Firewater Retention Study

For Janssen Pharmaceutical Sciences UC

Final Rev.1

3rd September 2020

Environet Solutions

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Document Control

Status	Draft	Final Draft	Final	Final Rev. 1
Date	27/07/20	31/07/20	31/07/20	03/09/20
Version #	1	2	3	4
Written				
Checked				
Approved				

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1 Executive Summary

Environet Solutions (Environet) was commissioned by Janssen Pharmaceutical Sciences UC (Janssen) to assess the status of its Little Island facility with respect to firewater retention.

The work completed was as follows:

- Assessment of Environmentally Hazardous Substance Storage Thresholds;
- Assessment of Environmental Receptor Criteria;
- Risk Assessment of Significance and Hazard Potential;
- Firewater Retention Capacity Calculations.

Environet has reviewed the activities, location, stormwater discharge points, material types and quantities, fire detection and protection measures at the site and concluded that firewater retention facilities are required due to the quantities of hazardous materials on-site. There is also a high significance of a fire event and hazard potential resulting from the materials on-site. The site was compartmentalised into ten zones (Zones A – J) which were individually risk assessed. The firewater risk assessment concluded that firewater retention is required for Zones A, D, E and I.

The site has firewater retention capacity of 5,092 m^3. A maximum firewater retention quantity of 4,799.8 m^3 has been calculated, which relates to a fire in assessment Zone I (Tank Farm 1) and includes rainfall contribution from a 1 in 10 year 24-hour rainfall event. Therefore, there is sufficient capacity available at the site to cover the retention required as calculated in this report.

1.1. Report Preparation

This report was prepared on behalf of the operator by Environet Solutions.

Environet Solutions

Dungarvan Business Centre

Dungarvan

Co. Waterford

1.2. Assumptions

The following assumptions have been made in order to facilitate the production of this report:

- It is assumed that all relevant information and material has been provided to Environet by the client.

2 Introduction

Environet was commissioned by Janssen to assess the status of its Little Island facility with respect to firewater retention.

The firewater risk assessment included the following:

- Assessment of Environmentally Hazardous Substance Storage Thresholds;
- Assessment of Environmental Receptor Criteria;
- Risk Assessment of Significance and Hazard Potential;
- A Description of Fire Protection Systems;
- Firewater Retention Capacity Calculations.

2.1 Activity Details

Name:	Janssen Pharmaceutical Sciences UC
Address:	Wallingstown, Little Island, Cork
IE Licence Number:	P0016-02
Activity Licensed:	*The production of pharmaceutical products including intermediates (production means the production on an industrial scale by chemical or biological processing)*

2.2 Requirement to carry out the Assessment

The Industrial Emissions (IE) licence condition relating to firewater retention is as follows:

9.2 Fire-water Retention

9.2.1 The licensee shall carry out a risk assessment to determine if the activity should have a fire-water retention facility. The licensee shall submit the assessment and a report to the Agency on the findings and recommendations of the assessment within six months of the date of grant of this licence.

9.2.2 In the event that a significant risk exists for the release of contaminated firewater, the licensee shall, based on the findings of the risk assessment, prepare and implement, with the agreement of the Agency, a suitable risk management programme. The risk

management programme shall be fully implemented within three months from date of notification by the Agency.

9.2.3 The licensee shall have regard to the Environmental Protection Agency Draft Guidance Note to Industry on the Requirements for Fire-Water Retention Facilities when implementing Conditions 9.2.1 and 9.2.2 above.

The assessment has been prepared in accordance with the methodology set out in the Environmental Protection Agency (EPA) guidance document titled 'EPA Guidance on Retention Requirements for Firewater Run-off' (2019). This guidance document is referred to hereafter as the 'EPA Guidance Note'.

2.3 Overview of the Firewater Risk Assessment (FWRA)

The following stages were undertaken in order to determine the requirement for firewater retention.

Stage 1:

Stage 1 consists of the examination of the requirement for firewater retention based on automatic qualifying criteria. The automatic qualifying criteria assessed are as follows:

1. Environmentally Hazardous Substance Storage Thresholds

The first qualifying criterion is the quantity of substances on-site that possess environmental H-Statements, as defined in the Classification, Labelling and Packaging 'CLP' Regulation (EC) No.1272/2008. The CLP/GHS uses a system of Hazard Statements (H-Statements) which describes the nature of the hazard associated with a substance or mixture. The H-Statements can be classified by groups relating to their physical, health, and environmental hazards. Only substances with environmental H-Statements are considered for this qualifying criteria assessment. These H-Statements fall within the following range:

- *H400 - H499 Environmental hazards (e.g. Toxic to Aquatic Life, Harmful to Aquatic Life).*

The quantity of material on-site is then assessed against storage thresholds of these specific environmental H-Statements, as outlined in the EPA Guidance Note. Where storage of substances with these H-Statements is at or above the stated thresholds, firewater retention is required.

2. *Environmental Receptor Criteria for Sites whose Activities Involve Potentially Polluting Substances*

The second qualifying criterion is a source to receptor assessment to determine if the site's activities involve potentially polluting substances and a **direct stormwater discharge** to any one of the following types of receiving waters:

- Municipal drinking water intake points;
- Designated bathing waters;
- Freshwater pearl mussel rivers;
- Designated shellfish waters;
- Waterbodies characterised as 'High' Status under the Water Framework Directive;
- Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Natural Heritage Areas (NHA).

If either of the above criteria are met at a facility, firewater retention is automatically required. If the facility does not meet either of the above criteria, a firewater risk assessment is required, in line with the EPA Guidance Note as described in Stage 2.

Stage 2:

If a facility does not automatically require firewater retention (as outlined in Stage 1), then a risk assessment is undertaken to establish if there is a further requirement for firewater retention. A comprehensive risk assessment is critical to ensuring that all risks are identified. Considered here are the Significance of Fire Event (S), Environmental Hazard Potential (H) and Firewater Run-Off Risk (R). The Risk Assessment Excel Tool is used to calculate firewater run-off risk based on these variables. The Significance of Fire Event inputs include the quantities and types of flammable and combustible material on-site, fire detection and fire protection measures in place in the facility. The Environmental Hazard Potential inputs include the properties and quantities of hazardous substances stored on-site. The combination of the two variables gives the overall firewater run-off risk and determines whether firewater retention is required at the facility.

Stage 3:

Stage 3 involves the calculation of firewater retention capacity. Three methods of calculating retention capacity are set out in the EPA guidance document. The applicability of each method is dependent on the activities undertaken in, and the characteristics of, the area being evaluated, the availability of data and the

associated fire suppression measures. The following quantities are determined, as a basis for the calculation:

a) The volume of contaminated firewater run-off likely to be produced for the whole site or for each separate assessment area identified for the risk assessment (e.g. Process Area, Tank Farm and Warehouse);
b) The expected volume of rainfall contribution for the whole site, during the fire event.

The largest volume of firewater run-off determined for (a) is then combined with (b) to determine the total retention volume required.

It should be noted that Stage 3 is only required if Stage 1 and/or Stage 2 conclude that firewater retention is required.

3 Site Description

Janssen is in the Little Island Industrial Estate, as shown in Figure 1. The facility is located approximately 7 km east of Cork City. The nearest waterbody is Lough Mahon which is approximately 750 m south of the facility. The R623 borders the site to the north. The facility is surrounded in all directions by industrial units.

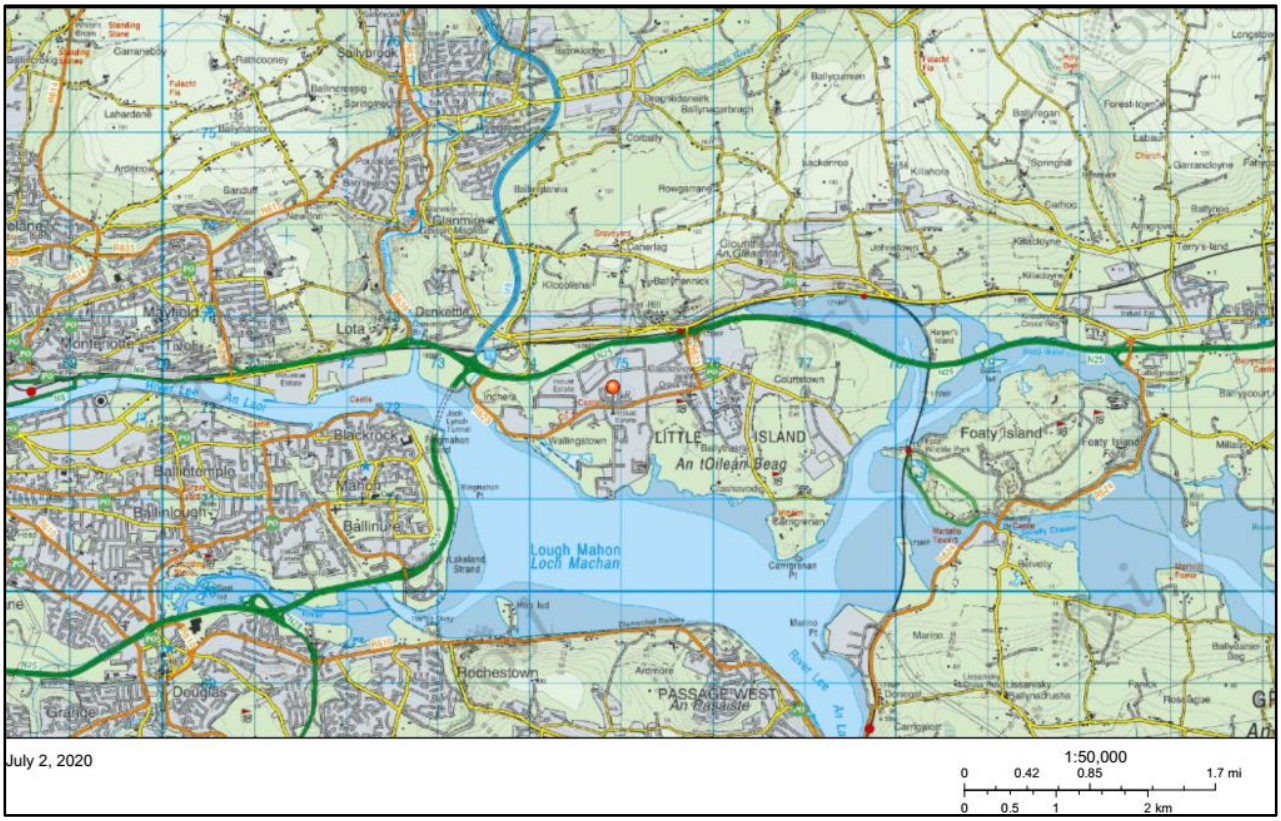


Figure 1: Site Location

3.1 Company Details

Janssen Pharmaceutical Sciences Unlimited Company is a wholly owned subsidiary of Johnson & Johnson (the US healthcare company) and is an associate company of Janssen Pharmaceutical NC of Beerse, in Belgium.

3.2 Site History

Janssen purchased the Little Island site in 1981 from Pilmar Pharmaceuticals. Since then, the facility has been expanded and upgraded. Janssen has been licenced by the EPA since 1995. This licence was reviewed, and a new licence was issued in 2005 for the use of a chemical process for the production of basic pharmaceutical products.

3.3 Site Operations

The Janssen Little Island site manufactures a range of Active Pharmaceutical Ingredients (APIs) for use in human pharmaceutical products. These pharmaceuticals are used in psychiatry, mycology, parasitology, allergology, immunology, cardiovascular medicine and in the treatment of HIV/AIDS.

3.4 Site Drainage

Stormwater from the site is discharged to the Cork County Council Storm Drainage Network. This drainage system ultimately discharges to Lough Mahon. The area of the site is 58,479 m^2, of which 41,596 m^2 has been calculated to be hardstanding and drains to surface water drainage network.

3.5 Surface Waters

Lough Mahon (Transitional Waterbody Code IE_SW_060_0750) is located approximately 800 m south of the facility as shown in Figure 2. The Kilcoolishal River (River Waterbody Code: IE_SW_19T250870) is located approximately 500 m north of the site. This flows into the Dunkettle Shore (Site Code: 001082) and is joined by the Rowgarrane River (River Waterbody Code: IE_SW_19G010600) which subsequently flows into Cork Harbour approximately 1.2 km northwest of the facility.

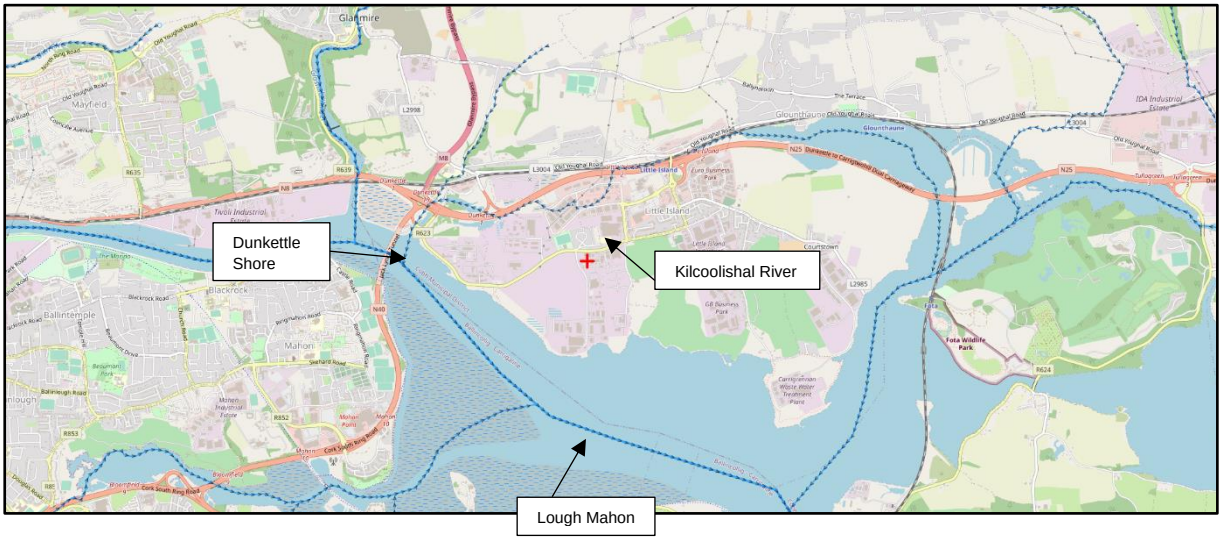


Figure 2: Surface Waters Surrounding the Janssen Facility

3.6 Materials

The primary raw materials used on-site include:

- Organic Solvents (Isopropyl Alcohol, Acetone, Toluene, Ethanol, Methanol, etc.);
- Ammonia;
- API.

3.7 Site Containment Measures

According to the Office of Public Works (OPW) flood maps, there is less than 0.1% Annual Exceedance Probability (i.e. less than a 1-in-a-1,000 chance of occurring or being exceeded in any given year) of flooding at the Janssen site. Therefore, it is unlikely that the facility will experience flooding.

All tanks and materials on-site are appropriately bunded as per EPA Guidelines. All bunds comply with volume requirements specified in the IE Licence. There are also spill kits strategically located throughout the site.

3.8 Site Zoning

The site has been compartmentalised into the zones outlined in Table 1 below for the purpose of the risk assessment. A site layout plan outlining the compartments is shown in Figure 3 and Appendix K. Further supporting information for site compartmentalisation is given in Section 7.2.

Zone	Area	Basis for Compartmentalisation
A	Warehouse, Technical Services Building	There is at least 15 m between the buildings in Zone A and any other buildings.
B	Logistics Building, Administration Building, Engineering Office, Maintenance Workshop, Laboratory, Dryer Building	There is at least 15 m between the buildings in Zone B and any other buildings.
C	Process Plant 1, Chiller Building, Utilities Building, Cooling Tower, Sprinkler Deluge House	Basis of sprinkler design (see Section 7.2)
D	Drumstore	There is at least 15 m between the Drumstore and any other buildings.
E	Tank Farm 2, Tank Farm 3, Ammonia Scrubber	Basis of deluge design (see Section 7.2)

Zone	Area	Basis for Compartmentalisation
F	Environmental Waste Management Building	There is at least 15 m between the Environmental Waste Management Building and any other buildings.
G	Process Plant 3, Headblock	There is at least 15 m between the buildings in Zone G and any other buildings.
H	Central Utilities Building	There is at least 15 m between the Central Utilities Building and any other buildings.
I	Tank Farm 1	Basis of deluge design (see Section 7.2)
J	Process Plant 2 ,Central Cleaning Building	Basis of sprinkler design (see Section 7.2)

Table 1: Site Zones used for the Risk Assessment and the Basis for Compartmentalisation for Each Zone

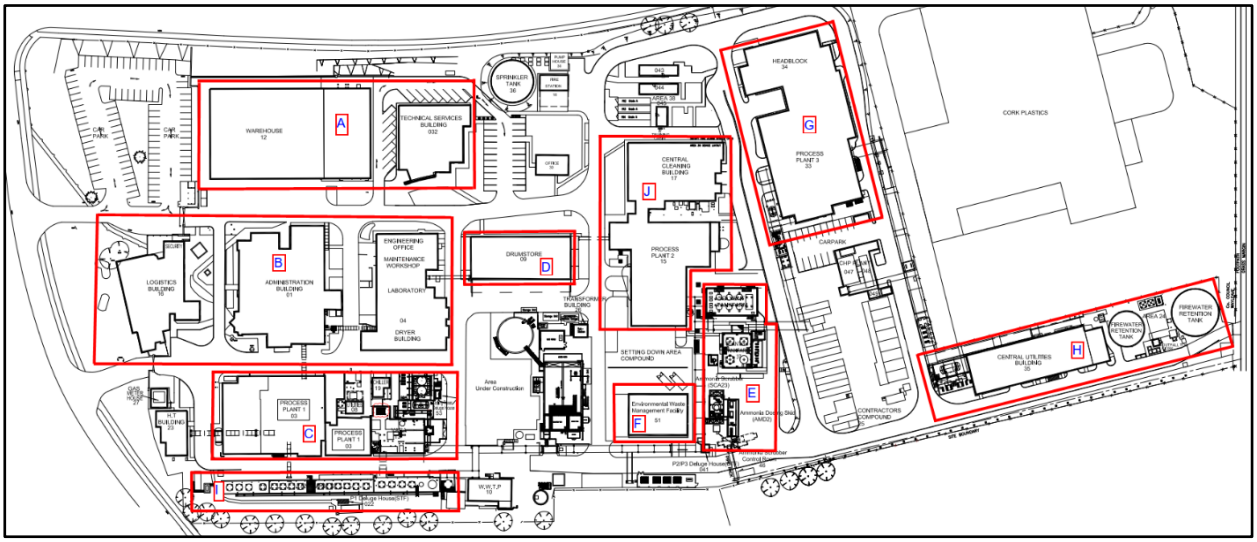


Figure 3: Site Zones used for the Purpose of the Risk Assessment

4 Stage 1 - Qualification

4.1 Qualifying Criteria

The *'EPA Guidance Note'* states that firewater retention is required if a site qualifies through the criteria outlined in Section 4.2. and Section 4.3.

4.2 Environmentally Hazardous Substance Storage Thresholds

This first qualifying criterion is the quantity of substances that contain environmental H-Statements on-site which are defined in the Classification, Labelling and Packaging 'CLP' Regulation (EC) No. 1272/2008. The H-Statements found in substances on-site that will require the facility to have firewater retention fall within the following range:

- *H400 – H499 Environmental Hazards (e.g. Toxic to Aquatic Life, Harmful to Aquatic Life).*

The storage thresholds of substances with the specific environmental H-Statements which will lead to the requirement for firewater retention are given in Table 2. Should the facility have quantities of these substances at or above any of these thresholds' firewater retention will be required. The quantities of the relevant materials stored at the Janssen facility are outlined in Table 3 and detailed further in Appendices A – J.

Hazard Statement	Hazard Details	Storage Quantity Thresholds (tonnes)[1]
H400 H410	Very toxic to aquatic life Very toxic to aquatic life with long lasting effects	1
OR		
H401 H411	Toxic to aquatic life Toxic to aquatic life with long lasting effects	10
OR		
H402 H412	Harmful to aquatic life Harmful to aquatic life with long lasting effects	100
OR		
H413	May cause long lasting harmful effects to aquatic life	1,000

Table 2: Storage Thresholds of Substances with Environmental H-Statements

	Quantity (tonnes)			
Zone	**H400/H410 Materials**	**H401/H411 Materials**	**H402/H412 Materials**	**H413 Materials**
A	1.183	0.115	27.737	0
B	0	0	0	0
C	0	0	0	0
D	9.503	0	1.348	0.033
E	0	0	0	0
F	0	0	0	0
G	0	0	0	0
H	0	0.845	0	0
I	0	0	0	0
J	0	0	0	0

Table 3: Storage Quantities of Substances with Environmental H-Statements at the Janssen Facility

[1] The multiplying factor of 10 between the categories is based on the CLP Methodology for Aquatic Life Hazard Classification and Labelling for 'substances'. Further information is available from the European Chemicals Agency

4.3 Environmental Receptor Criteria

This second qualifying criterion applies to sites whose activities involve potentially polluting substances and have a **direct stormwater discharge** from source to receptor, to any one of the following types of receiving waters:

- Municipal drinking water intake points;
- Designated bathing waters;
- Freshwater pearl mussel rivers;
- Designated shellfish waters;
- Waterbodies characterized as High Status under the Water Framework Directive (WFD); Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Natural Heritage Areas (NHA).

Stormwater is discharged from the Janssen site to the Cork County Council Storm Drainage Network, which is ultimately discharged to Lough Mahon.

4.3.1 Municipal Drinking Water Intakes

Janssen does not discharge stormwater directly to any drinking water intake points.

4.3.2 Designated Bathing Waters

Janssen does not discharge stormwater directly to any designated bathing waters. There is one designated bathing water within 15 km of the facility as shown in Figure 4:

- Fountainstown (BWID: IESWBWC050_0000_0100), approximately 14 km south of the site.

Figure 4: Location of Bathing Waters Surrounding Janssen

4.3.3 Freshwater Pearl Mussel Rivers

Janssen does not discharge stormwater directly to a freshwater pearl mussel river.

4.3.4 Designated Shellfish Waters

Janssen does not discharge stormwater directly to a designated shellfish water. There are four designated shellfish waters within 15 km of the Janssen site as shown in Figure 5.

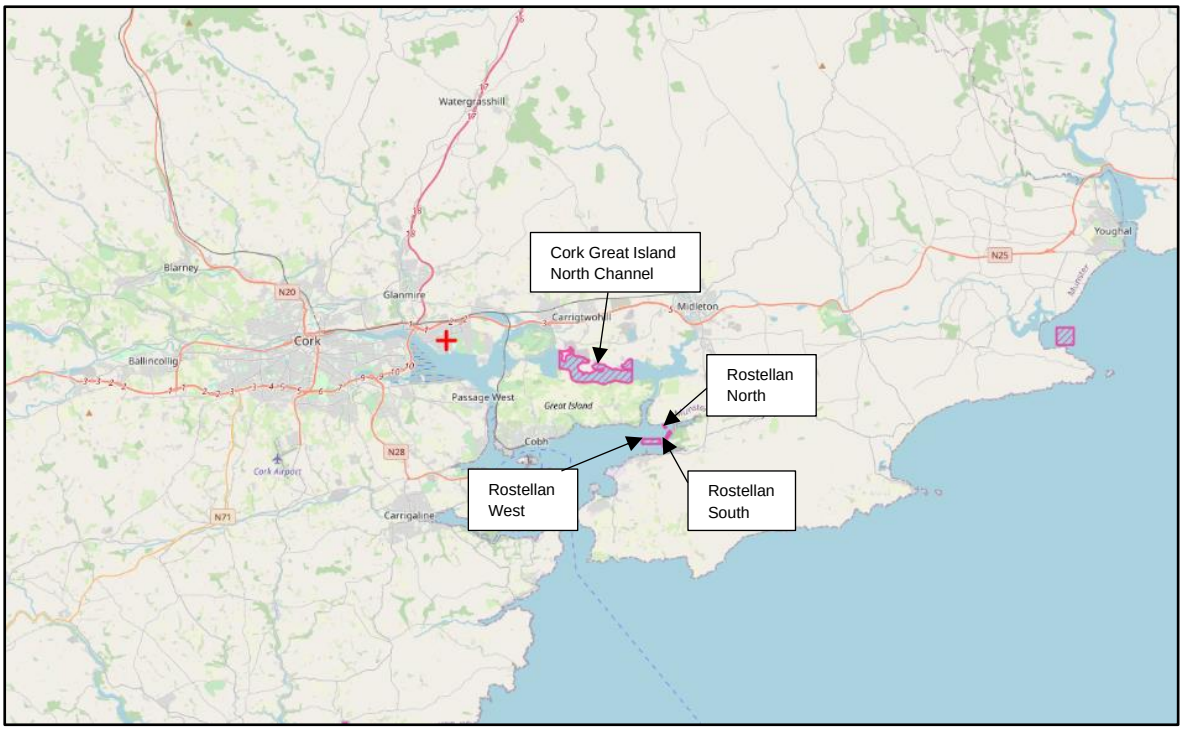


Figure 5: Location of Designated Shellfish Waters within 15 km of Janssen

4.3.5 Waterbodies Characterised as 'High' Status under the Water Framework Directive (WFD)

Stormwater from the Janssen facility is not discharged to a waterbody that is characterised as 'high' under the Water Framework Directive (WFD). Lough Mahon is classified as 'moderate' under the WFD as shown in Figure 6.

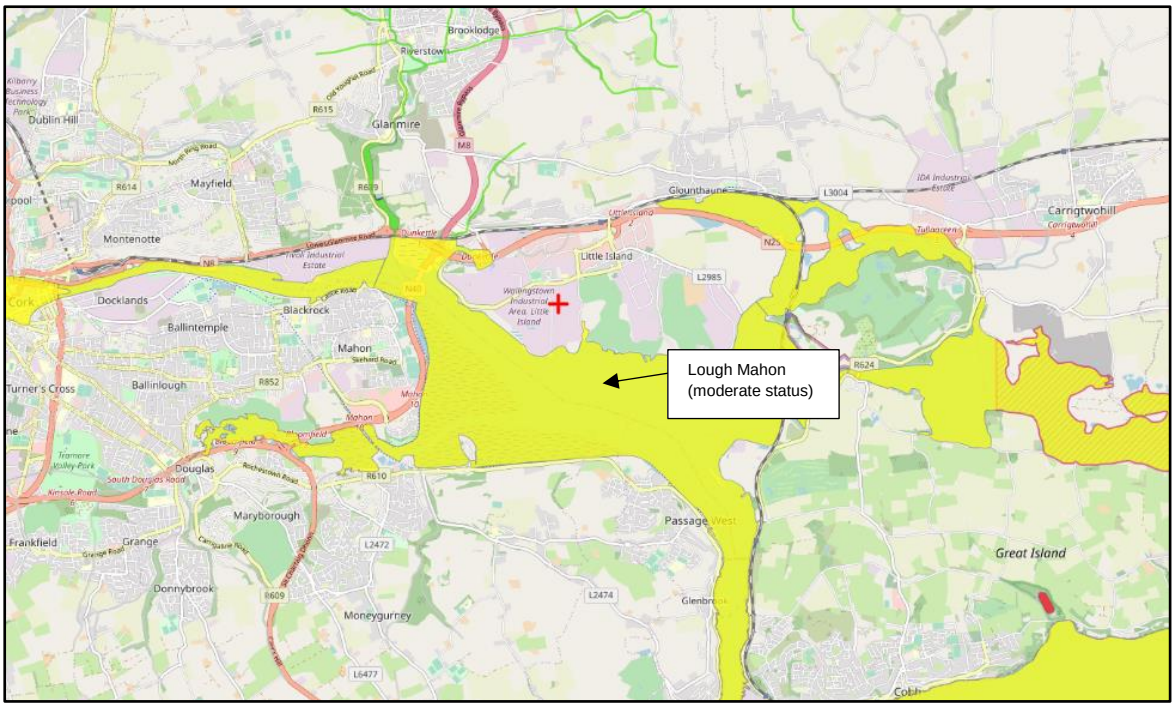


Figure 6: WFD Status of Water Bodies Surrounding the Janssen Facility

4.3.6 Special Areas of Conservation (SAC), Special Protection Areas (SPA), National Heritage Areas (NHA)

Janssen does not discharge stormwater directly to any European protected areas. Stormwater is discharged to the Cork County Council Storm Drainage Network. This drainage system ultimately discharges to Lough Mahon. There are two European sites within 15 km of the site as outlined in Table 4 and shown in Figure 7.

Protected Area	Distance from Janssen facility	Site Code
Cork Harbour SPA	100 m Southeast	004030
Great Island Channel SAC	3.2 km East	004124

Table 4: European Sites Surrounding the Facility

Figure 7: Protected Areas within 15 km of Janssen

4.4 Summary of Qualifying Criteria Thresholds

According to Stage 1 of the risk assessment, Zone A and Zone D automatically require firewater retention due to the quantity of Environmentally Hazardous Substances stored in these zones. Janssen does not discharge stormwater directly to any of the receptors outlined in Section 4.3.

5 Stage 2 - Firewater Risk Assessment (FWRA)

5.1 Firewater Risk Assessment Methodology

The Risk Assessment Excel Tool is provided by the EPA to assess the requirement for firewater retention using a methodology developed with reference to the VCI (German Chemical Industry Association) Firewater Retention Guidance. This methodology (see Figure 8) assesses the Firewater Run-off Risk (R) to the environment based on the Significance of Fire Event (S) that could generate substantial quantities of firewater, and the Environmental Hazard Potential (H), due to the generation of firewater run-off. The inputs into the tool are as follows:

- Significance of Fire Event: the fire detection and/or prevention measures as well as quantities and types of flammable materials stored on-site;
- Environmental Hazard Potential: quantities and types of materials on-site that are considered to be hazardous to the aquatic environment.

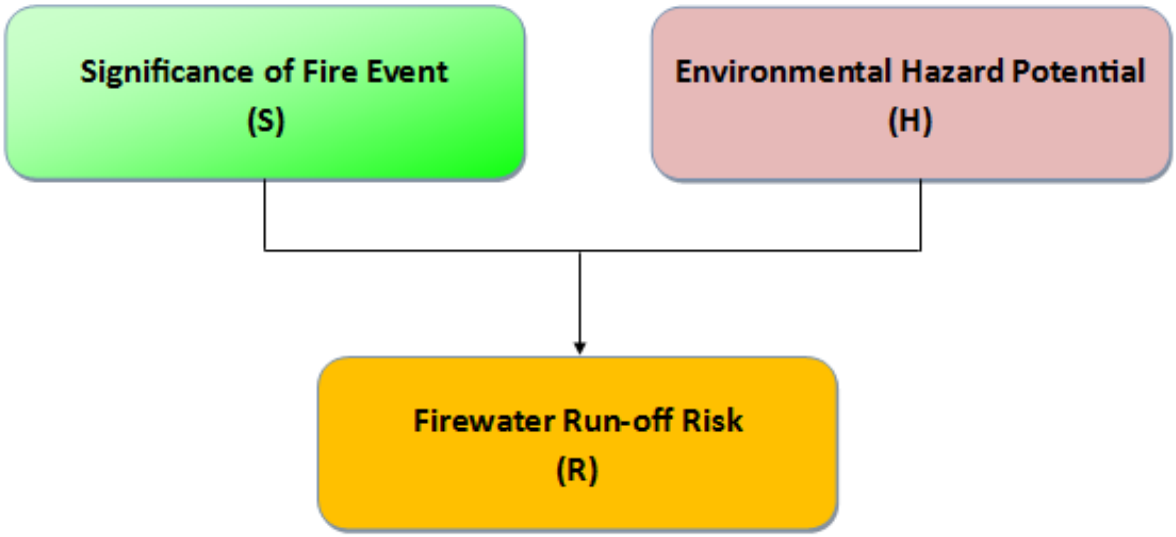


Figure 8: Methodology for Determination of Firewater Run-off Risk (R)

5.1.1 Significance of Fire Event

Within the Significance of Fire Event Section of the Risk Assessment, the following variables are taken into account:

- **Fire Detection and Alarm System** – If the facility has fire detection in situ, it must be designed, installed and maintained to IS 3218:2013 *Fire Detection and Fire Alarm Systems for Buildings – System Design, Installation, Servicing and Maintenance* or an equivalent recognised standard;

- **Automatic Fire Protection** – The facility may have automatic fire protection in the form of sprinklers, fixed water spray, foam water or a deluge system designed and maintained to an appropriate standard;
- **Fire Load – Flammables** – Quantities of flammables and combustible materials processed or stored in the assessment area should be considered. The materials with the following H-Statements should be considered in this section:
    - H224;
    - H225;
    - H226;
    - H227.

According to the EPA Guidance Note, any liquid with a H226 Hazard Statement that is stored at 15 °C or more below the flashpoint, as stated on the relevant SDS, can be considered H227 (a combustible liquid) for the purpose of this assessment.

The thresholds for Flammable Substances are shown in Table 5. The significance of a fire will depend on the fire load, and the detection and mitigation measures in place. The levels of significance used in the risk assessment are given in Table 6. The scoring details used in the excel tool in the Significance of Fire tab are shown in Table 7.

Threshold	Flammable Liquid	Flammable Solids	Flammable Gas	Combustibles
Upper	≥50	≥10	≥5	≥200
Middle	≥5 - ≥50	≥0.5 - <10	≥0.1 - <5	≥30 - <200
Lower	≥0.1 - <5	≥0.05 - <0.5	≥0.01 - <0.1	≥2 - <30
None/Negligible	<0.1	<0.05	<0.01	<2

Table 5: Flammable Substance Thresholds in Tonnes

Likelihood	Description
S1	Low Significance
S2	Medium Significance
S3	High Significance

Table 6: Significance of Fire Event

Flammable Material Threshold	Fire Protection	Significance
None	N/A	S 1
Lower	FDAS	S 1
Lower	None	S 2
Middle	FDAS Sprinklers	S 1
Middle	FDAS	S 2
Middle	None	S 3
Upper	Any	S 3

Table 7: Scoring of Significance of Fire Event

5.1.2 Environmental Hazard Potential

The Environmental Hazard Potential is determined by the following criteria:

- Properties of hazardous substances stored;
- Quantity of hazardous substances stored.

The hazard potential categories are given in Table 8. If H-Statements are not available for a material it is possible to use Water Hazard Classification (WGK) rating in the assessment. Materials such as food products may not be classified as dangerous substances according to EU Regulations but can be hazardous to waters if unintentionally released. The WGK rating would be used in this case but only one rating should be used for each material. Also considered in this assessment are Genetically Modified Organisms (GMO). These are organisms in which their DNA has been altered in a way that does not occur naturally. Certain groups of GMOs can have adverse effects on the environment and human health should they be released. There are no GMOs in the Janssen facility.

Hazard Potential	Description
H0	**No Hazard Potential**
H1	**Hazard Potential**

Table 8: Levels of Hazard Potential used in the Risk Assessment

5.1.3 Overall Firewater Run-Off Risk

The overall firewater run-off risk is determined using the results of the Significance of Fire Event assessment and the Hazard Potential assessment. The result is either a low or high risk and will determine if the 'assessment area' will require firewater retention.

The method of evaluating the firewater run-off risk based on the results of (S) and (H) is given in Table 9. Within this table the areas shown in green represent **R0** for which no firewater retention is required and the areas in red represent **R1** which indicates that retention is required. These risks are explained in Table 10.

	H0	H1
S1	**R0**	**R1**
S2	**R0**	**R1**
S3	**R1**	**R1**

Table 9: Overall Firewater Run-Off Risk Score Sheet

Risk	Minimum Firewater Retention Measures Required
R0 No Risk	No dedicated firewater retention required.
R1 Risk of Environmental Contamination	Firewater run-off must be retained within the operational site. The retention can be provided by means of the site's drainage system and other suitable infrastructure which is not exclusively foreseen for firewater retention (e.g. stormwater ponds/tanks in wastewater treatment plants). All elements of the site infrastructure to be used for firewater retention (including shutoff valves) must be regularly inspected to ensure functionality and impermeability. The retention

Risk	Minimum Firewater Retention Measures Required
	facility must remain impermeable for the duration of the incident up to the removal of the firewater run-off. The documented available retention capacity in the existing site infrastructure must be monitored and maintained. Automatic shut-off valves must be maintained and tested. Diversion of firewater to retention facilities must be automatic on activation of the site fire alarm. On-site bunds cannot be used to provide firewater retention unless the content of a bund is directly involved in the fire event.

Table 10: Firewater Risk Assessment Summary

5.2 Firewater Risk Assessment

The Significance of Fire Event and the Hazard Potential generated for each zone of the Janssen facility, based on the amounts of flammable materials and environmentally hazardous materials on-site, are shown in Table 11. See Appendices for the FWRA tables detailing each individual assessment zone.

Zone	Significance of Fire Event	Hazard Potential	Overall Risk
A	S1	H1	R1
B	S1	H0	R0
C	S1	H0	R0
D	S3	H1	R1
E	S3	H0	R1
F	S1	H0	R0
G	S1	H0	R0
H	S1	H0	R0
I	S3	H0	R1
J	S1	H0	R0

Table 11: Overall Firewater Run-off Risk Score for Each FWRA Area in the Janssen Site

5.3 Stage 2 – Firewater Risk Assessment Conclusion

Following the Stage 2 Environmental Risk Assessment, it can be concluded that due to the quantities of Flammable Materials and/or Environmentally Hazardous Materials, firewater retention is required for Zones A, D, E and I. Firewater

retention is not required for any other zones according to the risk assessment. Therefore, Stage 3 retention calculations have been carried out for Zones A, D, E and I.

6 Stage 3 Retention Capacity Calculation

6.1 Calculation Methods

There are three calculation methods for Retention Capacity outlined in the EPA Guidance Note. Each method aligns with ISO/TR 26368:2012 “Environmental damage limitation from fire-fighting run-off” issued by the ISO (the international organisation for standards), a worldwide federation of national standards bodies.

The three calculation methods are as follows:

- **Method 1: Warehouse Retention Calculation** – this method is based on the Swiss Federation Firewater Retention Practical Guide. This method is likely to be suitable for sites with warehouses built to high specifications. It considers the size of the warehouse, the storage density and the fire protection measures in place;
- **Method 2: Tank Farm/Process Plant Retention Calculation** – this method requires detailed information on the design of the tank farm or process plant fire protection measures. The method is based on inventory, fire protection measures, estimated extinguishing time and local containment;
- **Method 3: General Retention Calculation** – This method is used if Methods 1 or 2 are deemed to be inappropriate for the site or the required information or expertise is not available. it is based on the worst-case firewater volumes that could be generated.

6.2 Firewater Retention Infrastructure

The existing firewater retention facility was constructed in 1997 and consists of a 3,000 m^3 nominal capacity above ground glass lined steel tank, fed by a diesel pump set drawing from a 26 m^3 sump. In the event of a fire incident all storm water drains, overflows from process sumps and bund firewater control devices are diverted to this sump. A second retention tank was constructed in 2016 to the east of the current facility which has a nominal capacity of 1,610 m^3.

There is also infrastructure in place to pump liquid from the retention tanks to the site wastewater treat plant (WWTP). The spare operating capacity of the WWTP is 240m^3 (assuming both Diversion Tank and Balance tank are at 80% Capacity).

The additional storage volume available in the stormwater pipe network is 216 m^3, which brings the total retention volume available on-site to 5,092 m^3. The stormwater drainage system is integrity tested and certified on a 3-year cycle.

The underground storm network consists of 180 manholes and over 4,500 m of pipework varying in size from 150 mm diameter to 225 mm diameter and 180 manholes, each with a minimum volume of 0.76 m^3.

The firewater containment system operates on the basis the stormwater flows to the stormwater monitoring chamber located at the south eastern side of the site. Under normal operating conditions this chamber discharges directly to the Cork County Council public stormwater system. However, in the event of an incident, triggered by automatic monitoring within the chamber, a shutoff valve is activated, and the incoming water is diverted to the firewater retention tank sump. This diversion can also be activated manually.

Level switches within this sump activate the high capacity diesel driven dual duty/standby pump set which fills the above ground firewater retention tanks.

Ancillary retention elements include the storage tank farm bunds, wastewater treatment plant storage elements where capacity above operating level exists and the underground process water pipe network, sumps and manholes.

6.3 Zone A Retention Calculations

The method used to calculate firewater retention in Zone A (Warehouse and Technical Services Building) is Method 1: Warehouse Calculation. The Fire Detection and Alarm Systems (FDAS) in this zone are certified to IS 3218:2013. The retention calculations for this zone are given in Table 12 below. It has been calculated that there is sufficient firewater retention capacity available for Zone A.

Number	Calculation Steps	Response
1.1	Size of Storage Area (m^2)	2,004
1.2	Flammable Material (tonnes)	0
1.3	Combustible Material (tonnes)	81.29
1.5	Aerosol materials, not already classified as flammable - H222, H223 (tonnes)	0
1.6	Oxidising Material not already classified - H270, H271 (tonnes)	0
1.7	Oxidising Material not already classified - H272 (tonnes)	0
1.4	Non Combustible Material (tonnes)	0
1.8	Total F1/F2 Materials	0
1.9	Total F3/F4 Materials	81.29
1.1	Total Storage in this Area (tonnes)	81.29

Number	Calculation Steps	Response
1.11	Fire Hazard Category	F3/F4
1.12	Storage Density (kg/m^2)	40.57
1.13	Storage Density Factor	0.5
1.14	Type of Storage	Rack: Height = 6m - 12m
	Preliminary Fire Water Retention Required m^3 (without storage density factor)	320
	Sprinklers	Yes
	Note on Preliminary Result	**Fire Compartment Size is Acceptable**
	Total Storage Quantity (kg)	81.29
	Fire Hazard Category	F3/F4
	Warehouse Area (m^2)	2,004
	Sprinklers?	Yes
	Storage Type	Rack: Height = 6m - 12m
	Retention Volume Required m^3 (with density factor)	160
1.10	Area of Site which shares common drainage with Area (m^2)	41,596
1.11	1 in 10 year 24hour rainfall event for local area (m)	0.0701
1.12	Rain Water (m^3)	2,915.90
	Fire Water Retention Required (m^3)	**3,075.90**

Table 12: Assessment Zone A Retention Calculations

6.4 Zone D Retention Calculations

The method used to calculate firewater retention in Zone D (Drumstore) is Method 1: Warehouse Calculation. The Fire Detection and Alarm Systems (FDAS) in this zone are certified to IS 3218:2013. The retention calculations for this zone are given in Table 13 below. It has been calculated that there is sufficient firewater retention capacity available for Zone D.

Number	Calculation Steps	Response
1.1	Size of Storage Area (m^2)	600
1.2	Flammable Material (tonnes)	84.272

Number	Calculation Steps	Response
1.3	Combustible Material (tonnes)	88.34
1.5	Aerosol materials, not already classified as flammable - H222, H223 (tonnes)	0
1.6	Oxidising Material not already classified - H270, H271 (tonnes)	0
1.7	Oxidising Material not already classified - H272 (tonnes)	0
1.4	Non Combustible Material (tonnes)	0
1.8	Total F1/F2 Materials	84.27
1.9	Total F3/F4 Materials	88.34
1.1	Total Storage in this Area (tonnes)	172.61
1.11	Fire Hazard Category	F1/F2
1.12	Storage Density (kg/m^2)	287.69
1.13	Storage Density Factor	0.8
1.14	Type of Storage	Rack: Height = <6
	Preliminary Fire Water Retention Required m^3 (without storage density factor)	160
	Sprinklers	Yes
	Note on Preliminary Result	**Fire Compartment Size is Acceptable**
	Total Storage Quantity (kg)	172.61
	Fire Hazard Category	F1/F2
	Warehouse Area (m^2)	600
	Sprinklers?	Yes
	Storage Type	Rack: Height <6m
	Retention Volume Required m^3 (with density factor)	128
1.10	Area of Site which shares common drainage with Area (m^2)	41,596
1.11	1 in 10 year 24hour rainfall event for local area (m)	0.0701
1.12	Rain Water (m^3)[1]	2,915.90
	Fire Water Retention Required (m^3)	**3,043.90**

Table 13: Assessment Zone D Retention Calculations

6.5 Zone E Retention Calculations

The method used to calculate firewater retention in Zone E (Tank Farm 2, Tank Farm 3 and Ammonia Scrubber) is Method 2: Tank Farm/Process Plant Retention Calculation. This method is used particularly for tank farms and process plants. The capacity of the tanks that may be lost can be determined by the fire protection measures in place. If there are automatic fire-fighting systems in place, the volume of the largest vessel need only be included in the firewater retention calculation. If there are no automatic fire-fighting systems in place, the inventory of all tanks or process equipment must be included in the calculation. Given that all tanks within this area have automatic fire protection (sprinklers/delude systems) then only the volume of the largest tank within this zone has been considered in the calculation. The retention calculation for this zone are given in Table 14 below. It has been calculated that there is sufficient firewater retention capacity available for Zone E.

The calculation used in Method 2 is outlined below.

$$V_R = V_T + W_E + W_F + R_W - E$$

The variables used in this method are as follows:

- **V_T** – Inventory (liquids and solids) that could be released in a fire scenario;
- **W_E** – Fire-fighting water and foam from the following sources:
  - Automatic fire-fighting systems;
  - The expansion rates of any foam that will be used;
  - Extinguishing period based on design standard or systems specifications.
- **W_F** – Cooling water (based on design standards or systems specifications);
- **R_W** – Rainwater contributions;
- **E** – Local containment (bunding) available surrounding the area of the fire only e.g. Tank Farm Bund;
- **V_R** – Firewater retention required.

Variable	Volume m^3	Information Source
V_T	53.00	The largest tank in the assessment zone is a 53 m^3 tank located in Bund 21 (Tank S22).
W_E	1,872.36	4 no. Fire Tenders each carrying 1.8 m^3. Deluge system flow rate 5,524 l/min operating for 1.5 hours. 2 no. fire hydrants at 1,900 l/min operating for 6 hours. The P2 and P3 tank farms and the Ammonia Scrubber consist of individual bunds for each tank farm and each

Variable	Volume m^3	Information Source
		bund is protected by water deluge systems for. Design Density is 12.0 litres per min per sqm over the entire surface area of each tank. The maximum design water flow from a single bund in this area is P-2 Tank Farm is 5,524 litres per minute.
W_F	0.00	Cooling water for all tanks within the bund is provided by the deluge system. Cooling water would be provided from the hydrant supply calculated above in W_E figure above.
R_W	2,924.48	The rainwater contribution will arise from the surface area of the site and a 1 in 10 year 24-hour rainfall event as per the EPA Guidance Note. The hardstanding surface area of the site which shares common drainage with area is 41,719 m^2. The 1 in 10 year 24-hour rainfall for the site is 70.1 mm according to Met Éireann data.
E	116.88	This is the retention volume directly available in bunds (Ref. No. 20 & 21).
V_R	4,732.96	This is the firewater retention required according to the calculation.
Retention Available	5,092.00	This is the retention capacity of the firewater infrastructure.
Shortfall	**0**	**This is the shortfall in retention capacity.**

Table 14: Firewater Retention Calculation for Zone E

6.6 Zone I Retention Calculations

The method used to calculate firewater retention in Zone I (Process Plant 1 Tank Farm) is Method 2: Tank Farm/Process Plant Retention Calculation. This method is used particularly for tank farms and process plants. Given that all tanks within this area have automatic fire protection (sprinklers/delude systems) then only the volume of the largest tank within this zone has been considered in the calculation. The retention calculation for this zone are given in Table 15 below. It has been calculated that there is sufficient firewater retention capacity available for Zone I.

The Process Plant 1 Tank Farm bunds have a high-level overflow pipe system and collection channel connected to a drain line to the storm water drainage system and ultimately the firewater retention tank preventing over spilling of the bunds.

The calculation used in Method 2 is outlined below.

$$V_R = V_T + W_E + W_F + R_W - E$$

The variables used in this method are as follows:

- **V_T** – Inventory (liquids and solids) that could be released in a fire scenario;
- **W_E** – Fire-fighting water and foam from the following sources:
  - Automatic fire-fighting systems;
  - The expansion rates of any foam that will be used;
  - Extinguishing period based on design standard or systems specifications.
- **W_F** – Cooling water (based on design standards or systems specifications);
- **R_W** – Rainwater contributions;
- **E** – Local containment (bunding) available surrounding the area of the fire only e.g. Tank Farm Bund;
- **V_R** – Firewater retention required.

Variable	Volume m^3	Information Source
V_T	50.00	The largest tank in the assessment zone is a 50 m^3 tank located in Bund 15 (Tank S21).
W_E	1,987.74	4 no. Fire Tenders each carrying 1.8 m^3. Deluge system flow rate 6,806 l/min operating for 1.5 hours 2 no. fire hydrants at 1,900 l/min operating for 6 hours. This tank farm is protected by a water deluge system for each bund and for the tanker unloading area. Design Density is 10.2 litres per min per sqm over the entire surface area of each tank. The maximum design water flow from a single bund in P-1 Tank Farm is 6,806 litres per min.
W_F	0.00	Cooling water for all tanks within the bund is provided by the deluge system. Cooling water would be provided from the hydrant supply calculated above in W_E figure above.
R_W	2,934.64	The rainwater contribution will arise from the surface area of the site and a 1 in 10 year 24-hour rainfall event as per the EPA Guidance Note. The hardstanding surface area of the site which shares common drainage with area is 41,864 m^2. The 1 in 10 year 24-hour rainfall for the site is 70.1 mm according to Met Éireann data.
E	172.58	This is the retention volume directly available from Process Plant 1 tank farm bunds (Ref No. 14, 15, 30).
V_R	4,799.80	This is the firewater retention required according to the calculation.

Variable	Volume m^3	Information Source
Retention Available	5,092.00	This is the retention capacity of the firewater infrastructure.
Shortfall	**0**	**This is the shortfall in retention capacity.**

Table 15: Firewater Retention Calculation for Zone I

6.7 Post Fire Treatment & Disposal of Retained Firewater

It is proposed that any retained firewater would be treated in the site WWTP. If for any reason the firewater cannot be treated in the site WWTP, then it would be removed from site by an appropriately licensed waste contractor. The site will get agreement on the proposed treatment option from the EPA prior to the removal of retained firewater from the site.

7 Fire Response Measures

7.1 Automatic Fire Protection

The automatic fire protection systems in each zone of the site are outlined in Table 16 below.

Zone	Fire Protection in Place
A	There is a fire detection and alarm system designed, installed and maintained to I.S.3218:2013 *Fire Detection and Fire Alarm Systems for Buildings - System Design, Installation, Servicing and Maintenance.* An automatic sprinkler system is installed in all internal areas.
B	There is a fire detection and alarm system designed, installed and maintained to I.S.3218:2013 *Fire Detection and Fire Alarm Systems for Buildings - System Design, Installation, Servicing and Maintenance.* An automatic sprinkler system is installed in all internal areas.
C	There is a fire detection and alarm system designed, installed and maintained to I.S.3218:2013 *Fire Detection and Fire Alarm Systems for Buildings - System Design, Installation, Servicing and Maintenance.* An automatic sprinkler system is installed in all internal areas. Zone C has a fixed foam monitor in place.
D	There is a fire detection and alarm system designed, installed and maintained to I.S.3218:2013 *Fire Detection and Fire Alarm Systems for Buildings - System Design, Installation, Servicing and Maintenance.* An automatic sprinkler system is installed in all internal areas.
E	There is a fire detection and alarm system designed, installed and maintained to I.S.3218:2013 *Fire Detection and Fire Alarm Systems for Buildings - System Design, Installation, Servicing and Maintenance.* An automatic deluge system is installed in this area.
F	There is a fire detection and alarm system designed, installed and maintained to I.S.3218:2013 *Fire Detection and Fire Alarm Systems for Buildings - System Design, Installation, Servicing and Maintenance.* An automatic sprinkler system is installed in all internal areas.
G	There is a fire detection and alarm system designed, installed and maintained to I.S.3218:2013 *Fire Detection and Fire Alarm Systems for Buildings - System Design, Installation, Servicing and Maintenance.* An automatic sprinkler system is installed in all internal areas.
H	There is a fire detection and alarm system designed, installed and maintained to I.S.3218:2013 *Fire Detection and Fire Alarm Systems for Buildings - System Design, Installation, Servicing and Maintenance.* An automatic sprinkler system is installed in all internal areas.
I	There is a fire detection and alarm system designed, installed and maintained to I.S.3218:2013 *Fire Detection and Fire Alarm Systems for*

Zone	Fire Protection in Place
	Buildings - System Design, Installation, Servicing and Maintenance. An automatic deluge system is installed in this area.
J	There is a fire detection and alarm system designed, installed and maintained to I.S.3218:2013 *Fire Detection and Fire Alarm Systems for Buildings - System Design, Installation, Servicing and Maintenance.* An automatic sprinkler system is installed in all internal areas.

Table 16: Automatic Fire Protection in Each Zone of the Janssen Site

7.2 Sprinkler/Deluge Fire Protection

Fire protection systems are installed in Janssen to control the fire within the area of origin, this objective remains the same irrespective of the type of installation be it wet or dry sprinklers, deluge or pre-action systems.

Wet Sprinkler systems have been installed in heated building whereas dry pipe system have been installed in unheated buildings and pre-action systems have been used for the protection of Motor Control Centre (MCC), I/O (Input/output) and Communications Rooms.

Deluge protection systems have been installed for the protection of the external ignitable liquid storage tanks with individual systems dedicated to the protection of individual bunds. These systems consist of a separate pneumatic detection system which triggers the simultaneous discharge of all of the sprayer heads in a single bund deluge system.

Janssen ensure the reliability of the fire protection systems operation with the following inspection, maintenance and testing programmes.

- Weekly sprinkler valve inspections to ensure all sprinkler valves on site are open.
- Weekly starting and running of the plant fire pumps to ensure the availability of the plant fire protection water supply.
- Quarterly testing of all sprinkler water flow and supervisory alarms
- Annual maintenance and testing of all aspects of the fire protection system including trip testing of all deluge systems, dry pipe and pre-action systems on site.
- The prompt repair of any equipment failure.
- Procedures for the management of all fire protections impairments and shut-downs to limit their duration and impact.

By the installation of a properly designed fire protection system, coupled with a robust maintenance inspection and testing programme and an adequate drainage system, a fire is expected to be contained in its area of origin.

7.3 Sprinkler/Delude System Standards

The sprinkler/deluge systems in the following areas are designed, installed and maintained to the following standards:

7.3.1 Warehouse (Zone A)

FM Global Data Sheet: 2.0 entitled “Installation Guidelines for Automatic Sprinklers”

FM Global Data Sheet: 2-81 entitled “Fire Protection System Inspection, Testing and Maintenance”

FM Global Data Sheet: 8-9 entitled “Storage of Class 1, 2, 3, 4 And Plastic Commodities”

7.3.2 Drum Store (Zone D)

FM Global Data Sheet: 2.0 entitled “Installation Guidelines for Automatic Sprinklers”

FM Global Data Sheet: 2-81 entitled “Fire Protection System Inspection, Testing and Maintenance”

FM Global Data Sheet: 7-29 entitles “Ignitable Liquid Storage in Portable Containers”

7.3.3 P1 Tank Farm and P2/3/Scrubber Tank Farm (Zone E & Zone I)

FM Global Data Sheet: 2-81: entitled “Fire Protection System Inspection, Testing and Maintenance”

FM Global Data Sheet: 4-1N entitled “Fixed Water Spray Systems for Fire Protection”

FM Global Data Sheet: 7-88 entitled “Outdoor Ignitable Liquid Storage Tanks”

7.3.4 Process Ares (Zone C, Zone J & Zone G)

FM Global Data Sheet: 7-14 entitled ”Fire Protection for Chemical Plants”

FM Global Data Sheet: 7-32 entitled “Ignitable Liquid Operations”

7.4 Fire Extinguishers

There are fire extinguishers located throughout the site.

7.5 Local Fire Service

The closest fire stations to the Janssen facility are the Cobh Fire Station and the Cork City Fire Station which are both approximately 7 km from the site.

7.6 Emergency Response

There is a site evacuation procedure in place. Janssen have an Emergency Response Team (ERT) at the site. The site carries out fire drills at random intervals. The fire alarm has a sounder check weekly.

8 Conclusion

The following conclusions have been reached through the firewater risk assessment:

Stage 1:

According to Stage 1 of the risk assessment, the Janssen site automatically requires firewater retention due to the quantities of Environmental Hazardous Substances stored in Zones A and D. Janssen does not discharge stormwater directly to any of the Environmental Receptors outlined in Section 4.3.

Stage 2:

Based on the results of Stage 2 of the risk assessment, firewater retention is required for Zones A, D, E and I due to the quantities of Environmentally Hazardous and/or Flammable Substance stored in these areas.

Stage 3:

Retention calculations were undertaken for Zone A and Zone D using the Method 1: Warehouse Calculation. In both cases, it has been calculated that there is sufficient retention available in the site's retention infrastructure.

Retention calculations were undertaken for Zone E and Zone I using the Method 2: Tank Farm/Process Plant Retention Calculation. In both cases, it has been calculated that there is sufficient retention available in the site's retention infrastructure.

8.1 Summary

Environet has reviewed the activities, location, stormwater discharge points, material types and quantities, fire detection and protection measures at the site and concluded that firewater retention facilities are required due to the quantities of hazardous materials on-site. There is also a high significance of a fire event and hazard potential resulting from the materials on-site. The site was compartmentalised into ten zones (Zones A – J) which were individually risk assessed. The firewater risk assessment concluded that firewater retention is required for Zones A, D, E and I.

The site has firewater retention capacity of 5,092 m^3. A maximum firewater retention quantity of 4,799.8 m^3 has been calculated, which relates to a fire in assessment Zone I (Tank Farm 1). Therefore, there is sufficient retention available in the site's retention infrastructure.

Appendix A – FWRA Tables for Zone A (Warehouse, Technical Services Building)

Materials Stored	Tonnes	Substance Name(s)
H224 (extremely flammable)	0	
H225 (highly flammable)	0	
H226 (flammable)	0	
Flammable Liquids Storage	**0**	
H220 (extremely flammable)	0	
H221 (flammable)	0	
Flammable Gas Storage	**0**	
H228 (flammable)	0	
Flammable Solids Storage	**0**	
H227 Combustible Liquids	0	
Waste	0	
Packaging (including pallets)	42.00	Plastic, cardboard. pallets
Plastic (if not in packaging above)	0	
Oils/fuels (not classified as flammable)	0	
Process materials (not classified as flammable)	71.77	Various process materials - T 1492, Itraconazole, 2, Infusorial Earth, T 2327, T 2488, R 278474 Crude, T 1624 Np, R 314585 Not Milled, Rilpivirine Hydrochloride, Hr076477, Rr076477, Darunavir Ethanolate, R 92670,Crude Low Bioburden, 2, T 2660, T 2593, Paliperidone Palmitate Sterile Ire, 4, Paliperidone Palmitate Sterile Ire, 2, R 14950 Not Milled, Risperidone Parenteral Use, R33812 Crude, Domperidone, T2251, T2633
Any other combustible material	0	
Combustible Material Storage	**113.77**	
Significance of Fire Event	**S1**	

Table 1: Flammable Materials Stored in Zone A

Material Stored in this Area	Tonnes	Substance Name(s)
H400/H410 Environmentally Hazardous Material (GHS Classification) (tonnes)	1.1832	R 14950 Not Milled
H401/411 Environmentally Hazardous Material (GHS Classification) (tonnes)	0.1154	Risperidone Parenteral Use
H402/412 Environmentally Hazardous Material (GHS Classification) (tonnes)	27.7371	R 33812 Crude, Domperidone, T 2251, T 2633, T 2633
H413 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
Total H400 Equivalent Material	**1.4721**	
Laboratories which contain Genetically Modified Micro-Organisms (GMOs) According to Directive 2009/41/EC (Groups 3 & 4)	No	
Licensed Hazardous Waste Facility	No	
Hazard Category	**H1**	

Table 2: Hazardous Materials Stored in Zone A

Appendix B – FWRA Tables for Zone B (Logistics Building, Administration Building, Engineering Office, Maintenance Workshop, Laboratory, Dryer Building)

Materials Stored	Tonnes	Substance Name(s)
H224 (extremely flammable)	0	
H225 (highly flammable)	1	Lab Solvents acetonitrile DMF and Methanol
H226 (flammable)	0	
Flammable Liquids Storage	**1**	
H220 (extremely flammable)	0	
H221 (flammable)	0	
Flammable Gas Storage	**0**	
H228 (flammable)	0	
Flammable Solids Storage	**0**	
H227 Combustible Liquids	0	
Waste	0.53	Waste DCM
Packaging (including pallets)	0	
Plastic (if not in packaging above)	0	
Oils/fuels (not classified as flammable)	0	
Process materials (not classified as flammable)	0	
Any other combustible material	0	
Combustible Material Storage	**0.53**	
Significance of Fire Event	**S1**	

Table 3: Flammable Materials Stored in Zone B

Material Stored in this Area	Tonnes	Substance Name(s)
H400/H410 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H401/411 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H402/412 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H413 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
Total H400 Equivalent Material	**0**	
Laboratories which contain Genetically Modified Micro-Organisms (GMOs) According to Directive 2009/41/EC (Groups 3 & 4)	No	
Licensed Hazardous Waste Facility	No	
Hazard Category	**H0**	

Table 4: Hazardous Materials Stored in Zone B

Appendix C – FWRA Tables for Zone C (Process Plant 1, Chiller Building, Utilities Building, Cooling Tower Sprinkler Deluge House)

Materials Stored	Tonnes	Substance Name(s)
H224 (extremely flammable)	0	
H225 (highly flammable)	46.84	Various Process Solvents
H226 (flammable)	0	
Flammable Liquids Storage	**46.84**	
H220 (extremely flammable)	0	
H221 (flammable)	0	
Flammable Gas Storage	**0**	
H228 (flammable)	0	
Flammable Solids Storage	**0**	
H227 Combustible Liquids	0	
Waste	0	
Packaging (including pallets)	0	
Plastic (if not in packaging above)	0	
Oils/fuels (not classified as flammable)	0	
Process materials (not classified as flammable)	0	
Any other combustible material	0	
Combustible Material Storage	**0**	
Significance of Fire Event	**S1**	

Table 5: Flammable Materials Stored in Zone C

Material Stored in this Area	Tonnes	Substance Name(s)
H400/H410 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H401/411 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H402/412 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H413 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
Total H400 Equivalent Material	**0**	
Laboratories which contain Genetically Modified Micro-Organisms (GMOs) According to Directive 2009/41/EC (Groups 3 & 4)	No	
Licensed Hazardous Waste Facility	No	
Hazard Category	**H0**	

Table 6: Hazardous Materials Stored in Zone C

Appendix D – FWRA Tables for Zone D (Drumstore)

Materials Stored	Tonnes	Substance Name(s)
H224 (extremely flammable)	0	
H225 (highly flammable)	42.179	Acetonitrile, Di-(2-propyl)amine, Ethyl Acetate, HCL IPA, Triethylamine, Tetrahydrofuran, Toluene, T 2675 in acetonitrile, Pyridine
H226 (flammable)	31.863	Acetic acid glacial, HBr in acetic acid, 1,3-Disopropylcarbodiimide (DIC), Dimethylformamide
Flammable Liquids Storage	**74.042**	
H220 (extremely flammable)	0	
H221 (flammable)	0.850	Ammonia gas
Flammable Gas Storage	**0.850**	
H228 (flammable)	0	
Flammable Solids Storage	**0**	
H227 Combustible Liquids	0	
Waste	0	
Packaging (including pallets)	4.000	Pallets
Plastic (if not in packaging above)	0	
Oils/fuels (not classified as flammable)	0	
Process materials (not classified as flammable)	95.227	Various Process Materials - Phosphorous Oxychloride solution mixed with acetonitrile, Potassium carbonate, Potassium Hydroxide, Sodium Bromide, Sodium Carbonate, Sodium Hydroxide Flakes, Sodium Sulphate, NORIT A SUPRA, OXATOMIDE (R 38142), Hydrochloric Acid, Palmitic Acid, DMAP, Dichloromethane, Sodium Hydroxide 50%, DIMETHYLACETAMIDE, T 2593 IN NMP, JNJ-16269994-AAA WET WIP, JNJ-16150108-AAA WET WIP RE-SLURRY, JNJ-7941726-AAA WET WIP, JNJ-25875382-AAA WET WIP SEED, JNJ-25875382-AAA WIP FOR PACKING, JNJ-25875382-AAA CRUDE, Sodium Hydroxide 25% Solution, JNJ-25875382-AAA CRUDE, JNJ-25875382-AAA WIP,

Materials Stored	Tonnes	Substance Name(s)
		JNJ-25875382-AAA CRUDE (Darunavir Ethanolate), JNJ-16269994-AAA WET WIP 2nd stage, N-Acetylsulfanilyl chloride, JNJ-25875382-AAA CRUDE, JNJ-25875382-AAA WIP, HCL 37%, METHANESULFONIC ACID, R 278474 CRUDE (Rilpivirine), AMMONIA 12.2N (Density/SG 1.245 Applied), FLUNARIZINE HYDROCHLORIDE, Butylhydroxytoluene, JNJ-116922-AAC WET WIP RE-SLURRY, JNJ-116922-AAC WET WIP, LOPERAMIDE HYDROCHLORIDE, JNJ-17296812-AAA WET WIP 1ST STAGE, Sodium Edetate
Any other combustible material	0	
Combustible Material Storage	**99.227**	
Significance of Fire Event	**S3**	

Table 7: Flammable Materials Stored in Zone D

Material Stored in this Area	Tonnes	Substance Name(s)
H400/H410 Environmentally Hazardous Material (GHS Classification) (tonnes)	9.5033	Ammonia 12.2N (Density/SG 1.245 Applied), Flunarizine Hydrochloride, Butylhydroxytoluene, JNJ-116922-AAC Wet WIP Re-Slurry, JNJ-116922-AAC Wet WIP
H401/411 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H402/412 Environmentally Hazardous Material (GHS Classification) (tonnes)	1.3478	Loperamide Hydrochloride, JNJ-17296812-AAA Wet WIP 1st Stage
H413 Environmentally Hazardous Material (GHS Classification) (tonnes)	0.0334	Sodium Edetate
Total H400 Equivalent Material	**9.5168**	
Laboratories which contain Genetically Modified Micro-Organisms (GMOs) According to Directive 2009/41/EC (Groups 3 & 4)	No	
Licensed Hazardous Waste Facility	No	
Hazard Category	**H1**	

Table 8: Hazardous Materials Stored in Zone D

Appendix E – FWRA Tables for Zone E (Tank Farm 2, Tank Farm 3, Ammonia Scrubber)

Materials Stored	Tonnes	Substance Name(s)
H224 (extremely flammable)	0	
H225 (highly flammable)	161.265	Methanol, Acetone, IPA, Toluene, Ethanol
H226 (flammable)	35.310	10% Acetic Acid 90% Water
Flammable Liquids Storage	**196.575**	
H220 (extremely flammable)	0	
H221 (flammable)	0.600	Ammonia Gas
Flammable Gas Storage	**0.600**	
H228 (flammable)	0	
Flammable Solids Storage	**0**	
H227 Combustible Liquids	0	
Waste	0	
Packaging (including pallets)	0	
Plastic (if not in packaging above)	0	
Oils/fuels (not classified as flammable)	0	
Process materials (not classified as flammable)	0	
Any other combustible material	0	
Combustible Material Storage	**0**	
Significance of Fire Event	**S3**	

Table 9: Flammable Materials Stored in Zone E

Material Stored in this Area	Tonnes	Substance Name(s)
H400/H410 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H401/411 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H402/412 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H413 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
Total H400 Equivalent Material	**0**	
Laboratories which contain Genetically Modified Micro-Organisms (GMOs) According to Directive 2009/41/EC (Groups 3 & 4)	No	
Licensed Hazardous Waste Facility	No	
Hazard Category	**H0**	

Table 10: Hazardous Materials Stored in Zone E

Appendix F – FWRA Tables for Zone F (Environmental Waste Management Building)

Materials Stored	Tonnes	Substance Name(s)
H224 (extremely flammable)	0	
H225 (highly flammable)	41.52	Waste solvent
H226 (flammable)	0	
Flammable Liquids Storage	**41.52**	
H220 (extremely flammable)	0	
H221 (flammable)	0	
Flammable Gas Storage	**0**	
H228 (flammable)	0	
Flammable Solids Storage	**0**	
H227 Combustible Liquids	0	
Waste	28.80	Solid waste mixture
Packaging (including pallets)	4.00	Pallets
Plastic (if not in packaging above)	0	
Oils/fuels (not classified as flammable)	0	
Process materials (not classified as flammable)	0	
Any other combustible material	0	
Combustible Material Storage	**32.80**	
Significance of Fire Event	**S1**	

Table 11: Flammable Materials Stored in Zone F

Material Stored in this Area	Tonnes	Substance Name(s)
H400/H410 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H401/411 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H402/412 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H413 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
Total H400 Equivalent Material	**0**	
Laboratories which contain Genetically Modified Micro-Organisms (GMOs) According to Directive 2009/41/EC (Groups 3 & 4)	No	
Licensed Hazardous Waste Facility	No	
Hazard Category	**H0**	

Table 12: Hazardous Materials Stored in Zone F

Appendix G – FWRA Tables for Zone G (Process Plant 3, Headblock)

Materials Stored	Tonnes	Substance Name(s)
H224 (extremely flammable)	0	
H225 (highly flammable)	45.213	Various Process Solvents
H226 (flammable)	0	
Flammable Liquids Storage	**45.213**	
H220 (extremely flammable)	0	
H221 (flammable)	0	
Flammable Gas Storage	**0**	
H228 (flammable)	0	
Flammable Solids Storage	**0**	
H227 Combustible Liquids	0	
Waste	0	
Packaging (including pallets)	0	
Plastic (if not in packaging above)	0	
Oils/fuels (not classified as flammable)	0	
Process materials (not classified as flammable)	0	
Any other combustible material	0	
Combustible Material Storage	**0**	
Significance of Fire Event	**S1**	

Table 13: Flammable Materials Stored in Zone G

Material Stored in this Area	Tonnes	Substance Name(s)
H400/H410 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H401/411 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H402/412 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H413 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
Total H400 Equivalent Material	**0**	
Laboratories which contain Genetically Modified Micro-Organisms (GMOs) According to Directive 2009/41/EC (Groups 3 & 4)	No	
Licensed Hazardous Waste Facility	No	
Hazard Category	**H0**	

Table 14: Hazardous Materials Stored in Zone G

Appendix H – FWRA Tables for Zone H (Central Utilities Building)

Materials Stored	Tonnes	Substance Name(s)
H224 (extremely flammable)	0	
H225 (highly flammable)	0	
H226 (flammable)	0	
Flammable Liquids Storage	**0**	
H220 (extremely flammable)	0	
H221 (flammable)	1.700	Ammonia Gas
Flammable Gas Storage	**1.700**	
H228 (flammable)	0	
Flammable Solids Storage	**0**	
H227 Combustible Liquids	0.845	Diesel
Waste	0	
Packaging (including pallets)	0	
Plastic (if not in packaging above)	0	
Oils/fuels (not classified as flammable)	50.000	Shellsol
Process materials (not classified as flammable)	0	
Any other combustible material	0	
Combustible Material Storage	**50.845**	
Significance of Fire Event	**S1**	

Table 15: Flammable Materials Stored in Zone H

Material Stored in this Area	Tonnes	Substance Name(s)
H400/H410 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H401/411 Environmentally Hazardous Material (GHS Classification) (tonnes)	0.845	Diesel
H402/412 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H413 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
Total H400 Equivalent Material	**0.0845**	
Laboratories which contain Genetically Modified Micro-Organisms (GMOs) According to Directive 2009/41/EC (Groups 3 & 4)	No	
Licensed Hazardous Waste Facility	No	
Hazard Category	**H0**	

Table 16: Hazardous Materials Stored in Zone H

Appendix I – FWRA Tables for Zone I (Tank Farm 1)

Materials Stored	Tonnes	Substance Name(s)
H224 (extremely flammable)	0	
H225 (highly flammable)	335.875	IPA, Acetone, IMS, Toluene, Methyl ter butyl ether, Methyl ethyl ketone, Acetonitrile, Methanol, Ethanol, DMF/MEK
H226 (flammable)	31.200	80% acetic acid
Flammable Liquids Storage	**367.075**	
H220 (extremely flammable)	0	
H221 (flammable)	0	
Flammable Gas Storage	**0**	
H228 (flammable)	0	
Flammable Solids Storage	**0**	
H227 Combustible Liquids	0	
Waste	0	
Packaging (including pallets)	0	
Plastic (if not in packaging above)	0	
Oils/fuels (not classified as flammable)	0	
Process materials (not classified as flammable)	70.78	NMP, 13.9% Sulphuric Acid
Any other combustible material	0	
Combustible Material Storage	**70.78**	
Significance of Fire Event	**S3**	

Table 17: Flammable Materials Stored in Zone I

Material Stored in this Area	Tonnes	Substance Name(s)
H400/H410 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H401/411 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H402/412 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H413 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
Total H400 Equivalent Material	**0**	
Laboratories which contain Genetically Modified Micro-Organisms (GMOs) According to Directive 2009/41/EC (Groups 3 & 4)	No	
Licensed Hazardous Waste Facility	No	
Hazard Category	**H0**	

Table 18: Hazardous Materials Stored in Zone I

Appendix J – FWRA Tables for Zone J (Process Plant 2, Central Cleaning Building)

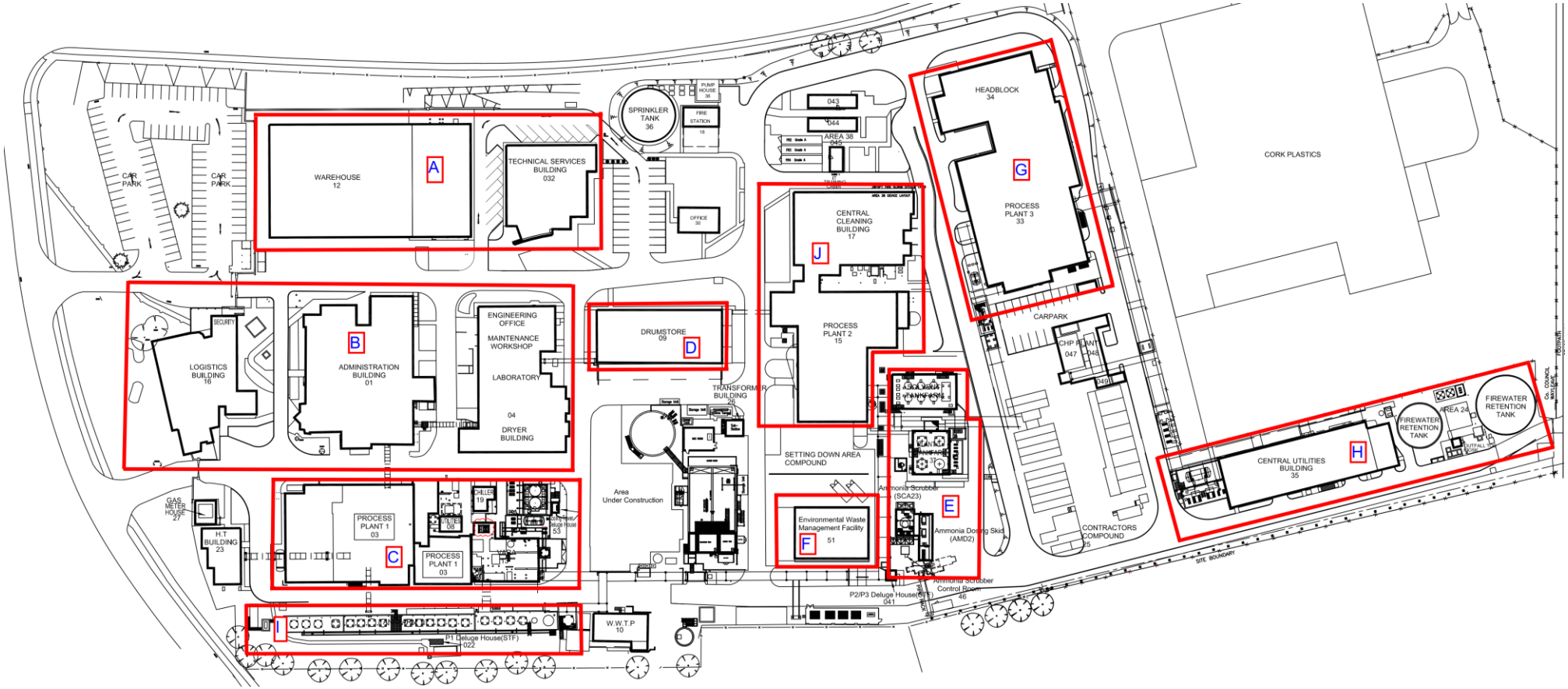
Materials Stored	Tonnes	Substance Name(s)
H224 (extremely flammable)	0	
H225 (highly flammable)	28.734	Various Process Solvents
H226 (flammable)	0	
Flammable Liquids Storage	**28.734**	
H220 (extremely flammable)	0	
H221 (flammable)	0	
Flammable Gas Storage	**0**	
H228 (flammable)	0	
Flammable Solids Storage	**0**	
H227 Combustible Liquids	0	
Waste	0	
Packaging (including pallets)	0	
Plastic (if not in packaging above)	0	
Oils/fuels (not classified as flammable)	0	
Process materials (not classified as flammable)	0	
Any other combustible material	0	
Combustible Material Storage	**0**	
Significance of Fire Event	**S1**	

Table 19: Flammable Materials Stored in Zone J

Material Stored in this Area	Tonnes	Substance Name(s)
H400/H410 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H401/411 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H402/412 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
H413 Environmentally Hazardous Material (GHS Classification) (tonnes)	0	
Total H400 Equivalent Material	**0**	
Laboratories which contain Genetically Modified Micro-Organisms (GMOs) According to Directive 2009/41/EC (Groups 3 & 4)	No	
Licensed Hazardous Waste Facility	No	
Hazard Category	**H0**	

Table 20: Hazardous Materials Stored in Zone J

Appendix K – Site Layout Plan Outlining Compartments for the Purpose of the FWRA



General Purpose Building	-01	Plant 2	-15	(reserved)	-29	Temp Unity Cabin 1	-43
Building De-Commissioned	-02	Logistics building	-16	Portacabin Office	-30	Temp Unity Cabin 2	-44
Plant 1	-03	Central Cleaning Building	-17	Portacabin De-Commissioned	-31	IT Training Cabin	-45
Dryer (R&D) Building	-04	Fire Station	-18	Technical Services Building	-32	Ammonia Scrubber SCA23	-46
(Security moved to 016)	-05	Chiller Building	-19	Process Plant 3	-33	CHP1 Waste Heat Boiler House	-47
Building De-Commissioned	-06	(reserved)	-20	Headblock	-34	CHP1 Genset Container	-48
Tank farm	-07	Portacabin Office De-Commissioned	-21	Central Utilities Building	-35	CHP1 Transformer Enclosure	-49
Utilities Building	-08	Deluge House P1 (Solvent Tank Farm)	-22	Sprinkler Tank & Pump House	-36	Community Centre Car Park	-50
New Drumstore	-09	H.T. Building	-23	Plant 3 Tankfarm	-37	Environmental Waste Management Facility	-51
W.W.T.P.	-10	Fire Water Retention	-24	Portacabin Area	-38	WWTP MCC Building	-52
Storage Area	-11	Contractor Compound Area	-25	Temp Cabin De-Commissioned	-39	Cooling Tower Sprinkler Deluge House	-53
Warehouse	-12	Transformer Building (P2)	-26	Temp Cabin De-Commissioned	-40		
Carbon Absorbtion	-13	Gas Meter House	-27	Deluge House P2/P3 (Solvent Tank Farm)	-41		
Building De-Commissioned	-14	Store/Garage De-Commissioned	-28	Old J&J Shop Cabin De-Commissioned	-42		