RISK ASSESSMENT

in terms of

THE MAJOR HAZARD INSTALLATION REGULATIONS

and

SANS 1461:2018

for the proposed hazardous installations at

RICHBAY CHEMICALS
FOUNDED 1984

on their property in

Waterlands Rd, Vosloorus

by

MHR Consultants

Major Hazard Risk Consultants

Nominated Representative	C C Thackwray
Technical Signatory	S A Steven

11 February 2022

GOVERNMENT APPROVED INSPECTION AUTHORITY No MHI 0007

sanas Inspection Body
MHI 0017

DETAILS AND CONTROL PAGE

TYPE OF ASSESSMENT							
New Installation	**X**	**Changes to Proposed Installation**		**5 Year Renewal**		**Other**	

Name	Richbay Chemicals (Pty) Ltd		
Address	Vlakplaats 138-IR Portion 86 Waterlands Road Vosloorus		
Contact Person	Martin Klopper 083 659 7775		
Date of Assessment	07 November 2019		
Date of Report	11 February 2022		
Dates of Previous Assessments	**Date**	**Reference**	**AIA**
	N/A		
Technical Signatory	T C Thackwray 13 Slade Street Parklands North Tel: 083 746 8933		
Reference Number	RICHVOSL001		
Revision	First		

This is to verify that an MHI Risk Assessment has been completed in accordance with the Major Hazard Installation Regulations. The risks associated with the MHI were found to be acceptable.

This Risk Assessment is valid for the duration of 5 years from the above date, unless:

- Changes have been made to the plant that can alter the risks on the facility;
- The Emergency Plan was invoked or there was a near miss;
- The changing neighbourhood resulted in offsite risks;
- There is reason to suspect that the current Assessment is no longer valid.

Signed

TC THACKWRAY
TECNICAL MANAGER

QUANTITATIVE RISK ASSESSMENT OF THE PROPOSED INSTALLATIONS AT THE NEW PLANT FOR RICHBAY CHEMICALS IN VOSLOORUS

EXECUTIVE SUMMARY

1. INTRODUCTION

Richbay Chemicals is a chemical manufacturer in South Africa. They are proposing to establish a new manufacturing plant in Vosloorus, Gauteng where they will manufacture ferric chloride and caustic soda lye. They will also be receiving various solvents in bulk which will be repackaged and shipped to customers as required.

The facility will be developed in three phases. The phases are as follows:

- Phase 1: Filling Plant
- Phase 2: Acid Regeneration Plant
- Phase 3: Solvent Filling Plant

Richbay Chemicals is currently busy with an Environmental Impact Assessment for the proposed plant.

They will be installing bulk tanks for the storage of the various acids and solvents as well as chlorine cylinders involved with in the manufacturing and distribution processes.

As solvents and chlorine can cause onsite and offsite incidents, Major Hazard Risk Consultants cc was commissioned to conduct a Risk Assessment in accordance with the Major Hazard Installation Regulations to determine the impact of the proposed facility on the surrounding area.

This investigation would serve as a basis for the notification of the facility in accordance with the Major Hazard Installation Regulations. The purpose of this report is to convey the essential details, including a short description of the hazards, the receiving environment, the design, the risks, and consequences of an accident.

The main aim of the investigation was to quantify the risks to employees and neighbours regarding the facility in Vosloorus.

Risk is the severity of the consequence of a hazardous event and the probability of the event occurring.

This Risk Assessment was conducted in accordance with the Major Hazard Installation Regulations and SANS 1461:2018 Codes of Practice and could be used as notification of the facility. The Risk Assessment includes the following:

- Identifying likely hazards associated with the processes of the installations including the causes, consequences and their effects;
- Quantifying the likely hazards in terms of their magnitude;
- Quantifying the consequences for each hazard (thermal radiation, domino effect, toxic cloud formation, etc.);
- Determining the lethality of the effects of the consequences;
- Determining the frequency of all the hazardous events;
- Calculating the individual risk values considering all accidents, meteorological conditions and lethality;

- Using the population density around the facility to determine the societal risk posed by the facility;
- Reporting on the risks in terms of internationally acceptable criteria;
- Providing an assessment of the adequacy of emergency response programmes, fire prevention and fire-fighting measures;
- Proposing measures to reduce or eliminate the risks.
- The Risk Assessment may not meet the requirements of environmental legislation as it is not intended as an Environmental Risk Assessment.

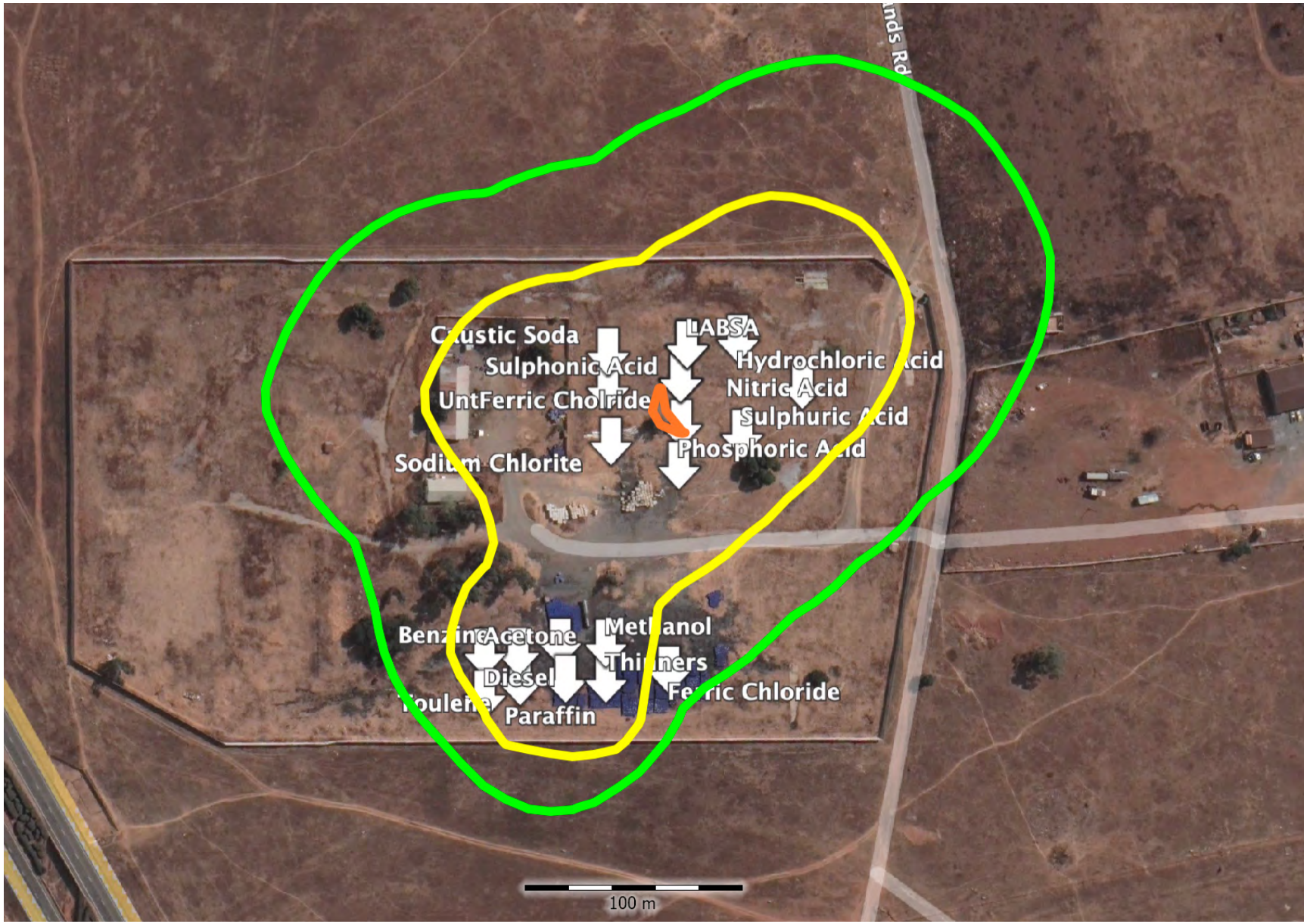
2. CONCLUSIONS

This Risk Assessment has modelled the effects of the flammable installations. The results are as follows:

- The 1.0e-5 (one-in-a-hundred thousand) orange contour, is confined to the chlorine installation.
- The 1.0e-6 (one-in-a-million) yellow contour, extends 8m past the southern boundary at the solvents tank farm. The contour extends for about 29m past the northern boundary at the chlorine installation.
- The 3.0e-7 (one-in-thirty million) green contour, extends 32m past the southern boundary at the solvents tank farm. The contour extends for about 90m past the northern boundary at the chlorine installation.

The contours do not reach any residential areas.

The risk contours are acceptable for this site.



Individual Risk

3. RECOMMENDATIONS

The scenario contributing the most towards the total risk at the facility is a catastrophic failure of the Shellsol A road tanker.

The risks posed by the installations were found to be acceptable for the area in which they are located.

The recommendations are as follows:

- Good housekeeping must always be observed on site;
- Emergency Plan must be compiled for the site and the risks identified in this report must be addressed;
- Venting on solvent tanks to be designed by an engineer;
- Installations to comply with the applicable SANS standards and Municipal Bylaws;
- Fire protection for storage, manufacturing and decanting area to be designed by suitably qualified and experienced organisations;
- Staff to be trained in the safe handling of the various chemicals on site;
- Once the design of the facility has been completed the MHI Risk Assessment needs to be reviewed in order to incorporate the manufacturing, decanting areas as well as the safety systems to reduce the risks of the various installations;
- Chlorine installation to be designed as to comply with international best practices;
- Strict access control to be implemented on site;
- Maintenance on the equipment to be done as per the manufacturers requirements;
- Emergency Plan must comply with the MHI Regulations;
- Emergency Plan must comply with SANS 1514 Codes;
- This MHI report must be distributed to Local, Provincial and National Government as per the MHI Regulations.

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DEFINITIONS

As Low as Reasonably Practicable (ALARP)

Risks in this range are risks that the public are generally prepared to tolerate in order to secure certain benefits. A risk in the ALARP range risk means that for new installations or modifications/ expansions to existing installations, the risk assessment shall not advise against the development. For existing installations (without modifications/ expansions) a broadly acceptable risk means that risk should continue to be monitored and all reasonably practicable risk reduction measures shall be implemented. A level of risk that is tolerable and cannot be reduced further without expenditure at costs that are disproportionate to the benefit gained, or where the solution is impractical to implement.

Broadly Acceptable

Risks which are broadly acceptable are generally regarded as insignificant and adequately controlled. Risk in the region would usually not require further action to reduce risks unless reasonably practicable measures are available. A broadly acceptable risk means that for new installations or modifications/ expansions to existing installations the risk assessment shall not advise against the development. For existing installations (without modifications/ expansions) a broadly acceptable risk means that risk should continue to be monitored and reduction implemented if necessary. For either new or existing installations, if reasonably practicable risk reduction measures are available, then these should be implemented.

BLEVE

Boiling liquid expanding vapour explosion.

Containment System

One or several devices, any parts of which are continuously in open contact with one another and are intended to contain one or several substances.

Critical Scenarios

Intended to mean:

- The scenarios that when added together define at least 90% of the location-specific risk for the 1.0e-6 contour (i.e. the ‘remainder’ that has not been defined in detail is added together as < 10%);
- The scenarios that are added together define at least 90% of the societal risk in the intervals 10 – 100 and 100 – 1000.

Informal Residential Area

A residential area where the structures are not formally approved.

Inspection

An examination or measurement to verify whether an item or activity conforms to specified requirements.

Intolerable

Risks in this range are generally regarded as unacceptable whatever the level of benefits associated with the activity. An intolerable risk means that for new installations or modifications/ expansions to existing installations the risk assessment shall advise against the development. For existing installations (without modifications/ expansions) an

intolerable risk means that risk reduction shall be implemented until the risks fall within the ALARP range or the broadly acceptable range.

Location Specific Individual Risk

The probability that during a period of one year a person will become the victim of an accident, in which case this person is in a particular location permanently and without protection and without means of escape.

Major Hazard Installation

The Operational Health and Safety Act defines a Major Hazard Installation as the following:

- where more than the prescribed quantity of any substance is or may be kept, whether permanently or temporarily; or
- where any substance is produced, used, handled or stored in such a form and quantity that it has the potential to cause a major incident.

Maximum Capacity

For equipment this is the total amount of material that can be accommodated in that equipment in the absence of equipment inventory control. For example, the volume of a cube vessel would be the product of the width, length and height of the vessel.

Occupied Building

Permanent or temporary structures/ buildings within a major hazard installation that are occupied by employees and/or contractors or that contain critical process control equipment (e.g. control rooms).

Procedure

Description of how to perform an activity, usually in the form of a document.

Recommendations

Suggestions put forward by the AIA, within the scope of the accreditation of the AIA, for consideration by the owner/ user of an MHE/ MHI.

Regulations

Regulations promulgated under the relevant Act.

Regulatory Authority

Body authorised to make Regulations or to control the application of such Regulations, in the field of Major Hazard Installations (see 3.1.22) which includes the Occupational Health and Safety Act, 1993 (Act 85 of 1993) and the South African National Accreditation System.

Restricted Development Distance

The maximum distance from an MHI/ MHE where land use planning restrictions should be considered. This is defined as the 3.0e-7 fatalities / person / year location specific individual risk contour.

Safety Report

A report which addresses major incident prevention and safety management systems at the installation/ establishments.

Sensitivity Level

The sensitivity levels of a proposed development take into consideration the structure of the development and the characteristics of the population occupying the development. The larger the development and the more vulnerable the occupying population, the higher the level of sensitivity.

Societal Risk (F-N Curve)

Societal risk is a measure of the risk posed on a society and an F-N Curve is a tool to indicate societal risk. They are plots of the cumulative frequency (F) of various accident scenarios against the number (N) of fatalities associated with the modelled incidents. The plot is cumulative in the sense that, for each frequency, N is the number of fatalities that could be equalled or exceeded.

Verification

The act of reviewing, inspecting, testing, checking, auditing or otherwise determining and documenting whether items, processes, services or documents conform to specified requirements.

Vulnerable Groups/ Populations

The elderly, children, persons in hospitals/ clinics and people with certain disabilities are considered particularly vulnerable and may need special attention. In the South African context, concentrations of homeless persons and persons occupying informal settlements should also be considered vulnerable.

ABBREVIATIONS

The following are key abbreviations used in this document:

ACDS	Advisory Committee on Dangerous Substances
AIA	Approved Inspection Authority
ALARP	As Low as Reasonably Practicable
API	American Petroleum Institute
BEVI	Besluit Externe Veiligheid Inrichtingen (Dutch safety legislation)
BLEVE	Boiling Liquid Expanding Vapour Explosion
BP	Boiling Point (usually at 101.325 kPa)
CAS	Chemical Abstracts Service
CASRN	Chemical Abstracts Service Registry Number
RDD	Restricted Development Distance
CFD	Computational Fluid Dynamics
CIA	Chemical Industries Association
DTL	Dangerous Toxic Load
ERPG	Emergency Response Planning Guideline
F – N (cumulative)	Frequency - Number
FMECA	Failure Mode Effect and Criticality Analysis

FP	Flash Point
HAZID	HAZard IDentification
HAZAN	HAZard ANalysis
HEL	Higher Explosive Limits
IBC	Intermediate Bulk Container (typically 1m^3 capacity)
IDLH	Immediately Dangerous to Life and Health
IEC	International Electro-technical Commission
ISO	International Standards Organisation
IZ	Inner Zone
kPa	Kilopascal
kW/m^2	Kilowatts Per Square Meter
L/D	Length/ Diameter
LEL	Lower Explosive Limits
LFL	Lower Flammable Limit
LOC	Loss of Containment
LOPA	Layer of Protection Analysis
LPG	Liquefied Petroleum Gas
MAHPs	Major Accident Hazard Pipelines
MAPP	Major Accident Prevention Policy
mg/m^3	Milligram Per Cubic Meter
MHI	Major Hazard Installation
MZ	Middle Zone
OHS	Occupational Health and Safety
OZ	Outer Zone
PAC	Protective Action Criteria
PAHDI	Planning Advice for Developments near Hazardous Installations
PFD	Process Flow Diagram
P&ID	Piping and Instrumentation Diagram
ppm	Parts-per-million (volume basis)
PSM	Process Safety Management
QRA	Quantitative Risk Assessment
UFL	Upper Flammable Limit

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As solvents and chlorine can cause onsite and offsite incidents, Major Hazard Risk Consultants cc was commissioned to conduct a Risk Assessment in accordance with the Major Hazard Installation Regulations to determine the impact of the proposed facility on the surrounding area.

This investigation would serve as a basis for the notification of the facility in accordance with the Major Hazard Installation Regulations. The purpose of this report is to convey the essential details, including a short description of the hazards, the receiving environment, the design, the risks, and consequences of an accident.

The main aim of the investigation was to quantify the risks to employees and neighbours regarding the facility in Vosloorus.

Risk is the severity of the consequence of a hazardous event and the probability of the event occurring.

This report summarises the results of the Risk Assessment conducted by MHR Consultants.

This Assessment is based on the best possible information and expertise and MHR Consultants cannot be held liable for any incident which may occur at this facility which directly or indirectly relates to the work in this report.

1.1. Legal Framework

The Occupational Health and Safety Act (OHS Act) defines an Approved Inspection Authority (AIA) in Section 1(1)(i) as *“An inspection authority approved by the Chief Inspector: Provided that an inspection authority approved by the Chief Inspector with respect to any particular service shall be an approved inspection authority with respect to that service only.”*

The Major Hazard Installation Regulations (MHI Regulations), which were promulgated under the OHS Act provides more specifically for an AIA in terms of MHI Regulation 5 (5)(a)

as *"An employer, self-employed person and a user shall ensure that the assessment contemplated in Sub-regulation (1), shall be carried out by an Approved Inspection Authority which is competent to express an opinion as to the risks associated with the major hazard installation."*

This Risk Assessment was conducted as per SANS 1461:2018 Codes of Practice.

1.2. Purpose and Scope of Investigation

The purpose of this investigation was to quantify the risks to employees and neighbours regarding the facilities in Vosloorus.

This Risk Assessment was conducted in accordance with the Major Hazard Installation Regulations and could be used as notification of the facility. The Risk Assessment includes the following:

- Identifying likely hazards associated with the processes of the installations including the causes, consequences and their effects;
- Quantifying the likely hazards in terms of their magnitude;
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- Proposing measures to reduce or eliminate the risks.

1.3. Methodologies

Methodologies and techniques used for this Assessment are as follows.

- Site visits and meetings were conducted to collect as much technical information to accurately determine all the processes, materials, etc.;
- It was accepted that the process and storage installations were designed using the correct Codes of Practice and design specifications, and that the installations were built by qualified professionals;
- For this report the public refers to all people outside the boundaries of the facility, including neighbouring facilities and everyone inside the facility is regarded as employees, including visitors;
- The hazards were identified at the site visits and meetings and analysed using international reference publications;
- The consequences were calculated using the computer software *'Effects'* by TNO in the Netherlands;
- The risk calculations were made using the computer software *'Risk Curves'* by TNO in the Netherlands.

2. COMPANY, SITE AND INSTALLATION DESCRIPTION

2.1. Main Activity

The main activity of Richbay Chemicals is chemical manufacturing and distribution.

The site will be equipped with fire hydrants, hose reels and all the required fire-fighting equipment.

(See site plan in the Appendices.)

2.2. Site Address

Vlakplaats 138-IR Portion 86
Waterlands Road
Vosloorus

2.3. Site Installations

The proposed installations will consist of the following:

	Product	**Size of Tank (m^3)**	**Number of Tanks**
1.	Hydrochloric Acid	50	6x Vertical
2.	Nitric Acid	30	2x Vertical
3.	Sulphuric Acid	30	3x Vertical
4.	Caustic Soda Lye	50	6x Vertical
5.	Sodium Hypo Chloride	15	4x Vertical
6.	Sodium Chlorite	15	2x Vertical
7.	Sodium Metbisulphite	15	2x Vertical
8.	Sulphonic Acid	30	2x Vertical
9.	Ferric Chloride (Filling Plant)	30	2x Vertical
10.	Linear Alkyl Benzene Sulphonic Acid	30	2x Vertical
11.	Ferric Chloride (Regeneration Plant)	30	3x Vertical
12.	Phosphoric Acid	30	2x Vertical
13.	Methanol	40	1x Vertical
14.	Thinners	40	1x Vertical
15.	Paraffin	40	1x Vertical
16.	Diesel	40	1x Vertical
17.	Shellsol A	40	1x Vertical
18.	Benzine	40	1x Vertical
19.	Toluene	40	1x Vertical
20.	Acetone	40	1x Vertical
21.	Chlorine Cylinder Storage Building	0.786	80

2.4. Process Flow and Flow Diagrams

Phase 1 – Filling Plant

Phase 1 of the development is the construction of the Filling Plant. No manufacturing will be undertaken during this phase. All chemicals will arrive by road tanker and offloaded into bulk storage tanks or medium bulk storage tanks.

At the Filling Plant, various chemicals will be decanted from bulk tankers to medium and small sized packages. The packed products will be transferred to the warehouse in preparation for distribution to customers. Palletising, strapping and partial dilutions might be required. Chemicals to be decanted in the Filling Plant are as follows:

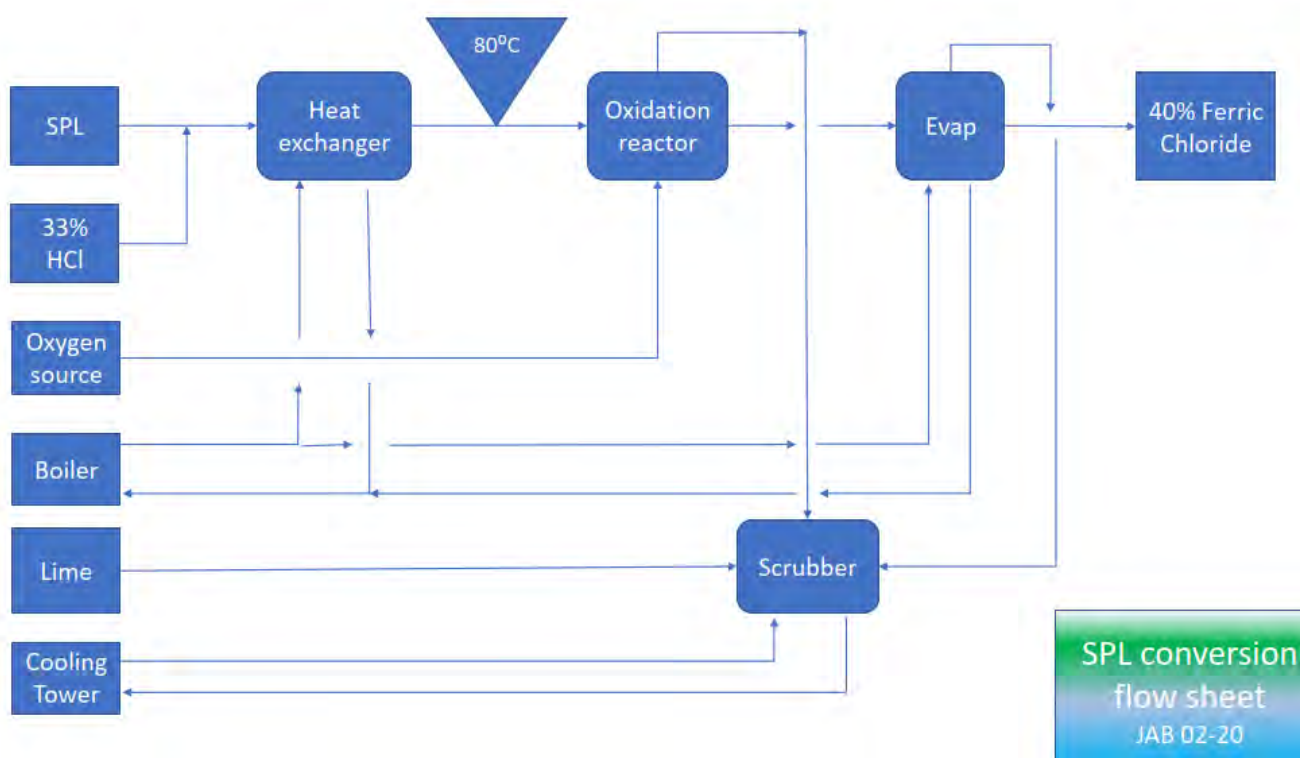
Chemicals	Number of Tanks	Net Throughput per Tank (m^3/yr)
Hydrochloric Acid	6x 55m^3	18,701.3
Sulphuric Acid	3x 33m^3	4,721.3
Ferric Chloride	2x 33m^3	1,234.3
Sodium Hypo Chlorite	4x 16.5m^3	7,140.5
Sodium Chlorite Liquid	2x 16.5m^3	1,404.9
Sodium Metabisulphite	2x 16.5m^3	1,270.6
Nitric Acid	2x 33m^3	3,200.0
Sodium Laureth Sulphate	2x 33m^3	1,661.6
Linear Alkyl Benzene Sulphonic acid	To Be Confirmed	To Be Confirmed
Caustic Soda Lye	6x 55m^3	11,520.0
Chlorine Gas	To Be Confirmed	To Be Confirmed
Phosphoric Acid	2x 33m^3	1,016.5
Sodium Metabisulphite	2x 16.5m^3	1,270.6
Nitric Acid	2x 33m^3	3,200.0

Phase 2 – Acid Regeneration Plant

Phase 2 includes the construction of an Acid Regeneration Plant for the reprocessing of waste HCl into ferric chloride and a small portion of calcium chloride, the chemicals to be used in this process is indicated below:

Chemicals	Number of Tanks	Net Throughput per Tank (m^3/yr)
Ferric Chloride (In Regeneration Plant)	3x 33m^3	4,937.1
Paraffin	1x 44m^3	264.0

This process is detailed as follows:



Spent acid will be received from galvanising plants in the area and from other users and producers of acid. Waste acid will go through an iron exchange process and strengthened with HCl (from the Phase 1 Filling Plant).

The mixture will then be put through an evaporation process (with the use of a paraffin fuelled boiler) to increase the percentage of FeCl3 from approximately 30% to 40-44%. FeCl3 will be stored in bulk tanks and then decanted into smaller pack sizes or bulk road tankers for distribution.

Waste zinc chloride (ZnCl2) will be sold to the market as a dust suppressor or will be used in waste processes requiring zinc chloride.

Exhaust emissions from the evaporator will pass through a scrubber to remove HCl from flue gases prior to release. The acid regeneration process is illustrated in the above figure.

Phase 3 – Solvent Filling Plant

Phase 3 includes the construction of a Solvent Filling Plant. Product will be decanted from bulk storage tanks to medium tanks and then smaller package sizes as required. The packed product is transferred to the warehouse for distribution. Palletising and strapping might be required.

It is estimated that at full operational capacity, the Solvent Filling Plant will have a maximum of 352m^3 total storage. Solvent chemicals to be stored and decanted at the Solvent Filling Plant are indicated in the table below:

Chemicals	Number of Tanks	Net Throughput per Tank (m3/yr)
Methanol / ethanol	1x 44m^3	2,187.3
Thinners	1x 44m^3	1,986.2
Shellsol A	1x 44m^3	1,986.2
Paraffin	1x 44m^3	2,304.0
Benzine	1x 44m^3	2,032.9
Toluene	1x 44m^3	1,440.0
Acetone	1x 44m^3	2,187.3
Diesel	1x 44m^3	5,112.4

2.5. Proposed Bulk Installation

There will be two tank farms at the site. The first tank farm will be for the storage of acids and inflammable products.

Tank Farm 1

There will be individual bunded areas per type of chemical to reduce interaction between different types of chemicals. The bunded areas will be on concreted and the tanks will be covered. All the tanks will be vertical.

Each bunded area will also have an effluent sump that will be linked to an effluent treatment plant, of which the daily throughput will be less than 2 000 cubic metres. The effluent will be treated to be reused in the plant.

The acids were not included in this report as it does not fall within the requirements of the MHI regulations and MHI standards.

Tank Farm 2

There will be individual bunded areas per type of solvent to reduce interaction between different types of solvents. All the tanks will be horizontal and located in concreted bunds.

The site layout needs to be finalised and the tanker loading and offloading needs to be confirmed. For this Assessment the road tankers were located at the various tanks. Deliveries to be made 2-3 times per day per chemical.

No fire-fighting equipment has been included in this report as it must still be designed by a fire engineer. The installation was modelled as a typical bulk installation.

2.6. Proposed Chlorine Gas Installation

The chlorine will be stored in a purpose-built building. The building will be fitted with a scrubbing system with the capacity to scrub the catastrophic release of a 1ton chlorine cylinder. The building will be fitted with sensors that will activate the scrubber automatically.

There will be a total of 80x 1-ton chlorine cylinders stored on site.

2.7. Receiving Environment

The site is situated in the industrial area of Vosloorus.

2.7.1. Topography of the Surrounding Area

The area surrounding the facility is flat industrial small holdings. Some of the properties are undeveloped.

The residential area of Vosloorus Extension 2 is situated 110m to the west of the site.

(See satellite image below.)

Location of Site

2.7.2. Location Population Information

Area	Population Type	Daytime	Night-time
Site	Staff	24.379	12.189

2.7.3. Surrounding Facilities and Other MHIs

The following sensitive areas are located close to the site:

- Rebontsheng Primary School – 360m Northwest
- Masithwalisane Secondary School – 560m Southeast

There are no known MHIs near the site.

(See satellite image on previous page.)

2.8. Meteorological Information

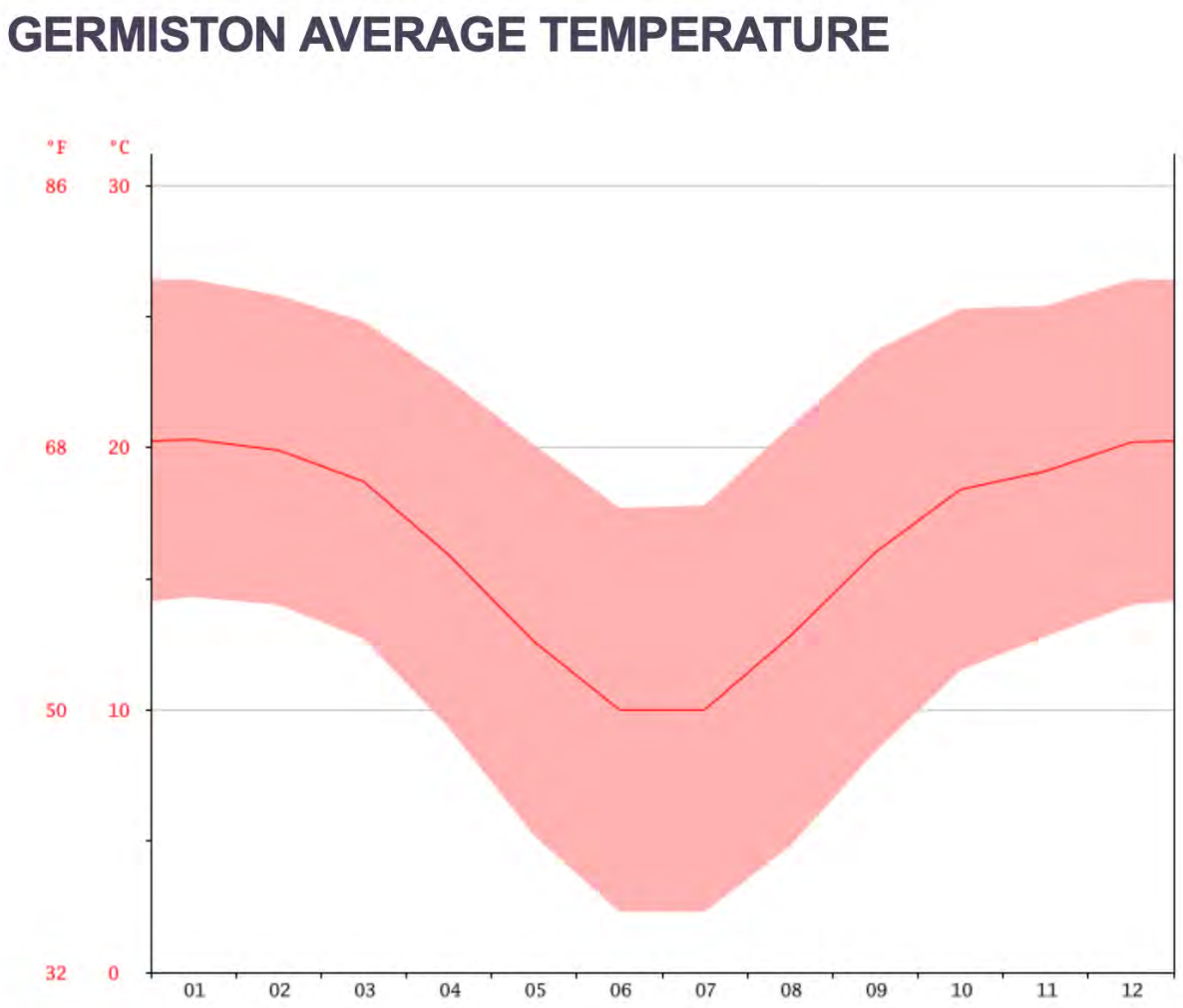
2.8.1. Climate

The warm season lasts from October to March with an average daily high temperature above 25°C. The hottest day of the year is in December and January, with an average high above 26°C.

The cold season lasts from May to August with an average daily temperature below 13°C. The coldest day of the year is in June/ July, with an average low of 3°C.

GERMISTON WEATHER BY MONTH // WEATHER AVERAGES

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	20.3	19.9	18.7	15.9	12.6	10	10	12.8	16	18.4	19.1	20.2
Min. Temperature (°C)	14.3	14	12.7	9.3	5.2	2.3	2.3	4.8	8.4	11.5	12.8	14
Max. Temperature (°C)	26.4	25.8	24.8	22.6	20.1	17.7	17.8	20.8	23.7	25.3	25.4	26.4

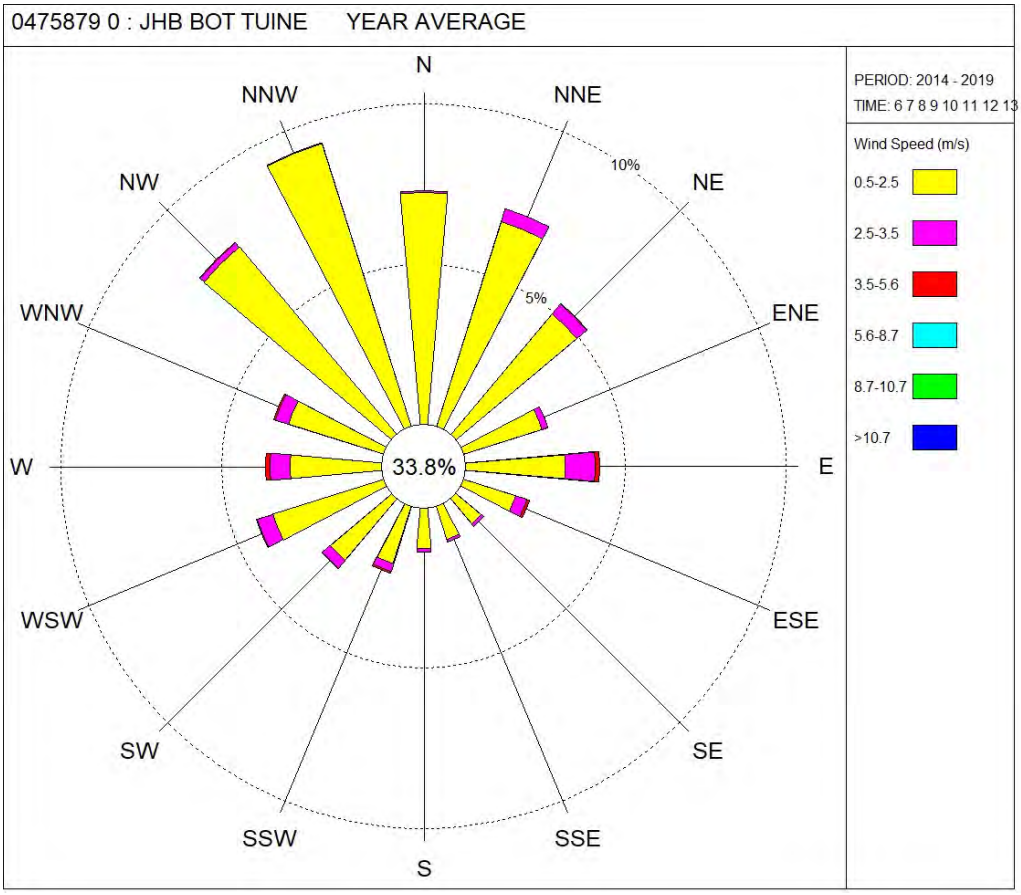


2.8.2. Wind Direction

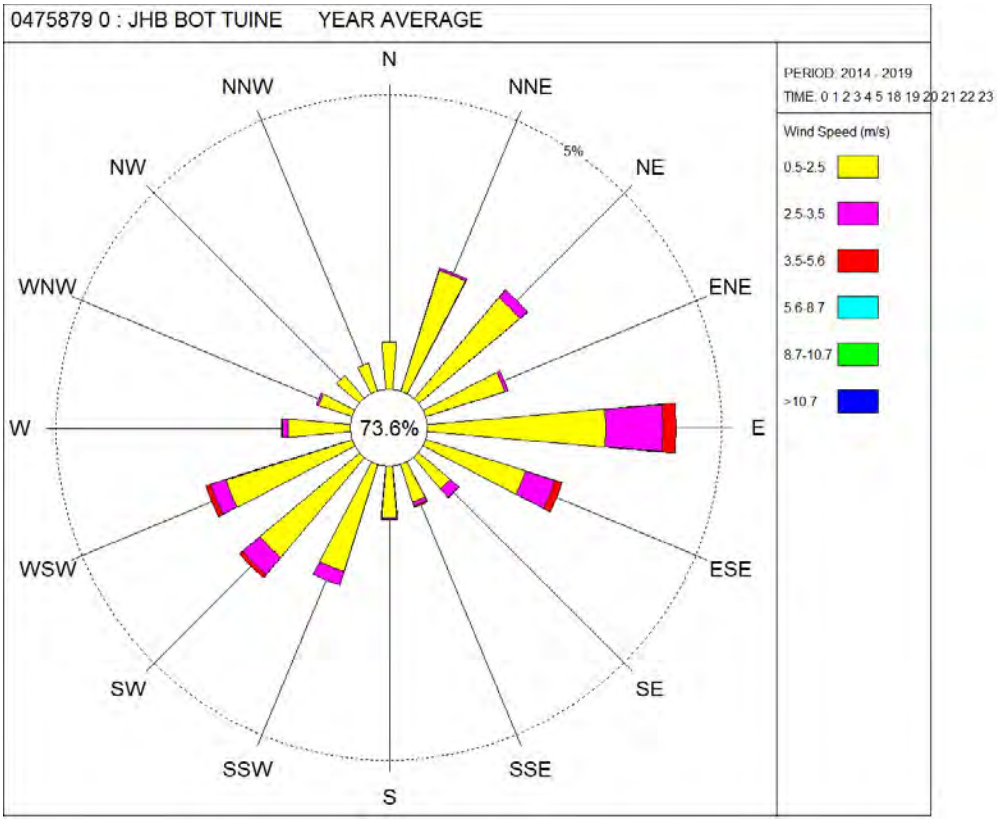
Over the course of the year typical wind speeds vary from 0.5m/s to 5.6m/s (light air to fresh breeze), rarely exceeding 6m/s (fresh breeze). The predominant wind direction during the day is north-northwest and at night it is east.

2.8.3. Wind Roses

The annual wind roses for the area are as follows:



Daytime Wind Rose



Night-time Wind Rose

Dispersion models also require the atmospheric condition to be categorised into one of six stability classes, namely:

Stability Category	Meteorological Conditions	Occurrence
A	Very Unstable	Hot daytime conditions, clear skies, calm wind
B	Unstable	Daytime conditions, clear skies
C	Slightly Unstable	Daytime conditions, moderate winds, slightly overcast
D	Neutral	Day and night, high winds or cloudy conditions
E	Stable	Night-time, moderate winds, slightly overcast conditions
F	Very Stable	Night-time, low winds, clear skies, cold conditions

2.8.4. Summary

Based on the above information the meteorological information extracted for the modelling of scenarios was as follows:

- Wind, stability and temperature information:
  - B 4m/s meaning a stability class of B (moderately unstable conditions) where the wind speed is 4m/s with the maximum daytime temperature.
  - D 7m/s meaning stability class of D (neutral conditions) where the wind speed is greater than 7m/s. D 7m/s gives a conservative daytime and night-time weather condition.
  - F 2m/s meaning a stability class of F (moderately stable) where the wind speed is less than or equal to 2m/s with the min daytime temperature.
- The relative humidity was set to be 0.7.
- The solar radiation flux was set to be 0.5KW/m^2 during the day and 0KW/m^2 at night.
- The *Pasquil stability* was selected instead of the mixing layer height.

3. HAZARD IDENTIFICATION

This is the process of examining each work area and work task for the purpose of identifying all the hazards which are inherent to the job.

Hazard analysis is used as the first step in a process used to assess risk. The result of a hazard analysis is the identification of different types of hazards. A hazard is a potential condition and exists or not (probability is 1 or 0). It may be in single existence or in combination with other hazards (sometimes called events) and conditions become an actual Functional Failure or Accident (mishap). Once a hazard has been identified, it is necessary to evaluate it in terms of the risk it presents to the employees and the neighbouring community. In principle, both probability and consequence should be considered, but there are occasions where if either the probability or the consequence can be shown to be sufficiently low or sufficiently high, decisions can be made on just one factor.

During the hazard identification process the complete system of assets, materials, human activities and process operations within the boundaries of the site should be clearly defined and understood, taking account of the original design, subsequent changes and current conditions. Typically, the system should be divided into distinct separate components or sections to enable manageable quantities of information to be handled at each stage.

Some key questions and issues could be:

- What is the design intent, what are the broad ranges of activities to be conducted, what is the condition of equipment, and what limitations apply to activities and operations?
- What are the critical operating parameters? What process operations occur, and how could they deviate from the design intent or critical operating parameters? This should consider routine and abnormal operations, start-up, shutdown and process upsets.
- What materials are present? Are they a potential source of major accidents in their own right? Could they cause an accident involving another material? Could two or more materials interact with each other to create additional hazards?
- What operations, construction or maintenance activities occur that could cause or contribute towards hazards or accidents? How could these activities go wrong? Could other hazardous activities be introduced into this section by error or by work in neighbouring sections of the facility?
- Could other materials, not normally or not intended to be present, be introduced into the process?
- What equipment within the section could fail or be impacted by internal or external hazardous events? What are the possible events?
- What could happen in this section to create additional hazards, e.g. temporary storage or road tankers?
- Could a particular section of the facility interact with other sections (e.g. adjacent equipment, an upstream or downstream process, or something sharing a service) in such a way as to cause an accident?

3.1. Site Layout Details

The Site Plan is included in the Appendices.

3.2. Significant Incidents at the Site and Related Sites

No incidents have been recorded at Richbay in Vosloorus as this is a proposed facility.

The few incidents that have occurred at similar installations were mainly caused by a lack of maintenance and operator negligence.

3.3. Preventative Measures

A good Maintenance Plan and Maintenance Register must be compiled for the installation.

3.4. Hazard Details

3.4.1. Hazardous Materials

The materials on site were categorised as per SANS 10228:2003 classes of dangerous substances as per the table below:

Class	Description
1	Explosives (Not included in MHI Regulations)
2	Gases (Flammable or Toxic gases only)
3	Flammable Liquids
4	Flammable Solids
5	Oxidising Substances and Peroxides
6	Toxic and Infectious Substances
7	Radioactive Materials (Not included in MHI Regulations)
8	Corrosives
9	Combustible Materials

3.4.2. Hazardous Materials on Site

Richbay uses hazardous products on site, categorised as per the table below:

Substance	CAS Number	Gases	Flammable Liquids	Flammable Solids	Potential for an MHI
Class		2	3	4	
Hydrochloric Acid	7647-01-0				No
Nitric Acid	7697-37-2				No
Sulphuric Acid	7664-93-9				No
Caustic Soda Lye	1310-73-2				No
Sodium Hypo Chloride	7681-52-9				No
Sodium Chlorite	7758-19-2				No
Sodium Metbisulfite	7681-57-4				No
Sulphonic Acid	70775-94-9				No

Ferric Chloride	7705-08-0				No
Linear Alkyl Benzene Sulphonic Acid	68584-22-5				No
Phosphoric Acid	7664-38-2				No
Chlorine	7782-50-5	Yes			Yes
Methanol	67-56-1		Yes		Yes
Thinners	1330-20-7		Yes		Yes
Paraffin	8008-20-6		Yes		Yes
Diesel	68334-30-5		Yes		Yes
Shellsol A	64742-95-6		Yes		Yes
Benzine	8032-32-4		Yes		Yes
Toluene	108-88-3		Yes		Yes
Acetone	67-64-1		Yes		Yes

This Assessment deals with the following products:

- Chlorine
- Methanol
- Thinners
- Paraffin
- Diesel
- Shellsol A
- Benzine
- Toluene
- Acetone

The detailed properties of the above products are included in the Appendices.

3.5. Accidents and Incidents

Richbay has had no incidents at this facility as it is a proposed facility.

3.6. Containment and Safety Systems in Design

The only containment system currently mentioned is that the products will be installed in separate bunds. The detailed safety systems still need to be designed.

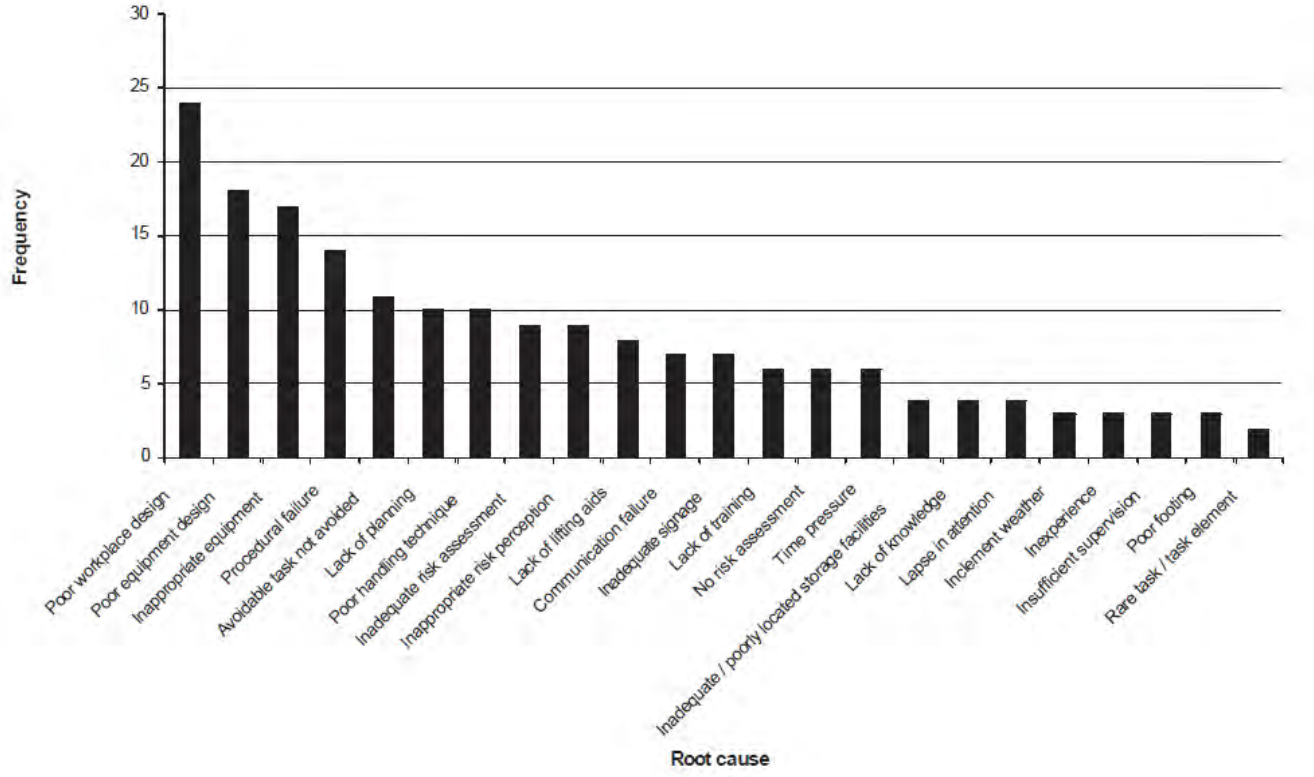
3.7. Environmental Hazards

Environmental Hazards are not included in the MHI Regulations and were not included in this report.

4. HAZARD ANALYSIS

4.1. Incident Root Causes

One hundred and twenty-six incidents were recorded an HSE report database in the UK. A greater number were reviewed but were not taken forward for analysis. The graph below shows the frequency with which each root cause was identified for the 126 incidents analysed.



The most common causes shown above are linked to the workplace and equipment available:

- Poor workplace design (representing 13%);
- Poor equipment design (10%);
- Inappropriate equipment (9%);
- Procedural failure (7%).

The next most found issues are more closely linked with day-to-day organisation and management:

- Avoidable task not avoided (6%);
- Lack of planning (5%);
- Poor handling technique (5%);
- Inadequate risk assessment (5%);
- Inappropriate risk perception (5%).

The report mentions more than one root cause could be present in the same incident. In the sample analysed, 78 incidents were attributed to a single root cause; the remaining 48 had two or more root causes.

Most incidents are due to a mismatch between the operators' requirements or expectations and workplace or equipment design. If the root causes were principally to do with training or risk assessment (i.e. linked to risk perception and avoidance), it would imply that personnel were failing to use their experience and prior training to predict and avoid manual handling risks. Where an individual has unintentionally harmed themselves or others, it follows that the task carried risks which the operator(s) had to avoid by using safe working procedures and their skill and knowledge. The root cause in fact lies with one or more risky elements of the task that the operator then must deal with. Training and experience help only to avoid the background risks.

The findings suggest that operators are mostly being injured because of poor equipment, task or workplace design, and to a lesser extent misunderstanding the level of risk. Failure to avoid an avoidable task is like a lack of planning as both indicate that an overview of the work was not held that could have highlighted alternatives to risky manual handling. 'Procedural failure' is linked to planning and overview too as this root cause indicates that agreed procedures inadvertently placed operators at risk of injury.

4.2. Events Following a Loss of Containment SPACING

4.2.1. Flammable Gas/ Liquid

Where no Boiling Liquid Expanding Vapour Explosion (BLEVE) and fireball occur following an instantaneous release with direct ignition, a liquid pool is formed, and a vapour cloud will expand to atmospheric pressure. The direct ignition of the vapour cloud is modelled as a flash fire (probability 0.6) and explosion (probability 0.4).

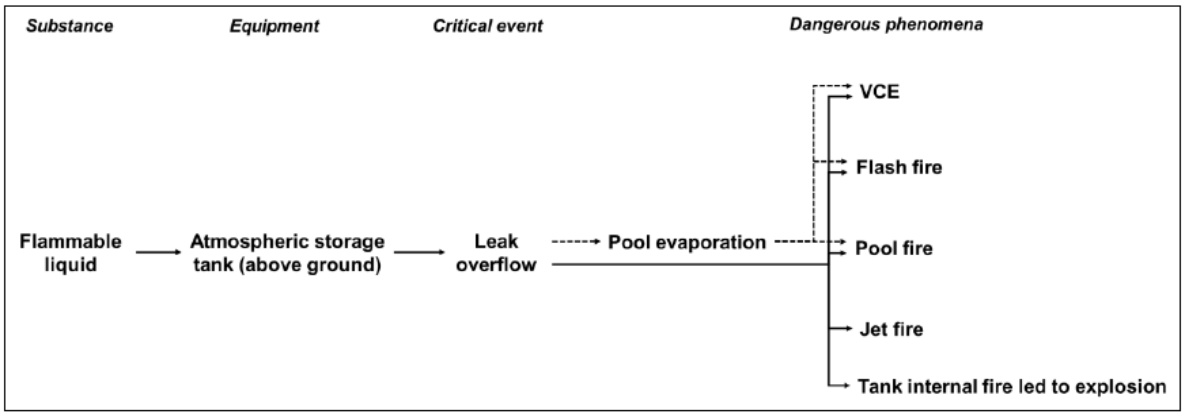
For an above-ground storage tank (or road tanker), a BLEVE or fireball may occur. A BLEVE can occur when a flame impinges on a tank containing a material that is a gas at atmospheric pressure and temperature but is a liquid at storage temperature and pressure. Again, it is assumed that a BLEVE occurs when the vessel or road/ rail tanker is full. While BLEVEs are possible because of catastrophic vessel failure and localised vessel failure, they typically occur outside of these two events. Should this not occur, a vapour cloud may form. The ignition of the vapour cloud is modelled as a flash fire and explosion.

The flash fire is modelled through simulating the expansion of the initial cloud to the lower flammability limit (LFL) with air entrainment. The damage area then corresponds to the LFL cloud footprint. The explosion is modelled using the total mass subject to the lower flammability limit (LFL).

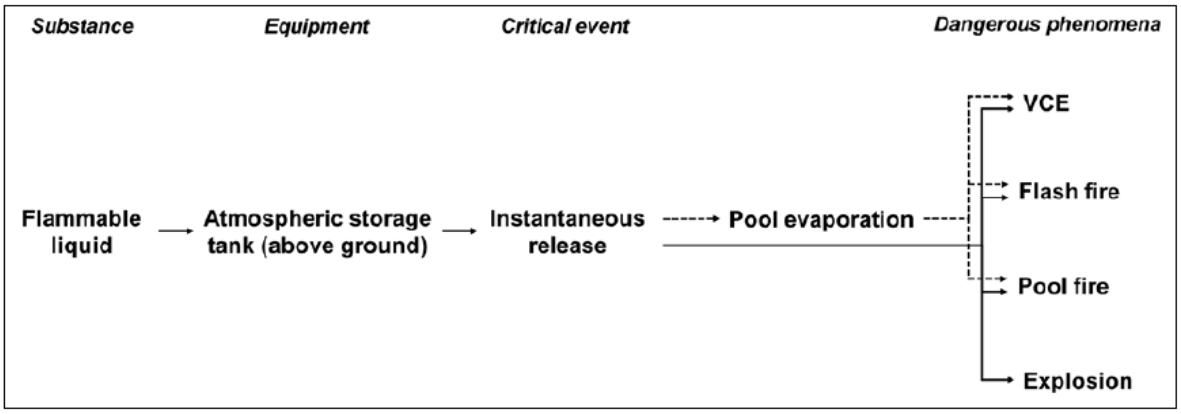
Accidental high velocity releases of ignited flashing liquids of pressurised flammable material at ambient temperature are classed as liquid jet fires. Jet fires occur when the jet of hydrocarbon can entrain air and burn at its edge. The jet remains ignited because the burning of the flame is greater than the velocity of the hydrocarbon jet, i.e. the flame can burn back towards the source of the jet. As a worst-case scenario, it is assumed that all failures occur in a horizontal position, i.e. the flame is orientated horizontally.

4.3. Event Trees

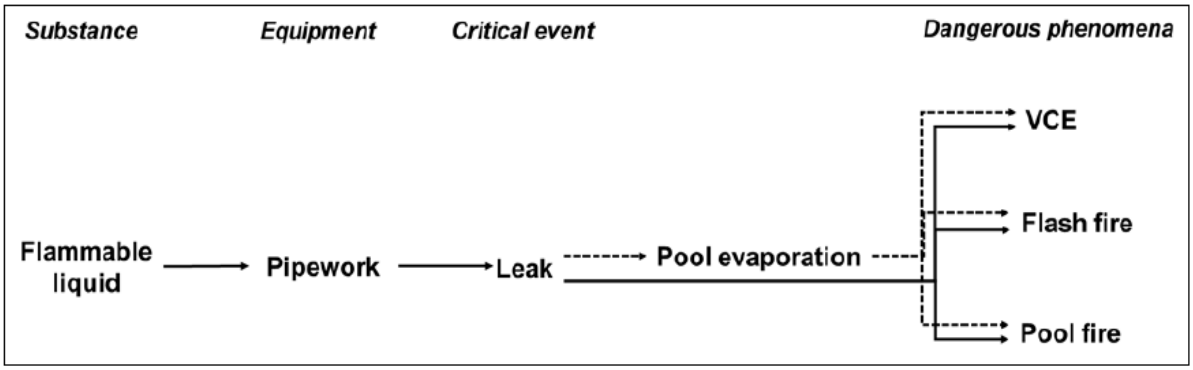
The probability of the toxic gas and flammable liquid identified above is represented as *event trees* for working daytime and night-time periods in the following diagrams.



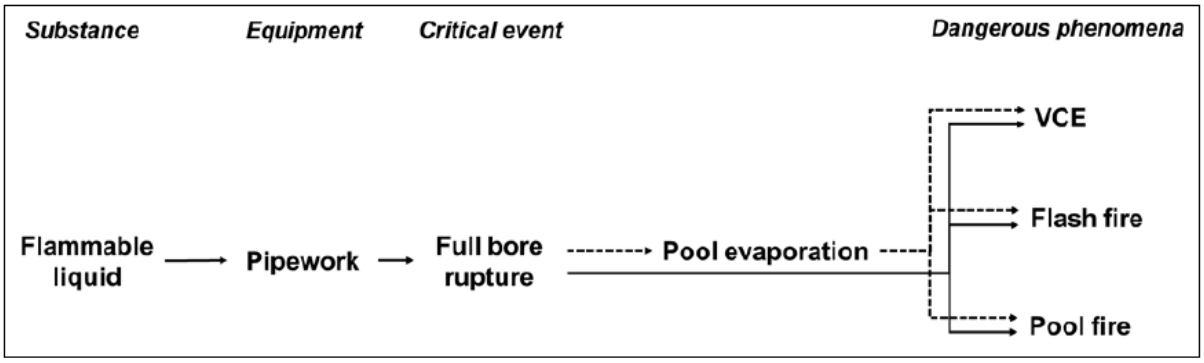
Event Tree of an Atmospheric Tank Leak



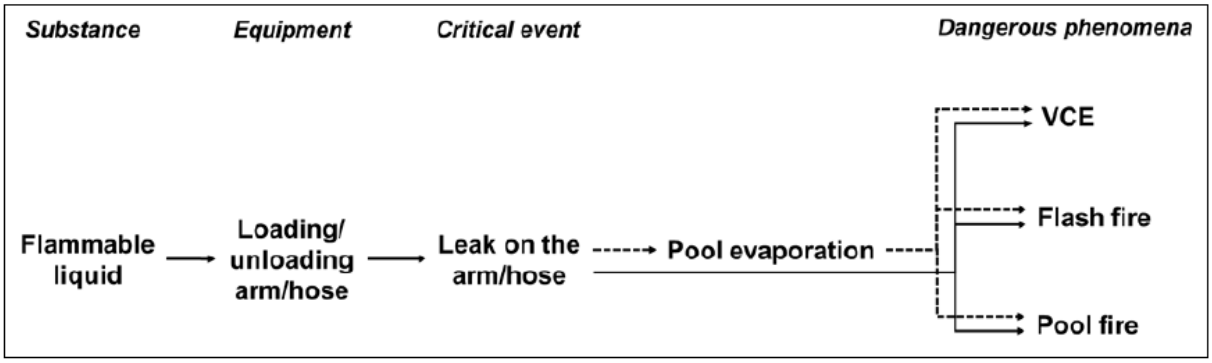
Event Tree of an Instantaneous Release of an Atmospheric Tanks



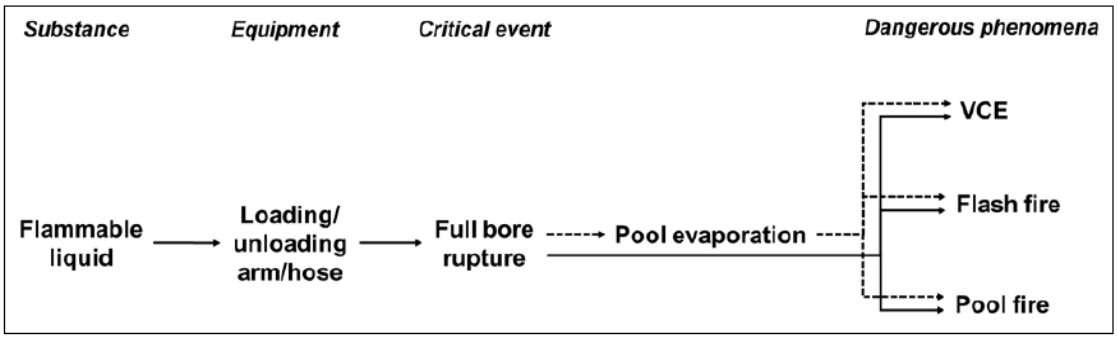
Event Tree of Flammable Liquid Pipe Leak



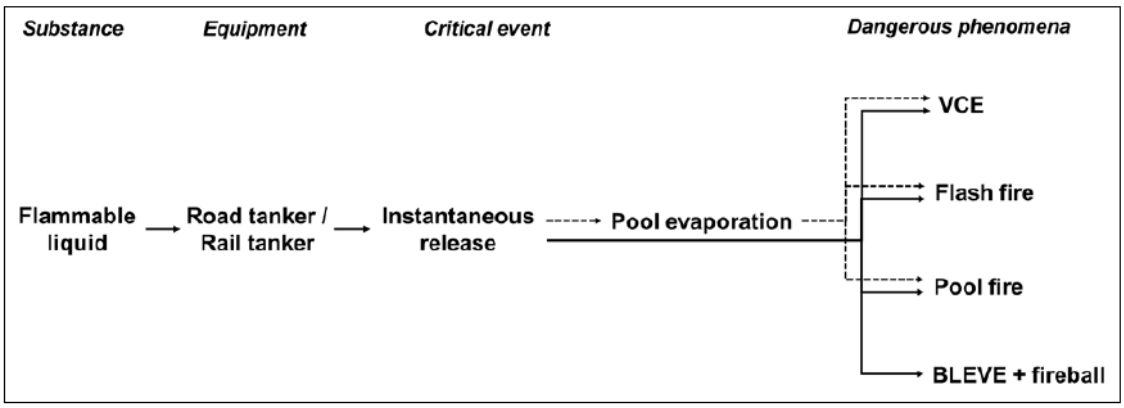
Event Tree of Flammable Liquid Pipe Rupture



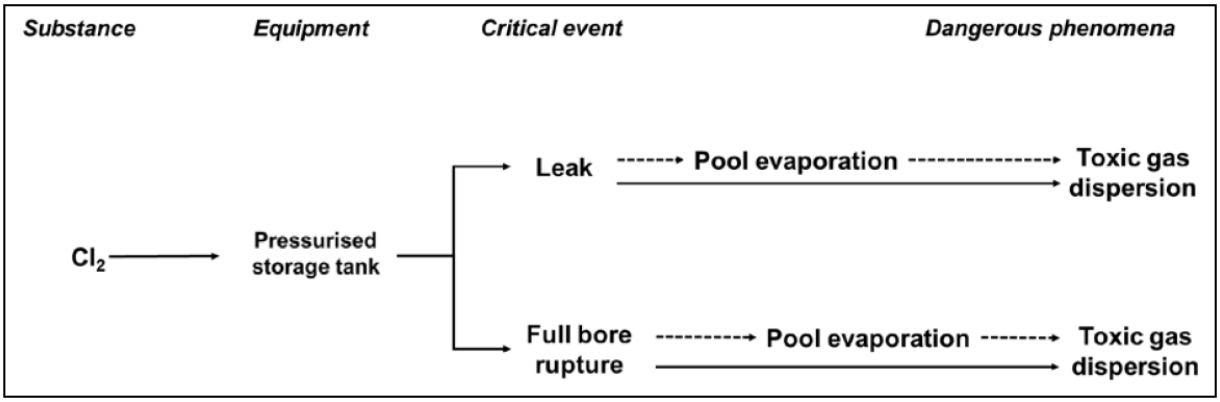
Event Tree of Flammable Liquid Loading Hose Leak



Event Tree of Flammable Liquid Loading Hose Rupture



Event Tree of Instantaneous Release of a Flammable Liquid Road Tanker



Event Tree for Chlorine Pipe Leak

4.4. Scenarios Modelled

The following scenarios were modelled for this Risk Assessment:

Flammable Scenarios

Solvent Fire Scenarios

- Pool fire as the result of a 10mm hole in one of the tanks;
- Pool fire as the result of a pipe shear;
- Pool fire as the result of a loading hose shear;
- Pool fire as the result of a 10mm hole in a loading hose;
- Pool fire as the result of a catastrophic tank failure.

Toxic Scenarios

Chlorine Scenarios

- Chlorine release from cylinder failure;
- Chlorine release from cylinder leak.

4.5. Hazard Analysis Breakdown

Flammable and Toxic Installation					
Equipment	**Failures and Causes**	**Preventative Measures**	**Hazardous Event**	**Protective Measures**	**Final Consequence**
Solvent Tank	- Leak - Catastrophic Rupture	- Solvent tanks will be installed in a bunded area - Suitably qualified companies to do maintenance and repairs	- Pipe leak/ rupture resulting in a pool fire - Tank leak/ rupture resulting in a pool fire	- Fire-fighting equipment to be installed - Tanks will be installed in a bunded area to contain spills - Emergency Plan will be implemented - Regular maintenance to be done as per manufacturer requirements	- Possible employee injuries or fatalities - Possible public injuries or fatalities Possible domino effect on diesel road tanker causing pool fire or catastrophic failure
Solvent Road Tanker	- Hose Leak - Hose Rupture - Catastrophic Rupture	- Installation will comply with relevant SANS standards - Only trained staff and driver to exercise offloading procedures	- Hose leak/ rupture resulting in a pool fire - Road Tanker leak resulting in a pool fire	- Fire-fighting equipment to be installed - Emergency Plan will be implemented - Driver to be suitably trained in off loading procedure and emergency procedure - Tanker to be earthed prior and during off loading operation	- Possible employee injuries or fatalities - Possible public injuries or fatalities - Possible domino effect on diesel tanks causing pool fire or catastrophic failure
Chlorine Cylinder	- Valve Leak - Catastrophic Failure	- Only trained staff to handle Chlorine cylinders	- Valve leak can lead to toxic release - Catastrophic failure can lead to toxic release	- Fire-fighting equipment to be installed - Emergency Plan must be implemented - All employees handling Chlorine must receive suitable training - Emergency equipment must be available and maintained as required	- Possible employee injuries or fatalities - Possible public injuries or fatalities

5. CONSEQUENCE ANALYSIS

5.1. Background

The consequence analysis describes the extent of impacts from major events. The results of this analysis are used as input to the risk analysis section as well as providing guidance to Emergency Planning.

To establish the impact following an accident, it is necessary to first estimate the physical process of the spill (i.e. rate and size), spreading of the spill, the evaporation from the spill and the subsequent atmospheric dispersion of the airborne cloud or, in the case of ignition, the burning rate, the resulting thermal radiation or the overpressures from an explosion.

The second step is to estimate the consequences of a spill on humans and structures. For humans this is normally expressed as a probability of fatality at distances from the release point.

The consequence analysis as documented in the Risk Assessment report is to provide sufficient process data, calculations, etc. to allow for a reasonable verification of key consequence modelling results.

5.2. Source Term Analysis

When determining the volume of materials possibly released or involved in an incident, the following aspects should be considered:

- The amount of material available for release from each item should be at least the full inventory of the piece of equipment when it is filled to its maximum capacity. The maximum capacity of equipment is the total amount of fluid that can be accommodated in that equipment in the absence of equipment inventory control. For example, the volume of a cube vessel would be the product of the width, length and height of the vessel.
- When a component fails, such as a vessel, subsequent delivery of other system components which are connected to the vessel may take place. If the quantity that is subsequently delivered is significant, the combined volume/flows need to be taken into consideration.
- If in the case of an on-site pipeline failure an increased pumping rate occurs, this is modelled by increasing the flow rate to that of 1.5 times the pumping rate.
- The effects of measures affecting outflow, such as shutting off valves can be considered.
- In the case of a ‘long pipeline’ rupture scenario the outflow is calculated based upon the content of the pipeline and a pumping rate. This means that the outflow from a reservoir that may be connected is not included. The ‘long pipeline’ scenario can therefore only be used when the pumping rate and the content of the transport pipeline is critical for the outflow. It is also important that the condition that L/D > 1000 is complied with, where L is the (total) length of the pipeline and D is the diameter of the pipeline.
- In the case of a line rupture, outflow occurs from both ends of the rupture. There are several possibilities:
    - If the outflow mainly takes place from one end, the scenario can be modelled as a rupture of one pipeline (‘line rupture’).
    - If the rupture occurs in a long transport pipeline, the various contributions from both ends of the rupture are included in the calculation of the outflow.

- If the contributions from both ends of the line rupture are relevant to the outflow, one effective pipeline diameter must be used in the calculation, for which the outflow rate matches the outflow rate from both ends added together.

5.3. Site Specific Consequence Analysis

At the flammable installations, the impacts of a loss of containment have been calculated without taking the probability of it occurring into account. This is done to show the consequence of an incident and how it will impact on the site and the surrounding area. Domino effects were also investigated in this section.

In the following sections various scenarios were calculated for the installations.

5.4. Fires

Flammable liquids and gases may ignite and burn if ignited. This normally occurs because of a loss of containment and ignition. Fires include pool fires, jet fires and flash fires.

The consequence of a fire will be thermal radiation.

It is expected that an individual either in pain from a thermal dose received or suffering from first degree burns should escape rapidly as the injury should not be sufficient to impede movement, yet the pain will be too uncomfortable to bear standing still.

An individual with second degree burns will have even greater motivation to escape, commonly referred to as the fight or flight response. However, at this level of injury, any exposed skin will be uncomfortable and difficult to use in contact with another surface. Simple tasks, such as turning door handles or dressing in survival equipment will take longer, if possible. Depending on the location and extent of injury, more difficult tasks such as operating control panels or turning valves may be impossible.

With third degree burns an individual will be in severe pain and will realise that they are in immediate danger of losing their life. Individual response is hard to predict. Fine control of injured extremities will be impossible and other functions will be severely impaired. Escape will probably incur further injury as skin may fall away from the wound. Individuals with third degree burns should be considered as casualties who cannot evacuate unaided.

Thermal radiation levels used in this report are as follows:

- 4.5 kW/m^2 is the radiation that would cause pain and second degree burns within 20 seconds (Yellow Contour).
- 12.5 kW/m^2 represents a 1% fatality for people exposed to the fire for 20 seconds (Orange Contour).
- 37.5 kW/m^2 indicates the lower limit of damage to steel equipment and represents a 100% fatality for people exposed to the flame (Red Contour).

5.4.1. Thermal Radiation

The effect of thermal radiation is dependent on the type of fire and duration exposed to the thermal radiation. Codes such as API 520 and 2000 suggest the maximum heat absorbed on vessels for adequate relief designs to prevent the vessel from failure due to overpressure. Other codes such as API 510 and BS 5980 give guidelines for the maximum thermal radiation intensity as a guide to equipment layout.

The effect of thermal radiation on human health has been widely studied and it has been found that injuries developed due to the exposure and intensity of the radiation. Two values normally quoted are 1.5kW/m^2 or 'safe' value where people can be exposed for a long period of time and 5kW/m^2 for people performing an emergency operation for short periods of time.

Thermal Radiation Guidelines (BS 5980-1990)

Thermal Radiation Intensity (kW/m^2)	Limit
1.5	Will cause no discomfort for long exposure
2.1	Sufficient to cause pain if unable to reach cover within 40 seconds
4.5	Sufficient to cause pain if unable to reach cover within 20 seconds
12.5	Minimum energy required for piloted ignition of wood and melting of plastic tubing
25	Minimum energy required to ignite wood at indefinitely long exposures
37.5	Sufficient to cause serious damage to process equipment

5.4.2. Pool Fires

On ignition of a flammable pool, the fire would extend to the limit of the pool but would shrink rapidly as the fuel within the pool is consumed.

The solvent tanks at the facility are stored as flammable liquids under atmospheric temperatures and pressures. A loss of containment at the tanks would result in a pool. The pool will be contained within the bunded area or until the liquid finds a natural barrier. A leak from the loading hose or road tanker will cause the pool to expand until it reaches a natural barrier.

On ignition of a contained flammable pool, the fire would extend to the limit of the pool but would shrink rapidly as the fuel within the pool is consumed.

The tanks are installed in bunded areas to mitigate the consequence of pool fires.

The consequences of pool fires at the bulk solvent storage areas are as follows:

Catastrophic Tank Leak/ Failure				
Product	**Radiation Contour 37.5kW/m^2**	**Radiation Contour 12kW/m^2**	**Radiation Contour 4.5kW/m^2**	**1% Lethality Contour**
Methanol	0m	8m	11m	9m
Thinners	0m	8m	11m	9m
Paraffin	7m	11m	17m	12m
Diesel	7m	11m	16m	12m
Shellsol A	8m	12m	20m	14m
Benzine	7m	12m	19m	13m
Toluene	7m	11m	17m	12m
Acetone	0m	9m	13m	10m

Small Tank Leak				
Product	**Radiation Contour 37.5kW/m^2**	**Radiation Contour 12kW/m^2**	**Radiation Contour 4.5kW/m^2**	**1% Lethality Contour**
Methanol	0m	3m	4m	3m
Thinners	0m	3m	5m	4m
Paraffin	0m	3m	5m	3m
Diesel	0m	3m	5m	3m
Shellsol A	0m	3m	4m	3m
Benzine	0m	3m	5m	3m
Toluene	0m	3m	5m	3m
Acetone	0m	3m	5m	3m

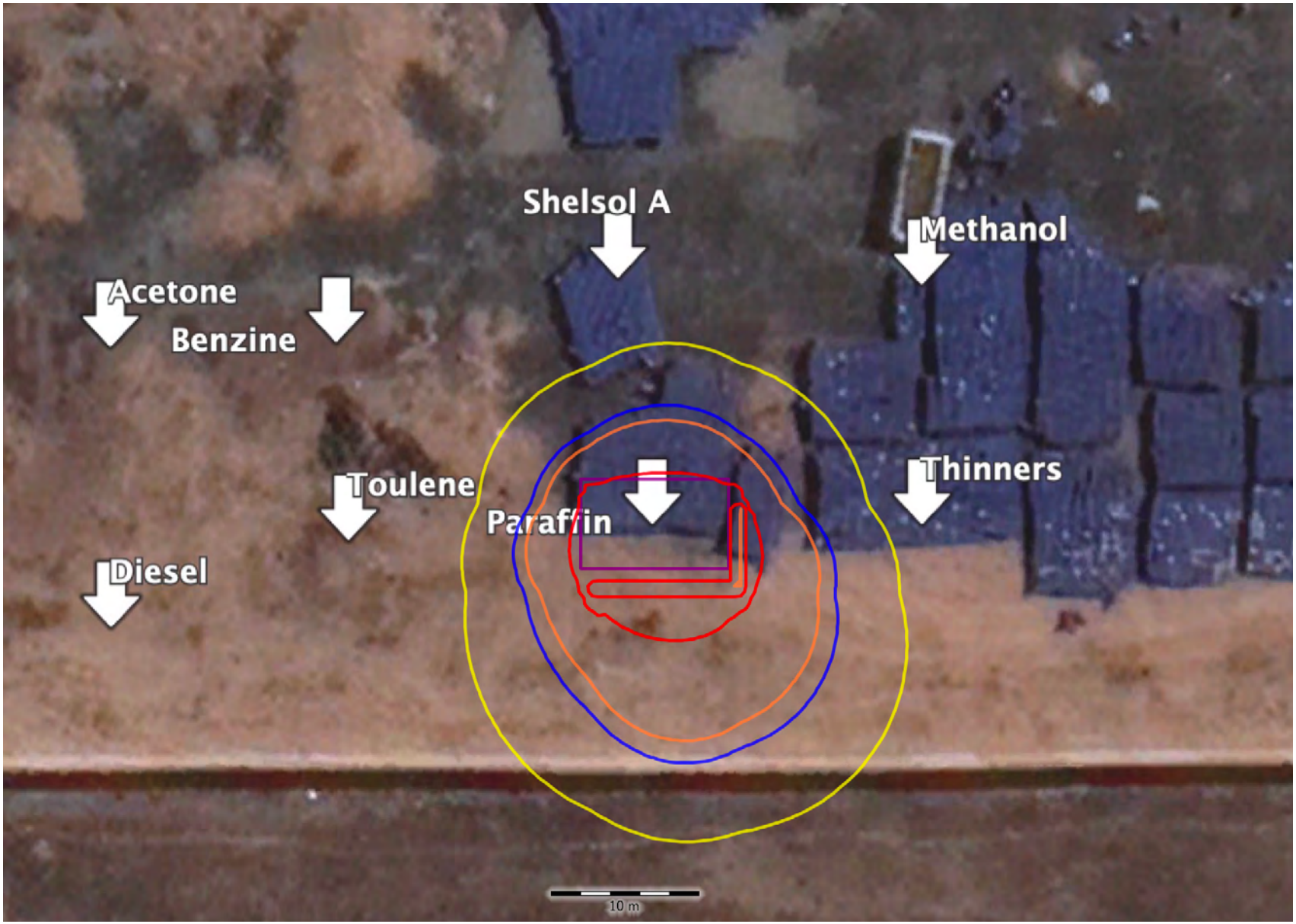
Road Tanker Loading Hose Leak				
Product	**Radiation Contour 37.5kW/m^2**	**Radiation Contour 12kW/m^2**	**Radiation Contour 4.5kW/m^2**	**1% Lethality Contour**
Methanol	0m	4m	5m	4m
Thinners	0m	4m	5m	4m
Paraffin	0m	4m	6m	5m
Diesel	0m	4m	6m	5m
Shellsol A	0m	4m	6m	5m
Benzine	0m	5m	7m	5m
Toluene	0m	5m	6m	5m
Acetone	0m	4m	5m	5m

Road Tanker Loading Hose Rupture				
Product	**Radiation Contour 37.5kW/m^2**	**Radiation Contour 12kW/m^2**	**Radiation Contour 4.5kW/m^2**	**1% Lethality Contour**
Methanol	0m	23m	32m	25m
Thinners	0m	24m	33m	26m
Paraffin	13m	23m	35m	26m
Diesel	13m	23m	36m	26m
Shellsol A	11m	21m	34m	24m
Benzine	12m	23m	37m	26m
Toluene	37m	24m	13m	27m
Acetone	0m	22m	33m	24m

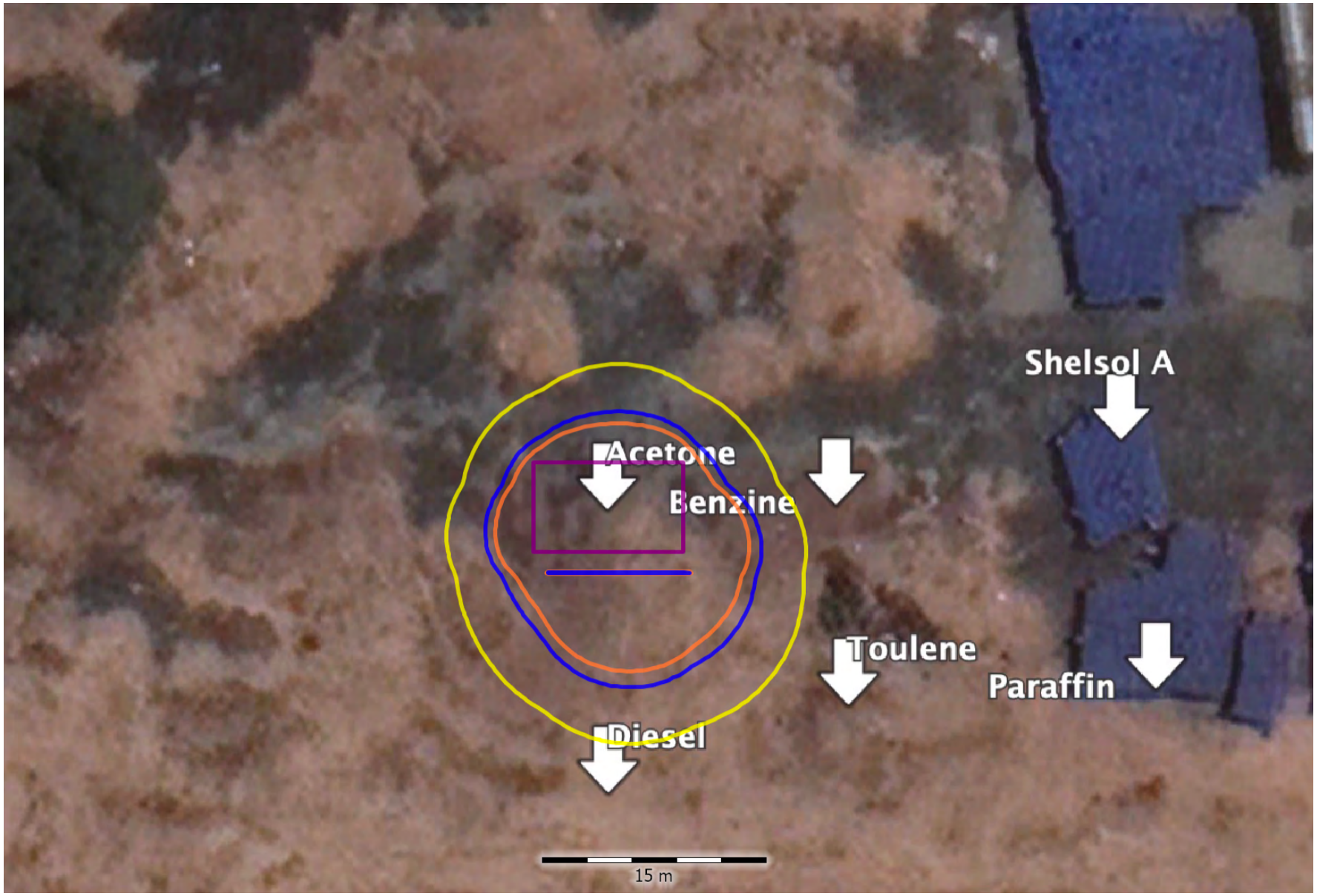
Road Tanker Catastrophic Failure				
Product	**Radiation Contour 37.5kW/m^2**	**Radiation Contour 12kW/m^2**	**Radiation Contour 4.5kW/m^2**	**1% Lethality Contour**
Methanol	0m	35m	50m	39m
Thinners	0m	2m	4m	39m
Paraffin	31m	57m	86m	63m
Diesel	30m	54m	80m	59m
Shellsol A	34m	66m	102m	74m
Benzine	33m	61m	94m	68m
Toluene	31m	56m	85m	62m
Acetone	0m	42m	63m	47m

Thermal radiation from pool fires at the solvent installations is shown below.

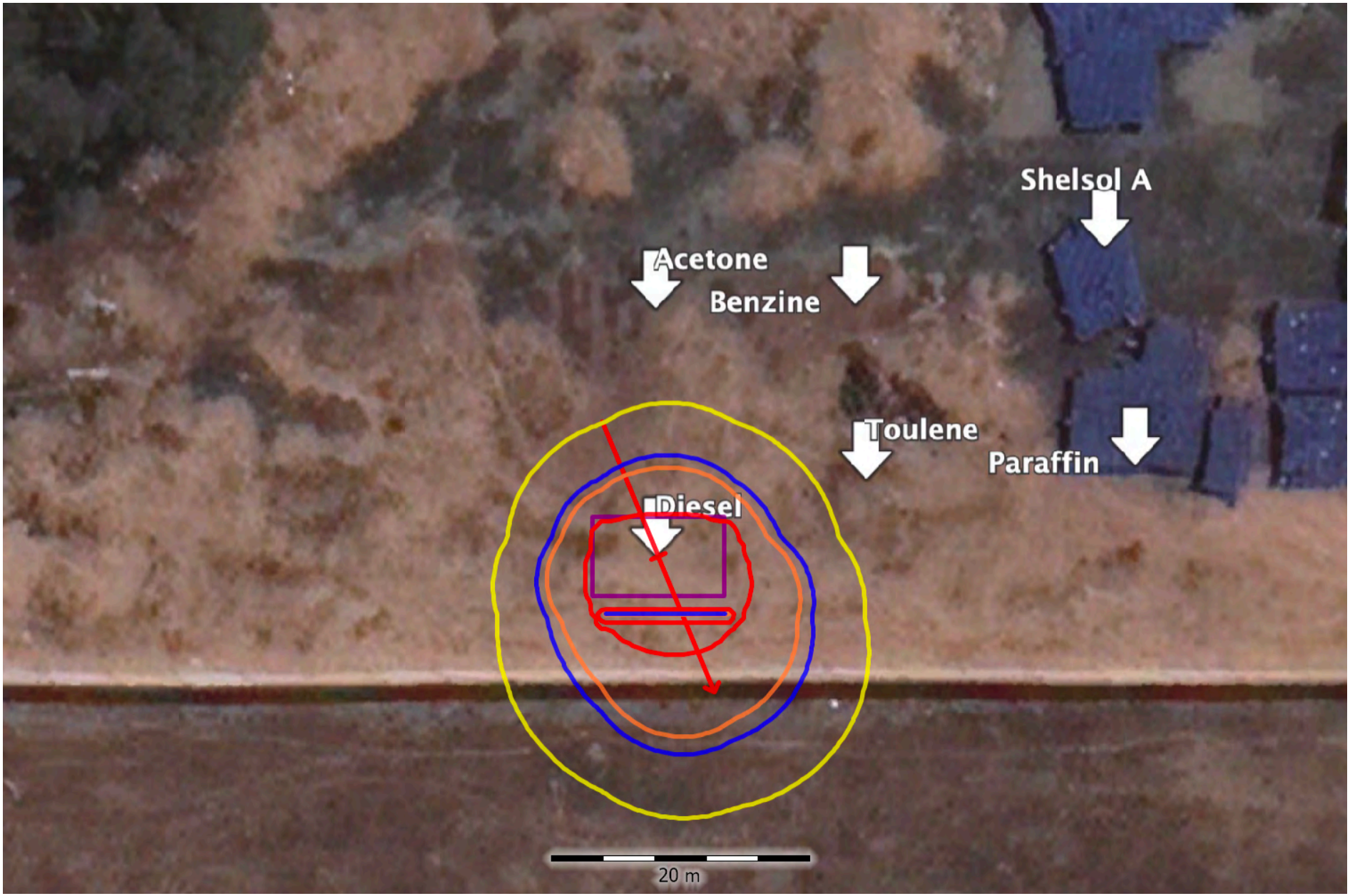
- 4.5 kW/m^2 is the radiation that would cause pain and second degree burns within 20 seconds. (Yellow Contour)
- 12.5 kW/m^2 is the energy required for pilot ignition of wood. (Orange Contour)
- 37.5 kW/m^2 indicates the lower limit of damage to steel equipment and represents a 100% fatality for people exposed to the flame. (Red Contour)
- 1% Lethality contour represents a 1% fatality for people exposed to the fire for 20 seconds. (Blue Contour)
- The flame is represented by the purple contour.



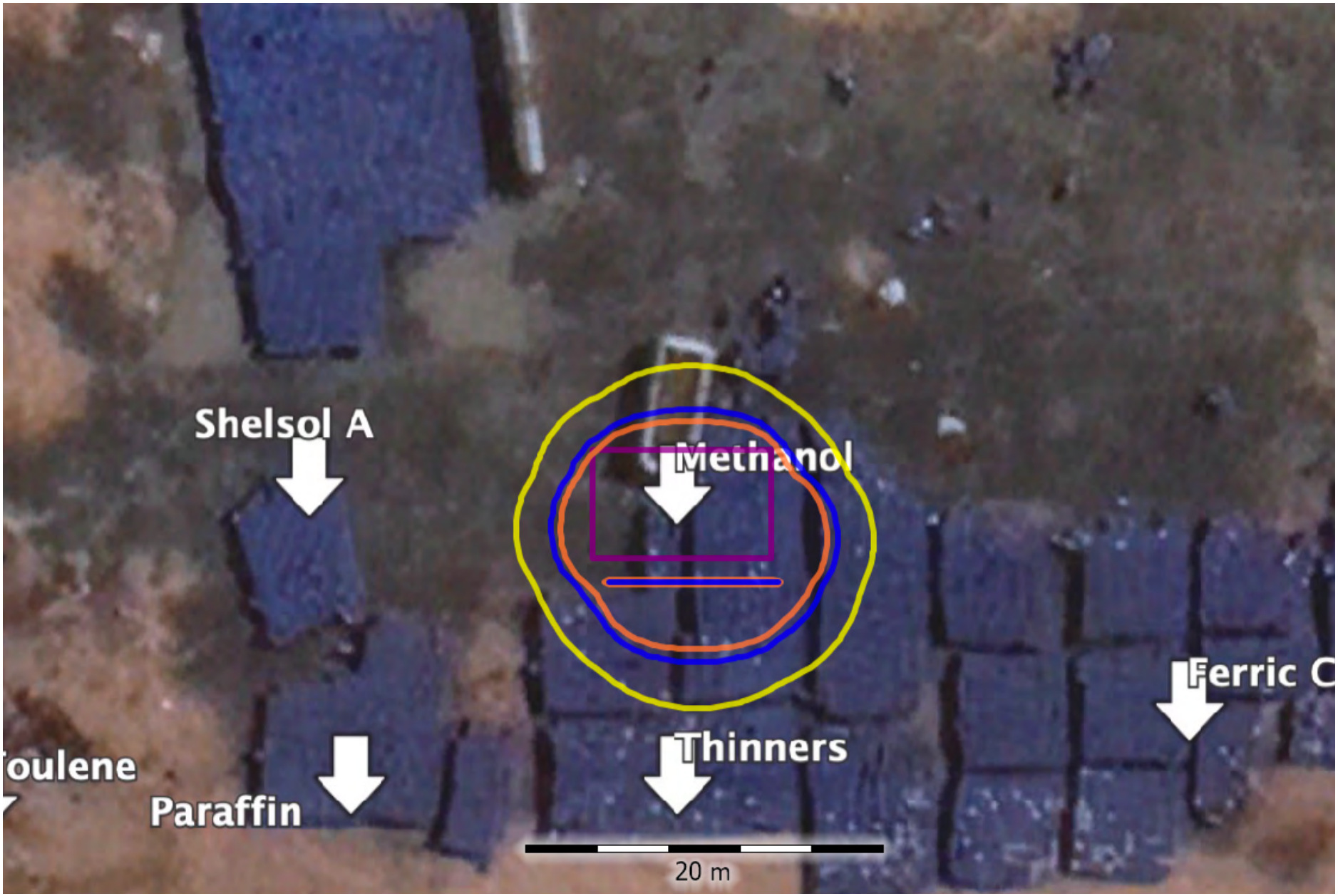
Pool Fire Consequences of a Catastrophic Leak/ Failure at Paraffin Tank



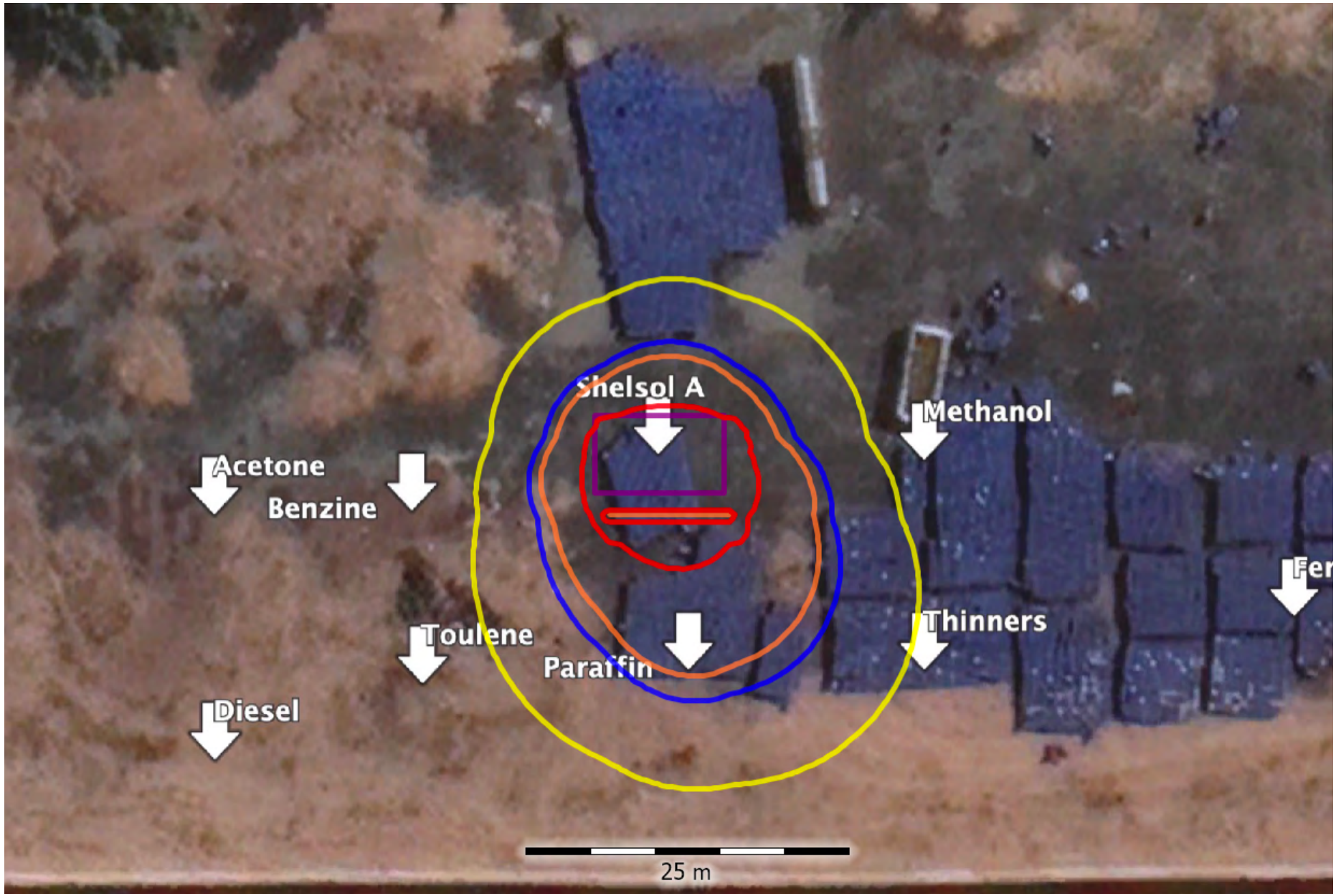
Pool Fire Consequences of a Catastrophic Leak/ Failure at Acetone Tank



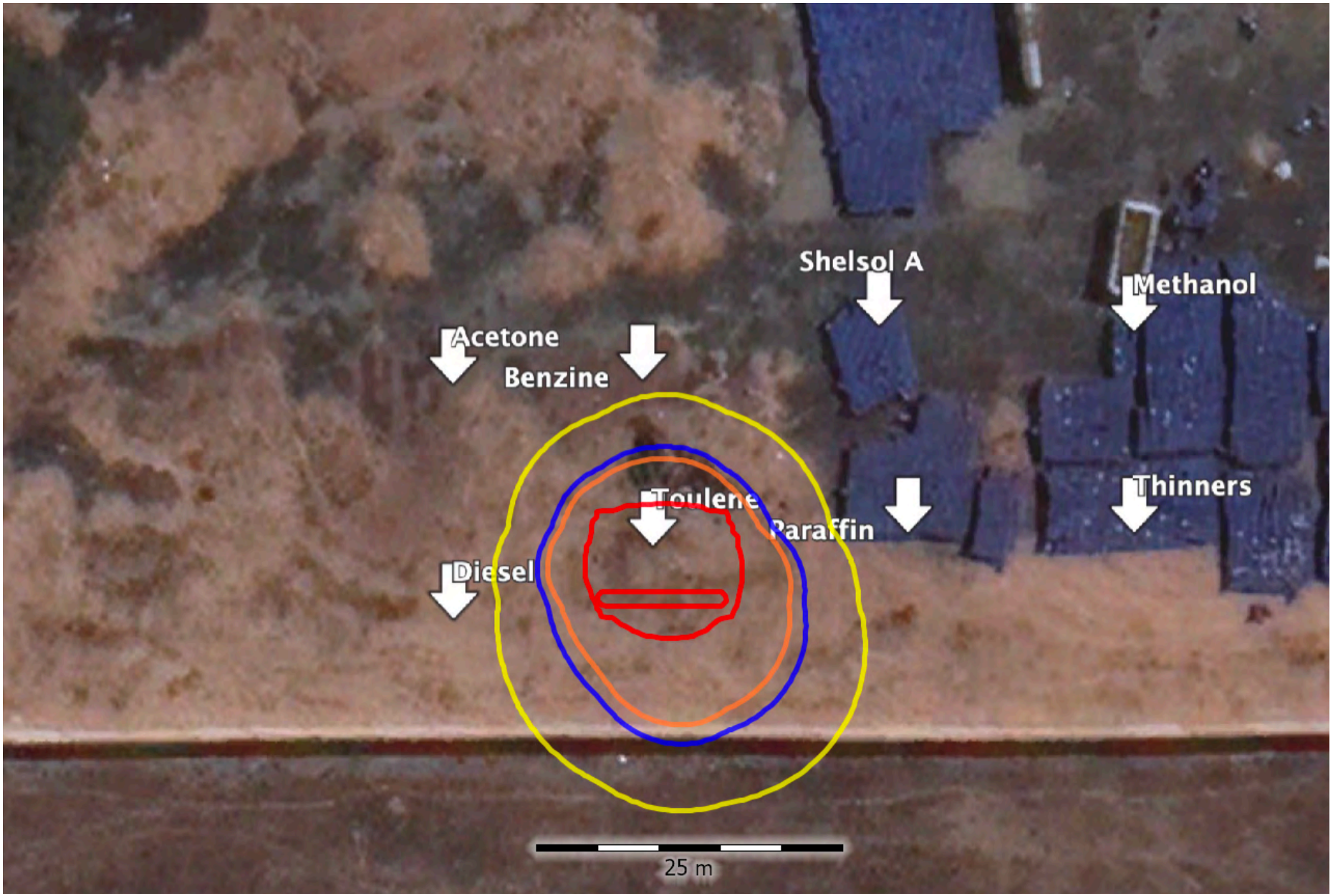
Pool Fire Consequences of a Catastrophic Leak/ Failure at Diesel Tank



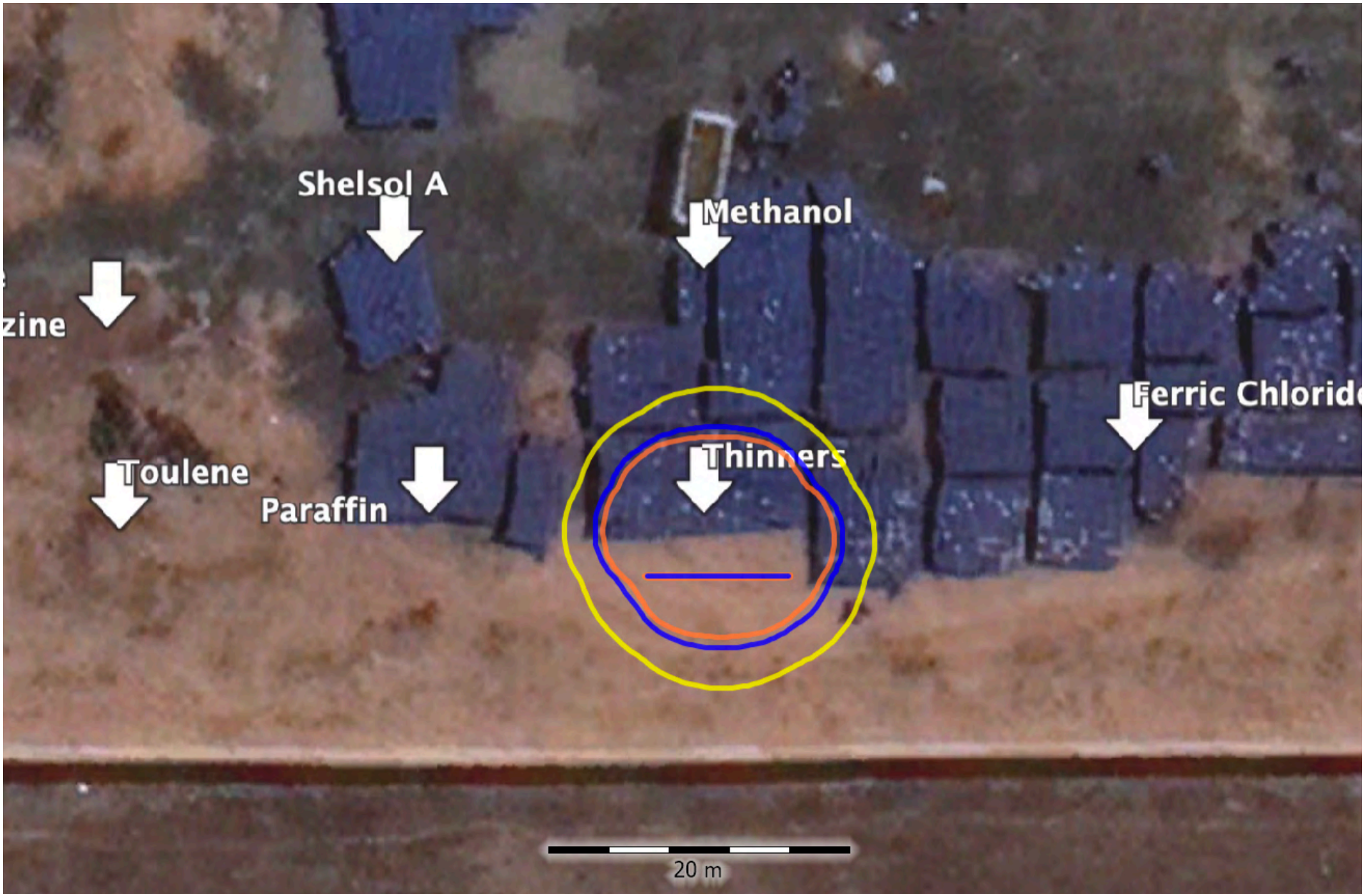
Pool Fire Consequences of a Catastrophic Leak/ Failure at Methanol Tank



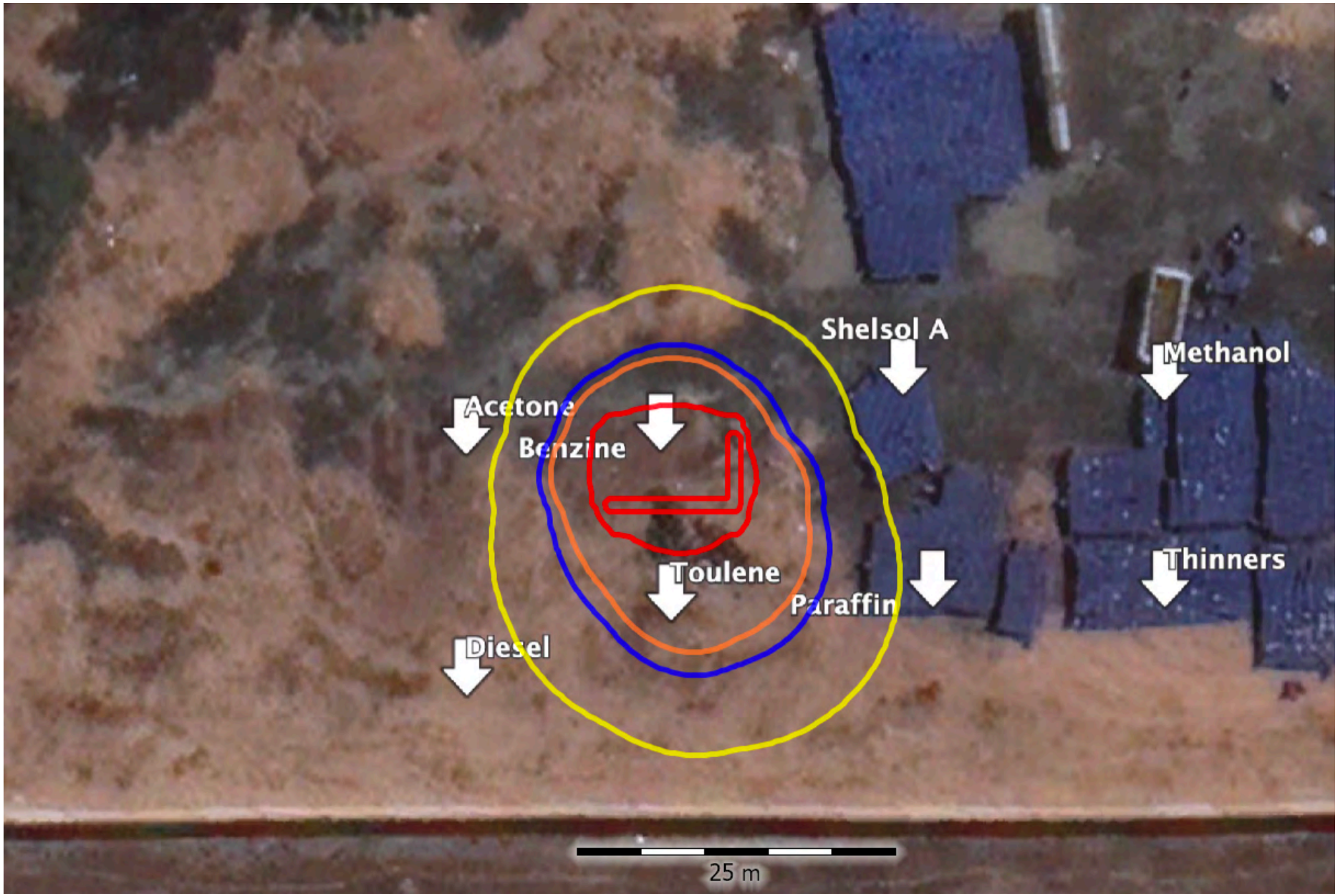
Pool Fire Consequences of a Catastrophic Leak/ Failure at Shellsol A Tank



Pool Fire Consequences of a Catastrophic Leak/ Failure at Toluene Tank



Pool Fire Consequences of a Catastrophic Leak/ Failure at Thinners Tank



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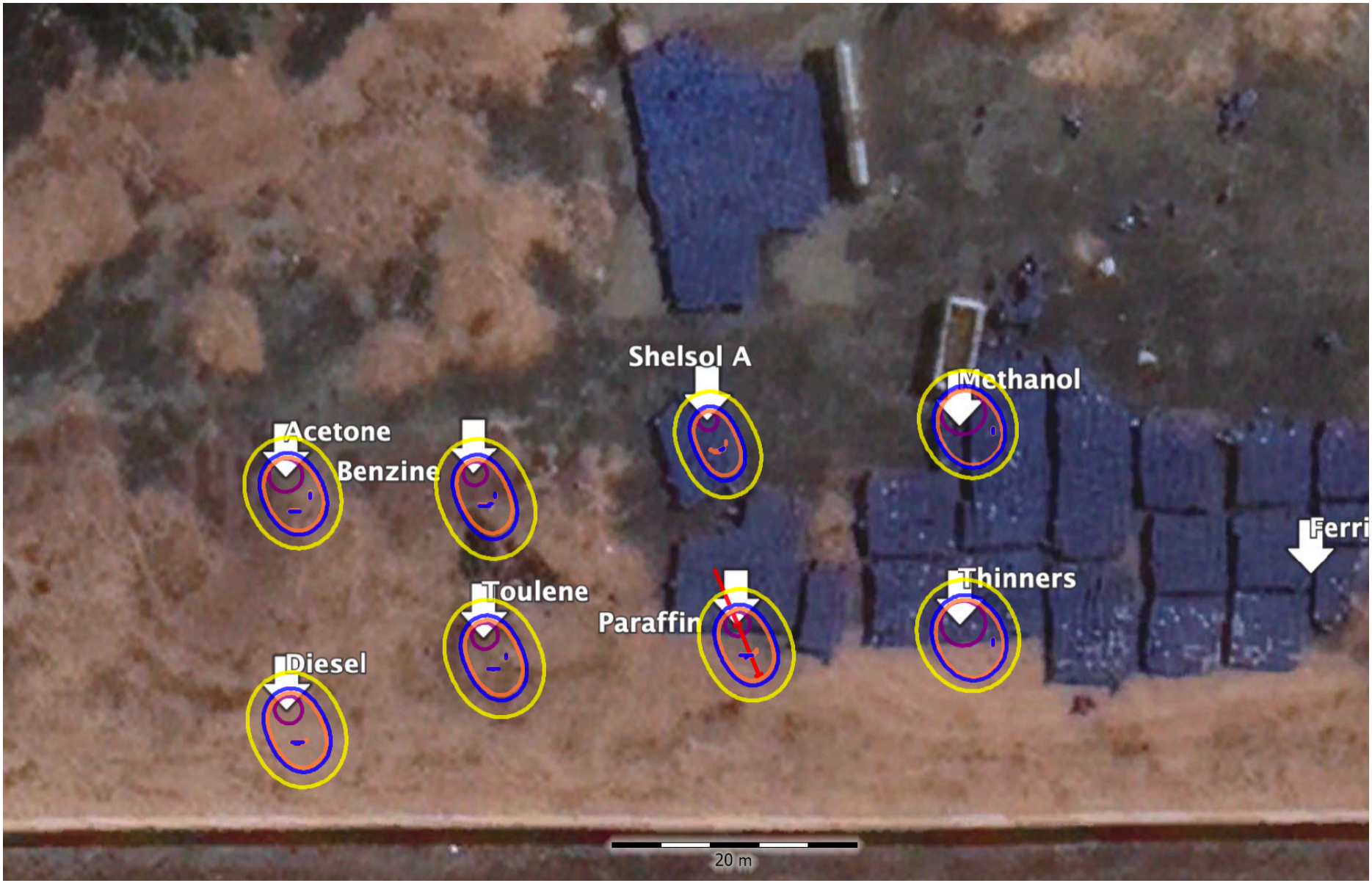
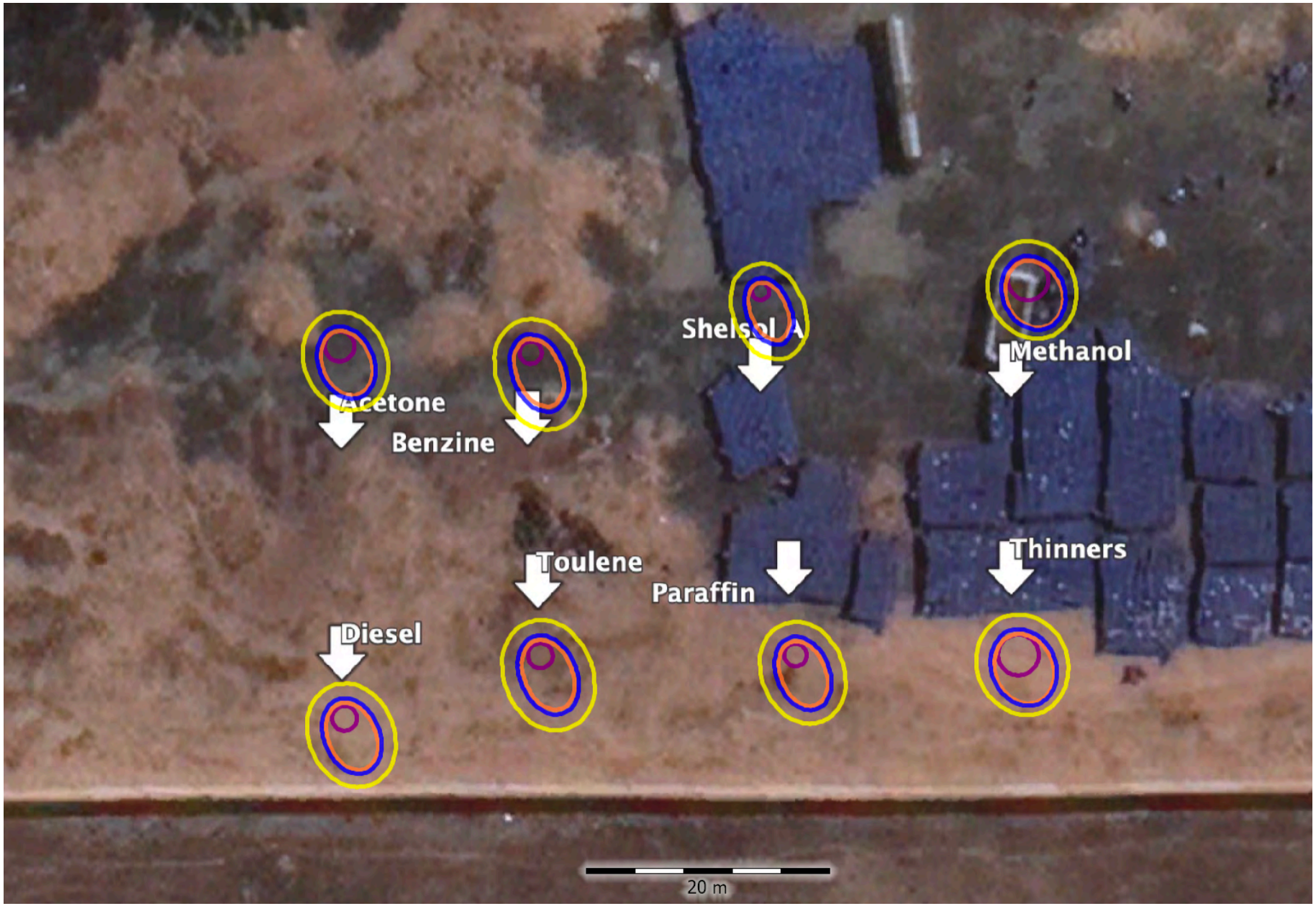
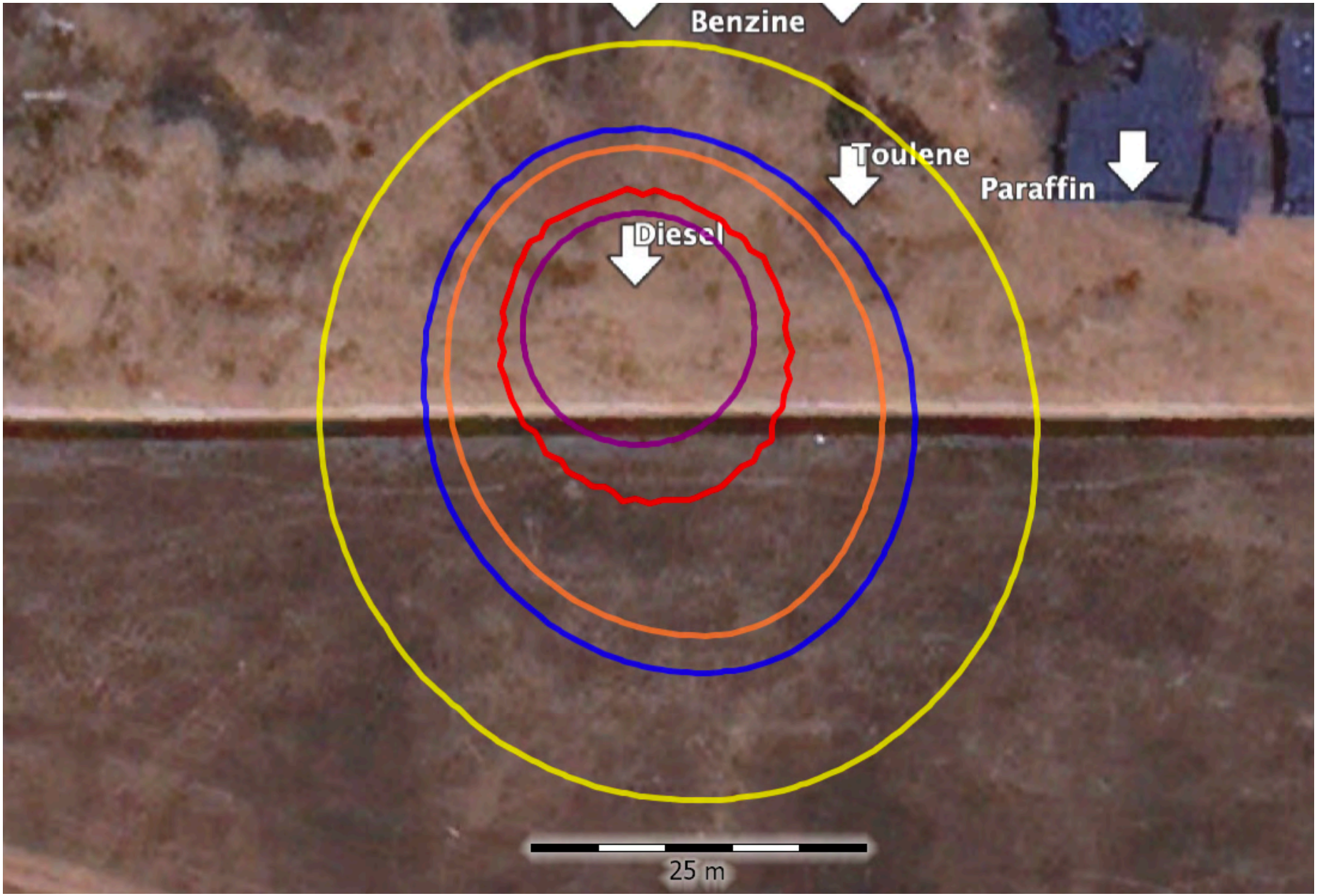


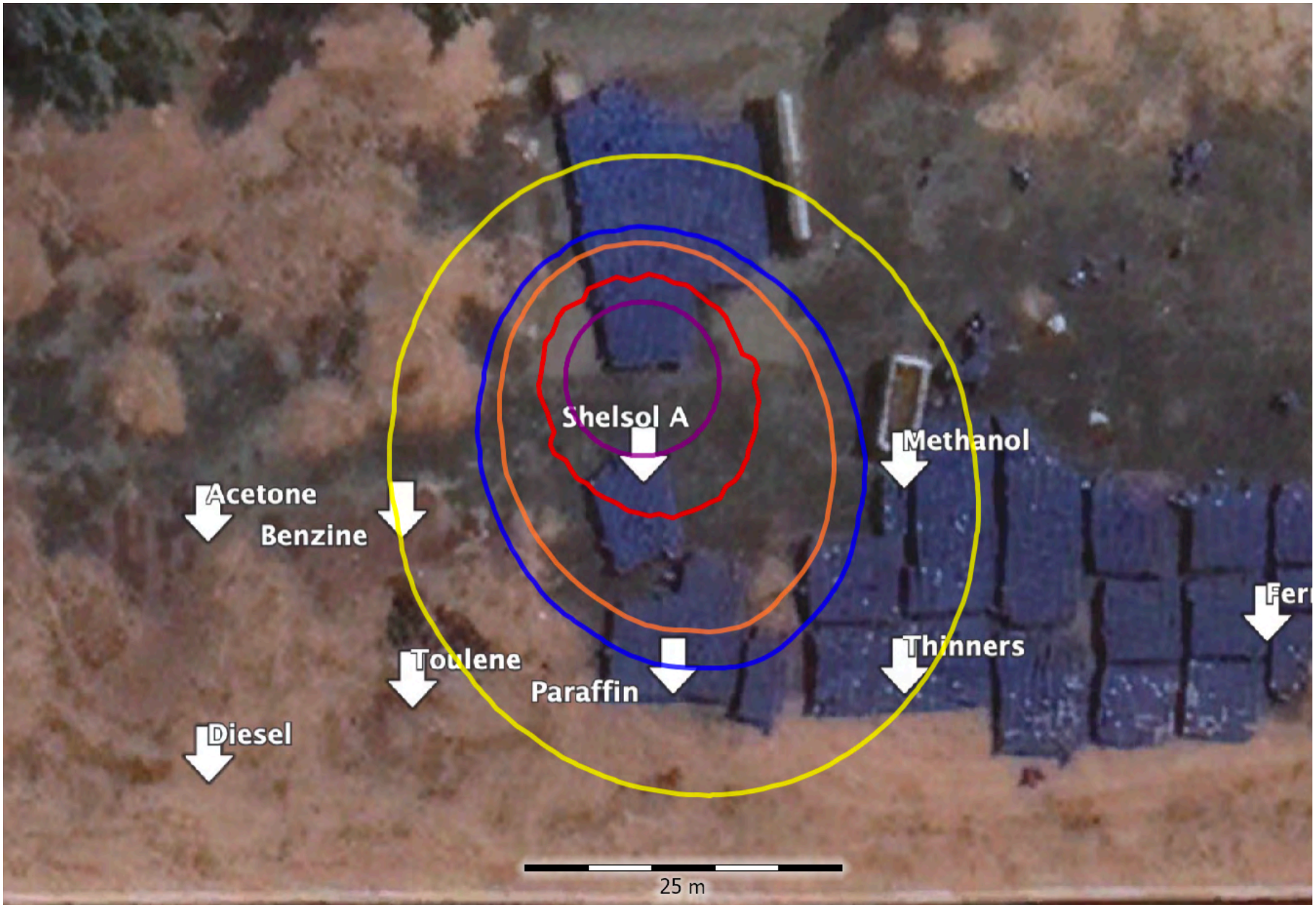
Pool Fire Consequences of a Small Tank Leak



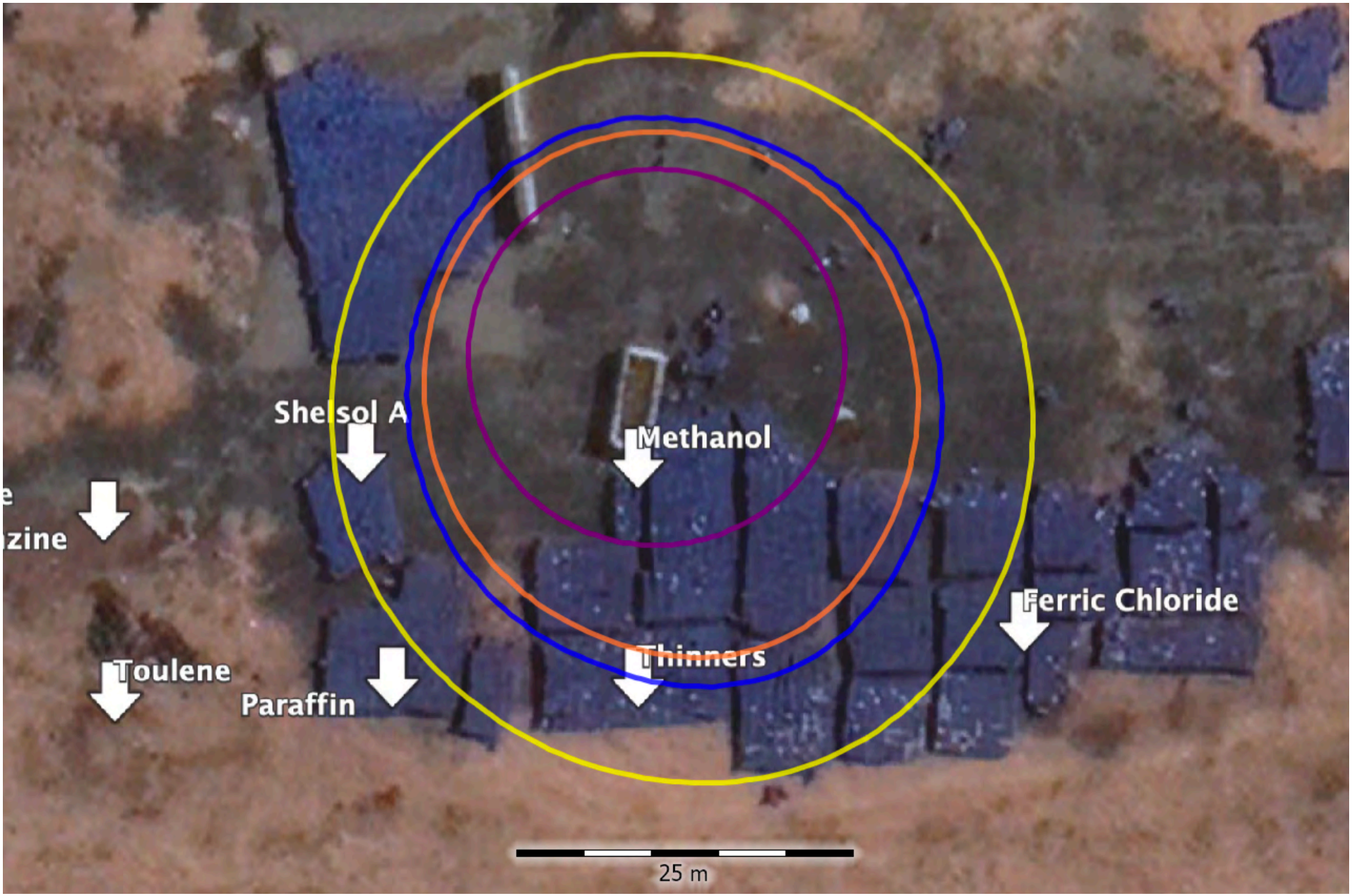
Pool Fire Consequences of a Loading Hose Leak at the Road Tankers



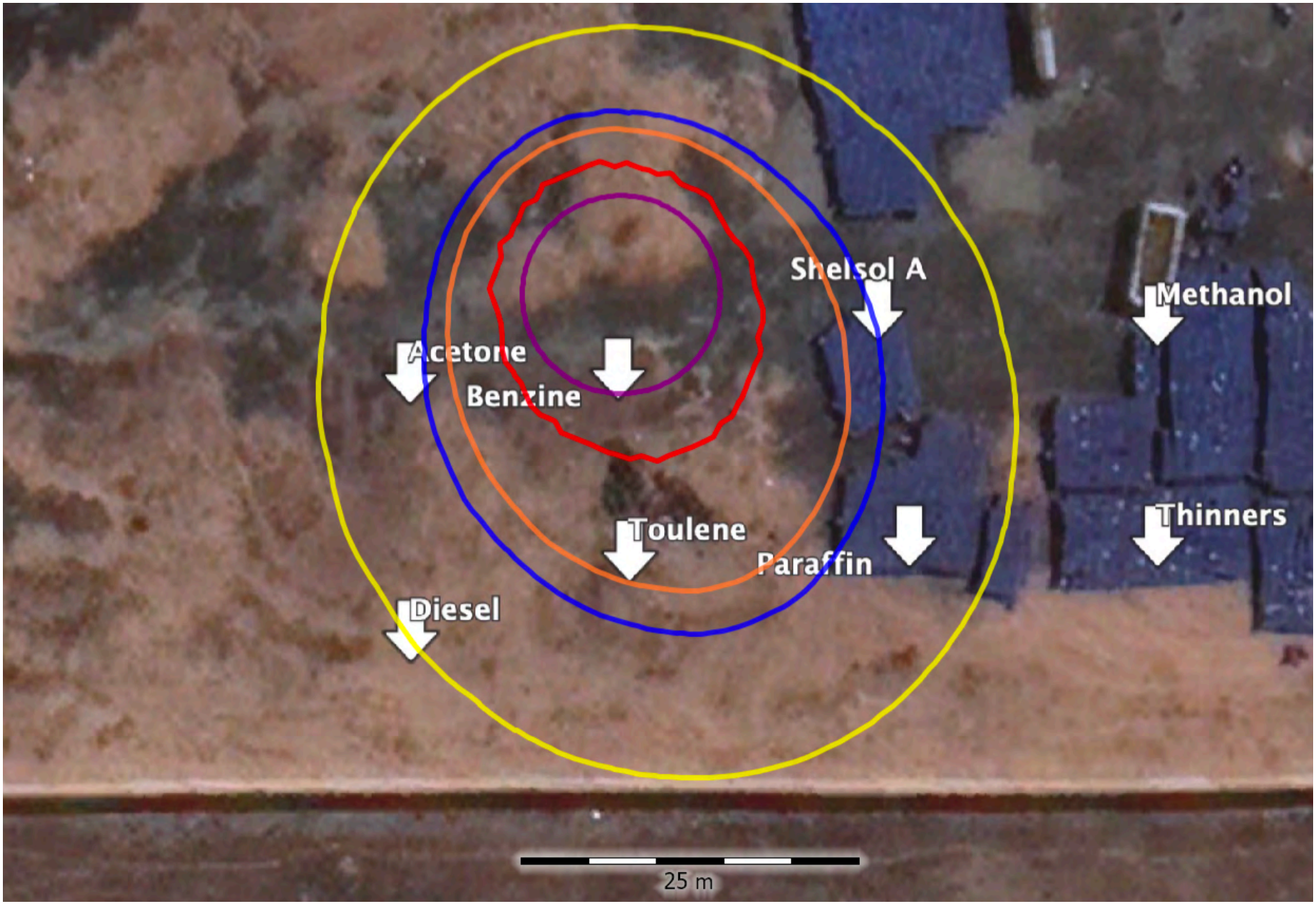
Pool Fire Consequences of a Loading Hose Rupture at the Diesel Road Tanker



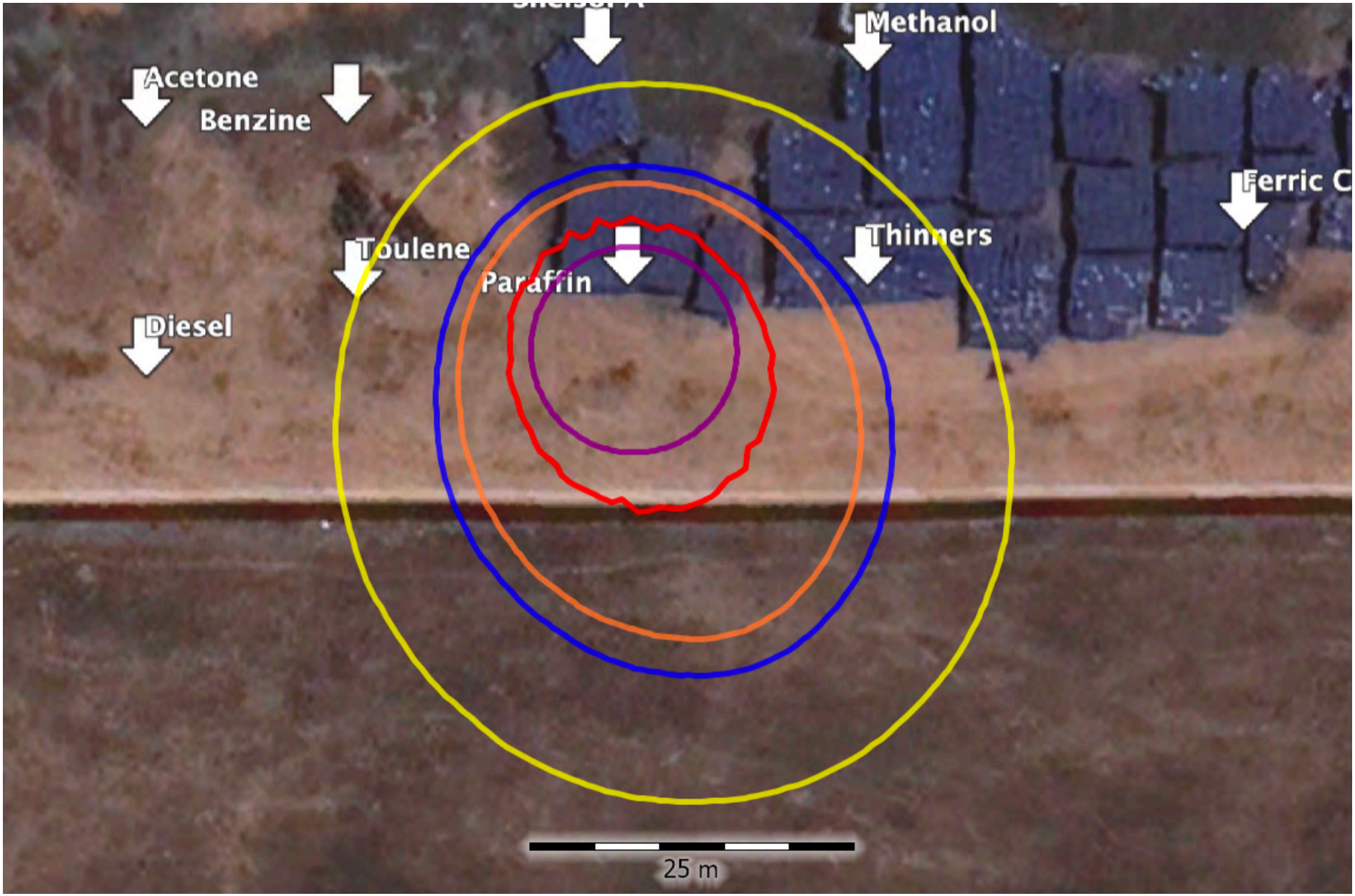
Pool Fire Consequences of a Loading Hose Rupture at the Shellsol A Road Tanker



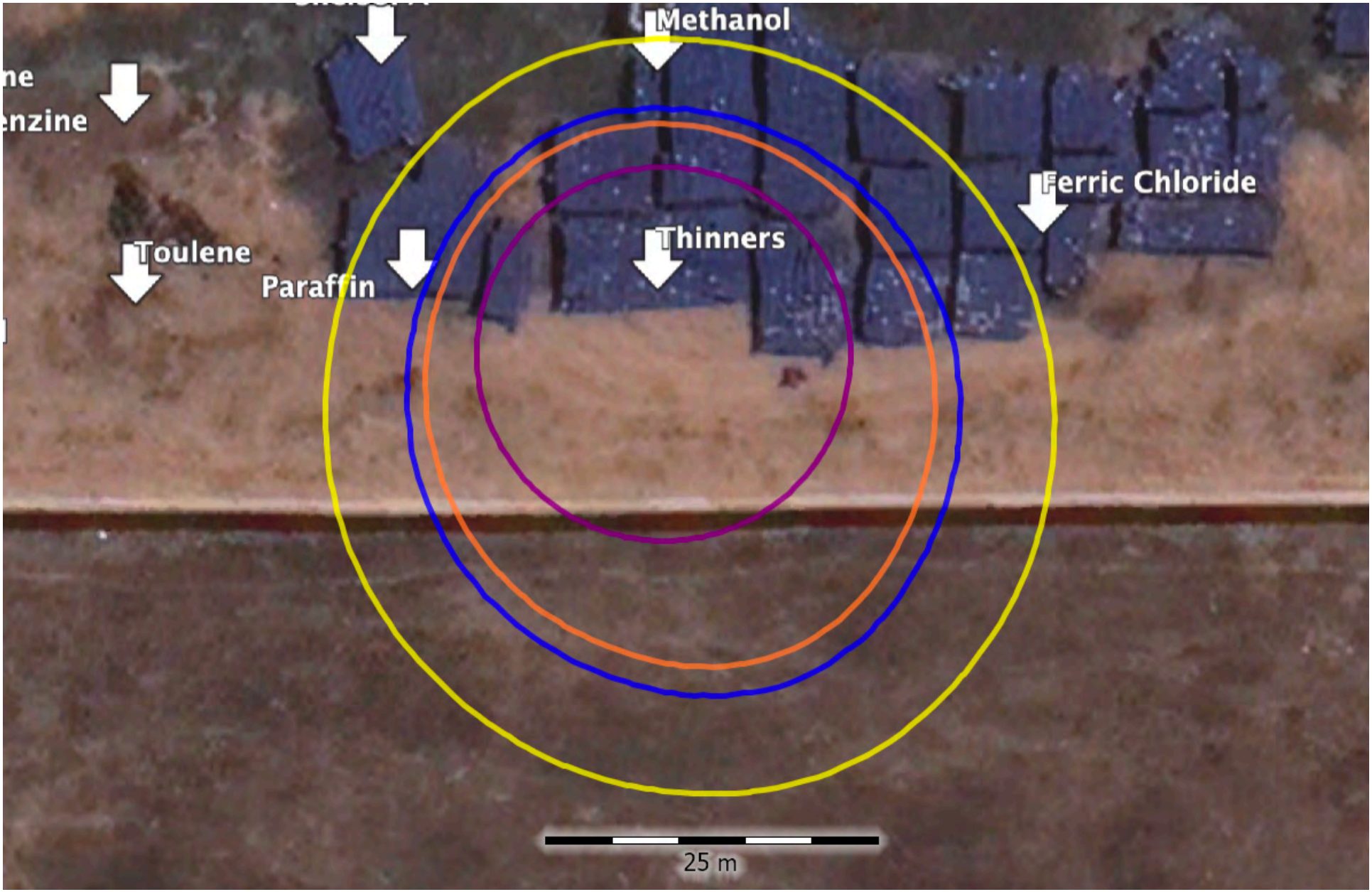
Pool Fire Consequences of a Loading Hose Rupture at the Methanol Road Tanker



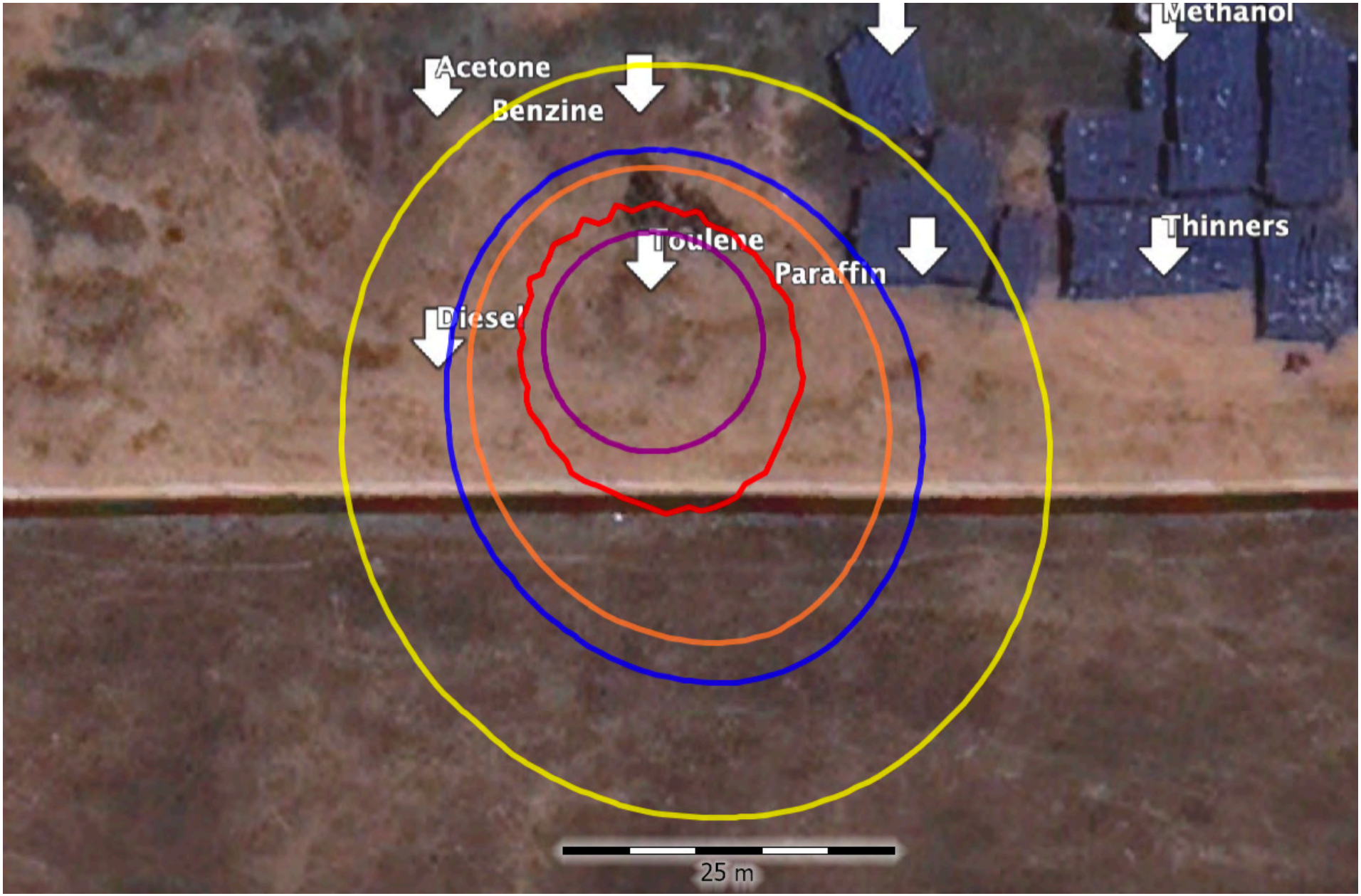
Pool Fire Consequences of a Loading Hose Rupture at the Benzine Road Tanker



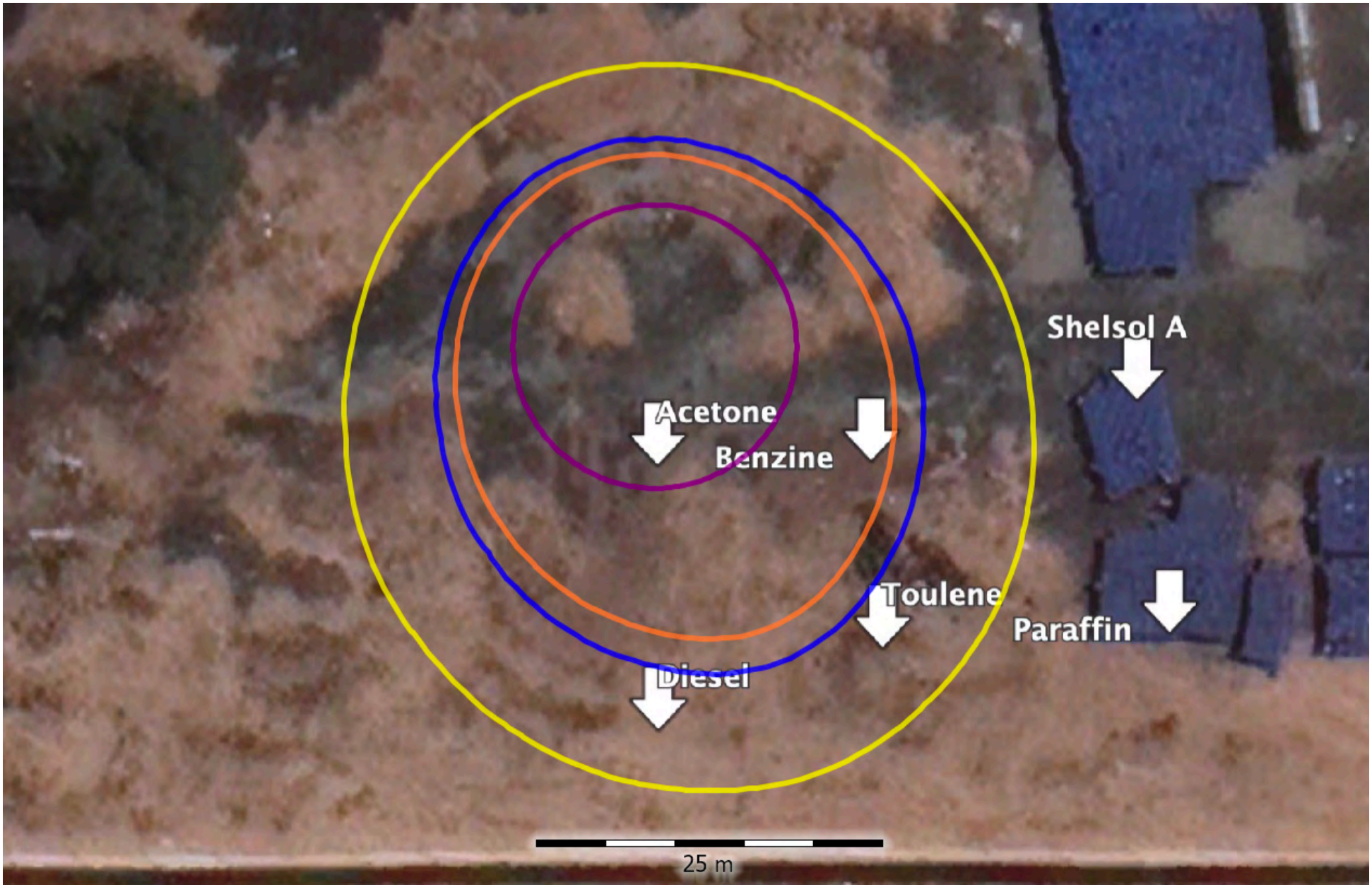
Pool Fire Consequences of a Loading Hose Rupture at the Paraffin Road Tanker



Pool Fire Consequences of a Loading Hose Rupture at the Thinners Road Tanker

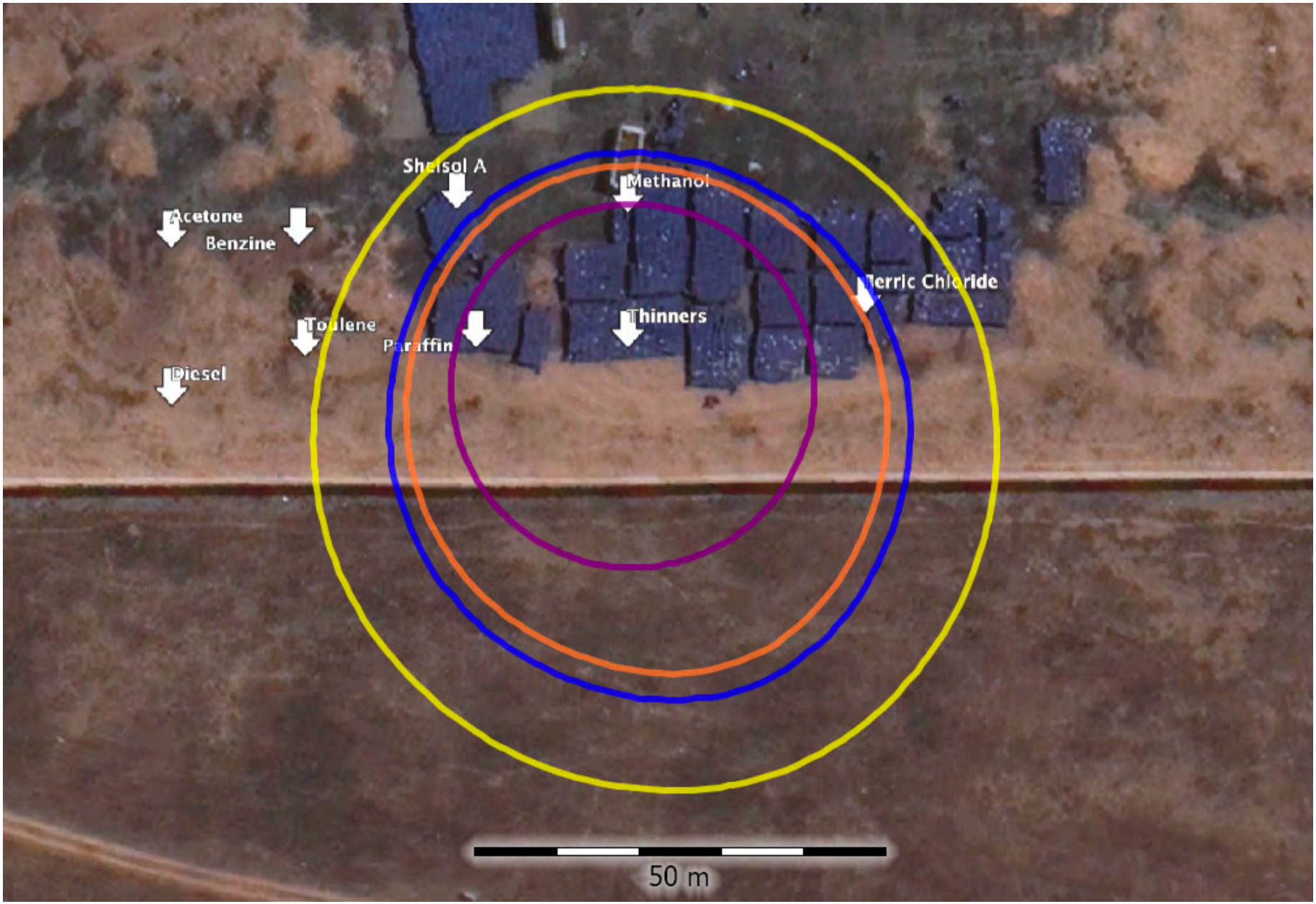


Pool Fire Consequences of a Loading Hose Rupture at the Toluene Road Tanker



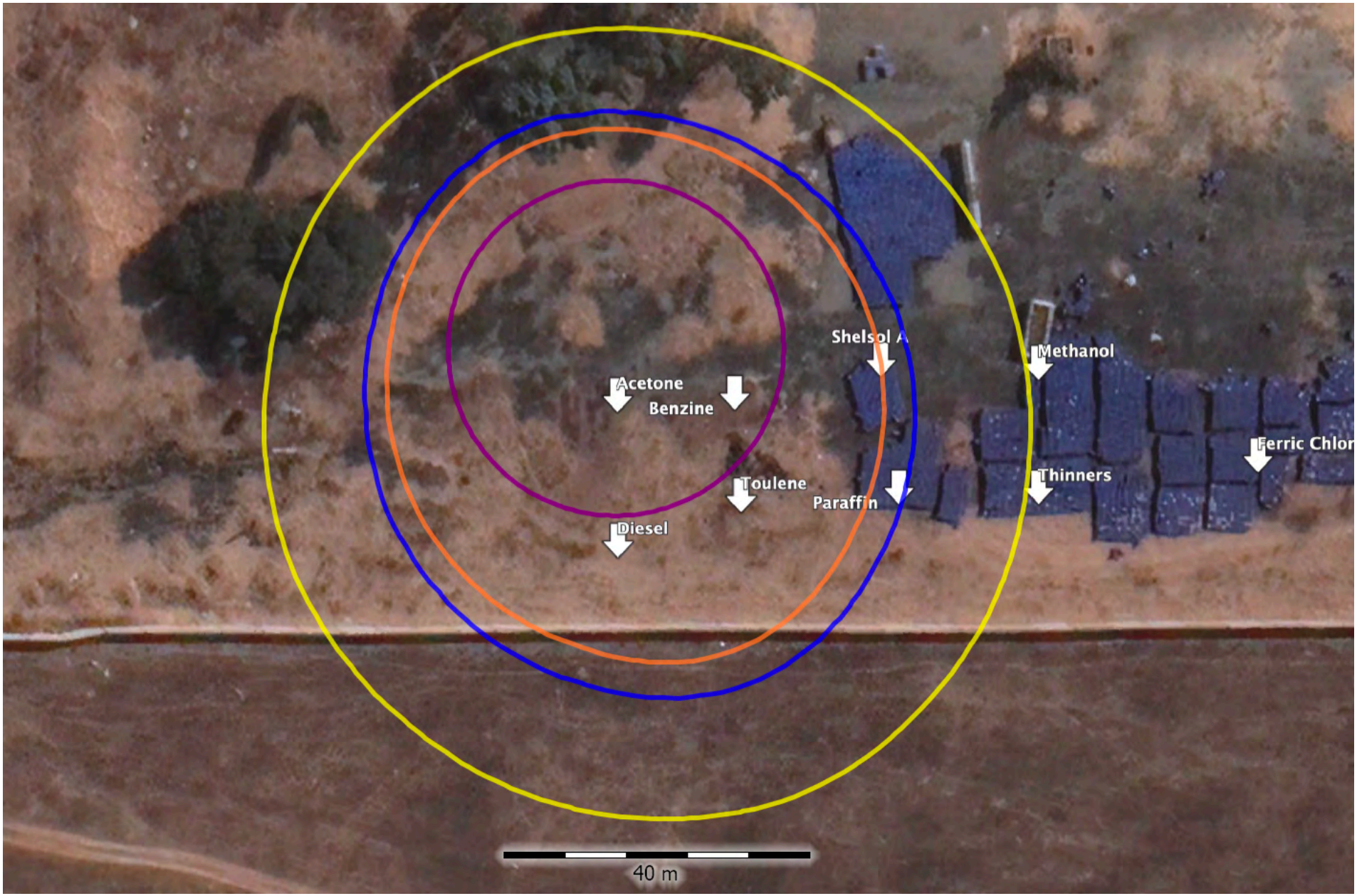
Pool Fire Consequences of a Loading Hose Rupture at the Acetone Road Tanker

Pool Fire Consequences of a Catastrophic Failure at the Diesel Road Tanker

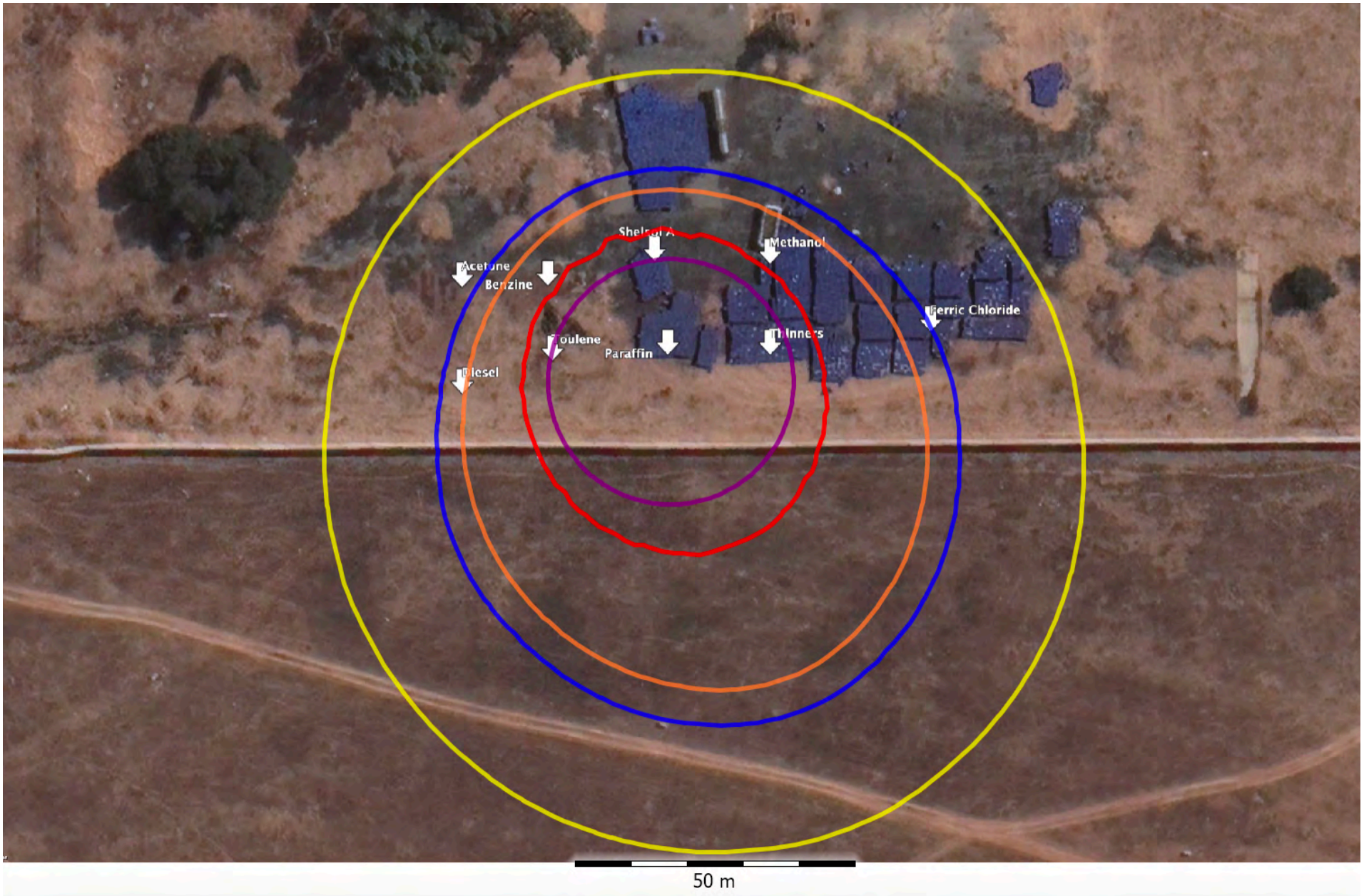


Pool Fire Consequences of a Catastrophic Failure at the Thinners Road Tanker

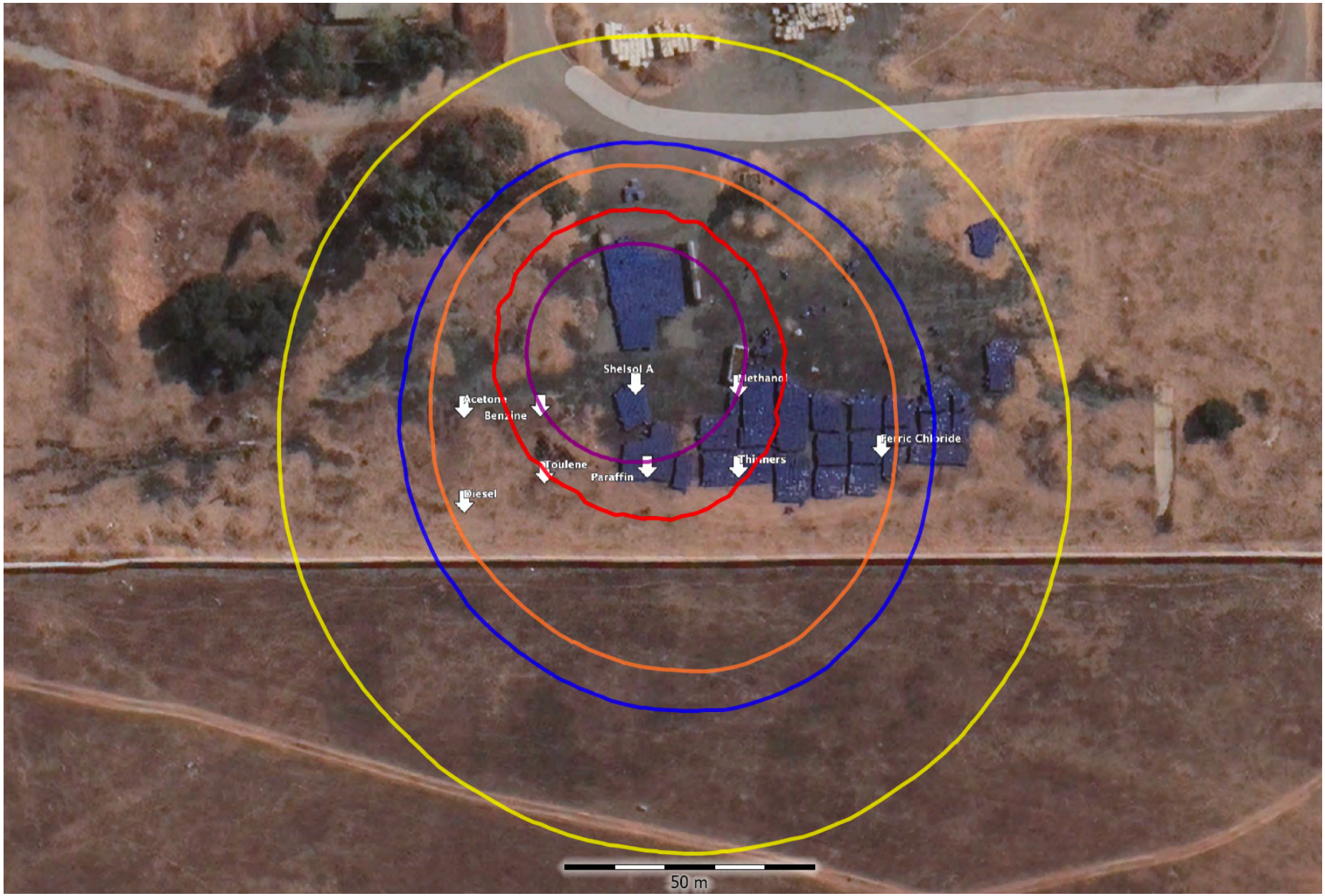
Pool Fire Consequences of a Catastrophic Failure at the Toluene Road Tanker



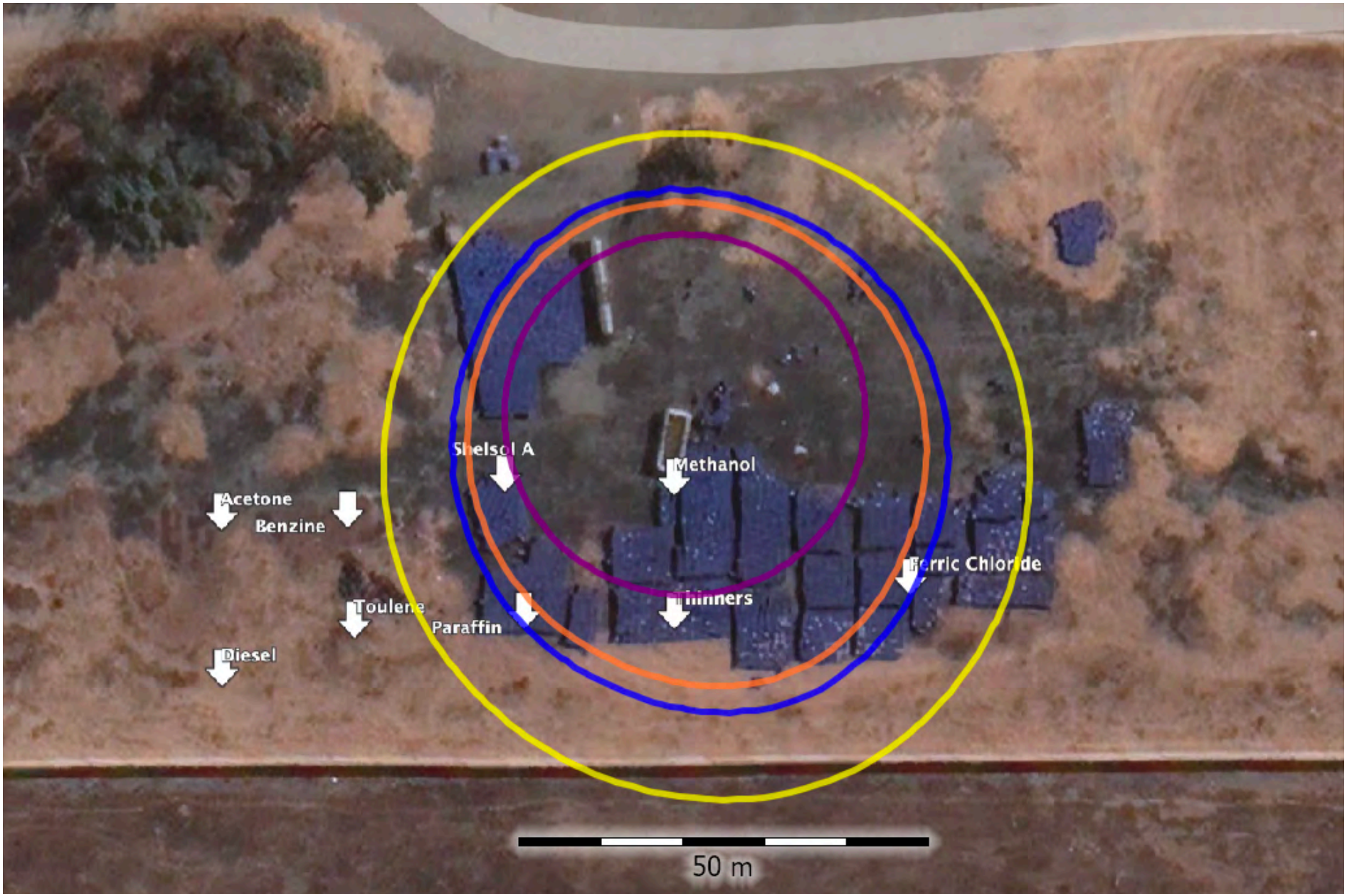
Pool Fire Consequences of a Catastrophic Failure at the Acetone Road Tanker



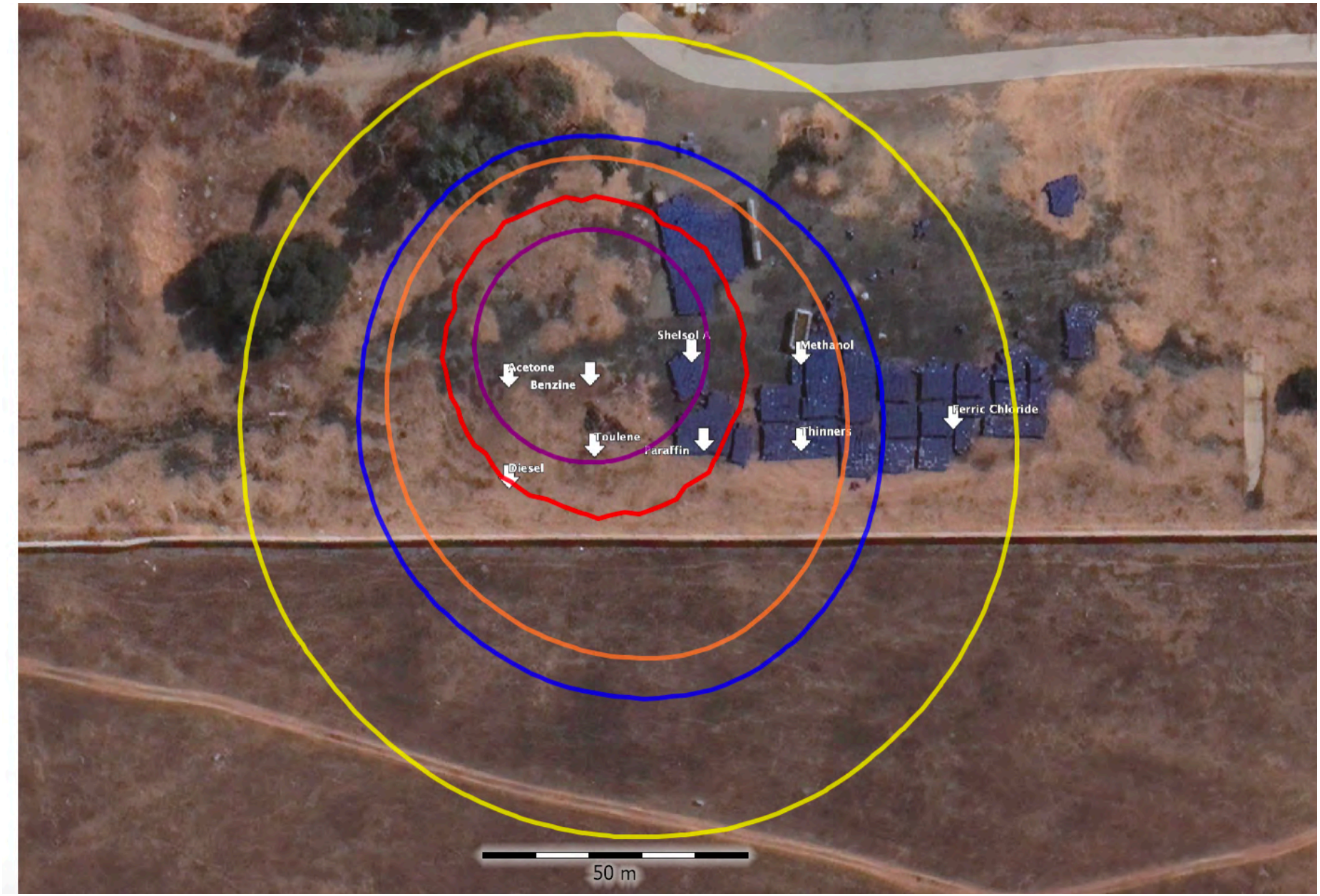
Pool Fire Consequences of a Catastrophic Failure at the Paraffin Road Tanker



Pool Fire Consequences of a Catastrophic Failure at the Shellsol A Road Tanker



Pool Fire Consequences of a Catastrophic Failure at the Methanol Road Tanker



Pool Fire Consequences of a Catastrophic Failure at the Benzine Road Tanker

5.5. Toxic Vapour Clouds

Vapour clouds originating from a toxic release can have far-reaching effects on communities or sensitive areas. There are various types of toxic vapour releases. These are as follows:

- Release of toxic gas from pressure cylinder or system;
- Spill of toxic liquid;
- Combustion of various materials;
- Various reactions between two or more chemicals.

The following table shows the effect of the exposure concentrations and duration of exposure to chlorine:

Exposure limits (ppm)	Health Effects
0.2 – 0.4	Odour threshold
< 0.5	No known acute or chronic effect
0.5	ACGIH TLV-TWA (Threshold Limit Value–Time-Weighted Average, 8-hour time-weighted average)
1	ERPG-1: The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odour.
1 – 3	Mild mucous membrane irritation, tolerated up to 1 hour
3	ERPG-2: The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.
5 – 15	Moderate irritation of the respiratory tract. The gas is very irritating, and it is unlikely that any person would remain in such an exposure for more than a very brief time unless the person is trapped or unconscious
10	The airborne concentration that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere. Values are based on a 30-minute exposure.
20	ERPG-3: The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.
30	Immediate chest pain, vomiting, dyspnoea (shortness of breath), and cough
40 - 60	Toxic pneumonitis (inflammation of the lungs) and pulmonary oedema (accumulation of fluid in the lungs)
430	Lethal over 30 minutes
1000	Fatal within minutes

There are various standards for exposure limits. These are detailed below:

Emergency Response Planning Guidelines (ERPG)

ERPGs estimate the concentrations at which most people will begin to experience health effects if they are exposed to a hazardous airborne chemical for one hour. (Sensitive members of the public - such as old, sick, or very young people - aren't covered by these guidelines and they may experience adverse effects at concentrations below the ERPG values.) A chemical may have up to three ERPG values, each of which corresponds to a

specific tier of health effects.

The three ERPG tiers are defined as follows:

- ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.
- ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.
- ERPG-1 is the maximum airborne concentration below which nearly all individuals could be exposed for up to one hour without experiencing more than mild, transient adverse health effects or without perceiving a clearly defined objectionable odour.

Threshold Limit Value (TLV)

The threshold limit value (TLV) of a chemical substance is a level to which it is believed a worker can be exposed day after day for a working lifetime without adverse effects.

Short-Term Exposure Limit (STEL)

A short-term exposure limit (STEL) is the acceptable average exposure over a short period of time, usually 15 minutes, as long as the time-weighted average is not exceeded. STEL is a term used in occupational health, industrial hygiene and toxicology.

Immediately Dangerous to Life or Health (IDLH)

The term immediately dangerous to life or health (IDLH) is defined by the US National Institute for Occupational Safety and Health (NIOSH) as exposure to airborne contaminants that is ‘likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment.’

The above values for chlorine are listed in the table below:

Substance	TLV	STEL	IDLH	ERPG 1	ERPG 2	ERPG 3
Chlorine	0.5ppm	1ppm	10ppm	1ppm	3ppm	20ppm

5.5.1. Chlorine

There are various reasons for a release of chlorine. These include the following:

- Cylinder failure;
- Pipeline rupture;
- Pipeline leak;
- Valve failure;
- Valve leak.

The chlorine installation is indoors.

The worst-case weather conditions considered for a chlorine release is F2 at night. The low temperature will cause the chlorine to stay relatively low and the wind will cause the cloud to move without dispersing the chlorine.

The modelling of the release was done in a southerly direction, as this is the predominant wind direction.

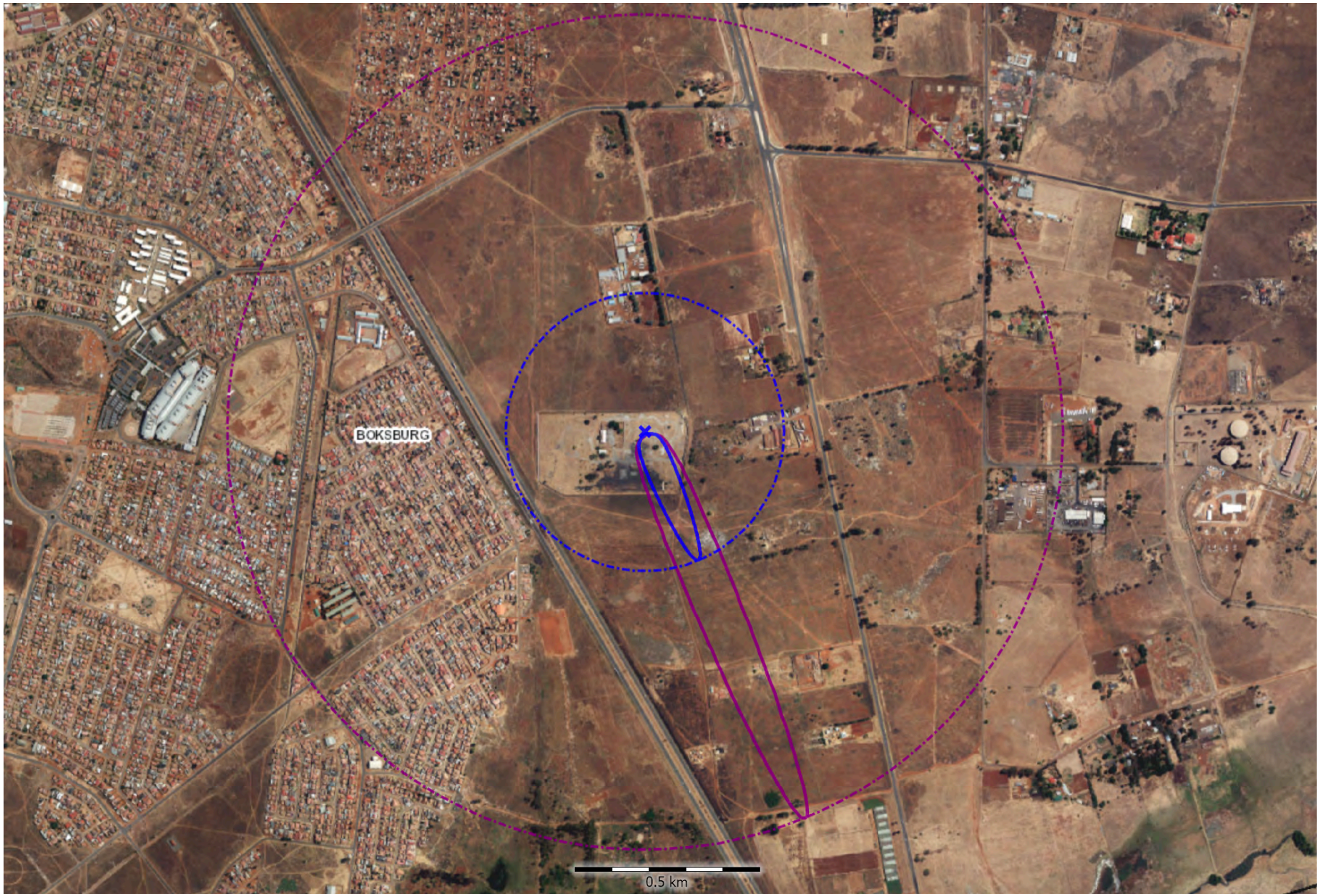
The table below shows the worst-case scenarios considered for a chlorine release. In the following figures, the ERPG 3 (purple contour) and 1% fatality (blue contour) contours are shown. The solid contour is in the predominant wind direction and the broken contour is in all wind directions.

In the event of a catastrophic cylinder failure the chlorine cloud could reach the surrounding residential areas to the east and the south.

Chlorine Toxic Release Results

Component	Scenarios	Cause of Release	ERPG 3 Distance	1% Fatality Distance
Cylinder	Catastrophic Cylinder Failure	Mechanical failure of cylinder because of overpressure in system, corrosion weakening cylinder, faulty PSV valve or the cylinder being exposed to fire and causing a BLEVE	1983m	521m
Cylinder	Valve Leak	Mechanical failure on pipeline because of lack of maintenance on equipment, faulty solenoid switch, faulty seals or corrosion in equipment	1121m	373m

Catastrophic Chlorine Cylinder Failure



Chlorine Valve Leak

5.6. Potential Offsite and Onsite Domino Effects

Domino effects occur when the failure/leak of one installation causes a catastrophic failure of another. Domino effects are considered where the consequence of a scenario exceeding 35kPa overpressure or 37kW/m^2 reaches an adjacent Major Hazard Installation.

The solvent road tankers can impact on the adjacent solvent tanks and vice versa.

The risks of these domino effects have been included in the risk calculations.

6. FREQUENCY ANALYSIS

6.1. Site Specific (Final) Frequencies

The frequencies indicated below are generic frequencies as specified in *BEVI*. Site specific frequencies are calculated utilising these generic frequencies as a base. The final frequency calculations are included in the Appendices.

6.2. Generic Equipment Failure Scenarios

The main hazard when storing toxics is the loss of containment. The toxic vapour cloud would move with the wind until the effects of dispersion dilute the cloud below the toxic concentration. A loss of containment of toxics may occur during delivery or during the operation of the refrigeration plant. The possible hazards are to be identified, together with the failure modes and the possible initiating events that may cause such a failure. Failure rates were obtained from *'RIVM - Reference Manual Bevi Risk Assessments'.*

6.3. Blocking Systems

Blocking systems are used to limit the released quantity following a loss of containment. A blocking system consists of a detection system, for example gas detection, combined with shut-off valves. The shut-off valves can be closed automatically or manually. The effectiveness of a blocking system is determined by various factors, such as the position of gas detection monitors and their distribution throughout the various wind directions. Furthermore, the detection limit and the response time of the system as well as the operator's intervention time are also relevant.

The following conditions must be met to include the operation of a blocking system in the risk analysis:

- An automatic detection system must be present that results in signalling within the control room, or automatic control of the blocking valves. An example of this is a gas detection system with sufficiently sensitive monitors and adequate detection points. In the case of signalling in the control room this room must be continuously staffed.
- The detection system and the shut-off valves must regularly be tested.

The default values specified here for three representative systems were used as a guideline:

1. Automatic blocking system

An automatic blocking system is a system in which the detection of the leak and the closing of the blocking valves take place automatically. Action by an operator is not necessary.

2. Semi-automatic blocking system

A semi-automatic blocking system is a system in which the detection of the leak takes place automatically and leads to an alarm signal in a continuously staffed control room. After validation of the signal the operator closes the blocking valves by actuating a switch in the control room. The probability of failure per operation is equal to 0.01, the time required for closing the blocking valves is equal to 10 minutes.

3. Non-automated blocking system

A non-automated blocking system is a system in which the detection of the leak takes place automatically and leads to an alarm signal in a continuously staffed control room. The operator does not have the facilities to shut off the blocking valves by actuating a switch in

the control room but must take action outside the control room. For such a system the time required to effectively perform the required actions is so long that there is no effect on the QRA, given the maximum duration of an outflow of 30 minutes that is generally applied.

The installations were modelled as having a non-automated blocking system. This is discussed in Section 2 of the report.

6.4. Pressure Vessels

The scenarios considered under this category are partial failure and catastrophic failure. Factors that have been identified as influencing the integrity of cylinders are related to design, inspection, maintenance, and corrosion.

- A pressure cylinder is a storage vessel that contains a fluid under a design pressure equal to, or greater than 50kPa.

The failure frequencies are as follows:

	Frequency (per annum)
Instantaneous release of entire contents	5 x 1.0e-7
Release of entire contents in 10 minutes in a continuous and constant stream	5 x 1.0e-7
Continuous release of contents from a hole with an effective diameter of 10mm	1x 1.0e-5

6.5. Atmospheric Tanks

The scenarios considered under this category are partial failure and catastrophic failure. Factors that have been identified as influencing the integrity of cylinders are related to design, inspection, maintenance, and corrosion.

- An atmospheric vessel is a storage vessel that contains a fluid under a design pressure equal to, or less than 50kPa.

The scenarios and failure frequencies for an atmospheric storage tank apply to tanks with welded stumps, mounting plates, pipe connections up to the first flange and instrumentation pipes.

The failure frequencies for above-ground atmospheric tanks are as follows:

	Frequency (per annum)
Instantaneous release of entire contents	5 x 1.0e-6
Release of entire contents in 10 minutes in a continuous and constant stream	5 x 1.0e-6
Continuous release of contents from a hole with an effective diameter of 10mm	2x 1.0e-4

6.6. Valves

The failure frequency of valves is dependent on the valve and the leak size. The ratio of the leak size *(d)* to the valve size *(D)* should firstly be determined to determine the valve failure frequency per year, for example:

d/D	Leak Frequency (per valve per year)
0.1	1.4 x 1.0e-4
0.2	1.9 x 1.0e-4
0.5	2.5 x 1.0e-4
1.0	3.0 x 1.0e-4

6.7. Flanges

Pressure surge or significant deviations of pressure or temperature may cause a flanged joint to be over stressed, resulting in a small leak. Larger holes through to complete line fracture may conceivably result from mechanical impact or pressure surge. These events are likely to be detected more rapidly, resulting in a quicker isolation of the leak.

The flange failures per year vary greatly with the flange and gasket quality. A reasonable average based on current practices is summarised below:

Pipe Diameter (mm)	Equivalent Hole Size (mm)	Leak Frequency (per item per year)
100	5	1 x 1.0e-5
> 100	25	1 x 1.0e-6

6.8. Ignition Probability of Flammable Gases

6.8.1. Direct Ignition

The probability of direct ignition depends on the type of installation (stationary installation or transport unit), the substance category and the outflow quantity.

- Values for stationary installations are given in the table below;
- Values for transport units are given in the next table;
- Definition of the substance category is given in the third table.

Substance Category	Source Term Continuous	Source Term Instantaneous	Probability of Direct Ignition
Category 0 Average/High reactivity	<10 kg/s 10 – 100 kg/s >100 kg/s	<1000 kg 1000 – 10000 kg >10000 kg	0.2 0.5 0.7
Category 0 Low reactivity	<10 kg/s 10 – 100 kg/s >100 kg/s	<1000 kg 1000 – 10000 kg >10000 kg	0.2 0.4 0.9
Category 1	All flow rates	All quantities	0.065
Category 2	All flow rates	All quantities	0.01
Category 3, 4	All flow rates	All quantities	0

Substance Category	Transport Unit	Scenario	Probability of Direct Ignition
Category 0	Road tanker	Continuous	0.1
	Road tanker	Instantaneous	0.4
	Tank wagon	Continuous	0.1
	Tank wagon	Instantaneous	0.8
	Ships – gas tankers	Continuous, 180m^3	0.7
	Ships – gas tankers	Continuous, 90m^3	0.5
	Ships – semi gas tankers	Continuous	0.7
Category 1	Road tanker, tank Ships	Continuous, instantaneous	0.065
Category 2	Road tanker, tank ships	Continuous, instantaneous	0.01
Category 3, 4	Road tanker, tank ships	Continuous, instantaneous	0

Category	WMS Category	Limits
Category 0	Extremely flammable	Liquid substances and preparations with a flash point lower than 0°C and a boiling point (or the start of a boiling range) less than or equal to 35°C. Gaseous substances and preparations which may ignite at normal temperature and pressure when exposed to air.
Category 1	Highly flammable	Liquid substances and preparations with a flash point below 21°C, which are not extremely flammable
Category 2	Flammable	Liquid substances and preparations with a flash point greater than or equal to 21°C and less than or equal to 55°C.
Category 4	Flammable	Liquid substances and preparations with a flash point greater than 55°C and less than or equal to 100°C.
Category 4	Flammable	Liquid substances and preparations with a flash point greater than 100°C.

6.8.2. Delayed Ignition

The probability of delayed ignition depends on the end point of the calculation. In the calculation of the location-specific risk only ignition sources on the site of the establishment are considered. Ignition sources outside the establishment are ignored; it is assumed that if the cloud does not ignite on site and a flammable cloud forms outside the establishment, ignition always occurs at the biggest cloud size. In the calculation of societal risk, all ignition sources are considered, including population. If ignition sources are absent, it is possible in the societal risk calculation that the flammable cloud does not ignite (see the table below).

Substance Category	Probability of Delayed Ignition for the Biggest Cloud Size, PRm	Probability of Delayed Ignition, GR
Category 0	$1 - P_{direct\ ignition}$	Ignition sources
Category 1	$1 - P_{direct\ ignition}$	Ignition sources
Category 2	0	0
Category 3	0	0
Category 4	0	0

7. RISK CALCULATIONS

Consequence analysis has been the main focus of the report up to now while the consideration of probability has not been discussed. Risk is defined as consequence times probability.

Probability is defined as the risk of an event occurring and impacting on the individual and society at large.

7.1. Location Specific Individual Risk Levels

The likelihood that a person in some fixed relation to a hazard (e.g., at a particular location, level of vulnerability, protection, and escape) might sustain a specific level of harm.

The frequency at which an individual may be expected to sustain a given level of harm from the realisation of specified hazards. For example, there may be an individual risk of one-in-a-million that a particular person would be killed by an explosion at a major hazard near their home for every year that a person lives at that address. *[HSE Societal Risk: Initial briefing to Societal Risk Technical Advisory Group: p60].*

7.2. Employee Risk

Scenarios considered regarding risk to employees are fires and toxic release due to plant failures. Employees and the public are indoors and outdoors during the day and major events associated with these installations would occur outside of the building in the vicinity of the installation areas. When exposed to hazards such as fires, people who are indoors (sheltered) will generally be less vulnerable than those outdoors (unsheltered). The risks should not be more than one-in-a-thousand (1.0e-3 per year).

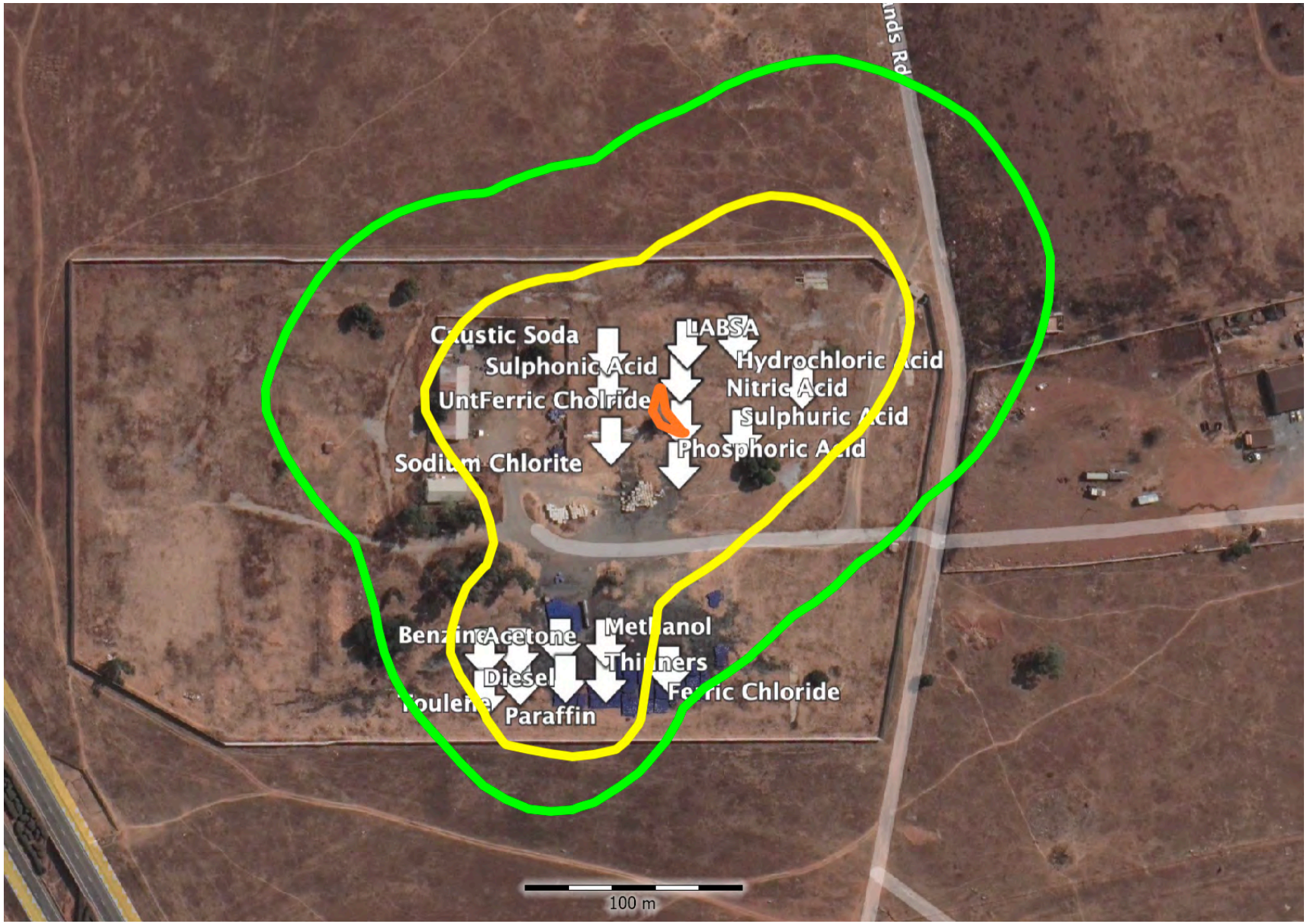
7.3. Individual Risk

This Risk Assessment has modelled the effects of the flammable installations. The results are as follows:

- The 1.0e-5 (one-in-a-hundred thousand) orange contour, is confined to the chlorine installation.
- The 1.0e-6 (one-in-a-million) yellow contour, extends 8m past the southern boundary at the solvents tank farm. The contour extends for about 29m past the northern boundary at the chlorine installation.
- The 3.0e-7 (one-in-thirty million) green contour, extends 32m past the southern boundary at the solvents tank farm. The contour extends for about 90m past the northern boundary at the chlorine installation.

The contours do not reach any residential areas.

The risk contours are acceptable for this site.



Individual Risk

7.4. Risk Levels and Ranking

Risk Levels and Ranking

Individual risk levels at several important points around the installations:

At Office

	Scenario	Contribution %	Risk Value
1.	Catastrophic Chlorine Cylinder Failure	59.3	2.11e-07
2.	Small Leak Chlorine Cylinder	40.7	1.45e-07

At Neighbour (East)

	Scenario	Contribution %	Risk Value
1.	Catastrophic Chlorine Cylinder Failure	56.6	1.13e-07
2.	Small Leak Chlorine Cylinder	43.4	8.62e-08

At Neighbour (North)

	Scenario	Contribution %	Risk Value
1.	Catastrophic Chlorine Cylinder Failure	54	2.78e-07
2.	Small Leak Chlorine Cylinder	46	2.38e-07

At Neighbour (South)

	Scenario	Contribution %	Risk Value
1.	Catastrophic Failure Toluene Road Tanker	40.9	3.02e-07
2.	Catastrophic Chlorine Cylinder Failure	20.5	1.51e-07
3.	Small Leak Chlorine Cylinder	14.9	1.10e-07
4.	Catastrophic Failure Shellsol A Road Tanker	11.5	8.50e-08
5.	Catastrophic Failure Paraffin Road Tanker	6.64	4.90e-08
6.	Loading Hose Rupture Toluene Road Tanker	2.19	1.62e-08
7.	Catastrophic Failure Thinners Road Tanker	1.79	1.32e-08
8.	Catastrophic Failure Benzine Road Tanker	0.608	4.49e-09
9.	Catastrophic Failure Diesel Road Tanker	0.567	4.18e-09
10.	Loading Hose Rupture Paraffin Road Tanker	0.474	3.50e-09

At Neighbour (West)

	Scenario	Contribution %	Risk Value
1.	Catastrophic Chlorine Cylinder Failure	65.3	3.85e-08
2.	Small Leak Chlorine Cylinder	34.7	2.04e-08

At Residential Area (West)

	Scenario	Contribution %	Risk Value
1.	Catastrophic Chlorine Cylinder Failure	100	5.80e-09

Risk Ranking

	Scenario	Contribution %	Risk Value
1.	Catastrophic Chlorine Cylinder Failure	50.2	8.45e-06
2.	Catastrophic Failure Shellsol A Road Tanker	14.6	2.45e-06
3.	Catastrophic Failure Benzine Road Tanker	7.97	1.34e-06
4.	Catastrophic Failure Toluene Road Tanker	5.89	9.90e-07
5.	Catastrophic Failure Acetone A Road Tanker	5.3	8.91e-07
6.	Catastrophic Failure Methanol Road Tanker	4.75	7.99e-07
7.	Catastrophic Failure Thinners Road Tanker	3.44	5.78e-07
8.	Loading Hose Rupture Benzine Road Tanker	1.04	1.74e-07
9.	Loading Hose Rupture Thinners Road Tanker	1.02	1.72e-07
10.	Loading Hose Rupture Toulene Road Tanker	1.02	1.72e-07

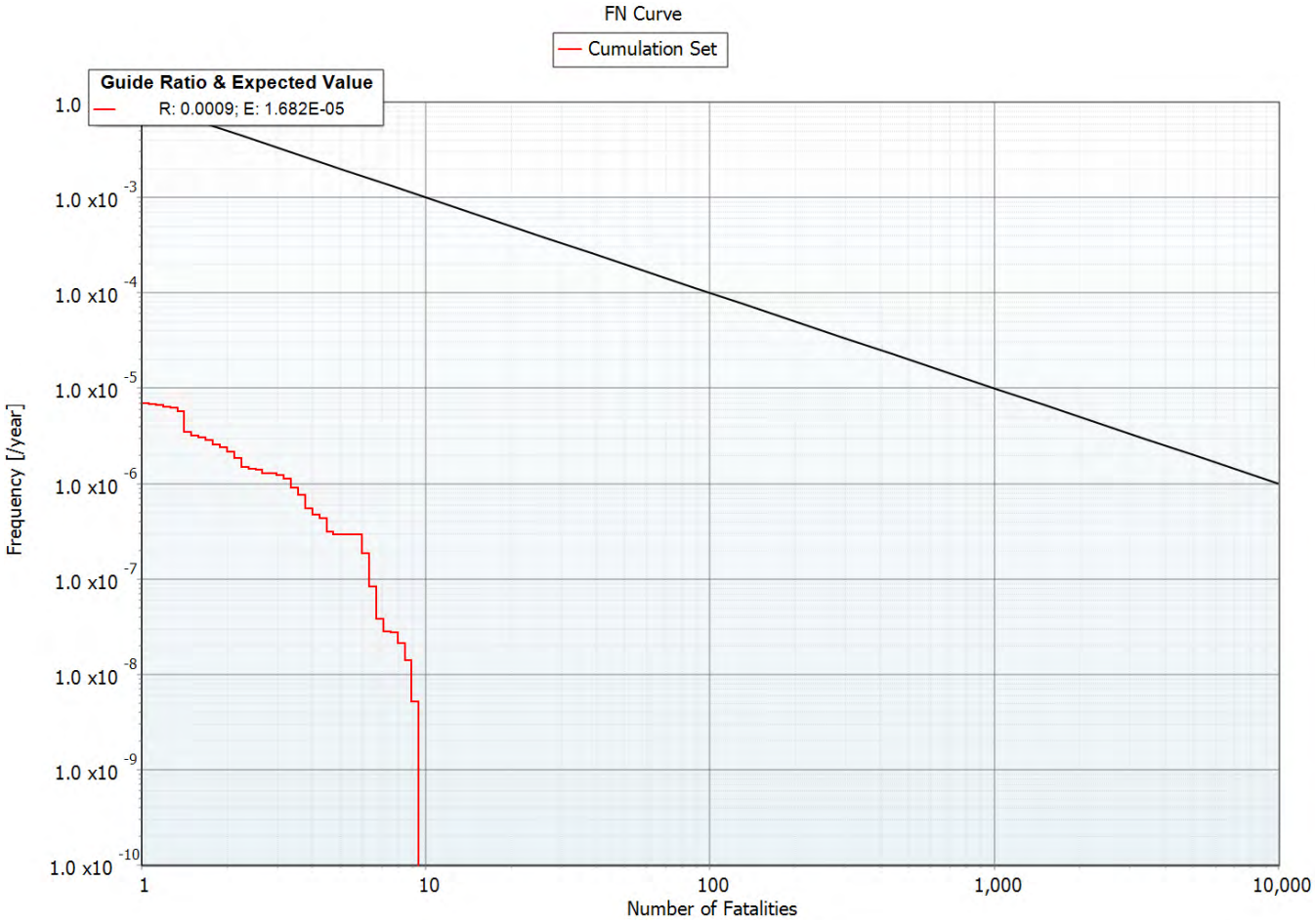
7.5. Societal Risk

Societal risk is defined as the relationship between frequency and the number of people suffering from a specified level of harm in a given population from the realisation of specified hazards *[Jones, 1985].* Societal risk evaluation is concerned with estimation of the chances of more than one individual being harmed simultaneously by an incident. The likelihood of the primary event (an accident at a major hazard installation) is still a factor, but the consequences are assessed in terms of level of harm and the numbers affected (severity), to provide an idea of the scale of an accident in terms of numbers killed or harmed.

Societal risk is dependent on the risks from the substances and processes located on a major hazard installation. A key factor in estimating societal risk is the population around the site, in particular its location and density. For example, the more (occupied) buildings in any particular area, the more people could be harmed by a flammable gas cloud passing through that area. For an installation with a population located in a specific compass direction, the chance of a flammable gas release would depend on the probability of drift in that direction.

Scenarios to be included in a risk assessment can be characterised as having a frequency (F) and a consequence (N, number of casualties). *F* is used to denote the sum of the frequencies of all the individual events that could lead to *N* or more fatalities (hence the reference to *FN curves*).

Societal risk can be represented by FN curves, which are plots of the cumulative frequency (F) of various accident scenarios against the number (N) of casualties associated with the modelled incidents. The plot is cumulative in the sense that, for each frequency, N is the number of casualties that could be equalled or exceeded. Often ‘casualties’ are defined in a risk assessment as fatal injuries, in which case N is the number of people that could be killed by the incident.



FN Curves for the Solvent and Toxic Installation

As can be seen on the graph above, the societal risk is less than 1.e-05 of one fatality, which is acceptable.

8. RISK JUDGEMENT

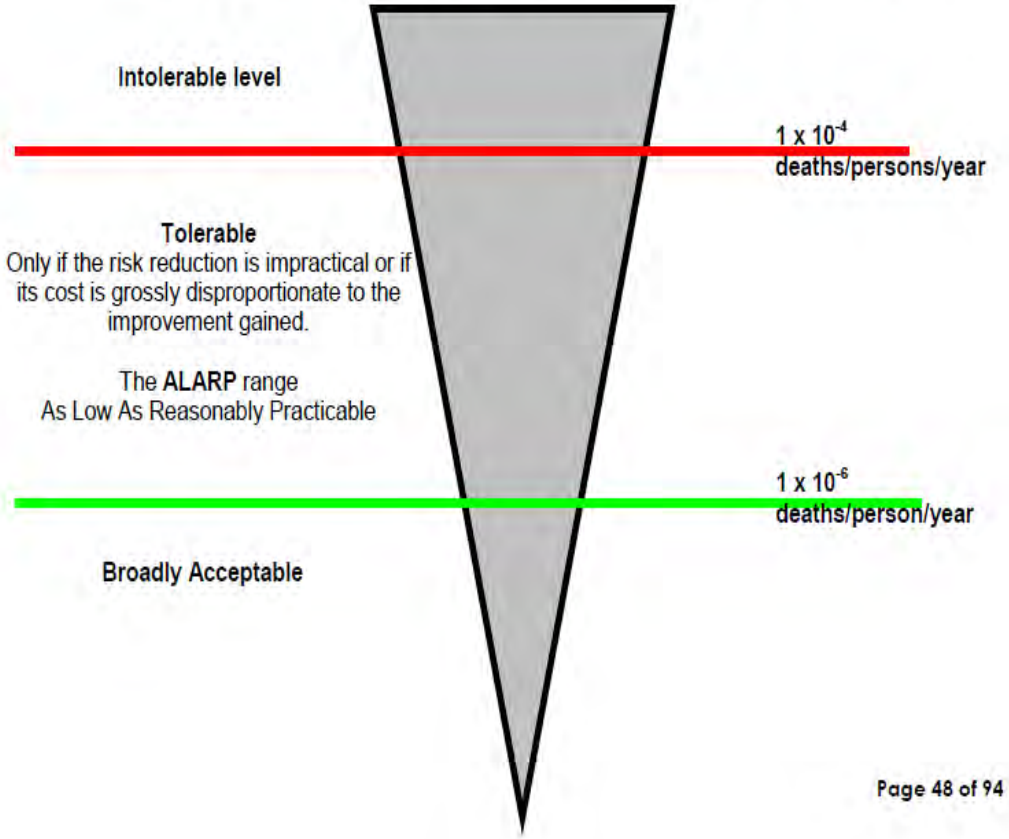
8.1. Risk Judgement Criteria

This Assessment indicates in a clear statement whether the risks or aspects of the risks are intolerably high, tolerable provided ALARP or broadly acceptable, both in terms of location specific, individual risk and societal risk.

The risk evaluation criteria are set out as follows:

- A risk of death for members of the public greater than 1.0e-4 (one-in-ten thousand) per year is considered intolerable.
- A risk of death below 1.0e-6 (one-in-a-million) per year for members of the public is considered broadly acceptable provided sensitive or vulnerable receptors in the vicinity have been considered.
- Risks between 1.0e-6 per year and 1.0e-4 per year for members of the public can be considered tolerable, provided the risks have been reduced so far as is reasonably practicable, i.e. this is referred to as the ALARP region.

Figure 1 - The public ALARP risk decision making framework



The individual risks at the Richbay site are ‘Broadly Acceptable’, as they fall within the ALARP range. The risks off site are ‘Broadly Acceptable’.

9. RISK TREATMENT

9.1. Major Hazard Installation

The scenario contributing the most towards the total risk at the facility is a catastrophic failure of the Shellsol A road tanker.

9.2. Risk Reduction

The recommendations are as follows:

- Good housekeeping must always be observed on site;
- Emergency Plan must be compiled for the site and the risks identified in this report must be addressed;
- Venting on solvent tanks to be designed by an engineer;
- Installations to comply with the applicable SANS standards and Municipal Bylaws;
- Fire protection for storage, manufacturing and decanting area to be designed by suitably qualified and experienced organisations;
- Staff to be trained in the safe handling of the various chemicals on site;
- Once the design of the facility has been completed the MHI Risk Assessment needs to be reviewed in order to incorporate the manufacturing, decanting areas as well as the safety systems to reduce the risks of the various installations;
- Chlorine installation to be designed as to comply with international best practices;
- Strict access control to be implemented on site;
- Maintenance on the equipment to be done as per the manufacturers requirements;
- Emergency Plan must comply with the MHI Regulations;
- Emergency Plan must comply with SANS 1514 Codes;
- This MHI report must be distributed to Local, Provincial and National Government as per the MHI Regulations.

9.3. ALARP Conclusions

If the installations are maintained as per the relevant SANS Codes, the necessary safety equipment and procedures are in place and the personnel are trained to deal with emergencies, risks imposed by the installations will always be acceptable.

10. LAND USE PLANNING

Where a site near to a major hazard chemical installation or pipeline is being developed, the City Council's Planning Authority has a statutory duty to refer to this Risk Assessment. This report will help the Planning Authority to 'Advise Against' or 'Don't Advise Against' the granting of planning permission on health and safety grounds that arise from the possible consequences of a major accident at the hazardous installation.

This report is designed to help planners, developers and others who want to work out for themselves about a planning proposal. In some cases, it may be that working through the report will allow one to modify the size, layout or location of a proposed development.

This report was compiled as per SANS 1461:2018 Codes of Practice. Land use planning is based on the United Kingdom's Health and Safety Executive *HSEs 'Planning Advice for Developments near Hazardous Installations (PADHI)'*.

10.1. The Principles Behind Land Use Planning Methodology

- The risk considered is the residual risk which remains after all reasonably practicable preventative measures have been taken to ensure compliance with the requirements of the Major Hazard Regulations.
- Advice takes account of risk as well as hazard, that is the likelihood of an accident as well as its consequences.
- Account is taken of the size and nature of the proposed development, the inherent vulnerability of the exposed population and the ease of evacuation or other emergency procedures for the type of development proposed. Some categories of development (e.g. schools and hospitals) are regarded as more sensitive than others (e.g. light industrial) and advice is weighted accordingly.
- Consideration of the risk of serious injury, including that of fatality, attaching weight to the risk where a proposed development might result in a large number of casualties in the event of an accident.

10.2. Introduction to PADHI

The Risk Assessor sets a consultation distance (CD) around major hazard sites and pipelines after assessing the risks and likely effects of major accidents at the installation or pipeline.

Major hazards comprise a wide range of chemical process sites, fuel and chemical storage sites, and pipelines. The CDs are based on scientific knowledge using quantitative risk assessments.

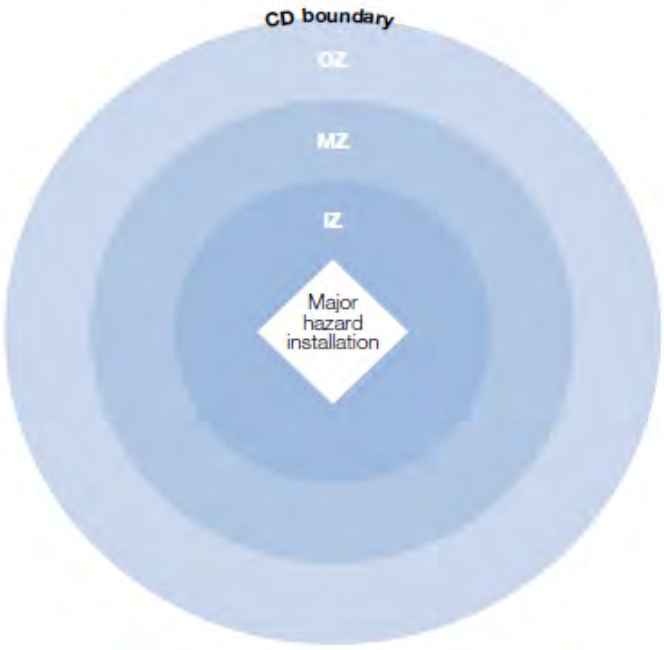
PADHI uses two inputs to a decision matrix to generate the CDs or 'Restricted Development Distances'

- The zone in which the development is located of the three zones (that make up the CD);
- The 'sensitivity level' of the proposed development (see 'Development type tables').

10.3. Zone Mapping

PADHI uses a 'three-zone' system. ('inner' (IZ), 'middle' (MZ) and 'outer' (OZ);) The zones are determined by a detailed assessment of the risks of the installation or pipeline which takes the following factors into account:

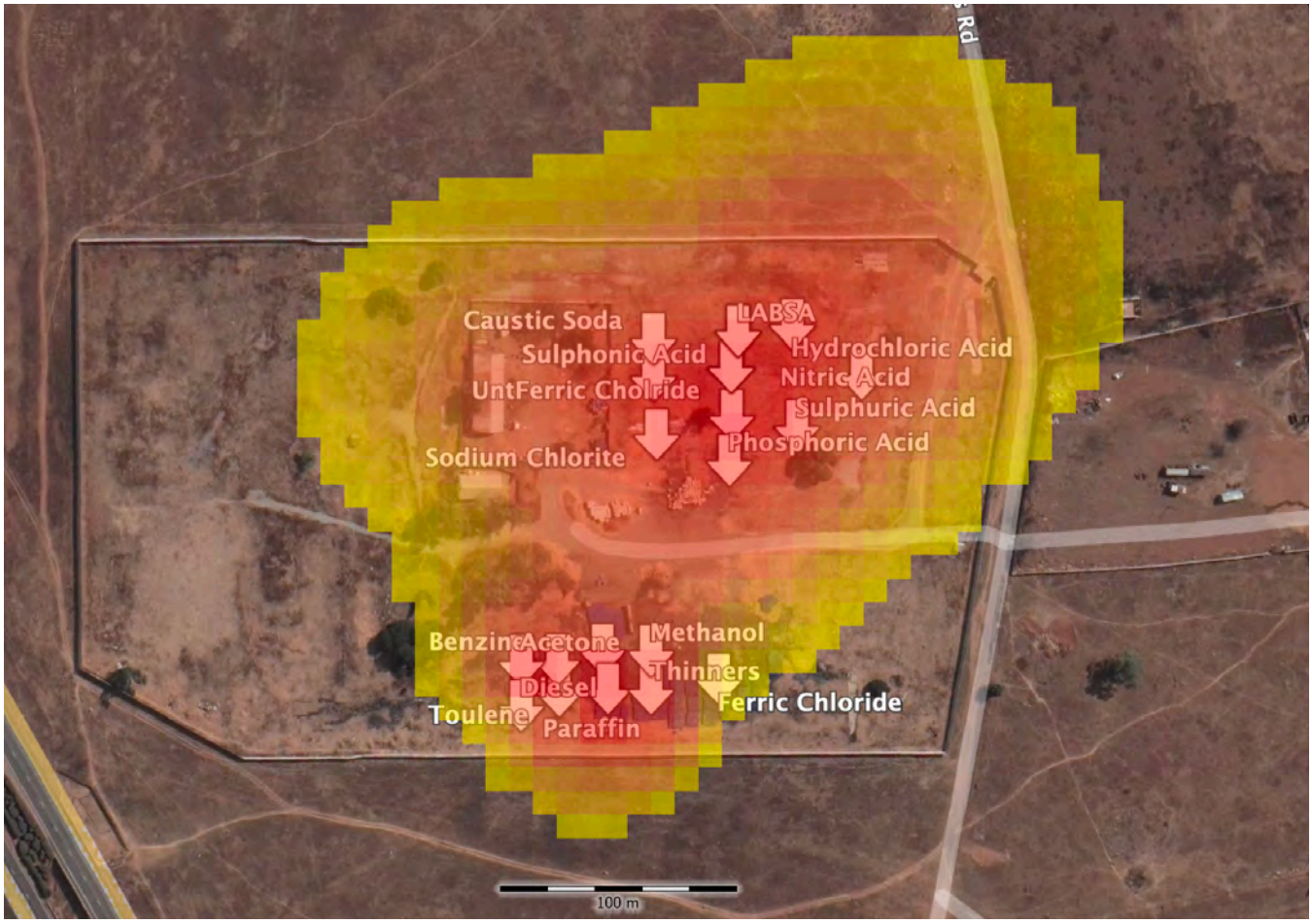
- The hazard ranges and consequences of the toxic and/or flammable substances present;
- The volume of those substances for which the site has consent;
- The method of storage. The risks and hazards from the major hazard are greatest in the inner zone, so the restrictions on development are strictest. The CD is all the land enclosed by all the zones and the installation itself.
  - Inner zone includes all areas where risk is > 10 chances per million per annum. (Red Contour)
  - Middle zone > 1 chance per million per annum. (Orange Contour)
  - Outer zone > 0.3 chances per million per annum. (Yellow Contour)



Three Zone Map

The development zones around the installations are indicated on the map below.

- The inner zone is confined to the site.
- The middle zone extends 23m past the southern boundary and 36m past the northern boundary.
- The outer zone extends a further 35m past the southern boundary and 86m past the northern boundary.



Current Installations Development Zone Map

10.4. Development 'Sensitivity Levels

The sensitivity levels are based on a clear rationale to allow progressively more severe restrictions to be imposed as the sensitivity of the proposed development increases. There are four sensitivity levels:

- Level 1 – Based on normal working population;
- Level 2 – Based on the general public – at home and involved in normal activities;
- Level 3 – Based on vulnerable members of the public (children, those with mobility difficulties or those unable to recognise physical danger);
- Level 4 – Large examples of Level 3 and very large outdoor examples of Level 2.

The tables in the Appendices expand on the four basic development types.

10.5. Decision Matrix

Having determined which risk zone, the surrounding developments fall into and the sensitivity level of these developments, the matrix below can be utilised to decide whether one should advise for or against a specific development. Beyond the outer risk zone there are no specified restrictions on developments.

Level of Sensitivity	Development in Inner Zone	Development in Middle Zone	Development in Outer Zone
Level 1	Do not Advise Against (DAA)	Do not Advise Against (DAA)	Do not Advise Against (DAA)
Level 2	Advise Against (AA)	Do not Advise Against (DAA)	Do not Advise Against (DAA)
Level 3	Advise Against (AA)	Advise Against (AA)	Advise Against (AA)
Level 4	Advise Against (AA)	Advise Against (AA)	Advise Against (AA)

Decision Matrix

10.6. Site Specific Zoning

- The area surrounding the site is undeveloped industrial.
- All the existing developments are Level 1 and 2.
- The zoning around the Richbay site is correct.

10.7. Land Use Conflicts

There are no land use conflicts at the site.

11. EMERGENCY RESPONSE DATA

11.1. Emergency Plan

Document Name	**None Available**
Date of Document	N/A
Fire Fighting Addressed	N/A
Emergency Evacuation Addressed	N/A
Statutory Requirements	N/A

12. CONCLUSION

12.1. Major Hazard Installation

This Assessment established that an incident involving the proposed installations at the premises of Richbay in Vosloorus could impact past the boundaries. The risks associated with this MHI were found to be acceptable.

A site is deemed to be an MHI if more than the prescribed quantity is stored as per the General Machinery Act or if a product is stored, handled or produced which has the potential to cause a major incident as per the Operational Health and Safety Act.

12.2. 1% Consequence Lethality Distances

Component	Scenarios	1% Fatality Distance
Bulk Solvent Storage Tanks		
Methanol Tank	Catastrophic Tank Failure/ Leak	9m
Methanol Tank	Small Leak	3m
Thinners Tank	Catastrophic Tank Failure/ Leak	9m
Thinners Tank	Small Leak	4m
Paraffin Tank	Catastrophic Tank Failure/ Leak	12m
Paraffin Tank	Small Leak	3m
Diesel Tank	Catastrophic Tank Failure/ Leak	12m
Diesel Tank	Small Leak	3m
Shellsol A Tank	Catastrophic Tank Failure/ Leak	14m
Shellsol A Tank	Small Leak	3m
Benzine Tank	Catastrophic Tank Failure/ Leak	13m
Benzine Tank	Small Leak	3m
Toluene Tank	Catastrophic Tank Failure/ Leak	12m
Toluene Tank	Small Leak	3m
Acetone Tank	Catastrophic Tank Failure/ Leak	10m
Acetone Tank	Small Leak	3m
Solvent Road Tanker		
Methanol Road Tanker	Catastrophic Tanker Failure	39m
Methanol Road Tanker	Loading Hose Leak	4m
Methanol Road Tanker	Loading Hose Rupture	25m
Thinners Road Tanker	Catastrophic Tanker Failure	39m
Thinners Road Tanker	Loading Hose Leak	4m
Thinners Road Tanker	Loading Hose Rupture	26m
Paraffin Road Tanker	Catastrophic Tanker Failure	63m
Paraffin Road Tanker	Loading Hose Leak	5m
Paraffin Road Tanker	Loading Hose Rupture	26m
Diesel Road Tanker	Catastrophic Tanker Failure	59m
Diesel Road Tanker	Loading Hose Leak	5m
Diesel Road Tanker	Loading Hose Rupture	26m
Shellsol A Road Tanker	Catastrophic Tanker Failure	74m
Shellsol A Road Tanker	Loading Hose Leak	5m
Shellsol A Road Tanker	Loading Hose Rupture	24m
Benzine Road Tanker	Catastrophic Tanker Failure	68m
Benzine Road Tanker	Loading Hose Leak	5m
Benzine Road Tanker	Loading Hose Rupture	26m
Toluene Road Tanker	Catastrophic Tanker Failure	62m
Toluene Road Tanker	Loading Hose Leak	5m

Toluene Road Tanker	Loading Hose Rupture	27m
Acetone Road Tanker	Catastrophic Tanker Failure	47m
Acetone Road Tanker	Loading Hose Leak	5m
Acetone Road Tanker	Loading Hose Rupture	24m
Chlorine Cylinder		
1-Ton Chlorine Cylinder	Catastrophic Cylinder Failure	521m
1-Ton Chlorine Cylinder	Cylinder Valve Leak	373m

12.3. Risk Level Posed to Various Populations

Individual risk levels at several important points around the installations:

At Office

	Scenario	Contribution %	Risk Value
1.	Catastrophic Chlorine Cylinder Failure	59.3	2.11e-07
2.	Small Leak Chlorine Cylinder	40.7	1.45e-07

At Neighbour (East)

	Scenario	Contribution %	Risk Value
1.	Catastrophic Chlorine Cylinder Failure	56.6	1.13e-07
2.	Small Leak Chlorine Cylinder	43.4	8.62e-08

At Neighbour (North)

	Scenario	Contribution %	Risk Value
1.	Catastrophic Chlorine Cylinder Failure	54	2.78e-07
2.	Small Leak Chlorine Cylinder	46	2.38e-07

At Neighbour (South)

	Scenario	Contribution %	Risk Value
1.	Catastrophic Failure Toluene Road Tanker	40.9	3.02e-07
2.	Catastrophic Chlorine Cylinder Failure	20.5	1.51e-07
3.	Small Leak Chlorine Cylinder	14.9	1.10e-07
4.	Catastrophic Failure Shellsol A Road Tanker	11.5	8.50e-08
5.	Catastrophic Failure Paraffin Road Tanker	6.64	4.90e-08
6.	Loading Hose Rupture Toluene Road Tanker	2.19	1.62e-08
7.	Catastrophic Failure Thinners Road Tanker	1.79	1.32e-08
8.	Catastrophic Failure Benzine Road Tanker	0.608	4.49e-09
9.	Catastrophic Failure Diesel Road Tanker	0.567	4.18e-09
10.	Loading Hose Rupture Paraffin Road Tanker	0.474	3.50e-09

At Neighbour (West)

	Scenario	Contribution %	Risk Value
1.	Catastrophic Chlorine Cylinder Failure	65.3	3.85e-08
2.	Small Leak Chlorine Cylinder	34.7	2.04e-08

At Residential Area (West)

	Scenario	Contribution %	Risk Value
1.	Catastrophic Chlorine Cylinder Failure	100	5.80e-09

Risk Ranking

	Scenario	Contribution %	Risk Value
1.	Catastrophic Chlorine Cylinder Failure	50.2	8.45e-06
2.	Catastrophic Failure Shellsol A Road Tanker	14.6	2.45e-06
3.	Catastrophic Failure Benzine Road Tanker	7.97	1.34e-06
4.	Catastrophic Failure Toluene Road Tanker	5.89	9.90e-07
5.	Catastrophic Failure Acetone A Road Tanker	5.3	8.91e-07
6.	Catastrophic Failure Methanol Road Tanker	4.75	7.99e-07
7.	Catastrophic Failure Thinners Road Tanker	3.44	5.78e-07
8.	Loading Hose Rupture Benzine Road Tanker	1.04	1.74e-07
9.	Loading Hose Rupture Thinners Road Tanker	1.02	1.72e-07
10.	Loading Hose Rupture Toulene Road Tanker	1.02	1.72e-07

12.4. Risk Reduction Recommendations

The following is recommended to reduce the risks associated with the installations:

- Good housekeeping must always be observed on site.
- Installation must comply with local by-laws and applicable SANS 10087 Codes;
- This MHI report must be distributed to Local, Provincial and National Government as per MHI Regulations.

12.5. Emergency Plan

There is no Emergency Plan for the site. It is recommended that an Emergency Plan be compiled, and the following adhered to:

- Must comply with SANS 1514 Codes;
- Must comply with the MHI Regulations;
- Must be accepted and signed by management and the Local Authority.

12.6. Review of Risk Assessment

This Risk Assessment is valid for the duration of 5 years from the above date unless:

- Changes have been made to the plant that can alter the risks on the facility;
- The Emergency Plan was invoked or there was a near miss;
- The changing neighbourhood could result in offsite risks;
- There is reason to suspect that the current Assessment is no longer valid.

12.7. Risk Reduction Programmes

Risk reduction programmes should continually be investigated to reduce the impact from accidental fires and explosions on surrounding communities.

12.8. Surrounding Land Development

The development of land surrounding the site should be done with caution as not to pose unnecessary risks onto the surrounding communities. This caution is aimed at ensuring the adjacent developments are suitable for the risk imposed.

12.9. MHI Notification

For this Major Hazard Installation (MHI), the following levels of Government need to be notified:

- Local Authority;
- Provincial Government;
- National Government.

The process is as follows:

- Copy of this report, along with a cover letter notifying the fire department/ emergency services (Local Authority). Proof of receipt needs to be obtained from the Local Authority;
- Copy of the report, along with a cover letter notifying the Provincial Director from the Provincial Department of Labour. A proof of receipt needs to be obtained from the Provincial Department of Labour;
- An advert needs to be placed in a local newspaper informing the public about the MHI. The information that needs to be included in the advert is as follows:
    - Physical address of the MHI;
    - Maximum quantity of the substance that resulted in the installation being classified as an MHI;
    - Contact person where more information can be obtained;
    - Notify the public that they can comment/ object to the installation with the Department of Labour or the Local Authority;
    - Expiry date of the 60-day commenting period;
    - Copy of the report, along with a cover letter notifying the Chief Inspector from the National Department of Labour. Copies of the proof of receipts and a copy of the advert must be included.

13. PROOF OF COMPETENCY

sanas
South African National Accreditation System

CERTIFICATE OF ACCREDITATION

In terms of section 22(2)(b) of the Accreditation for Conformity Assessment, Calibration and Good Laboratory Practice Act, 2006 (Act 19 of 2006), read with sections 23(1), (2) and (3) of the said Act, I hereby certify that:-

MAJOR HAZARD RISK CONSULTANTS CC
Co. Reg. No.: 2007/079078/23
CAPE TOWN

Accreditation Number: **MHI0017**

is a South African National Accreditation System Accredited Inspection Body to undertake **TYPE A** Inspection provided that all SANAS conditions and requirements are complied with

This certificate is valid as per the scope as stated in the accompanying scope of accreditation, Annexure "A", bearing the above accreditation number for

THE ASSESSMENT OF RISK ON MAJOR HAZARD INSTALLATIONS

The facility is accredited in accordance with the recognised International and National Standard

ISO/IEC 17020:2012 and SANS 1461:2018

The accreditation demonstrates technical competency for a defined scope and the operation of a management system

While this certificate remains valid, the Accredited Facility named above is authorised to use the relevant SANAS accreditation symbol to issue facility reports and/or certificates

Mr M Phaloane
Acting Chief Executive Officer

Effective Date: 21 January 2021
Certificate Expires: 20 January 2025

This certificate does not on its own confer authority to act as an Approved Inspection Authority as contemplated in the Major Hazard Installation Regulations. Approval to inspect within the regulatory domain is granted by the Department of Employment and Labour.

ANNEXURE A

SCOPE OF ACCREDITATION

Accreditation Number: MHI0017

TYPE A

Permanent Address: MHR Consultants CC 13 Slade Street Parklands Tableview 7441 Tel: (021) 426-5688 Fax: 086 520-4872 E-mail: claude@petrostruct.co.za	**Postal Address:** 13 Slade Street Parklands Tableview 7441 Issue No.: 08 Date of Issue: 19 January 2021 Expiry Date: 20 January 2025

Nominated Representative:	Technical Manager:	Technical Signatories
Mr CC Thackwray **Quality Manager:** Mr CC Thackwray	Mr SA Stevens	Mr TC Thackwray Mr SA Stevens

Field of Inspection	Type and Range of Inspection	Standards and Specifications
Regulatory: The supply of services as an Inspection Authority for Major Hazard Risk Installation as defined in the Major Hazard Risk Installation Regulations, Government Notice No. R 692 of 30 July 2001	Major Hazard Installation Risk Assessments for the following material categories: 1) Explosive chemicals 2) Gases: i) Flammable Gases ii) Non-flammable, non-toxic gases (asphyxiants) iii) Toxic gases 3) Flammable liquids 4) Flammable solids, substances liable to spontaneous combustion, substances that on contact with water release flammable gases 5) Oxidizing substances and organic peroxides 6) Toxic liquids and solids	MHI regulation par. **5 (5) (b)** i) Frequency/Probability Analysis ii) Consequence Modelling iii) Hazard Identification and Analysis iv) Emergency planning reviews SANS 31000 SANS 31010 SANS1461:2018 CPR 14 E. Methods for the Calculation of Physical Effects ("Yellow Book"), 3rd Edition, TNO, Apeldoorn. Guideline for Quantitative Risk Assessment ("Purple Book") CPR 18E, First Ed. 1999 A Guide for the Control of Major Accident Hazard Regulations 1999, UK HSE.

Original Date of Accreditation: 21 January 2009

ISSUED BY THE SOUTH AFRICAN NATIONAL ACCREDITATION SYSTEM

Accreditation Manager

employment & labour

Department:
Employment and Labour
REPUBLIC OF SOUTH AFRICA

National Department of Employment and Labour
Republic of South Africa

APPROVED INSPECTION AUTHORITY

Registered in accordance with the provisions of the Occupational Health and Safety Act, Act 85 of 1993, as amended and the Major Hazard Installation Regulations.

THIS IS TO CERTIFY THAT:

MAJOR HAZARD RISK CONSULTANTS CC

has been registered by the Department of Employment and Labour as an Approved Inspection Authority: Type A, to conduct Major Hazard Installation Risk Assessment, in terms of Regulation 5(5)(a), of the Major Hazard Installation Regulations.

CONDITIONS OF REGISTRATION:

- *The AIA must at all time comply with the requirements of the Occupational Health and Safety Act, Act 85 of 1993, as amended.*
- *This registration certificate is not transferable.*
- *This registration will lapse if there is a name change of the AIA or change in ownership.*

CHIEF INSPECTOR

Valid from: 21 January 2021
Expires: 20 January 2025
Certificate Number: CI MHI 0007

14. REFERENCES

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CPR 12 E (1997). 'Methods for Determining and Processing Probabilities' ("Red Book") First Edition, TNO, Apeldoorn

CPR 14 E (1997). 'Methods for the Calculation of Physical Effects' ("Yellow Book"), Third Edition, TNO, Apeldoorn.

CPR 16 E (1992). 'Methods for the Determination of Possible Damage' ("Green Book"), First Edition, TNO, Apeldoorn.

CPR 18 E (1999). 'Guidelines for Quantitative Risk Assessment. ("Purple Book"), First Edition, TNO, Apeldoorn.

EPA (1993). 'Offsite Consequence Analysis: Risk Management Programme Guidance', May 1996.

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HSE "*Planning advice for developments near hazardous installations (PADHI)*"

JRC Technical Reports (2017). 'Handbook of Scenarios for Assessing Major Chemical Accident Risks', Gyenes., Wood M-H, Struckl M.

RIVM Report 620100003/2005. 'Distance Table Ammonia Refrigeration' PAM Uijt the Hague

15. APPENDICES

15.1. Emergency Plan

None Available

15.2. Material Safety Data Sheets

Safety Data Sheet

Acetone

Version 1.13 ***Revision Date 29.03.2012***

1. Identification of the substance/mixture and of the company/undertaking

Trade name	***Acetone***
Synonyms	***Acetone, 2-propanone, Dimethyl ketone, Ketone propane, beta-Ketapropanone***
Product code	***2110***
Use	*Solvent, Industrial use*
Company	*Sasol Solvents* *A Division of Sasol Chemical Industries* *2 Sturdee Avenue* *Rosebank* *2196* *Republic of South Africa*
Information (Product safety)	***Telephone:*** *+27 11 280 0000* ***Fax:*** *+27 11 280 0198* ***E-mail address*** *msds.info@sasol.com*

Emergency telephone number	*Europe, Israel, Africa, Americas*	*+44 (0)1235 239 670*
	Middle East, Arabic African countries	*+44 (0)1235 239 671*
	Asia Pacific	*+65 3158 1074*
	China	*+86 10 5100 3039*
	South Africa	*+27 (0)17 610 4444*
	Australia	*+61 2 9032 0460*

2. Hazards identification

Identification of the risks

R11	*Highly flammable.*
R36	*Irritating to eyes.*
R66	*Repeated exposure may cause skin dryness or cracking.*
R67	*Vapours may cause drowsiness and dizziness.*

3. Composition/information on ingredients

Acetone; Propan-2-one; Propanone

Contents: *100.00 %W/W*

CAS-No. *67-64-1* ***Index-No.*** *606-001-00-8* ***EC-No.*** *200-662-2*
Symbol(s) *F, Xi* ***R-phrase(s)*** *-R11 -R36 -R66 -R67*

For the full text of the R-phrases mentioned in this Section, see Section 16.

Safety Data Sheet

Acetone

Version 1.13 ***Revision Date 29.03.2012***

4. First aid measures

General advice	*When symptoms persist or in all cases of doubt seek medical advice.*
Inhalation	*Move to fresh air in case of accidental inhalation of vapours. If breathing is irregular or stopped, administer artificial respiration. Call a physician immediately.*
Skin contact	*Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Wash contaminated clothing before re-use. If skin irritation persists, call a physician.*
Eye contact	*Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.*
Ingestion	*If swallowed, seek medical advice immediately and show this container or label. Do not induce vomiting without medical advice. Never give anything by mouth to an unconscious person.*

5. Firefighting measures

Suitable extinguishing media	*Water spray, Alcohol-resistant foam, Dry chemical, Carbon dioxide (CO_2)*
Extinguishing media which shall not be used for safety reasons	*No information available.*
Specific hazards during firefighting	*Flash back possible over considerable distance.*
Special protective equipment for firefighters	*Wear self-contained breathing apparatus and protective suit.*
Further information	*Cool containers / tanks with water spray.*

6. Accidental release measures

Personal precautions	*Keep people away from and upwind of spill/leak. Remove all sources of ignition. Do not breathe vapours or spray mist.*
Environmental precautions	*Should not be released into the environment. Prevent further leakage or spillage if safe to do so.*
Methods for cleaning up	*Soak up with inert absorbent material and dispose of as hazardous waste.*

Safety Data Sheet

Acetone

Version 1.13 **Revision Date 29.03.2012**

7. Handling and storage

Handling

Safe handling advice Provide sufficient air exchange and/or exhaust in work rooms. Wear personal protective equipment. Take precautionary measures against static discharge. Ensure all equipment is electrically grounded before beginning transfer operations.

Advice on protection against fire and explosion Keep away from heat and sources of ignition. Use explosion-proof equipment.

Storage

Requirements for storage areas and containers Store between 5 and 25 °C in a dry, well ventilated place away from sources of heat, ignition and direct sunlight.

8. Exposure controls/personal protection

Components with workplace control parameters

NATIONAL OCCUPATIONAL EXPOSURE LIMITS

Components	Type	Control parameters	Update	Basis
ACETONE	TWA	1,780 mg/m^3	1995	South Africa RELs
	TWA	750 ppm	1995	South Africa RELs
	STEL	3,560 mg/m^3	1995	South Africa RELs
	STEL	1,500 ppm	1995	South Africa RELs

EUROPEAN OCCUPATIONAL EXPOSURE LIMITS

Components	Type	Control parameters	Update	Basis
ACETONE	TWA	1,210 mg/m^3	12 2009	EU Exposure Limit Values
	TWA	500 ppm	12 2009	EU Exposure Limit Values

Engineering measures

Provide sufficient air exchange and/or exhaust in work rooms.

Personal protective equipment

Respiratory protection In case of insufficient ventilation, wear suitable respiratory equipment.

Hand protection Gloves suitable for permanent contact:
Material: butyl-rubber
Break through time: 4 h
Material thickness: 0.5 mm

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Eye protection	*Safety glasses with side-shields*
Skin and body protection	*Protective suit, Safety shoes*
Hygiene measures	*Wash hands before breaks and immediately after handling the product.*
Protective measures	*Wear suitable protective equipment.*

9. Physical and chemical properties

Form	*Liquid*
State of matter	*Liquid*
Colour	*Colourless*
Odour	*Pungent*
Melting point/range	*-95.35 °C*
Boiling point/boiling range	*56.2 °C*
Flash point	*-20 °C*
Autoignition temperature	*465 °C*
Lower explosion limit	*2.6 %(V)*
Upper explosion limit	*12.8 %(V)*
Vapour pressure	*307.974 hPa; 25 °C*
Density	*0.79 g/cm^3*
Water solubility	*Soluble*
Viscosity, kinematic	*0.4 mm^2/s*
Relative vapour density	*2*

10. Stability and reactivity

Materials to avoid	*Strong oxidizing agents, Incompatible with acids., Halogenated compounds*
Hazardous decomposition products	*Carbon oxides*
Hazardous reactions	*Hazardous polymerisation does not occur.*

11. Toxicological information

Acute oral toxicity	*LD50 rat: 5,800 mg/kg; literature value*
Acute inhalation toxicity	*LC50 rat: > 20 mg/l; ; 4 h; literature value*

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Acute dermal toxicity	*LD50 rabbit: 20,000 mg/kg; literature value*
Skin irritation	*rabbit: moderately irritating; (literature value)*
Eye irritation	*rabbit: irritating; (literature value)*
	rabbit: moderately irritating; Draize Test
Sensitisation	*No data available*
Carcinogenicity	*No data available*
Reproductive toxicity	*No toxicity to reproduction*
Human experience: If inhaled	*Vapours may cause drowsiness and dizziness.*
Human experience:In case of skin contact	*Repeated exposure may cause skin dryness or cracking*
Human experience:In case of eye contact	*Irritating to eyes*

12. Ecological information

Biodegradability	*100 %; 5 d*
	89 %; 21 d
Bioaccumulation	*1*
Ecotoxicity effects	
Toxicity to fish	*LC50 Oncorhynchus mykiss (rainbow trout): 5,540 mg/l; 96 h; literature value* *LC50 Lepomis macrochirus (Bluegill sunfish): 8,300 mg/l; 96 h; literature value* *LC50 Pimephales promelas: 8,120 mg/l; 96 h; literature value*
Toxicity to daphnia and other aquatic invertebrates.	*EC50 Daphnia magna: 10 mg/l; 24 h*
Toxicity to algae	*EC50 Pseudokirchneriella subcapitata: > 100 mg/l; 96 h; literature value*

13. Disposal considerations

Product	*In accordance with local and national regulations., Do not contaminate ponds, waterways or ditches with chemical or used container., The product should not be allowed to enter drains, water courses or the soil.*
Contaminated packaging	*Do not burn, or use a cutting torch on, the empty drum. Triple rinse containers., Can be offered for recycling, re-conditioning or puncture.*

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14. Transport information

ADR	UN number: 1090; Class: 3; Packaging group: II; F1; Description of the goods: ACETONE
RID	UN number: 1090; Class: 3; Packaging group: II; F1; Description of the goods: ACETONE
ADNR	UN number: 1090; Class: 3; Packaging group: II; F1; Description of the goods: ACETONE
IMDG	UN number: 1090; Class: 3; EmS: F-E, S-D; Packaging group: II; Description of the goods: ACETONE
ICAO/IATA	UN number : 1090; Class: 3; Packaging group: II; Description of the goods: Acetone

15. Regulatory information

Labelling

Regulatory base	67/548/EEC
Symbol(s)	F: Highly flammable Xi: Irritant
R-phrase(s)	R11: Highly flammable. R36: Irritating to eyes. R66: Repeated exposure may cause skin dryness or cracking. R67: Vapours may cause drowsiness and dizziness.
S-phrase(s)	S 2: Keep out of the reach of children. S 9: Keep container in a well-ventilated place. S16: Keep away from sources of ignition - No smoking. S26: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
Hazardous components which must be listed on the label	Acetone; Propan-2-one; Propanone

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16. Other information

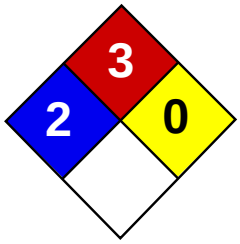
Full text of R-phrases referred to under sections 2 and 3

R11	*Highly flammable.*
R36	*Irritating to eyes.*
R66	*Repeated exposure may cause skin dryness or cracking.*
R67	*Vapours may cause drowsiness and dizziness.*

All reasonable efforts were exercised to compile this SDS in accordance with ISO 11014 and ANSIZ400.1.1993. The SDS provides information regarding the health, safety and environmental hazards, at the date of issue, to facilitate the safe receipt, use and handling of the product in the workplace. Since Sasol and its subsidiaries cannot anticipate or control all conditions under which the product may be handled, used and received in the workplace, it remains the obligation of each user, receiver or handler to, prior to usage, review this SDS in the context within which the product will be received, handled or used in the workplace. The user, handler or receiver must ensure that the necessary mitigating measures are in place as regards health and safety. This does not substitute the need or requirement for any relevant risk assessments to be conducted. It further remains the responsibility of the receiver, handler or user to communicate such information to all relevant parties that may be involved in the receipt, use or handling of the product.

Although all reasonable efforts were exercised in the compilation of this SDS, Sasol does not expressly warrant the accuracy or assume any liability for the incompleteness of the information contained herein or any advice given. The product is sold and risk passes in accordance with the specific terms and conditions of sale.

The MSDS was created by: F. SHAI
The MSDS was approved by: M. HUYSER



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Benzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Benzene

Catalog Codes: SLB1564, SLB3055, SLB2881

CAS#: 71-43-2

RTECS: CY1400000

TSCA: TSCA 8(b) inventory: Benzene

CI#: Not available.

Synonym: Benzol; Benzine

Chemical Name: Benzene

Chemical Formula: C6-H6

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
Benzene	71-43-2	100

Toxicological Data on Ingredients: Benzene: ORAL (LD50): Acute: 930 mg/kg [Rat]. 4700 mg/kg [Mouse]. DERMAL (LD50): Acute: >9400 mg/kg [Rabbit]. VAPOR (LC50): Acute: 10000 ppm 7 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of eye contact (irritant), of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE]. The substance is toxic to blood, bone marrow, central nervous system (CNS). The substance may be toxic to liver, Urinary System. Repeated or prolonged exposure to the substance can produce target organs 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. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

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. Seek 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: Flammable.

Auto-Ignition Temperature: 497.78°C (928°F)

Flash Points: CLOSED CUP: -11.1°C (12°F). (Setaflash)

Flammable Limits: LOWER: 1.2% UPPER: 7.8%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Slightly flammable to flammable in presence of oxidizing materials. Non-flammable in presence of shocks.

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. Explosive in presence of oxidizing materials, of acids.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Extremely flammable liquid and vapor. Vapor may cause flash fire. Reacts on contact with iodine heptafluoride gas. Dioxygenyl tetrafluoroborate is as very powferful oxidant. The addition of a small particle to small samples of benzene, at ambient temperature, causes ignition. Contact with sodium peroxide with benzene causes ignition. Benzene ignites in contact with powdered chromic anhydride. Virgorous or incandescent reaction with hydrogen + Raney nickel (above 210 C) and bromine trifluoride.

Special Remarks on Explosion Hazards:
Benzene vapors + chlorine and light causes explosion. Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate. Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion. Interaction

of nitryl perchlorate with benzene gave a slight explosion and flash. The solution of permanganic acid (or its explosive anhydride, dimaganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene. Peroxodisulfuric acid is a very powferful oxidant. Uncontrolled contact with benzene may cause explosion. Mixtures of peroxomonsulfuric acid with benzene explodes.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. 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 locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor 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 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: 0.5 STEL: 2.5 (ppm) from ACGIH (TLV) [United States] TWA: 1.6 STEL: 8 (mg/m3) from ACGIH (TLV) [United States] TWA: 0.1 STEL: 1 from NIOSH TWA: 1 STEL: 5 (ppm) from OSHA (PEL) [United States] TWA: 10 (ppm) from OSHA (PEL) [United States] TWA: 3 (ppm) [United Kingdom (UK)] TWA: 1.6 (mg/m3) [United Kingdom (UK)] TWA: 1 (ppm) [Canada] TWA: 3.2 (mg/m3) [Canada] TWA: 0.5 (ppm) [Canada]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor:
Aromatic. Gasoline-like, rather pleasant. (Strong.)

Taste: Not available.

Molecular Weight: 78.11 g/mole

Color: Clear Colorless. Colorless to light yellow.

pH (1% soln/water): Not available.

Boiling Point: 80.1 (176.2°F)

Melting Point: 5.5°C (41.9°F)

Critical Temperature: 288.9°C (552°F)

Specific Gravity: 0.8787 @ 15 C (Water = 1)

Vapor Pressure: 10 kPa (@ 20°C)

Vapor Density: 2.8 (Air = 1)

Volatility: Not available.

Odor Threshold: 4.68 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:
Miscible in alcohol, chloroform, carbon disulfide oils, carbon tetrachloride, glacial acetic acid, diethyl ether, acetone. Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatibles.

Incompatibility with various substances: Highly reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Benzene vapors + chlorine and light causes explosion. Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate. Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion. Interaction of nitryl perchlorate with benzene gave a slight explosion and flash. The solution of permanganic acid (or its explosive anhydride, dimaganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene. Peroxodisulfuric acid is a very powferful oxidant. Uncontrolled contact with benzene may cause explosion. Mixtures of peroxomonsulfuric acid with benzene explodes.

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.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 930 mg/kg [Rat]. Acute dermal toxicity (LD50): >9400 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 10000 7 hours [Rat].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE]. Causes damage to the following organs: blood, bone marrow, central nervous system (CNS). May cause damage to the following organs: liver, Urinary System.

Other Toxic Effects on Humans:
Very hazardous in case of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (female fertility, Embryotoxic and/or foetotoxic in animal) and birth defects. May affect genetic material (mutagenic). May cause cancer (tumorigenic, leukemia)) Human: passes the placental barrier, detected in maternal milk.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. It can be absorbed through intact skin and affect the liver, blood, metabolism,and urinary system. Eyes: Causes eye irritation. Inhalation: Causes respiratory tract and mucous membrane irritation. Can be absorbed through the lungs. May affect behavior/Central and Peripheral nervous systems (somnolence, muscle weakness, general anesthetic, and other symptoms similar to ingestion), gastrointestinal tract (nausea), blood metabolism, urinary system. Ingestion: May be harmful if swallowed. May cause gastrointestinal tract irritation including vomiting. May affect behavior/Central and Peripheral nervous systems (convulsions, seizures, tremor, irritability, initial CNS stimulation followed by depression, loss of coordination, dizziness, headache, weakness, pallor, flushing), respiration (breathlessness and chest constriction), cardiovascular system, (shallow/rapid pulse), and blood.

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 products of degradation are less toxic than the product itself.

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 3: Flammable liquid.

Identification: : Benzene UNNA: 1114 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Benzene California prop. 65 (no significant risk level): Benzene: 0.007 mg/day (value) California prop. 65: This product contains the following ingredients

for which the State of California has found to cause cancer which would require a warning under the statute: Benzene Connecticut carcinogen reporting list.: Benzene Connecticut hazardous material survey.: Benzene Illinois toxic substances disclosure to employee act: Benzene Illinois chemical safety act: Benzene New York release reporting list: Benzene Rhode Island RTK hazardous substances: Benzene Pennsylvania RTK: Benzene Minnesota: Benzene Michigan critical material: Benzene Massachusetts RTK: Benzene Massachusetts spill list: Benzene New Jersey: Benzene New Jersey spill list: Benzene Louisiana spill reporting: Benzene California Director's list of Hazardous Substances: Benzene TSCA 8(b) inventory: Benzene SARA 313 toxic chemical notification and release reporting: Benzene CERCLA: Hazardous substances.: Benzene: 10 lbs. (4.536 kg)

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 B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R11- Highly flammable. R22- Harmful if swallowed. R38- Irritating to skin. R41- Risk of serious damage to eyes. R45- May cause cancer. R62- Possible risk of impaired fertility. 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. S53- Avoid exposure - obtain special instructions before use.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor 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: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:35 PM

Last Updated: 11/01/2010 12:00 PM

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ENGEN DIESEL (STD, 0.05)

MATERIAL SAFETY DATA SHEET

Revision Date : 27.05.2008

1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	ENGEN DIESEL (STD, 0.05)
Chemical name	:	Diesel fuel
Synonyms	:	Hydrocarbon Liquid
Product use	:	Automotive diesel fuel
UN number	:	1202
Supplier	:	Engen Petroleum Limited (Tel: 021-403 4911, a/h: 021-403 4099)
Health Emergency Telephone	:	021-689 5227 (Red Cross Poison Service)
Transport Emergency Telephone	:	011-975 1278/83 (Hazchemwise)
Customer Service Center	:	0860 036 436 (Sales and Technical Information)
MSDS Internet website	:	www.engen.co.za/content/products/default2.htm

2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical name	CAS-No.	Weight%	Symbol Codes	R-Phrase Numbers
Diesel fuel	68334-30-5	> 98.00	Xn, N	R40, R51/53, R65, R66
Ethyl Benzene	100-41-4	< 1.00	Xn	R20, R45
Naphthalene	91-20-3	< 1.00		R45

See Section 15 for European Label Information.

See Section 8 for Exposure Limits (if applicable).

3. HAZARDS IDENTIFICATION

Emergency response data : Light Amber Liquid. Flammable. Product can accumulate a static charge and release vapours which may cause a fire or explosion. DOT ERG No. : 128

Potential health effects

Inhalation : Respiratory irritation, dizziness, nausea and loss of consciousness. In cases of extreme exposure death is possible. Diesel exhaust may cause lung cancer.

Skin : Irritation or more serious skin disorders. Note: This product may contain polycyclic aromatic hydrocarbons, some of which have been reported to cause skin cancer in humans under conditions of poor personal hygiene, prolonged repeated contact, and exposure to sunlight.

Eye : Irritant.

Ingestion : Low viscosity material if swallowed may enter the lungs and cause lung damage.

Potential environmental effects : Toxic to fish, aquatic organisms and wildlife. Do not discharge into lakes, streams, ponds and ground water supply.

See Section 11 for further health effects/toxicological data.

4. FIRST AID MEASURES

Inhalation : Remove from further exposure. If respiratory irritation, dizziness,

		nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with mechanical device or use mouth-to-mouth resuscitation with a mouthpiece.
Skin contact	:	Remove contaminated clothing. Dry wipe exposed skin and cleanse with hand cleaner, soap and water. Launder contaminated clothing before reuse. (See Section 16 - Injection Injury)
Eye contact	:	Flush thoroughly with water for at least 15 minutes. Get medical assistance.
Ingestion	:	Seek immediate medical attention. Do not induce vomiting.
Note to doctors	:	Material if aspirated into the lungs may cause chemical pneumonitis. Skin contact may aggravate an existing dermatitis. Treat appropriately.

5. FIRE-FIGHTING MEASURES

Extinguishing media	:	Carbon dioxide, foam, dry chemical and water fog.
Special fire fighting procedure	:	Water spray should only be used to keep fire-exposed containers cool, flush spills away from exposures, disperse vapours and protect personnel attempting to stop leak. Prevent runoff from fire control or dilution from entering streams, municipal sewers, or drinking water supply.
Special protective equipment for firefighters	:	For fires in enclosed areas, fire fighters must use Self-Contained Breathing Apparatus.
Products of decomposition	:	Fumes, smoke, carbon monoxide, sulphur oxides, aldehydes and other decomposition products, in the case of incomplete combustion.
Flash Point	:	> 55 °C (ASTM D-93)
Upper Explosion Limit (UEL)	:	7 %(V)
Lower Explosion Limit (LEL)	:	0.6 %(V)
NFPA Hazard Id	:	Health: 1; Flammability: 2; Reactivity: 0

6. ACCIDENTAL RELEASE MEASURES

Procedure if material is released or spilled	:	Report spills/releases as required to appropriate authorities.
Methods for cleaning up	:	Eliminate sources of ignition. Warn occupants and/or ships in the downwind areas of fire and explosion hazard, and warn them to stay clear. LAND SPILL: Shut off source taking normal safety precautions. Take measures to minimize the effects on ground water. Recover by pumping using explosion-proof equipment or contain spilled liquid with sand or other suitable absorbent and remove mechanically into containers. If necessary, dispose of absorbed residues as directed in Section 13. WATER SPILL: Notify port and relevant authorities. Confine with booms if skimming equipment is available to recover the spill for later recycling or disposal. If permitted by local authorities and environmental agencies disperse in unconfined waters. If allowed by regulatory authorities the use of suitable dispersants should be considered where recommended in local oil spill procedures.
Personal precautions	:	See Section 8.
Environmental precautions	:	Prevent spill from entering municipal sewers, water sources or low lying areas. Advise the relevant authorities if contaminations have occurred.

7. HANDLING AND STORAGE

Safe handling advice	:	Keep product away from high energy ignition sources, heat, sparks, pilot lights, static electricity, and open flames. Harmful in contact with or if absorbed through the skin. Avoid inhalation of vapours or mists. Use in well ventilated area away from all ignition sources. See Section 8 for additional personal protection advice when handling this product.

Storage information	:	Store away from all ignition sources in a cool, well ventilated area. This product is a static accumulator, therefore, all storage containers should be grounded and bonded. Drums should also be equipped with self-closing valves, pressure vacuum bungs and flame arresters.
Storage and handling procedures	:	Electrical equipment and fittings must comply with local fire prevention regulations for this class of product. Refer to national or local regulations covering safety at petroleum handling and storage areas for this product.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational Exposure Limits (OELs)

Components	CAS-No.	Source	TWA	Value		Notations
Naphthalene	91-20-3	ACGIH TLV	LTEL STEL	52 mg/m3 79 mg/m3	10 ppm 15 ppm	Skin; A4
		OSHA PEL	LTEL STEL	50 mg/m3 75 mg/m3	10 ppm 15 ppm	
Diesel fuel	68334-30-5	ACGIH TLV	LTEL	100 mg/m3	15 ppm	Skin; A3
Ethyl Benzene	100-41-4	ACGIH TLV	LTEL STEL	434 mg/m3 543 mg/m3	100 ppm 125 ppm	A3; BEI
		OSHA PEL	LTEL STEL	435 mg/m3 545 mg/m3	100 ppm 125 ppm	

LTEL: Long Term Exposure Limits - Time Weight Average (TWA) over 8 hours.

STEL: Short Term Exposure Limits - Time Weight Average (TWA) over 15 Minutes

Note: Limits Shown for guidance only. Follow applicable regulations.

Personal Protection Equipment (PPE)

Engineering controls	:	Use in well ventilated area. Explosive-proof ventilation equipment with local exhaust is desirable.
Respiratory protection	:	Approved respiratory equipment must be used when airborne concentrations are unknown or exceed the recommended exposure limit. Self-Contained Breathing Apparatus may be required for use in confined or enclosed spaces.
Eye protection	:	If splash with liquid is possible, chemical type goggles should be worn.
Skin and body protection	:	Impervious gloves must be worn. If body contact is likely, appropiate personal protective equipment must be worn. Good personal hygiene practices should always be followed.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Liquid.
Colour	:	Light Amber
Odour	:	Hydrocarbon
Solubility	:	Negligible
Boiling point	:	> 180 °C
Flash Point	:	> 55 °C (ASTM D-93)
Upper Explosion Limit (UEL)	:	7 %(V)
Lower Explosion Limit (LEL)	:	0.6 %(V)
Vapour pressure	:	0.5 hPa
Relative vapour density	:	2
Density	:	0.8450 g/cm3 @ 20 °C
Pour point	:	< -7 °C
Viscosity, kinematic	:	3.5 mm2/s @ 40 °C (ASTM D-445) < 1 mm2/s @ 100 °C (ASTM D-445)

10. STABILITY AND REACTIVITY

Stability	:	Stable.
Conditions to avoid	:	Extreme heat and high energy sources of ignition, such as sparks and static electricity.
Materials to avoid	:	Halogens, strong acids, alkalis and oxidizers.
Hazardous decomposition products	:	Fumes, smoke, carbon monoxide, sulphur oxides, aldehydes and other decomposition products, in the case of incomplete combustion.

11. TOXICOLOGICAL INFORMATION

Acute oral toxicity	:	(Rats): Practically non-toxic (LD50: Greater than 2000 mg/kg). Based on testing of similar products and/or components.
Acute inhalation toxicity	:	(Rats): Practically non-toxic (LC50: greater than 5mg/l). Based on testing of similar products and/or the components.
Acute dermal toxicity	:	(Rabbits): Practically non-toxic (LD50: greater than 2000 mg/kg). Based on testing of similar products and/or the components.
Skin irritation	:	(Rabbits): Practically non-irritating. (Primary Irritation Index: greater than 0.5 but less than 3). Based on testing of similar products and/or the components.
Eye irritation	:	(Rabbits): Practically non-irritating. (Draize score: greater than 6 but 15 or less). Based on testing of similar products and/or the components.
Sensitization	:	Middle distillate oils were not skin sensitizers when tested in a Modified Buehler Guinea Pig Sensitization Assay.
Repeated dose toxicity	:	Repeated dermal application of middle distillates, heating oils and diesel oils to rabbits for 2-4 weeks at up to 1 gm/kg resulted in strong to severe skin irritation with some weight loss at the higher dose. Toxic effects ranging from weight loss to mortality was observed in rabbits treated repeatedly with very high doses (6 gm/kg) of these oils. Repeated inhalation exposure of middle distillate and diesel vapour and aerosol to rats for 2-4 weeks at up to 6 mg/l resulted in respiratory tract irritation, lung changes/infiltration/accumulation, and some reduction in lung function.
Teratogenicity	:	Diesel fuel vapours were tested in an inhalation teratology (developmental toxicity) study in rats and when only minimal maternal toxicity was observed, no fetotoxic or developmental effects were observed. A developmental toxicity study of dermally applied middle distillates did indicate fetotoxicity (reduced litter size, litter weight, increased resorptions) at doses that also caused significant maternal toxicity.
Carcinogenicity	:	Diesel fuel vapours were tested in an inhalation teratology (developmental toxicity) study in rats and when only minimal maternal toxicity was observed, no fetotoxic or developmental effects were observed. A developmental toxicity study of dermally applied middle distillates did indicate fetotoxicity (reduced litter size, litter weight, increased resorptions) at doses that also caused significant maternal toxicity.
Other toxicological information	:	Overexposure to diesel exhaust fumes may result in eye irritation, headaches, nausea, and respiratory irritation. Animal studies involving lifetime exposure to high levels of diesel exhaust have produced variable results, with some studies indicating a potential for lung cancer. Limited evidence from epidemiological studies suggest an association between long-term occupational exposure to diesel engine emissions and lung cancer. Diesel engine exhaust typically consists of gases and particulates, including carbon dioxide, carbon monoxide, nitrogen compounds, oxides of sulphur, and hydrocarbons. Diesel exhaust composition will vary with fuel, engine type, load cycle, engine maintenance, tuning and exhaust gas treatment. Use of adequate

ventilation and/or respiratory protection in the presence of diesel exhaust is recommended to minimize exposures. This product contains ethylbenzene. The International Agency for Research on Cancer (IARC) has evaluated ethylbenzene and classified it as possibly carcinogenic to humans (Group 2B) based on sufficient evidence for carcinogenicity in experimental animals, but inadequate evidence for cancer in exposed humans.

12. ECOLOGICAL INFORMATION

Elimination information (persistence and degradability)

Biodegradability	:	The majority of the components in this product would be expected to be inherently biodegradable. The constituents of diesel fuels which are volatilized will photodegrade in the atmosphere. The less volatile, more water-soluble components which are aromatic hydrocarbons will also undergo aqueous photodegradation.
Physico-chemical removability	:	Dissolution of the higher molecular weight hydrocarbon components in water will be limited, but losses through sediment adsorption may be significant.
Bioaccumulation	:	Not established.

Ecotoxicity effects

Toxicity to fish	:	This substance has also been shown to be toxic to specific fish species (LL50 = 1-10 mg/l for rainbow trout, Atlantic silverside).
Toxicity to aquatic organisms	:	Based on test results for similar products, this substance may to toxic to aquatic organisms such as algae and daphnia (EL50/IrL50 = 1-10 mg/l).

Further information on ecology

Remarks	:	In the absence of specific environmental data for this product, this assessment is based on information for representative substances.

13. DISPOSAL CONSIDERATIONS

Waste disposal	:	Product is suitable for burning for fuel value in compliance with applicable laws and regulations, and consideration of product characteristics at time of disposal.
Other regulations	:	Disposal of unused product may be subject to RCRA regulations (40 CFR 261). Disposal of the used product may also be regulated due to ignitability, corrosivity, reactivity, or toxicity as determined by the Toxicity Characteristic Leaching Procedure (TCLP).
Flash Point	:	> 55 °C (ASTM D-93)

14. TRANSPORT INFORMATION

Note	:	The flash point of this material is > 55 °C, and hence regulatory classifications for flammability may vary.

In accordance with 49 CFR 173.150(f)(2), non-bulk quantities of this material (<119 gallons per container) may be shipped as non regulated for USA domestic shipments.

ADR

Proper shipping name	:	GAS OIL
UN number	:	1202
DOT ERG number	:	128
Class	:	3
Letter	:	F
Packing group	:	III
Labelling number	:	3
Placard	:	Flammable

CFR

Proper shipping name	:	GAS OIL
UN number	:	1202
DOT ERG number	:	128
Class	:	3
Letter	:	F
Packing group	:	III
Labelling number	:	3
Placard	:	Combustible

IATA_C

Proper shipping name	:	GAS OIL
UN number	:	1202
DOT ERG number	:	128
Class	:	3
Letter	:	F
Packing group	:	III
Labelling number	:	3
Placard	:	Flammable

IMDG

Proper shipping name	:	GAS OIL
UN number	:	1202
DOT ERG number	:	128
Class	:	3
Letter	:	F
Packing group	:	III
Labelling number	:	3
Placard	:	Flammable
Marine pollutant	:	Marine pollutant
Medical First Aid Guide (MFAG) table	:	311
Emergency Schedule (EmS) number	:	3-07
IMDG code page number	:	3375
Static Accumulator (50 picosiemens or less)	:	Yes

15. REGULATORY INFORMATION

US OSHA Hazard Communication Standard	:	Product assessed in accordance with OSHA 29 CFR 1910.1200 and determined to be hazardous.
Governmental Inventory Status	:	All components comply with TSCA, EINECS/ELINCS, AICS, METI, DSL, KECI, ENCS, PICCS and IECSC.
EU Labelling	:	Product is dangerous as defined by the European Union Dangerous Substances/Preparations Directives.
Symbols	:	F, T, N Flammable, Toxic, Dangerous for the environment
R-Phrase(s)	:	R10, R40, R65, R66, R51/53 Flammable., Limited evidence of a carcinogenic effect., Harmful: may cause lung damage if swallowed., Repeated exposure may cause skin dryness or cracking., Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
S-phrase(s)	:	S24, S2, S36/37, S62 Avoid contact with the skin., Keep out of the reach of children., Wear suitable protective clothing and gloves., If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label.
Note	:	Contains Gas Oil - unspecified.

SARA

U.S. Superfund Amendments and	:	This product contains no "EXTREMELY HAZARDOUS SUBSTANCES".

Reauthorization Act SARA
Title III

SARA (311/312) Reportable Hazard Categories : Fire Chronic Acute

SARA (313) Toxic Release Chemicals: : Ethyl Benzene (100-41-4) - Conc < 1 %.

The following product ingredients are cited on the lists below

Chemical name	CAS-No.	Concentration [%]	List Citations
Diesel fuel	68334-30-5	> 98.00	21, 26
Ethyl Benzene	100-41-4	< 1.00	1, 8, 10, 18, 19, 20, 21, 23, 24, 25, 26
Naphthalene	91-20-3	< 1.00	16, 22

Regulatory List Searched

1 = ACGIH ALL	6 = IARC 1	11 = TSCA 4	17 = CA P65	22 = MI 293
2 = ACGIH A1	7 = IARC 2A	12 = TSCA 5a2	18 = CA RTK	23 = MN RTK
3 = ACGIH A2	8 = IARC 2B	13 = TSCA 5e	19 = FL RTK	24 = NJ RTK
4 = NTP CARC	9 = OSHA CARC	14 = TSCA 6	20 = IL RTK	25 = PA RTK
5 = NTP SUS	10 = OSHA Z	15 = TSCA 12b	21 = LA RTK	26 = RI RTK

Code Key: CARC = Carcinogen; SUS = Suspected Carcinogen

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16. OTHER INFORMATION

Note: Engen products do not contain PCBs.

Health studies have shown that many hydrocarbons pose potential human health risks which may vary from person to person. Information provided on this MSDS reflects intended use. This product should not be used for any other applications. In any case, the following advice should be considered:

INJECTION INJURY WARNING: If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a doctor as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

Precautionary Label Text:

CONTAINS DIESEL OIL.. C9-20

WARNING!

COMBUSTIBLE LIQUID AND VAPOUR. RESPIRATORY IRRITATION, HEADACHE, DIZZINESS, NAUSEA, LOSS OF CONSCIOUSNESS, AND IN CASES OF EXTREME EXPOSURE, POSSIBLY DEATH. LOW VISCOSITY MATERIAL-IF SWALLOWED, MAY BE ASPIRATED AND CAN CAUSE SERIOUS OR FATAL LUNG DAMAGE.

MAY CAUSE SKIN CANCER ON PROLONGED, REPEATED SKIN CONTACT. ANIMAL SKIN ABSORPTION STUDIES RESULTED IN INCREASED MORTALITY, EFFECTS ON BODY WEIGHT, THE IMMUNE SYSTEM AND THE UNBORN CHILD. PROLONGED, REPEATED SKIN CONTACT MAY CAUSE IRRITATION. DIESEL FUMES MAY CAUSE LUNG CANCER.

SAFETY: Keep away from heat and flame. Avoid prolonged or repeated overexposure by skin contact or inhalation. Use with adequate ventilation. Keep container closed. Keep out of reach of children.

FIRST AID: If inhaled, remove from further exposure. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation. In case of contact, remove contaminated clothing. Dry wipe the exposed skin and cleanse with waterless hand cleaner and follow by washing thoroughly with soap and water. For those providing assistance, avoid further skin contact to yourself and others. Wear impervious gloves. If swallowed, seek immediate medical attention. Do not induce vomiting. Only induce vomiting at the instruction of a doctor.

This warning is given to comply with California Health and Safety Code 25249.6 and does not constitute an admission or a waiver of rights. This product contains a chemical known to the State of California to cause cancer, birth defects, or other reproductive harm. Chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm are created by the combustion of this product. Refer to product

ENGEN DIESEL (STD, 0.05)

Material Safety Data Sheet for further safety and health information.

Disclaimer

Information given herein is offered in good faith as accurate, but without guarantee. Conditions of use and suitability of the product for particular uses are beyond our control; all risks of use of the product are therefore assumed by the user and we expressly disclaim all warranties of every kind and nature, including warranties of merchantability and fitness for a particular purpose in respect to the use or suitability of the product. Nothing is intended as a recommendation for uses which infringe valid patents or as extending license under valid patents. Appropriate warnings and safe handling procedures should be provided to handlers and users.

Prepared by	:	Product Safety Adviser Health, Safety, Environment and Quality Department Engen Petroleum Limited P.O.Box 35, Cape Town, 8000
Telephone	:	(021) 403 4805 / 4911 (Office Hours) (021) 403 4099 (After Hours) 083 628 4415 (Cellular)

ENGEN TOLUENE

SAFETY DATA SHEET

Revision Date : 11.07.2011

1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	ENGEN TOLUENE
Chemical name	:	Toluene
Synonyms	:	Methyl benzene
Product use	:	Petroleum solvent
UN number	:	1294
Supplier	:	Engen Petroleum Limited (Tel: 021-403 4911, a/h: 021-403 4099)
Health Emergency Telephone	:	021-689 5227 (Red Cross Poison Service)
Transport Emergency Telephone	:	011-975 1278/83 (Hazchemwise)
Customer Service Centre	:	0860 036 436 (Sales and Technical Information)
Engen Website	:	http://www.engen.co.za/

2. HAZARDS IDENTIFICATION

Emergency response data : Colourless Liquid. Highly flammable. Vapour accumulation could flash and/or explode if in contact with any ignition source. DOT ERG No. : 130

GHS Classification:

Health			
Acute inhalation toxicity	Hazard category 4.	May be harmful if inhaled.	Warning
Acute oral toxicity	Hazard category 5.	May be harmful if swallowed.	Warning
Skin irritation	Hazard category 2.	Causes skin irritation.	Warning
Eye irritation	Hazard category 2B.	Mild irritant.	Warning
Reproductive toxicity (Teratogenicity)	Hazard category 2.	May adversely affect foetal development.	Warning
STOT - single exposure	Hazard category 3.	Central nervous system depressant leading to narcotic effects.	Warning
Aspiration hazard	Hazard category 1.	May cause chemical pneumonitis.	Danger
Environmental			
Aquatic toxicity :	Hazard category 2.	Very toxic to fish, aquatic organisms and wildlife.	Warning
Physical			
Flammability :	Hazard category 2.	Highly flammable liquid and vapour.	Danger

GHS Labels/Pictograms:

Hazard Statements

Highly flammable liquid and vapour. Suspected of damaging fertility or the unborn child. May be fatal if swallowed and enters airways. Causes skin irritation. May cause mild eye irritation. May cause drowsiness or dizziness.

Precautionary Statements

Prevention

Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep away from heat/sparks/open flames/hot surfaces – No smoking.

Response
IN CASE OF FIRE: Use carbon dioxide, foam or dry chemical for extinction. IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breath. IF ON SKIN: Immediately remove all contaminated clothing. Gently wash skin with plenty of soap and water. Launder contaminated clothing before re-use. If skin irritation occurs: Get medical attention. IF SWALLOWED: Immediately call a POISON CENTRE or doctor. Do NOT induce vomiting.

Storage
Take precautionary measures against static discharge. Ground/bond container and receiving equipment. Use explosion-proof electrical, ventilating and transfer equipment. Store in a well-ventilated place and keep the container cool and tightly closed. Use only non-sparking tools.

Disposal
Do not discharge into lakes, streams, ponds and ground water supply.

See Section 11 for further health effects/toxicological data.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical name	CAS-No.	Weight%
Toluene	108-88-3	> 99.00
Benzene	71-43-2	< 0.10

See Section 8 for Exposure Limits (if applicable).

4. FIRST AID MEASURES

Inhalation	:	Remove from further exposure. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with mechanical device or use mouth-to-mouth resuscitation with a mouthpiece.
Skin contact	:	Remove contaminated clothing. Dry wipe exposed skin and cleanse with hand cleaner, soap and water. Launder contaminated clothing before reuse. (See Section 16 - Injection Injury)
Eye contact	:	Flush thoroughly with water for at least 15 minutes. Get medical assistance.
Ingestion	:	Seek immediate medical attention. Do not induce vomiting.
Note to doctors	:	Material if aspirated into the lungs may cause chemical pneumonitis. Skin contact may aggravate an existing dermatitis. Treat appropriately.

5. FIRE-FIGHTING MEASURES

Extinguishing media	:	Carbon dioxide, foam, dry chemical and water fog.
Special fire fighting procedure	:	Water spray should only be used to keep fire-exposed containers cool, flush spills away from exposures, disperse vapours and protect personnel attempting to stop leak. Prevent runoff from fire control or dilution from entering streams, municipal sewers, or drinking water supply.
Special protective equipment for firefighters	:	For fires in enclosed areas, fire fighters must use Self-Contained Breathing Apparatus.
Unusual fire and explosive hazards	:	Vapour accumulation could flash or explode if in contact with an open flame.
Products of decomposition	:	Fumes, smoke and carbon monoxide.
Flash Point	:	9 °C (ASTM D-56)
Upper Explosion Limit (UEL)	:	7.1 %(V)
Lower Explosion Limit (LEL)	:	1.2 %(V)
NFPA Hazard Id	:	Health: 2; Flammability: 3; Reactivity: 0

6. ACCIDENTAL RELEASE MEASURES

Procedure if material is released or spilled	:	Report spills/releases as required to appropriate authorities.
Methods for cleaning up	:	SMALL SPILLS: Eliminate all ignition sources. Remove leaking containers to detached area. Absorb on fire-retardant treated sawdust, diatomaceous earth, etc. Shovel up with spark-resistant utensils for later disposal at an approved facility, in accordance with current laws and regulations. LARGE SPILLS: Contain material and pump back to holding tank for disposal or recycling in accordance with product characteristics and applicable regulations.
Personal precautions	:	See Section 8.
Environmental precautions	:	Prevent spills from entering municipal sewers or drains and contact with soil.

7. HANDLING AND STORAGE

Safe handling advice	:	Avoid contact with eyes. Use in well ventilated area away from all ignition sources. Avoid sparking conditions. Ground and bond all transfer equipment.
Storage information	:	This product is a static accumulator, therefore, all storage containers should be grounded and bonded. Drums should also be equipped with self-closing valves, pressure vacuum bungs and flame arresters.
Storage and handling procedures	:	Electrical equipment and fittings must comply with local fire prevention regulations for this class of product. Refer to national or local regulations covering safety at petroleum handling and storage areas for this product.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational Exposure Limits (OELs)

Components	CAS-No.	Source	TWA	Value		Notations
Toluene	108-88-3	ACGIH TLV	LTEL	188 mg/m3	50 ppm	Skin; A4; BEI
			STEL	560 mg/m3	150 ppm	Estimated
		OSHA PEL	LTEL	375 mg/m3	100 ppm	
			STEL	560 mg/m3	150 ppm	
		SA OEL	LTEL	188 mg/m3	50 ppm	Skin
			STEL	560 mg/m3	150 ppm	Recommended Limit
Benzene	71-43-2	ACGIH TLV	LTEL	1.6 mg/m3	0.5 ppm	Skin; A1; BEI
			STEL	8 mg/m3	2.5 ppm	
		OSHA PEL	LTEL	2 mg/m3	1 ppm	
			STEL	16 mg/m3	5 ppm	

LTEL: Long Term Exposure Limits - Time Weight Average (TWA) over 8 hours.

STEL: Short Term Exposure Limits - Time Weight Average (TWA) over 15 Minutes

Note: Limits Shown for guidance only. Follow applicable regulations.

Personal Protective Equipment (PPE)

Engineering controls	:	Use in well ventilated area. Explosive-proof ventilation equipment with local exhaust is desirable.
Respiratory protection	:	Approved respiratory equipment must be used when airborne concentrations are unknown or exceed the recommended exposure limit. Self-Contained Breathing Apparatus may be required for use in confined or enclosed spaces. Respirator with a vapour filter (EN 141) is recommended.

Eye protection	:	If splash with liquid is possible, chemical type goggles should be worn.
Skin and body protection	:	Suitable gloves: Material: butyl-rubber Break through time: 4 hours Material thickness: 0.5 mm Unsuitable gloves: Material: Polyvinylchloride, leather, nitrile rubber/latex, natural rubber/latex.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Liquid.
Colour	:	Colourless
Odour	:	Aromatic
Solubility	:	Negligible
Melting point/range	:	-95 °C
Boiling point	:	110 °C
Flash Point	:	9 °C (ASTM D-56)
Upper Explosion Limit (UEL)	:	7.1 %(V)
Lower Explosion Limit (LEL)	:	1.2 %(V)
Vapour pressure	:	22 hPa
Relative vapour density	:	3.2
Density	:	0.872 g/cm3 @ 20 °C
Viscosity, kinematic	:	0.6 mm2/s @ 40 °C 0.3 mm2/s @ 100 °C

10. STABILITY AND REACTIVITY

Stability	:	Stable.
Conditions to avoid	:	Heat, sparks, flame and build up of static electricity.
Materials to avoid	:	Strong oxidizers.
Hazardous decomposition products	:	Fumes, smoke and carbon monoxide.

11. TOXICOLOGICAL INFORMATION

Acute oral toxicity	:	(Rats): LD50: > 7 000 mg/kg. Considered to be practically non-toxic based on single dose level testing at 7 000 mg/kg. Warning Hazard category 5. Practically non-toxic, but when swallowed can cause lung damage.
Acute dermal toxicity	:	(Rats): Practically non-toxic (LD50: > 2 000 mg/kg). Based on single dose level testing at 2 000 mg/kg. Warning Hazard category 4. May be harmful in contact with skin.
Acute inhalation toxicity	:	(Rats): Harmful (LC50: greater than 10 but less than 20mg/l) 4 hours. Based on testing of similar products and/or the components. Warning Hazard category 4. Harmful if inhaled.
Skin irritation	:	(Rabbits): Mild irritant. (Primary Irritation Index: greater than 0.5 but less than 3). Based on testing of similar products and/or the components. Warning Hazard category 3. Causes mild skin irritation.
Eye irritation	:	(Rabbits): Practically non-irritating. Eye irritation scores: 12.0 at 24 hours, 18.0 at 48 hours, 18.0 at 72 hours, 16.0 at 4 days, 9.0 at 7 days. Warning Hazard category 2B. May cause mild eye irritation.
Respiratory and skin sensitization	:	Not expected to be sensitizing based on tests of this product, components, or similar products.
Germ cell mutagenicity	:	This product tested negative in a series of mutagenic tests.
Carcinogenicity	:	No carcinogenic effects were observed when toluene was applied to the skin of mice for two years. A 2 year NTP inhalation study (rodents) at

		levels up to 1200 ppm toluene was negative. Prolonged or repeated exposure to toluene does not result in bone marrow injury or blood changes characteristic of benzene.
Reproductive toxicity (Teratogenicity)	:	The NOEL for toluene was 500 ppm. Levels greater than 1500 ppm may adversely affect foetal development. Warning Hazard category 2.
Specific target organ toxicity (STOT) - single exposure	:	Irritation to the respiratory tract. At levels above 200 ppm, headache, dizziness, nausea, loss of coordination and/or consciousness. Central nervous system depression may result at levels approaching 10,000 ppm. Warning Hazard category 3.
Specific target organ toxicity (STOT) - repeated exposure	:	Toluene Inhalation studies (1500 ppm), 6 hours/day, 5 days/week for 6 months in rats: No neurotoxicity. However, deliberate inhalation associated with substance abuse could damage the brain and central nervous system. Prolonged repeated skin contact with low viscosity materials may defat the skin resulting in possible irritation and dermatitis.
Aspiration hazard	:	Material if aspirated into the lungs may cause chemical pneumonitis. Danger Hazard category 1.

12. ECOLOGICAL INFORMATION

Ecotoxicity effects

Toxicity to fish	:	(Salmon) LC/EC50: 8.1 mg/l at 96 hours.
Toxicity to aquatic organisms	:	(Daphnia magna) LC/EC50: 6 mg/l at 48 hours. (Green algae) LC/EC50: 9.4 mg/l at 8 hours.

Elimination information (persistence and degradability)

Biodegradability	:	Readily Biodegradable.
Mobility	:	Water solubility: 500 mg/l @ 20 C.
Bioaccumulation	:	Bioconcentration factor (BCF) < 100.

Further information on ecology

Remarks	:	This environmental assessment is based on test data for this product (or estimated data).

13. DISPOSAL CONSIDERATIONS

Waste disposal	:	Product is suitable for burning for fuel value in compliance with applicable laws and regulations, and consideration of product characteristics at time of disposal.
Contaminated packaging	:	Empty containers retain residue (liquid and/or vapour) and can be dangerous. DO NOT PRESSURIZE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. Do not attempt to refill or clean container since residue is difficult to remove. Empty drums should be completely drained, properly bunged and promptly returned to a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations.
Other regulations	:	Disposal of unused product may be subject to RCRA regulations (40 CFR 261). Disposal of the used product may also be regulated due to ignitability, corrosivity, reactivity, or toxicity as determined by the Toxicity Characteristic Leaching Procedure (TCLP).
Flash Point	:	9 °C (ASTM D-56)

14. TRANSPORT INFORMATION

ADR

ENGEN TOLUENE

Proper shipping name	:	TOLUENE
UN number	:	1294
Class	:	3
Letter	:	F
Packing group	:	II
Labelling number	:	3
Product Reportable Quantity	:	500 kg

CFR

Proper shipping name	:	TOLUENE
UN number	:	1294
Class	:	3
Letter	:	F
Packing group	:	II
Labelling number	:	3
Product Reportable Quantity	:	

IATA_C

Proper shipping name	:	TOLUENE
UN number	:	1294
Class	:	3
Letter	:	F
Packing group	:	II
Labelling number	:	3
Product Reportable Quantity	:	

IMDG

Proper shipping name	:	TOLUENE
UN number	:	1294
Class	:	3
Letter	:	F
Packing group	:	II
Labelling number	:	3
Product Reportable Quantity	:	
Marine pollutant	:	Marine Pollutant
Medical First Aid Guide (MFAG) table	:	310
Emergency Schedule (EmS) number	:	3-07
IMDG code page number	:	3285
Static Accumulator (50 picosiemens or less)	:	Yes

15. REGULATORY INFORMATION

US OSHA Hazard Communication Standard	:	Product assessed in accordance with OSHA 29 CFR 1910.1200 and determined to be hazardous.
U.S. Drug Enforcement Administration Chemical Diversion and Trafficking Act	:	Sales, receipts, movements or unexplainable losses of the following chemical(s) may require recordkeeping and reporting in accordance with 21 CFR 1310/1313. Contains Toluene.
Governmental Inventory Status	:	All components comply with TSCA, EINECS/ELINCS, AICS, METI, DSL, KECI, ENCS, PICCS and IECSC.
EU Labelling	:	Product is dangerous as defined by the European Union Dangerous Substances/Preparations Directives.
Symbols	:	F, Xn Highly flammable, Harmful
R-Phrase(s)	:	R11, R20 Highly flammable., Harmful by inhalation.
S-Phrase(s)	:	S16, S25, S29, S33 Keep away from sources of ignition - No smoking., Avoid contact with eyes., Do not empty into drains., Take precautionary measures against static discharges.

Note : Contains Toluene.

SARA

U.S. Superfund Amendments and Reauthorization Act SARA Title III : This product contains no "EXTREMELY HAZARDOUS SUBSTANCES".

SARA (311/312) Reportable Hazard Categories : Fire Chronic Acute

SARA (313) Toxic Release Chemicals: : Toluene (108-88-3) - Conc > 98 %.

The following product ingredients are cited on the lists below

Chemical name	CAS-No.	Concentration [%]	List Citations
Toluene	108-88-3	> 99.00	1, 10, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26
Benzene	71-43-2	< 0.10	1, 2, 4, 6, 9, 10, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26

Regulatory List Searched

1 = ACGIH ALL	6 = IARC 1	11 = TSCA 4	17 = CA P65	22 = MI 293
2 = ACGIH A1	7 = IARC 2A	12 = TSCA 5a2	18 = CA RTK	23 = MN RTK
3 = ACGIH A2	8 = IARC 2B	13 = TSCA 5e	19 = FL RTK	24 = NJ RTK
4 = NTP CARC	9 = OSHA CARC	14 = TSCA 6	20 = IL RTK	25 = PA RTK
5 = NTP SUS	10 = OSHA Z	15 = TSCA 12b	21 = LA RTK	26 = RI RTK

Code Key: CARC = Carcinogen; SUS = Suspected Carcinogen

16. OTHER INFORMATION

Note: Engen products do not contain PCBs.

INJECTION INJURY WARNING: If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a doctor as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

Note: No significant changes have been made to this Safety Data Sheet since the previous date.

Disclaimer

Information given herein is offered in good faith as accurate, but without guarantee. Conditions of use and suitability of the product for particular uses are beyond our control; all risks of use of the product are therefore assumed by the user and we expressly disclaim all warranties of every kind and nature, including warranties of merchantability and fitness for a particular purpose in respect to the use or suitability of the product. Nothing is intended as a recommendation for uses which infringe valid patents or as extending license under valid patents. Appropriate warnings and safe handling procedures should be provided to handlers and users.

Prepared by : Product Safety Specialist
Corporate Health, Safety, Environment and Quality Department
Engen Petroleum Limited
P.O.Box 35, Cape Town, 8000

Telephone : (021) 403 4805 / 4911 (Office Hours)
(021) 403 4099 (After Hours)
083 628 4415 (Cellular)

Shell Chemicals

Material Safety Data Sheet

1. MATERIAL AND COMPANY IDENTIFICATION

Material Name	:	**SHELLSOL A100**
Uses	:	Industrial Solvent.
Product Code	:	Q7391, Q7291
Company	:	**Shell Chemical LP** PO Box 2463 HOUSTON TX 77252-2463 USA
MSDS Request	:	1-800-240-6737
Customer Service	:	1-866-897-4355

Emergency Telephone Number

Chemtrec Domestic (24 hr)	:	1-800-424-9300
Chemtrec International (24 hr)	:	1-703-527-3887

Other Information	:	PR.nr., 76807SHELLSOL is a registered trademark of Shell trademark Management BV.

2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No.	Concentration
Solvent Naphtha (Petroleum), Light Aromatic	64742-95-6	100.00 %W

Contains Xylene (Mixed Isomers), CAS # 1330-20-7.
Contains Tri-methyl-benzene (all isomers), CAS# 25551-13-7
Contains Cumene, CAS# 98-82-8

3. HAZARDS IDENTIFICATION

Emergency Overview

Appearance and Odour	:	Colourless. Liquid. Aromatic.
Health Hazards	:	Irritating to respiratory system. Vapours may cause drowsiness and dizziness. Harmful: may cause lung damage if swallowed.
Safety Hazards	:	Combustible liquid. Vapours are heavier than air. Vapours may travel across the ground and reach remote ignition sources causing a flashback fire danger.
Environmental Hazards	:	Toxic to aquatic organisms. May cause long-term adverse effects in the aquatic environment.

Health Hazards

Inhalation	:	Irritating to respiratory system. Vapours may cause drowsiness and dizziness.
Skin Contact	:	May cause moderate irritation to skin. Repeated exposure may cause skin dryness or cracking.

Eye Contact	:	Vapours may be irritating to the eye.
Ingestion	:	Harmful: may cause lung damage if swallowed.
Other Information	:	Possibility of organ or organ system damage from prolonged exposure; see Chapter 11 for details. Target organ(s): Auditory system. Cardiovascular system. Central nervous system (CNS).
Signs and Symptoms	:	Respiratory irritation signs and symptoms may include a temporary burning sensation of the nose and throat, coughing, and/or difficulty breathing. Breathing of high vapour concentrations may cause central nervous system (CNS) depression resulting in dizziness, light-headedness, headache, nausea and loss of coordination. Continued inhalation may result in unconsciousness and death. If material enters lungs, signs and symptoms may include coughing, choking, wheezing, difficulty in breathing, chest congestion, shortness of breath, and/or fever. Defatting dermatitis signs and symptoms may include a burning sensation and/or a dried/cracked appearance. Auditory system effects may include temporary hearing loss and/or ringing in the ears.
Aggravated Medical Condition	:	Pre-existing medical conditions of the following organ(s) or organ system(s) may be aggravated by exposure to this material: Skin.
Environmental Hazards	:	Toxic to aquatic organisms. May cause long-term adverse effects in the aquatic environment.

4. FIRST AID MEASURES

General Information	:	In general no treatment is necessary, however, obtain medical advice.
Inhalation	:	Remove to fresh air. If rapid recovery does not occur, transport to nearest medical facility for additional treatment.
Skin Contact	:	Remove contaminated clothing. Flush exposed area with water and follow by washing with soap if available.
Eye Contact	:	Flush eyes with water while holding eyelids open. Rest eyes for 30 minutes. If redness, burning, blurred vision, or swelling persist, transport to the nearest medical facility for additional treatment.
Ingestion	:	If swallowed, do not induce vomiting: transport to nearest medical facility for additional treatment. If vomiting occurs spontaneously, keep head below hips to prevent aspiration.
Advice to Physician	:	Causes central nervous system depression. Dermatitis may result from prolonged or repeated exposure. Potential for chemical pneumonitis. Consider: gastric lavage with protected airway, administration of activated charcoal.

5. FIRE FIGHTING MEASURES

Clear fire area of all non-emergency personnel.

Flash point	:	38 - 47.22 °C / 100 - 117.00 °F (IP 170)

Explosion / Flammability limits in air	:	0.6 - 7 %(V)
Auto ignition temperature	:	460 - 507.22 °C / 860 - 945.00 °F (ASTM E-659)
Specific Hazards	:	Carbon monoxide may be evolved if incomplete combustion occurs. Will float and can be reignited on surface water. The vapour is heavier than air, spreads along the ground and distant ignition is possible.
Extinguishing Media	:	Foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only. Do not discharge extinguishing waters into the aquatic environment.
Unsuitable Extinguishing Media	:	Do not use water in a jet.
Protective Equipment for Firefighters	:	Wear full protective clothing and self-contained breathing apparatus.
Additional Advice	:	Keep adjacent containers cool by spraying with water.

6. ACCIDENTAL RELEASE MEASURES

Observe all relevant local and international regulations.

Protective measures	:	Avoid contact with spilled or released material. Immediately remove all contaminated clothing. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. For guidance on disposal of spilled material see Chapter 13 of this Material Safety Data Sheet. Shut off leaks, if possible without personal risks. Remove all possible sources of ignition in the surrounding area. Use appropriate containment to avoid environmental contamination. Prevent from spreading or entering drains, ditches or rivers by using sand, earth, or other appropriate barriers. Attempt to disperse the vapour or to direct its flow to a safe location for example by using fog sprays. Take precautionary measures against static discharge. Ensure electrical continuity by bonding and grounding (earthing) all equipment. Monitor area with combustible gas indicator.
Clean Up Methods	:	For small liquid spills (< 1 drum), transfer by mechanical means to a labelled, sealable container for product recovery or safe disposal. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely. For large liquid spills (> 1 drum), transfer by mechanical means such as vacuum truck to a salvage tank for recovery or safe disposal. Do not flush away residues with water. Retain as contaminated waste. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely.
Additional Advice	:	See Chapter 13 for information on disposal. Notify authorities if any exposure to the general public or the environment occurs or is likely to occur. U.S. regulations may require reporting releases of this material to the environment which exceed the reportable quantity (refer to Chapter 15) to the National Response Centre at (800) 424-8802. Under Section 311 of the

Clean Water Act (CWA) this material is considered an oil. As such, spills into surface waters must be reported to the National Response Centre at (800) 424-8802. This material is covered by EPA's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Petroleum Exclusion. Therefore, releases to the environment may not be reportable under CERCLA.

7. HANDLING AND STORAGE

General Precautions : Avoid breathing of or contact with material. Only use in well ventilated areas. Wash thoroughly after handling. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material.

Handling : Extinguish any naked flames. Do Not smoke. Remove ignition sources. Avoid sparks. Avoid contact with skin, eyes, and clothing. Electrostatic charges may be generated during pumping. Electrostatic discharge may cause fire. Ensure electrical continuity by bonding and grounding (earthing) all equipment. Restrict line velocity during pumping in order to avoid generation of electrostatic discharge (<= 1 m/sec until fill pipe submerged to twice its diameter, then <= 7 m/sec). Avoid splash filling. Do NOT use compressed air for filling, discharging, or handling operations.

Storage : Must be stored in a diked (bunded) well- ventilated area, away from sunlight, ignition sources and other sources of heat. Bulk storage tanks should be diked (bunded). Keep away from aerosols, flammables, oxidizing agents, corrosives and from other flammable products which are not harmful or toxic to man or to the environment. Storage Temperature: Ambient.

Product Transfer : Keep containers closed when not in use. Do not use compressed air for filling, discharging or handling.

Recommended Materials : For containers, or container linings use mild steel, stainless steel. For container paints, use epoxy paint, zinc silicate paint.

Unsuitable Materials : Avoid prolonged contact with natural, butyl or nitrile rubbers.

Container Advice : Containers, even those that have been emptied, can contain explosive vapours. Do not cut, drill, grind, weld or perform similar operations on or near containers.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Limits

In the absence of occupational exposure standards for this product, it is recommended that the following are adopted.

Material	Source	Type	ppm	mg/m3	Notation

Rubber solvent	ACGIH	TWA	400 ppm		
	OSHA Z1	PEL	100 ppm	400 mg/m3	
	OSHA Z1A	TWA	100 ppm	400 mg/m3	
1,2,4-Trimethyl benzene	ACGIH	TWA	25 ppm		
	OSHA Z1A	TWA	25 ppm	125 mg/m3	
1,3,5-Trimethyl benzene	ACGIH	TWA	25 ppm		
	OSHA Z1A	TWA	25 ppm	125 mg/m3	
Cumene	ACGIH	TWA	50 ppm		
	OSHA Z1	PEL	50 ppm	245 mg/m3	
	OSHA Z1	SKIN_DES			Can be absorbed through the skin.
	OSHA Z1A	TWA	50 ppm	245 mg/m3	
	OSHA Z1A	SKIN_FINAL			Can be absorbed through the skin.
1,2,3-Trimethyl benzene	ACGIH	TWA	25 ppm		
	OSHA Z1A	TWA	25 ppm	125 mg/m3	
Xylene, Mixed Isomers	ACGIH	TWA	100 ppm		
	ACGIH	STEL	150 ppm		
	OSHA Z1	PEL	100 ppm	435 mg/m3	
	OSHA Z1A	TWA	100 ppm	435 mg/m3	
	OSHA Z1A	STEL	150 ppm	655 mg/m3	

Additional Information : Shell has adopted as Interim Standards, the OSHA PELs that were established in 1989 and later rescinded. Skin notation means that significant exposure can also occur by absorption of liquid through the skin and of vapour through the eyes or mucous membranes.
Wash hands before eating, drinking, smoking and using the toilet.

Exposure Controls : The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. Appropriate measures include: Adequate explosion-proof ventilation to control airborne concentrations below the exposure guidelines/limits. Eye washes and showers for emergency use.

Personal Protective Equipment : Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers.

Respiratory Protection : If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select

		respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter. Select a filter suitable for organic gases and vapours [boiling point >65 °C (149 °F)] meeting EN141. Where air-filtering respirators are unsuitable (e.g., airborne concentrations are high, risk of oxygen deficiency, confined space) use appropriate positive pressure breathing apparatus.
Hand Protection	:	Longer term protection: Nitrile rubber gloves Incidental contact/Splash protection: PVC or neoprene rubber gloves
Eye Protection	:	Chemical splash goggles (chemical monogoggles).
Protective Clothing	:	Use protective clothing which is chemical resistant to this material. Safety shoes and boots should also be chemical resistant.
Monitoring Methods	:	Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls. For some substances biological monitoring may also be appropriate. Examples of sources of recommended air monitoring methods are given below or contact supplier. Further national methods may be available. National Institute of Occupational Safety and Health (NIOSH), USA: Manual of analytical Methods http://www.cdc.gov/niosh/nmam/nmammenu.html Occupational Safety and Health Administration (OSHA), USA: Sampling and Analytical Methods http://www.osha-slc.gov/dts/sltc/methods/toc.html Health and Safety Executive (HSE), UK: Methods for the Determination of Hazardous Substances http://www.hsl.gov.uk/search.htm
Environmental Exposure Controls	:	Local guidelines on emission limits for volatile substances must be observed for the discharge of exhaust air containing vapour.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Colourless. Liquid.
Odour	:	Aromatic.
Boiling point	:	148 - 182 °C / 298 - 360 °F
Flash point	:	38 - 47.22 °C / 100 - 117.00 °F (IP 170)
Explosion / Flammability limits in air	:	0.6 - 7 %(V)
Auto-ignition temperature	:	460 - 507.22 °C / 860 - 945.00 °F (ASTM E-659)
Vapour pressure	:	210 - 1,300 Pa at 20 °C / 68 °F
Specific gravity	:	0.87 - 0.88 at 20 °C / 68 °F
Density	:	Typical 876 kg/m3 at 15 °C / 59 °F (ASTM D-4052)
Water solubility	:	Insoluble.
Volatile organic carbon content	:	100 %
Evaporation rate (nBuAc=1)	:	< 1.0 (ASTM D 3539, nBuAc=1)

10. STABILITY AND REACTIVITY

Stability	:	Stable under normal conditions of use.
Conditions to Avoid	:	Avoid heat, sparks, open flames and other ignition sources.
Materials to Avoid	:	Strong oxidising agents.
Hazardous Decomposition Products	:	Thermal decomposition is highly dependent on conditions. A complex mixture of airborne solids, liquids and gases, including carbon monoxide, carbon dioxide and other organic compounds will be evolved when this material undergoes combustion or thermal or oxidative degradation.

11. TOXICOLOGICAL INFORMATION

Basis for Assessment	:	Information given is based on product testing, and/or similar products, and/or components.
Acute Oral Toxicity	:	Low toxicity: LD50 >2000 mg/kg , Rat Aspiration into the lungs may cause chemical pneumonitis which can be fatal.
Acute Dermal Toxicity	:	Low toxicity: LD50 >2000 mg/kg , Rat
Acute Inhalation Toxicity	:	Low toxicity: LC50 greater than near-saturated vapour concentration. / 1 hours, Rat High concentrations may cause central nervous system depression resulting in headaches, dizziness and nausea; continued inhalation may result in unconsciousness and/or death.
Skin Irritation	:	May cause moderate irritation to skin. Prolonged/repeated contact may cause defatting of the skin which can lead to dermatitis.
Eye Irritation	:	Essentially non-irritating to eyes.
Respiratory Irritation	:	Repeated inhalation of vapours and mists is expected to cause irritation of the respiratory tract.
Sensitisation	:	Not a skin sensitiser.
Repeated Dose Toxicity	:	Auditory system: prolonged and repeated exposures to high concentrations have resulted in hearing loss in rats. Solvent abuse and noise interaction in the work environment may cause hearing loss. Central nervous system: repeated exposure affects the nervous system. Cardiovascular system: chronic abuse of similar materials has been associated with irregular heart rhythms and cardiac arrest.

Material	:	**Carcinogenicity Classification**
Xylene, Mixed Isomers	:	ACGIH Group A4: Not classifiable as a human carcinogen.
Xylene, Mixed Isomers	:	IARC 3: Classification not possible from current data.

Reproductive and Developmental Toxicity	:	Causes foetotoxicity in animals at doses which are maternally toxic.

12. ECOLOGICAL INFORMATION

Acute Toxicity

Fish	:	Toxic: 1 < LC/EC/IC50 <= 10 mg/l

Aquatic Invertebrates	:	Toxic: 1 < LC/EC/IC50 <= 10 mg/l
Algae	:	Toxic: 1 < LC/EC/IC50 <= 10 mg/l
Mobility	:	Adsorbs to soil and has low mobility. Floats on water.
Persistence/degradability	:	Expected to be readily biodegradable. Oxidises rapidly by photo-chemical reactions in air.
Bioaccumulation	:	Has the potential to bioaccumulate.
Other Adverse Effects	:	

13. DISPOSAL CONSIDERATIONS

Material Disposal	:	Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations.
Container Disposal	:	Drain container thoroughly. After draining, vent in a safe place away from sparks and fire. Residues may cause an explosion hazard. Do not puncture, cut or weld uncleaned drums. Send to drum recoverer or metal reclaimer.
Local Legislation	:	Disposal should be in accordance with applicable regional, national, and local laws and regulations. Local regulations may be more stringent than regional or national requirements and must be complied with.

14. TRANSPORT INFORMATION

US Department of Transportation Classification (49CFR)

Identification number	UN 1268
Proper shipping name	Petroleum distillates, n.o.s.
Class / Division	3
Packing group	III
Contains OIL	
Emergency Response Guide No .	128
Additional Information	This material is an 'OIL' under 49 CFR Part 130 when transported in a container of 3500 gallon capacity or greater.

IMDG

Identification number	UN 1268
Proper shipping name	PETROLEUM DISTILLATES, N.O.S.
Class / Division	3
Packing group	III
Marine pollutant:	No

IATA (Country variations may apply)

Identification number	UN 1268
Proper shipping name	Petroleum distillates, n.o.s.
Class / Division	3
Packing group	III

15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

Federal Regulatory Status

Notification Status

DSL	Listed.	
INV (CN)	Listed.	
TSCA	Listed.	
EINECS	Listed.	265-199-0
KECI (KR)	Listed.	KE-31662
PICCS (PH)	Listed.	

Comprehensive Environmental Release, Compensation & Liability Act (CERCLA)

SHELLSOL A100 (64742-95-6)	Reportable quantity: 3,333 lbs
Cumene (98-82-8)	Reportable quantity: 5,000 lbs
Xylene, Mixed Isomers (1330-20-7)	Reportable quantity: 100 lbs
Toluene (108-88-3)	Reportable quantity: 1,000 lbs
Benzene (71-43-2)	Reportable quantity: 10 lbs

Shell classifies this material as an "oil" under the CERCLA Petroleum Exclusion, therefore releases to the environment are not reportable under CERCLA. The components with RQs are given for information.

Clean Water Act (CWA) Section 311

Xylene, Mixed Isomers (1330-20-7)	Reportable quantity: 100 lbs
Toluene (108-88-3)	Reportable quantity: 1,000 lbs
Benzene (71-43-2)	Reportable quantity: 10 lbs

Under Section 311 of the Clean Water Act (CWA) this material is considered an oil. As such, spills into surface waters must be reported to the National Response Centre at (800) 424-8802. The components with RQs are given for information.

SARA Hazard Categories (311/312)

Immediate (Acute) Health Hazard. Fire Hazard.

SARA Toxic Release Inventory (TRI) (313)

1,2,4-Trimethyl benzene (95-63-6)	45.00%
Cumene (98-82-8)	6.00%
Xylene, Mixed Isomers (1330-20-7)	3.00%
Toluene (108-88-3)	0.025%

Benzene (71-43-2) 0.005%

State Regulatory Status

California Safe Drinking Water and Toxic Enforcement Act (Proposition 65)

Known to the State of California to cause birth defects or other reproductive harm.
Known to the state of California to cause cancer.

Toluene (108-88-3) 0.025%	Developmental toxin.
Benzene (71-43-2) 0.005%	Carcinogenic. Developmental toxin. Male reproductive toxin.

New Jersey Right-To-Know Chemical List

1,2,4-Trimethyl benzene (95-63-6) 45.00%	
1,3,5-Trimethyl benzene (108-67-8) 12.00%	Listed.
Cumene (98-82-8) 6.00%	
1,2,3-Trimethyl benzene (526-73-8) 4.00%	Listed.
Xylene, Mixed Isomers (1330-20-7) 3.00%	
Toluene (108-88-3) 0.025%	
Benzene (71-43-2) 0.005%	

Pennsylvannia Right-To-Know Chemical List

1,2,4-Trimethyl benzene (95-63-6) 45.00%	Environmental hazard. Listed.
1,3,5-Trimethyl benzene (108-67-8) 12.00%	Listed.
Cumene (98-82-8) 6.00%	Environmental hazard. Listed.
1,2,3-Trimethyl benzene (526-73-8) 4.00%	Listed.
Xylene, Mixed Isomers (1330-20-7) 3.00%	Environmental hazard. Listed.
Toluene (108-88-3) 0.025%	Environmental hazard. Listed.
Benzene (71-43-2) 0.005%	Special hazard. Environmental hazard. Listed.

16. OTHER INFORMATION

HMIS Rating (Health, Fire, Reactivity)	:	1, 2, 0
NFPA Rating (Health, Fire, Reactivity)	:	1, 2, 0
MSDS Version Number	:	5.2
MSDS Effective Date	:	07/07/2005

MSDS Revisions	:	A vertical bar (|) in the left margin indicates an amendment from the previous version.
MSDS Regulation	:	The content and format of this MSDS is in accordance with the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
Uses and Restrictions	:	Industrial Solvent.
MSDS Distribution	:	The information in this document should be made available to all who may handle the product
Disclaimer	:	The information contained herein is based on our current knowledge of the underlying data and is intended to describe the product for the purpose of health, safety and environmental requirements only. No warranty or guarantee is expressed or implied regarding the accuracy of these data or the results to be obtained from the use of the product.

MATERIAL SAFETY DATA SHEET

This Material Safety Data Sheet (MSDS) complies with the United Nations Globally Harmonized System (GHS) of Classification and Labeling, Second revised Edition and meets or exceeds the Canadian and United States Requirements for Hazard Communication

1. Product and Supplier Identification

Product Name: Methanol
GHS Product Identifier: Methanol

Recommended Use: Solvent, fuel, feedstock

Restrictions on Use: Do not use in a confined area without proper ventilation. Contact lenses may cause further damage in case of splash into eye. Avoid use near heat, flames, sparks, and other sources of ignition.

Product:	**Methanol (CH_3OH)**	**Methanex Tel. #:** (604) 661-2600
Synonyms:	Methanol, methyl hydrate, wood spirit, methyl hydroxide	**Emergency Tel. #:** 1-800-262-8200 **(CHEMTREC)** (Canada and USA)
Company Identification:	**Methanex Corporation 1800 Waterfront Centre 200 Burrard Street Vancouver, B.C. V6C 3M1**	
Importer:	**Methanex Methanol Company 15301 Dallas Parkway, Suite 900 Addison, Texas 75001 Telephone: (972) 702-0909**	

2. Hazards Identification

Classification: Flammable Liquid, Category 1, Acute Toxicity Category 1*, Reproductive Toxicity 1B, Specific Target Organ Toxicity (Repeated Exposure)

Label:

Hazard Communication: DANGER! Extremely flammable liquid and vapour. Fatal if swallowed.
May damage fertility or the unborn child (fetotoxic and teratogenic effects).
May cause damage to eyes and central nervous system if ingested or inhaled.

***Note:** Assigned to classification based on human experience rather than the strict application of classification criteria set out in the Recommendations on the Transport of Dangerous Goods, Model Regulations Special Provision 279.

Hazards: Colourless liquid, with a mild, characteristic alcohol odour when pure. Crude methanol may have a repulsive, pungent odour. Hygroscopic (moisture absorbing).

***FLAMMABLE LIQUID AND VAPOUR*:** Burns with a clean, clear flame, which is almost invisible in daylight, or a light blue flame. Can decompose at high temperatures forming carbon monoxide and formaldehyde.

Confined space toxicity hazard. Mild central nervous system depressant following inhalation, skin absorption or ingestion. May cause headache, nausea, dizziness, drowsiness, and un-coordination. Severe vision effects, including increased sensitivity to light, blurred vision, and blindness may develop following an 8-24 hour symptom-free period. Coma and death may result.

IRRITANT: Causes eye irritation. Aspiration hazard. Swallowing or vomiting of the liquid may result in aspiration (breathing) into the lungs.

POSSIBLE REPRODUCTIVE HAZARD: May cause fetotoxic (toxic to the fetus during the latter stages of pregnancy, often through the placenta) and teratogenic effects (causing malformations of the fetus), based on animal information.

NFPA Ratings: (Health, Fire, Reactivity): 1, 3, 0

3. Composition

Component	% (w/w)	Exposure Limits (ACGIH)*	LD_{50}	LC_{50}
Methanol (CAS 67-56-1)	99-100	ACGIH* TLV-TWA: 200 ppm, skin; TLV-STEL: 250 ppm, skin PEL-TWA: 200 ppm, skin PEL-STEL: 250 ppm, skin IDLH: 6000 ppm, acute inhalation toxicity to animals TLV Basis, critical effects: neuropathy, vision, central nervous system(CNS)	5628 mg/kg (oral/rat) 15800 mg/kg (dermal/ rabbit)	64000 ppm (inhalation/rat)

* Exposure limits may vary from time to time and from one jurisdiction to another. Check with local regulatory agency for the exposure limits in your area. ACGIH, American Conference of Governmental Industrial Hygienists.

4. First Aid Measures

Note: *Emergency assistance may also be available from the local poison control centre.*

Eye Contact: Remove contact lenses if worn. In case of contact, immediately flush eyes with plenty of clean running water for at least 15 minutes, lifting the upper and lower eyelids occasionally. Obtain medical attention.

Skin Contact: In case of contact, remove contaminated clothing. In a shower, wash affected areas with soap and water for at least 15 minutes. Seek medical attention if irritation occurs or persists. Wash clothing before reuse. Prolonged contact with methanol may defat skin tissue, resulting in drying and cracking.

Inhalation: Remove to fresh air, restore or assist breathing if necessary. Obtain medical attention.

Ingestion: Swallowing methanol is potentially life threatening. Onset of symptoms may be delayed for 18 to 24 hours after digestion. If conscious and medical aid is not immediately available, do not induce vomiting. In actual or suspected cases of ingestion, transport to medical facility immediately.

NOTE TO PHYSICIAN: Acute exposure to methanol, either through ingestion or breathing high airborne concentrations can result in symptoms appearing between 40 minutes and 72 hours after exposure. Symptoms and signs are usually limited to the Central Nervous System (CNS), eyes and gastrointestinal tract. Because of the initial CNS's effects of headache, vertigo, lethargy and confusion, there may be an impression of ethanol intoxication. Blurred vision, decreased acuity and photophobia are common complaints. Treatment with ipecac or lavage is indicated in any patient presenting within two hours of ingestion. A profound metabolic acidosis occurs in severe poisoning and serum bicarbonate levels are a

more accurate measure of severity than serum methanol levels. Treatment protocols are available from most major hospitals and early collaboration with appropriate hospitals is recommended.

Ethanol significantly decreases the toxicity of methanol because it competes for the same metabolic enzymes, and has been used to treat methanol poisoning.

5. Fire Fighting Measures

Suitable Extinguishing Media: Extinguishing Media: Small fires: Dry chemical, CO_2, water spray
Large fires: Water spray(see note in Unsuitable Extinguishing Media), AFFF(R) (Aqueous Film Forming Foam (alcohol resistant)) type with either a 3% or 6% foam proportioning system.

Unsuitable Extinguishing Media: General purpose synthetic foams or protein foams may work, but much less effectively. Water may be effective for cooling, but may not be effective for extinguishing a fire because it may not cool methanol below its flash point.

Specific Hazards: Methanol vapours may burn with an invisible flame. During a fire, carbon monoxide, carbon dioxide and irritation and toxic gases such as formaldehyde may be generated. Vapours can accumulate in confined spaces resulting in a toxicity and flammability hazard. Closed containers may rupture violently and suddenly release large quantities of methanol when exposed to fire or excessive heat for a sufficient period of time. Vapours are slightly heavier than air and may travel long distances toward sources of ignition.

Hazardous Combustion Products: Toxic gases and vapours; oxides of carbon and formaldehyde.

Fire Fighting Instructions: Methanol burns with a clean clear flame that is almost invisible in daylight. Stay upwind! Isolate and restrict area access. Concentrations of greater that 25% methanol in water can be ignited. Use fine water spray or fog to control fire spread and cool adjacent structures or containers. Contain fire control water for later disposal. Fire fighters must wear full face, positive pressure, self-contained breathing apparatus or airline and appropriate protective fire fighting clothing as per NFPA. Note that methanol fires may require proximity suits. Take care not to walk through any spilled chemical.

Special Information: Vapours can flow along surfaces to distant ignition sources and flash back.

6. Accidental Release Measures

Overview: Flammable liquid! Can burn without a visible flame. Release can cause an immediate risk of fire and explosion. Eliminate all ignition sources, stop leak and use absorbent materials. If necessary, contain spill by diking. Fluorocarbon alcohol resistant foams may be applied to spill to diminish vapour and fire hazard. Maximize methanol recovery for recycling or re-use. Restrict access to area until completion of cleanup. Ensure cleanup is conducted by trained personnel only. Wear adequate personal protection and remove all sources of ignition. Notify all governmental agencies as required by law.

Personal Protection: Full face, positive pressure self-contained breathing apparatus or airline, and fire resistant protective clothing with chemical resistant splash suit must be worn. If product ignites, approach and fire fighting must be done with appropriate fire fighting clothing.

Environmental Precautions: Biodegrades easily in water. Methanol in fresh or salt water may have serious effects on aquatic life. A study on methanol's toxic efffects on sewage sludge bacteria reported little effect on digestion at 0.1% while 0.5% methanol retarded digestion. Methanol will be broken down to carbon dioxide and water.

Remedial Measures: Flammable liquid. Release can cause an immediate fire/explosion hazard. Eliminate all sources of ignition, stop leak and use absorbent materials. Collect liquid with explosion proof pumps. Do not walk through spill product as it may be on fire and not visible.

Small Spills: Soak up spill with non-combustible absorbent material. Recover methanol and dilute with water to reduce fire hazard. Prevent spilled methanol from entering sewers, confined spaces, drains, or waterways. Restict access to unprotected personnel. Put material in suitable, covered, labeled containers. Flush area with water.

Large Spills: If necessary, contain spill by diking. Fluorocarbon alcohol resistant foams may be applied to spill to diminish vapour and fire hazard. Maximize methanol recovery for recycling or reuse. Collect liquid with explosion proof pumps.

7. Handling and Storage

Precautions for Handling: No smoking or open flame in storage, use or handling areas. Use explosion proof electrical equipment. Ensure proper electrical grounding procedures are in place.

Storage: Store in totally enclosed equipment, designed to avoid ignition and human contact. Tanks must be grounded, vented, and should have vapour emission controls. Tanks must be diked as per NFPA or API Standards. A flammable mixture of methanol vapour and air is possible inside a storage tank or transportation tank, and handlers should take appropriate precautions to reduce the risk of ignition. Handlers must eliminate ignition sources or purge the tank with an inert gas such as nitrogen. All equipment must be grounded - bonded when transferring product in order to avoid static discharge from the equipment, and subsequent possible fire. Avoid storage with incompatible materials. Anhydrous methanol is non-corrosive to most metals at ambient temperatures except for lead, nickel, monel, cast iron and high silicon iron. Coatings of copper (or copper alloys), zinc (including galvanized steel), or aluminum are unsuitable for storage. These materials may be attacked slowly by the methanol. Storage tanks of welded construction are normally satisfactory. They should be designed and built in conformance with good engineering practice for the material being stored. While plastics can be used for short term storage, they are generally not recommended for long-term storage due to deterioration effects and the subsequent risk of contamination.

Corrosion rates for several construction materials:

<0.508 mm/year:	Cast iron, monel, lead, nickel
<0.051 mm/year:	High silicon iron
Some attack:	Polyethylene
Satisfactory:	Neoprene, phenolic resins, polyesters, natural rubber, butyl rubber
Resistant:	Polyvinyl chloride, unplasticized

8. Exposure Controls, Personal Protection

Occupational Controls: ACGIH* TLV-TWA: 200 ppm, skin (262 mg/m^3);
TLV-STEL: 250 ppm, skin (328 mg/m^3);
PEL-TWA: 200 ppm, skin
PEL-STEL: 250 ppm, skin
TLV Basis: critical effects: neuropathy, vision, central nervous system(CNS)
IDLH: 6000 ppm, acute inhalation toxicity to animals

Engineering Controls: In confined areas, local and general ventilation should be provided to maintain airborne concentrations below permissable exposure limits. Ventilation systems must be designed according to approved engineering standards.

Respiratory Protection: NIOSH/OSHA recommendations for methanol concentrations in air:

Up to 2000 ppm: supplied air respirator
Up to 5000 ppm: supplied air respirator operated in a continuous-flow mode.
Up to 6000 ppm: supplied air respirator with a tight-fitting facepiece operated in a continuous- flow mode; or Full-facepiece self-contained breathing apparatus or Full-facepiece supplied air respirator.

Cartridge type respirators are NOT recommended.

Emergency or Planned entry into unkown concentrations or IDLH (immediately dangerous to life or health) conditions:

Respirator selection must be done by a qualified person and be based upon a risk assessment of the work activities and exposure levels. Respirators must be fit tested and users must be clean shaven where the respirator seals to the face. Exposure must be kept at or below the applicable exposure limits and the maximum use concentration of the respirator must not be exceeded.

Positive pressure, full-facepiece self-contained breathing apparatus; or Positive pressure, full-facepiece supplied air respirator with an auxiliary positive pressure self-contained breathing apparatus.

Skin Protection: Butyl and nitrile rubbers are recommended for gloves. Check with manufacturer. Wear chemical resistant pants and jackets, preferably of butyl or nitrile rubber. Check with manufacturer.

Eye and Face Protection: Face shield and chemical splash goggles when transferring is taking place. Contact lenses should not be worn when working with methanol.

Footwear: Chemical resistant and as specified by the workplace.

Other: Eyewash and showers should be located near work areas. NOTE: PPE must not be considered a long-term solution to exposure control. PPE usage must be accompanied by employer programs to properly select, maintain, clean, fit and use. Consult a competent industrial hygiene resource to determine hazard potential and/or the PPE manufacturers to ensure adequate protection.

Careful consideration must be made of the added danger of the concenentration being in the LEL/UEL range and so there may be a fire/explosion hazard.

9. Physical and Chemical Properties

Appearance: Liquid, clear, colourless
Odour: Mild characteristic alcohol odour
Odour Threshold: detection: 4.2 - 5960 ppm
(geometric mean) 160 ppm
recognition: 53 – 8940 ppm
(geometric mean) 690 ppm
pH: Not applicable
Freezing Point: -97.8°C
Boiling Point: 64.7°C
Boiling Range: Not determined
Flash Point: 11.0^{o}C
Solubility: Completely soluble
Partial Coefficient: Log P (oct) = -0.82
Vapour Pressure: 12.8 kPa @ 20°C
Upper Explosive Limit (UEL): 36.5 %
Lower Explosive Limit (LEL): 6%
Auto Ignition Temperature: 464°C
Solvent Solubility: Soluble in all proportions in ethanol, benzene, other alcohols, chloroform, diethyl ether, other ethers, esters, ketones and most organic solvents
Critical Temperature: 239.4°C
Specific Gravity: 0.791 @ 20°C
Evaporation Rate: 4.1 (n-butyl acetate =1)
Vapour Density: 1.105 @ 15°C (air = 1)
Decomposition Temperature: Not determined
Sensitivity to Impact: No
Sensitivity to Static Charge: Low

10. Stability and Reactivity

Chemical Stability: Stable as supplied.

Hazardous Reactions: Yes. Avoid contact with strong oxidizers, strong mineral or organic acids, and strong bases. Contact with these materials may cause a violent or explosive reaction. May be corrosive to lead, aluminum, magnesium, and platinum.

Conditions to Avoid: Avoid contact with sparks, heat, open flame, or ignition sources.

Incompatibility: Yes. Avoid contact with strong oxidizers, strong mineral or organic acids, and strong bases. Contact with these materials may cause a violent or explosive reaction. May be corrosive to lead, aluminum, magnesium, and platinum. May react with metallic aluminum or magnesium and generate hydrogen gas. May attack some forms of plastic, rubber, and coatings.

Hazardous Decomposition Products: Formaldehyde, carbon dioxide, and carbon monoxide.

Hazardous Polymerization: Will not occur.

11. Toxicological Information

Signal Word/Label: DANGER! Extremely flammable liquid and vapour. Fatal if swallowed.
May damage fertility or the unborn child (fetotoxic and teratogenic effects).
May cause damage to eyes and central nervous system if ingested or inhaled.

Primary Routes of Entry:

Skin Contact:	Yes
Skin Absorption:	Yes
Eye Contact:	Yes
Ingestion:	Yes
Inhalation:	Yes

Emergency Overview: Colourless liquid, with a mild, characteristic alcohol odour when pure. Crude methanol may have a repulsive, pungent odour. Hygroscopic. Can decompose at high temperatures forming carbon monoxide and formaldehyde. Confined space toxicity hazard. Mild central nervous system depressant following inhalation, skin absorption or ingestion. May cause headache, nausea, dizziness, drowsiness, and incoordination. Severe vision effects, including increased sensitivity to light, blurred vision, and blindness may develop following an 8-24 hour symptom-free period. Coma and death may result. Causes eye irritation. Aspiration hazard. Swallowing or vomiting of the liquid may result in aspiration (breathing) into the lungs. May cause fetotoxic (toxic to the fetus during the latter stages of pregnancy, often through the placenta) and teratogenic effects (causing malformations of the fetus), based on animal information.

Acute Exposure:

Inhalation: Inhalation of high airborne concentrations can also irriate mucous membranes, cause headaches, sleepiness, nausea, confusion, loss of consciousness, digestive and visual disturbances and even death. NOTE: Odour threshhold of methanol is several times higher than the TLV-TWA. Depending upon severity of poisoning and the promptness of treatment, survivors may recover completely or may have permanent blindness, vision disturbances and/or nervous system effects. Concentrations in air exceeding 1000 ppm may cause irritation of the mucous membranes.

Skin Contact: Methanol is moderately irritating to the skin. Methanol can be absorbed through the skin and harmful effects have been reported by this route of entry. Effects are similar to those described in “Inhalation”.

Eye Contact: Methanol is a mild to moderate eye irritant. High vapour concentration or liquid contact with eyes causes irritation, tearing and burning.

Ingestion: Swallowing even small amounts of methanol could potentially cause blindness or death. Effects of sub lethal doses may be nausea, headache, abdominal pain, vomiting and visual disturbances ranging from blurred vision to light sensitivity.

Chronic Exposure:

Irritancy: Prolonged contact with skin may defat tissue causing dermititis or aggravate existing skin problems.

Sensitization: None reported.

Carcinogenicity: Not listed by IARC, NTP, ACGIH, or OSHA as a carcinogen.

Teratogenicity: Methanol has produced fetotoxicity in rats and teratogenicity in mice exposed by inhalation to high concentrations of methanol vapours **.**

Reproductive Toxicity: Information available does not suggest that methanol is a reproductive toxin.

Mutagenicity: There is insufficient information available to conclude that methanol is mutagenic.

Synergistic Products: In animals, high concentrations of methanol can increase the toxicity of other chemicals, particularly liver toxins like carbon tetrachloride. Ethanol significantly reduces the toxicity of methanol because it competes for the same metabolic enzymes, and has been usd to treat methanol poisoning.

Potential for Accumulation: Methanol is readily absorbed into the body following inhalation and ingestion. Skin absorption may occur if the skin is broken or exposure is prolonged. Once absorbed, methanol is rapidly distributed to body tissues. A small amount is excreted unchanged in exhaled air and the urine. The rest is first metabolized to formaldehyde, which is then metabolized to formic acid and/or formate. The formic acid and formate are eventually converted to carbon dioxide and water. In humans, methanol clears from the body, after inhalation or oral exposure, with a half-life of 1 day or more for high doses (greater than 1000 mg/kg) or about 1.5-3 hours for low doses (less than 100 mg/kg or 76.5-230 ppm (100-300 mg/m^3)).

Medical Conditions Aggravated By Exposure: Persons with pre-existing skin disorders, eye problems, respiratory conditions, or impaired liver or kidney functions may be more susceptable to the effects of this substance.

12. Ecological Information

Environmental toxicity: DO NOT discharge into sewer or waterways.

Methanol:

LC_{50} Pimephales promelas (fathead minnows) 29.4 g/L/96 hr, (28-29 days old), confidence limit= 28.5-30.4; Test conditions: Water temp= 25°C, dissolved oxygen= 7.3 mg/L, water hardness= 43.5 mg/l $CaCO_3$, alkalinity= 46.6 $CaCO_3$, tank volume= 6.3 L, additions= 5.71 V/D, pH= 7.66
LC_{50} Pimephales promelas (Fathead minnow, 28-32 day old, 0.126 g) 29,700 mg/L/24 hr; flow-through, 23.3+/-1.7°C, hardness 46.4 mg/L $CaCO_3$, pH 7.0-8.0
LC_{50} Pimephales promelas (Fathead minnow, 30 day old 0.12 g) 28,100 mg/L/96 hr; flow-through, 24-26°C, hardness 45.5 mg/L $CaCO_3$, pH 7.5
LC_{50} Daphnia pulex (Water flea, <24 hr old) 19,500 mg/L/18 hr; static, 22°C, hardness 23+/-2 mg/L $CaCO_3$
EC_{50} Daphnia obtusa (Water flea, <24 hr old; immobilization) 23,500 mg/L/24 hr; static, 20+/-2°C, hardness 250 mg/L $CaCO_3$, pH 7.8+/-0.2
EC_{50} Daphnia obtusa (Water flea, <24 hr old; immobilization) 22,200 mg/L/48 hr; static, 20+/-2°C, hardness 250 mg/L $CaCO_3$, pH 7.8+/-0.2

log K_{ow}: -0.82 – -0.66
Half-life (hr) air: 427
Half-life (hr) H_2O surface water: 5.3 – 64
Henry's Law constant (atm m^3/mol): $4.55X10^{-6}$
BOD 5 if unstated: 0.76 – 1.12
COD: 1.05 – 1.50, 99%
ThOD: 1.05
BCF: 0.2 – 10
TLm(48 hr): 8000mg/L (trout)
Toxicity Arthropoda: NOEL 10 g/L/48 hr (Daphnia)
HSNO Classification: 9.3C – Harmful to terrestrial vertebrates

Methanol in fresh or salt water may have serious effects on aquatic life. A study on methanol's toxic effects on sewage sludge bacteria reported little effect on digestion at 0.1% while 0.5% methanol retarded digestion. Methanol will be broken down into carbon dioxide and water.

Environmental Fate:

Biodegradability: Biodegrades easily in water and soil.

Bioaccumulation:

- **TERRESTRIAL FATE:** Based on a classification scheme, an estimated Koc value of 1 determined from a structure estimation method indicates that methanol is expected to have very high mobility in soil. Volatilization of methanol from moist soil surfaces is expected to be an important fate process given a Henry's Law constant of $4.55X10^{-6}$ (atm m^3/mol). The potential for volatilization of methanol from dry soil surfaces may exist based upon a vapor pressure of 127 mm Hg. Biodegradation is expected to be an important fate process for methanol.

- **AQUATIC FATE:** Based on a classification scheme, an estimated Koc value of 1, determined from a structure estimation method, indicates that methanol is not expected to adsorb to suspended solids and sediment. Volatilization from water surfaces is expected based upon a Henry's Law constant of $4.55X10^{-6}$ (atm m^3/mol). Using this Henry's Law constant and an estimation method, volatilization half-lives for a model river and model lake are three and 35 days, respectively. According to a classification scheme, a BCF of less than 10 measured in fish, suggests bioconcentration in aquatic organisms is low. Hydrolysis and photolysis in sunlit surface waters is not expected to be an important environmental fate process for methanol since this compound lacks functional groups that hydrolyze or absorb light under environmentally relevant conditions. Methanol has been shown to undergo rapid biodegradation in a variety of screening studies using sewage seed and activated sludge inoculum, which suggests that biodegradation will occur in aquatic environments.
- **ATMOSPHERIC FATE:** According to a model of gas/particle partitioning of semi volatile organic compounds in the atmosphere, methanol, which has a vapor pressure of 127 mm Hg at 25°C, is expected to exist solely as a vapor in the ambient atmosphere. Vapor-phase methanol is degraded in the atmosphere by reaction with photo chemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 17 days, calculated from its rate constant of $9.4X10^{-13}$ cu cm/molecule-sec at 25°C

13. Disposal Considerations

Review federal, provincial or state, and local government requirements prior to disposal. Store material for disposal as indicated in Section #7, ***Handling and Storage***. Disposal by controlled incineration or by secure land fill may be acceptable.

Recycle wherever possible. Large volumes may be suitable for re-distillation or, if contaminated, incinerated. Can be disposed of in a sewage treatment facility. Methanol levels of up to 0.1% act as a food source for bacteria; above this level may be toxic to bacteria. When pumping through sewage collection systems, the level of methanol should be kept below the flammable range (a 25% methanol/water mixture is non-flammable at temperatures below 39**°C**). 1 ppm of methanol is equivalent to 1.5 ppm BOD loading in the sewage plant.

Container disposal:

Empty containers may contain hazardous residue. Return to supplier for reuse if possible. Never weld, cut or grind empty containers. If disposing of containers, ensure they are well rinsed with water, then disposed of at an authorised landfill. After cleaning, all existing labels should be removed.

14. Transport Information

Canada Transportation of Dangerous Goods (TDG):	UN 1230, Methanol, Class 3(6.1), P.G. II Limited Quantity: ≤ 1 litres ERG Guide Number: 131
United States Department of Transport (49CFR): (Domestic Only)	UN 1230, Methanol, Class 3, P.G. II, (RQ 5000 lbs/2270 kg) Limited Quantity: ≤ 1 litres ERG Guide Number: 131
International Air Transport Association (IATA):	UN 1230, Methanol, Class 3(6.1), P.G. II Packaging Instruction (passenger aircraft): 305, 1 litre maximum per package,
International Maritime Organization (IMO):	UN 1230, Methanol, Class 3(6.1), P.G.II, Flash Point = 11°C EmS No. F-E, S-D Stowage Category "B", Clear of living quarters
Marine Pollutant:	No

15. Regulatory Information

CANADIAN FEDERAL REGULATIONS:

CEPA, DOMESTIC SUBSTANCES LIST:	Listed (Canadian Environmental Protection Act (CEPA) Schedule I)
WHMIS CLASSIFICATION:	B2, D1B, D2A, D2B

UNITED STATES REGULATIONS:

29CFR 1910.1200 (OSHA):	Hazardous
40CFR 116-117 (EPA):	Hazardous
40CFR 355, Appendices A and B:	Subject to Emergency Planning and Notification
40CFR 372 (SARA Title III):	Listed
40CFR 302 (CERCLA):	Listed

TOXIC SUBSTANCES CONTROL ACT (TSCA): Listed in the inventory.

16. Other Information

References:

1. International Programme on Chemical Safety, Methanol, Environmental Health Criteria, World Health Organization 1997.
2. Patty's Industrial Hygiene and Toxicology, 5th Edition.
3. Fire Protection Guide to Hazardous Materials, 13th Edition.
4. Lanigan, S., Final report on the Safety Assessment of Methyl Alcohol, International Journal of Toxicology., Volume 20, Supplement 1 (2001).
5. Forsberg, K., Quick Selection Guide to Chemical Protective Clothing.
6. Nelson, B.K., Teratological assessment of Methanol and Ethanol at high inhalation levels in rats, Fundamental and Applied Toxicology, Volume 5.
7. NIOSH Guide to Chemical Hazards
8. Hazardous Substance Data Base (HSDB).
9. Cheminfo.

Original Preparation Date: September 22, 2005

Prepared by: Kel-Ex Agencies Ltd., P.O. Box 52201, Lynnmour RPO, North Vancouver, B.C., Canada, V7J 3V5

Disclaimer: The information above is believed to be accurate and represents the best information currently available to us. Users should make their own investigations to determine the suitability of the information for their particular purposes. This document is intended as a guide to the appropriate precautionary handling of the material by a properly trained person using this product.

Methanex Corporation and its subsidiaries make no representations or warranties, either express or implied, including without limitation any warranties of merchantability, fitness for a particular purpose with respect to the information set forth herein or the product to which the information refers. Accordingly, Methanex Corp. will not be responsible for damages resulting from use of or reliance upon this information.

This Material Safety Data Sheet may not be changed, or altered in any way without the expressed knowledge and permission of Methanex Corporation

Revisions: Revised and re-issued in GHS Format September 22, 2008

ENGEN LAUREL PARAFFIN

SAFETY DATA SHEET

Revision Date : 25.10.2011

1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	ENGEN LAUREL PARAFFIN
Chemical name	:	Kerosene
Synonyms	:	Paraffin
Product use	:	General purpose fuel
UN number	:	1223
Supplier	:	Engen Petroleum Limited (Tel: 021-403 4911, a/h: 021-403 4099)
Health Emergency Telephone	:	021-689 5227 (Red Cross Poison Service)
Transport Emergency Telephone	:	011-975 1278/83 (Hazchemwise)
Customer Service Centre	:	0860 036 436 (Sales and Technical Information)
Engen Website	:	http://www.engen.co.za/

2. HAZARDS IDENTIFICATION

Emergency response data : Colourless Liquid. Flammable. Product can accumulate a static charge and release vapours which may cause a fire or explosion. DOT ERG No. : 128

GHS Classification:

Health		
Acute inhalation toxicity	Hazard category 3. Toxic if inhaled.	Danger
Skin irritation	Hazard category 3. Hazard category 3.	Warning
Eye irritation	Hazard category 2B. Causes eye irritation.	Warning
Aspiration hazard	Hazard category 1. May cause chemical pneumonitis.	Danger
Environmental		
Aquatic toxicity :	Hazard category 3. Very toxic to fish, aquatic organisms and wildlife.	Warning
Physical		
Flammability :	Hazard category 2. Flammable liquid and vapour.	Warning

GHS Labels/Pictograms:

Hazard Statements

Flammable liquid and vapour. May be fatal if swallowed and enters airways. May cause eye and mild skin irritation.

Precautionary Statements

General
Keep locked up and out of reach of children.

Prevention
Keep away from heat/sparks/open flames/hot surfaces – No smoking.

Response
IN CASE OF FIRE: Use carbon dioxide, foam or dry chemical for extinction. IF SWALLOWED: Immediately call a POISON CENTRE or doctor. Do NOT induce vomiting. IF INHALED: Call a POISON CENTRE or doctor immediately. IF ON SKIN: Immediately remove all contaminated clothing. Gently wash skin with plenty of

soap and water. Launder contaminated clothing before re-use.

Storage
Store in a well-ventilated place and keep the container cool and tightly closed. Take precautionary measures against static discharge. Ground/bond container and receiving equipment. Use only non-sparking tools.

Disposal
Do not discharge into lakes, streams, ponds and ground water supply.

See Section 11 for further health effects/toxicological data.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical name	CAS-No.	Weight%
Kerosene	8008-20-6	> 98.00
Ethyl Benzene	100-41-4	< 1.00
Naphthalene	91-20-3	< 1.00

See Section 8 for Exposure Limits (if applicable).

4. FIRST AID MEASURES

Inhalation	:	Remove from further exposure. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with mechanical device or use mouth-to-mouth resuscitation with a mouthpiece.
Skin contact	:	Remove contaminated clothing. Dry wipe exposed skin and cleanse with hand cleaner, soap and water. Launder contaminated clothing before reuse. (See Section 16 - Injection Injury)
Eye contact	:	Flush thoroughly with water. If irritation occurs call a doctor.
Ingestion	:	Seek immediate medical attention. Do not induce vomiting.
Note to doctors	:	Material if aspirated into the lungs may cause chemical pneumonitis. Skin contact may aggravate an existing dermatitis. Treat appropriately.

5. FIRE-FIGHTING MEASURES

Extinguishing media	:	Carbon dioxide, foam, dry chemical and water fog.
Special fire fighting procedure	:	Water spray should only be used to keep fire-exposed containers cool, flush spills away from exposures, disperse vapours and protect personnel attempting to stop leak. Prevent runoff from fire control or dilution from entering streams, municipal sewers, or drinking water supply.
Special protective equipment for firefighters	:	For fires in enclosed areas, fire fighters must use Self-Contained Breathing Apparatus.
Unusual fire and explosive hazards	:	Flammable.
Products of decomposition	:	Fumes, smoke and carbon monoxide.
Flash Point	:	>= 38 °C (ASTM D-56)
Upper Explosion Limit (UEL)	:	5.0 %(V)
Lower Explosion Limit (LEL)	:	0.7 %(V)
NFPA Hazard Id	:	Health: 0; Flammability: 2; Reactivity: 0

6. ACCIDENTAL RELEASE MEASURES

Procedure if material is	:	Report spills/releases as required to appropriate authorities.

released or spilled

Methods for cleaning up	:	Absorb on fire retardant treated sawdust, diatomaceous earth, etc. Shovel up for later approved disposal. LARGE SPILLS: Contain material and pump back to holding tank for disposal or recycling in accordance with product characteristics and applicable regulations.
Personal precautions	:	See Section 8.
Environmental precautions	:	Prevent spills from entering municipal sewers or drains and contact with soil.

7. HANDLING AND STORAGE

Safe handling advice	:	Harmful in contact with or if absorbed through the skin. Avoid inhalation of vapours or mists. Use in well ventilated area away from all ignition sources.
Storage information	:	Store in a cool area. Small containers of approved design, properly sealed and labeled, should be stored in well ventilated surroundings and kept out of reach of children.
Storage and handling procedures	:	To minimize the risk of fire or explosion from discharges, static and/or vapour accumulation, effectively bond and ground product storage and transfer systems. Electrical equipment and fittings must comply with local fire prevention regulations for this class of product. Refer to national or local regulations covering safety at petroleum handling and storage areas for this product.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational Exposure Limits (OELs)

Components	CAS-No.	Source	TWA	Value		Notations
Kerosene	8008-20-6	ACGIH	LTEL	200 mg/m3	50 ppm	Skin; A3
Ethyl Benzene	100-41-4	ACGIH TLV OSHA PEL	LTEL STEL LTEL STEL	434 mg/m3 543 mg/m3 435 mg/m3 545 mg/m3	100 ppm 125 ppm 100 ppm 125 ppm	A3; BEI
Naphthalene	91-20-3	ACGIH TLV OSHA PEL	LTEL STEL LTEL STEL	52 mg/m3 79 mg/m3 50 mg/m3 75 mg/m3	10 ppm 15 ppm 10 ppm 15 ppm	Skin; A4

LTEL: Long Term Exposure Limits - Time Weight Average (TWA) over 8 hours.

STEL: Short Term Exposure Limits - Time Weight Average (TWA) over 15 Minutes

Note: Limits Shown for guidance only. Follow applicable regulations.

Personal Protective Equipment (PPE)

Engineering controls	:	Use in well ventilated area. Explosive-proof ventilation equipment with local exhaust is desirable.
Respiratory protection	:	Approved respiratory equipment must be used when airborne concentrations are unknown or exceed the recommended exposure limit. Self-Contained Breathing Apparatus may be required for use in confined or enclosed spaces.
Eye protection	:	If splash with liquid is possible, chemical type goggles should be worn.
Skin and body protection	:	Impervious gloves must be worn. If body contact is likely, appropiate personal protective equipment must be worn. Good personal hygiene practices should always be followed.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Liquid.
Colour	:	Colourless
Odour	:	Mild
Solubility	:	Negligible
Boiling point	:	> 140 °C
Flash Point	:	>= 38 °C (ASTM D-56)
Upper Explosion Limit (UEL)	:	5.0 %(V)
Lower Explosion Limit (LEL)	:	0.7 %(V)
Vapour pressure	:	< 1.0 hPa
Density	:	0.79 g/cm3 @ (ASTM D-4052)
Viscosity, kinematic	:	1.5 mm2/s @ 40 °C (ASTM D-445)

10. STABILITY AND REACTIVITY

Stability	:	Stable.
Conditions to avoid	:	Heat, sparks, flame and build up of static electricity.
Materials to avoid	:	Strong oxidizers.
Hazardous decomposition products	:	Fumes, smoke and carbon monoxide.

11. TOXICOLOGICAL INFORMATION

Acute oral toxicity	:	(Rats): Toxic (LD50: 50 or greater, but 300 mg/kg or less). Based on testing of similar products and/or the components. Danger Hazard category 3. May be fatal if swallowed and enters airways.
Acute dermal toxicity	:	(Rabbits): Practically non-toxic (LD50: greater than 2000 mg/kg). Based on testing of similar products and/or the components. Warning See Section 15 for a Regulatory analysis of the ingredients. May be harmful in contact with skin.
Acute inhalation toxicity	:	(Rats): Toxic (LC50: greater than 2 but 10mg/l or less) 4 hours. Based on testing products and/or components. Danger Hazard category 3. Toxic if inhaled.
Skin irritation	:	(Rabbits): Mild irritant. (Primary Irritation Index: greater than 0.5 but less than 3). Based on testing of similar products and/or the components. Warning Hazard category 3. Causes mild skin irritation.
Eye irritation	:	(Rabbits): Mild irritant. (Draize score: greater than 6 but 15 or less). Based on testing of similar products and/or the components. Warning Hazard category 2B. Causes eye irritation.
Respiratory and skin sensitization	:	Middle distillate oils were not skin sensitizers when tested in a Modified Buehler Guinea Pig Sensitization Assay.
Germ cell mutagenicity	:	This product tested negative in a series of mutagenic tests.
Carcinogenicity	:	This product contains ethylbenzene. The International Agency for Research on Cancer (IARC) has evaluated ethylbenzene and classified it as possibly carcinogenic to humans (Group 2B) based on sufficient evidence for carcinogenicity in experimental animals, but inadequate evidence for cancer in exposed humans.
Reproductive toxicity (Teratogenicity)	:	A review of the literature indicates that inhalation of kerosene vapours does not cause reproductive or developmental effects in laboratory animals. There is no evidence of effects on humans.
Specific target organ toxicity (STOT) - single exposure	:	Low viscosity material if swallowed may enter the lungs and cause lung damage.
Specific target organ toxicity (STOT) - repeated exposure	:	Certain straight-run middle distillates have been found to produce skin tumors in laboratory mouse skin-painting tests, but these have usually been associated with a high level of skin irritation. Laboratory tests have

		indicated that the irritation can produce tumours. Therefore, if the precautions outlined in this SDS are followed to minimize repeated or prolonged skin contact which could cause irritation, these oils should pose no carcinogenic hazard to humans. Prolonged repeated skin contact with low viscosity materials may defat the skin resulting in possible irritation and dermatitis.
Aspiration hazard	:	Material if aspirated into the lungs may cause chemical pneumonitis.

12. ECOLOGICAL INFORMATION

Ecotoxicity effects

Toxicity to fish	:	(Rainbow trout) LC/EC50: 18 - 25 mg/l at 96 hours.
Toxicity to aquatic organisms	:	(Daphnia) Immobilisation (50%): 1.4 - 21 mg/l at 48 hours. (Algae) Growth Inhibition (50%): 4 - 15 mg/l at 72 hours.

Elimination information (persistence and degradability)

Biodegradability	:	The majority of the components in this product would be expected to be inherently biodegradable. The constituents of kerosene which are volatilized will photodegrade in the atmosphere. The less volatile, more water-soluble components which are aromatic hydrocarbons will also undergo aqueous photodegradation.
Mobility	:	Not established.
Bioaccumulation	:	Not established.

Further information on ecology

Remarks	:	This environmental assessment is based on test data for this product (or estimated data).

13. DISPOSAL CONSIDERATIONS

Waste disposal	:	Product is suitable for burning for fuel value compliance with applicable laws and regulations.
Contaminated packaging	:	Empty containers retain residue (liquid and/or vapour) and can be dangerous. DO NOT PRESSURIZE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. Do not attempt to refill or clean container since residue is difficult to remove. Empty drums should be completely drained, properly bunged and promptly returned to a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations.
Other regulations	:	Disposal of unused product may be subject to RCRA regulations (40 CFR 261). Disposal of the used product may also be regulated due to ignitability, corrosivity, reactivity, or toxicity as determined by the Toxicity Characteristic Leaching Procedure (TCLP).
Flash Point	:	>= 38 °C (ASTM D-56)

14. TRANSPORT INFORMATION

Note	:	The flash point of this material is > 38 °C, and hence regulatory classifications for flammability may vary.

ADR

Proper shipping name	:	KEROSENE
UN number	:	1223
Class	:	3
Letter	:	F
Packing group	:	III
Labelling number	:	3

ENGEN LAUREL PARAFFIN

CFR

Proper shipping name	:	KEROSENE
UN number	:	1223
Class	:	3
Letter	:	F
Packing group	:	III
Labelling number	:	3

IATA_C

Proper shipping name	:	KEROSENE
UN number	:	1223
Class	:	3
Letter	:	F
Packing group	:	III
Labelling number	:	3

IMDG

Proper shipping name	:	KEROSENE
UN number	:	1223
Class	:	3
Letter	:	F
Packing group	:	III
Labelling number	:	3
Marine pollutant	:	Marine Pollutant
Medical First Aid Guide (MFAG) table	:	311
Emergency Schedule (EmS) number	:	3-07
IMDG code page number	:	3375
Static Accumulator (50 picosiemens or less)	:	Yes

15. REGULATORY INFORMATION

US OSHA Hazard Communication Standard	:	Product assessed in accordance with OSHA 29 CFR 1910.1200 and determined to be hazardous.
Governmental Inventory Status	:	All components comply with TSCA, EINECS/ELINCS, AICS, METI, DSL, KECI, ENCS, PICCS and IECSC.
EU Labelling	:	Product is dangerous as defined by the European Union Dangerous Substances/Preparations Directives.
Symbols	:	Xn, N Harmful, Dangerous for the environment
R-Phrase(s)	:	R10, R38, R67, R65, R51/53 Flammable., Irritating to skin., Vapours may cause drowsiness and dizziness., Harmful: may cause lung damage if swallowed., Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
S-Phrase(s)	:	S2, S16, S43, S24, S62 Keep out of the reach of children., Keep away from sources of ignition - No smoking., In case of fire use foam/drypowder/carbon dioxide., Avoid contact with the skin., If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label.
Note	:	Contains straight-run Kerosene.

SARA

U.S. Superfund Amendments and Reauthorization Act SARA Title III	:	This product contains no "EXTREMELY HAZARDOUS SUBSTANCES".
SARA (311/312) Reportable Hazard Categories	:	Fire Chronic Acute

SARA (313) Toxic Release Chemicals: : This product contains no chemicals reportable under SARA (313) Toxic Release Chemicals:

The following product ingredients are cited on the lists below

Chemical name	CAS-No.	Concentration [%]	List Citations
Kerosene	8008-20-6	> 98.00	19, 21, 25, 26
Ethyl Benzene	100-41-4	< 1.00	1, 8, 10, 18, 19, 20, 21, 23, 24, 25, 26
Naphthalene	91-20-3	< 1.00	16, 22

Regulatory List Searched

1 = ACGIH ALL	6 = IARC 1	11 = TSCA 4	17 = CA P65	22 = MI 293
2 = ACGIH A1	7 = IARC 2A	12 = TSCA 5a2	18 = CA RTK	23 = MN RTK
3 = ACGIH A2	8 = IARC 2B	13 = TSCA 5e	19 = FL RTK	24 = NJ RTK
4 = NTP CARC	9 = OSHA CARC	14 = TSCA 6	20 = IL RTK	25 = PA RTK
5 = NTP SUS	10 = OSHA Z	15 = TSCA 12b	21 = LA RTK	26 = RI RTK

Code Key: CARC = Carcinogen; SUS = Suspected Carcinogen

16. OTHER INFORMATION

Note: Engen products do not contain PCBs.

INJECTION INJURY WARNING: If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a doctor as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

This warning is given to comply with California Health and Safety Code 25249.6 and does not constitute an admission or a waiver of rights. This product contains a chemical known to the State of California to cause cancer, birth defects, or other reproductive harm. Chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm are created by the combustion of this product. Refer to product Material Safety Data Sheet for further safety and health information.

Note: No significant changes have been made to this Safety Data Sheet since the previous date.

Disclaimer

Information given herein is offered in good faith as accurate, but without guarantee. Conditions of use and suitability of the product for particular uses are beyond our control; all risks of use of the product are therefore assumed by the user and we expressly disclaim all warranties of every kind and nature, including warranties of merchantability and fitness for a particular purpose in respect to the use or suitability of the product. Nothing is intended as a recommendation for uses which infringe valid patents or as extending license under valid patents. Appropriate warnings and safe handling procedures should be provided to handlers and users.

Prepared by : Product Safety Specialist
Corporate Health, Safety, Environment and Quality Department
Engen Petroleum Limited
P.O.Box 35, Cape Town, 8000

Telephone : (021) 403 4805 / 4911 (Office Hours)
(021) 403 4099 (After Hours)
083 628 4415 (Cellular)

THINNERS - MSDS

Classified as hazardous

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Product Name:	THINNERS
Recommended Use:	Industrial Solvent
Company:	Omega International Coatings Pty Ltd
Address:	**111,** Kurrajong Av., Mt Druitt NSW 2770
Telephone Number:	(02) 98320000
Emergency Telephone:	(02) 96770566

2. HAZARDOUS IDENTIFICATION

Hazardous Classification: Hazardous substance according to the criteria of NOHSC. Dangerous goods classification according to the Australian Dangerous Goods Code.

Risk Phrase(s):
R11 – Highly flammable
R20 – Harmful by inhalation
R36/37 – Irritating to eyes and respiratory system

Safety Phrase(s):
S2 – Keep out of reach of children
S9 – Keep container in a well-ventilated place
S16 – Keep away from sources of ignition
S25 – Avoid contact with eyes
S29 – Do not empty into drains
S33 – Take precautionary measures against static discharges

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients: (w/w):	**Name:**	**CAS No:**	**Proportion**
	X3B	108-88-3	95%
	Methyl Ethyl Ketone	78-93-3	5 %

4. FIRST AID MEASURES

Inhalation:
Remove from contaminated area. Apply artificial respiration if not breathing. Seek medical assistance.

Ingestion:
If poisoning occurs, contact a Doctor or Poisons Information Centre. Phone 131126 in Australia. If swallowed, do not induce vomiting. Give a glass of water.

Skin:
If skin contact occurs, remove contaminated clothing and wash skin thoroughly. Remove contaminated clothing. Wash clothing before reuse.

Eye:
If in eyes, hold eyes open, flood with water for at least 15 minutes and see a doctor.

First Aid Facilities:
Provide eye baths and safety showers close to areas where splashing may occur.

Advice to Doctor:
Due to the risks of lung damage by aspiration of this product, gastric lavage should only be undertaken after endotracheal intubation.

5. FIRE FIGHTING MEASURES

Substantial Extinguishing Media:
Use foam or dry agent extinguisher.

Special Protective Equipment for Fire Fighters:
Wear chemical goggles or face shield. Wear protective clothing as necessary to avoid skin contact. Wear chemical resistant gloves. Respiratory protection should be used if there is a risk of exposure to high vapour concentrations.

Specific Hazards:
This product is extremely flammable. Vapours are heavier than air and will “travel” to low-level areas eg. Sumps, drains, etc. and flashback. Precautions should be taken to eliminate the build up of explosive mixtures.

Hazchem Code:
3[Y]E

6. ACCIDENTAL RELEASE MEASURES

Emergency Procedures:
All Purpose Thinners is a flammable liquid. Vapour may form explosive mixtures with air. Avoid heat and all ignition sources. Use only in well-

ventilated areas. Flameproof equipment is necessary in any area where product is being used. Product transfer and storage equipment must be earthed. Prevent build-up of flammable vapours. Consult AS1940 for further information on safe storage and handling of flammable liquids. Handle in accordance with state or territory regulations for flammable liquids.

7. HANDLING AND STORAGE

Precautions for Safe Handling:
Wear chemical goggles or face shield. Wear protective clothing as necessary to avoid skin contact. Wear chemical resistant gloves. Respiratory protection should be used if there is a risk of exposure to high vapour concentrations. This product is harmful if it is inhaled. Respirators should comply with AS1716 or an equivalent approved by a state/territory authority.

Conditions for Safe Storage:
Store in a cool well-ventilated area away from heat and ignition sources. Containers should always be kept closed in storage and properly labeled. Many plastics may be unsuitable as storage and handling materials. Store only in original or approved containers.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

National Exposure Standards:

Substance	STEL mg/m³	STEL ppm	TWA mg/m³	TWA ppm
Lacquer Thinners	- 150	-	50	

Engineering Controls:
Keep away from sources of ignition. Take precautionary measures against static discharges. Provide sufficient ventilation to control exposure levels below the exposure standards. Use local exhaust ventilation at sources of air contamination such as open process equipment. Dangerous concentrations may exist in areas with poor ventilation such as confined spaces.

Respiratory Protection:
Respiratory protection should be used if there is a risk of exposure to high vapour concentrations. This product is harmful if it is inhaled. Respirators should comply with AS1716 or an equivalent approved by a state/territory authority.

Eye Protection:
Wear chemical goggles or face shield.

Hand Protection:
Wear chemical resistant gloves.

Body Protection:
Wear protective clothing as necessary to avoid skin contact.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Clear, colourless, mobile liquid with hydrocarbon odour
Boiling Point:	80-110°C
Solubility in Water:	Miscible with water
Specific Gravity:	0.84g/mL
Vapour Pressure:	50mm Hg @ 20°C
Vapour Density (Air = 1):	2.0
Volatile Component:	100%
Flash Point:	1
Flammability:	HIGHLY FLAMMABLE. This product should be stored and used in a well-ventilated area away from naked flames, sparks and other sources of ignition. Electrically link and ground metal containers for transfers of the product to prevent accumulation of static electricity. Keep the container tightly closed.

10. STABILITY AND REACTIVITY

Chemical Stability:
Stable under normal use conditions.

Conditions to Avoid:
Heat, direct sunlight, open flames or other sources of ignition and incompatibles.

11. TOXICOLOGICAL INFORMATION

Inhalation:
Avoid breathing vapour or spray mist. Vapour concentrations are irritating to nose and throat resulting in possible headaches, dizziness, and lack of coordination, nausea and possible loss of consciousness.

Ingestion:
All Purpose Thinners is classified as flammable and harmful if ingested. Exposure to this product may result in nausea, dizziness and lack of consciousness. Vomiting may cause the product to be aspirated in the lungs possibly resulting in chemical pneumonitis.

Skin:
Avoid contact with skin. Exposure may cause the product to be absorbed into the skin promoting the potential for over-exposure.

Eye:
Avoid contact with eyes. Product may cause moderate to severe eye irritation and pronounced inflammation.

Chronic Effects:
Repeated or prolonged contact may cause irritant contact dermatitis.

12. ECOLOGICAL INFORMATION

Ecotoxicity:
A low potential to affect aquatic organisms.
A low potential to affect secondary waste treatment microbial metabolism.
A low potential to affect the growth of some plant seedlings.

Environment Protection:
Do not allow product to enter drains, waterways or sewers.

13. DISPOSAL CONSIDERATIONS

Waste Disposal:
Prevent entry into drainage systems, sewers and waterways.

14. TRANSPORT INFORMATION

Transport Information:
All Purpose Thinners is classified as flammable under the Australian Code for the Transportation of Dangerous Goods by Road and Rail.

U.N Number:	1993
Proper Shipping Name:	All Purpose Thinners
DG Class:	3
Hazchem Code:	3[Y]E
Packing Group:	II

15. REGULATORY INFORMATION

Poisons Schedule: S6

National and or International Regulatory Information: Classified as hazardous according to criteria of National Occupational Health and Safety Commission (NOHSC).

Packaging & Labeling: As required by the ADG Code. As required by the National Code of Practice for the Labeling of Workplace substances. As required by the Standard for the Uniform Scheduling of Drug and Poisons.

16. OTHER INFORMATION

References: (1) National Code of Practice for the preparation of Material Safety Data Sheets 2nd Edition [NOHSC:2011(2003)],

Contact Point: Director **Telephone:** (02) 98320000

DISCLAIMER: All information given in this data sheet and by the company's technical staff is compiled from the information currently available to the company. The company accepts no responsibility whatsoever for its accuracy, or for any results which may be obtained by customers. Any customer who relies upon any advice or information given in this data sheet by the company or by its technical staff does so entirely at its own risk, and the company will not be liable for any loss or damage thereby suffered notwithstanding any want of care on the part of the company or its staff in compiling or giving the advice or information.

ISSUE DATE: January 2008

15.3. Drawings

Ref: RICHVOSL001

RICHBAY CHEMICALS VOSLOORUS FILLING PLANT

VOSLOORUS FILLING PLANT
LAYOUT ALTERNATIVE 1

Legend

- Preferred Alternative
- Access Gate

Layout Alternative 1

- Acid Regeneration Plant
- Admin Buildings
- Chemical Filling Plant
- Effluent Treatment Plant
- Existing Ablution Facilities
- Gravel / Paved / Internal Roads
- Logistics / Truck Parking Area
- Maintenance Workshop
- Mixing Area / Interim Storage Area
- Solvent Filling Plant
- Warehouse
- Weighbridge

N

0 10 20 30 40 50
Metres

DATA SOURCE:
ARC GIS 10.2

PROJECTION: UTM Zone 35S (WSG1984)

PROJECT TITLE: RICHBAY VOSLOORUS

PROJECT NO: 41101911

SCALE: 1:2 074 AT A4 | DATE: 2021/04/08

DRAWN BY: ANRI SCHEEPERS

REVIEWED BY: ASHLEA STRONG

WWW.WSP.COM


Caustic Soda
Sulphonic Acid
LABSA
Hydrochloric Acid
UntFerric Cholride
Chlorine Gas Storage
Nitric Acid
Sodium Hypo Chlorite
Sodium Metbisulphite
Sulphuric Acid
Sodium Chlorite
Phosphoric Acid
Shelsol A
Methanol
Acetone
Benzine
Ferric Chloride
Toulene
Thinners
Diesel
Paraffin
Waterlands Rd
Waterlands Rd
Waterlands Rd
3
3
Google Earth

15.4. Frequency ANALYSIS

Chemical Installations

PROJECT: Richbay Feb 2022

Vessels and Tanks (BEVI)

Number of Loading Operations in Hours

Equipment Description	Scenario	Base Frequency	Reasons for Adjustment	Adjustment	Final Frequency
Ammonia Small Vessel	Atmos Tank A/G Instant Release	5,00E-06	Typical Average System 1	1	5,00E-06
Solvent and Fuel Tanks	Atmos Tank A/G 10 Minute Release	5,00E-06	Typical Average System 1	1	5,00E-06
	Pressure Vessel A/G 10mm Leak	1,00E-05	Typical Average System 1	1	1,00E-05
		#N/A		#N/A	#N/A

Loading (BEVI)

	Frequency of Use Per Annum		Scenario	Base Frequency	Conversion from /hr to /pa	Reasons for Adjustment		Final Frequency
Solvent and Fuel Road Tanker		130	Rupture Loading	3,00E-08	3,90E-06	Typical Avera	1	3,90E-06
		130	Leak in Loading /	3,00E-07	3,90E-05	Typical Avera	1	3,90E-05
		130	Road Tank Atmo	5,80E-09	7,54E-07	Typical Avera	1	7,54E-07
				#N/A	#N/A		#N/A	#N/A

Cylinders

Description	Amount of Cylinders Stored		Scenario	Base Frequency	Failure Frequency	Reasons for Adjustment		Final Frequency
Chlorine		80	Cylinder BLEVE		1,0E-07	8,0E-06	Typical Avera	1	8,00E-06
		80	Cylinder Leak		5,0E-07	4,00E-05	Typical Avera	1	4,00E-05
				#N/A		#N/A	#N/A		#N/A

15.5. On-site Emergency Plan Requirements as per the MHI Regulations

On-site Emergency Plan Requirements as per the MHI Regulations

(1) An employer, self-employed person and user shall after submission of the information contemplated in regulation 3(4) –
  (a) establish an on-site emergency plan to be followed inside the premises of the installation or part of the installation classified as a major hazard installation in consultation with the relevant health and safety representative or the relevant health and safety committee;
  (b) discuss the emergency plan with the relevant local government, taking into consideration any comment on the risk related to the health and safety of the public;
  (c) review the on-site emergency plan and, where necessary, update the plan, in consultation with the relevant local government, at least once every three years;
  (d) sign a copy of the on-site emergency plan in the presence of two witnesses, who shall attest the signature;
  (e) ensure that the on-site emergency plan is readily available at all times for implementation and use;
  (f) ensure that all employees are conversant with the on-site emergency plan;
  (g) cause the on-site emergency plan to be tested in practice at least once year and keep a record of such test.

(2) Any employer, self-employed person and user owning in control of a pipeline that could pose a threat to the general public shall inform the relevant local government and shall be jointly responsible with the relevant government for the establishment and implementation of an on-site emergency plan.

(3) Subregulation (1) shall not apply to rolling stock in transit: Provided that the operator of a railway shall –
  (a) establish an emergency plan for each route traversed within 12 months of the coming into operation of these regulations;
  (b) draw up the plan contemplated in paragraph (a) in consultation with the local government through whose jurisdiction that rolling stock is being transported;
  (c) sign a copy of the on-site emergency plan in the presence of two witnesses, who shall attest the signature;
  (d) ensure that the plan is readily available at all times for implementation and use;
  (a) cause that plan to be tested when reasonably practicable and keep a record of such test.

15.6. HSE Development Sensitivity Tables

Table 1 Development type: People at work, parking
DT1.1 – Workplaces
DT1.2 – Parking area

Development type	Examples	Development detail and size	Justification
DT1.1 – Workplaces	Offices, factories, warehouses, haulage depots, farm buildings, non-retail markets, builder's yards	Workplaces (predominantly non-retail), providing for less than 100 occupants in each building **and** less than 3 occupied storeys – **Level 1**	Places where the occupants will be fit and healthy, and could be organised easily for emergency action. Members of the public will not be present or will be present in very small numbers and for a short time
	Exclusions		
		DT1.1 x1 Workplaces (predominantly non-retail) providing for 100 or more occupants in any building **or** 3 or more occupied storeys in height – **Level 2** (except where the development is at the major hazard site itself, where it remains **Level 1**)	Substantial increase in numbers at risk with no direct benefit from exposure to the risk
	Sheltered workshops, Remploy	**DT1.1 x2** Workplaces (predominantly non-retail) specifically for people with disabilities – Level 3	Those at risk may be especially vulnerable to injury from hazardous events and/or they may not be able to be organised easily for emergency action
DT1.2 – Parking areas	Car parks, truck parks, lock-up garages	Parking areas with no other associated facilities (other than toilets) – **Level 1**	
	Exclusions		
	Car parks with picnic areas, or at a retail or leisure development, or serving a park and ride interchange	**DT1.2 x1** Where parking areas are associated with other facilities and developments the sensitivity level and the decision will be based on the facility or development	

Table 2 Development type: Developments for use by the general public
DT2.1 – Housing
DT2.2 – Hotel/hostel/holiday accommodation
DT2.3 – Transport links
DT2.4 – Indoor use by public
DT2.5 – Outdoor use by public

Development type	Examples	Development detail and size	Justification
DT2.1 – Housing	Houses, flats, retirement flats/ bungalows, residential caravans, mobile homes	Developments up to and including 30 dwelling units **and** at a density of no more than 40 per hectare – **Level 2**	Development where people live or are temporarily resident. It may be difficult to organise people in the event of an emergency
	Exclusions		
	Infill, backland development	**DT2.1 x1** Developments of 1 or 2 dwelling units – **Level 1**	Minimal increase in numbers at risk
	Larger housing developments	**DT2.1 x2** Larger developments for more than 30 dwelling units – **Level 3**	Substantial increase in numbers at risk
		DT2.1 x3 Any developments (for more than 2 dwelling units) at a density of more than 40 dwelling units per hectare – **Level 3**	High-density developments
DT2.2 – Hotel/ hostel/holiday accommodation	Hotels, motels, guest houses, hostels, youth hostels, holiday camps, holiday homes, halls of residence, dormitories, accommodation centres, holiday caravan sites, camping sites	Accommodation up to 100 beds or 33 caravan/ tent pitches – **Level 2**	Development where people are temporarily resident. It may be difficult to organise people in the event of an emergency

Table 2 Development type: Developments for use by the general public (continued)

DT2.2 – Hotel/ hostel/holiday accommodation	**Exclusions**		
	Smaller – guest houses, hostels, youth hostels, holiday homes, halls of residence, dormitories, holiday caravan sites, camping sites	**DT2.2 x1** Accommodation of less than 10 beds or 3 caravan/tent pitches – **Level 1**	Minimal increase in numbers at risk
	Larger – hotels, motels, hostels youth hostels, holiday camps, holiday homes, halls of residence, dormitories, holiday caravan sites, camping sites	**DT2.2 x2** Accommodation of more than 100 beds or 33 caravan/tent pitches – **Level 3**	Substantial increase in numbers at risk
DT2.3 – Transport links	Motorway, dual carriageway	Major transport links in their own right, ie not as an integral part of other developments – **Level 2**	Prime purpose is as a transport link. Potentially large numbers exposed to risk, but exposure of an individual is only for a short period
	Exclusions		
	Estate roads, access roads	**DT2.3 x1** Single carriageway roads – **Level 1**	Minimal numbers present and mostly a small period of time exposed to risk. Associated with other development
	Any railway or tram track	**DT2.3 x2** Railways – **Level 1**	Transient population, small period of time exposed to risk. Periods of time with no population present

Table 2 Development type: Developments for use by the general public (continued)

DT2.4 – Indoor use by public	**Food & drink:** Restaurants, cafes, drive-through fast food, pubs **Retail:** Shops, petrol filling station (total floor space based on shop area not forecourt), vehicle dealers (total floor space based on showroom/sales building not outside display areas), retail warehouses, super-stores, small shopping centres, markets, financial and professional services to the public **Community & adult education:** Libraries, art galleries, museums, exhibition halls, day surgeries, health centres, religious buildings, community centres. Adult education, 6th-form college, college of FE **Assembly & leisure:** Coach/bus/railway stations, ferry terminals, airports. Cinemas, concert/ bingo/dance halls. Conference centres. Sports/leisure centres, sports halls. Facilities associated with golf courses, flying clubs (eg changing rooms, club house), indoor go-kart tracks	Developments for use by the general public where total floor space is from 250 m^2 up to 5000 m^2 – **Level 2**	Developments where members of the public will be present (but not resident). Emergency action may be difficult to co-ordinate

Table 2 Development type: Developments for use by the general public (continued)

DT2.4 – Indoor use by public	**Exclusions**		
		DT2.4 x1 Development with less than 250 m^2 total floor space – **Level 1**	Minimal increase in numbers at risk
		DT2.4 x2 Development with more than 5000 m^2 total floor space – **Level 3**	Substantial increase in numbers at risk
DT2.5 – Outdoor use by public	**Food & drink:** Food festivals, picnic areas **Retail:** Outdoor markets, car boot sales **Community & adult education:** Open-air theatres and exhibitions **Assembly & leisure:** Coach/bus/railway stations, park & ride interchange, ferry terminals. Sports stadia, sports fields/ pitches, funfairs, theme parks, viewing stands. Marinas, playing fields, children's play areas, BMX/go-kart tracks. Country parks, nature reserves, picnic sites, marquees	Principally an outdoor development for use by the general public, ie developments where people will predominantly be outdoors and not more than 100 people will gather at the facility at any one time – **Level 2**	Developments where members of the public will be present (but not resident) either indoors or outdoors. Emergency action may be difficult to co-ordinate
	Exclusions		
	Outdoor markets, car boot sales, funfairs. Picnic area, park & ride interchange, viewing stands, marquees	**DT2.5 x1** Predominantly open-air developments likely to attract the general public in numbers greater than 100 people but up to 1000 at any one time – **Level 3**	Substantial increase in numbers at risk and more vulnerable due to being outside

	Exclusions (continued)		
DT2.5 – Outdoor use by public	Theme parks, funfairs, large sports stadia and events, open-air markets, outdoor concerts, pop festivals	**DT2.5 x2** Predominantly open-air developments likely to attract the general public in numbers greater than 1000 people at any one time – **Level 4**	Very substantial increase in numbers at risk, more vulnerable due to being outside and emergency action may be difficult to co-ordinate

Table 3 Development type: Developments for use by vulnerable people
DT3.1 – Institutional accommodation and education
DT3.2 – Prisons

Development type	**Examples**	**Development detail and size**	**Justification**
DT3.1 – Institutional accommodation and education	Hospitals, convalescent homes, nursing homes. Old people's homes with warden on site or 'on call', sheltered housing. Nurseries, crèches. Schools and academies for children up to school leaving age	Institutional, educational and special accommodation for vulnerable people, or that provides a protective environment – **Level 3**	Places providing an element of care or protection. Because of age, infirmity or state of health the occupants may be especially vulnerable to injury from hazardous events. Emergency action and evacuation may be very difficult
	Exclusions		
	Hospitals, convalescent homes, nursing homes, old people's homes, sheltered housing	**DT3.1 x1** 24-hour care where the site on the planning application being developed is larger than 0.25 hectares – **Level 4**	Substantial increase in numbers of vulnerable people at risk
	Nurseries, crèches, schools for children up to school leaving age	**DT3.1 x2** Day care where the site on the planning application being developed is larger than 1.4 hectares – **Level 4**	Substantial increase in numbers of vulnerable people at risk
DT3.2 – Prisons	Prisons, remand centres	Secure accommodation for those sentenced by court, or awaiting trial etc – **Level 3**	Places providing detention. Emergency action and evacuation may be very difficult

Table 4 Development type: Very large and sensitive developments
DT4.1 – Institutional accommodation
DT4.2 – Very large outdoor use by public

(Note: All Level 4 developments are by exception from Level 2 or 3. They are reproduced in this table for convenient reference)

Development type	Examples	Development detail and size	Justification
DT4.1 – Institutional accommodation	Hospitals, convalescent homes, nursing homes, old people's homes, sheltered housing	Large developments of institutional and special accommodation for vulnerable people (or that provide a protective environment) where 24-hour care is provided and where the site on the planning application being developed is larger than 0.25 hectare – **Level 4**	Places providing an element of care or protection. Because of age or state of health, occupants may be especially vulnerable to injury from hazardous events. Emergency action and evacuation may be very difficult. The risk to an individual may be small but there is a larger societal concern
	Nurseries, crèches. Schools for children up to school leaving age	Large developments of institutional and special accommodation for vulnerable people (or that provide a protective environment) where day care (not 24-hour care) is provided and where the site on the planning application being developed is larger than 1.4 hectare – **Level 4**	Places providing an element of care or protection. Because of age the occupants may be especially vulnerable to injury from hazardous events. Emergency action and evacuation may be very difficult. The risk to an individual may be small but there is a larger societal concern
DT4.2 – Very large outdoor use by public	Theme parks, large sports stadia and events, open air markets, outdoor concerts, and pop festivals	Predominantly open air developments where there could be more than 1000 people present at any one time – **Level 4**	People in the open air may be more exposed to toxic fumes and thermal radiation than if they were in buildings. Large numbers make emergency action and evacuation difficult. The risk to an individual may be small but there is a larger societal concern

Decision matrix

47 Having determined which zone the development falls into and also the sensitivity level of the development, the following matrix is used to decide the type of advice.

Level of sensitivity	Development in inner zone	Development in middle zone	Development in outer zone
1	DAA	DAA	DAA
2	AA	DAA	DAA
3	AA	AA	DAA
4	AA	AA	AA

DAA = Don't Advise Against development
AA = Advise Against development

48 If all developments result in DAA then DAA is the final HSE advice.

49 If any one development gives an AA result then the interim result for the consultation is AA. Each AA result is always subjected to an additional rule check (Rule 4) to determine if it will remain AA or change to a DAA. If any one development is still AA after application of this rule then the final advice will be AA.

How the rules are applied

Overview of the rules

50 The rules have been developed to allow consideration of the more complex planning consultations. More detail on each of the rules is given after this overview.

51 There are five main rules to consider for each development:

- **Rule 1 – Straddling developments.** When the site area of the proposed development lies across a zone boundary you need to use this rule to decide which zone will be used in the decision matrix. The CD is considered a zone boundary in this context.
- **Rule 2 – Multiple major hazards.** For each major hazard, you need to determine which zone the development is in, after applying the straddling rule if necessary. The final advice is decided on the basis of the most onerous of the zones that the development is in.
- **Rule 3 – Multiple-use developments.** You need to use this rule when the planning consultation is for a multiple use development (eg a mix of housing, indoor use by the public and a workplace). You need to identify the separate parts of the proposal according to the development types. You then need to group together all facilities of the same development type before proceeding (for example before going on to use the straddling rule – Rule 1).
- **Rule 4 – Developments which involve a small extension to an existing facility.** This rule is concerned with Advise Against responses and taking any

existing development on the site into account, if the proposed development is a **small** extension to the existing development, before deciding on the final advice. It is only concerned with 'extensions' to existing developments, not to new developments, or change of use, on sites which may have an existing use.

- **Rule 5 – Temporary/time-limited planning permissions.**

The rules in detail

Rule 1 – Straddling developments

52 Use this rule set (1a, then 1b if applicable) when the site area of the proposed development lies across a zone boundary.

53 Rule 1a: Developments that 'straddle' zone boundaries will normally be considered as being in the innermost zone to the major hazard unless either of the two following conditions applies. The development is in the **outermost** of the zones if:

- less than 10% of the site area marked on the application for that development type is inside that boundary; or
- it is only car parking, landscaping (including gardens of housing), parks and open spaces, golf greens and fairways, or access roads etc, associated with the development that are in the inner of the zones.

54 Rule 1b: For the special case where the development straddles the CD boundary, follow the rule above, then:

- If, after using the rules, the development is 'considered' to be outside the CD, then there is no need to categorise further; a DAA response is appropriate.
- If, after using the rules, the development is 'considered' to be within the CD then look at all the facilities that make up the development proposal. Any that are **entirely outside** the CD should be discounted when coming to a decision about the sensitivity level. All the facilities that are **completely and/or partly inside** the CD are then considered together for the purpose of determining the sensitivity level. (If appropriate, apply the 'multiple-use developments' rule – Rule 3.)

(NB: Rules 1a and 1b do not apply where the development type is a [sensitivity level 2] transport link. Even though this type of development is likely to 'straddle' zone boundaries, it must always be considered as being in the innermost of the zones to the major hazard that it straddles.)

Rule 2 – Multiple major hazards

55 Where the development is in the CD of more than one hazardous installation and/or pipeline, it is necessary to determine which zone the development is in for each major hazard (after applying the straddling rule (Rule 1) if necessary). The overall advice is decided on the basis of the most onerous of any of the zones the development is in (inner zone more onerous than middle zone, middle zone more onerous than outer zone).

56 In some cases HSE has provided a composite three-zone map for complexes of adjacent major hazards and has merged the zones. In this case the assessment is simplified, as only the one three-zone map needs to be considered.

Rule 3 – Multiple-use developments

57 This rule set is used when the planning consultation is for multiple-use developments (eg a mix of housing, indoor use by the public and a workplace).

- First identify the separate parts of the proposal according to the development types, as in column 1 of Tables 1–4. Group together all facilities of the same development type and determine the sensitivity level of each of the groups. The only exception, where facilities are not grouped together, are sensitivity level 4 examples of 'Outdoor use by the public' and 'Institutional accommodation and education' development types. These should be considered separately to other (sensitivity level 3 and below) facilities of the same development type, but as part of the same consultation record.
- Determine which zone each development is in, if necessary using the straddling rule (Rule 1) for each development type.
- Determine the appropriate AA or DAA response from the decision matrix for each development.
- Apply Rule 4a.

Rule 4 – Developments which involve a small extension to an existing facility

58 Many proposed developments are not on 'green field' sites. They may involve extension to an existing development.

59 Rule 4a. First **consider the development in the application on its own merit** according to the normal procedure and rules. There are two outcome options:

- a DAA outcome, in which case there is no need to apply Rule 4b. (For 'multiple-use developments', if the application of Rule 3 results in all outcomes from the matrix being DAA, then that is the final advice. In which case there is no need to apply Rule 4b); or
- an AA outcome, then Rule 4b should be applied if appropriate. (For 'multiple-use developments', if the application of Rule 3 results in one or more AA outcomes from the matrix, then apply Rule 4b individually to every one of the development type groups resulting in these AA outcomes.)

NB only the details supplied with the planning application or pre-planning enquiry are used to determine if, and how, Rule 4b applies.

56 Rule 4b. Extensions **(including minor modifications, alterations, or additions)**:

If…	**Then…**
the proposal is for an extension to an existing development, and the proposed extension is of the same development type as the existing development that is going to be extended. **And** the population at the development will not increase by more than 10% (or, if the population data is not readily available, the total floor area will not increase by more than 10%).	the consultation should be treated as though the proposed extension had a sensitivity level one less than the sensitivity level of the existing (ie not that of the proposed) development. If this reduced sensitivity level, combined with the zone that the extension is in, produces a DAA response, then this will replace the initial AA response.
For 'multiple-use developments', if the application of Rule 4b changes ALL of the AA outcomes to DAA.	this will replace the initial AA response. If at least one outcome remains AA, then an AA response is the final advice. Any remaining AA from 4b dominates for 'multiple-use developments' and an AA response is the final advice.

Rule 5 – Temporary/time-limited planning permissions

57 HSE treats proposals for these the same way as any other planning permission consultations; no allowance is given for the time restriction. Existing temporary/time limited permissions are not taken into account when applying Rule 4, however.

Glossary

beds the number of residents/visits for which sleeping accommodation is provided.

consultation the enquiry that comes to HSE (normally from a PA) for HSE's comment on a proposed change to land usage within a CD. The consultation will consist of at least one 'development'.

development to consider any planning proposal using the PADHI system, all proposed new buildings (or extension, change of use of land etc) need to be categorised into a PADHI 'development type'. A proportion of planning proposals will consist of more than one development type. Having identified all development types, each is subsequently assessed using the decision matrix. An Advise Against decision for any single development will dominate the final PADHI advice for the proposal.

development type (see the first column in the development type tables) term used to group together developments (and/or facilities) that are considered to be of the same sensitivity level.

DPZ development proximity zone.

dwelling units mean the smallest individual unit of accommodation, eg house, apartment, caravan.

extension clarification on what constitutes an extension is provided on the relevant PADHI+ Help screen, which can be accessed by clicking on the 'Help' button on the screen which asks if the proposed development is an extension to an existing development. If you do not have access to PADHI+, then contact the PA or HSE if you need further information.

facilities buildings and other provisions (eg picnic area, children's play area, park-and-ride bus stop) where people may congregate.

'green field' site site to be developed where the current use generally involves minimal buildings and also does not attract people to it in significant numbers. Typically agricultural land, but can also be parkland or other open spaces of a similar nature.

hectare unit of area equal to 10 000 square metres (m^2) in any shape (eg rectangles 10 m x 1000 m or 25 m x 400 m; square 100 m x 100 m; or other regular and irregular shapes).

LUP land use planning.

multiple-use development see 'development'.

PA planning authority.

PADHI planning advice for developments near hazardous installations.

Health and Safety Executive

pre-planning enquiry (PPE) an informal, non-statutory LUP consultation made by a developer (or a PA) to determine what HSE's advice is likely to be before submitting a formal planning permission application to the PA.

protective environment there is provision of some element of supervision or care, eg by a warden being available on site or on call.

school leaving age the minimum age at which a young person can leave school – currently 16.

sensitivity level the scale used in the PADHI system to define the vulnerability of a development population to major accident hazards. It is based on pragmatic criteria; the type of development, likely numbers present and whether any vulnerable people will be present. The scale ascends from Level 1 to Level 4: the more vulnerable the population, the higher the sensitivity level.

total floor space – the area of buildings enclosed by the exterior walls multiplied by the number of floors (units are m^2).

use class – the way different types of development are described by planners. They are not identical to HSE's development types or sensitivity levels.

vulnerable people – people who by virtue of age (children and elderly) and/or ill health may be particularly susceptible to the effects of a major accident.

Annex 1

HSE's land use planning advice provision

1 HSE's land use planning (LUP) advice is based on the recommendations of the Advisory Committee on Major Hazards (ACMH) enshrined in Government-agreed principles and framework; see for example Planning Circular 04/2000. These principles remain valid today. A failure to adopt them can only lead to non-compliance with Article 12 of the Seveso Directive. Indeed the principles and objectives HSE uses in giving its advice received strong support in a public consultation in 2007 (CD211 *Proposals for revised policies for HSE advice on development control around large-scale petrol storage sites*).

2 It is currently delivered promptly and transparently through the PADHI (planning advice for developments near hazardous installations) scheme, which is a codification of that given by HSE over the last 30 years or more. Pre-PADHI, HSE staff in local offices used a codified matrix from which the majority of consultations could be quickly turned around with either an 'allow' or 'refuse' decision. However, the system still required a significant number of consultations to be forwarded to a central HSE team of specialist risk assessors. The need for this risk assessment work resulted in a lengthy turnaround time on these consultations and was extremely resource intensive for HSE. Following a review of its position on land use planning around hazardous installations HSE developed a comprehensive, codified methodology, PADHI, which allowed all consultations to be dealt with at a local level, significantly speeding up the provision of advice to PAs.

3 Under Section 16 of the Town and Country Planning (Development Management Procedure) (England) Order 2010 (the 'DMPO'), Article 10 of the Town and Country Planning (General Development Procedure) Order 1995 as

amended (the 'GDPO') in Wales, and section 25 of the Town and Country Planning (Development Management Procedure) (Scotland) Regulations 2008, decision-makers are required to consult HSE on certain planning proposals around major hazard establishments and major hazard pipelines and to take into account HSE's representations when determining associated applications. This is to ensure that the UK complies with Article 12 of the Seveso II Directive which has the specific objective of controlling certain new development to maintain adequate separation, including residential areas, buildings and areas of public use around major hazards when the development is such as to increase the risk or consequences of a major accident. In essence, decision-makers should ensure that new development does not significantly worsen the situation should a major accident occur.

4 In some instances there may already be existing development which is closer to a potentially hazardous installation. In these cases HSE has recognised the views of the ACMH as expressed in paragraphs 108 and 109 of their Second Report which read as follows:

> *'108... The HSE is also frequently asked to comment on proposals to develop or to redevelop land in the neighbourhood of an existing hazardous undertaking where there may already be other land users which are closer and possibly incompatible. In these cases, HSE tells us that it takes the view, which we fully endorse, that the existence of intervening developments should not in any way affect the advice that it gives about the possible effects of that activity on proposed developments which may appear to be less at risk than the existing ones.*
>
> *'109... The overall objective should always be to reduce the number of people at risk, and in the case of people who unavoidably remain at risk, to reduce the likelihood and the extent of harm if loss of containment occurs…'*

5 HSE's approach balances the principle of stabilising and not increasing the numbers at risk with a pragmatic awareness of the limited land available for development in the UK. An HSE discussion document in 1989 *(Risk criteria for land-use planning in the vicinity of major industrial hazards* ISBN 978 0 1188 5491 7, available from HSE Books) sets out the basis of HSE's approach at that time.

6 The Government committee of experts, ACMH, which originally proposed HSE's role in the LUP system, did recognise *'the remote possibility that in some instances a local planning authority may not feel inclined, for a variety of reasons, to follow the advice of the Executive on particular applications for potentially hazardous developments or other developments in their vicinity.'* As a consequence, arrangements were set up so that in this rare circumstance, a planning authority is required by Planning Circular 04/2000 (England and Wales) or Circular 3/2009 (Scotland) to formally notify HSE of its intention to grant against HSE's advice. This is so that HSE can decide whether or not to request the Secretary of State to call-in the application for his own determination. There have been recent changes to procedures in Scotland. Part 3 of the Planning etc. (Scotland) Act 2006 introduced changes to the way in which the planning system will operate in Scotland. See Scottish planning circular 6/2009 *Planning Appeals*, and planning circular 7/2009 *Schemes of Delegation and Local Reviews*. These circulars accompany the Town and Country Planning (Schemes of Delegation and Local Review Procedure) (Scotland) Regulations 2008.

7 HSE's consideration of call-in should not be confused with its LUP advice delivered through PADHI; it is the latter which is provided to enable LUP decision-makers to comply with the objectives of Seveso II, Article 12. In line with Government policy, HSE normally requests call-in only in cases of exceptional concern (there have been only four such requests over the last 30 years in England

and Wales). However if HSE decides not to make such a request this does not mean that it has withdrawn its advice against permission, which remains on file and is likely to be published on the HSE website. **A decision not to request call-in does not disregard HSE's LUP advice**.

8 HSE's role in the LUP process is to provide independent advice on the residual risks from major accidents to people at certain proposed new developments. This is delivered through PADHI+ and planning authorities must 'seriously consider' it in accordance with Planning Circular 04/2000, which advises decision-makers that:

> *'A5. In view of their acknowledged expertise in assessing the off-site risks presented by the use of hazardous substances, any advice from HSE that planning permission should be refused for development for, at or near a hazardous installation or pipeline, ..., should not be overridden without the most careful consideration.'*

Furthermore the Courts (Regina v Tandridge District Council, Ex parte Al Fayed, Times Law Report 28 January 1999) have decided that on technical issues, local authorities, while not bound to follow the advice of statutory bodies such as HSE, *'should nevertheless give great weight to their advice'* when determining planning applications.

A published external review, *Analysis of planning appeal decision reports CRR262/2000, concluded 'It is clear the HSE's risk policies have largely been upheld at planning appeals. It is viewed as a competent and expert body, and its advice provides considerable support to PA decisions.'*

Annex 2

Types of development on which to consult HSE under the Town and Country Planning (Development Management Procedure) (England) Order 2010, the Town and Country Planning (General Development Procedure) Order 1995 (as amended) in Wales, and the Town and Country Planning (Development Management Procedure) (Scotland) Regulations 2008

The following circulars provide further guidance on when HSE is a statutory consultee:

DCLG Circular 04/2000
SOEnD Circular 5/1993 (This document is not available on the internet)
National Assembly for Wales Circular 20/01

They identify the following developments:

1 Within the Consultation Distance (CD) of major hazard installations/complexes and pipelines, HSE should only be consulted on developments involving:

- residential accommodation;
- more than 250 square metres of retail floor space;
- more than 500 square metres of office floor space;
- more than 750 square metres of floor space to be used for an industrial process;
- transport links (railways, major roads etc);
- a material increase in the number of persons working within, or visiting, a CD;
- and then only if the development is within the CD.

2 For licensed explosive sites the criteria are the same as above, but only if within the explosive site's safeguarding zone.

3 The Office for Nuclear Regulation (ONR) is a non-statutory consultee for certain developments near licensed nuclear sites. The criteria are:

- any development involving more than 50 people (or 20 people if previously advised of this figure by ONR) within the detailed emergency planning zone;
- any development of more than 500 people within the outer zone (only applies on sites which have an outer zone).

4 HSE will also:

- advise hazardous substances authorities prior to them determining a hazardous substances consent application;
- comment on planning developments involving quarries.

5 HSE does not give retrospective advice on planning applications where the decision has already been made by the planning authority.

Annex 3

Information needed when using PADHI

To properly apply the PADHI methodology to a planning proposal you will require the following information:

1 Sufficient details of the location of the proposed development to relate it to the consultation distance and the zones of all the relevant hazardous installations, complexes and pipelines.

2 Sufficient details of the proposed development, and those people likely to be there, to enable you to categorise the development within its 'sensitivity levels'. (If the proposal involves the extension of an existing facility then, to be able to take account of that when formulating the final advice, it is necessary to have similar information for that existing use.) These details should include:

- Principal purpose of the proposed development.
- The area (hectare or m^2) of the development site.
- Certain building sizes:

Development type	Indication
predominantly workplaces (ie not retail, community, leisure, accommodation etc) – the number of normally occupied storeys. Or at the very least an indication that:	■ all buildings have less than 3 occupied storeys; or ■ at least one building has at least 3 occupied storeys.
for **retail, community, assembly or leisure** etc use – the total floor area (m^2). Or at the very least an indication if this total is:	■ less than 250 m^2; or ■ between 250 m^2 and 5000 m^2; or ■ more than 5000 m^2.

Development type	Indication
institutional accommodation and educational facilities where day-care is provided – the total site area (hectares). Or at the very least an indication if this is:	■ 1.4 hectares or less; or ■ more than 1.4 hectares.
institutional accommodation and educational facilities where 24-hour care is provided – the total site area (hectares). Or at the very least an indication if this is:	■ 0.25 hectares or less; or ■ more than 0.25 hectares.

- For certain developments it is essential that there is an indication of the maximum number of people likely to be at the development at any one time. These may be actual numbers or best estimates/guesses. This can be in the form of:

Development type	Indication
predominantly workplaces (ie not retail, community, leisure, accommodation etc) – the number of people and the number of normally occupied buildings. Or at the very least an indication:	■ that no building is likely to contain more than 100 people; or ■ if any building is likely to contain more than 100 people.
for **houses, flats, residential caravans** etc – the actual number of 'dwelling units'. Or at the very least an indication if it is for:	■ less than 3 dwelling units; or ■ between 3 and 30 dwelling units; or ■ more than 30 dwelling units.
for **hotels, hostels, campsites, caravan sites** etc – the actual number of beds. Or at the very least an indication if it is for:	■ less than 10 beds, or less than 3 caravan/tent pitches; or ■ between 10 and 100 beds, or between 3 and 33 caravan/tent pitches; or ■ more than 100 beds, or more than 33 caravan/tent pitches.
for **predominantly outdoor events** and outdoor facilities – the number of people anticipated. Or at the very least an indication if the event will attract a peak attendance of:	■ less than 100 people; or ■ between 100 and 1000 people; or ■ more than 1000 people.

Development type	Indication
institutional accommodation and educational facilities where day-care is provided – the total site area (hectares). Or at the very least an indication if this is:	■ 1.4 hectares or less; or ■ more than 1.4 hectares.
institutional accommodation and educational facilities where 24-hour care is provided – the total site area (hectares). Or at the very least an indication if this is:	■ 0.25 hectares or less; or ■ more than 0.25 hectares.

- For certain developments it is essential that there is an indication of the maximum number of people likely to be at the development at any one time. These may be actual numbers or best estimates/guesses. This can be in the form of:

Development type	Indication
predominantly workplaces (ie not retail, community, leisure, accommodation etc) – the number of people and the number of normally occupied buildings. Or at the very least an indication:	■ that no building is likely to contain more than 100 people; or ■ if any building is likely to contain more than 100 people.
for **houses, flats, residential caravans** etc – the actual number of 'dwelling units'. Or at the very least an indication if it is for:	■ less than 3 dwelling units; or ■ between 3 and 30 dwelling units; or ■ more than 30 dwelling units.
for **hotels, hostels, campsites, caravan sites** etc – the actual number of beds. Or at the very least an indication if it is for:	■ less than 10 beds, or less than 3 caravan/tent pitches; or ■ between 10 and 100 beds, or between 3 and 33 caravan/tent pitches; or ■ more than 100 beds, or more than 33 caravan/tent pitches.
for **predominantly outdoor events** and outdoor facilities – the number of people anticipated. Or at the very least an indication if the event will attract a peak attendance of:	■ less than 100 people; or ■ between 100 and 1000 people; or ■ more than 1000 people.

Annex 4

HSE office addresses

Only HSE offices that deal with land-use planning are listed. Please address any correspondence to Health and Safety Executive, Hazardous Installations Directorate, Chemical Industries Division at the addresses below.

Offices	**Geographical coverage**
SCOTLAND AND NORTH EAST	
Belford House 59 Belford Road Edinburgh EH4 3UE	Scotland
BP6301 Benton Park View Newcastle-upon-Tyne NE98 1YX	Cleveland, Durham, Tyne & Wear, Northumberland, North Yorkshire (except Selby District Council)
Marshall House Ringway Preston PR1 2HS	Cumbria, Greater Manchester, Lancashire
WALES & WESTERN ENGLAND	
Redgrave Court (HID CI2) Merton Road Bootle Merseyside L20 7HS	Merseyside, Conwy, Gwynedd, Isle of Anglesey, Denbighshire, Flintshire, Wrexham, Shropshire, Staffordshire, Cheshire
1 Hagley Road Birmingham B16 8HS	West Midlands, Powys, Worcestershire, Gloucestershire, South Gloucestershire, Bristol
Government Buildings Ty Glas Llanishen Cardiff CF14 5SH	Cardiganshire, Pembrokeshire, Carmarthenshire, Swansea, Neath and Port Talbot, Bridgend, Rhondda Cynon, Taff, Blaeunau Gwent, Merthyr Tydfil, Vale of Glamorgan, Cardiff, Caerphilly, Torfaen, Newport, Monmouthshire, North West Somerset, Bath and North East Somerset, Somerset, Devon, Cornwall, Isle of Scilly

SOUTH & EAST ENGLAND	
Foundry House 3 Millsands Riverside Exchange Sheffield S3 8NH	South Yorkshire, Humberside, Derbyshire, Nottinghamshire, Lincolnshire
The Lateral 8 City Walk Leeds LS11 9AT	West Yorkshire, Selby District Council
Wren House Hedgerows Business Park Colchester Road Springfield Chelmsford Essex CM2 5PF	Essex, Norfolk, Suffolk
900 Pavilion Drive Northampton Business Park Northampton NN4 7RG	Leicestershire, Northamptonshire, Oxfordshire, Bedfordshire, Buckinghamshire, Cambridgeshire, Warwickshire, Hertfordshire, London boroughs north of the Thames
Priestley House Priestley Road Basingstoke RG24 9NS	Berkshire, Dorset, Hampshire, Wiltshire, Isle of Wight, East & West Sussex, London boroughs south of the Thames, Surrey
Phoenix House 23–25 Cantelupe Road East Grinstead West Sussex RH19 3BE	Kent

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Marshall House Ringway Preston PR1 2HS	Cumbria, Greater Manchester, Lancashire
WALES & WESTERN ENGLAND	
Redgrave Court (HID CI2) Merton Road Bootle Merseyside L20 7HS	Merseyside, Conwy, Gwynedd, Isle of Anglesey, Denbighshire, Flintshire, Wrexham, Shropshire, Staffordshire, Cheshire
1 Hagley Road Birmingham B16 8HS	West Midlands, Powys, Worcestershire, Gloucestershire, South Gloucestershire, Bristol
Government Buildings Ty Glas Llanishen Cardiff CF14 5SH	Cardiganshire, Pembrokeshire, Carmarthenshire, Swansea, Neath and Port Talbot, Bridgend, Rhondda Cynon, Taff, Blaeunau Gwent, Merthyr Tydfil, Vale of Glamorgan, Cardiff, Caerphilly, Torfaen, Newport, Monmouthshire, North West Somerset, Bath and North East Somerset, Somerset, Devon, Cornwall, Isle of Scilly

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Our Ref J3614R-1 11 September, 2023

PEER REVIEW OF RISK ASSESSMENT DONE BY: *MAJOR HAZARD CONSULTANTS*
Technical Signatory: T C Thackwray
Project: Richbay Chemicals -Vlakplaats 138-IR Portion 86, Waterlands Rd, Vosloorus Gauteng
Report: RICHVOSL001, 11 February 2023

1 METHOD OF REVIEW

The report was read and reviewed, page by page, to understand the contents. This was followed by assessing whether the standard format for risk assessment had been followed. Checks were carried out regarding the correct identification of hazards, consequences, mitigation and protection measures and risks. Finally it was assessed whether the conclusion and recommendations made were meaningful as an outcome of the risk assessment.

2 FINDINGS

2.1 The risk assessment complies with the major Hazard Installation Regulations in the OHSAct as well as the Major Hazard Installation Risk Assessment Standard SANS 1461.

2.2 The assessment is quantitative and inputs and calculation are based on acceptable methodology (TNO BEVE from the Netherlands).

2.3 The risk assessment is comprehensive with explanations and justifications.

2.4 Hazards are well defined, consequence modelling suitable and correct risk estimations.

2.5 No indication of what software was used for the modelling but based on the results and outputs it was accepted as suitable for carrying out the assessment.

2.6 The assessment stated that the highest contributor to risk is the burst of a Shellsol A road tanker. However, from the results it would appear that the main contributor is a rupture of a chlorine cylinder. This does not influence the overall outcome and conclusions from the assessment.

2.7 Risks for the site are broadly acceptable i.e. low.

2.8 Several recommendations were made, mainly implementing the safe practices contained in the various standards and guidelines.

3 DEDUCTION FROM THE PEER REVIEW

It can be concluded that the risk assessment was carried out in a professional manner detailing the requirements from standards and guidelines, and in addition, followed the principles of an international risk assessment procedures.

Based on the review it can be stated that the assessment is an acceptable evaluation of the risks and can be submitted to the authorities for approval of the project.

D J E Rademeyer
Technical Manager
Date: 9 September 2023

Note ISHECON is an Approved Inspection Authority for Major Hazard Installation and Explosive risk assessments. See attached approval and accreditation certificates.

labour
Department:
Labour
REPUBLIC OF SOUTH AFRICA

National Department of Labour
Republic of South Africa

APPROVED INSPECTION AUTHORITY

Registered in accordance with the provisions of the Occupational Health and Safety Act, Act 85 of 1993, as amended and the Major Hazard Installation Regulations.

This is to certify that:

ISHECON CC

has been registered by the Department of Labour as an Approved Inspection Authority: Type A, to conduct Major Hazard Installation Risk Assessment, in terms of Regulation 5(5)(a), of the Major Hazard Installation Regulations.

CONDITIONS OF REGISTRATION:
- The AIA must at all time comply with the requirements of the Occupational Health and Safety Act, Act 85 of 1993, as amended.
- This registration certificate is not transferable.
- This registration will lapse if there is a name change of the AIA or change in ownership.

CHIEF INSPECTOR

Valid from: 13 June 2017
Expires: 12 June 2021
Certificate Number: CI MHI 0001

sanas
South African National Accreditation System

CERTIFICATE OF ACCREDITATION

In terms of section 22(2) (b) of the Accreditation for Conformity Assessment, Calibration and Good Laboratory Practice Act, 2006 (Act 19 of 2006), read with sections 23(1), (2) and (3) of the said Act, I hereby certify that:-

ISHECON CC
Co. Reg. No.: 1999/029022/23
MODDERFONTEIN

Accreditation Number: **MHI0008**

is a South African National Accreditation System Accredited Inspection Body to undertake **TYPE A** inspection provided that all SANAS conditions and requirements are complied with

This certificate is valid as per the scope as stated in the accompanying scope of accreditation, Annexure "A", bearing the above accreditation number for

THE ASSESSMENT OF RISK ON MAJOR HAZARD INSTALLATIONS

The facility is accredited in accordance with the recognised International and National Standards

ISO/IEC 17020:2012 AND SANS 1461:2018

The accreditation demonstrates technical competency for a defined scope and the operation of a management system

While this certificate remains valid, the Accredited Facility named above is authorised to use the relevant SANAS accreditation symbol to issue facility reports and/or certificates

Mr M Phaloane
Acting Chief Executive Officer
Effective Date: 13 June 2021
Certificate Expires: 12 June 2025

This certificate does not on its own confer authority to act as an Approved Inspection Authority as contemplated in the Major Hazard Installation Regulations. Approval to inspect within the regulatory domain is granted by the Department of Employment and Labour.

ANNEXURE A

SCOPE OF ACCREDITATION

Accreditation Number: MHI0008

TYPE A

Permanent Address: ISHECON CC H6 Pinelands Office Park Maxwell Drive Modderfontein Ekurhuleni Gauteng 1645 Tel: (011) 201-4783 Cell: 082 348 0070 Fax: 086 549-0678 E-mail: bothad@ishecon.co.za	**Postal Address:** P O Box 320 Modderfontein Ekurhuleni Gauteng 1645 Issue No.: 13 Date of Issue: 11 June 2021 Expiry Date: 12 June 2025

Nominated Representative:	Quality Manager:	Technical Signatories:
Mr CF Botha	Mr CF Botha **Technical Manager:** Mr DJE Rademeyer	Mr DJE Rademeyer Ms DC Mitchell Mr CF Botha

Field of Inspection	Service Rendered	Codes and Regulations
Regulatory: The supply of services as an Inspection Authority for Major Hazard Risk Installation as defined in the Major Hazard Risk Installation Regulations, Government Notice No. R692 of 30 July 2001	Major Hazard Installation Risk Assessments for the following material categories: 1) Explosive chemicals 2) Gases: i) Flammable Gases ii) Non-flammable, non-toxic gases (asphyxiants) iii) Toxic gases 3) Flammable liquids 4) Flammable solids, substances liable to spontaneous combustion, substances that on contact with water release flammable gases 5) Oxidizing substances and organic peroxides 6) Toxic liquids and solids	MHI regulation par. 5 (5) (b) i) Frequency/Probability Analysis ii) Consequence Modeling iii) Hazard Identification and Analysis iv) Emergency planning reviews SANS 31000 SANS 31010 SANS 1461:2018

Original Date of Accreditation: 13 June 2005 Page 1 of 1

ISSUED BY THE SOUTH AFRICAN NATIONAL ACCREDITATION SYSTEM

Accreditation Manager