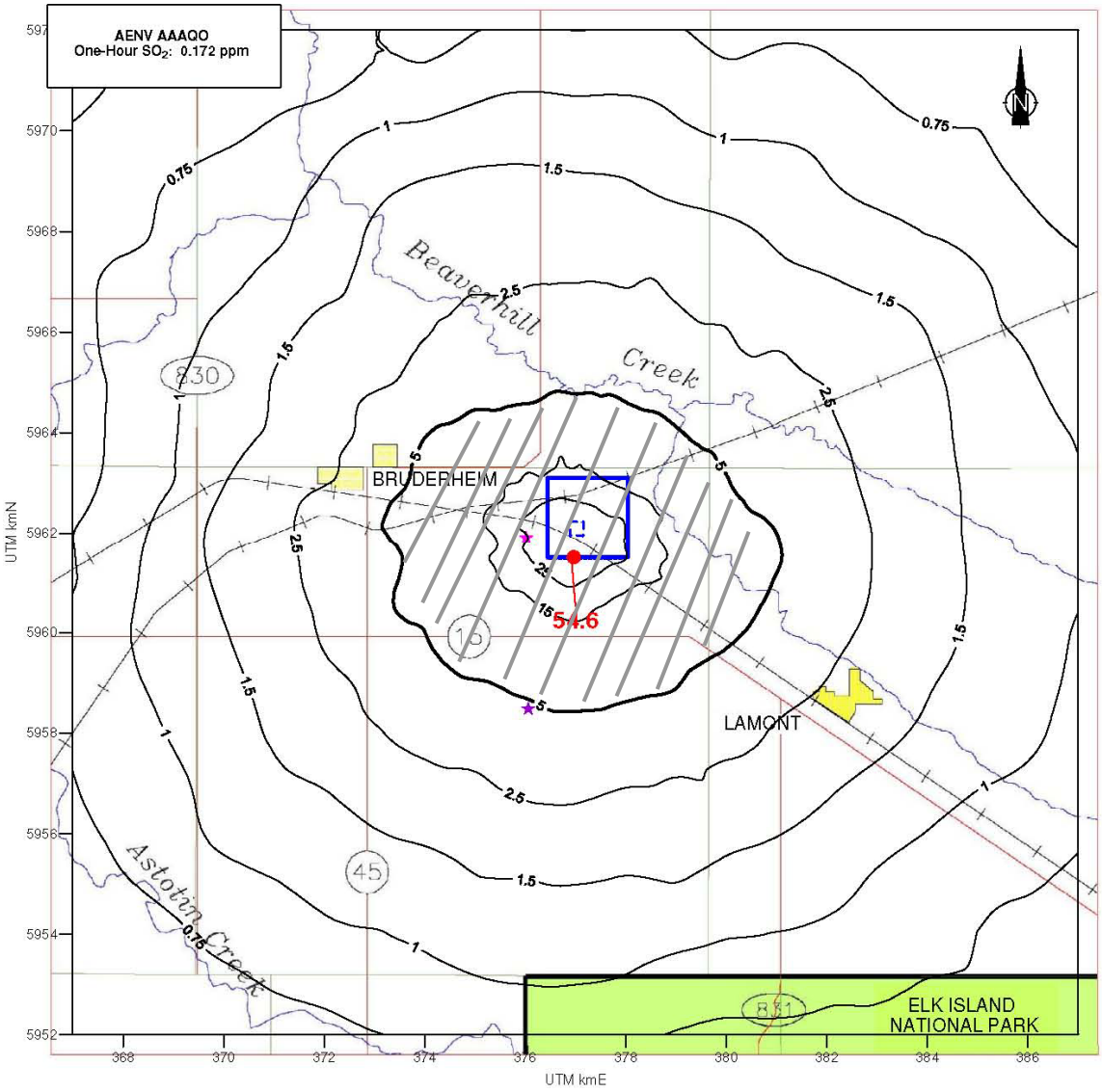
1. Introduction and Methodology

The Preliminary Emergency Response Plan (ERP) was developed using the following documents as a guide:

- Northeast Region Community Awareness and Emergency Response Guide (NR CAER) Emergency Response Plan
- Emergency Preparedness and Response CAN/CSA-Z731-03, a national Canadian standard
- EUB Directive 071 (Dec. 06) Emergency Preparedness and Response Requirements for the Petroleum Industry

These guides were used to establish best practices for this facility and do not constitute regulatory requirements. The Bruderheim Sulphur Forming and Shipping Facility is not required to conform with Z731 or Directive 071, and participation in the NR CAER is voluntary.

To conform to NR CAER requirements, Figure V-1 illustrates the evacuation zone under the worst case scenario, which is based on modelled SO_2 concentrations of 5 ppm, and EUB guidelines (ID 2001-5) for evacuation limits related to SO_2 concentrations.



Legend

- The Site
- Principal Development Area (PDA)
- Canexus Sodium Chlorate Plant
- Rivers and Streams
- Lamont Continuous Air Monitoring Station
- Highways
- Railways
- National Park
- Towns and Settlements
- Call Out Zone for Worst-case Scenario – SO_2 Release of 5 ppm (EUB ID 2001-5)

Scale (km) 0 2 4 6

Figure V-1: Evacuation Zone

2. Location and Directions

2.1 Location

The AST Bruderheim Sulphur Forming and Shipping Facility is situated on a portion of Section 35-55-20 W4M (the Site). The Site and Principal Development Area (PDA) are shown in Figure V-2. Project operations encompass:

- rail and road access for receiving molten sulphur
- molten sulphur unloading and transfer facilities
- sulphur forming facilities to produce sulphur pastilles
- loading and shipping facilities for formed sulphur
- sulphur pastilles temporary storage area

Mailing Address

Box 1090, Lamont, AB, T0B 2R0

Legal Description

Section 35–55–20 W4M

Aviation Bearings

- Latitude: 53° 47’ 45.73” N
- Longitude: 112° 51’ 51.51” W
- Northing: 5962441.4 mN
- Easting: 377205.4 mE

Road Directions

See Figure V-3 and the directions below.

From Bruderheim

- travel east on Highway 45 for approximately 2.2 km
- turn right onto Twp. Road 560 for approximately 0.3 km
- turn right (South) onto R.R. 202 for 0.9 km
- turn left (East) to enter site

From Lamont:

- travel northwest on Highway 15 for approximately 6 km
- turn right (North) onto R.R. 202 for 2.2 km
- turn right (East) to enter site

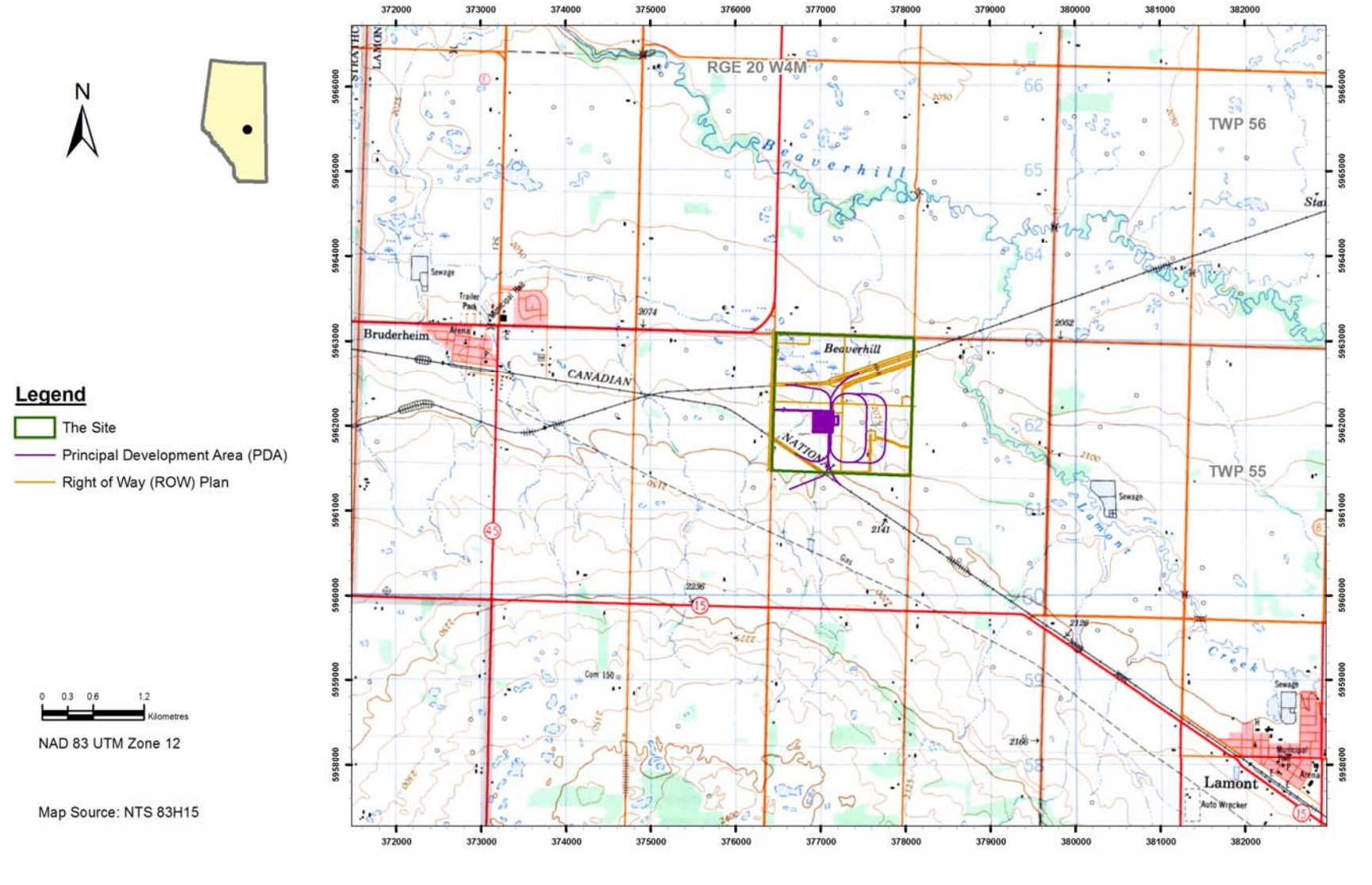


Figure V-2: Site Plan for Section 35-55-20 W4M and PDA

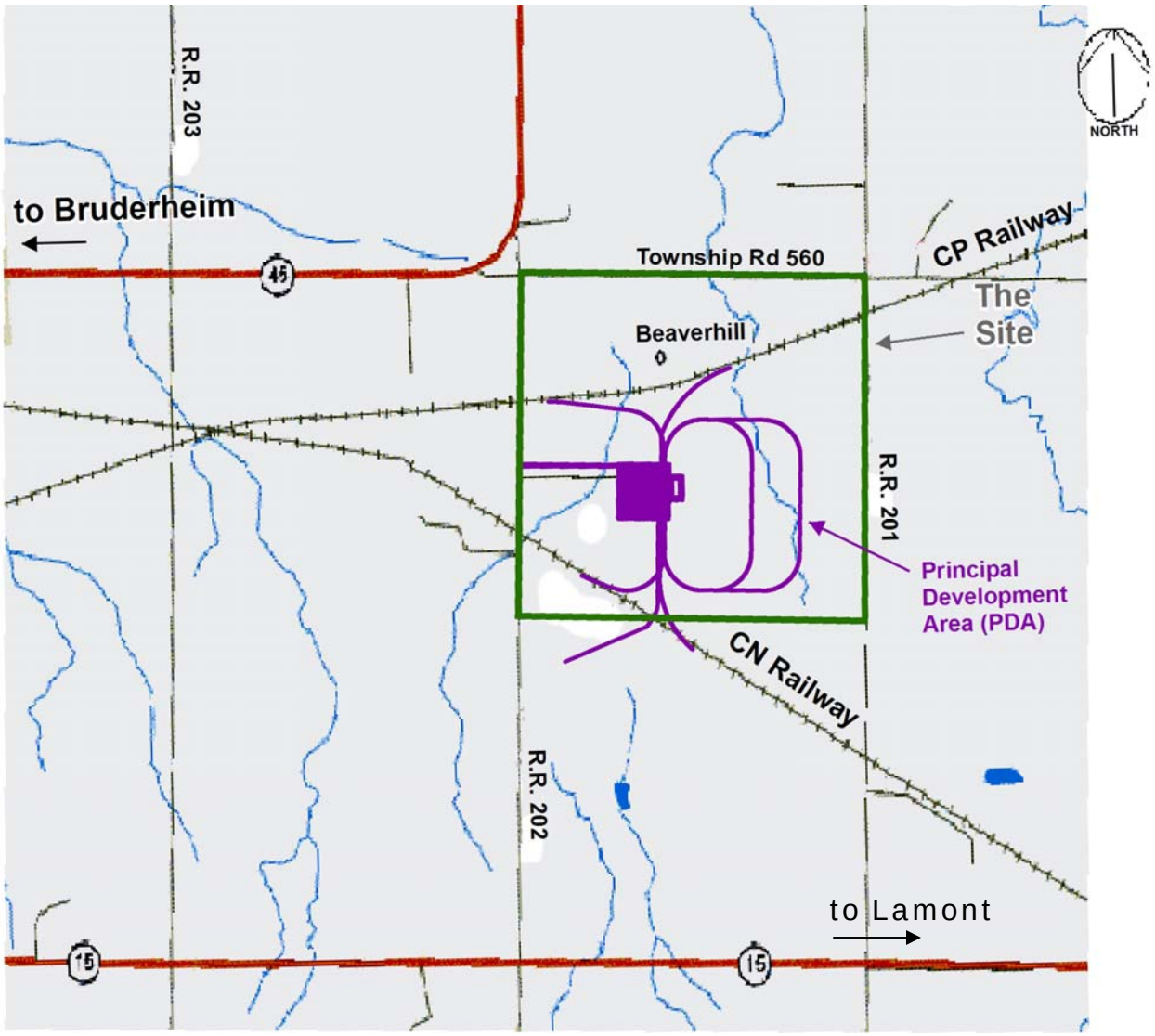


Figure V-3: Project Location and Surrounding Roadways

3. Communications

3.1 Internal Communications

Communication between the Incident Site Manager (ISM) and Emergency Operations Centre (EOC) should follow the protocol shown in Figure V-4. The primary communication from the ISM to the EOC should be by two-way radio on assigned frequencies. The first alternate is cell phone with the second alternate being is telephone landlines. Communication from the site EOC to the corporate EOC will be priority telephone landline and alternately cell phone.

3.2 External Communications

Communications between the EOC and external agencies including government regulators are as follows:

- NR CAER and all responding mutual aid assistance:
  - primary method is two-way radios utilizing NR CAER frequency
  - secondary method is telephone landline followed by cell phone
- all others including government:
  - primary method – telephone landline
  - secondary method – cell phone

3.3 Protocol

Communication between the ISM and EOC should employ the same point of contact to ensure consistency. When radios are the primary means of communication, audio traffic will be concise and direct as required by the radio-telephony license.

3.4 Alerting and Activation

Emergency levels in this section are categorized according to the EUB Directive 071 Criteria Matrix for Classifying Incidence (see Figure V-5) which includes an alert state followed by three emergency levels. The emergency levels range in ascending order of severity from Level 1 to Level 3. Each level has a different response matrix and a guide on moving from one level to the next

	Incident	Emergency		
Responses	**Alert**	**Level 1**	**Level 2**	**Level 3**
Communications				
Internal	Discretionary, depending on licensee policy	Discretionary, depending on licensee policy	Immediate notification of off-site management	Immediate notification of off-site management
External Public	Courtesy at licensee discretion	Mandatory for individuals within the EPZ requiring notification	Planned and instructive as per the specific ERP	Planned and instructive as per the specific ERP
Media	Reactive, as required	Reactive, as required	Proactive – media management to local or regional interest	Proactive – media management to local or regional interest
Government	Notify EUB if public contacted	Notify EUB. Call local authority and RHA, if public or media is contacted	Notify EUB and local authority	Notify EUB and local authority
Actions				
Internal	On site, as required, by licensee	On site, as required, by licensee. Initial response undertaken in accordance with the specific or corporate-level ERP	Predetermined public safety actions are underway. Corporate management team alerted and may be appropriately engaged to support on-scene responders.	Full implementation of incident management system
External	On site, as required, by licensee	On site, as required, by licensee	Potential for multi-agency (operator, municipal, provincial or federal) response	Immediate multi-agency (operator, municipal, provincial or federal) response
Resources				
Internal	Immediate and local. No additional personnel required	Establish what resources would be required	Limited supplemental resources or personnel required	Significant incremental resources required
External	None	Begin to establish resources that may be required	Possible assistance from government agencies and external support services as required	Assistance from government agencies and external support services as required

Source: EUB 2003

Figure V-4: Communications Protocol

Summary of Qualitative Measures of Consequence or Impact		
Level	**Descriptor**	**Example of Detail Description**
1	Minor	No injuries, limited and localized environmental impact, low financial loss ($50,000), nil press interest. First Aid treatment, on-site release contained with outside assistance, short-term, temporary environmental impact, low press interest.
2	Moderate	Medical treatment required, on-site release contained with outside assistance, medium environmental impact, local and possibly regional media interest publicity.
3	Major	Public safety jeopardized, off-site release with significant and ongoing environmental impact, adverse national publicity
4	Catastrophic	Fatality, toxic pollution and off-site contamination with long-term environmental impact, national and international publicity

Qualitative Measures of Likelihood		
Level	**Descriptor**	**Description**
1	Unlikely	• Incident contained/controlled • No change of additional hazards • Ongoing monitoring required
2	Moderate	• Imminent control of the hazard probable
3	Likely	• Uncontrolled incident • Operator has capability to manage and control incident
4	Almost Certain or Currently Occurring	• Uncontrolled incident • Little change hazard will be controlled in the near future • Assistance from outside parties required
What is the likelihood that the incident will escalate, resulting in an increased exposure to public health, safety or the environment?		

Risk Levels Based on Likelihood and Consequences					
Risk Assessment Map					
Consequences	**Minor (1)**	**2**	**3**	**4**	**5**
	Moderate (2)	**3**	**4**	**5**	**6**
	Major (3)	**4**	**5**	**6**	**7**
	Catastrophic (4)	**5**	**6**	**7**	**8**
		Likely (1)	**Moderate (2)**	**Likely (3)**	**Almost Certain (4)**
		Likelihood			

Control Considerations	
Risk Level	**Assessment Results**
Very Low 2–3	**Level 0 (Alert)** No action required
Low 4–5	**Level 1 Emergency** There is no danger outside company property or ROW. The situation can be handled entirely by company personnel. • Immediate control of the hazard/source is possible • No threat to public • Minimal environmental impact • Little or no media interest
Medium 6	**Level 2 Emergency** Potential for the emergency to extend beyond company property. Imminent control of the situation is probable; some threat to the public, moderate environmental impact; local regional media interest.
High 7–8	**Level 3 Emergency** • Uncontrolled hazard • Public safety jeopardized • Significant ongoing environmental impact • Significant media interest • Immediate municipal and provincial government involvement • Assistance from outside parties required

Source: EUB 2003

Figure V-5: Criteria Matrix for Classifying Incidence

3.4.1 Emergency Calls

Fire Department.....911

NR CAER.....1 (780) 424-0162

Police/RCMP Fort Saskatchewan 1 (780) 992-6100

Ambulance.....911

Hospital

Lamont .....(780) 895–2211

Fort Saskatchewan .....(780) 998–2256

Poison Centre

Toll Free 1 (800) 332–1414

If busy call (Calgary) .....(403) 944–1414

3.4.2 Information for the Ambulance Dispatcher

- provide your name
- telephone number
- location
- number of patients
- name of patient (if known)
- estimate of the patient's age
- sex of the patient
- nature of the problem
- if the patient is breathing
- if the patient is conscious
- if pulse is fast, slow, or irregular
- if there is any bleeding
- if there is a possibility of back or neck injury

Stay on the line – do not hang up until the emergency service dispatcher has obtained all of the necessary information and advises you that it is safe to hang up. They may also provide valuable information on how to help the patient.

The dispatcher will provide pre-arrival instructions. On the direction of a Command Officer, they will request a Shock Trauma Air Rescue (STARs) helicopter and have the pilot respond to a predetermined GPS location. If the prearranged LZ (landing zone) is not available, a qualified LZ Officer must be provided to ensure safety. This LZ Officer may be a plant responder, member of the municipal department or a qualified mutual aid partner.

4. Gas Detection

Automatic gas detection systems for H_2S and SO_2 are installed in the plant process and sulphur handling areas. These systems monitor the ambient air and supply data indicating the level of H_2S and SO_2 present in parts per million (ppm).

Should the amount of gas in the process or sulphur handling areas reach 5 ppm H_2S or SO_2, a panel light will illuminate in the Control Room and an audible alarm will sound in both the Control Room and contaminated area. This will warn operators that the atmosphere is contaminated and where the release has occurred.

4.1 Building Alarm Levels

H_2S and SO_2 gas detection systems are located as follows:

- rail car sulphur reception area – one
- truck sulphur reception area – one
- sulphur forming building– two
- sulphur load out area – two

4.2 Responding to a Building Alarm

If the building alarm sounds, a minimum of two operations personnel must check the area:

- one person tests the area with the portable gas detector
- the second person maintains radio contact with the Control Room Incident Commander at all times. Personnel should use the following guidelines:
- evacuate all personnel from the affected area
- open all doors prior to entering affected buildings
- conduct H_2S and SO_2 testing: when checking for H_2S, a Self-contained Breathing Apparatus (SCBA) or Supplied Air Breathing Apparatus (SABA) must be worn until the area has been proven safe
- if a leak is detected, determine remedial action in accordance with the severity of the leak
- once the situation has been corrected, reset the detector at the monitoring location

4.3 Personal Monitor Alarm Levels

All personnel working in the sulphur forming and processing areas are required to wear personal monitors. Personal monitors alarm at a level audible to the individual. Under warning circumstances, the worker should stop work immediately and exit the building or risk area. The building or risk area should then be ventilated and attempts made to reduce or eliminate the potential source of the hazardous atmosphere. Workers shall not re-enter the building or risk area until it has been cleared to do so.

5. Emergency Horn Alarm System

The Emergency Horn Alarm is located outside of the Control Room.

5.1 Activation

The Emergency Horn Alarm, activated by any worker observing an emergency, sounds throughout the plant site and surrounding area when the following emergencies occur:

- toxic gas release (unknown, uncontrolled)
- personnel potentially overcome by toxic gas
- fire or explosions
- rescue assistance is required
- other (i.e., approaching severe weather (tornado) or transportation incident (train derailment) in proximity to the facility)

The NR CAER Community Notification System (CNS) protocol should be activated and a Level 2 incident declared based on the siren sound.

5.2 Location of Horn Activation Device

The Emergency Horn Alarm is activated from the Control Room.

5.2.1 Emergency Horn Alarm Testing and Use

For both testing and use of the Emergency Horn Alarm, the NR CAER Community Notification System (CNS) should be followed. Both testing and emergency use should be treated as a Level 2 incident for communication purposes.

5.2.2 Monthly Check

The test lights and horns are activated from a push button station located in the Control Room. This test should be performed after regular hours when there are no ongoing activities.

5.2.3 Emergency Evacuation Practice

One long series .....Continuous

5.2.4 Emergency Event

One long series .....Continuous

5.3 Emergency Response Actions

5.3.1 Sound the Alarm when Necessary

Based on the criteria described in Section 5.1, call or radio to warn others and activate the alarm from the Control Room.

5.3.1.1 Response to an H_2S or SO_2 Release

Protect Yourself

- shut off all vehicles and ignition-causing equipment
- determine the wind direction
- egress to a safe area (exit away from potential hot zones)
- identify the source of the release
- evacuate upwind or across wind from the release to the emergency muster point in the Control Room
- if an alternate muster point is used, advise the Control Room Incident Commander
- move quickly; avoid running
- do not enter buildings or areas that can entrap released gases

5.3.1.2 Communicate to the Control Room Incident Commander

Communicate the nature of the emergency and confirm that assistance is on the way. Advise the Control Room Incident Commander of the following:

- what happened
- where it happened
- current wind speed and direction
- present status of the emergency
- safe routes and directions of approach

Ensure that others do not enter the area affected by the emergency. Establish hot and warm zones by marking-off the area with signs and barrier tape.

5.3.1.3 Responding to an Emergency Horn Alarm

When the emergency horn alarm is sounded, follow the guidelines below.

5.3.1.3.1 Operators

Protect Yourself

- shut off all vehicles and ignition-causing equipment
- determine the wind direction
- egress to a safe area (exit away from potential hot zones)
- identify the source of the release
- evacuate upwind or across wind from the release to the emergency muster point in the Control Room; if an alternate muster point is used, advise the Control Room Incident Commander
- move quickly; avoid running
- do not enter buildings or areas that can entrap released gases

Close the Gate

- Evacuate all non-involved personnel to the emergency muster point in the Control Room.
- Unit operators are to assist the emergency rescue team (see Section 5.3.1.3.4 below) with rescue efforts, as the situation requires
- The unit operator will perform necessary isolations and act as a self-sufficient rescue team during off-hours

5.3.1.3.2 Maintenance and Contractors

Protect Yourself

- shut off all vehicles and ignition-causing equipment
- determine the wind direction
- evacuate upwind or across wind from the release to the emergency muster point in the Control Room
- if an alternate muster point is used, advise the Control Room Incident Commander
- move quickly; avoid running
- do not enter buildings or areas that can entrap released gases
- congregate at the emergency muster point in the Control Room for roll call and await further instruction
- if individuals are missing, notify the Control Room Incident Commander. State the name and last known location of the missing individual(s).

5.3.1.3.3 Sulphur Loading/Unloading

If Loading or Unloading

- evacuate upwind or across wind from the release to the emergency muster point
- if an alternate muster point is used, advise the Control Room Incident Commander

Administration

- disconnect outside telephone calls immediately
- proceed to the emergency muster point for roll call

Visitors

- all office visitors who are signed in are to muster in the Control Room
- all visitors in the plant area are to be AST escorted to the Control Room evacuation muster point

5.3.1.3.4 Emergency Rescue Team

The emergency rescue team consists of three individuals, including the pre-designated team leader, who carries a radio and assumes the duties of emergency rescue team leader. The remaining team members are shift workers. They are to respond to rescue requirements during an emergency event and during practice.

Organizing

- the emergency rescue team leader is updated and instructed by the Control Room Incident Commander via radio
- dependent upon the situation, the team may or may not congregate at the emergency muster point prior to a rescue attempt but may visually acknowledge each other
- if the team leader does not muster outside the Control Room and may be a 'possible victim', a team member may step into the Control Room to assume the role of team leader. In this case, the acting team leader would enter the Control Room to gather required information, receive instructions from the Incident Commander and obtain a radio.
- the team leader accounts for all team members via radio for roll-call purposes

5.3.1.3.5 Emergency Rescue Team Response to Emergency Alarm

DO NOT RUSH INTO ANYTHING – consider all consequences prior to taking action.

Get Out of the Area

- shut off all vehicles and ignition-causing equipment
- determine the wind direction
- evacuate upwind or across wind from the release to the emergency muster point
- if an alternate muster point is used, advise the Control Room Incident Commander
- move quickly; avoid running
- do not enter buildings or areas that can entrap released gases

Don Breathing Apparatus

- locate the nearest breathing apparatus and any appropriate personal protective equipment located in a safe, accessible area
- check for hazards

Victim(s) Rescue Procedure

Medical aid must be provided to anyone who has been exposed to H_2S or SO_2 vapours above alarm concentrations.

- evaluate the situation
- ensure personal safety
- if medical attention is required, alert the Incident Commander
- assess the victim and select an appropriate rescue technique based on the condition of the victim and the surrounding environment
- remove the victim from danger or remove the danger from the victim
- if egress or rescue is delayed, begin mechanical resuscitation on the spot
- continue mechanical resuscitation while moving the victim to fresh air (the air must be proven safe and continue to be monitored)

Revive Victim(s)

- check the condition of the victim(s)
- establish the patient's level of consciousness
- check airway (is patient breathing?)
- check pulse (circulation)
- apply resuscitation/CPR until medical help arrives
- continue to revive/monitor downed victims until medical help has arrived

5.3.1.3.6 Evacuation Muster Points

When egressing to an evacuation muster point, do not choose a route that may be contaminated.

If an alternate muster point is used, advise the Control Room Incident Commander.

The Emergency Muster Point

The emergency muster point is located in the Control Room.

Notification – Documentation

In the event of an emergency alarm, the form 'Responding to an Emergency Alarm' must be completed.

6. Odour Complaint

An odour complaint initiates the same response as an H_2S or SO_2 alarm.

Notification Documentation

Complete an 'Odour Complaint Report' when an actual or suspected sour gas leak report has been received.

The on-call supervisor is to be notified of all complaints.

7. Hazardous Material Spills

All hazardous material spills on or off-site, larger than 0.5 m^3, are reportable to Alberta Environment (AENV). Perform the community notification protocol as per NR CAER as a Level II incident based on the potential for the public hearing an on-site siren.

7.1 Minor Spills – Molten Sulphur

Minor spills are defined by the nature of the material, quantity of the spill, ease of controlling, and potential damage to the environment and/or property. A minor spill may or may not be reportable to AENV (greater than 0.5 m^3). Minor spills are normally handled internally.

7.1.1 Action for a Minor Spill

- assess the situation – there is no need for an alarm for non-hazardous or minor spills
- request assistance and any required equipment
- shut off all vehicles and ignition-causing equipment
- isolate the source of the leak
- supervisors are to be notified of minor spills

7.2 Major Spills

A major spill is defined as one that, by the nature of the material, quantity of the spill, ease of controlling, and potential damage to the environment or property, renders it to be considered serious. A major spill may or may not be reportable to AENV (greater than 0.5 m^3).

Use NR CAER and EUB Directive 071 for establishing incident levels as this may help incident commanders in establishing the severity of an incident and the level of response.

7.3 Spill Containment and Recovery

Product Storage and Recovery

- transfer liquid from the leaking tank into a spare tank
- check levels to ensure flow is in the spare tank

Chemical Storage Areas

- contain the spill by damming up ditches and blocking runoff areas

Process Building Areas

- plug affected floor drains as spills may enter the surface water system via these drains

Product Trucks En route

- dam up ditches by blocking the nearest culverts
- transfer liquid from the leaking truck into another truck/storage tank as available
- establish roadblocks as required

7.3.1 Molten Sulphur

Mutual aid responders will be trained to work with AST staff when dealing with molten sulphur to ensure that the joint command protects the safety of all responders working near the substance.

Molten Sulphur Properties:

- red to almost black in colour
- hot – the melting point of sulphur is 119°C (246°F)
- may have H_2S and SO_2 entrained in it
- extremely flammable

IMPORTANT NOTE:

Molten pools could exist in sulphur handling areas but may be hidden by a thin crust of solid sulphur.

Protective clothing is required while handling molten sulphur and includes:

- hardhat
- safety glasses
- fire retardant clothing
- eight inch or higher CSA-approved leather or rubber boots

8. Fire/Explosions

The levels adopted by NR CAER apply to all incidents but as noted in this ERP, they are particularly important in describing fire and explosion events and shall be followed by Incident Command.

8.1 Level I Fires

A Level I fire is defined as a minor fire that can be isolated or controlled and is not of a serious nature. Operating personnel, trained in basic fire fighting, will apply their training to a Level I facility fire. It is required that the on-duty supervisor is notified in the case of a Level I fire.

8.1.1 Action for Level I Fires

- evaluate the situation and determine if the flames should be maintained until the source of fuel is isolated
- isolate and depressurize the fire area utilizing protective equipment if possible
- extinguish the fire

8.2 Level II Fires

A Level II fire is defined as a fire that cannot be isolated or controlled, but can be managed by the local fire and/or emergency response service.

8.2.1 Non-hydrocarbon Fire

The local fire department must be contacted for control (call 911) and specialists must also be contacted – see Section 3.4.1 for contact information.

8.2.2 Action for Level II Fires

- apply water to affected area using monitors to cool equipment and buildings
- there is approximately three hours of reserve water in storage
- notify and activate the notification system by contacting NR CAER – see Section 3.4.1 for contact information

8.3 Level III Fires

A Level III fire is defined as a fire that cannot be isolated or controlled and cannot be managed by the local fire and emergency response service.

8.3.1 Action for a Level III Fire

- apply water to the affected area using monitors to cool equipment and buildings – there is approximately three hours of reserve water in storage
- notify and activate the notification system by contacting NR CAER – see Section 3.4.1 for contact information

8.3.2 Fire Response Definitions

- Defensive Strategy: allow the fire to burn out under controlled conditions or have engineered systems in place to extinguish the fire. The principle strategy is to minimize loss and protect exposures by use of equipment spacing, cooling water, fireproofing, shielding, product transfer, system depressurizing, and fuel isolation. Manually extinguishing a fire in open areas is acceptable provided if it is safe to do so and is within the definition of a defensive strategy.
- Aggressive Offensive Strategy: extinguish the fire in the shortest possible time without exposing response personnel to undue risk. Aggressive offensive response strategies utilize all of the elements of a defensive strategy to minimize the overall fire loss. However, resources are provided to allow personnel to approach the fire with the element of extinguishment.
- First Responders: the first person to respond to an incident is normally an operator but could be any individual at the facility. First responders require Emergency Response Training thereby ensuring safe, appropriate action is taken. Extreme caution must be practiced at all times when responding to any type of emergency.

8.3.3 Basic Fire Response – SINE

Given the understanding between a defensive and an aggressive offensive fire response strategy, it is critical to follow the SINE methodology when approaching a fire.

8.3.3.1 SINE Means:

Safety for all people involved

Isolate/identify the source of the fire area

Notify additional support

Evacuate the area

IMPORTANT NOTE: Depending upon the combustible source at the point of ignition, an explosion may occur.

8.3.3.2 If a Fire Occurs

- ensure personal/personnel safety
- isolate the area and deny/restrict entry
- sound the alarm and call for help
- isolate/identify the fuel source and extinguish the fire if safe to do so
- confirm the location and the status of the situation
- notify the appropriate person (Supervisor/Incident Commander) of known facts including
    - what happened
    - where it happened
    - when it happened
    - known injuries, if any

- present status
- appoint an Incident Commander and account for all personnel
- conduct search and rescue procedures for missing person(s)
- treat and evacuate the injured immediately
- establish/adjust control perimeters:
  - hot zone
  - warm zone
  - cold zone
- identify additional hazards and assess the level of risk

8.3.3.3 If an Explosion Occurs

- ensure personal/personnel safety
- sound the alarm and call for assistance
- confirm the situation and location
- isolate the area and deny/restrict entry
- notify the appropriate person (Supervisor) of known facts including:
  - what happened
  - where it happened
  - when it happened
  - known injuries, if any
  - present status
- account for all personnel
- conduct search and rescue procedures for anyone missing
- treat and evacuate the injured immediately.
- establish/adjust control perimeters
  - hot zone
  - warm zone
  - cold zone
- identify hazards and assess the level of risk

8.3.4 Grass Fires

If a grass fire occurs:

- ensure personal safety
- call for assistance

8.3.4.1 For a Small Grass Fire (Primarily Along Roadways):

- use shovels, backpack water sprayers and/or ABC type hand held portable fire extinguishers
- use a defensive strategy only
- if it moves beyond the site perimeter, do not continue and contact the local Fire Department (call 911)

8.3.4.2 If the Fire is a Large Grass Fire

Do not attempt to extinguish a large grass/forest fire as it could be dangerous. Instead, contact the local Fire Department (call 911) for assistance.

If the fire is a large, threatening grass fire that may involve pipelines, facilities, etc.:

- contact the local Fire Department
- isolate or shut in facilities if it is safe to do so
- follow the SINE methodology of Safety First
- isolate the affected area and/or process
- notify the Control Room Incident Commander
- evacuate if the situation dictates
- contact fire fighting specialists
- contact NR CAER if the fire may become a Level III emergency

8.3.5 Vehicle Fires

There is a regulated duty to report all fires which result in property damage and/or injury and death to the Office of the Provincial Fire Commissioner and a Safety Codes Officer may be required to carry out an authorized investigation. This may be provided by the local fire department depending on the complexity of the incident.

8.3.5.1 If a Vehicle Fire Occurs

- ensure personal safety
- call for assistance

8.3.5.2 Small Vehicle Fires

For small vehicle fires only, use vehicle ABC type handheld fire extinguishers (defensive strategy). Examples of small fires include:

- cable or electrical fires
- fires contained to the contents of cargo space or trunk
- engine fires

8.3.5.3 Large Vehicle Fires

Involving fuel or storage tanks (gas tanks) use an aggressive offensive strategy:

- call for assistance
- evacuate the immediate area (within 25 m)
- standby, evaluate the situation and wait for assistance
- conduct post emergency; refer to Section 13 Post Emergency

8.4 Iron Sulphides

8.4.1 History

This impure sulphide forms when steel processing equipment is used with materials containing hydrogen sulphide or volatile sulphur compounds. When moist, iron sulphides exothermically oxidize in air and may reach incandescence. Iron sulphides are pyrophoric (spontaneously explode in the air) and have caused many fires and explosions when steel processing equipment is opened up.

Iron sulphides can be found in all process equipment containing hydrogen sulphides such as:

- process vessels
- compressors
- flow lines/pig barrels
- used filters

8.4.1.1 For Fires Involving/Caused by Iron Sulphide

- ensure personnel safety
- call for assistance

8.4.1.2 For Fires Involving Iron Sulphide

- use ABC type hand portable fire extinguisher, backpack water sprayers
- ensure that the iron sulphide remains wet by using water or water and wetting agents (surfactants)

8.4.1.3 For Fires Caused by Iron Sulphide

- extinguishment must take place in direct relation to the product that is burning. Refer to that area for information.
- generally, fires caused by iron sulphides start explosively but the iron sulphides will burn quickly leaving the other products to continue to burn
- Preventative Measures
- use water and wetting agents (surfactants) to ensure equipment is kept wet prior to and during disassembly
- properly purge with an inert gas prior to disassembling piping and equipment

8.5 Process Fires

8.5.1.1 Process Fires are Fires Within or Adjacent To

- tanks
- transfer equipment
- sulphur forming equipment
- piping
- sulphur loading facilities

8.5.1.2 If a Process Fire Occurs

- ensure personal safety
- classify the fire as a Level I, II, or III fire and react according to the procedures
- sound the alarm
- isolate the area and deny/restrict entry
- account for all personnel
- conduct search and rescue procedures for any missing persons
- establish/adjust control perimeter
    - hot zone
    - warm zone
    - cold zone
- shut down, isolate and depressurize any additional or related process piping/equipment if it is possible to do so safely.
- conduct post emergency; refer to Section 11 Post Emergency

See Figure V-6 for a summary of fire and explosion emergency response procedures.

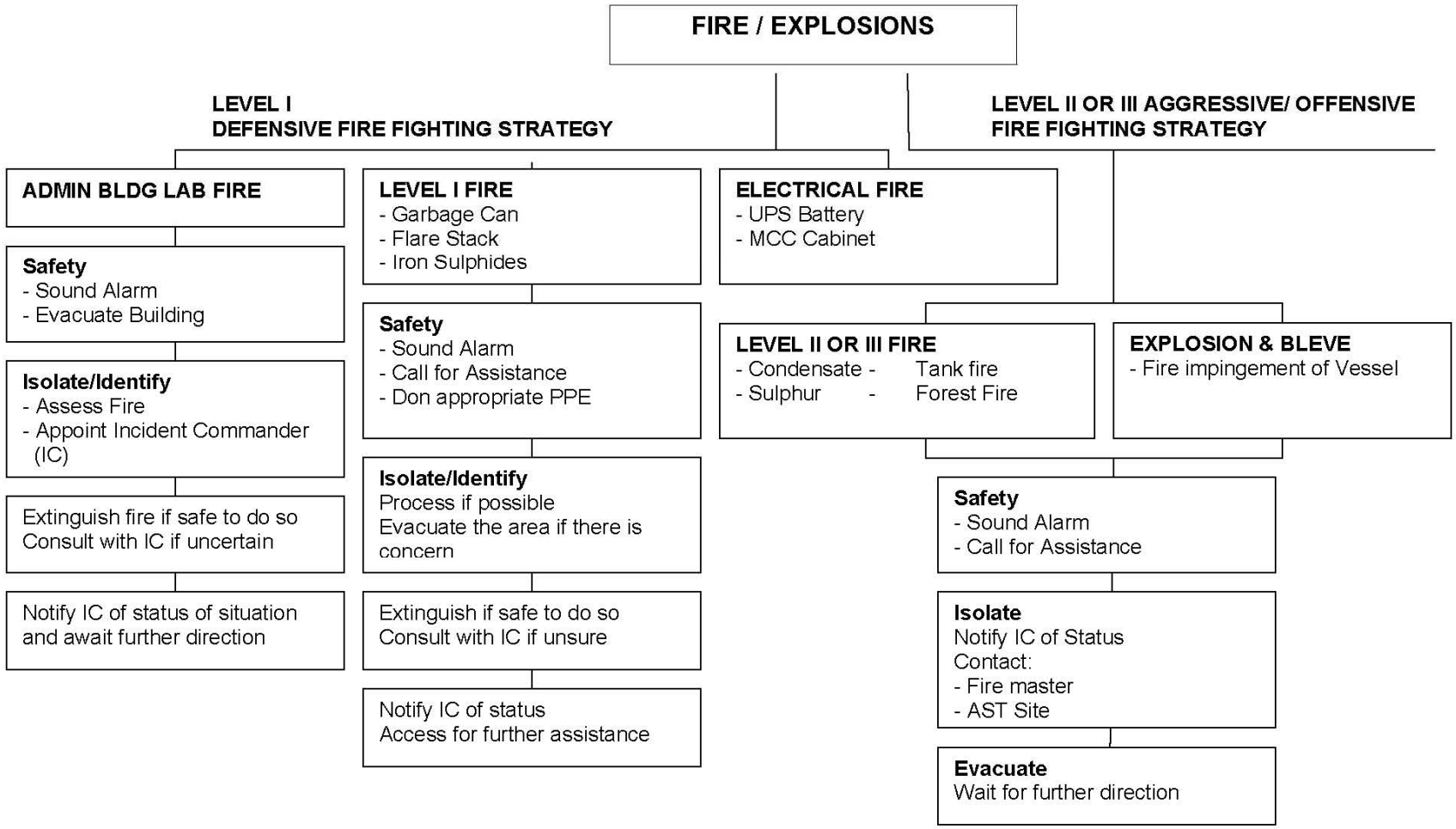


Figure V-6: Summary of Fire/Explosion Emergency Response Strategies

9. Alberta Sulphur Terminals: Specific Coverage Areas

9.1 Sulphur Fires

The maximum SO_2 concentration during a sulphur fire is predicted to be 54.6 ppm at the southwest corner of the Site (Figure V-1). The evacuation muster point will be designated upwind or across wind from the release. Strategic procedures are shown in Table V-1.

Table V-1: Strategic Procedures

Defensive Strategy	Aggressive Offensive Strategy
Cool exposures	Extinguishment of fire
Cool affected area	Direct valve/source isolation
Attempt to prevent fire from advancing	Disassembly of equipment

9.1.1.1 If a Sulphur Fire Occurs

- ensure personal safety
- call for assistance

9.1.1.2 For Small Sulphur Fires (low risk – aggressive offensive strategy)

- use water, fog-form hand line, or portable fire trailer
- approach the fire from an upwind position
- use SCBA
- monitor for SO_2 release
- control water/product runoff

9.1.1.3 For Large Sulphur Fires (aggressive offensive strategy)

- contact the local Fire Department for a Level II fire or the NR CAER for a Level III fire
- evacuate the area to an upwind location
- monitor for SO_2 release
- initiate shut down procedures for plant operations
- use water or water treated with class ‘A’ foam. A portable water storage reservoir may be required. Due to limited numbers and locations, fire hydrants should be utilized for filling purposes only.
- determine firewater and foam flows from a site assessment conducted by responders
- control water/product runoff
- conduct post emergency; refer to Section 13 Post Emergency

9.2 Train Fires

9.2.1 Train Fires Involve

- hot boxes (axle bearings)
- sparks coming in contact with vegetated areas, the load out tower, or the loaded product

9.2.2 If a Train Fire Occurs

- ensure personnel safety
- call for assistance

9.3 For Small Grass Fires

- use shovels, back pack water sprayers and/or ABC type hand held portable fire extinguishers
- use a defensive strategy only
- if grass fire enters coulees, river, creek banks or forests, do not continue. Contact the local fire department.

9.4 For Fires in the Load Out Tower (Involving Sulphur Pastilles)

- use shovels, backpack water sprayers or ABC type hand held portable fire extinguishers
- use a defensive strategy only
- small fires may be extinguished from an upwind location. It is important that the SO_2 created from the burning sulphur is monitored closely.
- for larger fires involving piles of product, personnel must employ the use of Self-contained Breathing Apparatus (SCBA) and hose lines or fire trailers and the fixed tower system

9.4.1 For Fires Involving Sulphur Pastilles

- discontinue loading rail cars and move rail cars away from the loading tower and any other potential hazards
- evacuate to an upwind location
- contact the local Fire Department
- conduct post emergency; refer to Section 13 Post Emergency

9.4.2 Loadout Tower

9.4.2.1 For Fires Involving the Loadout Tower

- ensure personnel safety
- call for assistance

9.4.2.2 Load Out Tower Fires Include

- dust type fires and explosions
- fires caused by static electricity
- fire caused by sparks from mechanical devices such as heated bearings, motors, etc.

9.4.3 For Small Fires or Incipient Stage Fires (Defensive Strategy)

- use water fog from a hand line or portable fire trailer. Use caution so dust is not created by agitating the product.
- utilize the fixed sprinkler system
- approach the fire from an upwind direction
- use Self-Contained Breathing Apparatus (SCBA)
- monitor for SO_2 release
- control water/product runoff

9.4.4 For Large Fires (Aggressive Offensive Strategy)

- contact the local Fire Department for a Level II fire or the NR CAER for a Level III fire
- evacuate the area to an upwind location
- monitor for SO_2 release
- initiate shut down procedures of plan operations
- determine firewater and foam flows using a site assessment conducted by responders
- conduct post emergency; refer to Section 13 Post Emergency

9.4.5 Oil Bath (Parts Cleaner)

The oil bath (parts cleaner) for the Project consists of a 91 cm x 91 cm oil bath heated to 140°C (flash point to 228°C). The oil bath contains Shell Rotela 10W-30 Oil.

9.4.5.1 If a Fire Occurs in the Oil Bath

- ensure personnel safety
- call for assistance

9.4.5.2 For Small Fires Only

- use a hand held, portable fire extinguisher and close the lid
- use the product within the tank

9.4.5.3 For Large Fires Only

- two people, equipped with two hand held, portable fire extinguishers are required
- spill the product over the top of the fire

9.4.5.4 Boil Over

- use extreme caution as the lid of the tank has a heat fuse closure
- conduct post emergency; refer to Section 13 Post Emergency

10. Public Notification

The NR CAER CNS manual forms part of this ERP so it can be utilized by authorized responders.

In the case of a large-scale fire or air quality alarm, residents within a high-risk area are automatically contacted via the Automated Emergency Dial-out Program managed by NR CAER. They receive information pertaining to the nature of the emergency and the appropriate safety instructions. People who do not have transportation or cannot follow the instructions will be asked to contact the local fire authority for assistance.

11. Post Emergency Analysis and Debriefing (CAN-Z731)

Attachment V-1: Debriefing Forms

Note: This Annex is not a mandatory part of this Standard.

Description/name of incident_____

Date of incident_____

		Went Well	Requires Improvement	Not Applicable
Emergency Activation				
Initial call (radio, telephone)				
Information received (clear, precise, location)				
Incident commander informed				
Notification				
Communicator: EOC call out				
Backup emergency response team				
Resource Mobilization				
Internal resources:	Maintenance			
	Environmental			
	Hygiene			
External Resources:	Police			
	Fire			
	Mutual aid			
	Contractors			
Appropriate Response				
Accurate emergency assessment				
Hot/cold zone establishment				
Proper protective equipment				
Strategies established				
Ongoing emergency evacuation				
Reporting				
External agencies notified				
Corporate call-down				
Corporate reporting (fire)				
Communication				
EOC ← →				
Critical Incident Stress Debriefing				

Attachment V-2: Debriefing Table

Input #	Time	Response	Description	Action Expected	Action Taken	Acton Item	Who	When
Sequence of events	Time of the input	Description of the input given to a role involved in the drill (response)	Action is determined from the existing emergency response plans/procedures					
This area utilized in developing the exercise								
					Observations made by the evaluators of the response			
						Follow-up to the debriefing: changes made should be brought forward to the next exercise to ensure continuous improvement		
				These columns should reconcile. Why is the action taken different from the action expected? Should the procedures change, do we need more training, etc.?				
1.	0800	Panel operator	Unit operator advises of a large fire in the loading rack.	• Sound the alert • Activate emergency number • Activate emergency response team				

Steps toward developing an exercise:

1. Determine your objective (why – limit to 1 or 2).
2. Determine the scenario (what, when and where)
3. Identify the scope of the drill (who will be involved internally and externally)
4. Identify rules of exercise conduct (e.g., weather conditions, safety issues, process to call of the drill in the event of a real emergency, etc.)
5. Use exercise worksheet to assist in developing the context of, evaluation of, and follow-up to the drill
6. Debrief the exercise (use debriefing questions that meet the objectives of the drill)
7. Provide a report utilizing the exercise worksheet and the exercise drill report

Attachment V-2: Debriefing Table (Cont'd)

Input #	Time	Response	Description	Action Expected	Action Taken	Acton Item	Who	When

Attachment V-3: Debriefing Questions

Were the necessary resources available?

Was there adequate support data?

Were the roles and responsibilities clearly defined?

Was communication effective?

Was there adequate control of the site?

Was the coordination of the emergency response effective?

Were we adequately prepared (e.g., training requirements/resources)?

Were the emergency response procedures/plans adequate?

Were the emergency response procedures/plans known and understood?

Were the emergency response procedures/plans followed?

Which emergency response procedures/plans worked well?

Which emergency response procedures/plans didn't worked well?

What helped?

What hindered?

Lessons Learned: