ATTACHMENT No. J.

ACCIDENT PREVENTION AND EMERGENCY RESPONSE

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J.1. Management of Emergencies

Helsinn Chemicals Ireland (HCI) Ltd is committed to ensuring the safety and well-being of its staff, the community and the receiving environment.

A comprehensive Internal Emergency Plan has been prepared for potential emergencies that may arise at the HCI facility. A copy of the HCI Internal Emergency Plan is included in this attachment.

The plant currently operates 16 hours a day five days per week. Outside normal office hours a security person (from an established security firm) is always on site. Emergency Response Team (ERT) members are present on each and every production shift. Therefore at all times adequate provisions are available for emergency response at the HCI facility.

The company has provided safety and environmental protection equipment on-site and has implemented operating procedures to prevent and minimise accidental emissions to the environment. These emergency measures include:

- Qualified first aiders and first aid equipment
- Emergency Response Team (ERT) and ETR equipment
- Fire detection and alarms systems
- Portable extinguishers
- Fire water retention
- Isolation of services/utilities: Gas isolation valve and electricity isolation switch.

All staff are trained on their role in an emergency, and practice drills are carried out on a regular basis.

Outside of normal office hours, security staff monitor conditions at the site and are trained to respond to any incidents. Staff contact numbers are in the emergency folder, and assigned staff in production and maintenance is provided with bleeper units and mobile phones for contact at all times.

J.2. Storage of Materials

All materials at the HCI site are stored according to their optimum storage requirements. HCI adopt a 'just in time' policy to ensure materials are not stored for excessive periods of time. Materials are only stored in designated areas. Flammable materials are stored in separate area to contain them in the event of a fire. Only the material necessary for the day's production is held in the process area to minimise the quantity of flammable materials in the synthesis building. Refer to Attachment No. H for more information of storage of materials.

J.3. Transport of Materials

Bulk solvents and wastes, as well as Sodium Hydroxide and Hydrochloric Acid are pumped to the process via an overhead piperack, thus the operating staff do not come into direct contact with these chemicals.

Drummed materials are carried from/to the drum store on pallets using a forklift.

Refer to Attachment No. H for more information on the transport of materials.

J.4. Bunding, Surface Treatment, Collection Systems

All storage areas are contained and drains routed to the wastewater treatment plant. In addition, the caustic tank, tank farm and diesel storage areas are bunded. HCI tested the integrity of all bunds on site. The bunds were tested in accordance with BS 8007. All bunds were tested in 2002/2003 and

all passed. Bund integrity report is provided overleaf. The locations of the bunds are shown in Figure J.1.

A continuous pH recorder that will activate the automatic diverter valves in the event of deviation of pH outside the limits (6.5-10). This diverts surface water from the site to the collection sump and prevents outflow to the river. Refer to Attachment No. F, Section F.1.2 for more details.

Process drainage system overflow and potentially contaminated surface water can be collected in a firewater runoff collection system, with a capacity of 1,600m^3.

Tanker unloading areas are enclosed by spillage containment gullies to contain any potential spillage for treatment.

J.5. Process Piping Details

Copies of drawings showing invert levels of surface water and process drains are provided in Attachment No. E, Figures E.2.

J.6. Major Accident Hazardous Scenarios

Major accident hazards have been identified and an assessment of the extent and severity of the consequences of such accidents has been carried out.

The following major-accident scenarios were assessed in the Modelling of Accident Hazardous Scenario Report, May 2005, Arup Menzies:

- Loss of containment of solvent tank in the tank farm
- Acid/caustic mixing in the caustic bulk storage tank
- Synthesis plant pool fire and subsequent domino effects

A copy of this report is provided in this attachment.

J.7. Other Scenarios

J.7.1 Fire

Fire detection and alarm systems are installed throughout the site to provide early warning in the event of fire or other emergency. Fire or smoke is detected by ionised chamber/smoke detectors or Rate of Rise/Heat detector.

J.7.2 Explosion

Where necessary, vessels are protected from explosion through the most appropriate relief system. The accidental release of dust in the event of a dust explosion has been previously identified as a potential emission to the environment.

Gas and electricity supply can be isolated by the gas isolation valve and electricity isolation switch respectively.

J.7.3 Power Failure

In the event of a power failure, power will be reinstated using the standby generator.

J.7.4 PLC (Programmable Logic Controller) Failure

All PLCs are specified to self-check at periodic intervals. Failure of a PLC will result in a plant and equipment shut down in a controlled and safe manner.

J.8. Areas of Potential Risk

The following table shows the areas that are most likely to be at risk from contamination.

Area	Measures
Solvent tank farm	Tanks are bunded, water contained in the bunded area is tested before being released. The Solvent/Aqueous Waste Tank Farm bund overflows to the 1,600m^3 firewater retention facility.
Warehouse	Toxic drummed material is stored on pallet bunds. A spillage response kit containing absorbent equipment is located near the drum store. Staff are trained in the use of this equipment. The warehouse area is contained; water/spillage contained in the secondary containment area is tested before being released.
Flammable Materials Storage	Flammable materials are stored in a separate area.
Laboratory	Cabinets used for laboratory solvent storage are self-bunded.
Manufacturing areas	All reaction processes undergo risk analysis to determine safe operation conditions for production. Bulk solvents are stored under a nitrogen blanket. Only the material necessary for the day's production is held in the process area. An overpressure safety tank is installed and reactor vents are routed through it to atmosphere. All electrical apparatus in areas where flammable materials are handled is designed as suitable for such use, i.e. EExd or EExi. All pipework and vessels are earthed and interconnected to prevent accumulation of static electricity. In the event of a spillage the emergency spill response plan is activated. The material is assessed and the Emergency Response Team selects a procedure for safe disposal and/or discharge.

Area	Measures
General yard area – surface water contamination in the event of a spillage.	In the event of a spillage or discharge or if the alarm is activated by a break-glass unit, the diverter valve can be remotely closed from the security hut. In the event of a fire, the diverter valve will automatically be closed. Both procedures ensure that any spillage or potentially contaminated firewater that enters the surface water drainage system is retained on site until the material is assessed and a procedure for safe disposal and/or discharge is selected by the Emergency Response Team.

J.9. Fire Water Retention Facilities

The system is designed to contain 1,600m³ of contaminated run-off liquid arising from a major spillage or the firewater run-off arising from fire fighting activities. Refer to Figure F.1.5. for a schematic diagram of the surface water emissions abatement system.

The process draining system, including the effluent balancing tanks, overflows to the firewater containment pond in the event of excessive hydraulic loading.

In the event of a fire, the activation of the fire alarm system shuts the diverter valve automatically, diverting the surface water run-off from the site to the collection sump and prevents outflow to the river.

The diverter valve may also be remotely closed from the security hut in an emergency as a precautionary measure.

The collection sump consists of a 96 m³ collection sump with two self priming pumps each with capacity 270 m³/hr at 12 m lift. The sump is fitted with a low level switch LS1 which stops both pumps, and two high levels switches which operate Pump 1 and Pump 2 in turn. The system is designed based on an assumed inflow of 400m³/hour. Both pumps are capable of manual and automatic operation.

The pipe-work is configured so that the pumps normally pump from the sump to the containment tank, but may also be used to pump out the containment tank when full.

In the event of a power failure, the pumps receive power from the standby generator.

J.10. Wastewater Treatment

Helsinn Chemicals exercise an aggressive water and liquid waste conservation programme. The main sources of process effluent are from in plant cleaning processes (CIP) which are mandatory for inter and intra batch cleaning cycles at predefined intervals.

These are custom designed to minimise chemical and water usage. As a consequence these effluents contain relatively high concentrations of BOD and COD but have been shown to be highly biodegradable and of low toxicity. The appended toxicity and respirometry data demonstrates this fact.

In this application the company are seeking an increase in mass allowances to sewer due to increased production and diversification of product. These matters are under discussion with Fingal County Council as the Sanitary Authority and a separate portfolio of information is being collated for their consideration.

Since the allocation of sewer capacity is within the remit of the Sanitary Authority, the company will forward the agreement reached and the supporting information when they come to hand.

In seeking the changed allowances the company have taken into consideration:

- BAT requirements of on and off site treatment
- BREF compliance
- The Greater Dublin Strategic Drainage Study policy document
- National Water Pricing Policy
- Requirements for sewer, sewer worker and treatment process protection under the draft Water Services Bill as passed by the Seanad
- The Water Framework Directive

- Best Practicable Environmental Option for treatment
- Proximity principle for waste management.

J.11. Contamination due to Firewater Run-off Response

Surface water, ground and groundwater protection is provided at the facility through the following measures:

J.11.1 Surface water protection

In the event of major spillage or discharge of contaminated firewater to the surface water (storm water) drainage system, the fire alarm will activate the closure of the diverter valve. The diverter valve may also be remotely closed from the security hut in an emergency as a precautionary measure. This ensures that any spillage or potentially contaminated firewater that enters the surface water drainage system is retained on site until the material is assessed and the Emergency Response Team selects a procedure for safe disposal and/or discharge.

J.11.2 Ground/groundwater protection

Protection of the ground and groundwater from potentially contaminated groundwater is provided by containment of all materials that are potentially harmful to the aquatic environment.

In order to contain the potential impacts of a fire event at selected locations within the HCI site, dedicated bunds and storage tanks are currently used for firewater retention purposes.

Refer to Attachment No. F Section F.1.4 for more details on groundwater protection.

J.11.3 Containment of potentially contaminated firewater

The principal firewater retention facilities provided are:

- Firewater Retention Tank, capacity 1,600m^3
- Caustic bund in Tank Farm
- Tank Farm Bund
- Diesel Bund.

J.12. Spill Response

The company has prepared and implemented comprehensive spill response procedures to provide the emergency action and remedial measures required in the event of a spillage on-site.

J.13. Public Liability Insurance

The public liability insurance for HCI provides adequate cover for site operations. A letter from Marsh Ireland confirming the amount of public and products liability insurance cover is provided in this attachment.

J.14. Environmental Liability Risk Assessment

A copy of the Environmental Liability Risk Assessment (ELRA) is provided in this attachment.

BUND TEST CERTIFICATES

FAX

Date: 17/8/05	
Company: Hell	Project No: 13077/01
Att: Ed Murphy	From: N Keeney
Fax No:	Phone No:
Subject: Hell - Bund testing	Total No. of Pages (including this page) 4
CC:	

McElroy Associates
Consulting Engineers
72 Haddington Road, Dublin 4.
Tel: 6609000
Fax: 6609099
EMail: info@mea.ie

Ed,

Copy of letters you requested.

Regards

Noel Keeney

McElroy Associates
Consulting Engineers
72 Haddington Road, Dublin 4
Tel: 660 9000 Fax: 660 9099
E Mail: info@mea.ie

Our Ref: 13017 / F1.1
10 July 03

Mr Willie Murphy
Helsinn Chemicals Ireland Ltd
Damastown
Mulhuddart
Dublin 15

Re: Tank farm 2 Bund – Bund test

Dear Willie

As reported in our interim status report dated 10 July 2003 we confirm that the test results for this bund were satisfactory and that the bund is deemed to be watertight.

Should you have any queries please do not hesitate to contact us.

Yours sincerely

Niall Kearney
for McElroy Associates

McElroy Associates
Consulting Engineers
72 Haddington Road, Dublin 4
Tel: 660 9000 Fax: 660 9099
E-Mail: info@mcae.ie

Our Ref: 13 017 / F1.1
19 August 2003

Mr Willie Murphy
Helsinn Chemicals Ireland Ltd
Damastown
Mulhuddart
Dublin 15

Re: Diesel Tank Bund – Bund test

Dear Willie

Further to the tests carried out on the above bund (July 2003) we confirm that the test results were satisfactory and the bund was deemed to be watertight.

Should you have any queries please do not hesitate to contact us.

Yours sincerely

Niall Kearney
for McElroy Associates

McElroy Associates
Consulting Engineers
72 Haddington Road, Dublin 4
Tel: 660 9000 Fax: 660 9099
E Mail: info@mce.ie

Our Ref: 13 017 / F1.1
13th December 2004

Mr Willie Murphy
Helsinn Chemicals Ireland Ltd
Damastown
Mulhuddart
Dublin 15

Re: Caustic Bund Test

Dear Willie

Please find enclosed a copy of our Bund Test Report for the Caustic Bund Test. Please note that this test supersedes the previous testing carried out (due to loss of results and test sheets for that test).

As noted in the report the test was successful in this case.

Should you have any queries please do not hesitate to contact us.

Yours sincerely

Niall Kearney
for McElroy Associates

BUND TESTING PROCEEDURE

WATER TESTING

A control barrel is to be set up in a location, which has a similar environment to the bund to be tested. Particular attention should be paid to draughts, evaporation, amounts of direct sunlight, susceptibility to rainfall collection etc.

Each bund shall be water tested in accordance with the requirements of BS 8007 Section 9.

The bunds are to be filled with water and allowed to stabilise for seven days prior to being tested on a 24 hourly basis over a period of seven days. The variations in water level are to be compared in each instance with the levels measured in a control barrel set with in the bund. The test results for each of the bunds are to be recorded for interpretation on the attached sheets.

Client: Helsinn Chemicals Ireland
Project: Caustic Bund Test
Title: Bund test Sheet

Doc. No.: 13 017 / F1.2
Issue: Reporting purposes
Date: November/December 2004

Project No. 13017

Project: HCIL – Bund Testing

Bund Name	Caustic Bund
Location	Tank farm
Tester	W Murphy
Start date	24/11/04

	CONTROL BARREL READING	BUND READING	WEATHER CONDITIONS/OBSERVATIONS
Initial Reading	392	193	
DAY 1 (29/11)	391	193	Cold & dry
DAY 2 (01/12)	391	192	Cold & dry
DAY 3 (03/12)	390	193	Cold & light drizzle
DAY 4 (07/12)	392	194	Cold & light drizzle
DAY 5 (08/12)	392	194	Cold & dry
DAY 6			
DAY 7			
LEVEL DROP			
% DIFFERENCE			

REMARKS:

The bund was tested over a period of 2 weeks to fully check if any loss could be detected through the horizontal joint in the bund wall. This joint had leaked under a previous test and was repaired.

On the basis of the above test results the bund has **passed** the integrity test for containment.

Signed: Niall Clarney (Engineer)
For McElroy Associates

PUBLIC AND PRODUCTS LIABILITY INSURANCE LETTER

MARSH

Marsh Ireland Ltd.
Risk & Insurance Services
25-28 Adelaide Road
Dublin 2
Ireland
+353 1 6048321 Fax +353 1 6048476

09 January 2006

To Whom It May Concern

Dear Sirs,

Re: Helsinn Chemicals Ireland Ltd.

We confirm that the above noted Company has Public and Products Liability Insurance in regard to the Insurance period 1st January 2006 – 31st December 2006 inclusive.

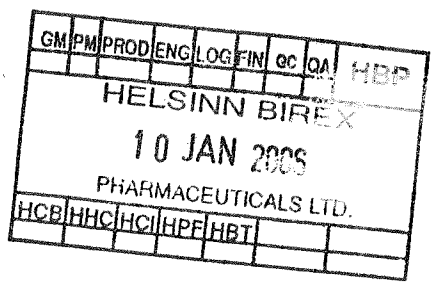
The details in regard to cover regarding Environmental Risks are:-

Insurers:	Zurich Insurance Company Ltd.
Policy Number:	LA35265 A
Limit of Indemnity:	€5,000,000 any one occurrence

The Insured has further cover over and above this indemnity limit and should you require any further details do not hesitate to contact us.

Yours Sincerely,

Melvyn McCambridge
Assistant Partner
Direct Dial: 01-6048321
Direct Fax: 01-6048476



HCI INTERNAL EMERGENCY PLAN

HELSINN CHEMICALS IRELAND LTD

INTERNAL EMERGENCY PLAN (IEP)

SECTION	DETAILS
1.0 **INTRODUCTION**	**Background** • Brief description of operations • Reason for designation as a Seveso II Lower Tier Establishment • Major Accident Hazard Scenarios • Other scenarios (non-Seveso II) **Purpose** • Purpose of the IEP **Objectives** • HCI's objectives **Definitions** • E.g. ERT, ECC, External Emergency Services, Competent Authority **References** • Other relevant documents and legislation
2.0 **EMERGENCY ORGANISATION STRUCTURE**	**General** • Schematic layout indicating, reporting and communications lines. **Responsibilities** • General overall responsibilities of the various Groups/Individuals
3.0 **LIAISON WITH EXTERNAL EMERGENCY SERVICES & REGULATORY AUTHORITIES**	**Fire Service** • Notification • On Arrival at Site **Ambulance Service** • Notification • On Arrival at Site **Police** • Notification • On Arrival at site **Regulatory Authorities (Local Authority, HSA, EPA and AN Others)**

SECTION	DETAILS
	• Notification • On Arrival at Site
4.0 **LIAISON WITH EXTERNAL ORGANISATIONS**	**Neighbouring Companies** **Local Residents**
5.0 **LIAISON WITH THE MEDIA**	**General Overview** **Media Plan**
6.0 **EMERGENCY EQUIPMENT & RESOURCES**	**First Aid** **ERT Equipment** **Fire Detection and Alarm Systems** **Portable Extinguishers** **Fire Water Retention** **Isolation of Services/Utilities**
7.0 **EMERGENCY RESPONSE PROCEDURE – STAFF**	**Action on Hearing the Alarm** **Action on Discovering an Incident (Fire/Spill)**
8.0 **EMERGENCY RESPONSE PROCEDURE - GENERIC**	**Action by Emergency Response Organisation** General Response to all types of incidents
9.0 **EMERGENCY RESPONSE PROCEDURE – SPECIFIC INCIDENTS**	**Response Actions in respect of Specific Major Accidents as listed in MAPP/SMS** **Response Actions in respect of Specific Accidents not listed in MAPP/SMS** Specific details only required here (most of the details will already be covered under Generic Response)
10.0 **EMERGENCY RESPONSE PROCEDURE – OUTSIDE NORMAL HOURS**	**Response Actions in respect of Outside of Normal Office Hours with particular reference to Security Officer and Manager on Being Notified**
11.0 **TRAINING & EXERCISES**	Introduction Training & Exercises • Emergency Response Organisation, Staff, Contractors and Visitors • Use Table Format

SECTION	DETAILS
	Group/Individual **Type of Training** **Frequency of Training & Duration** Record of Training
12.0 **AUDIT, REVIEW AND MAINTENANCE OF PLAN**	Introduction Responsibility When will the plan be audited/reviewed?
APPENDIX 1	**Emergency Telephone Directory** • Emergency Services (Fire, Ambulance, Police) • Utility Providers (e.g. ESB, Bord Gais etc.) • Regulatory Authorities/Agencies • Hospitals • Management & Internal Contacts • Staff Next of Kin • Corporate/Group • Neighbouring Companies • Local Residents (if applicable) • Contractors (including contractors who could be involved in clean-up) • Suppliers • Media • Others (e.g. Pharmaceutical Ireland, Insurance Companies, customers etc.) **Briefing Pack Fire Service (including site drawings, hazards etc.)** **Proformae** • Evacuation Report Form
APPENDIX 2	Modelling of Major Accident Hazard Scenarios • Modelling of releases of MSC • Modelling of release of HCL • Modelling of loss of containment in tank farm • Acid/Caustic mixing in the caustic bulk storage tank

SECTION	DETAILS
	• Synthesis plant pool fire and subsequent domino effects

Section 1.0 Introduction

1.1 Background

1.1.1 Description of Operation

Helsinn Chemicals Ireland Limited operates a manufacturing facility on the Damastown Industrial Estate, at Mullhuddart, close to the N3. The plant was purpose built in 1992/93, on a greenfield site, for the manufacture of bulk pharmaceutical chemicals. Additional warehousing, a micronisation and drying unit, a tank farm, fire-water retention pond and stand-by generator were added in 1994/95. Additional warehousing and a mill and blender were added in 2001. The site area is 4.5 acres (1.8 hectares). These buildings are surrounded by an internal ring road.

Raw materials are delivered to the site in drums or bulk containers and stored in the tank farm or drum store. Synthesis and purification of the intermediates and final product takes place in the main process building (P1) using reaction vessels with capacities 8,000 litres, 6,300 litres and 4,000 litres. Wet intermediates are isolated by centrifugation and drying of one of the intermediates also takes place in this building. The purified products are dried and then micronised or milled and blended in a separate area in the Finishing Unit (Fl). Drying is carried out under vacuum in rotary dryers and micronisation is by means of an air jet mill. The finished products are packed into drums and stored in the finished goods warehouse prior to shipment.

The plant operates to current Good Manufacturing Practices as defined by the EC. It is subject to both third party audits from regulatory bodies (Irish Medicines Board), corporate headquarters and customers. All staff are trained in safety, environmental awareness and current good manufacturing practices (cGMPs).

The plant currently operates on a two-shift basis (from 6.30 a.m. to 10.30 p.m.) five days per week. Outside normal office hours (8.00 a.m. to 4.45 p.m.) a security person (from an established security firm) is always on site. The site is surrounded by a palisade fence (2.5 m steel spikes) and the entrance gates can only be opened internally, or by means of a security code.

On-site treatment of effluent consists of carbon filtration and neutralisation. Two holding tanks with a combined capacity of 100 m^3 are located near the tank farm. Hazardous wastes are shipped through a waste handler for recovery, incineration or blending as cement fuel. Non- hazardous waste stored in skips is sent for landfill off-site.

The site has been accredited to ISO 14001 since 1996.

Helsinn Chemicals is classified as a Lower Teir Seveso Site under the European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations, 2000 (S.I. No.476 of 2000)

1.1.2 Reason for Designation as a SEVESO II Lower Tier Establishment

Helsinn Chemicals Ireland Ltd is classified as a Lower Teir Seveso site as the storage quantity of Very Toxic substances is greater than 5 mt which exceeds the qualifying quantity under the European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations, 2000 (S.I. No.476 of 2000). For all other classes of substances, Helsinn Chemicals does not fall within the qualifying threshold.

	Dangerous Substance	Risk Phrases	Qualifying quantity (tonnes) of the dangerous substance		Quantity in storage (tonnes)
			Articles 6 and 7	Article 9	
1	Very Toxic	R26,R27, R28,R39	5	20	10

1.1.3 Major Accident Hazard Scenarios

The following is a summary table of the Major Accident Hazard scenarios identified on site.

Hazard No.	Area	Activity	Hazard & Consequence
1	03 NIME Production	Hot Work	Hot work in plant leading to major fire
2	04 NIME Crude & Final Production	Hot Work	Hot work in plant leading to major fire
3	04 NIME Micronised	Hot Work	Hot work in plant leading to major fire
4	Tank Farm	Hot Work	Hot work in tank farm leading to major fire
5	Tank Farm	Charging of materials	Contents of Hydrochloric acid tank charged to Caustic tank and vice versa resulting in major exotherm

1.1.4 Other Scenarios

Other scenarios which have been investigated include:

Release of 33% Hydrochloric Acid to bund and to open ground
Spill of 200 litre drum of Methane Sulphonyl Chloride to open ground

1.2 Purpose of the IEP

This purpose of the Internal Emergency Plan is to inform personnel on what to do in the event of an unplanned, unforeseen incident occurring at Helsinn Chemicals Ireland Ltd. An incident involves serious disruption to normal activities, which may require the assistance of the Emergency Services to be dealt with.

Prompt action by personnel can:

- Save a life.
- Relieve suffering.
- Minimise damage to the environment.
- Contain the incident.
- Return conditions to normal.

1.3 Objectives of the IEP

This Internal Emergency Plan defines the following:

- Emergency Organisation Structure inside and outside normal working hours.
- Responsibilities in relation to emergency response.
- Liaison with the Emergency services and regulatory authorities.
- Liaison with Neighbouring companies and local residents.
- Emergency Equipment and Resources.
- Evacuation.
- Emergency contact details for all interested parties.
- Communications and Media Plans.
- Investigation of incidents and follow up actions to prevent recurrence.

1.4 Definitions

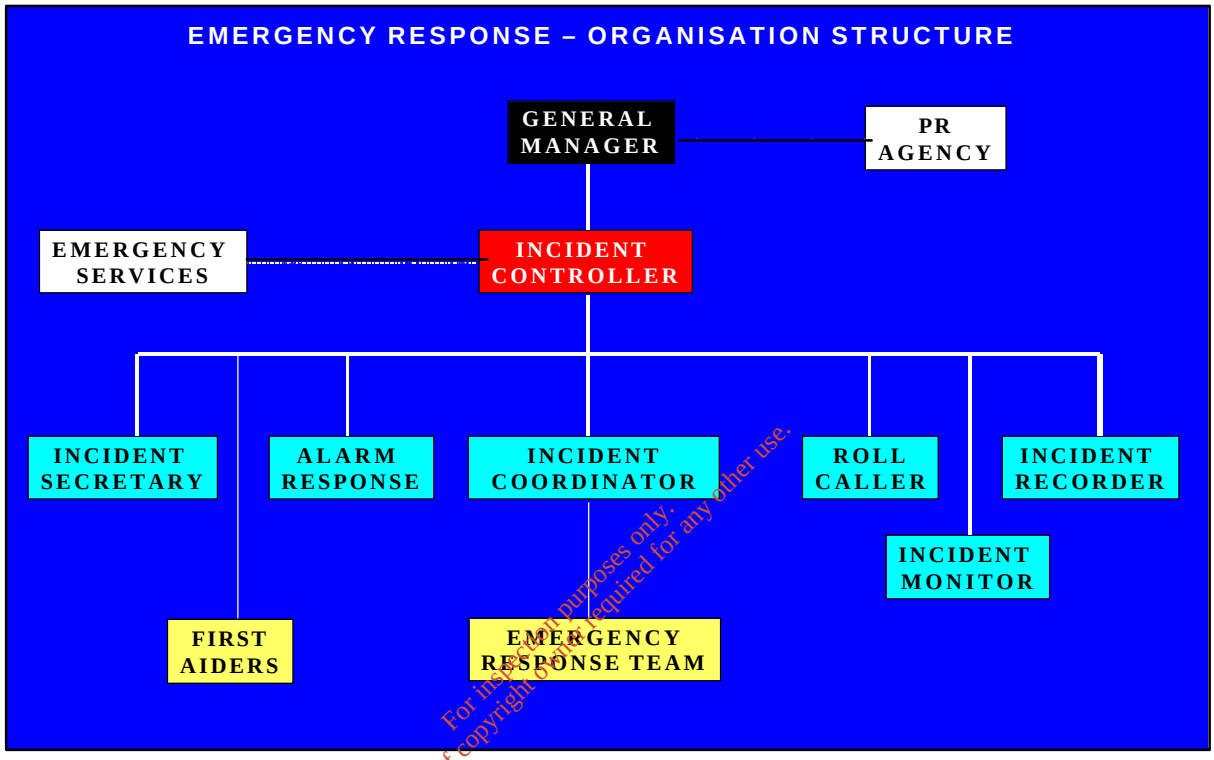
ERT	Emergency Response Team
IEP	Internal Emergency Plan
MAPP	Major Accident Prevention Policy

1.5 References

- SDS/002 Evacuation and Incident Response Procedure
- SDS/015 Evacuation and Incident Response Outside Normal Working Hours Procedure
- SDS/006 Firewater Containment System
- SMS/001 Safety Management System containing Manual Major Accident Prevention Policy
- Report for HCI on Modelling of Releases of Methane Sulphonyl Chloride (MSC), Don Menzies & Associates 19 February 2001
- Report for HCI on Modelling of Releases of Hydrochloric Acid (HCL), Don Menzies & Associates 23 November 2000
- Report for HCI on Compliance with COMAH Directive, Don Menzies & Associates 24 November 2000
- Identification and ranking of Major Accident Hazards

Section 2.0 Emergency Organisation Structure

2.1 Schematic Layout Indicating, Reporting and Communication Lines During Normal Working Hours



2.2 RESPONSIBILITIES

(Refer to SOP SDS/002 Evacuation and Incident Response)

INCIDENT CONTROLLER (IC)

The Incident Controller has overall responsibility for major decision making during on-site emergencies.

In particular, he shall ensure that

- all persons known to be on site are accounted for. This may involve authorising 'search and rescue' teams to re-enter the building if necessary.
- an accurate assessment is made of what activities were in progress at the time of the incident.
- the emergency services have been called for assistance, if required, and that they are informed of all hazards known to be present in the incident area.
- personnel are sent to the all site access gates to prevent entry of people and to ensure quick access for Emergency Services.
- he shall maintain direct contact with the Incident Co-ordinator at all times using 'walkie-talkies'
- premises and residents living within a 500m radius are advised if there is a risk of the effects of the incident spreading outside site boundaries.
- the general public is kept informed of developments during the incident, and subsequent to any investigation.

The Incident Controller is the only person who can authorise a 'stand down' and return to work.

ROLL CALL

He/she must account for all onsite personnel by calling out each employee/visitor/contractor who is on site. He/she is to then inform the IC if there are any missing personnel. This procedure must be done as fast as possible therefore co-operation from all personnel is vital.

The Roll Caller may wish to move the assembled personnel into a location which does not interfere with the Emergency Response team or organise assembled personnel into departments. This may aid the Incident Controller when calling on personnel with expertise in a particular area.

ALARM RESPONSE

It will be the responsibility of the Alarm Response Team to check the fire alarm print out and determine the location of the incident.

They will proceed to within a safe distance of were the fire alarm has been activated. They will advise the Incident Controller of the situation and the response required. They will then return to the assembly point.

N.B. This will only be done after having been accounted for at the assembly roll call.

INCIDENT CO-ORDINATOR

It is the duty of the appointed Co-ordinator after being accounted for at Roll Call, to select and prepare n Emergency Response The Alarm Response Person will assess the situation and inform the IC of the Response required e.g. fire, spillage. The IC will in turn inform the Incident Co-ordinator.

The Co-ordinator will advise on the following:

If there is a fire he will (depending on the nature of the fire):

- Ensure the ERT Team are gowned appropriately
- Investigate and mitigate the effects of the fire (only if it is considered safe to do so)

If there is a spillage he will (if it is safe to do so):

- Determine the substances and quantities, and inform the Incident Controller.
- Determine if any risk of loss of containment to ground or surface waters and inform the Incident Controller.
- Inform the Incident Controller if a back-up spillage crew is required.
- Inform the Incident Controller of any Emergency Services that may be required

When the incident has been dealt with and the Co-ordinator feels there is no further danger he will advise the Incident Controller of the situation. The Incident Controller is the only person who can authorise a 'stand down' and return to work.

FIRST AID TEAM

Following evacuation the First Aid team should make themselves available to the Emergency Response Team. In particular they should:

- Get accounted for during roll call
- Obtain the First Aid kit from the Muster station
- Keep in contact with the Incident Controller to determine nature of injuries of missing persons
- Assess the situation and bring relevant First Aid Equipment to the scene
- Move the injured party to a safe location
- Do not put yourself at risk
- Follow instructions on Incident Controller and/or Incident Co-Ordinator

INCIDENT SECRETARY

This person must ensure the fireproof safes are locked. He/she must bring the fireproof safe keys, the security keys, a blank evacuation report form and the 'visitors sign in book' report to the assembly point.

He/she is also responsible for switching the phone system to the Security Hut and manning the telephone in the Security Hut for the duration of the evacuation.

The Incident Secretary should remove the 'personnel on-site' report, check that the date and time are correct and give to the roll call person.

The Incident Secretary will be responsible for taking calls from interested parties including the media. She should follow the proforma for each as detailed in Appendix 13.

INCIDENT MONITOR (IM)

This person should monitor the incident response to ensure that safe work practices and good environmental practices are followed. In an effort to deal with a crisis, the above can sometimes be overlooked.

The personnel involved should be alerted to the hazards, and details should be given to the Incident Recorder and noted in the Evacuation Report Form.

INCIDENT RECORDER

It will be the responsibility of the Incident Recorder:

To record the sequence of events, decisions, actions taken and the associated times and persons involved on the Evacuation Report Form HCI 054.

Section 3.0 Liaison with External Emergency Services and Regulatory Authorities

3.1 Fire Services

- **Notification**

The Fire services should be notified immediately if an incident such as a fire or spillage has occurred on site. It is imperative that the initial and subsequent information provided to them is accurate and timely.

Dial 999 and inform the Security Company that the fire services are required.

Provide the fire services with:

- clear and concise directions to site (see below)
- details of the type of incident that has occurred
- the site telephone number should they need to contact the site subsequent to initial notification **(01 8206111)**

Directions to site:

Take the N3 or Navan Road past Blanchardstown. Turn off the N3 at the sliproad for Clonee. Take a right turn onto the motorway flyover. At the traffic lights continue straight ahead into the industrial estate. At the roundabout take the third exit or right exit and Helsinn Chemicals is the first gates on the right.

Consider sending a member of staff to the entrance of the industrial estate to guide the fire services to the site.

- **On Arrival On site**

The Fire services should be met on site by the Incident Controller.

The Incident Controller should provide the following information to the Senior Fire Officer:

- Is everyone accounted for
- If a person is missing, what was there last know location
- On site hazards
- a weather proof site drawing
- Material Safety Data Sheets
- Any additional information as requested

3.2 Ambulance

- **Notification**

The ambulance service should be notified if a person has sustained injuries on site.

Dial 999 and inform the Security Company that an ambulance is required.

Directions to site:

Take the N3 or Navan Road past Blanchardstown. Turn off the N3 at the sliproad for Clonee. Take a right turn onto the motorway flyover. At the traffic lights continue straight ahead into the industrial estate. At the roundabout take the third or right exit and Helsinn Chemicals is on the right.

Consider sending a member of staff to the entrance of the industrial estate to guide the ambulance to the site.

- **On arrival on site**

The ambulance services should be met on site by the Incident Controller or a member of senior management as designated by the Incident Controller. The ambulance crew will want to talk with the Senior Fire Officer to determine nature of injuries and safety status of site.

3.3 Police

- **Notification**

The Gardai should be notified if there is reason to summon the Fire Service and/or ambulance to the site. They should be notified immediately if a fatality occurs on site.

Dial 999 and contact the local garda station in Blanchardstown at phone number 01 8213023

- **On arrival on site**

The Gardai should be met on site by the Incident Controller or a member of senior management as designated by the Incident Controller. The Gardai will want to talk with the Senior Fire Officer to determine if any additional measures external to the site need to be put in place i.e. limiting access to the industrial estate, closing roads etc.

3.4 Regulatory Authorities

- **Notification**

Health & Safety Authority:

The Health and Safety Authority should be contacted as soon as practicable after the occurrence if:

- Fire services and ambulance services are summoned
- A Major Accident as defined under the European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations, 2000 (S.I. No.476 of 2000) has occurred
- A fatality has occurred on site
- A reportable accident has occurred

Contact the Head office of the Health & Safety Authority at phone number 01 6147000. Inform the receptionist that you wish to report an on site incident. Leave details of how they may contact the site for further information.

Environmental Protection Agency:

The Environmental Protection Agency should be contacted as soon as practicable after the occurrence of any of the following:

- any release to atmosphere from any potential emission point
- any emission which does not comply with the requirements of the licence
- any malfunction or breakdown of control or monitoring equipment which is likely to lead to loss of control of the abatement system
- any incident with the potential for environmental contamination of surface water or groundwater, or posing an environmental threat to air or land, or requiring an emergency response by the Local Authority

Contact the Head office of the Environmental Protection Agency Wexford at phone number 053 60600. Our Inspector is Mary Gurrie. If he is not available inform the receptionist that you wish to report an on site incident. Leave details of how they may contact the site for further information.

Local Authorities

The Local and Sanitary Authority should be notified as soon as practicable after the occurrence in the event of any incident with the potential for environmental contamination of surface water or groundwater, or posing an environmental threat to air or land which relates to discharges to sewers.

Contact Fingal County Council Keith Hanratty at phone number 01 8905903/087 2786916 or Jim Kavanagh at 01 8905961/087 679 1595
As effluent form the site is discharged to Ringsend Waste Treatment Plant, inform Dublin City Council, Dave Guerin mobile 087 8150608 pollution officer

Fisheries Board

The Eastern Regional Fisheries Board should be notified as soon as practicable after the occurrence in the event of any incident with the potential for environmental contamination of surface water or groundwater, or posing an environmental threat to air or land which relates to discharges to waters.

Contact the Eastern Regional Fisheries Board at phone number 01-2787022. Gretta Hannigan. Leave details of how they may contact the site for further information.

- **On arrival on site**

Regulatory authorities should be met on site by the Incident Controller or a member of senior management as designated by the Incident Controller.
The regulatory authorities will require the following information:

- The circumstances of the accident/incident
- The dangerous substances(s) involved
- The data available for assessing the effects of the accident on man and on the environment, and
- The emergency measures taken
- Steps envisaged to alleviate any medium term or long term effects of the accident and to prevent any recurrence of the accident
- Updated information if further investigation reveals additional facts which alter that information or the conclusions drawn.

Section 4.0 Liaison with External Organisations

4.1 Neighbouring companies

- **Notification:**

A list of Neighbouring companies with contact names and numbers is included in Appendix 13.0.

Neighbouring companies should be contacted if there is a possibility that there may be off site effects as a result of the incident. The Incident Controller will authorise the Incident Secretary or another to contact specific companies and give them the following information;

- Nature of the Incident that has occurred
- Off site Hazards associated with the Incident
- Precautionary measures to be taken by the company
- Contact telephone number if additional information is required

Neighbouring companies may also be in a position to assist. They may have additional ERT equipment or they may make their facilities available to staff who have been evacuated.

4.2 Local Residents

- **Notification**

Local Residents should be contacted if as a result of the incident there is a possibility that there may be off site effects. The Senior Fire Officer in consultation with the Incident Controller will make this call. The services of the Gardai should be used to notify local residents of the precautionary measures to be taken in order to protect themselves from harm.

Section 5.0 Liaison with the Media

General overview

Media Plan

WRITTEN STATEMENTS

Sample Statement Physical Incident – No Injuries

Headed Paper

Date: ________________

For Immediate Release

Following an incident, which occurred today at Helsinn Chemicals' facility in Damastown, Mulhuddart, the premises was evacuated in accordance with our Safety and Emergency Procedures. All employees, visitors and contractors on the premises are being / have been accounted for.

The incident consisted of a [*brief description* -.

The Emergency Services were alerted at [*time/date*] and are at present on site. The incident is being [*investigated / dealt with etc.* -].

[*Short account of /facility history including the number of employees, main services, turnover etc. from fact-file* -]

For further background information on [*incident/accident*] please contact the company's media spokesperson / PR consultants [*name*] at [*telephone number(s) (mobile/landline)*].

Signed: ______________________________
Appointment: ______________________________

Sample Statement Physical Incident – Injuries

Date: _____

For Immediate Release

Helsinn Chemicals regret to announce that following an [*incident/accident*] at its facility in Damastown, Mulduddart, a number of persons have sustained injuries.

The incident occurred at approximately [*date/time*] and our emergency plan was implemented immediately. The emergency services are at present on site and our local emergency team is assisting them.

At this stage, specific information about the casualties is not known, but a detailed press statement will be issued as soon as this information becomes available and the families and relatives of those injured have been informed. It is expected that this will take place within [*time*].

Members of the media are requested not to telephone the switchboard at our facility as the line is heavily committed to emergency calls relating to the [*incident/accident*] (or because the premises has been completely evacuated).

Signed: _____

Appointment: _____

Section 6.0 Emergency Equipment and Resources

6.1 First Aid

Qualified First Aiders maintain a stock of first aid equipment in the muster station. This is made up of the following:

- First Aid box fully stocked
- Stretcher
- Various inflatable splints for fractures
- Extrication collars – short and regular
- Emergency First Aid kit for burns – WaterJel
- Blankets

6.2 ERT Equipment

The ERT equipment is stored in the muster station. It consists of the following:

Number	Description
4	Draeger PA 94 Breathing Apparatus
1	Stage II Control Board with Digital Clock
2 2	**Gas Tight Suits** Prochem Tychem TK Coverall Gastight suits with boots attached (extra Large) fitted with radio pocket Prochem Tychem TK Coverall Gastight suits with boots attached (Large) fitted with radio pocket
2 2	**Liquid tight suits** Prochem Tyvek Type F (extra large) Prochem Tyvek Type F (large)
6	Chemical resistant boots (for use with liquid tight suits)
24	Chemical resistant gloves (for use with liquid tight suits)
4	Fire Helmet - Gallet F1E Helmet c/w 43% Gold Visor
4	Fire Jacket - Combination Suit
4	Fire Pull-ups - Combination Suit Dungarees
4	Fire Boots - SABF Rubber Fire Boots
4	Fire Gloves - GD Thermo Fighter Gloves
3	Walkie talkies
2	Ex torches
6	Hydrants running off mains at 2.5 Bar, a fire box located beside each hydrant containing a stand pipe, ‘T’ bar, 3 75ft fire hoses, branch pipe
2	Fire Fighting Foam units

6.3 Fire Detection and alarm Systems

The facility at Mulhuddart is equipped with a fire detection system which is divided into two main areas:

i) Administration
ii) Production and Utilities Area

Upon activation, the on-site alarm bells ring and an alarm is indicated at the control station of the Security Company.

The location of the activated alarm can be identified in the remote panel in the security hut or the main alarm panel located in reception.
Fire or smoke are detected by

i) Ionised Chamber/Smoke detectors.
ii) Rate of Rise/Heat detectors

The rate of rise detectors are used in areas where there is a likelihood of dust/powder particles or fumes during daily operation e.g. Workshop, Warehouse and Laboratory. The use of smoke detectors would cause false alarms.

6.4 Portable Extinguishers

All employees receive fire extinguisher training. An external company carry out annual inspections of the fire extinguishers and hose reels on-site. The Maintenance department also carry out monthly inspections of fire extinguishers on-site.

There are 3 types of fire extinguishers on site:

1. Powder
2. Foam
3. Carbon Dioxide

The type of fire extinguisher selected for installation in an area is dependant on the type of hazards that exist in the area.

6.5 Fire Water Retention

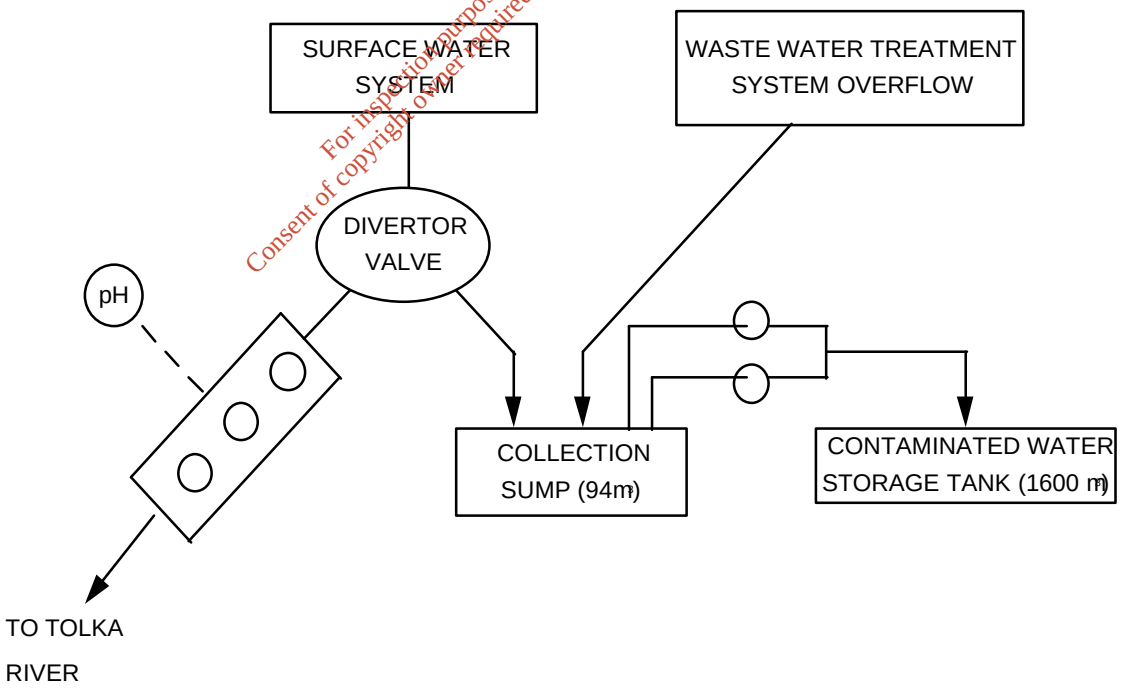
System Description (Refer to SOP SDS006 for further detail)

The system is designed to contain 1,600m³ of contaminated run-off liquid arising from a major spillage or the firewater run-off arising from fire fighting activities.

The process draining system, including the effluent balancing tanks, overflows to the firewater containment pond in the event of excessive hydraulic loading.

The surface water interceptor is monitored for pH continuously and will activate the automatic divertor valves in the event of acid/base contamination. This diverts surface water from the site to the collection sump and prevents outflow to the river. In addition, the activation of the fire alarm system starts the valve automatically.

The divertor valve may also be remotely closed from the security hut in an emergency as a precautionary measure.



6.6 Isolation of Utility/Services

GAS

Gas supply isolation valve to plant is located on footpath opposite Helsinn Birex entrance. The isolation valve handle is located in the ERT room

ELECTRICITY

Electricity supply to site can be isolated in Switch room 2. An isolation switch is located on panel inside the door to the left hand side. The isolation switch is outlined with red and white tape. Turn isolater to off position.

Section 7.0 Emergency Response Procedure – Staff

7.1 Action on Hearing the Alarm

Upon hearing the alarm bell each employee and visitor must make their way to the nearest Emergency Exit, walking at all times and must meet at the Assembly Point at the front of the Security Hut.

If at any time, a person's primary route is blocked and/or hazardous, they should choose their secondary evacuation route without delay. Evacuation routes are shown on A3 drawings throughout the site.

Note: It is important to memorise the nearest fire/emergency exit.

Do not stop to collect personal belongings. It is the responsibility of **ALL** personnel to ensure that Emergency Exits are kept clear and unlocked during working hours.

All personnel are to queue in front of the Roll Call Caller until the names are checked off the 'Personnel on-site report'. When called they must acknowledge **loudly** and then move behind the Roll Caller. He/She advises the Incident Controller of any missing personnel.

Even if the alarm stops sounding, all personnel must remain at the assembly point until they receive further instructions from the Incident Controller. When a 'stand down' announcement is made, the area of the emergency may be declared 'out of bounds' by the Incident Controller. All employees must follow his instructions.

7.2 Action on Discovering an Incident (Fire/Spill/Injured Person)

The HCI facility fire detection and alarm system may be activated automatically if any of the detectors throughout the building detect heat or smoke.

In addition should it be necessary, an employee may raise the alarm by shouting 'Fire' and breaking the glass in one of the Break Glass Units (BGU) located through out the premises.

If an employee discovers a fire, a large spillage or a situation, which is sufficiently serious to evacuate the premises, even on a precautionary basis, he/she should activate the fire alarm by pressing one of the BGU.

If an employee discovers an injured person they may be in a position to notify first aiders and get help by contacting other members of staff. If it is not possible to leave the injured person raise the alarm by breaking a BGU. This will identify the area in which the missing persons are located.

Section 8.0 Emergency Response Procedure – Generic

8.1 General Response to all types of incidents

ACCOUNTING FOR PERSONNEL ON EVACUATION

In order to ensure that all staff are accounted for as quickly as possible the following should happen:

a) All personnel are to queue in front of the Roll Caller until the names are checked off the 'Personnel on-site report'. When called they must acknowledge **loudly** and then move behind the Roll Caller.

b) The Roll Call Secretary will then account for any visitors or contractors on site.

c) He/She will advise the Incident Controller of any missing personnel.

d) Taking a Walkie Talkie with them, the Alarm Response Team will check the fire alarm print out and determine the location of the incident. They will proceed to within a safe distance to the location were the fire alarm has been activated. They will advise the Incident Controller of the situation and the response required i.e. fire/spillage. They will then return to the assembly point.

N.B. This will only be done after having been accounted for at the assembly roll call.

e) The Incident Controller will inform the Incident Co-ordinator of the situation and they will decide whether it is safe to authorise the Emergency Response Team to respond.

f) If it is deemed safe to do so the ERT will gown up appropriately. The Incident Co-ordinator will lead the team to the location, keeping in contact with the IC at all times by radio.

The Co-ordinator will advise on the following:

If there is a fire he will (depending on the nature of the fire):

- Advise the Incident Controller to phone the appropriate Emergency Services.
- Advise the Incident Controller that a back up fire crew is needed.

If there is a spillage he will:

- Determine the substances and quantities, and inform the Incident Controller.
- Inform the Incident Controller of any Emergency Services that may be required
- Determine if any risk of loss of containment to ground or surface waters and inform the Incident Controller.
- Inform the Incident Controller if a back-up spillage crew is required.

g) Once the fire brigade arrive, the Senior Fire Officer takes charge of the incident and has full authority on site.
The company personnel must assist by providing information as required and assistance in dealing with the incident if requested to do so

Section 9.0 Emergency Response Procedure – Specific Incidents

9.1 Spillage of drum of Methane Sulphonyl Chloride (MSC)

Methane Sulphonyl Chloride is stored in 200 litre drums at ground level in the warehouse. Drums of MSC are brought by fork-lift into the production plant, a distance of 15m approximately. The drums are transported on a pallet. The model perdicts what would happen if a drum of MSC falls from the pallet and its contents are dipersed onto the yard.

On loss of containment, the pool of MSC would vapourise, and the MSC cloud would be driven by the wind and dispersed. The dispersion was modelled using PHASTMicro, version 6.0, using the physical property data.

The distance to dispersion to various concentrations is predicted to be as follows:

MSC spill to yard				
Concentration parameter	**Concentration (ppm)**	**Averaging Time (sec)**	**Distance to maximum downwind effect distance for metrological conditions (m)**	
			D5	**F2**
ERPG3	25	3600	11	6
ERPG2	1	3600	16	11
ERPG1	0.1	3600	47	44

Definitions:

Emergency Response Guidelines

Parameter	Description	Concentration (ppm)
ERPG3	The max airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects	25
ERPG2	The max airborne concentration below which it is believed that 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 individuals ability to take protective action.	1
ERPG1	The max airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing other than mild, transient adverse health effects or without perceiving a clearly defined objectionable odour.	0.1
IDLH	Immediate danger to Life and Health	400

Stability Categories that are used in air dispersion modelling:

Stability Category	Description	Conditions
D5	Neutral	High wind speeds (5m/s) at night time or in overcast cloudiness
F2	Moderately stable	Moderate wind speeds (2m/s) and clear skies at night

Conclusions:

Under adverse weather conditions i.e. stability class F, wind speed (2m/s), the concentration of MSC could exceed 25ppm at distances up to 6m, i.e. largely be confined to site. Lower concentrations, giving rise to lachrymatory effects, could be experienced up to 40m from the source.

Similarly under weather conditions D5, wind speed 5m/s, the concentration of MSC could exceed 25ppm at distances up to 11m i.e. largely be confined to site. Lower concentrations giving rise to lachrymatory effects, could be experience up to 47m from the source.

The Helsinn Emergency Response Plan in response to an MSC is as follows:

- Initiate the Evacuation procedure
- Take account of wind speed and direction
- Stop air intake into the building and close all doors and windows
- Ensure persons are kept upwind of the spill
- Alert neighbours of the incident and inform them of need to stop air intake systems. Ensure that persons in neighbouring sites are kept upwind of the spill – this may require remaining indoors.
- Cover spills of MSC with foam to minimise vapourization
- Ensure that area is contained with spill equipment
- Neutralise the MSC with a solution of Sodium Carbonate
- Contain liquid using absorbents and collect and dispose of into open top UN approved combination drums and label appropriately

SEE APPENDIX 1 FOR MODELLING REPORT INCLUDING DRAWINGS OF DISPERSION DISTANCES. Ref: Report on Modelling of releases of Methane Sulphonyl Chloride Dated 19th February 2001

9.2 Spillage of drum of Hydrochloric Acid (HCL)

HCL is a solution of hydrogen chloride gas in water. The acid is delivered to site by a road tanker, which parks in a bunded area beside the tank bund. An area of approximately 12m x 5m ($60m^2$) which drains to a containment gully.

The following HCL release scenarios were examined:

- Spill of aqueous hydrochloric acid to bund
- Spill of aqueous hydrochloric acid to open ground

The distance to dispersion to various concentrations is predicted to be as follows:

Hydrochloric acid to bund				
Concentration parameter	Concentration (ppm)	Averaging Time (sec)	Distance to maximum downwind effect distance for metrological conditions (m)	
			D5	F2
ERPG3	150	3600	24	84
ERPG2	20	3600	64	340
ERPG1	3	3600	202	1087

Hydrochloric acid to hard standing				
Concentration parameter	Concentration (ppm)	Averaging Time (sec)	Distance to maximum downwind effect distance for metrological conditions (m)	
			D5	F2
ERPG3	150	3600	32	60
ERPG2	20	3600	91	336
ERPG1	3	3600	313	1142

Definitions:
Emergency Response Guidelines HCL

Parameter	Description	Concentration (ppm)
ERPG3	The max airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects	150
ERPG2	The max airborne concentration below which it is believed that 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 individuals ability to take protective action.	20
ERPG1	The max airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing other than mild, transient adverse health effects or without perceiving a clearly defined objectionable odour.	3
IDLH	Immediate danger to Life and Health	100
OEL-TWA	Occupational Exposure limit – Time weighted Average	5
OEL – STEL	Occupational Exposure Limit – short term exposure limit	10

	Odour threshold	0.26 – 10

Stability Categories that are used in air dispersion modelling:

Stability Category	Description	Conditions
D5	Neutral	High wind speeds (5m/s) at night time or in overcast cloudiness
F2	Moderately stable	Moderate wind speeds (2m/s) and clear skies at night

Conclusions:

Under adverse weather conditions i.e. stability class F, wind speed (2m/s), the concentration of HCL could exceed 3ppm at distances up to 2km from the site.

Significant concentrations could be generated on neighbouring sites under a greater range of weather conditions.

The Helsinn Emergency Response Plan in response to an HCL is as follows:

- Initiate the Evacuation procedure
- Take account of wind speed and direction
- Stop air intake into the building and close all doors and windows
- Ensure persons are kept upwind of the spill
- Alert neighbours of the incident and inform them of need to stop air intake systems. Ensure that persons in neighbouring sites are kept upwind of the spill – this may require remaining indoors.
- Cover spill with foam to minimise vapourization
- Ensure that area is contained with spill equipment
- Contact Minchem Environmental services to help with cleanup operation.

SEE APPENDIX 1 FOR MODELLING REPORT INCLUDING DRAWINGS OF DISPERSION DISTANCES. Ref: Report on Modelling of Releases of Hydrochlorc Acid Dated 23rd November 2000

9.3 Loss of containment of solvent tanks in the tank farm

Exert from Executive summary to Report D 3873/12 Seveso Comah Directive Modelling – Modelling of Major Accident Hazard Scenarios.

No potential vapour cloud was predicted for the release of xylene or acetic acid in the tank farm. The release of ethyl acetate of IPA could result in a vapour cloud with potential offsite health effects depending on the weather conditions at the time of release. Occupational exposures limits could be reached at distances of over 4 km off site if a catastrophic rupture of the triethylamine (TEA) tank were to occur.

The furthest predicted drift of its flammable vapour cloud is 18m from the point of release.

A pool fire resulting from loss of containment of IPA or TEA in the bund could result in a 10.8kw/m2 radiation level at the neighbouring Helsinn Birex site. This is the 50% fatality risk heat level for an exposure time of 75seconds. IPA would produce the furthest such offsite heat effect (30m from the point if release of the solvent). IPA would also produce the furthest distance to the 37.5kw/m2 heat level (19m from the point of release. This heat level is sufficient to cause damage to process equipment.

Only release of IPA poses an explosion risk. The furthest predicted safe distance i.e. 95% probability of no damage beyond this point, is 20m downwind of the point of release of the IPA.

The Helsinn Emergency Response Plan to loss of containment in the tank farm is:

- Initiate the Evacuation procedure
- Take account of wind speed and direction
- Stop air intake into the building and close all doors and windows
- Ensure persons are kept upwind of the spill
- Alert neighbours of the incident and inform them of need to stop air intake systems. Ensure that persons in neighbouring sites are kept upwind of the spill – this may require remaining indoors.
- If possible cover spill with foam to minimise vapourization

Emergency alarm call out to a chemical spill *(Refer to SOP SDS/020 Chemical Spill Response)*

If specialised knowledge is required or the spill is so large that it is beyond the expertise of Helsinn Chemicals staff, **Indaver Ireland Ltd** should be contacted at **01 – 2804534.**

Outside office hours, calls to Indaver's main number are automatically forwarded to the answering service – pageboy. In the event of an emergency pageboy contact the names on the emergency contact list. The following information should be made available

- Exact location of the incident
- Contact number for person on site or at site of incident
- Name of chemical spilled, approximately quantity and location of spill inside or outside
- Material safety data sheet for substances
- How long since spill occurred
- Are there appropriate UN approved empty drums on site

9.4 Acid/Caustic mixing in the caustic bulk storage tank

Exert from Executive summary to Report D 3873/12 Seveso Comah Directive Modelling – Modelling of Major Accident Hazard Scenarios.

The worst credible case for acid/caustic mixing in the caustic bulk tank was decided on through discussions with Helsinn and Arup Menzies. The downwind distance reached by the resulting hydrochloric (HCL) vapour was modelled to various air quality parameters. The furthest predicted distance to ERPG3 i.e. the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing life threatening health effects is 128m.

The Helsinn Emergency Response Plan to loss of containment in the tank farm is:

- Initiate the Evacuation procedure
- Take account of wind speed and direction
- Stop air intake into the building and close all doors and windows
- Ensure persons are kept upwind of the spill
- Alert neighbours of the incident and inform them of need to stop air intake systems. Ensure that persons in neighbouring sites are kept upwind of the spill – this may require remaining indoors.

Emergency alarm call out to a chemical spill *(Refer to SOP SDS/020 Chemical Spill Response)*

If specialised knowledge is required or the spill is so large that it is beyond the expertise of Helsinn Chemicals staff, **Indaver Ireland Ltd** should be contacted at **01 – 2804534.**

Outside office hours, calls to Indaver's main number are automatically forwarded to the answering service – pageboy. In the event of an emergency pageboy contact the names on the emergency contact list. The following information should be made available

- Exact location of the incident
- Contact number for person on site or at site of incident

- Name of chemical spilled, approximately quantity and location of spill inside or outside
- Material safety data sheet for substances
- How long since spill occurred
- Are there appropriate UN approved empty drums on site

9.5 Synthesis plant pool fire and subsequent domino effects

Exert from Executive summary to Report D 3873/12 Seveso Comah Directive Modelling – Modelling of Major Accident Hazard Scenarios.

The worst case scenario for the loss of containment of solvent in the Synthesis plant is the loss of entire ethanol inventory. The 10.8kw/m2 radiation level resulting from the subsequent fire was predicted at up to 88m from the point of release. The furthest predicted distance to the 37.5kw/m2 heat level is 33m from the point of release of the ethanol inventory. However the model does not account for the protection offered by the walls of the building.

The following knock on effects of a pool fire in the Synthesis Plant were postulated and modelled:

- Vaporisation of MSC
- Thermal decomposition of MSC giving rise to HCL and sulphur dioxide (SO2) vapour
- Thermal decomposition of nitric spilled into the fire giving rise to nitrogen dioxide (NO2) vapour

The maximum predicted downwind distances to the ERPG3 concentrations are as follows:

MSC 25m (due to vaporisation of MSC)
HCL 10.2m (due to thermal decomposition of MSC)
SO2 55m due to thermal decomposition of MSC)
NO2 6.3m (due to thermal decomposition of 61-63% nitric acid)

SEE APPENDIX 1 FOR MODELLING REPORT INCLUDING DRAWINGS OF DISPERSION DISTANCES. Ref:D 3873/12 Seveso COMAH Directive Modelling – Modelling of Major Accident Hazard scenarios.

Emergency alarm call out to a chemical spill *(Refer to SOP SDS/020 Chemical Spill Response)*

If specialised knowledge is required or the spill is so large that it is beyond the expertise of Helsinn Chemicals staff, **Indaver Ireland Ltd** should be contacted at **01 – 2804534.**

Outside office hours, calls to Indaver's main number are automatically forwarded to the answering service – pageboy. In the event of an emergency pageboy contact the names on the emergency contact list. The following information should be made available

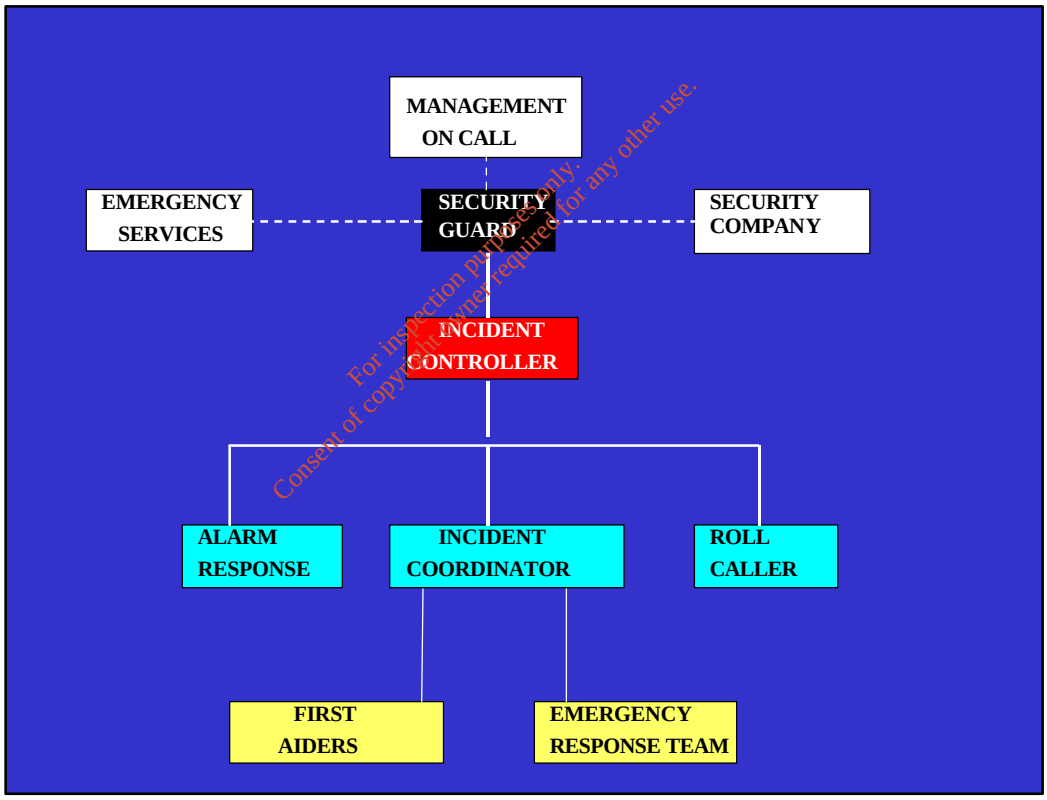
- Exact location of the incident
- Contact number for person on site or at site of incident
- Name of chemical spilled, approximately quantity and location of spill inside or outside
- Material safety data sheet for substances
- How long since spill occurred
- Are there appropriate UN approved empty drums on site

Section 10.0 Emergency Response Procedure – Outside normal working hours

RESPONSIBILITIES

Refer to SOP SDS/015 Evacuation and Incident Response Outside of Normal Working hours for additional detail on responsibilities

EMERGENCY RESPONSE – ORGANISATION STRUCTURE OUTSIDE NORMAL WORKING HOURS



Section 11.0 Training and Exercises

Introduction

Training requirements are identified for specific roles within the Emergency Plan. A training matrix (see next page) outlines specific training requirements.

Upon arrival on site visitors are given a short documents to read which outlines site rules and the location of the evacuation assembly point. Visitors must be accompanied by a Helsinn member of staff at all times.

Contractors undergo the Site Safety Induction.. Each day, upon arrival on site, a contractor must notify the person responsible for having them on site and obtain a permit to work. The permit outlines the rules that must be complied with when undertaking work on site and what to do in the event of an emergency.

Training Requirements

POSITION	Evacuation & Incident Response SOP SDS002/SDS015	Major Accident Hazards	B.A. Training	Fire And Spillage Response	Dealing with stakeholders*	Dealing with Regulatory authorities	Media Training
General Manager	Yes	Yes	No	Yes	Yes	Yes	Yes
Incident Controller	Yes	Yes	No	Yes	Yes	Yes	Yes
Incident Co-ordinator	Yes	Yes	Yes	Yes	No	Yes	No
Alarm Response	Yes	Yes	No	Yes	No	No	No
Roll Call	Yes	No	No	No	No	No	No
Incident Secretary	Yes	No	No	No	Yes	No	Yes
Incident Recorder	Yes	No	No	Yes	No	No	No
First Aid	Yes	No	No	Yes	No	No	No
Security	Yes	No	No	Yes	No	No	No
Emergency Response Team	Yes	Yes	Yes	Yes	No	No	No
Employees	Yes	No	No	Yes	No	No	No
Contractors	Yes	No	No	No	No	No	No
Visitors	Yes	No	No	No	No	No	No

* employees, relatives of employees, relatives of injured persons, hospitals, insurers, corporate, local politicians

Section 12.0 Audit Review and Maintenance of Plan

Responsibility:

The Materials Control, HSE Manager is responsible for ensuring that the Internal Emergency plan is reviewed for effectiveness.

When will plan be audited/reviewed

The Internal Emergency plan will be reviewed audited annually or in light of any incidents which were not dealt with effectively be the plan.

STANDARD OPERATIONAL PROCEDURE
SDS/002

	HELSINN CHEMICALS IRELAND LTD. STANDARD OPERATING PROCEDURE FOR EVACUATION AND INCIDENT RESPONSE	SOP No:HCI/SDS/002 Rev : 05 Superceded Rev: 04 Page: 1 of 10 Date Effective: 29/Sep/05

	Name	Title	Signature	Date
Prepared by	P. KIERANS	MATERIALS CONTROL HSE MANAGER	P. Kierans	05th July 05
Reviewed by	D. Keenan	Plant Director	D. Keenan	17th May 05
Approved by	N. Cunning	Quality Mgr.	N. Cunning	29/Sept/05

1. PURPOSE:

This procedure informs personnel on what to do in the event of an unplanned, unforeseen incident occurring at Helsinn Chemicals Ireland Ltd. An incident involves serious disruption to normal activities, which may require the assistance of the Emergency Services to be dealt with.

Prompt action by personnel can:

- Save a life.
- Relieve suffering.
- Minimise damage.
- Contain the incident.
- Return conditions to normal.

2. SCOPE:

This procedure defines actions and responsibilities in relation to the following aspects of emergency response.

a) Responsibilities.
b) Raising the alarm.
c) Evacuation of personnel and accounting for same.
d) Search and rescue.
e) Assessment of the incident and standing orders for incidents of
    1. Fire and Explosion
    2. Spillage.
    3. Release of Toxic Gas.
    4. Gas leak.
f) Involvement of emergency services.
g) Communications.
h) Standing down after an incident.

3. REFERENCES:

Evacuation Report Form HCI 054
Evacuation and Incident Response outside of Normal Working Hours SDS-015
Major Accident Prevention Policy.
SOP HCI/SDS/018 External Communication on Safety Matters.
SOP HCI/SDS/020 Chemical Spill Response.
Internal Emergency Plan.

APPROVED BY:	DATE: 21/Sept/05

4. PROCEDURE:

INTRODUCTION

The facility at Mulhuddart is equipped with a fire detection system, which is divided into main loops:

Loop 1: Synthesis Plant, Utilities Area, Administration Building, Drum Stores and Tank Farm
Loop 2: Administration and Phase II
Loop 3: Synthesis Plant – D1, Z3, Water Room, Pilot Plant.
Loop 4: Synthesis Plant – D1 (upstairs) R6, AHU 5.

Upon activation the on-site alarm bells ring and an alarm is indicated at the control station of the Security Company.

Fire or smoke are detected by:
(i) Ionised chamber/Smoke detectors
(ii) Rate of rise/Heat detectors

Each employee and visitor should familiarise himself/herself with the nearest emergency exit to the area in which they are located. Employees who bring a visitor on site are responsible for that visitor. A3 plans of the building are posted adjacent to all emergency exits. These plans show the primary and secondary evacuation routes and the position of all fire fighting equipment.

NOTE: The roller shutter door between the reactor production area and the adjoining warehouse closes automatically when the alarm is raised, similarly the roller shutter door to the loading area for D closes when the alarm is raised.

A) DEFINITION OF RESPONSIBILITIES

Title	Responsibility
Incident Controller	Most Senior member of Management on site.
Incident Co-Ordinator	Most Senior member of Production Process on site.
Alarm Response	Most senior member of maintenance on site.
Incident Recorder	Member of Materials Control.
Administration Duties	Member of Administration Department.
Roll Call	1st Manager Materials Control, HSE Manager 2nd QC Supervisor.
Monitor	1st Manager Materials Control, HSE Manager

APPROVED BY:	DATE: 22/Sept/05

INCIDENT CONTROLLER (IC)

The Incident Controller has overall responsibility for major decision making during on-site emergencies.

In particular, he shall ensure that

- all persons known to be on site are accounted for. This may involve authorising 'search and rescue' teams to re-enter the building if necessary.
- an accurate assessment is made of what activities were in progress at the time of the incident.
- the emergency services have been called for assistance if required, and that they are informed of all hazards known to be present in the incident area.
- personnel are sent to the all site access gates to prevent entry of people and to ensure quick access for Emergency Services.
- he shall maintain direct contact with the Incident Co-ordinator at all times using 'walkie-talkies'
- premises and residents living within a 500m radius are advised if there is a risk of the effects of the incident spreading outside site boundaries.
- the general public is kept informed of developments during the incident, and subsequent to any investigation.
- The Incident Controller is the only person who can authorise a 'stand down' and return to work.

INCIDENT CO-ORDINATOR

It is the duty of the appointed Co-Ordinator after being accounted for at Roll Call, to select and prepare an Emergency Response Team. The alarm response person will assess the situation and inform the Incident Controller of the response required e.g. fire, spillage. The Incident Controller will in turn inform the incident co-ordinator.
The Co-Ordinator will advise on the following:

If there is a fire he will (depending on the nature of the fire):

- Ensure the Emergency Response Team are gowned up appropriately
- Investigate and mitigate the fire (only if it is considered safe to do so.

If there is a spillage he will:

- Determine the substances and quantities, and inform the Incident Controller.
- Determine if any risk of loss of containment to ground or surface waters and inform the Incident Controller.
- Inform the Incident Controller if a back-up spillage crew is required.
- Inform the Incident Controller of any Emergency Services that may be required

When the incident has been dealt with and the Co-Ordinator feels there is no further danger he will advise the Incident Controller of the situation. The Incident Controller is the only person who can authorise a 'stand down' and return to work.

APPROVED BY:	DATE: 22/12/05

INCIDENT SECRETARY

This person must ensure the fireproof safes are locked. He/she must bring the fireproof safe keys, the security keys, a blank evacuation report form and the 'visitors sign in book' report to the assembly point. He/she is also responsible for switching the phone system to the Security Hut and manning the telephone in the Security Hut for the duration of the evacuation.

The Incident Secretary should remove the 'personnel on-site' report, check that the date and time are correct and give to the roll call person.
The Incident Secretary is responsible for taking calls from interested parties including the media.

ROLL CALL

He/she must account for all on-site personnel by calling out each employee/visitor/contractor who is on site. He/she is to then inform the IC if there are any missing personnel. This procedure must be done as fast as possible therefore co-operation from all personal is vital.

The Roll Caller may wish to move the assembled personel into a location which does not interfere with the Emergency Response team or organise assembled personnel into departments. This may aid the Incident Controller when calling on personnel with expertise in a particular area.

INCIDENT MONITOR (IM)

This person should monitor the incident response to ensure that safe work practices and good environmental practices are followed. In an effort to deal with a crisis, the above can sometimes be overlooked.

The personnel involved should be alerted to the hazards, and details should be given to the Incident Recorder and noted in the Evacuation Report Form.

ALARM RESPONSE

It will be the responsibility of the Alarm Response Team to check the fire alarm print out and determine the location of the incident. They will proceed to within a safe distance of were the fire alarm has been activated. They will proceed to within a safe distance of where the fire alarm has been activated. They will advise the Incident Controller of the situation and the response required. They will then return to the assembly point.
N.B. This will only be done after having been accounted for at the assembly roll call.

INCIDENT RECORDER

It will be the responsibility of the Incident Recorder:

- To record the sequence of events, decisions, actions taken and the associated times and persons involved on the Evacuation Report Form.

FIRST AID TEAM

Following evacuation the First Aid team should make themselves available to the Emergency Response Team. In particular they should:

- Get accounted for during roll call
- Obtain the First Aid kit from the Munster station
- Keep in contact with the Incident Controller to dermine nature of injuries of missing persons
- Assess the situation and bring relevant First Aid Equipment to the scene
- Move the injured party to a safe location
- Do not put yourself at risk
- Follow instructions on Incident Controller and/or Incident Co-ordinator

TRAINING

At regular intervals the Co-Ordinators will operate both planned drills and surprise drills. This will ensure that all employees are aware of the Emergency Evacuation Procedure.

B) RAISING THE ALARM

The HCI facility fire detection and alarm system may be activated automatically if any of the detectors throughout the building detect heat or smoke.

In addition should it be necessary, an employee may raise the alarm by shouting 'Fire' and breaking the glass in one of the Break Glass Units (BGU) located through out the premises.

When to Raise the Alarm

If an employee discovers a fire, a large spillage or a situation, which is sufficiently serious to evacuate the premises, even on a precautionary basis, he/she should activate the fire alarm by pressing one of the BGU.

APPROVED BY:	DATE: 22/Sept/05

C) EVACUATION

Upon hearing the alarm bell each employee and visitor must make their way to the nearest Emergency Exit, walking at all times and must meet at the Assembly Point at the front of the Security Hut. If at any time a person's primary route is blocked and/or hazardous, they should choose their secondary evacuation route without delay. Evacuation routes are shown on A3 drawings throughout the site.

Note: It is important to memorise the nearest fire/emergency exit. Do not stop to collect personal belongings. It is the responsibility of **ALL** personnel to ensure that Emergency Exits are kept clear and unlocked during working hours.

The following items should be brought from their normal storage areas to the assembly point.

	Responsibility
• Switch Phone over to Security Hut	Receptionist
• Security Keys	Administration Staff
• Fire Proof Safe Keys	Administration Staff
• 'On Site' report	Administration Staff
• Evacuation Report Form	Administration Staff

ACCOUNTING FOR PERSONNEL ON EVACUATION

In order to ensure that all staff are accounted for as quickly as possible the following should happen:

a) All personnel are to queue in front of the Roll Call until the names are checked off the 'Personnel on-site report'. When called they must acknowledge **loudly** and then move behind the Roll Call Secretary. The Roll Caller will then account for visitors and contractors on site. He/she advised the Incident Controller of any missing personnel. Even if the alarm stops sounding, all personnel must remain at the assembly point until they receive further instructions from the Incident Controller. When a 'stand down' announcement is made, the area of the emergency may be declared 'out of bounds' by the Incident Controller. All employees must follow his instructions.

D) PLANT SHUTDOWN BEFORE EVACUATION

If you are operating equipment at the time of the incident, try and ensure that it will not contribute to the incident by taking some of the following actions

- stop all additions/transfers
- exothermic reactions – stop addition and reset to initial set-point temperature
- Hot filtrations – leave in operation

APPROVED BY:	DATE: 22/Sept/05

Administration duties before evacuation

- Responsibilities for evacuation personnel.
- Shut fire safe cabinet.
- Bring the Security Keys and Fire Safe Keys to assembly point.
- Visitors book.
- Switch phone over.

Laboratory duties before evacuation:

- Close any bottles of flammable chemicals in use and ensure waste container is closed.
- Close doors and windows.
- Close fume hood shutters.

E) SEARCH AND RESCUE

Search and rescue should only be undertaken if it is generally considered safe to do so based on knowledge of the incident. It should only take place after the Incident Controller has being made aware of the status of the incident by the Alarm Response Person.
Search and rescue should be carried out by a minimum of two people, wearing appropriate Personal Protective Equipment, and backed up by additional personnel ready to go in and support in the event of difficulties. They should be in contact with the Incident Controller at all times using walkie-talkies.

F) ASSESSMENT OF THE INCIDENT AND STANDING ORDERS

It is essential to determine the nature of the incident as quickly as possible using the following questions as a guide.

- Did the incident involve
  - fire and/or explosion,
  - spillage (volume, chemical),
  - gas leak (identity),
  - other (specify)?
- Note the time and precise location of the incident.
- Who should have been working in the area and are they accounted for? What is the nature of injuries received if any?
- What consequential hazards exist arising from the incident?
- Are personnel in a safe location based on wind direction?
- What other hazards are present in the vicinity of the initial incident? Is there potential for escalation?
- Can monitoring be done to measure air contamination?

Complete the **Evacuation Report Form HCI 054.**

G) STANDING ORDERS

General

1. Sound the fire/emergency alarm at once by breaking the glass on the nearest red coloured break glass unit. Evacuate the area and go to the assembly area. (ALL)
2. Account for all personnel on site. (ROLL CALL)
3. Seal off the area to ensure that people do not accidentally walk into danger. Send personnel to both access gates to prevent entry. (INCIDENT CONTROLLER)
4. Look for injuries on oneself and those working in the area of the incident. (ALL)
5. Identify clearly the hazard(s) present and form a plan. (IC,CO-ORDINATOR & OTHERS)

Fire

Upon discovering a fire:

1. Stop transfer of all flammable materials.
2. Attack seat of fire with suitable fire extinguisher. Always make sure you have an air supply and exit.
1. Do not continue to fight the fire:

    a) if it is dangerous to do so.
    b) if there is a possibility that your escape route might be cut off by fire and smoke.
    c) if the fire continues to grow despite your efforts.
    d) if there are gas cylinders or explosives in the vicinity of the fire.
4. If you have to leave, close all doors and windows behind you if possible.

Major Spillage

1. Activate Alarm.
2. Shut surface water line to Tolka River.
3. Suit up.
   Wear appropriate personal protective clothing to deal with the spill. Double-check its effectiveness.
4. Obtain correct materials.
   It is important that correct materials are used as absorbents. Check MSDS sheets.
5. Contain the spill.
   Using appropriate equipment contain the spill and if possible soak up spill and dispose in a suitable container.
6. Container.
   Seal container and label contents correctly.
7. Wash down.
   Before taking off protective suit, wash off any contaminated areas with copious amounts of water.

Explosions

1. Try to identify the cause of the explosion.
2. Based on the information you have concerning the explosion, form a plan, with the primary objectives being the safety of personnel, protection of property and the environment.

Release of Toxic Gas

1. Hit break glass unit and evacuate building
2. Inform incident controller that toxic gas release has occurred
3. Incident controller will make necessary decisions in relation to on site and off site safety

Gas Leak

1. Unless there is a good reason for intervening, it is generally better to vent off the gas to atmosphere.
2. Isolate supply at main valve, which is located in front of the Helsinn Birex entrance.

H) EMERGENCY SERVICES

Upon initial assessment of an incident it must be decided quickly if it is necessary to involve the Emergency Services.

If in doubt, based on common sense, then it is better to request assistance.

Once the fire brigade arrives, the lead officer takes charge of the incident and has full authority on site.

The company personnel must assist by providing information as required and assistance in dealing with the incident if requested to do so.

The MSDS and Internal Emergency Plan should be provided to the chief fire officer in charge. These should be kept up to date and in good order at all times

I) COMMUNICATIONS

The need for clear communication is essential in dealing with any crisis situation, especially where the media are involved.

News Media

The only person authorised to make statements to the news media on any item concerning HCI is the General Manager. In the absence of the GM, any enquirer must be informed of the above in a courteous manner and told a statement will be made at an appropriate time.

APPROVED BY:	DATE: 22/Sept/05

J) STANDING DOWN AFTER AN INCIDENT

The decision to stand down rests with the Incident Controller or Fire Officer in charge.

Upon standing down, it is important to resume normal activities as soon as it is safe to do so, and the causes of the incident have been fully investigated, reported on to management and the relevant external agencies, and actioned as necessary.

In the immediate aftermath of an incident,

- workgroups will be organised to inspect the premises to assess damage. Identify, in particular, control/containment system, in a weakened state, requiring urgent attention.
- with the agreement of insurers, HSA, EPA and other interested parties, clean up of the areas affected will commence as soon as possible. Waste materials will be disposed of properly according to the hazard presented.
- all equipment, pipework, electrical installations and instrumentation should be thoroughly inspected and tested prior to restarting.
- assess the impact, if any, on the local environment (air, soil, water).
- perform any remedial work, or reconstruction necessary.
- resume normal activities.
- prepare a communication plan to inform the public on subsequent investigations and follow up actions.

5. HISTORY:

Revision No:	Date:	Purpose of Revision:
03	12/03/2004	CCR-04-044 Inclusion of reference to SDS020 Chemical Spill response.
04	23/08/2004	CCR-04-095 To include sections on roll call and first aid team.
05	05/07/05	CCR-05-071 Remove reference to emergency folder

Copy to be distributed to (please tick):

HCI									
Production Office	Production Plant	Plant Manager	QC	Engineering	Warehouse	Process Development	IT	HSE	Finance/ Administration
✓			✓	✓	✓	✓	✓	✓	✓

MODELLING OF MAJOR ACCIDENT HAZARD SCENARIOS REPORT

Arup Menzies

Helsinn Chemicals Ireland Ltd

Seveso/COMAH Directive Modelling

Modelling of Major Accident Hazard Scenarios

Job title	Seveso/COMAH Directive Modelling		Job number D 3873/12
Document title	Modelling of Major Accident Hazard Scenarios		File reference
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Revision	Date				
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		Name	Colm Leahy	Don Menzies	Niamh O'Sullivan
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		Name	Colm Leahy	Don Menzies	Niamh O'Sullivan
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		Name	Colm Leahy	Don Menzies	Niamh O'Sullivan
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		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			

Issue Document Verification with Document ☑

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Toxicity Parameters for Gases and Vapours

EXECUTIVE SUMMARY

Three major accident hazard scenarios were modelled for the Mulhuddart plant:

- loss of containment of solvent tank in the tank farm
- acid/caustic mixing in the caustic bulk storage tank
- Synthesis Plant pool fire and subsequent domino effects

No potential vapour cloud was predicted for the release of xylene or acetic acid in the tank farm. The release of ethyl acetate or IPA could result in a vapour cloud with potential offsite health effects depending on the weather conditions at the time of release. Occupational exposures limits could be reached at distances of over 4 km offsite if a catastrophic rupture of the triethylamine (TEA) tank were to occur.

The furthest downwind drift of a flammable vapour cloud resulting from a solvent spill would occur for TEA. The furthest predicted drift of its flammable vapour cloud is 18 m from the point of release.

A pool fire resulting from loss of containment of IPA or TEA in the bund could result in a 10.8 kW/m² radiation level at the neighbouring Helsinn Birex site. This is the 50% fatality risk heat level for an exposure time of 75 sec. IPA would produce the furthest such offsite heat effect (30 m from the point of release of the solvent). IPA would also produce the furthest distance to the 37.5 kW/m² heat level (19 m from the point of release). This heat level is sufficient to cause damage to process equipment.

Only release of IPA poses an explosion risk. The furthest predicted 'safe distance' i.e. 95% probability of no damage beyond this point, is 20 m downwind of the point of release of the IPA.

The worst credible case for acid/caustic mixing in the caustic bulk tank was decided on through discussions with Helsinn staff. The downwind distance reached by the resulting hydrochloric acid (HCl) vapour was modelled to various air quality parameters. The furthest predicted distance to ERPG3 i.e. the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects is 128 m.

The worst-case scenario for the loss of containment of solvent in the Synthesis Plant is the loss of the entire ethanol inventory. The 10.8 kW/m² radiation level resulting from the subsequent fire was predicted at up to 88 m from the point of release. The furthest predicted distance to the 37.5 kW/m² heat level is 33 m from the point of release of the ethanol inventory. However, the model does not account for the protection offered by the walls of the building.

The following knock-on effects of a pool fire in the Synthesis Plant were postulated and modelled:

- Vaporistaion of MSC
- Thermal decomposition of MSC giving rise to HCl and sulphur dioxide (SO_2) vapour
- Thermal decomposition of nitric acid spilled into the fire giving rise to nitrogen dioxide (NO_2) vapour

The maximum predicted downwind distances to the ERPG3 concentrations are as follows:

MSC 25m (due to vaporisation of MSC)

HCl 1.2m (due to thermal decomposition of MSC)

SO_2 55m (due to thermal decomposition of MSC)

NO_2 6.3m (due to thermal decomposition of 61-63% nitric acid)

1. INTRODUCTION

The quantities of flammable and toxic materials stored at the Helsinn Chemicals Limited site at Damastown, Mulhuddart, Dublin 15 are such as bring the facility under the requirements of the European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations, 2000 (SI No 476 of 2000).

Article 9(2)(a) of SI No 476 of 2000 requires the operator of a facility that is subject to the Regulations to identify all major accident hazards in the establishment. The operator is also obliged to assess the extent and severity of the consequences of such accidents.

Modelling was carried out of the heat, explosion and vapour cloud effects resulting from the loss of containment of acetic acid, ethyl acetate, xylene, isopropanol (IPA), triethylamine (TEA) in the tank farm and acetone, ethyl acetate, IPA, xylene, ethanol, methane sulphonyl chloride (MSC) and nitric acid in the Synthesis Plant. The effect of a release of hydrochloric acid (HCl) vapour following the inadvertent charging of 32% HCl to the caustic bulk storage tank was also modelled.

2. MAJOR-ACCIDENT SCENARIOS

The following major-accident scenarios were modelled:

- Tank Farm Loss of Containment
- Acid/Caustic Mixing in Storage Tank
- Synthesis Plant:
  - Pool Fire following solvent spill
  - MSC:
    - Vaporisation, or
    - Thermal decomposition
  - NO_X emissions from:
    - Nitration reaction, or
    - Spill of nitric acid into solvent fire

2.1 Tank Farm Loss of Containment

The scenario is loss of containment to the bund of the contents of a solvent tank. The following are the possible outcomes:

Cause	Result
Immediate ignition	Bund fire
Prolonged fire	Tank roof collapse
Slightly delayed ignition	Vapour cloud explosion (“early explosion”)
Delayed ignition or ignition some distance from tank farm	Vapour cloud explosion (“late explosion”)
No ignition	Vapour cloud dispersion
Overheating of adjacent tank	Vapour emission from vent

Modelling was carried out for each solvent stored (acetic acid, xylene, IPA, ethyl acetate, TEA) within the bund.

Solvent fires can emit plumes of gases, including unburned solvent, combustion gases and products of incomplete combustion.

No sprinkler protection is provided for the tank farm. In the event of a fire in a bund, other tanks would become heated, and vapours would be released from the vents. If these vapours do not ignite, they may be dispersed.

The materials were modelled at the following quantities:

Material	Quantity (Litres)	Density	Mass (kg)
Acetic acid	25,000	1.049	26,225
Ethyl acetate	20,000	0.8946	17,892
Xylene	25,000	0.864	21,600
IPA	25,000	0.7854	19,635
TEA	25,000	0.7255	18,138

2.2 Acid/Caustic Mixing in Storage Tank

This scenario envisages inadvertent discharge of HCl acid or caustic soda from a road tanker into the wrong bulk storage tank. The worst-case scenario was decided upon in consultation with Helsinn as follows: 32% HCl is mistakenly charged from the road tanker to the caustic soda bulk storage tank. The heat of neutralisation causes the temperature of the mixture to rise. As the temperature reaches the boiling point of the acid, steam is emitted from the tank. It is assumed that in the worst-case scenario acid continues to be pumped to the storage tank for a further 10 minutes after its boiling point has been reached. Based on the pump rate, this would result in 2,500 L of 32% HCl being added to the hot mixture. The maximum quantity of HCl vapour which could be released in this scenario is the mass of acid contained in 2,500 litres of 32% HCl solution i.e. 928 kg.

2.3 Synthesis Plant

The scenario is loss of containment of a vessel full of flammable solvent, followed by ignition.

Domino effects are assumed as follows:

- Loss of containment of 610 kg MSC into fire or fire engulfing tank containing MSC, which would then:
  - evaporate, or
  - decompose thermally to give sulphur dioxide and hydrogen chloride gas
- Loss of containment of 600 kg 61-63% nitric acid into fire or fire engulfing tank containing nitric acid, which would then decompose thermally to give nitrogen dioxide.

The materials were modelled at the following quantities:

Material	Quantity (Litres)	Density	Mass (kg)
Acetone	2,000	0.7972	1,594
Ethyl acetate	18,000	0.8946	16,100
IPA	5,000	0.7854	3,927
Xylene	5,000	0.864	4,320
Ethanol	6,000	0.7893	4,736
MSC	-	-	610*
61-63% Nitric acid	-	-	600*

* quantities provided by Helsinn

3. MODEL

For consequence modelling, the model used was the DNV Technica package ***PHAST Professional V6.42***. Modelling was carried out for three meteorological conditions representative of the climate in Ireland:

Atmospheric Stability Category	Wind Speed (m/s)
D	0.5
D	5
F	0.5

3.1 Fires

For fires, the model was used to predict the distances to specified thermal radiation levels as follows:

HSA Thermal Radiation Benchmarks for Land Use Planning

Fatality Risk (%)	TDU[1]	Equivalent Thermal Radiation (kW/m²)[2]
50	1,800	10.8
1	1,000	7.0
0	500	4.1

[1] TDU = Thermal dose unit = Thermal Radiation $(kW/m^2)^{4/3}$ Exposure time t (sec)

[2] For t = 75 sec

Effects of Radiation (World Bank)

Radiation Level (kW/m²)	Observed Effect
37.5	Sufficient to cause damage to process equipment.
12.5	Minimum energy required for piloted ignition of wood, melting of plastic tubing.
4	Sufficient to cause pain to personnel if unable to reach cover within 20s; however blistering of the skin (second degree burns) is likely, 0% lethality.

Diagrams were prepared showing radiation level contours.

3.2 Explosions

For vapour cloud explosions (VCEs) explosions, the model was used to predict the distances to specified overpressures as follows:

Effects of Explosions (World Bank)

Overpressure (barG)	Effect
0.0207	"Safe distance" (probability 0.95 no serious damage beyond this value); projectile limit; some damage to house ceilings; 10% window glass broken
0.14	Partial collapse of walls and roofs of houses
0.21	Heavy machines (3,000 lb) in industrial building suffered little damage; steel frame building distorted and pulled away from foundations

Diagrams were prepared showing overpressure contours downwind of the point of release of the flammable material.

3.3 Catastrophic Release Method

Vapour cloud explosions were modelled using the catastrophic release method. This scenario is designed to model an incident in which the vessel is destroyed by an impact, a crack, or some other failure, which propagates very quickly. The release is assumed to form a homogeneous mass, expanding rapidly with no restrictions from the shattered vessel. If the release is on the ground it will form a hemispherical cloud, and if it is elevated it will form a spherical cloud.

3.3.1 Vapour Cloud Release

3.3.1.1 End Points

The dispersion of vapours was modelled to determine distances to the following air quality parameters:

- Emergency Response Planning Guideline (ERPG) values (published by the American Industrial Hygiene Association)
- OEL-STEL (Occupational Exposure Limit – Short Term Exposure Limit) values published by the HSA
- IDLH (Immediately Dangerous to Life and Health) values published by the American NIOSH

Refer to Appendix A1 and B1 for definitions and values.

4. MODELLING RESULTS SUMMARY TABLES

4.1 Tank Farm Loss of Containment

4.1.1 Dispersion of Vapour Cloud

Table 1 summarises the modelling results for the catastrophic release of xylene, IPA, acetic acid, ethyl acetate or TEA. The worst-case results for each scenario (i.e. the weather conditions which produced the furthest distance to the concentration of interest) are presented.

The distances to IDLH concentrations are shown in Figures 1 – 5. Figures show fine and bold lines. The bold lines indicate the 'shape zone' i.e. the total area subjected to the concentration of interest at the maximum downwind distance of the vapour cloud. Further downwind the vapour cloud would be less concentrated than the OEL-STEL/IDLH. The default wind direction is southerly for all figures. The fine lines indicate the extent of the 'effect zone'. This zone represents all possible areas that could be swept by the shape zone depending on wind direction.

Table 1 Distance to Specified Concentrations

Material	Distance (m)		
	IDLH	OEL -TWA	OEL -STEL
Xylene	3.6	7.9	7.3
IPA	87	31	30
Acetic Acid	16	23	25
Ethyl Actate	23	66	-*
TEA	131	5033	3095

4.1.2 Ignition of Flammable Vapour Cloud

Table 2 summarises the distances to dispersion to the lower flammable limits (LFL) for the catastrophic rupture of the entire contents xylene, IPA, acetic acid, ethyl acetate or TEA. The LFL is the lowest concentration of flammable vapour which will burn if the cloud encounters a source of ignition. Concentrations below the LFL cannot, however, be considered completely safe from ignition. Therefore, the distances to 50% of the LFL were modelled. The results for the worst-case weather conditions are shown i.e. the weather conditions that produced the furthest distances to the LFL.

Table 2 Distances to LFL and 50% LFL

Material	Concentration (ppm)	Effect	Distance (m)
Xylene	5,500	50%LFL	2.2
	11,000	100%LFL	2.2
IPA	10,000	50%LFL	15
	20,000	100%LFL	11
Acetic Acid	27,000	50%LFL	3.5
	54,000	100%LFL	3.5
Ethyl Actate	11,000	50%LFL	9.5
	22,000	100%LFL	4.9
TEA	6,000	50%LFL	18
	12,000	100%LFL	9.6

4.1.3 Fire

Tables 3 and 4 summarises the modelling results for the catastrophic release of an entire tank of xylene, IPA, acetic acid, ethyl acetate or TEA and ignition of the spilled material in the bund. The worst-case results for each scenario (i.e. the weather conditions which produced the furthest distance to the radiation level of interest) are presented.

The 'effect zones' for these incidents are shown in Figures 6 – 10.

Table 3 Distances to HSA-specified incident radiation levels (kW/m^2)

Material	Distance (m)		
	Radiation 4.1 kW/m^2	Radiation 7 kW/m^2	Radiation 10.8 kW/m^2
Xylene	24	19	11
IPA	43	35	30
Acetic Acid	17	14	12
Ethyl Actate	23	19	17
TEA	36	30	25

Table 4 Distances to default model incident radiation levels (kW/m²)

Material	Distance (m)		
	Radiation 4 kW/m²	Radiation 12.5 kW/m²	Radiation 37.5 kW/m²
Xylene	24	9	Not reached
IPA	44	29	19
Acetic Acid	17	11	Not reached
Ethyl Actate	24	16	5.4
TEA	37	23	6.8

4.1.4 Explosion

Table 5 below summarises the explosion modelling results for the catastrophic release of an entire tank of xylene, IPA, acetic acid, ethyl acetate or TEA.

An explosion occurs when ignition of the flammable gas leads to rapid propagation of a flame with an accompanying pressure wave. Early and late explosions were modelled. An early explosion is one which occurs before the vapour cloud resulting from the spill has dispersed. A late explosion occurs after the vapour cloud has migrated downwind and has encountered an ignition source (for definitions for early and late explosion refer to Appendix A2). No early explosion hazard was predicted any of the materials. Only IPA produced a late explosion hazard.

The worst-case results (i.e. the weather condition which produced the furthest distance to the overpressure of interest) are presented in Table 5. The ‘shape’ and ‘effect’ zones are shown in Figure 11.

Table 5 Distances to Overpressures (barG)

Material	Distance (m)		
	Overpressure 0.0207 barG	Overpressure 0.14 barG	Overpressure 0.21 barG
Xylene	No hazard	No hazard	No hazard
IPA	20	13	12
Acetic Acid	No hazard	No hazard	No hazard
Ethyl Actate	No hazard	No hazard	No hazard
TEA	No hazard	No hazard	No hazard

4.2 Acid/Caustic Mixing in Storage Tank

Table 6 summarises the results for the release of 928 kg of HCl acid vapour at 120°C from the caustic soda bulk storage tank. The distances reported are for the worst-case weather conditions i.e. the weather conditions that resulted in the maximum downwind distances for the parameters modelled. Distance to the concentrations of interest are presented in Figures 12 – 15.

Table 6 HCI Vapour Release Results

Concentration Parameter	Concentration (ppm)	Averaging time (sec)	Distance (m) to maximum downwind effect distance
ERPG 3	150	3600	128
ERPG 2	20	3600	547
ERPG 1	3	3600	2688
IDLH	50	1800	357
OEL-TWA	5	3600	1836
OEL-STEL	10	900	1324

4.3 Synthesis Plant Pool Fire

4.3.1 Incident Radiation Levels

The distances to the HSA-specified heat levels are summarised in Table 7 and 8. The results for the weather conditions that produced the worst results i.e. the furthest distances from the fire at which the radiation levels would be experienced are presented. The 'late pool fire' radiation ellipse results are presented. For a late pool fire the program takes the state of the evaporating pool at the time when it reaches its largest diameter, calculates the size, shape and intensity of the flame, and then calculates the size of the contours to the radiation levels of interest. The radiation level contours for the release and ignition of 6,000L of ethanol in the Synthesis Plant are shown in Figure 16.

It is important to note that the model does not take into account the fact that the walls of the building would act as a barrier to the heat effects of the fire. Therefore, the results presented below are very conservative.

Table 7 Distances to the HSA specified incident radiation levels for quasi-instantaneous release of entire volume of solvent in the Synthesis Plant – Late Pool Fire Ellipse

Material	Distance (m)		
	Radiation 4.1 kW/m^2	**Radiation 7 kW/m^2**	**Radiation 10.8 kW/m^2**
Acetone	38	32	27
Ethyl acetate	63	52	45
IPA	63	52	44
Xylene	28	21	12
Ethanol	74	60	51

Table 8 Distances to the default model incident radiation levels for quasi-instantaneous release of entire volume of solvent in the Synthesis Plant- Late Pool Fire Ellipse

Material	Distance (m)		
	Radiation 4 kW/m^2	Radiation 12.5 kW/m^2	Radiation 37.5 kW/m^2
Acetone	39	26	17
Ethyl acetate	64	42	18
IPA	64	42	29
Xylene	28	10	Not reached
Ethanol	75	49	33

4.3.2 Synthesis Plant Pool Fire Domino Effects

The possible domino effect scenarios are detailed in section 2.3. The modelling results are presented in Tables 9 – 12 below. In all scenarios the worst-case results for each scenario (i.e. the weather conditions which produced the furthest distance to concentration of interest) are presented.

4.3.2.1 MSC Spill to Pool Fire

The dispersion of the resulting MSC vapour cloud was modelled. The distances to OEL-STEL are presented in Figure 17. The distance to other specified concentrations are summarised in Table 9.

Table 9 Vaporisation of MSC: distances to specified concentrations for MSC

Concentration Parameter	Concentration (ppm)	Averaging time (sec)	Distance (m) to maximum downwind effect distance
ERPG 3	25	3600	21
ERPG 2	1	3600	1499
ERPG 1	0.1	3600	9145
IDLH	400	1800	0.7
OEL-TWA	0.1	3600	9145
OEL-STEL	0.1	900	11240

The dispersion of the HCl vapour cloud resulting from the thermal decomposition of MSC was modelled. The distances to OEL-STEL for all weather conditions are presented in Figure 18. The distance to other specified concentration are summarised in Table 10.

Table 10 Thermal Decomposition of MSC and HCl dispersion: distances to specified concentrations for HCl

Concentration Parameter	Concentration (ppm)	Averaging time (sec)	Distance (m) to maximum downwind effect distance
ERPG 3	25	3600	1.2
ERPG 2	10	3600	108
ERPG 1	1	3600	833
IDLH	50	1800	1.0
OEL-TWA	5	3600	249
OEL-STEL	10	900	158

The dispersion of the SO_2 vapour cloud resulting from the thermal decomposition of MSC was modelled. The distances to OEL-STEL for all weather conditions are presented in Figure 19. The distance to other specified concentration are presented in Table 11.

Table 11 Thermal Decomposition of MSC and SO_2 dispersion: distances to specified concentrations for SO_2

Concentration Parameter	Concentration (ppm)	Averaging time (sec)	Distance (m) to maximum downwind effect distance
ERPG 3	15	3600	55
ERPG 2	3	3600	449
ERPG 1	0.3	3600	3238
IDLH	100	1800	0.8
OEL-TWA	2	3600	625
OEL-STEL	5	900	351

4.3.2.2 Nitric Acid Spill to Pool Fire

A further possible domino effect of a fire in the Synthesis Plant is the rupture of 610 kg of nitric acid to the pool fire. The dispersion of the NO_2 vapour cloud resulting from the thermal decomposition of the nitric acid was modelled. The distances to OEL-STEL and IDLH are presented in Figures 20 and 21 respectively. The distances to other specified concentrations are summarised in Table 12.

Table 12 Thermal Decomposition of Nitric Acid and NO_2 dispersion: distances to specified concentrations for NO_2

Concentration Parameter	Concentration (ppm)	Averaging time (sec)	Distance (m) to maximum downwind effect distance
ERPG 3	30	3600	6.3
ERPG 2	15	3600	56
ERPG 1	1	3600	991
IDLH	20	1800	47
OEL-TWA	3	3600	450
OEL-STEL	5	900	377

FIGURES

Tank Farm Incidents

Figure 1 IPA Catastrophic Rupture 25,000 L in tank farm

Distance to IDLH for weather conditions 1.5/D

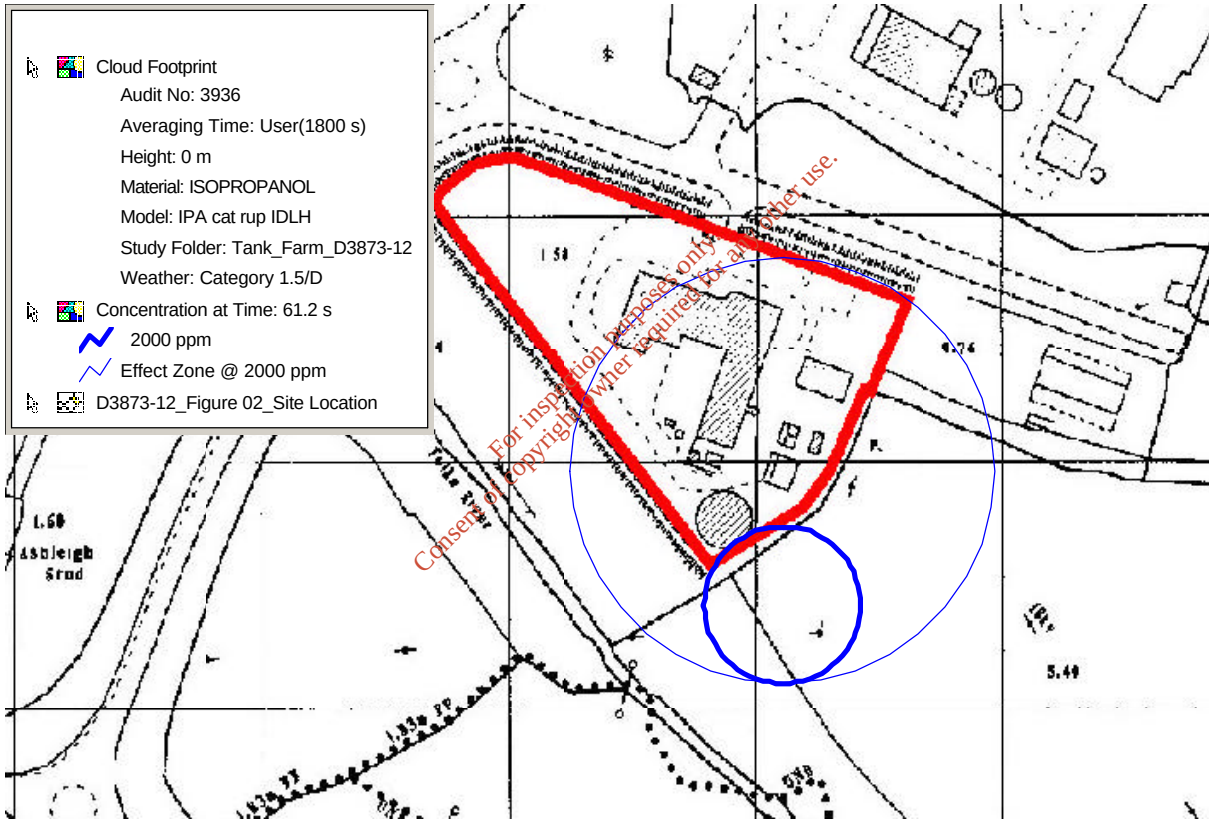

Figure 2 Acetic acid Catastrophic Rupture 25,000 L in tank farm

Distance to IDLH for weather conditions 1.5/F

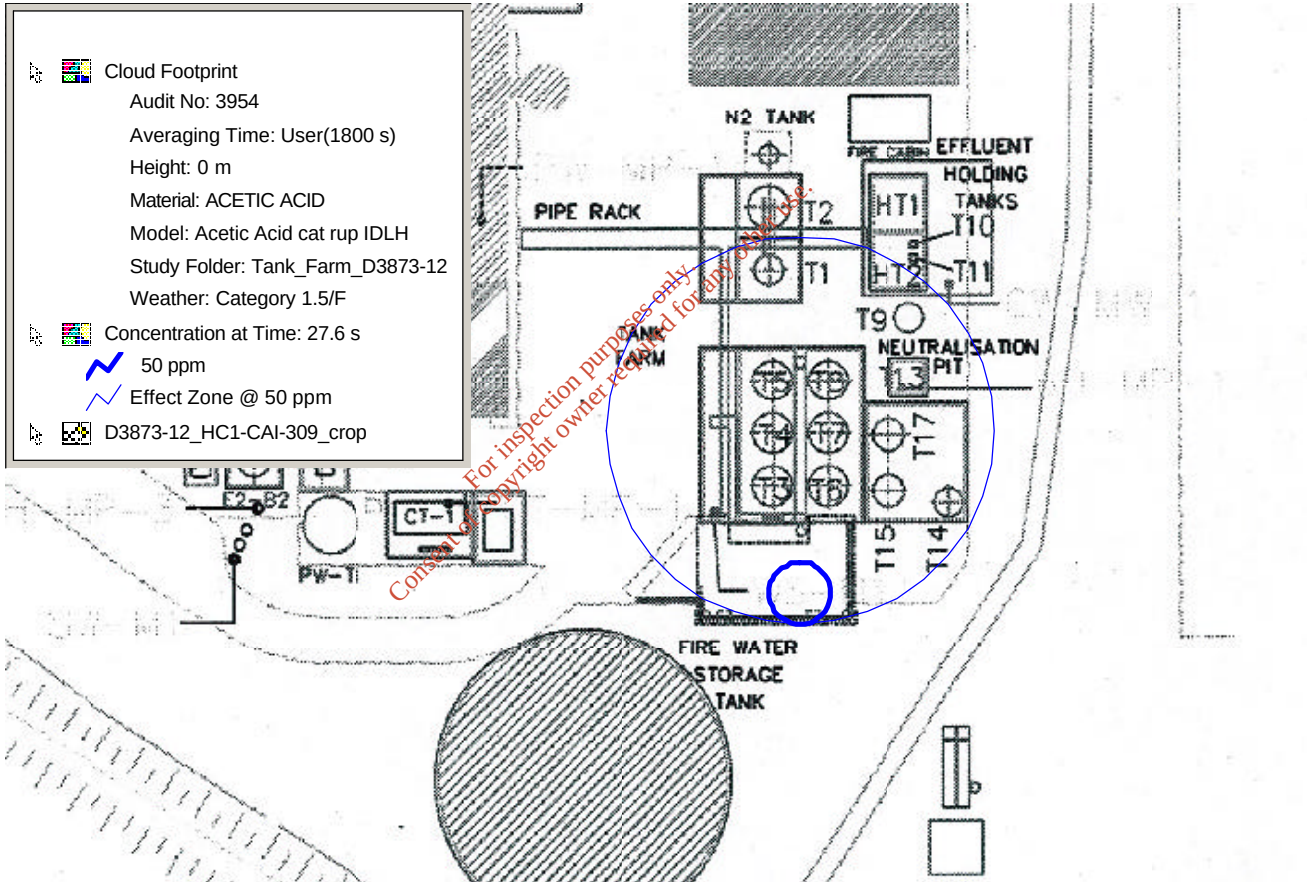

Figure 3 Xylene Catastrophic Rupture 25,000 L in tank farm

Distance to IDLH for weather conditions 5/D

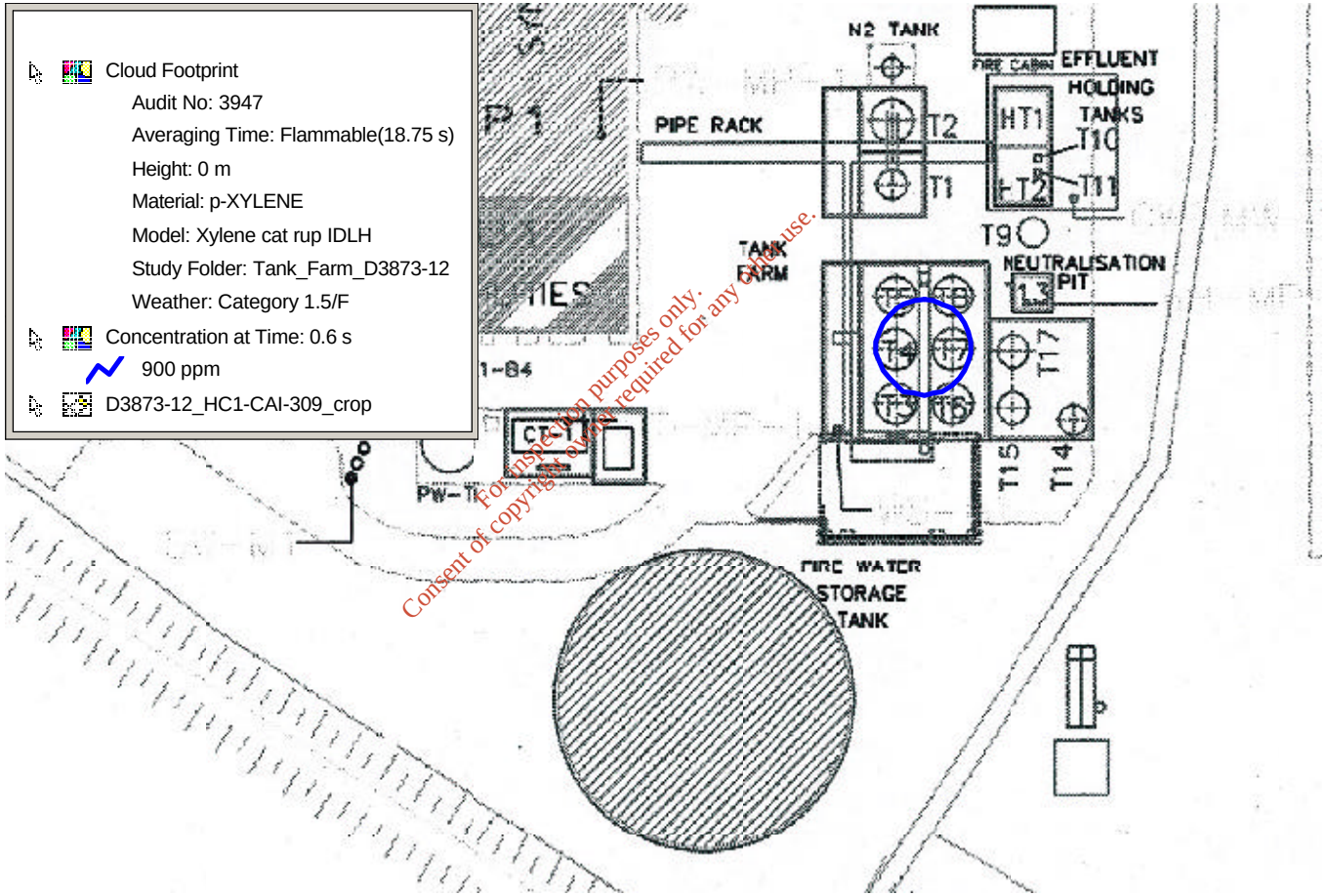

Figure 4 **Ethyl Acetate Catastrophic Rupture 20,000 L in tank farm**

Distances to IDLH for all weather conditions modelled

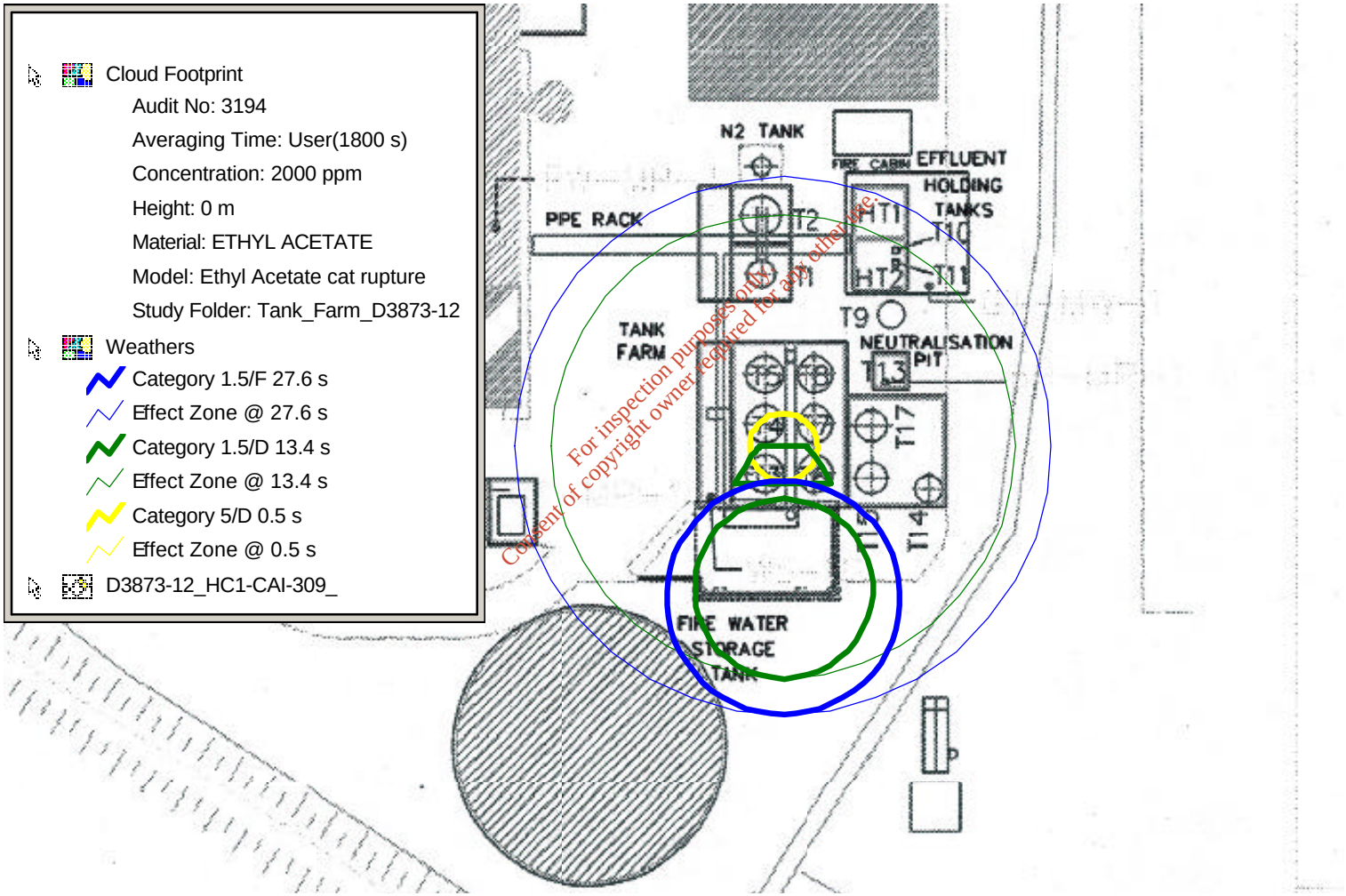

Figure 5 **TEA Catastrophic Rupture 25,000 L in tank farm**

Distance to IDLH for weather conditions 1.5/F

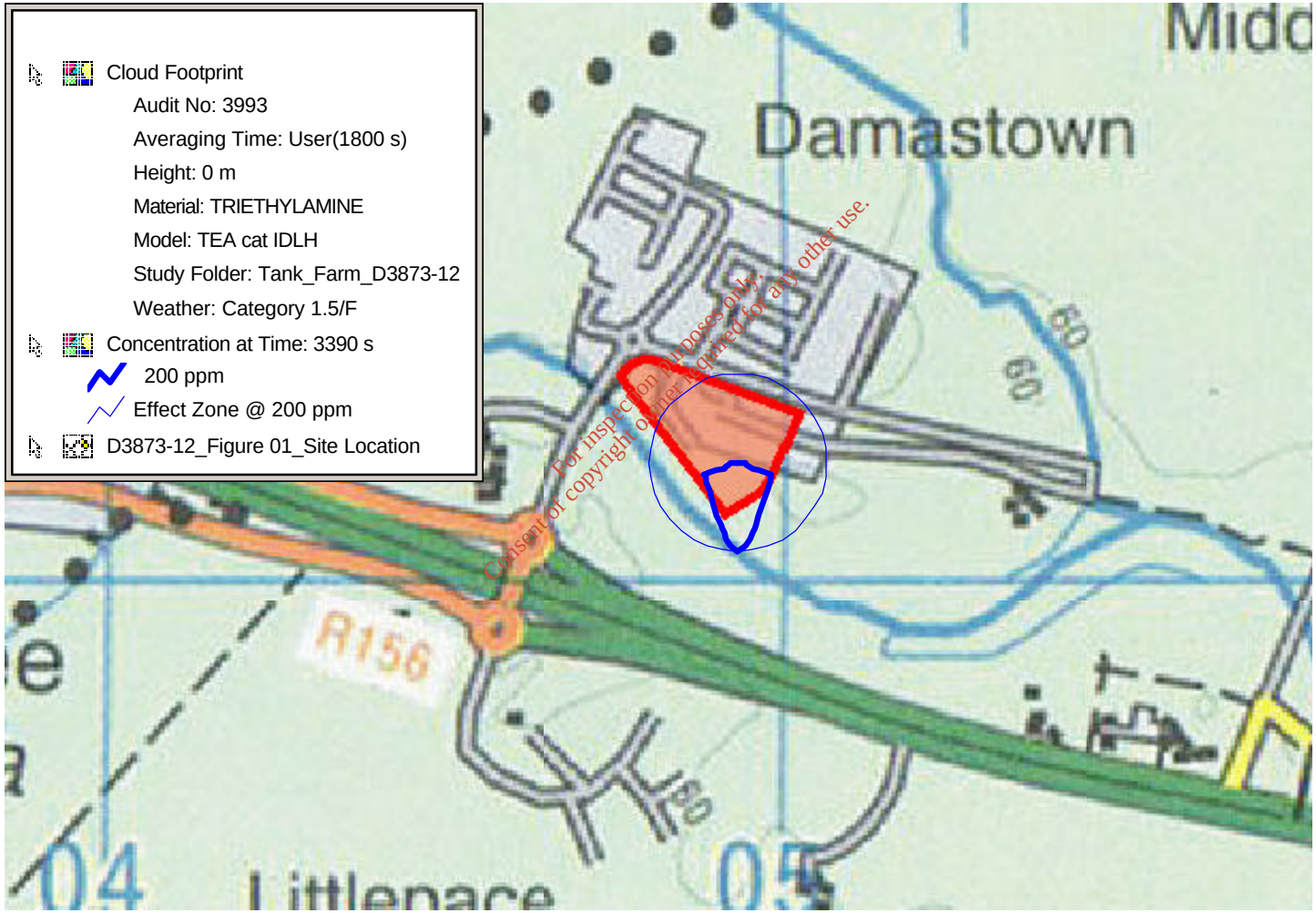

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Figure 6 IPA Catastrophic Rupture 25,000 L in tank farm

Distance to incident radiation levels for weather conditions 5/D

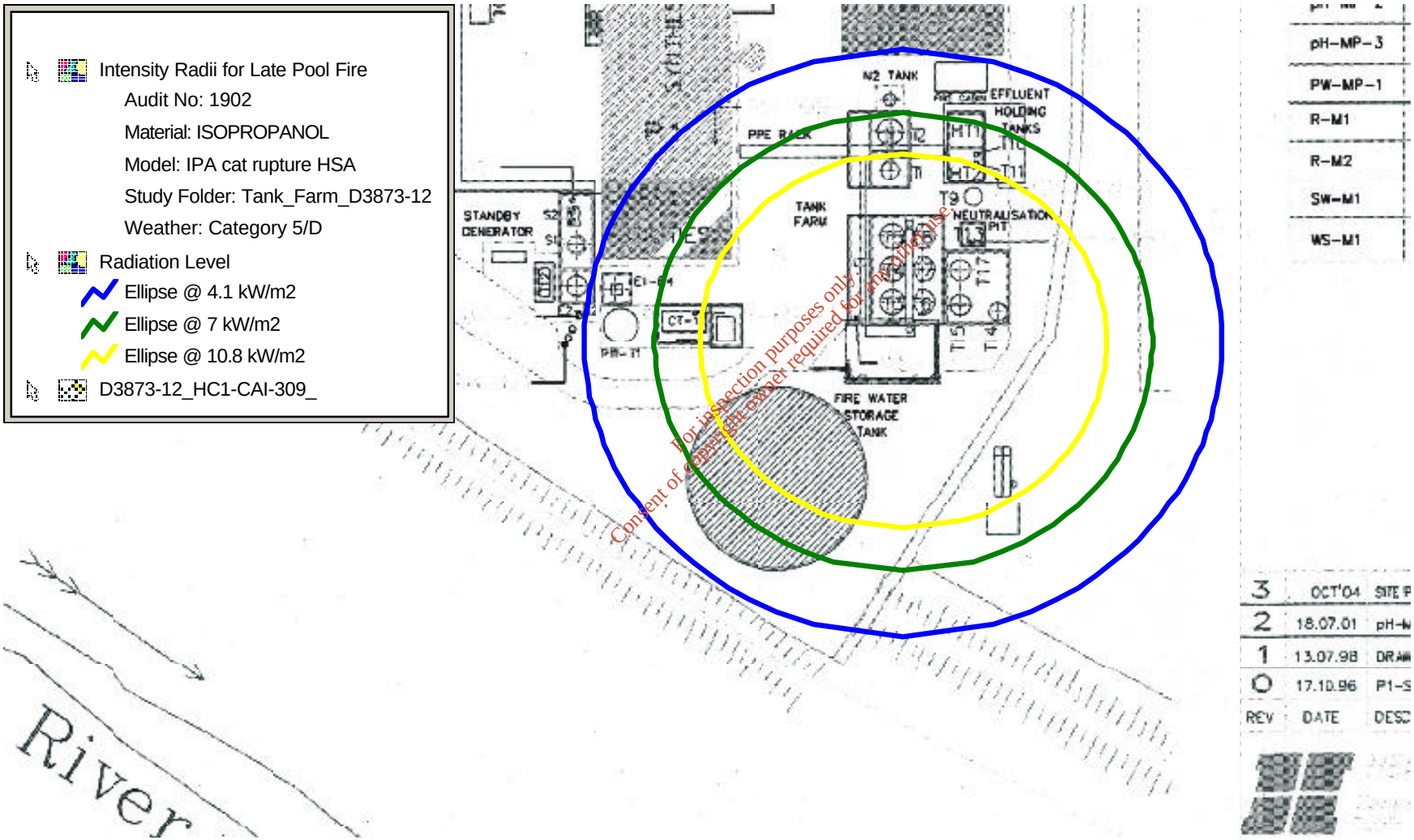


Figure 7 Acetic acid Catastrophic Rupture 25,000 L in tank farm

Distances to incident radiation levels for weather conditions 5/D

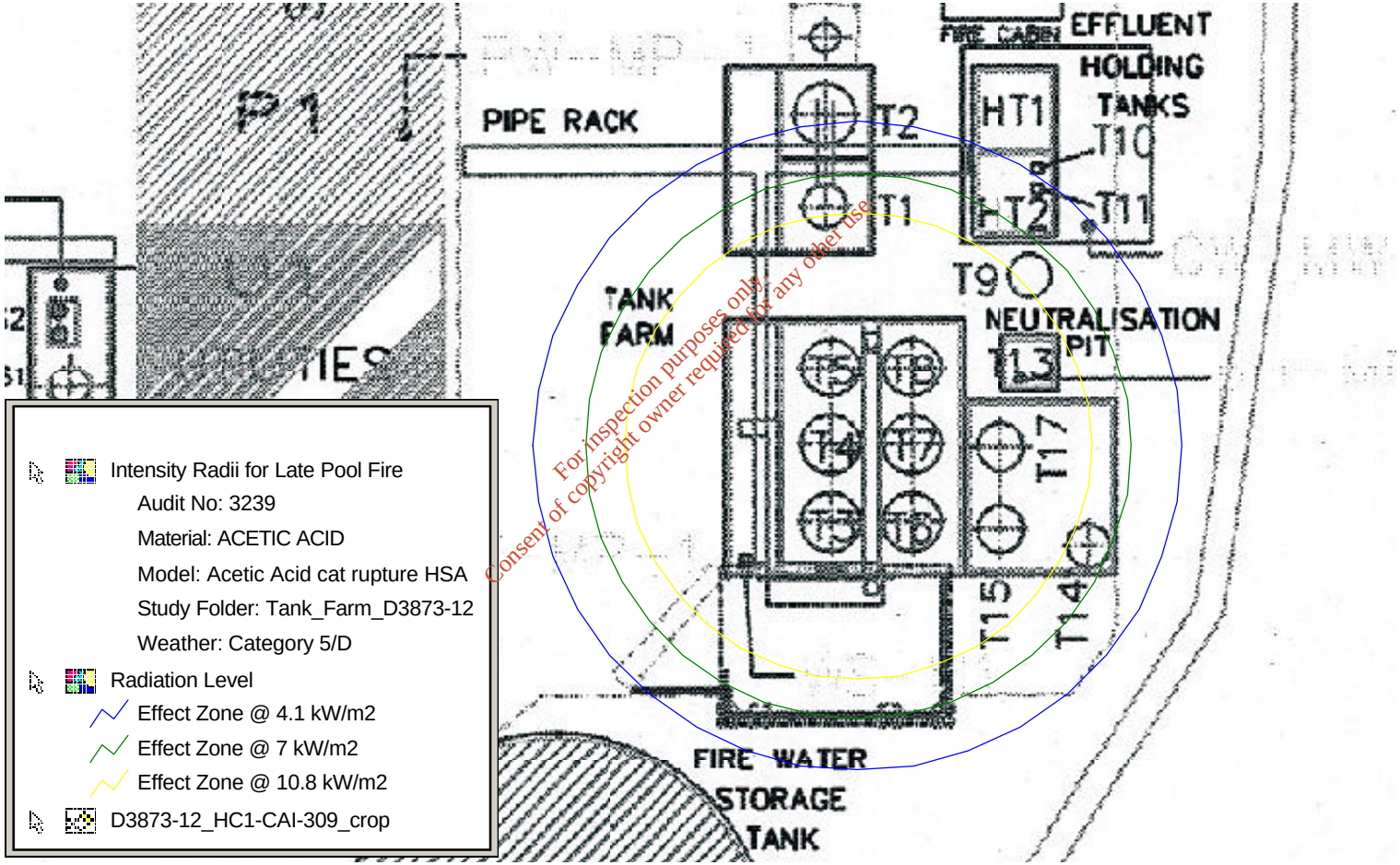


Figure 8 Xylene Catastrophic Rupture 25,000 L in tank farm

Distances to incident radiation levels for weather conditions 5/D

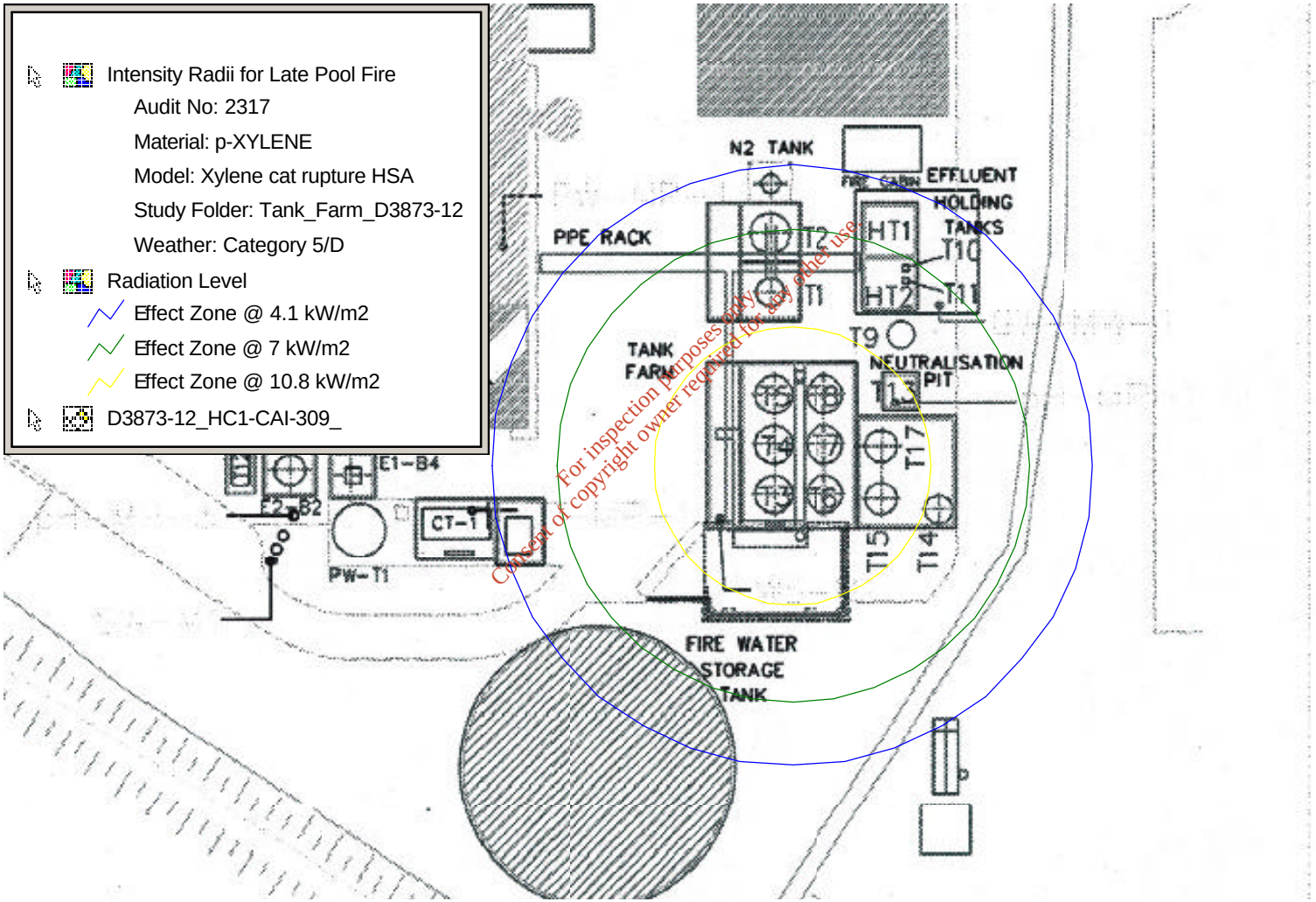


Figure 9 **Ethyl Acetate Catastrophic Rupture 20,000 L in tank farm**

Distances to incident radiation levels for weather conditions 5/D

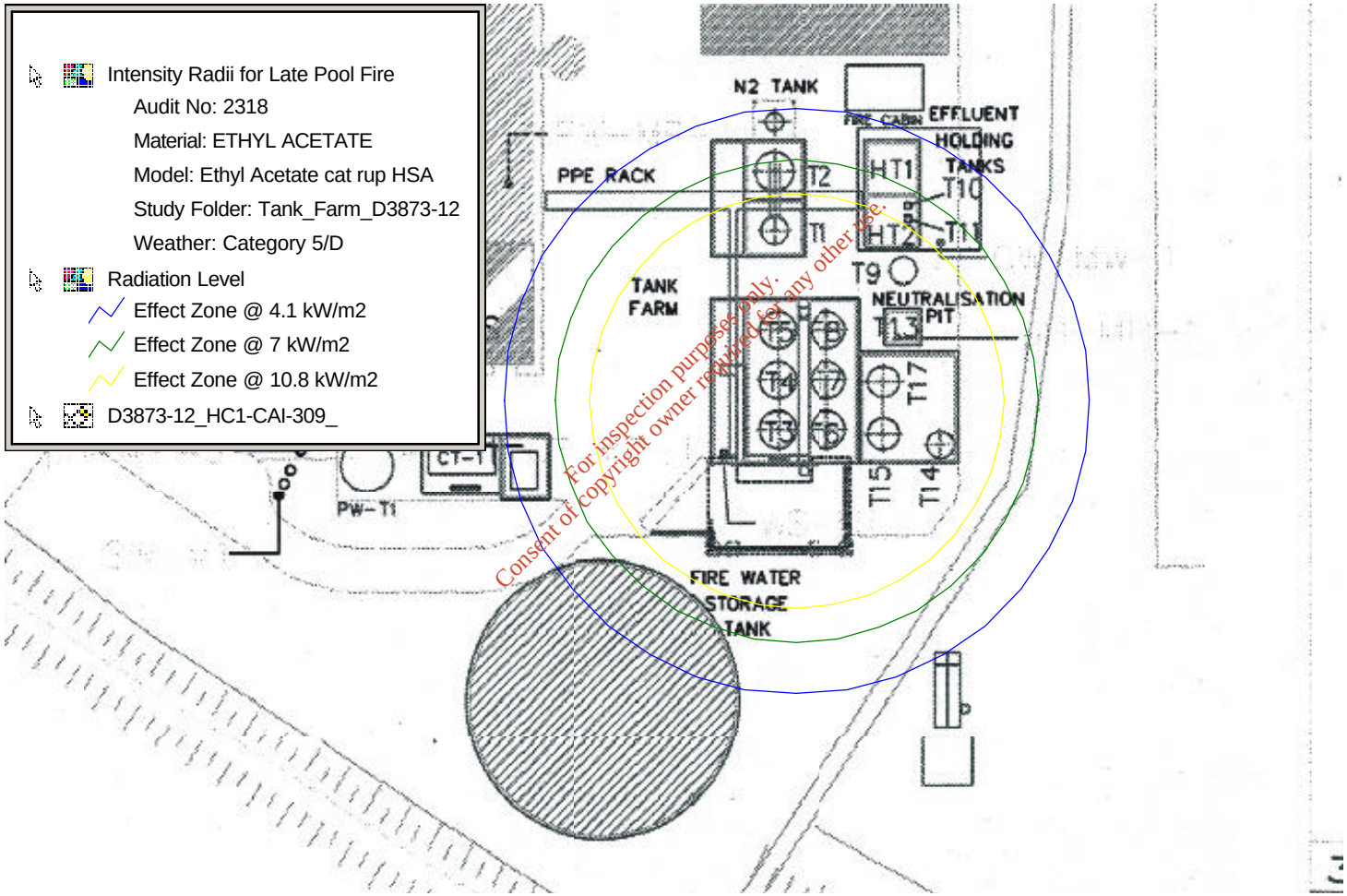


Figure 10 **TEA Catastrophic Rupture 25,000 L in tank farm**

Distances to incident radiation levels for weather conditions 5/D

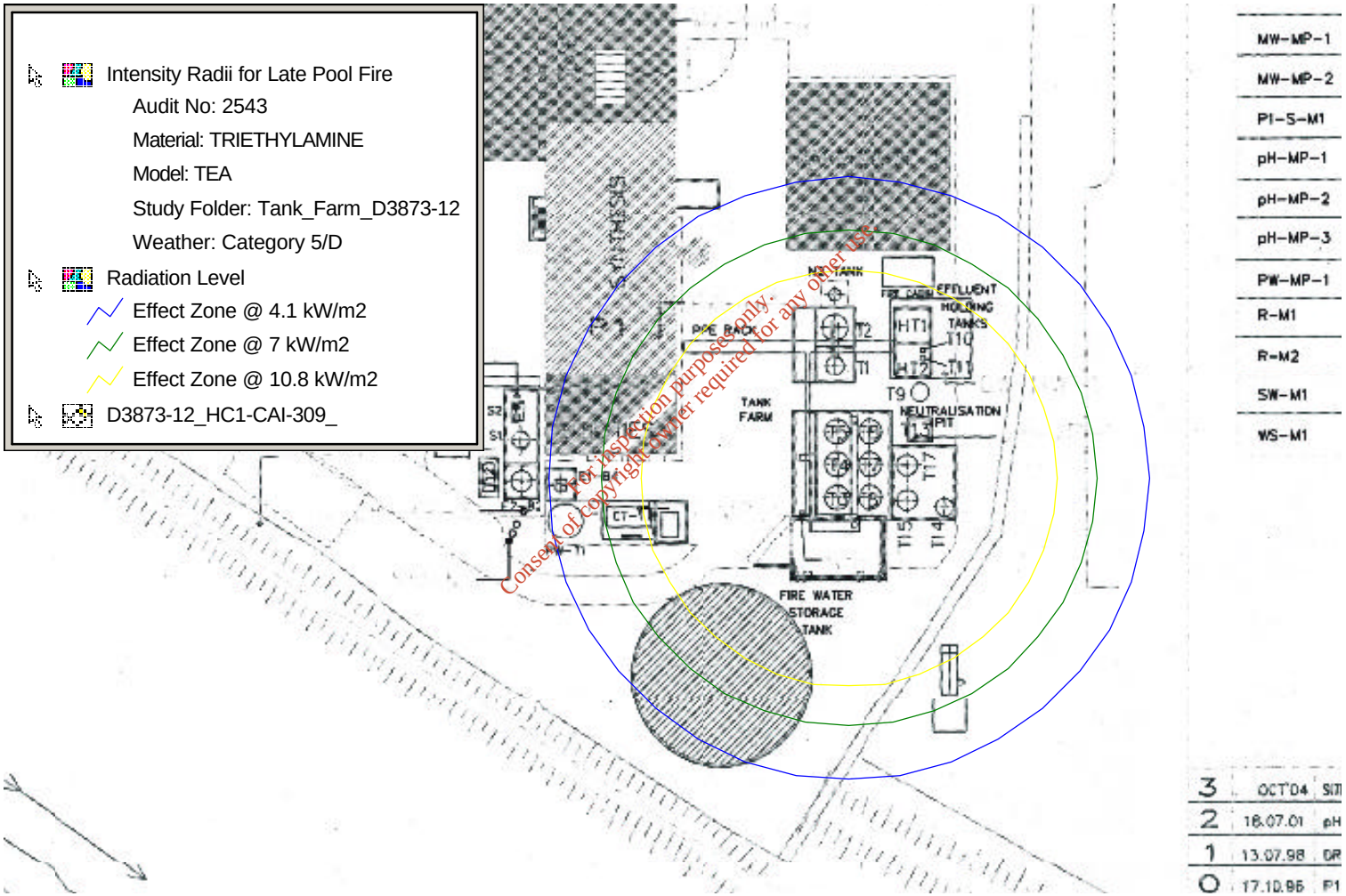
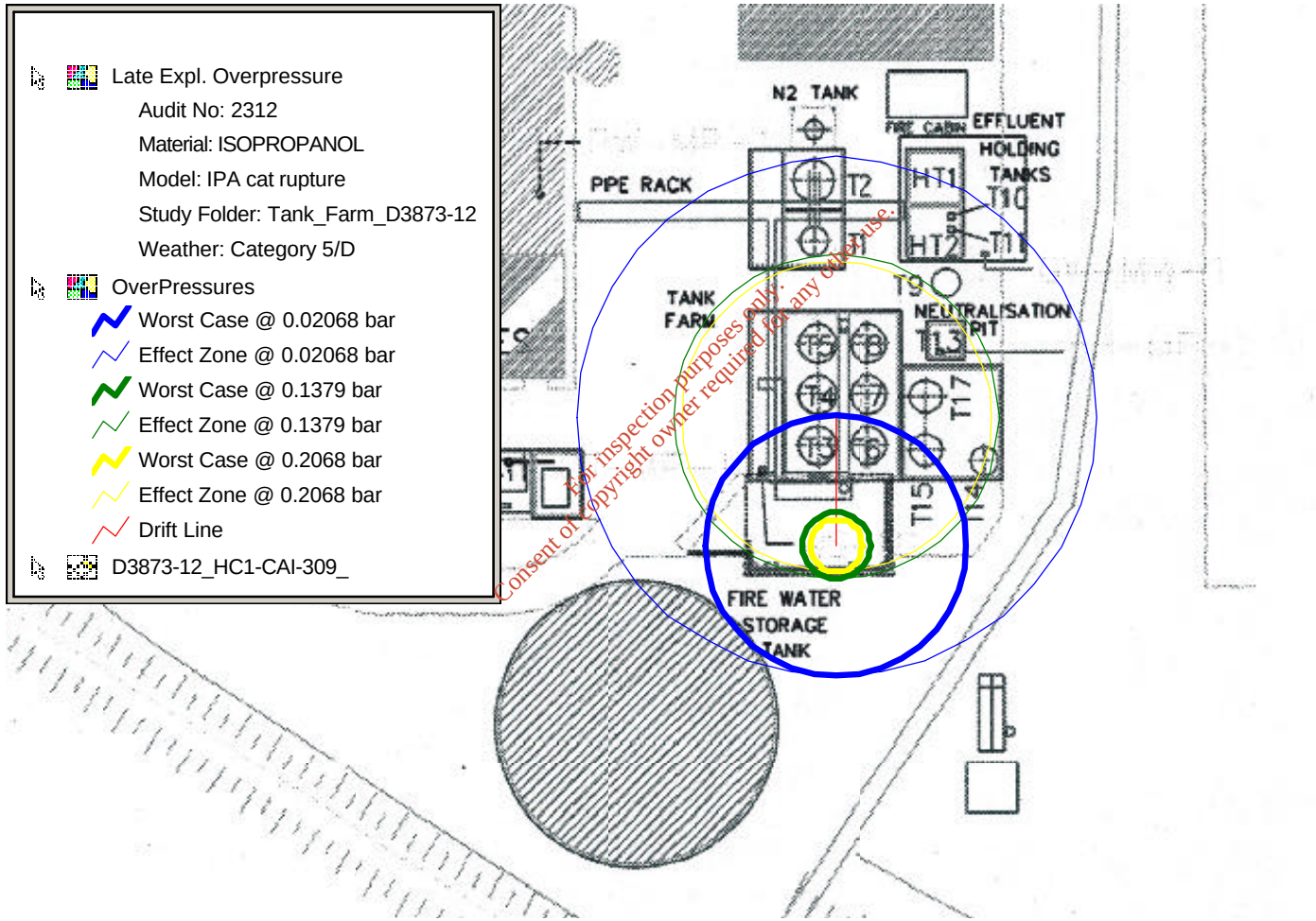


Figure 11 IPA Catastrophic Rupture 25,000 L in tank farm

Distances to overpressures, late ignition, for weather conditions 5/D



Acid/caustic Mixing

Figure 12 928 kg HCl vapour at 120°C

Distance to ERPG 1

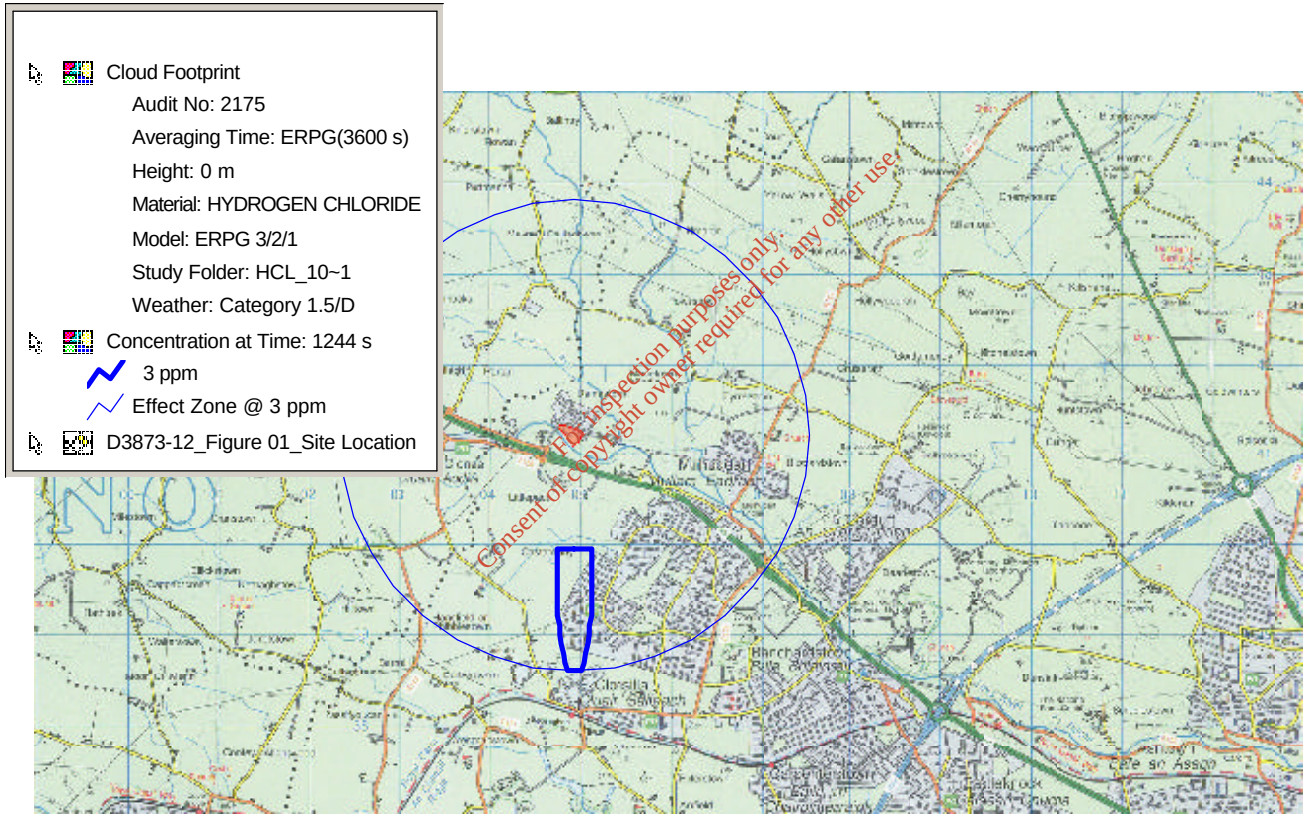


Figure 13 **928 kg HCl vapour at 120°C**

Distance to ERPG 2

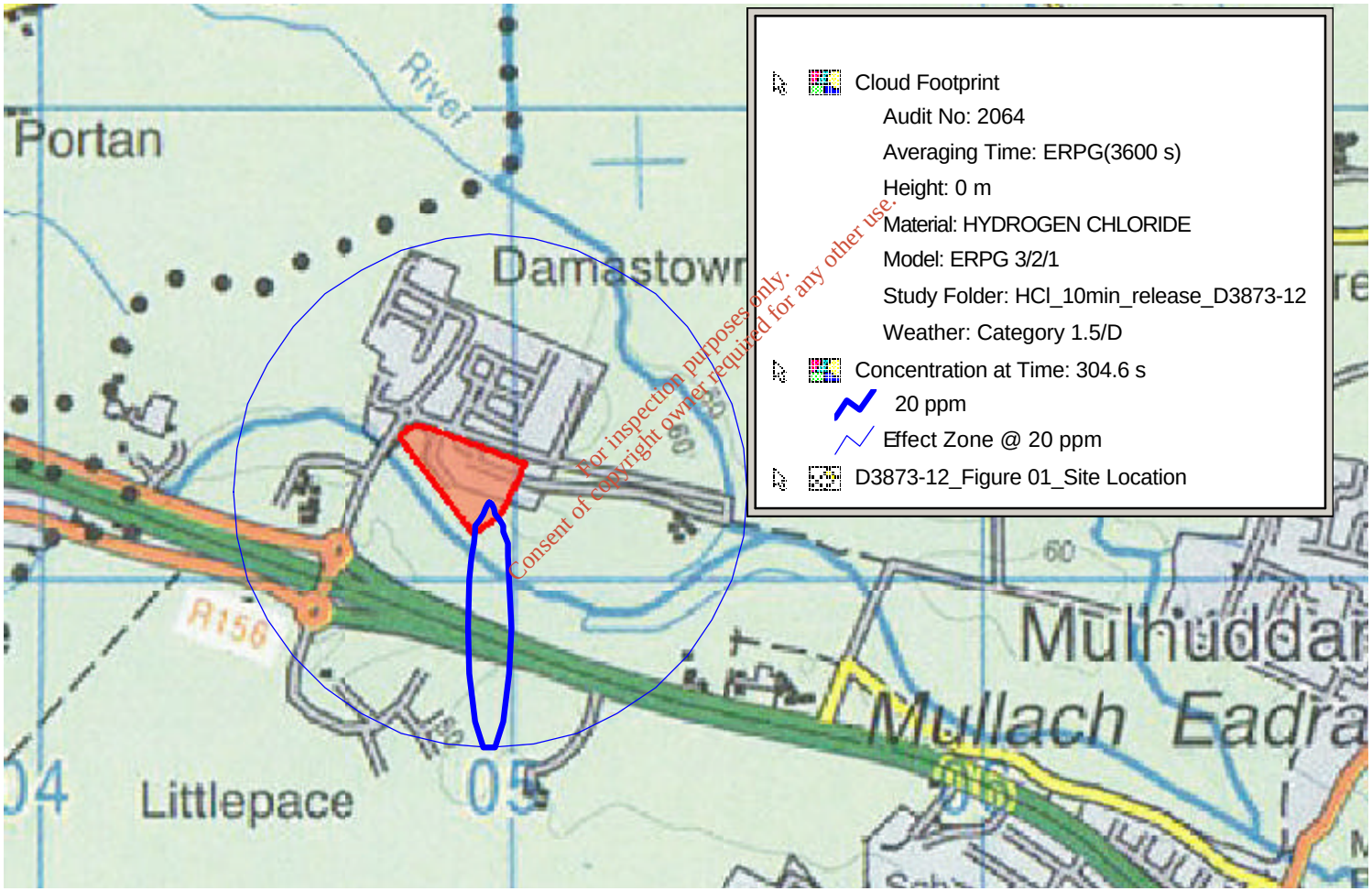


Figure 14 928 kg HCl vapour at 120°C

Distance to ERPG 3

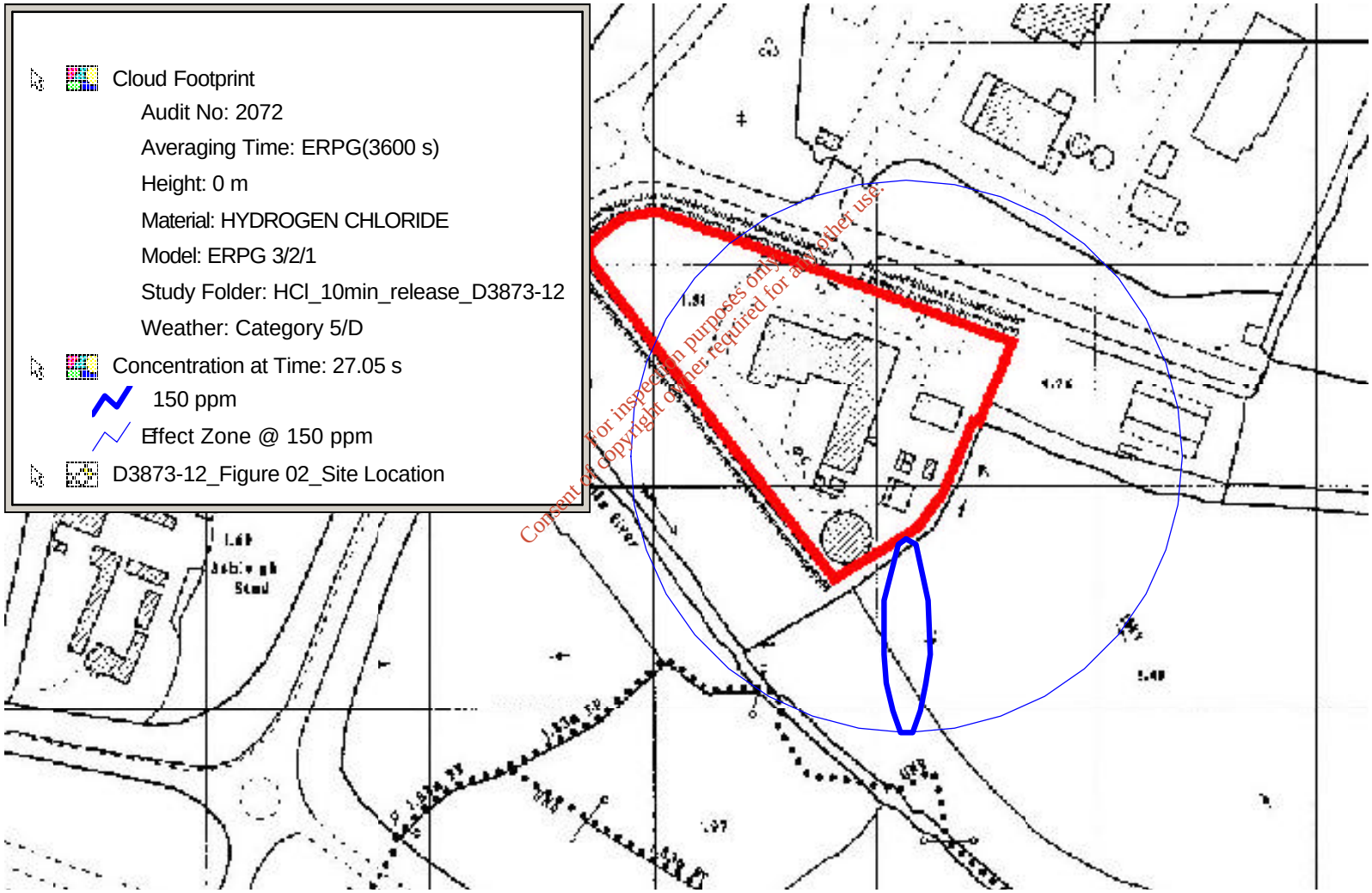
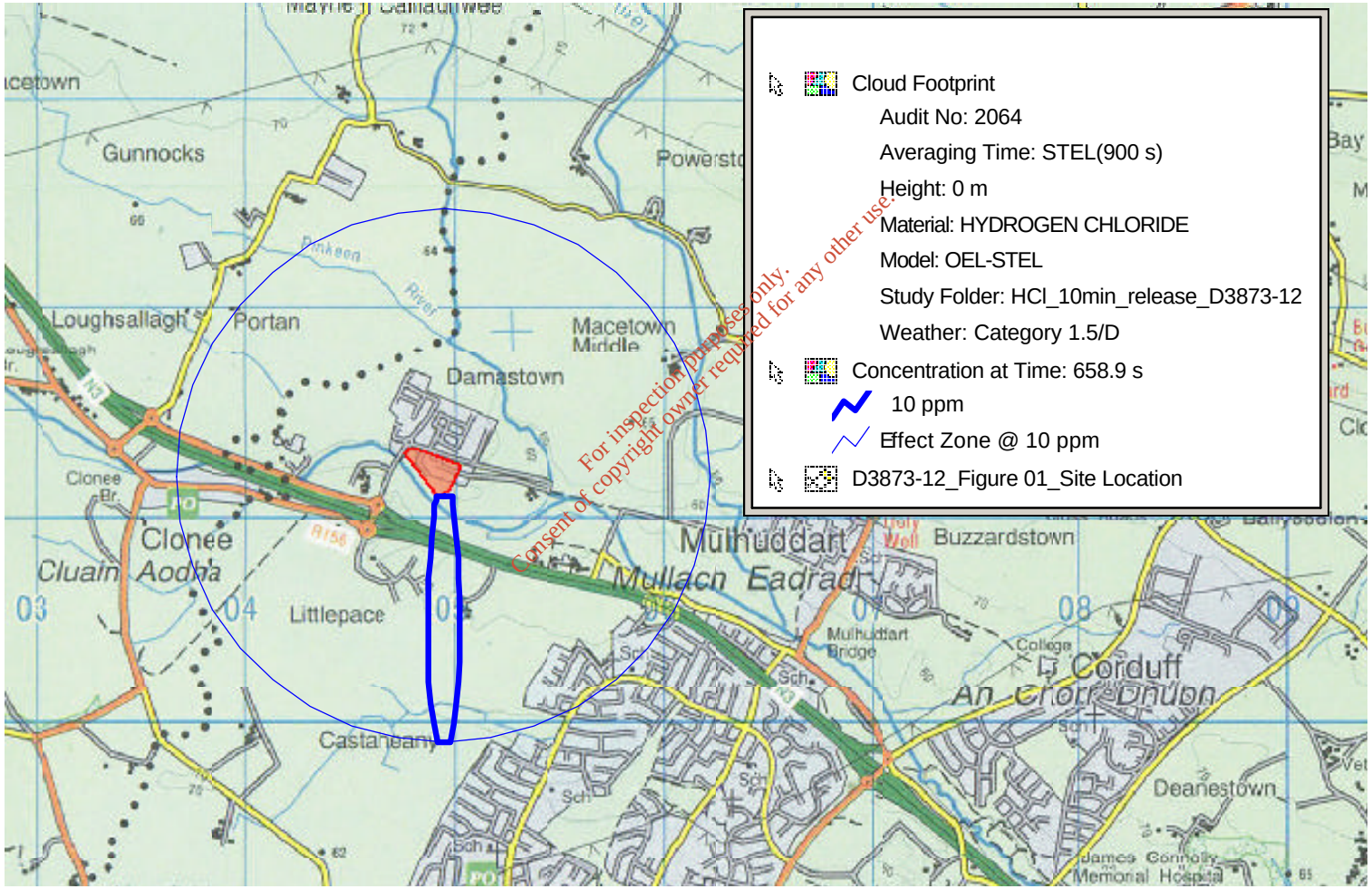


Figure 15 **928 kg HCl vapour at 120°C**

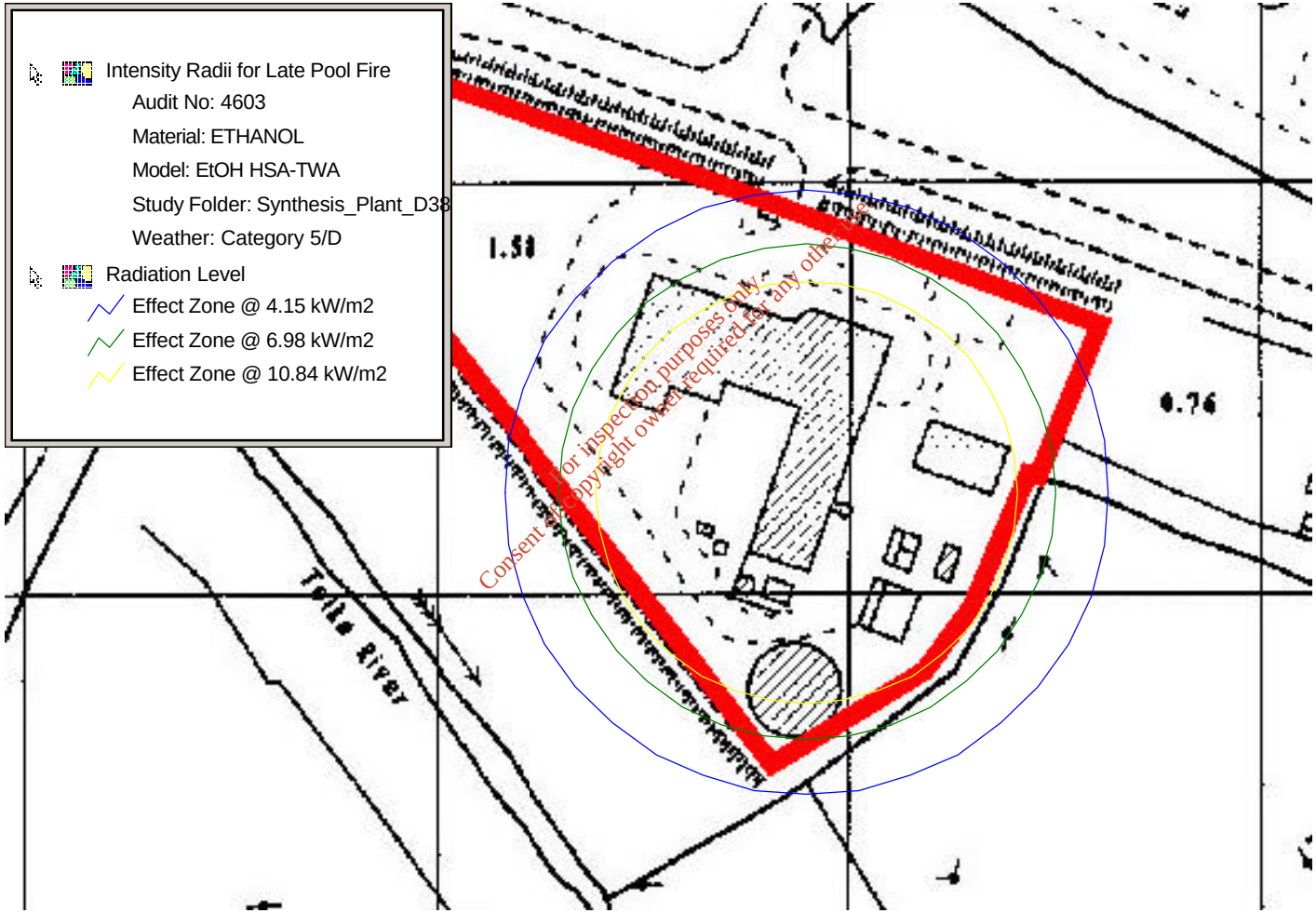
Distances to OEL-STEL for weather conditions 1.5/D



Synthesis Plant Incidents

Figure 16 Ethanol Catastrophic Rupture 6,000 L in Synthesis Plant

Distances to incident radiation levels for weather conditions 5/D



Synthesis Plant – Domino Effects

Figure 17 MSC Catastrophic Rupture 610 kg to fire in Synthesis Plant – Vaporisation of MSC

Distances to OEL-STEL for weather conditions 1.5/D and 5/D

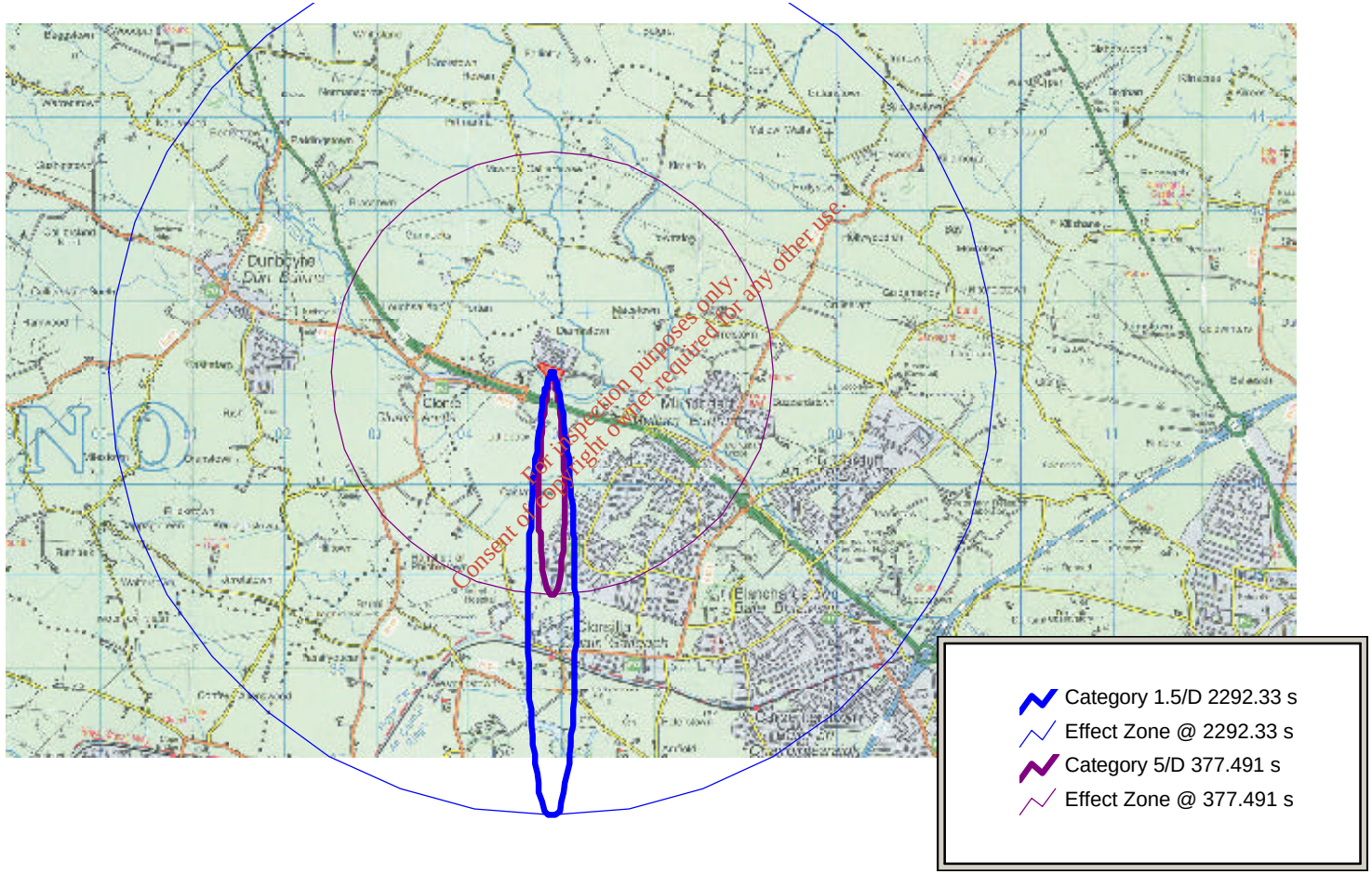


Figure 18 MSC Catastrophic Rupture 610 kg to fire in Synthesis Plant – thermal decomposition of MSC releasing HCl

Distances to OEL-STEL for all weather conditions modelled

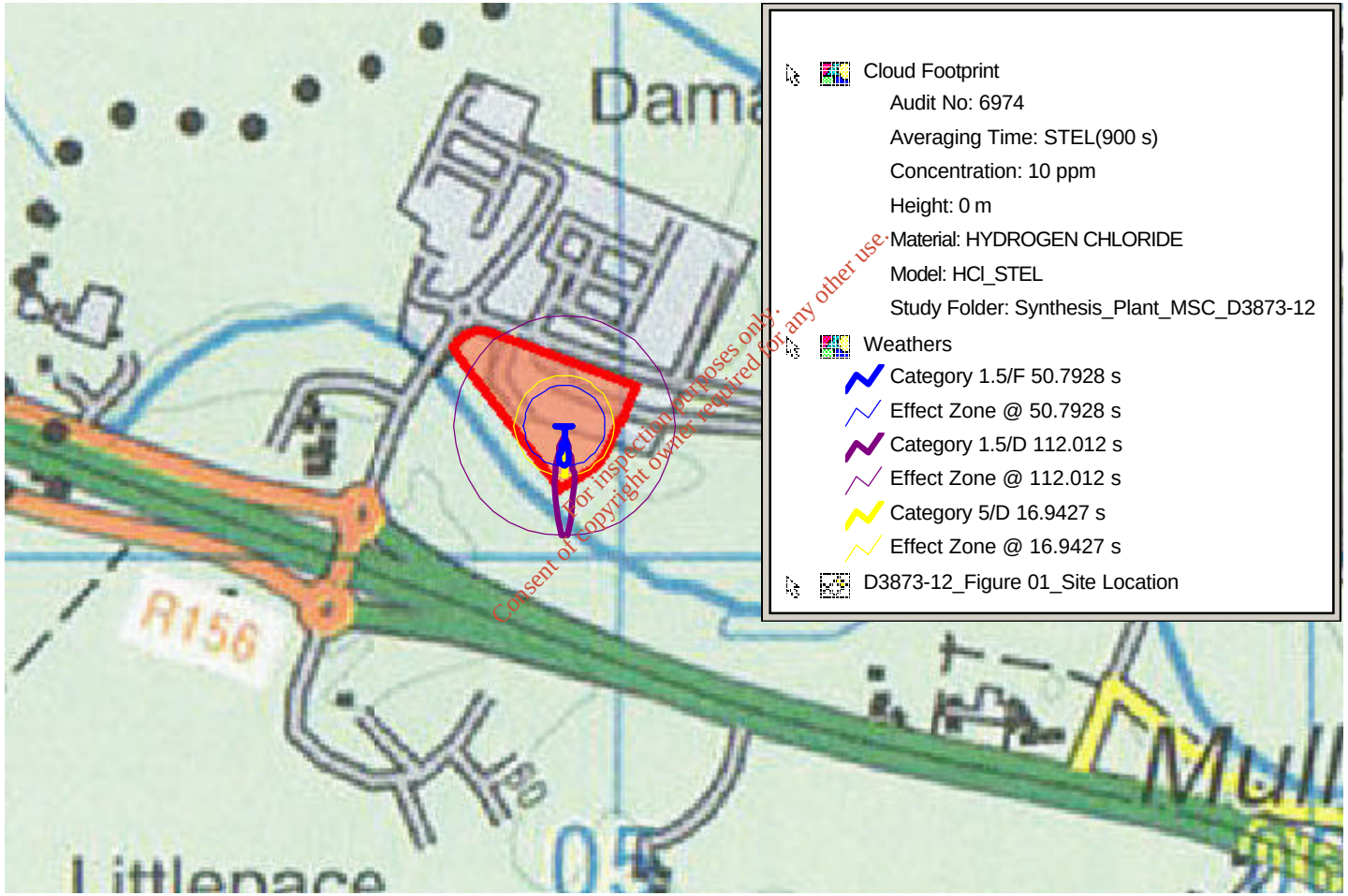


Figure 19 **MSC Catastrophic Rupture 610 kg to fire in Synthesis Plant – thermal decomposition of MSC releasing SO^2**

Distances to OEL-STEL for all weather conditions modelled

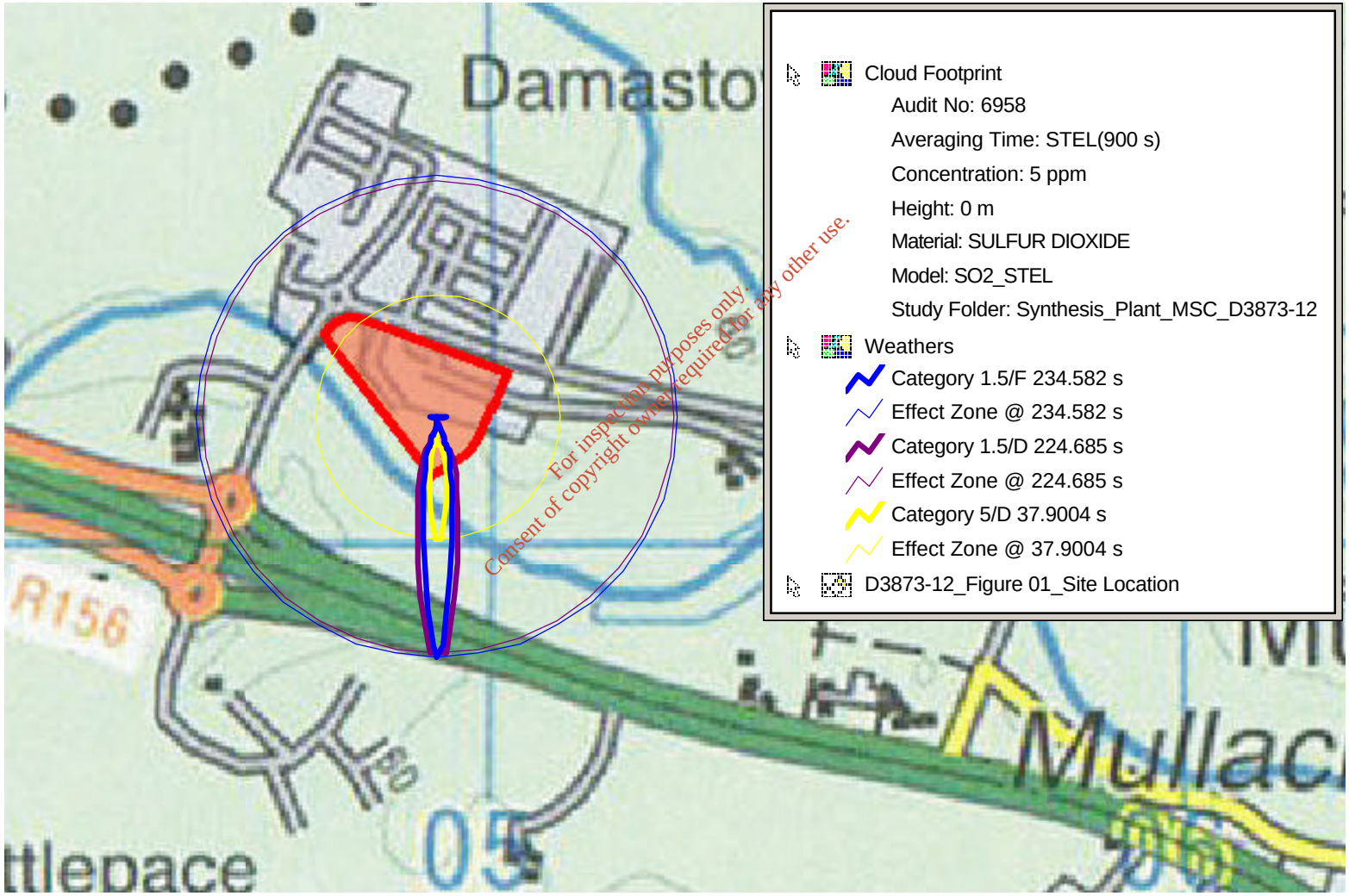


Figure 20 **63% Nitric Acid Catastrophic Rupture 600 kg to fire in Synthesis Plant – thermal decomposition of nitric acid releasing NO2**

Distances to OEL-STEL for all weather conditions modelled

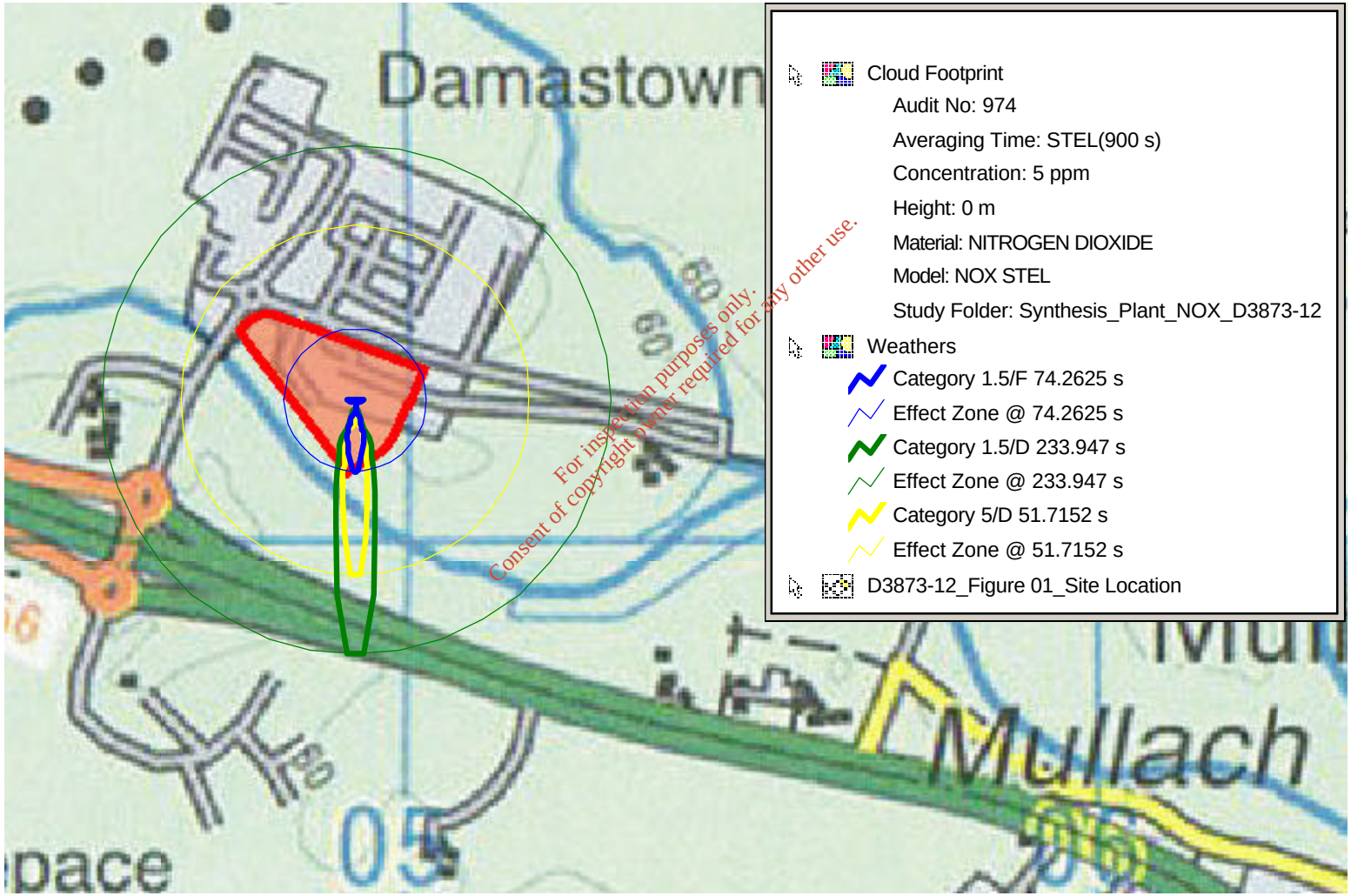
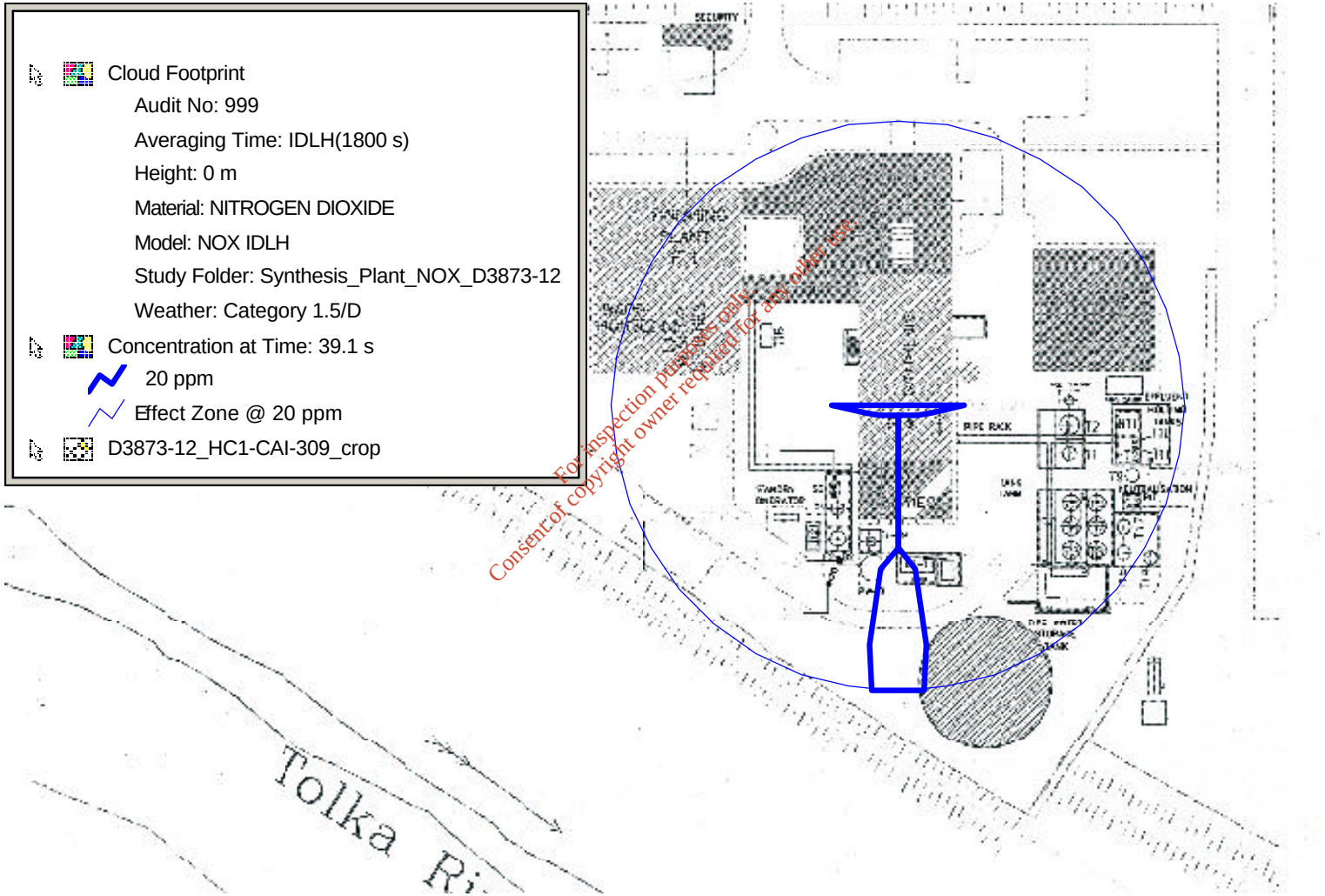


Figure 21 **63% Nitric Acid Catastrophic Rupture 600 kg to fire in Synthesis Plant – thermal decomposition of nitric acid releasing NO_2**

Distance to IDLH for weather conditions 1.5/D



APPENDIX A

Glossary

A1. DEFINITION OF AIR QUALITY PARAMETERS

Parameter	Meaning
ERPG3 (Emergency Response Planning Guidelines)	The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.
ERPG2	The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.
ERPG1	The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing other than mild, transient adverse health effects or without perceiving a clearly defined objectionable odour.
OEL-STEL (Occupational Exposure Limit – Short Term Exposure Limit)	The concentration to which workers can be exposed for short periods of time, usually 15 minutes, 4 times per day, without suffering adverse effects.
OEL-TWA (Occupational Exposure Limit – Time Weighted Average)	The concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may repeatedly be exposed, day after day, without adverse effect.
IDLH (Immediately Dangerous to Life and Health)	The maximum concentration of airborne contaminants, normally expressed as parts per million (ppm), from which one could escape within 30 minutes without a respirator and without experiencing any escape impairing (severe eye irritation) or irreversible health effects.

A2. DEFINITION OF MODELLING TERMS

- Early Explosion

An early (or immediate) explosion is one which occurs before the cloud has started to disperse, and is distinguished from late (or delayed) ignition. The effects of the explosion will depend only on the initial release.

- Flammable Envelope

This describes the range of concentration from the lower to the upper flammable limits over which the material will burn in air if ignited.

- Late Explosion

A late explosion can occur at any time while there is still a flammable concentration in the vapour cloud, and the size of the effect zone will depend on the timing and location of the ignition. The program performs the late explosion modelling at regular intervals during the dispersion of the cloud, and finds the conditions which give the greatest downwind effect distance for each overpressure of interest; this is described as the “Worst Case” explosion for that overpressure.

- Late Ignition

Delayed (or late) ignition is ignition which occurs after the flammable cloud has started to disperse and is distinguished from immediate (or early) ignition. The location and effects of ignition depend on the details of the dispersion behaviour.

- Late Pool Fire

The program takes the state of the evaporating pool at the time when it reaches its largest diameter, calculates the size, shape and intensity of the flame, and then calculates the size of the contours to the radiation levels of interest.

- Late Pool Fire Ellipse

The report gives the maximum downwind distances reached by the ground-level radiation ellipses for the radiation levels set in the input data.

- Lower Flammable Limit (LFL)

The flammability limits of a material are the lowest and highest concentrations in air, at normal temperature and pressure, at which a flame will propagate through the mixture.

- Model

A model is a definition of a hazardous event, such as a release of a flammable or toxic material, a fire or an explosion. Calculations for a model are run to determine the size and intensity of the hazardous effects that are associated with the event.

- Overpressure

A transient air pressure, such as the shock wave from an explosion, that is greater than the surrounding atmospheric pressure.

- Pool Fire

The model calculates the release of material from containment, through all the stages in its dispersion to a harmless concentration. The modelling includes discharge calculations to obtain the release rate and state, and fire, explosion and toxic calculations to obtain representative effect zones for the dispersing cloud.

If the release contains liquid that rains out to form a pool then the program will model the effects of an early pool fire.

- Quasi-instantaneous release (Catastrophic Rupture)

This scenario is designed to model an incident in which the vessel is destroyed by an impact, a crack, or some other failure which propagates very quickly. The release is assumed to form a homogeneous mass, expanding rapidly with no restrictions from the shattered vessel. If the release is on the ground it will form a semi-spherical cloud, and if it is elevated it will form a spherical cloud.

Arup Menzies

APPENDIX B

Toxicity Parameters for Gases and Vapours

B1. TOXICITY PARAMETERS FOR GASES AND VAPOURS

The following are the toxicity parameters for gases and vapours:

Chemical	IDLH	ERPG-1 (ppm)	ERPG-2 (ppm)	ERPG-3 (ppm)	OEL-TWA	OEL-STEL
Xylene	900	*	*	*	50	100
IPA	2000 [10%LEL]	*	*	*	400	500
Acetic Acid	50	5	35	250	10	15
Ethyl Actate	2000 [10%LEL]	*	*	*	400	-
TEA	200	*	*	*	1	3
MSC	*400*	*0.1*	*1*	*25*	*0.1*	*0.1*
HCl	50	3	20	150	5	10
SO_2	100	0.3	3	15	2	5
NO_2	20	1	15	30	3	5

* no published data

IDLH values are published by the NIOSH.

OEL values are published by the HSA.

ERPG values are published by the AIHA.

Methane Sulphonyl Chloride

Little data is available for MSC. The AIHA has not published ERPGs for MSC, nor has any agency published an OEL for MSC.

However, information in the Material Safety Data Sheet (MSDS) maintained by Helsinn can be used to estimate ERPGs.

- Lethal cases were reported in a man at a concentration of 400 ppm for 10 min. This is equivalent to the IDLH: “Immediate danger to life and health”.
- The LC_{50} (inhalation, rat) is 25 ppm (for 4 hours). This is equivalent to ERPG3: “The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.”
- The level reported as being intolerable to humans is 10 ppm. This is equivalent to ERPG2: “The maximum airborne concentration below which it is believed that 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.”
- Lachrymatory effects are reported from 1 ppm. This is equivalent to ERPG1: “The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing other than mild, transient adverse health effects or without perceiving a clearly defined objectionable odour.”
- Exposure limit recommended by the *Comité Valeur d’exposition* of ELF Atochem is 0.1 ppm, but it is not stated whether this is the TWA or STEL.

ENVIRONMENTAL LIABILITY RISK ASSESSMENT (ELRA)

Arup Consulting Engineers

Helsinn Chemicals Ireland

IPPC Licence Review

Environmental Liabilities Risk Assessment

Arup Consulting Engineers

Helsinn Chemicals Ireland

IPPC Licence Review

Environmental Liabilities Risk Assessment

January 2006

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1. INTRODUCTION

Helsinn Chemicals Ireland (HCI) Ltd. operates a pharmaceutical manufacturing facility at the Damastown Industrial Estate, Mulhuddart, County Dublin. The plant operates 16 hours per day using two shifts. The manufacture of pharmaceutical products and their intermediates is an activity that is listed as Class 5.6 in the First Schedule of the Environmental Protection Agency Act, 1992.

HCI obtained an Integrated Pollution Control (IPC) Licence (No. 125), from the Environmental Protection Agency (EPA) in 1996.

This document has been prepared based on the '*Guidance Documents and Assessment Tools on Environmental Liabilities Risk Assessment and Residuals Management Plan incorporating Financial Provision Assessment, Draft for Consultation, May 2005*'.

This report has been prepared to assess the environmental risks associated with the HCI facility that may result in potential or anticipated liability. Environmental risks include risks to surface water, groundwater, atmosphere, land and human health.

2. SITE ASSESSMENT

This section establishes the site context and defines areas that may potentially be impacted upon by the site.

2.1 Site Context

The HCI plant is located in the townland of Damastown, Co. Dublin. The site is located close to the Meath-Dublin county boundary line, 0.3km north of the N3 Navan Road and approximately 17 km northwest of Dublin City Centre. The site occupies 0.87 hectares (ha) of land within Damastown Industrial Estate, with 0.31ha of buildings surrounded by an internal ring road.

Industrial facilities are located on three sides of the site, to the north, east and west. The N3 Navan Road is located to the south of the site. Beyond the industrial estate, lands are used for farming, residential and retail.

Immediately to the south of the site, the River Tolka meanders gently in an easterly direction. A river walk runs adjacent to the river creating an amenity area.

Littlepace Paddocks, a housing estate of approximately 250 houses, is located on the southern side of the dual carriageway. The nearest house is approximately 400 m from the site boundary.

2.2 Environmental Sensitivity Evaluation

2.2.1 Surface Water

The nearest surface water is the River Tolka, which lies approximately 150 m south of the site. The next nearest surface water is the Kilmahudderick Stream, which flows through farmland in a northerly direction approximately 500m west of the site boundary.

The River Tolka rises in County Meath, in an area 12km north west of Dunboyne at an elevation of 140m above mean sea level. It flows in a south-easterly direction, along with a number of tributaries, through agricultural land until it reaches the Fingal County Council boundary at Clonee. From Clonee, it flows east south-east through Mulhuddart and Blanchardstown into Finglas. It flows through the urban areas of the Tolka Valley Park,

Botanic Gardens, Griffith Park and Fairview Park before discharging to the sea at the River Tolka Estuary.

Although the River Tolka is heavily nutrient enriched from agricultural runoff in its lower reaches, it has significant fisheries value with stocks of brown trout and some sea trout. It also has significant potential for improvement in fisheries value and is managed as a put-and-take fishery.

Surface water from car parks, roofs and non-bunded areas are visually examined weekly for odour and colour. In addition, a number of physical/chemical parameters are required to be monitored as part of the current IPC licence.

2.2.2 Proximity to SPAa/SACs/NHAs

The Department of the Environment, Heritage and Local Government has designated sensitive areas Nature Conservation Sites in order to preserve the habitats. There are no Special Protection Areas (SPA) proposed National Heritage Area (pNHA) or candidate Special Areas of Conservation (cSAC) in the vicinity of the site. Therefore the HCI site does not directly impact on any nature conservation sites.

The Tolka River Valley could be considered an area of ecological interest as heron, mallards, moorhen and kingfisher are observed along the stretch.

2.2.3 Site and Monuments Record

The Sites and Monuments Record (SMR) of the Department of the Environment, Heritage and Local Government, records known upstanding archaeological monuments, their original location (in case of destroyed monuments) and the position of possible sites identified as cropmarks on vertical aerial photographs. No registered national monuments are located within the area of the site.

2.2.4 Soil and Groundwater Conditions

The site is underlain by Lower Carboniferous Limestone with glacial till overlying the bedrock surface. While little is known about the groundwater potential of the glacial deposits in this area the limestone bedrock constitutes a useful aquifer. However, as with all fissure flow aquifers there can be a wide variation of well yields over a particular locality.

Groundwater levels are related to the nearby Tolka River, and flows towards the river. There are no direct emissions to the groundwater from the HCI site.

The HCI facility was built on a greenfield site therefore, no previous contamination is likely. However, groundwater monitoring carried out since 1997 shows some contamination of the groundwater at the HCI facility.

Elevated and fluctuating levels of various parameters have been measured as part of the groundwater monitoring programme. Ameliorative measures have been employed to reduce elevated concentrations, including:

- Repairs to sewers
- Pipe replacement
- Repairs to drains and bunds
- Testing of effluent holding tanks
- Extraction of groundwater
- Liner testing

Monitoring of groundwater is ongoing and it is proposed to carry out a review for the forthcoming monitoring round of all potential contamination sources, both on and off site to determine the cause of the fluctuating water quality trend. Consideration has also been given to requesting assistance from the EPA or Local Authority to determine potential off-site sources of contamination.

2.3 Site History

HCI was purpose built in 1992/1993, on a Greenfield site, for the manufacture of bulk pharmaceuticals. Therefore, no previous contamination is likely.

2.4 IPC Licence Compliance

HCI has had an excellent compliance record since they were issued with the IPC licence in 1996. No exceedences of emissions to air have been recorded. There have been only three exceedences of emissions to sewer for one parameter only. Noise levels show continued compliance with the IPC licence limits. HCI have not received any complaints from external parties.

2.5 Site Layout and Assets

The main entrance to the building is located on the north-eastern end of the building facing the distributor road and the Astellas Plant. The offices are located to the front of the building with warehouse and production areas to the rear. All storage areas and firewater containment tank are found to the southeast of the site. The building facilities can be summarised as follows:

- Offices/administration
- Production Areas
- Warehousing
- Utilities
- Engineering stores, workshop and vacuum pump room
- Security hut
- Laboratory

The site layout is shown in Figure 1.

The following process plant is provided at the facility:

- Reactors
- Centrifuges
- Dryers
- Micronisers/Mill blender
- Laboratory equipment
- Standby generator
- Effluent holding tanks
- Neutralisation pit
- Firewater storage tank

- Tank farm

Three storage tank bunds are located on site, as detailed in the table below.

Table 1: Site Bunds

Bund	Location
Tank farm bund	Surrounding Tank Farm
Caustic tank bund	Surrounding caustic tank
Diesel tank bund	Surrounding diesel tank

2.6 Site Processes

The HCI Damastown facility was developed in 1992/1993 for the manufacture of bulk pharmaceutical chemicals.

The process reactions are carried out in glass-lined/stainless steel reactors. The material is isolated in centrifuges, dried in vacuum dryers and the particle size is reduced in a microniser air jet mill or a finishing mill.

Synthesis and purification of the intermediates and final product takes place in the main process building (P1) using reaction vessels with capacities 8,000 litres, 6,300 litres and 4,000 litres. Wet intermediates are isolated by centrifugation and drying of the intermediates also takes place in this building. The purified products are dried and then micronised or milled and blended in a separate area in the Finishing Unit (F1). Drying is carried out under vacuum in rotary dryers and micronisation is by means of an air jet mill. The finished products are packed into drums and stored in the finished goods warehouse prior to shipment.

The plant was dedicated to the manufacture of one product, a non-steroidal anti-inflammatory drug called Nimesulide, which is used in the treatment of soft-tissue inflammation. It is sold in Ireland under the brand name "Aulin". The process reactions are carried out in glass lined reactors. The material is isolated in centrifuges, dried in vacuum dryers and the particle size is reduced in a microniser air jet mill.

Since 2001, other products have been introduced into the facility with the agreement of the EPA.

2.7 Materials Contained on Site

Raw materials are delivered to the site in drums or bulk containers and stored in the drum store or tank farm.

Bunds are located as described in the Table 1 above.

Details of all hazardous materials and substances are given in Appendix A.

2.8 Waste

Liquid wastes are generated at a number of stages in the processes and these are segregated into dedicated bulk holding tanks or drums and disposed of in accordance with the European Communities (Toxic and Dangerous) Waste Regulations. Process solid waste is similarly disposed of under the Waste Regulations.

Non-hazardous office and canteen waste is disposed of to a controlled landfill site. Cardboard and waste paper is recycled where possible.

Aqueous waste, consisting mostly of water and trace organics are filtered, balanced and tested for COD, pH and temperature before discharge to the Fingal County Council sewer which discharges to the Dublin City Council Waste Water Treatment Plant at Ringsend. Onsite treatment of effluent currently consists of carbon filtration and neutralisation. The efficiency of this system is being reviewed at present as part of a general reappraisal of effluent management on site. This in turn is linked to negotiations with Fingal County Council on sewer load allowances. The final configuration of effluent pre-treatment with be determined as part of those negotiations and the options which emerge will be communicated to the Agency. Two holding tanks with a combined capacity of 100m^3 are located near the tank farm. These will remain in service as part of the management system.

Hazardous wastes are shipped by a licenced waste handler (Indaver Ireland) for recovery, incineration or blending as cement fuel. Non-hazardous waste stored in skips is sent for landfill off-site.

2.9 Site Classification

Due to its location in an industrial estate, its environmental history and as the area in the vicinity of the site is not environmentally sensitive; the site is not considered a risk to the environment. Nonetheless, based on the use of initial screening risk assessment, the site is ranked as high risk as it is a low tier Seveso site as more than 5 tonnes of "Very Toxic" substances are stored on site. As the site is considered High Risk, a Site Specific ELRA is therefore required, as outlined in the guidance document. It should be noted that the EPA are currently reviewing this document.

3. ENVIRONMENTAL LIABILITIES RISK ASSESSMENT

3.1 Scope

In general a requirement of IPPC Licences states that a facility *"….shall arrange for the completion, by an independent and appropriately qualified consultant, of a comprehensive and fully costed Environmental Liabilities Risk Assessment for the operation, which will address liabilities from past and present activities"*

This section provides an assessment of any environmental liabilities that could occur under normal and abnormal operating conditions.

3.2 Methodology

The assessment of the risk of a facility to the environment is based on two risk classification tables. The first (Table 2) is based on the likelihood of occurrence of an event, the second (Table 3) on the severity of the impact if the event occurs.

Table 2: Risk Classification Table – Occurrence

Rating	Occurrence		
	Category	**Description**	**Likelihood of Occurrence (%)**
1	Very Low	Very low chance (0-5%) of hazard occurring in 30 year period *	0 – 5
2	Low	Low chance (5-10%) of hazard occurring in 30 year period	5 - 10
3	Medium	Medium chance (10-20%) of hazard occurring in 30 year period	10 - 20
4	High	High chance (20-50%) of hazard occurring in 30 year period	20 - 50
5	Very	High Greater than 50% chance of hazard occurring in 30 year period	>50

* The assessment of the environmental liabilities has been limited to a 30-year period in accordance with Article 10 of the *Council Directive 1999/31/EC of 26 April 1999 on the Landfill of Waste*.

Table 3: Risk Classification Table – Severity

Rating	Occurrence		
	Category	**Description**	**Cost of Remediation**
1	Trivial	No damage or negligible change to the environment.	€ 0-1,000
2	Minor	Minor impact/localised or nuisance	€ 1,000-10,000
3	Moderate	Moderate damage to environment	€ 10,000-50,000
4	Major	Severe damage to local environment	€ 50,000-100,000
5	Massive	Massive damage to a large area, irreversible in medium term	€ 100,000-500,000

3.3 Risk Identification

During normal operations there is little potential for any significant emissions to ground, surface water or air due to the environmental protection and abatement measures installed on site. Investigations into current groundwater contamination are on-going. It is hoped that these contamination issues can be resolved in the short to medium term.

Operations on site were examined to determine the potential for environmental liabilities to arise. A total of 27 plausible scenarios were identified that might directly lead to a risk of significant pollution off site. These scenarios were agreed upon following a workshop and a review by HCI.

The Helsinn Internal Emergency Plan (IEP) has most recently been updated in August 2005 and provides for:

- Establishment and maintenance of on-site emergency plans and procedures.
- Use of the identification and assessment of major accident hazards as the basis for emergency plans and procedures.
- Testing and review of emergency plans and procedures.

A risk assessment form has been completed for each area of the site and is shown in Table 4.

A number of risks were identified from the Arup Menzies report 'Seveso/COMAH Directive Modelling of Major Accident Hazard Scenarios, May 2005. It should be noted that the scenarios modelled in the report and included in this assessment are worst-case scenarios, and are modelled under worst-case meteorological conditions.

Table 4: Risk Assessment Form

Risk ID	Area	Potential Hazards	Environmental Effect	Severity Rating	Basis of Severity	Occurrence Rating	Basis of Occurrence	Risk Score
1	Storage	Leak from a bulk tank	No environmental impact	1	Tanks bunded so no change to the environment	1	Very low chance of leak occurring due to mitigation measures applied on site	1
2	Storage	Fire in bulk tank	Emissions and fire localised, no environmental effect	1	Tanks bunded so spread of fire to cause damage or change to the environment	1	Very low chance of fire occurring due to mitigation measures applied on site	1
3	Storage	Fire in tank farm bund	Emissions and fire localised, no environmental effect	1	Tanks bunded so spread of fire to cause damage or change to the environment	1	Very low chance of fire occurring due to mitigation measures applied on site	1
4	Storage	Spillage of drum of Methane Sulphonyl Chloride	Evaporation from surface of pool resulting in higher concentrations on site only*.	2	Measures in IEP to reduce impact	1	Very low chance of spillage due to staff training	2
5	Storage	Spillage of HCL to bund	Potential health impacts up to 1km from the site*	3	Measures in IEP to reduce impact	1	Very low chance of spillage due to staff training and self-contained tank with leak detection system	3
6	Storage	Spillage of HCL to open ground	Potential for health impacts up to 2km from the site*	3	Measures in IEP to reduce impact	1	Very low chance of spillage due to staff training	3
7	Storage	Loss of containment of solvent tanks	Potential for health impacts up to 4km from the site*	3	Measures in IEP to reduce impact	1	Very low chance of overheating tanks	3
8	Storage	Acid/Caustic mixing in caustic bulk storage tank	Potential for health impacts up to 128m from the site*	2	Measures in IEP to reduce impact	1	Very low chance of occurrence due to staff training and engineering controls.	2

Risk ID	Area	Potential Hazards	Environmental Effect	Severity Rating	Basis of Severity	Occurrence Rating	Basis of Occurrence	Risk Score
9	Storage	Loss of containment of solvent tanks resulting in rupture of bunds	Major spill to River Tolka	5	Massive damage to fish life in large area	1	Very low chance of occurring due to bund integrity testing, staff training and ERP.	5
10	Production	Fire in production area	Emissions and fire localised, no environmental effect	1	Fire would be limited to the site	1	Very low chance of fire occurring due to mitigation measures applied on site	1
			Possibly contaminated firewater that will require treatment.	1	Firewater retention system would be activated	1	Very low chance of fire occurring due to mitigation measures applied on site	1
11	Production	Loss of containment of flammable solvent in the production area	Radiation levels up to 75m from the site*	2	Measures in IEP to reduce impact	2	Low chance of fire occurring due to mitigation measures applied on site	4
12	Production	Loss of containment of MSC in the production area	MSC spill to pool fire: vapour cloud up to 11.3km from the site*	3	Measures in IEP to reduce impact	1	Very low chance of loss of containment	3
13	Production	Loss of containment of nitric acid in the production area	Nitric acid spill to pool fire up to 1km from site*	3	Measures in IEP to reduce impact	1	Very low chance of loss of containment	3
14	Production	Fugitive emissions from piping connections, pump seals etc.	Insignificant emissions to atmosphere of process fluids	1	Impact will be localised so non damage to environment	1	Very low due to training to minimise risk of spillage and maintenance of pumps	1

Risk ID	Area	Potential Hazards	Environmental Effect	Severity Rating	Basis of Severity	Occurrence Rating	Basis of Occurrence	Risk Score
15	Production	Piping rupture	Emission of vapours	1	Localised impact, environmental impact unlikely	2	Checking of pipes, pressure testing and preventative measures	2
			Spillage of material	1	Localised impact, environmental impact unlikely	2	Checking of pipes, pressure testing and preventative measures	2
16	Laboratory	Accidental spillage of material or chemicals	Localised effect, no environmental impact	1	Non damage to the environment	2	Low chance of occurring due to staff training	2
17	Laboratory	Fire	Emission of vapours	1	Localised impact due to staff training.	2	Occurrence of fire unlikely	2
18	Laboratory		Possibly contaminated firewater that will require treatment.	1	Firewater retention system would be activated	2	Low chance of fire occurring due to mitigation measures applied on site	2
19	Maintenance	Spillage of maintenance fluids	Localised spillage	1	As spill localised, no environmental issues	2	Occurrence of spill unlikely	2
20	Maintenance	Fire	Emission of vapours	1	Localised impact due to staff training.	2	Occurrence of fire unlikely	2
			Possibly contaminated firewater that will require treatment.	1	Firewater retention system would be activated	2	Low chance of fire occurring due to mitigation measures applied on site	2
21	Administration	Fire	Emission of vapours	1	Localised impact due to staff training.	2	Occurrence of fire unlikely	2

Risk ID	Area	Potential Hazards	Environmental Effect	Severity Rating	Basis of Severity	Occurrence Rating	Basis of Occurrence	Risk Score
22	Other areas	Accidental leakage from road tanker outside the loading bay	Short term emission of vapours and run-off of materials	1	Localised impact due to staff training.	2	Occurrence of spill unlikely	2
23		Road tanker crash in contained area	No environmental impact	1	Area bunded so no change to the environment	1	Very low chance of leak occurring due to mitigation measures applied on site	1
24		Road tanker collapse outside contained area or rupturing bund	Major spill to River Tolka	5	Massive damage to fish life in large area	1	Very low chance of occurring due to bund integrity testing and traffic management measures	5
25	Storage and transport	Leak from storage or underground transport pipework to ground	Groundwater contamination	2	Localised impact due to tightness of clays	1	Very localised impact due to soil and groundwater profile and mitigation measures.	2
26	Air abatement	Failure of scrubbing systems	Emission of vapours	2	Localised impact due to staff training	1	Very low chance of emissions due to staff training and pump maintenance	2
27	Air abatement	Failure of HEPA filters	Emission of API dust	2	Localised impact due to engineering controls	1	Very low chance of occurrence due to engineering controls	2

* Based on Arup Menzies report 'Seveso/COMAH Directive Modelling of Major Accident Hazard Scenarios', May 20

3.4 Assessment of Risks

A Risk Register has been prepared listing the risks to be assessed (Table 5). Minor risks (risk score ≤ 2) have been excluded at this stage. The environmental risks have been ranked according to their risk score.

Table 5: Risk Register Ranked by Risk Scores

Risk ID	Description	Severity Rating	Occurrence Rating	Risk Score
26	Road tanker collapse outside bunded area or rupturing bund	5	1	5
9	Loss of containment of solvent tanks resulting in rupture of bunds	5	1	5
11	Loss of containment of flammable solvent	2	2	4
5	Spillage of HCL to bund	3	1	3
6	Spillage of HCL to open ground	3	1	3
7	Loss of containment of solvent tanks	3	1	3
12	Loss of containment of MSC	3	1	3
15	Loss of containment of nitric acid	3	1	3

A risk matrix is provided below to allow the risks to be easily displayed and prioritised. The colour codes shown are as follows:

- Red – high-level risks requiring priority attention
- Yellow – medium-level risks requiring action, but not as critical as red-coded risks
- Green (light and dark) – lowest-level risks requiring continuing awareness and monitoring on a regular basis.

It is clear from the risk matrix that all risks can be deemed as low-level.

Risk Matrix

Occurrence	Very high	5					
	High	4					
	Medium	3					
	Low	2		Risk ID 11	Risk IDs 5, 6, 7, 12, 15		
	Very low	1					Risk ID 26, 9
			Trivial	Minor	Moderate	Major	Massive
			1	2	3	4	5
Severity							

3.5 Risk Prevention / Mitigation

This section revises the severity and occurrence rankings based on the inclusion of mitigation measures, as outlined in Table 6.

Table 6: Risk Mitigation Form

Risk ID	Potential Hazards	Risk Score Before Mitigation	Possible Mitigation Measures	Risk Manager	Time to complete Mitigation Measures	Revised Severity Rating	Revised Occurrence Rating	Revised Risk Score
26	Road tanker collapse outside bunded area or rupturing bund	5	Review traffic management procedures and provide additional controls, if necessary.	Site Manager	June 2006	4	1	4
9	Loss of containment of solvent tanks resulting in rupture of bunds	5	Additional refresher training in emergency procedures	Production manager	Ongoing	4	1	4
11	Loss of containment of flammable solvent in production	4	Additional refresher training in emergency procedures	Production manager	Ongoing	2	1	2
5	Spillage of HCL to bund	3	Additional refresher training in emergency procedures	Materials Control, HSE manager	Ongoing	2	1	2
6	Spillage of HCL to open ground	3	Additional refresher training in emergency procedures	Production manager	Ongoing	2	1	2

Risk ID	Potential Hazards	Risk Score Before Mitigation	Possible Mitigation Measures	Risk Manager	Time to complete Mitigation Measures	Revised Severity Rating	Revised Occurrence Rating	Revised Risk Score
7	Loss of containment of solvent tanks	3	Additional refresher training in emergency procedures	Production manager	Ongoing	2	1	2
12	Loss of containment of MSC	3	Additional refresher training in emergency procedures	Production manager	On-going	2	1	2
15	Loss of containment of nitric acid	3	Additional refresher training in emergency procedures	Production manager	On-going	2	1	2

Following the implementation of mitigation measures, the updated risk matrix is shown below. The matrix shows that all likelihood of occurrence of all risks is now considered very low.

Post-mitigation Risk Matrix

Occurrence	Very high	5					
	High	4					
	Medium	3					
	Low	2					
	Very low	1		Risk ID 11, 5, 6, 7, 12, 15		Risk ID 26, 9	
			Trivial	Minor	Moderate	Major	Massive
			1	2	3	4	5
			Severity				

3.6 Quantification of Unknown Environmental Liabilities

The financial liability of the risks is assessed based on the probability of the risk occurring and the cost implications should the risk occur. In this assessment, the worst-case scenario is considered, therefore the maximum of each range of costs is used. Table 7 below outlines the financial output for the worst-case scenario. Minor mitigated risks have again been excluded at this stage.

Table 7: Worst-case Financial Model

Risk ID	Occurrence Rating	Likelihood of Occurrence Range (%)	Severity Rating	Cost Range (€)	Worst-case Probability (%)	Worst-case Severity (€)	Worst-case Scenario (€)
9	1	0 – 5	4	50,000 – 100,000	5	100,000	5,000
26	1	0 - 5	4	50,000 – 100,000	5	100,000	5,000
Total							**€10,000**

3.7 Review of Risk Assessment

It is proposed to review the Risk Assessment, the risk management plan and Financial Provision on an annual basis to reflect the following:

- Review the risk register based on the addition and deletion of risks
- Verify the implementation of the Risk Management Plan
- Review financial provisions to ensure environmental liabilities covered
- Confirmation that financial instruments continue to effectively provide financial provision

4. FINANCIAL PROVISION

The area in the vicinity of the HCI site is not considered to be environmentally sensitive. Mitigation measures have been incorporated into the design of the plant to minimise the potential for environmental impacts. During normal operations the facility is not expected to have any significant environmental liability.

As with any industrial process, during abnormal operations it is possible for environmental liabilities to occur. The worst-case financial model quantifies the unknown environmental liability at the HCI site as €10,000. In general, the risk associated with abnormal activities on site is considered to be acceptable and therefore the environmental liability costs would be covered by HCI's public liability insurance of €5m.

Appendix 1: Details of Process Related Raw Materials, Intermediates, Products, Etc., used or Generated on Site

Ref. Nº or Code	Material/ Substance	CAS Number	Danger Category	Amount Stored (tonnes)	Annual Usage (tonnes)	Nature of Use	R- Phrase	S- Phrase
0400100001	Acetic acid	64-19-7	Corrosive, Flammable	53	424	Manufacturing	R10, R35	S1/2, S23, S26, S45
0100700274	Acetone	67-64-1	Irritant, Highly flammable	10	39	Manufacturing	R11, R36, R66, R67	S2, S9, S16, S26
0901500051	Acticarbone cx cvx	7440-44-0	Not available	0.5	1.65	Manufacturing	Not available	Not available
0100900278	Orthoaminodi-phenylether	2688-84-01	Dangerous for environment	40	110		R51/53	S61
0100900301	4-acetimo benzoic acid	556-08-01	Harmful, Irritant	8.2	11.3	Manufacturing	R20/21/22 R36/37/38	Not available
0400400003	Caustic	1310-73-2	Corrosive	20	278	Manufacturing	R35	S1/2, S26, S37/39, S45
0100300299	Dimethylisopropanol-amine	108-16-7	Flammable	7	12	Manufacturing	R10, R34, R22	S23, S26, S36, S45
0901500050	Dicalite	14808-60-7	Flammable	0.3	1.05	Manufacturing	R48/20	S22
	Dowfrost	57-55-6	Not available	2	3	Manufacturing	Not available	Not available
0602270116	Etodolac	41340-25-4	Toxic	3	5	Manufacturing	R23/24/25	S22, S36
0100900355	Etodolac methylester (02 todo)	122188-02-07	Not available	7	7	Manufacturing	Not Available	Not Available
0100700300	Ethanol draa + 0.1-3%methanol	64 – 17 – 5 67-56-1	Highly flammable	13	21	Manufacturing	R11	S2, S7/9, S16, S24

Ref. Nº or Code	Material/ Substance	CAS Number	Danger Category	Amount Stored (tonnes)	Annual Usage (tonnes)	Nature of Use	R- Phrase	S - Phrase
0400700006	Ethyl acetate	141-78-6	Highly flammable	45	120	Manufacturing	R11	S16, S23, S29, S33, S2
0400200002	Hydrochloric acid	7647-0-0	Corrosive	18	129	Manufacturing	R34, R37	S1/2, S26, S45
0100900302	Inosine p9101 1.00 gb current	58-63-9	Not available	2	3.8	Manufacturing	Not available	Not available
0602120001 1502120198 1502120199	Isoprinosine (incl intermediates)	61990-51-0	Not available	20	20	Manufacturing	Not available	Not available
	Metaclean 1	7664-38-2	Corrosive	0.5	1	Manufacturing	R34	R26
	Mobil rarus 427	Not available	Not available	0.5	1	Manufacturing	Not available	Not available
0100200269	Nitric acid	7697-37-2	Corrosive	10	50	Manufacturing	R35	S26, S28, S37/39, S45
0602000082 1502000128 1502000129 1502000131 1502000188	Nimesulide (incl intermediates)	51803-78-2	Harmful	120	164	Manufacturing	R22	Not available
	P3 – COSA – CIP95	1310-73-2	Corrosive	0.5	1	Manufacturing	R35	S26, S28, S37/39, S45
0602040031 1502040145 1502040144	Oxaprozin (incl intermediates)	21256-18-8	Not available	25	25	Manufacturing	Not available	Not available
0400700005	Isopropanol	67-63-0	Irritant, Highly flammable	45	125.2	Manufacturing	R11, R36, R67	S2, S7, S16, S24/25, S26
0100900267	Methane Sulphonyl Chloride	124-63-0	Very toxic	10	83	Manufacturing	R22, R26, R34, R41	S26, S28, S36/37/38, S45
0100850277	Sodium nitrite	7632-00-0	Oxidising, Toxic	1	1.2	Manufacturing	R8/25	S25/26/45
1502000126 1502000127	Sulfan (incl intermediates)	57765-57-6	Not available	30	125	Manufacturing	Not available	Not available

Ref. Nº or Code	Material/ Substance	CAS Number	Danger Category	Amount Stored (tonnes)	Annual Usage (tonnes)	Nature of Use	R- Phrase	S- Phrase
0100300270	Triethylamine	121-44-8	Corrosive, highly flammable	30	35	Manufacturing	R11, R20/21/22, R35	S3, S16, S26, S29, S36/37.39, S45
0400700011	Toluene	108-88-3	Harmful, highly flammable	10	39	Manufacturing	R11, R20	S16, S25, S29, S33
0400700004	Xylene	1330-20-7	Harmful	44	95	Manufacturing	R10, R20/21, R38, R65	S24, S25, S36/37, S43, S62
0100900207	Benzoin	119-53-9	Not available	10	34	Manufacturing	Not Available	Not Available
0100900194	Ammonium acetate	631-61-8	Irritant	10	17	Manufacturing	R20/21	S28
0100900120	Succinic anhydride	108-30-5	Irritant	10	20	Manufacturing	R36/37	S25
0100900301	Acetamidobenzoic Acid (PACBa)	556-08-1	Not available	0.025	0.05	Laboratory	Not available	Not available
	Acetanilide	103-84-4	Harmful	0.025	0.05	Laboratory	R22	Not Available
0400100001	Acetic acid, glacial	64-19-7	Corrosive	0.025	0.05	Laboratory	R10, R35	S1/2, S23, S26, S45
0100700274	Acetone	67-64-1	Irritant, highly flammable	0.025	0.05	Laboratory	R11, R36, R66, R67	S2, S9, S16, S26
	Acetonitrile	75-05-8	Harmful, flammable	0.025	0.05	Laboratory	R11, R20/21/22, R36	S16, S36/37
	Chloroform	67-66-3	Harmful	0.025	0.05	Laboratory	R22, R38, R40, R48/20/22	S36/37
	Dimethylformamide	68-12-2	Toxic	0.025	0.05	Laboratory	R20/21, R36, R61	S53, S45

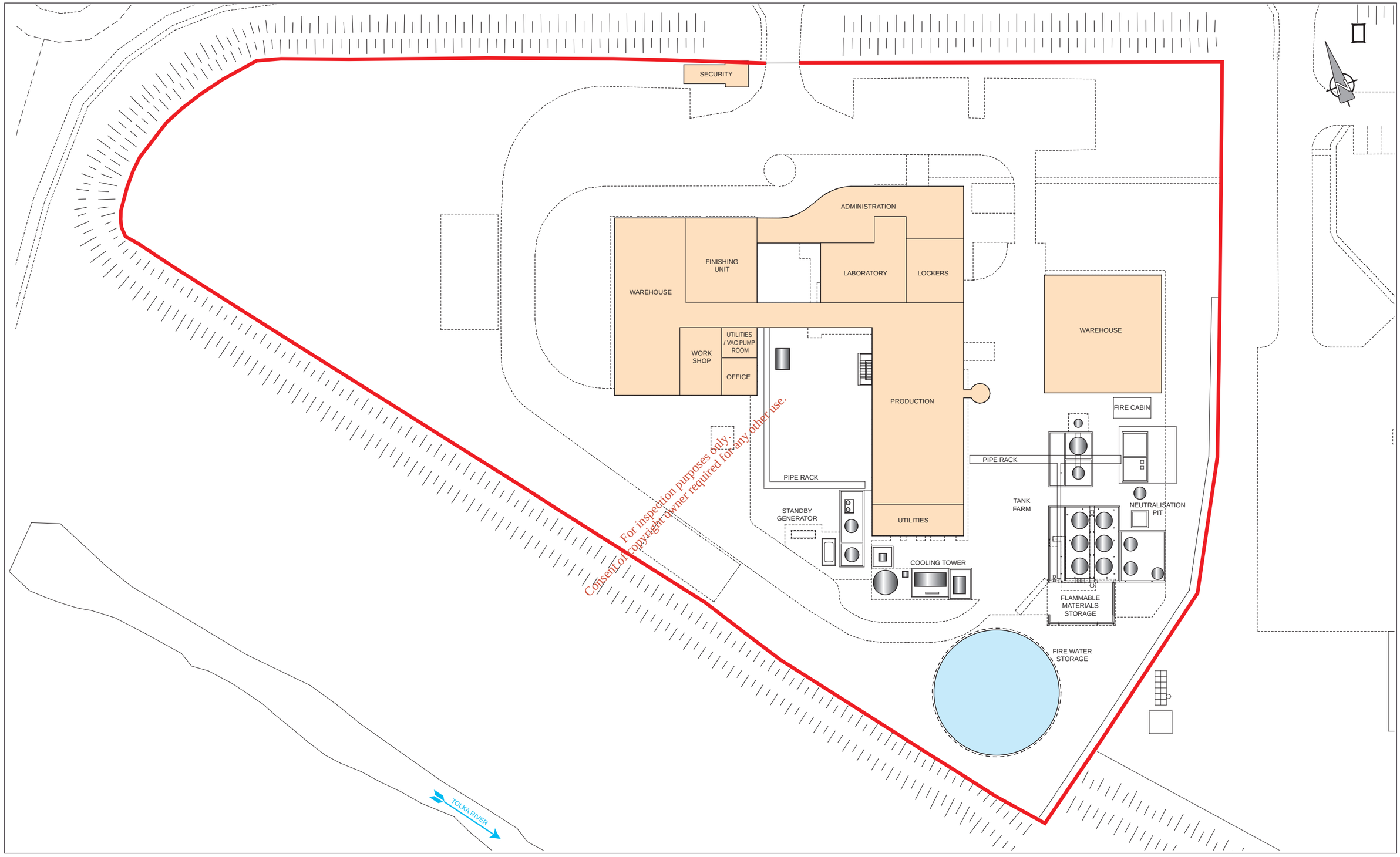
Ref. Nº or Code	Material/ Substance	CAS Number	Danger Category	Amount Stored (tonnes)	Annual Usage (tonnes)	Nature of Use	R - Phrase	S-Phrase
010070300	Ethanol	64-17-5	Flammable	0.025	0.05	Laboratory	R11	S7, S9, S16, S33
0400700006	Ethylacetate	141-78-6	Irritant, Flammable	0.025	0.05	Laboratory	R11, R36, R66, R67	S16, S26, S33
	Hydranal Coulomat Ag	67-56-1, 288-32-4, 7446-09-5, 111-42-2	Flammable, Toxic	0.025	0.05	Laboratory	R11, R23/24/25, R39/23/24/25, R41	S7, S16, S26, S36/37, S39, S45
	Hyrdanal Coulomat (Ak)	109-86-4, 67-66-3, 75-89-8, 288-32-4	Toxic	0.025	0.05	Laboratory	R60, R61, R10	S53, S26, S36/37, S45
	Hydranal Coulomat (Gk)	123-39-7	Toxic	0.025	0.05	Laboratory	R61, R21, R36/37/38	S53, S26, S36, S45
	Hydranal Solvent	67-56-1, 288-32-4, 7446-09-5	Highly Flammable, Toxic	0.025	0.05	Laboratory	R11, R23/24/25, R34, R39/23/24/25	S16, S26, S36/37/39, S45
0400200002	Hydrochloric Acid (25-36%)	7647-00-0	Corrosive	0.025	0.05	Laboratory	R34, R37	S1/2, S26, S45
	Isoprinosine	61990-51-0, 58-63-9	Not Available	0.025	0.05	Laboratory	Not Available	Not Available

Ref. Nº or Code	Material/ Substance	CAS Number	Danger Category	Amount Stored (tonnes)	Annual Usage (tonnes)	Nature of Use	R - Phrase	S - Phrase
0400700005	Isopropanol	67-63-0	Irritant, Highly Flammable	0.025	0.05	Laboratory	R11, R36, R67	S2, S7, S16, S24/25, S26
	Methanol	67-56-1	Toxic, Flammable	0.025	0.05	Laboratory	R11, R23/24/25, R39/23/24/25	S7, S16, S36/37, S45
	Nimesulide	51803-78-2	Harmful	0.025	0.05	Laboratory	R22	Not Available
0100200269	Nitric Acid (50-70%)	7697-37-2	Corrosive	0.025	0.05	Laboratory	R35	S23, S26, S36, S45
0100900278	O-ADPE	2688-84-8	Dangerous for Environment	0.025	0.05	Laboratory	R51/53	S61
	Orthophosphoric Acid	7664-38-2	Corrosive	0.025	0.05	Laboratory	R34	S26, S45, S1/2
	Perchloric Acid	7601-90-3	Oxidising, Corrosive	0.025	0.05	Laboratory	R35, R5, R8	S23, S26, S36, S45
	Silica Gel	63231-67-4	Not Available	0.025	0.05	Laboratory	Not Available	Not Available
	Sodium Hydroxide Pellets	1310-73-2	Corrosive	0.025	0.05	Laboratory	R35,	S26, S37/39, S45
0400400003	Sodium Hydroxide Solution	1310-73-2	Corrosive	0.025	0.05	Laboratory	R35	S1/2, S26, S37/39, S45
1502000126 1502000127	Sulfan	57765-57-6	Not Available	0.025	0.05	Laboratory	Not Available	Not Available

Ref. Nº or Code	Material/ Substance	CAS Number	Danger Category	Amount Stored (tonnes)	Annual Usage (tonnes)	Nature of Use	R - Phrase	S- Phrase
	Tetrabutyl Ammonium Hydroxide	7732-18-5	Corrosive	0.025	0.05	Laboratory	R20, R21, R22, R34	S7, S26, S36, S37, S39, S45
	Toluene	108-88-3	Harmful, Highly Flammable	0.025	0.05	Laboratory	R11, R20	S16, S25, S29, S33
	Polychem C1033ev	7631-95-0, 1310-58-3, 2809-21-4, 64665-57-2	Corrosive	0.060	0.120	Cooling Tower	R34	S26, S27, S37/39
	Chemhib 201	7632-00-0, 7631-99-4, 7631-95-0, 23783-26-8, 95-14-7	Not Available	0.028	0.056	Cooling Tower	Not Available	Not Available
	Biochem 1404	Not Available	Corrosive	0.025	0.050	Cooling Tower	R34, R20/21/22, R43	S26, S28, S36/37/39
	Biochem 1304	Not Available	Corrosive	0.025	0.050	Cooling Tower	R34, R22	S26, S36/37/39
	Bt2000	Not Available	Not Available	0.025	0.050	Cooling Tower	Not Available	Not Available
	Hydrogen	01333-74-0	Extremely Flammable	0.025	0.05	Laboratory	R12	S9, S16, S33
	Helium	7440-59-7	Not Available	0.025	0.05	Laboratory	Not Available	Not Available

Ref. Nº or Code	Material/ Substance	CAS Number	Danger Category	Amount Stored (tonnes)	Annual Usage (tonnes)	Nature of Use	R- Phrase	S- Phrase
	Compressed Air	Not Available	Not Available	0.025	0.05	Laboratory	Not Available	Not Available
	Acetylene	74-86-2	Extremely Flammable	0.025	0.05	Maintenance	R5, R6, R12	S9, S16, S33
	Argon	07440-37-1	Not Available	0.025	0.05	Maintenance	Not Available	Not Available
	Diisopropyl Ether	108-20-3	Highly Flammable	0.025	0.05	Laboratory	R11, R19, R66, R67	S9, S16, S29, S33
	Formaldehyde Soln	50-00-0	Toxic	0.025	0.05	Laboratory	R23/24/25, R34, R39/23/24/25, R40, R43	S26, S36/37/39, S45, S51
	Dioxane	123-91-1	Flammable, Harmful	0.025	0.05	Laboratory	R11, R19, R36/37, R40, R66	S9, S16, S36/37, S46
	Silica Gel/ Cobalt Chloride	112926-00-8, 7646-79-9	Toxic	0.025	0.05	Laboratory	R49, R42/43	S53, S22, S36/37, S45
	1, 2 Dichloromethane	107-06-2	Flammable, Toxic	0.025	0.05	Laboratory	R45, R11, R22, R36/37/38	S53, S45
	Acetic Anhydride	108-24-7	Corrosive	0.025	0.05	Laboratory	R10, R20/22, R34	S26, S36/37/39, S45
	Dichloromethane	75-09-2	Harmful	0.025	0.05	Laboratory	R40	S23, S24/25, S36/37

Ref. Nº or Code	Material/ Substance	CAS Number	Danger Category	Amount Stored (tonnes)	Annual Usage (tonnes)	Nature of Use	R - Phrase	S-Phrase
	Diethylene Glycol	111-46-6	Harmful	0.025	0.05	Laboratory	R22	S46
	Diethyl Ether	60-29-7, 128-37-0	Extremely Flammable, Harmful	0.025	0.05	Laboratory	R12, R19, R22, R66, R67	S9, S16, S29, S33
	N,N-Dimethylacetamide	127-19-5	Toxic	0.025	0.05	Laboratory	R61, R20/21	S53, S45
	N,N-Dimethylformamide	68-12-2	Toxic	0.025	0.05	Laboratory	R61, R20/21, R36	S53, S45
	Ethyl Acetate	141-78-6	Highly Flammable, Irritant	0.025	0.05	Laboratory	R11, R36, R66, R67	S16, S26, S33
	Heptane	142-82-5	Highly Flammable, Harmful, Dangerous For Environment	0.025	0.05	Laboratory	R11, R38, R50/53, R65, R67	S9, S16, S29, S33, S60, S61, S62
	Tert-Butyl-Methyl-Ether	1634-04-4	Highly Flammable, Harmful	0.025	0.05	Laboratory	R11, R40, R43	S16, S36/37
	Tetrahydrofuran	109-99-9	Highly Flammable, Irritant	0.025	0.05	Laboratory	R11, R19, R36/37	S16, S29, S33
	Nitrogen	7782-44-7	Not Available	0.025	0.05	Laboratory	R8	S9, S17
	Oxygen	07727-37-9	Not Available	0.025	0.05	Laboratory	Not Available	Not Available



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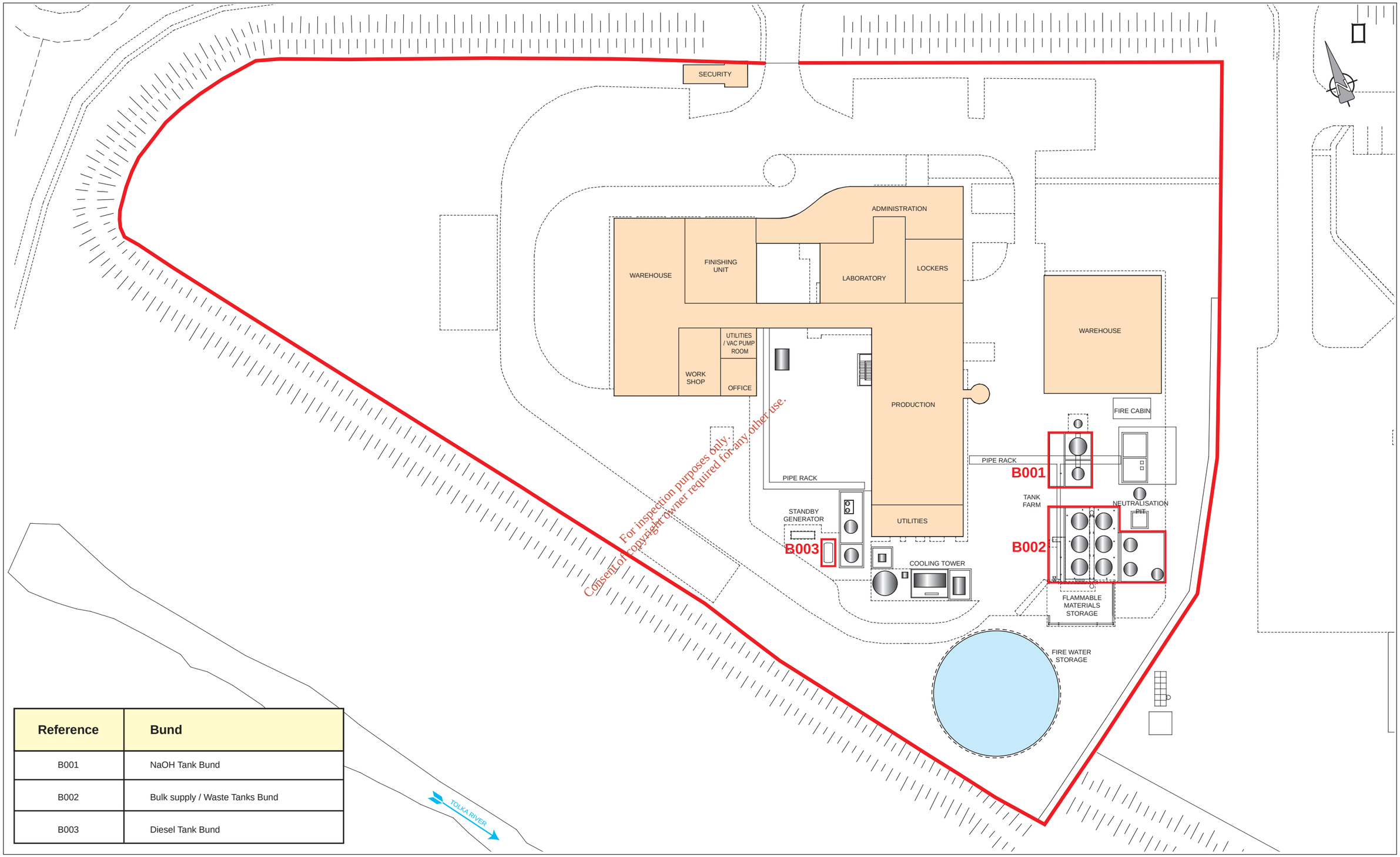
Site Layout

Environmental Liabilites Risk Assessment

D5106.12 | January 2006 | Figure 01

FIGURE



Reference	Bund
B001	NaOH Tank Bund
B002	Bulk supply / Waste Tanks Bund
B003	Diesel Tank Bund

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Bund Locations

Helsinn IPPC Licence

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