MULLER TELFORD DAIRY

Containment Assessment

Prepared for: **Muller UK & Ireland Group LLP**

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BASIS OF REPORT

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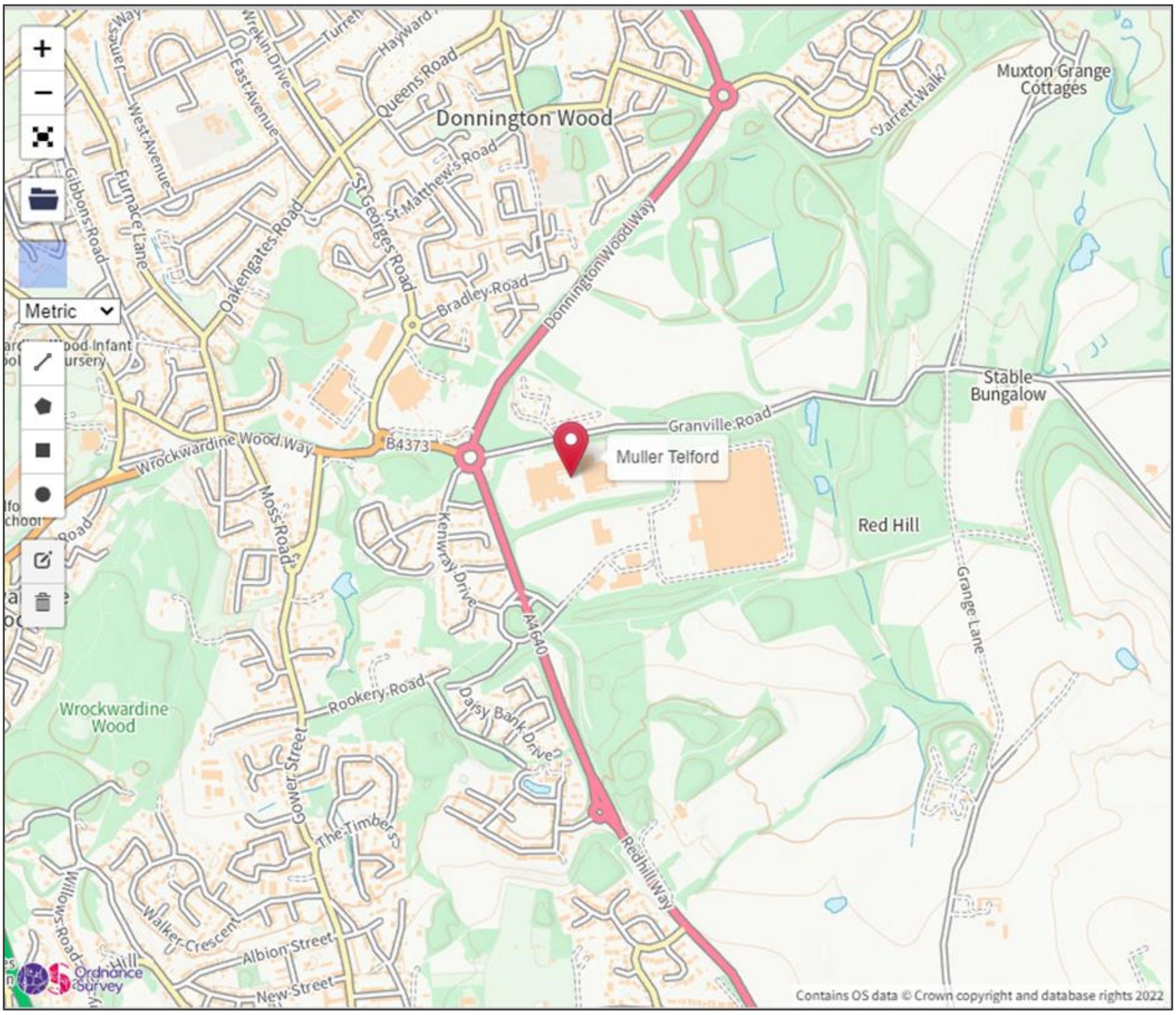
1.0 Introduction

SLR Consulting Limited (SLR) has been retained by Muller UK & Ireland Group LLP (Muller) to complete a Containment Assessment of their Telford Dairy Plant Facility (the Facility) at Donnington Wood Business Park, Granville Road, Telford, TF2 7GJ. The location of the Facility is shown by Figure 1-1.

Figure 1-1: Site Location Plan



This report has been completed in the form of a gap analysis against current good practice provided by *Containment systems for the prevention of pollution, Secondary, tertiary and other measures for industrial and commercial premises*[1] (C736) and concludes with recommendations on measure to address any gaps identified.

[1] CIRIA, 2014, *Containment systems for the prevention of pollution, Secondary, tertiary and other measures for industrial and commercial premises*

2.0 Site Setting

2.1 Location and Site Description

The Facility is centred at National Grid Reference SJ711122, to the northeast of Telford, UK as shown by Figure 1-1.

The Facility fronts Granville Road along its northern boundary and is separated and screened from all surrounding approaches by a strip of established woodland along each boundary. To the west and north of the site is housing and retail premises and to the southeast is a set of similar industrial and warehousing units. To the south and northeast is a mix of grass and wood land.

The Facility itself occupies an area of approximately 4.5 hectares (ha) with access off Granville Road.

Development within the Facility comprises:

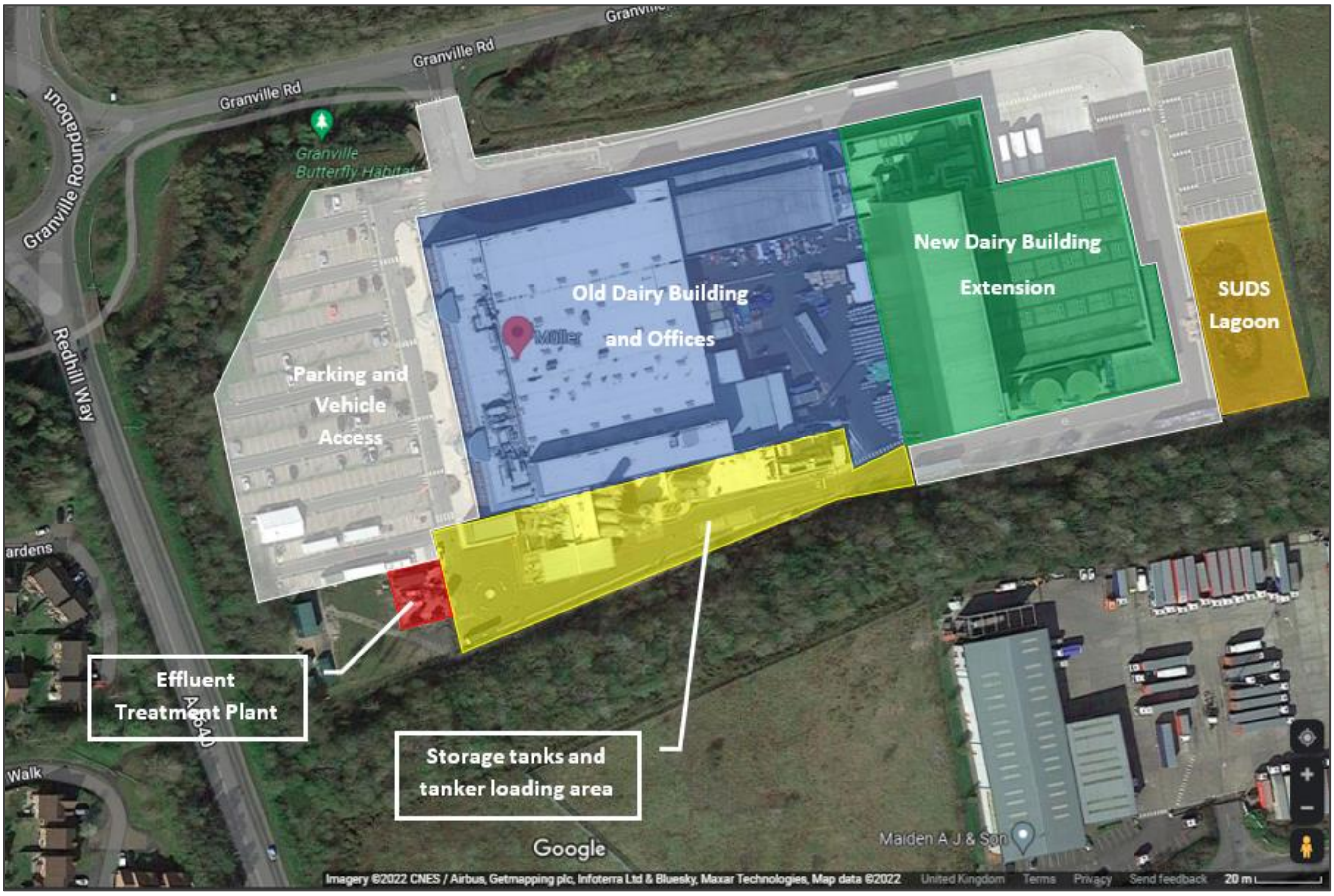
- Office and Administration Buildings housed in the western section of the older dairy building;
- Older dairy production building to the western half of the site;
- New dairy production building to the eastern half of the site;
- Tanker on and off-loading area with tank farms to south of site;
- Effluent treatment plant (ETP) to southwest of site;
- Sustainable urban drainage scheme (SUDs) to southeast of site;
- Main car park to west of site; and
- Site access roadway and lorry loading facility surrounding site and to east of site.

An annotated aerial photograph of the Facility is provided below as Figure 2-1 to aid in understanding the site layout.

The majority of the Facility is laid on hardstanding made up of a mixture of concrete pavement, tarmac (asphalt) and block brickwork, which is of generally good condition. Road surfaces have numerous manholes installed that may not be fully sealed. The manholes provide access to below ground systems (drains) for surface water drainage and effluent storage.

In general, the topography and drainage within the dairy plant buildings falls southward towards the southern perimeter of the site. The site itself is on a largely level plateau of land falling to drainage ditches that surround much of the site.

Figure 2-1: Schematic Site Layout



2.2 Site Surface Water Drainage Description

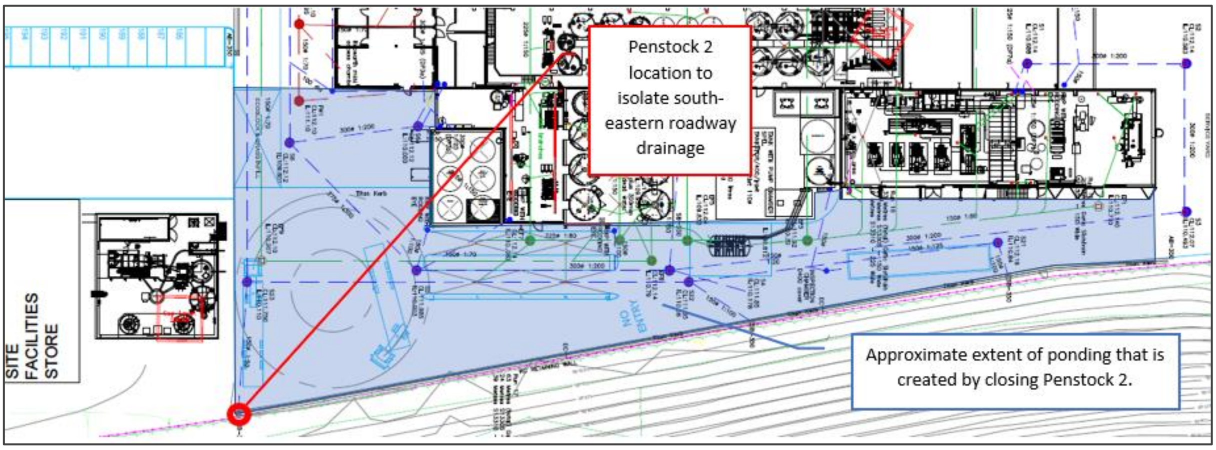
Surface water drainage (roof water, rainfall on roadways and carparks etc) is discharged off site via two separate systems, one discharges to the north-western corner of the site to surface water course and the second discharges to the north-eastern corner of the site to public sewer.

The first system is made up of two halves (north and south) and in general serves the older section of the site, with water being channelled in below ground pipework to discharge to a surface water course at the discharge point on the north-western boundary of the site. Prior to discharge, water from the northern half of the system passes through a ‘Conder By-Pass’ type buried interceptor (Interceptor 1) before combining in a chamber (S10) with the southern half of the system and thence to discharge from site. Similarly, the southern half of the system drains water from the southern access roadway around the south-western and western perimeter of the site, passing through a second ‘Conder By-Pass’ (Interceptor 2) type interceptor to chamber S10 prior to discharge off site. A 340m^3 Attenuation Tank is installed under the site carpark, under high flow conditions water from S10 can back-up into this tank for temporary storage before discharge off site. The tank is made up from cellular storage crates (Aquacell or similar) contained within a sealed impermeable membrane (see Drawing 04).

The second system drains water from the newer (eastern) extension to the dairy, essentially comprising the eastern end of the overall facility. Water from roofs and access roadways in this area of the site drain to a SUDs lagoon and then off site via a hydrobreak and full retention interceptor/separator (buried) prior to discharge from site to a Severn Trent sewer in the Granville Road.

Elements of the surface water systems can be isolated so as not to discharge off site. All discharge can be stopped by penstocks at each of the north-eastern and north-western final off-site discharge points. In addition, drainage associated with the access road, tankering area and ETP loading area in the south-west corner of the site can be isolated by closing a penstock at ‘Penstock 2’ (see Figure 2-2).

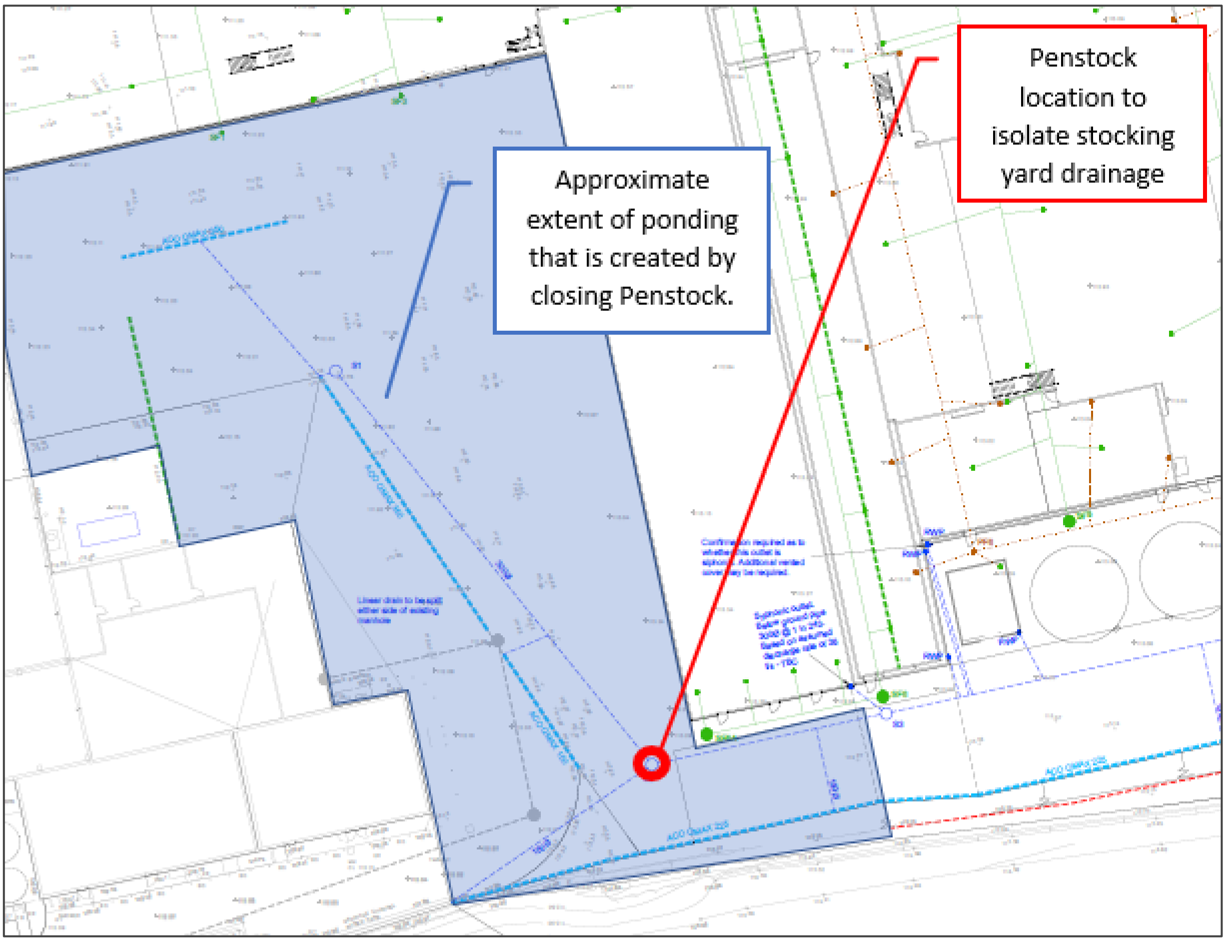
Figure 2-2: Isolation of Drainage at Penstock 2



Currently, normal operation is for Penstock 2 to be closed and it is only opened after testing of water to demonstrate that it is uncontaminated.

The slot drain running in a north-westerly direction through the stocking yard that separates the ‘old’ and ‘new’ dairy buildings is also fitted with a penstock valve (see Figure 2-3).

Figure 2-3: Isolation of Drainage in Stocking Yard Area



This valve is, under normal circumstances, left open and drains water to the 'eastern' system, via the SUDs lagoon. It can however be manually closed to allow drainage to be retained within the stocking yard area.

The three interceptor/separators installed on the surface water discharge systems are also all fitted with alarms that alert both locally and to the building management systems. Alarms are triggered when the presence of hydrocarbons are detected, and the interceptors can then be manually isolated to prevent discharge.

Finally, all surface water discharge from site can be prevented by closing manual penstock valves on the outlets at the sites north-eastern and north-western perimeters.

2.3 Site Effluent Drainage Description

The plant is effectively divided into two halves. The 'old', western half of the facility contains liquids. The 'new', eastern half is essentially concerned with packaged materials.

Storage of liquids and generation of liquid effluents therefore only relate to the 'old' western half of the facility. Effluent produced is generated at the site from off-specification raw materials and product and as a result of spillage and planned CIP (clean in progress) washing of equipment. Also, should any tank overtop, spilt material is either indirectly (by virtue of it being located inside the factory) or directly (by piped overflow) drained to the effluent drainage systems.

All factory floor drainage is drained to a separate effluent drainage system that discharges to a below ground effluent sump located beneath the access roadway in the south-western corner of the site, in the area adjacent to the tanker loading/off-loading facility. This is a 10m^3 GRP lined concrete tank. All CIP waters are also discharged into this sump.

From the site effluent sump, effluent is pumped to an above ground, vertical tank called the Effluent balance tank. This can itself hold 200m^3 of effluent. From the effluent tank effluent can either be discharged to tanker for off-site disposal via a permanent Bauer connection or pumped in a controlled manner to an on-site effluent treatment plant (ETP).

The ETP comprises a Dissolved Air Floatation (DAF) plant that essentially removes fats, oils and grease, some solids and a proportion of the Biochemical Oxygen Demand (BOD) of the effluent, along with pH control. Once treated, effluent is then pumped off site via a dedicated effluent treatment discharge pipeline to the public sewer via a buried pipeline along the western perimeter of the site. Sludge generated by the ETP process is stored in a sludge holding tank prior to removal and disposal from site by tanker. The ETP is housed within a purpose-built reinforced concrete bund. The bund also houses associated process chemical storage tanks.

2.4 Site Foul Drainage Description

The facility is served with a foul sewerage system to remove liquid wastes generated by domestic toilets and washing facilities. This material is piped in a sealed pipework system to discharge to the public sewer situated to the north-east of the site.

3.0 C739 Risk Assessment of Required Containment

The CIRIA C736 guidance requires that new and existing facilities are assessed for containment (bund) classification. C736 provides a risk assessment approach to support a three-tier risk-based classification system for secondary and tertiary containment. Chapter 2 of C736 provides the risk assessment approach.

The risk assessment approach recommends using a "Source, Receptor, Pathway" model. The source is the inventory stored at the Facility, the receptor is the ground, groundwater under the site and nearby surface waters, and the pathway is through the permeable soils on site, breaches in hardstanding's present on site, drainage systems within the site discharging to the public sewer and/or storm water drainage and overland runoff from the site to surrounding ground and stormwater drainage systems. CIRIA also considers the requirement to contain contaminated firewater.

3.1 C736 Chapter 2.3.1 - Source

C736 Chapter 2.3.1. identifies the source and refers to:

- the inventory,
- rainwater or surface water runoff contained by the inventory,
- firefighting agents that are harmful to the environment in their own right and / or are contaminated by the inventory, and,
- firefighting and cooling water contaminated by the inventory.

To inform the risk assessment of the inventory stored at the site an accompanied site visit was completed on 11th August 2022. Information subsequently supplied by Muller was also reviewed.

3.1.1 Operating Procedures

The principal function of the Facility is to process inputs (raw milk, fruit concentrates, cereals and other ingredients) into dairy products consisting of packaged yogurt and creams.

Ingredients and packaging materials are delivered to the site. For liquids this takes the form of ingredients delivered mainly by articulated road tanker (milk) and HGV delivery of fruit concentrate vessels. On arrival at the Facility delivery vehicles are weighed in via a weighbridge system, the details of their loads logged prior to off-loading. For bulk milk deliveries offloading takes place via dedicated Bauer connection in a roofed tanker offloading bay. Site operatives direct the milk to one of a number of milk storage vessels via a computerised control system Human Machine Interface (HMI). Other ingredients are delivered by HGV, this is principally fruit concentrates delivered on curtain sider type HGV. The concentrates are contained in stainless steel kegs designed for road transport (see Plate 13 in Appendix 01). Kegs are stored on the ground in the stocking yard and returned to the same location for collection after emptying.

Milk and other ingredients are then pumped into the main dairy facility for processing into various finished products prior to packaging for onward distribution to off-site retail facilities. Storage tanks related to raw material inputs and products are located both internally and externally to the 'old' dairy facility occupying the western half of the site. The eastern 'new' half of the site is essentially related to distribution of finished products in consumer packaging.

Chemicals for CIP cleaning of the production process equipment are stored in external, vertical steel tanks housed within their own bund (see Section 3.1.2 below). Cleaning chemicals (essentially acids and alkalis) are pumped in a controlled manner by computerised control system into production equipment where they mingle with residual raw materials (milk and fruit concentrates) before being returned along with rinse waters to the effluent systems. Any spillages that occur are also captured in slot drains installed around the production and storage areas, draining under gravity to the effluent sump before being pumped to the 200m^3 external, above ground vertical Effluent storage tank. Similarly, waste products such as off-spec materials can also be pumped to the Effluent storage tank.

Effluent from the site is pumped from the Effluent tank to the ETP where it is treated in a DAF plant prior to discharge off site. All aspects of the ETP operation are controlled by a computerised control system. The ETP incorporates localised storage of sodium hydroxide and sulphuric acid in self bunded tanks and flocculants in IBCs, all held with an overall ETP wide concrete bund.

So that production process can be controlled and shown to be hygienically clean for the purposes of compliance with food safety legislation such as the Food Safety Act 1990 etc, the controlled storage, batching and blending of tanks and other liquid conveying equipment is heavily controlled and is configured such that in all normal modes of operation tanks and vessels are not interconnected. Control of connecting pipework, valves and pumps is via the sites computerised control systems. These are interacted with by suitably qualified and permitted site operatives and the systems to enable this are password protected to ensure that only authorised personnel have access. Overall site access is controlled by security fencing, a guard room and an internal security-controlled door system that restricts access to parts of the plant only to those with suitable permission. As such, cascade failure of multiple tanks due to tank interconnections is not deemed to be a credible scenario due to the fact that personnel with very specific knowledge of the systems would need to choose to interconnect tanks against all normal site operational procedures. Similarly, physical interference with the plant equipment is not deemed to be a credible scenario as access to the site is restricted to authorised personnel only and any leaks or spills would be quickly noted by site monitoring equipment and/or frequent site inspections.

Other liquids stored on site include storage of diesel for a diesel generator used to power sprinkler systems in the event of a site emergency. Two large water storage tanks are also provided for use by the sprinkler system.

Storage of oil and waste oil associated with the site Combined Heat and Power (CHP) Plant is also present.

Diesel and oil storage are in standalone, propriety double skinned storage tanks designed to comply with the requirements of the Oil Storage Regulations. They have also been provided with additional impact protection to control the risk of loss of containment from a vehicle impact.

Storage of liquids in containers of <10m^3 capacity also occurs throughout the facility. As previously discussed, the majority of this material is fruit concentrates contained in extremely robust (designed to withstand road traffic collision impacts) stainless steel kegs. These are delivered full, emptied into the production process, washed out and then stored empty on the sites central service yard. Other cleaning chemicals etc are also present on site. With the exception of the fruit concentrates stored in kegs, all other small volumes of potentially polluting liquids are stored within robust, locked, self-bunded housings with adequate impact protection.

Vehicles associated with delivery and export of products and movement or materials around site are restricted to the use of clearly marked external roadways. These roadways are provided with ample suitable impact protection including bollards, Armco barriers and raised kerb lines and plinth arrangements. Internally forklift trucks operate under close supervision and are restricted to specific routes by road markings, bollards and similar protection measures to prevent damage from impact and collisions.

All materials handled by the site are non-flammable with the exception of the low flash point diesel and oils stored as described above.

No other liquid waste inventory is stored on site.

3.1.2 Inventory Storage

The location of the storage vessels within the Facility is shown below in Figure 3-1 and on Drawing 01.

Figure 3-1: Outline External Tanks, Bunds and Tanker Bay Layout

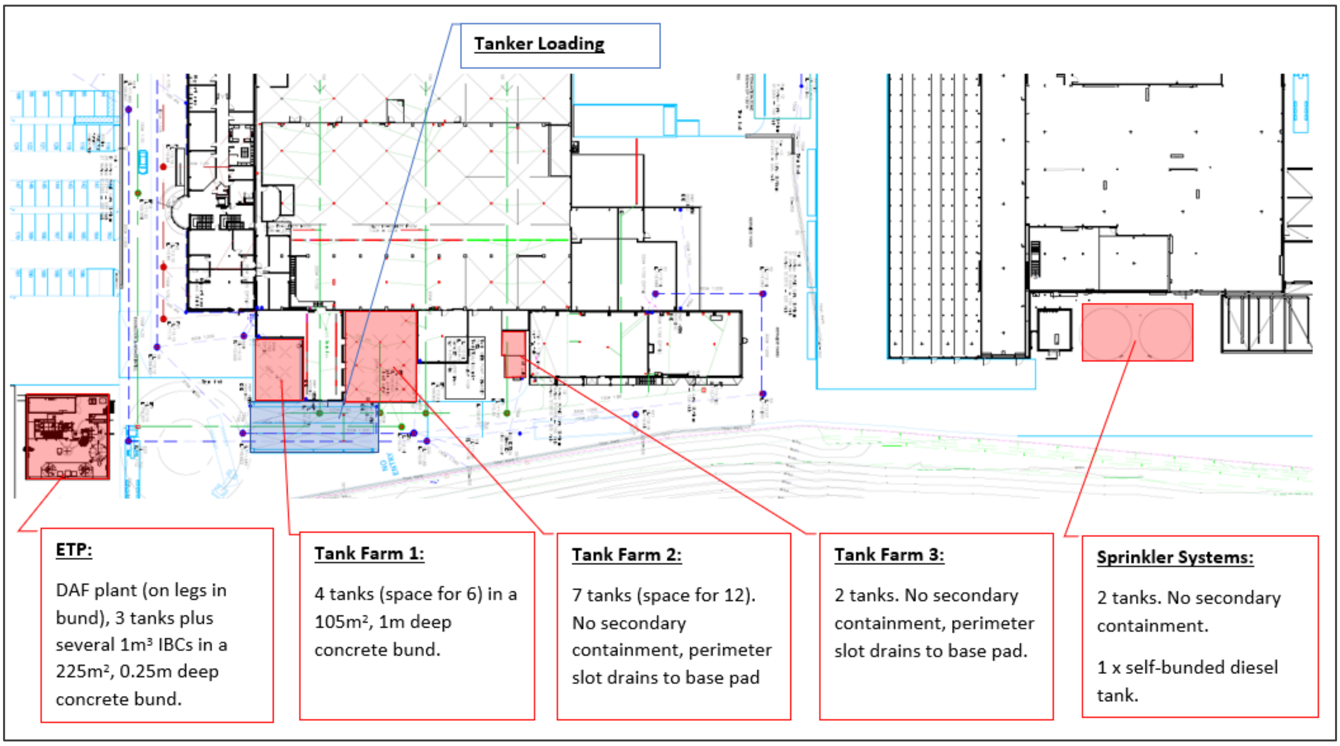


Table 3-1 summarises the primary containment vessels used to store inventory within the Facility that have a volume in excess of 10m^3 and that are permanent infrastructure at the site, their identification number, location (internal to the factory or external, above or below ground), year of installation, maximum capacity, shape, content (inventory) and construction materials.

Table 3-1: Primary Containment and Inventory

Tank Ref.	Above or Below Ground	Internal / External	Installation Date	Capacity of tank (m^3)	Tank Shape	Tank Contents	Tank Construction Detail
101TK01	Above	Internal	2009	100	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
102TK01	Above	Internal	2009	100	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
201TK01	Above	Internal	2009	200	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
202TK01	Above	Internal	2009	200	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
301TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
302TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
401TK01	Above	Internal	2009	10	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
402TK01	Above	Internal	2009	10	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
501TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
502TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
503TK01	Above	Internal	2009	60	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
2101TK01	Above	Internal	2009	60	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
2102TK01	Above	Internal	2009	60	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
2103TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
2104TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
2105TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
2106TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
2107TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
2108TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
3101TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel

Tank Ref.	Above or Below Ground	Internal / External	Installation Date	Capacity of tank (m^3)	Tank Shape	Tank Contents	Tank Construction Detail
3102TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
3102TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
3103TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
3104TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
3105TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
3106TK01	Above	Internal	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
3301TK01	Above	Internal	2012	60	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
3302TK01	Above	Internal	2012	60	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
3303TK01	Above	Internal	2019	40	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
3304TK01	Above	Internal	2019	40	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
3305TK01	Above	Internal	2019	40	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
3306TK01	Above	Internal	2019	40	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
3307TK01	Above	Internal	2019	40	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
3308TK01	Above	Internal	2019	40	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
9196TK01	Above	External	2009	30	Vertical Cylinder, Dished at top and bottom	Milk	Stainless Steel
9103TK01	Above	External	2009	30	Vertical Cylinder, Dished at top and bottom	Water	Stainless Steel
9101TK01	Above	External	2009	30	Vertical Cylinder, Dished at top and bottom	Acid*	Stainless Steel
9102TK01	Above	External	2009	30	Vertical Cylinder, Dished at top and bottom	Acid*	Stainless Steel
9104TK01	Above	External	2009	15	Vertical Cylinder, Dished at top and bottom	Water	Stainless Steel
9105TK01	Above	External	2009	15	Vertical Cylinder, Dished at top and bottom	Water	Stainless Steel
9301TK01 Not installed	Above	External Bunded	2019	15	Vertical Cylinder, Dished at top and bottom	Water	Stainless Steel

Tank Ref.	Above or Below Ground	Internal / External	Installation Date	Capacity of tank (m^3)	Tank Shape	Tank Contents	Tank Construction Detail
9302TK01	Above	External Bunded	2019	15	Vertical Cylinder, Dished at top and bottom	Caustic**	Stainless Steel
9303TK01	Above	External Bunded	2019	15	Vertical Cylinder, Dished at top and bottom	Acid*	Stainless Steel
9304TK01 Not installed	Above	External Bunded	2019	15	Vertical Cylinder, Dished at top and bottom	Water	Stainless Steel
9191TK01	Above	External Bunded	2019	30	Vertical Cylinder, Dished at top and bottom	Caustic**	Stainless Steel
9192TK01	Above	External Bunded	2019	30	Vertical Cylinder, Dished at top and bottom	Acid*	Stainless Steel
7251TK01	Above	External	2009	200	Vertical Cylinder, Dished at top and bottom	Water	Stainless Steel
Mains Water	Above	External	2009	200	Vertical Cylinder, Dished at top and bottom	Water	Stainless Steel
Chilled water	Above	External	2009	30	Vertical Cylinder, Flat top and bottom	Water	Stainless Steel
Site Effluent Sump	Below	External	2009	10	Horizontal Cylinder, Dished Ends	Effluent***	GRP lined concrete
Effluent Balance	Above	External	2009	200	Vertical Cylinder, Dished at top and bottom	Effluent***	Stainless Steel
DAF Sump	Below	External Bunded	2018	30	Vertical Cylinder, Flat bottom, open top	Effluent***	GRP lined concrete
DAF Sludge tank	Above	External Bunded	2018	28	Vertical Cylinder, cone bottom, flat top	Effluent***	Stainless Steel
Sprinkler Tank 1	Above	External	2018	500	Vertical Cylinder, Flat top and bottom	Water	Galvanised Steel

Tank Ref.	Above or Below Ground	Internal / External	Installation Date	Capacity of tank (m^3)	Tank Shape	Tank Contents	Tank Construction Detail
Sprinkler Tank 2	Above	External	2018	500	Vertical Cylinder, Flat top and bottom	Water	Galvanised Steel

Notes:

* Acids for CIP and cleaning, typically 60% nitric acid or proprietary cleaning products such as Mida Klenz (blend of sulphonic, citric and glycolic acids).

** 30-40% sodium hydroxide solution

*** Effluent consists of milk / CIP chemical / water - No Human Waste

At the Muller facility in Telford the inventory that will be used in the assessment is;

- Caustic, acid and flocculant for the ETP;
- Caustic and Acid in Tank Farm 1;
- Milk and effluent for Tank Farms 2, 3 and the Factory;
- Water for the sprinkler systems;
- Oil / waste oil (non-flammable) for the oil storage; and
- Diesel for the diesel tank.

Other liquids such as small volumes of cleaning chemicals or fruit concentrates are either held in such small volumes or are of so similar a nature to the inventory described above that separate consideration is not deemed necessary to determine the required secondary containment arrangements for the site.

3.2 C736 Chapter 2.3.2 - Pathway

There are several conceivable pathways for potentially escaped inventory to reach a receptor (ground, surface water or groundwater). These are as follows:

- Loss to ground via spillage to unsurfaced areas of the site;
- Leakage to ground beneath the site through cracks and joints in concrete slab floors, asphalt roadways, brickwork flooring etc;
- Loss to ground by overwhelming perimeter edging and/or leakage through unsealed joints in kerbing;
- Leakage to any groundwaters underlying the site by soakaway to ground beneath the site through cracks and joints in the floors or through manholes, underground chambers, pipelines or ducting and further transit through permeable geology underlying the site;
- Loss to surface water drainage systems installed within the surfaced areas surrounding the factory and administration buildings, ultimately possible to discharge off-site and thence to local surface water systems;
- Loss to surface water in ditch systems surrounding the site from overwhelming of or leakage through perimeter kerbing systems;
- Loss to public sewage treatment systems resulting in harm to sewage works processes and possible loss to surface water systems via overwhelming of public sewage works due to flooding of the ETP bund overwhelming the below ground ETP sump and discharging to sewer; and
- Tracking of material on vehicle tyres from the tanker bay to the public highway and from there to storm drains and ultimately to surface water courses.

3.2.1 Geology

Presented in Appendix 02 is a Groundsure Report that details local environmental conditions. The underlying geology is as follows:

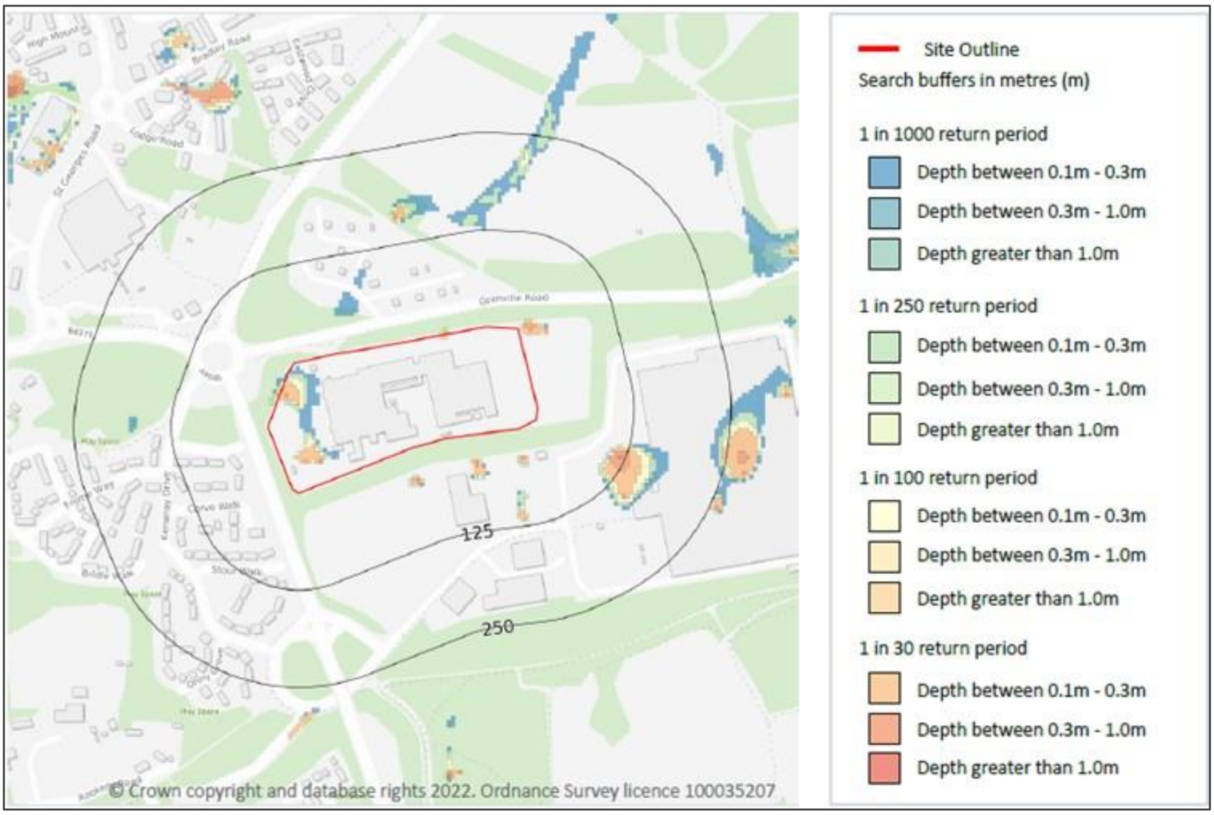
- Superficial deposits: Devensian Till (sandy clay, clayey sand and clay with gravel and boulders); and
- Bedrock: Faulted Etruria Formation (mudstones, sandstones and conglomerates), the site overlays extensive coal seams that have been actively extracted historically leaving behind a number of shafts etc.

These are characterised as having a high superficial permeability and moderate bedrock permeability characterised by fracture flow. There is negligible risk from subsidence or stability issues.

3.2.2 Flooding

Other potential transient pathways that may develop relate to the risk of flooding at the site. The information in Appendix 02 indicates that there is little risk of surface water flooding to the main areas of the facility that store liquids. However, the western end of the site is subject to a minor risk from flooding over return period of >30 years (see Figure 3-2). With reference to the *Check your long term flood risk* website[2], the facility at Telford is at 'very low risk' of flooding by rivers and surface waters and is not in a recognised flood zone.

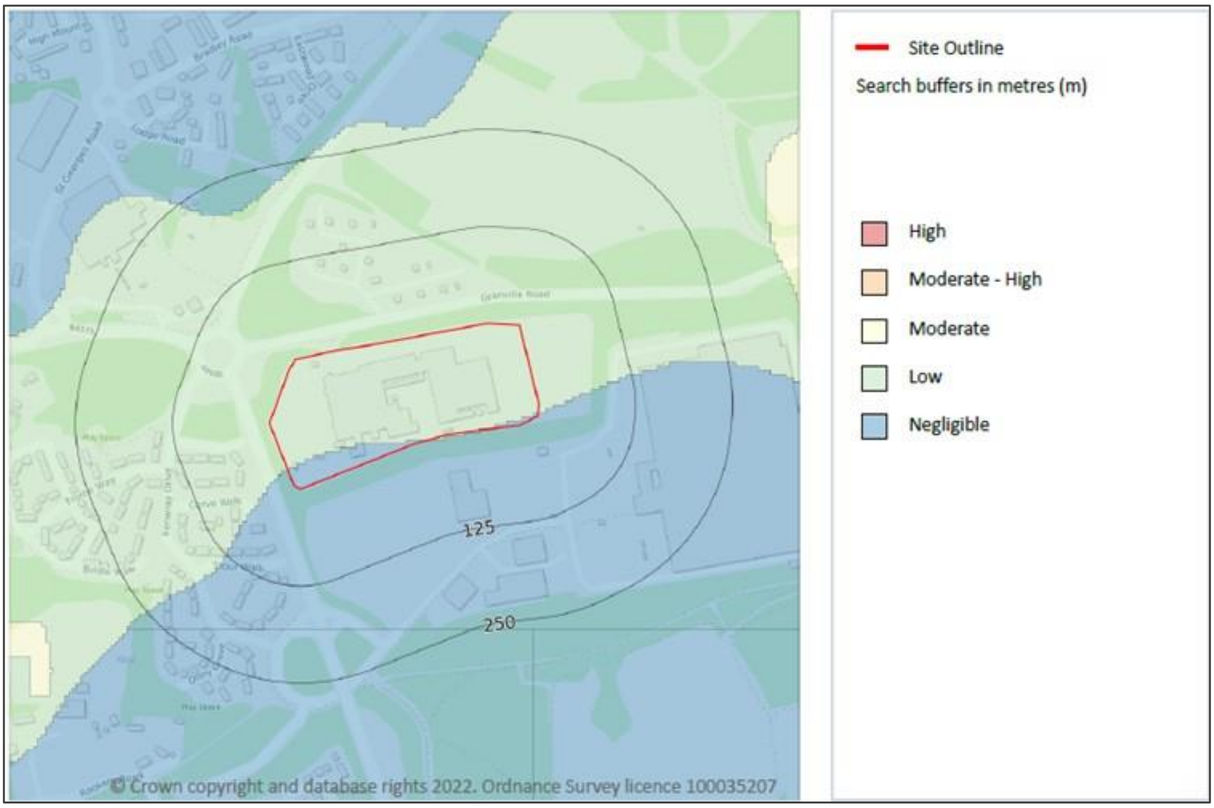
Figure 3-2: Surface Water Flood Risk Map



Groundwater flooding is caused by unusually high groundwater levels. Data in Appendix 02 indicates that, based on a 1 in 100-year return period, the site is not at risk from groundwater flooding (see Figure 3-3).

[2] https://www.gov.uk/check-long-term-flood-risk

Figure 3-3: Groundwater Flooding Map



3.2.3 Drainage

As shown in Figure 3-1, only two areas of the site are provided with secondary containment bunds. These are the ETP and Tank Farm 1. Water and/or spillage within these bunds are held within the sealed bund and is pumped out to treatment and ultimately disposal to sewer via manually operated submersible pumps that discharge to the site effluent systems. Other bunds on site associated with smaller storage vessels (<$10m^3$) are undercover and do not collect rainfall. These smaller bunds are regularly inspected, and any spilt content disposed of via the in-site effluent treatment systems.

As previously described any spillage or tank overtopping that takes place outside of the areas supplied with secondary containment will drain to the floor of the factory building or the external hardstanding. Any spilt liquids will drain southwards and be intercepted by various slot drains installed throughout the facility. Slot drains fall either to the sites effluent sump (and thence to the effluent tank and finally to on site treatment and discharge to sewer) or to the external surface water drainage system. Rainfall is also collected via the external surface water drainage system. As previously described, surface waters (plus any potential loss of containment from the sprinkler system tanks) from the eastern half of the site drains to the east, into a large SUDs lagoon, prior to discharge off site via an interceptor. Drainage from this half of the site does not have the potential to be contaminated as the processes involved in this half of the facility are essentially 'dry' processes of packaging and dispatch of consumer products. The only bulk stored liquid is clean water to be used in fire suppression (sprinkler) systems.

Surface water from the southern portion of the western half of the site does have the potential to be contaminated. This all falls to the far south-west corner where a penstock valve exists. In recognising the potential risk to the environment of allowing any possibly contaminated surface to discharge freely from the site, Muller currently maintain this valve in a closed position and then inspect and test the accumulated rainfall prior to opening the Penstock to release and drain water from this portion of the site. In this way the prevent any potential contamination from leaving the site. Should contamination be detected, the water is either pumped to the on-site effluent treatment system for treatment and disposal or is tankered away to suitably licensed 3rd party disposal outlets.

Surface water from the northern portion of the site is, similarly to the eastern portion, not deemed capable of being contaminated from the contents of stored inventory and surface waters from these areas pass through the surface water control systems previously described prior to discharge from site.

In any event, the site is regularly inspected and manned at all times. Should there be any risk of contamination of the site discharge to surface water or sewers then site procedures are in place to close penstock valves on any potentially affected outlet to the environment and to retain liquids on site for testing and if necessary safe treatment and disposal.

3.3 C736 Chapter 2.3.3 - Receptor

The receptor is the underlying ground, groundwater and surface waters in nearby ponds and rivers. It also potentially includes the local sewage treatment works.

Information presented in Appendix 02 indicates that the following receptors exist in the vicinity of the Facility:

3.4 Hydrology and Drainage

The facility is located on the watershed of a small local watercourse, the Wall Brook, that is ultimately in the Severn Middle Shropshire catchment. However, there are no recorded water networks or surface water features within 250m of the site perimeter. The Wall Brook is reported as being 2,865m to the north of the site. The Wall Brook has the following designations:

- Wall Brook (from its source to its confluence with the Piped Strine):
  - Chemical rating- Fail;
  - Ecological rating – Moderate;
  - Overall rating – Moderate.

Figure 3-4: Hydrology Map

Information presented in Appendix 02 indicates that there are no licensed surface water abstractions within 500m of the site boundary but there are five within 2,000m of the site. These abstraction licenses are for uses that include spray irrigation and make-up or top up waters, none are potable water abstractions.

3.5 Geology and Hydrogeology

As described in Section 3.2.1, the facility is underlain by a superficial deposit of Devensian Till (sandy clay, clayey sand and clay with gravel and boulders) overlying the Fractured Etruria Formations (mudstones, sandstones and conglomerates) bedrock.

The facility sits above a Superficial Secondary Undifferentiated Aquifer and a Bedrock Secondary 'A' Aquifer exists beneath this. Secondary (undifferentiated*)* aquifers have been designated in cases where it has not been possible to attribute either category 'A' or 'B' to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type. Secondary 'A' Aquifers are described as consisting of permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

There are no Source Protection Zones within 500 m of the site boundary, but the aquifer is classified as being vulnerable, this being described as areas where it is possible to easily transmit pollution to groundwater. They are likely to be characterised by high leaching soils and the absence of low permeability superficial deposits. The site is also within a Nitrate Vulnerable Zone.

3.6 Designated Sites

With reference to the information in Appendix 02, there is one SSSI (Muxton Marsh), four Local Nature Reserves (all associated with Granville Country Park) and an area of Greenbelt within 2,000m of the site boundary. There are however no Ramsar sites, Special Areas of Conservation, Special Protection Areas, National Nature Reserves, Designated Ancient Woodlands or other such nationally designated sites within 2,000m of the facility.

The site is also located within a SSSI impact zone (meaning that specific development activities have to be notified to the Planning Authority) and there are a number of Priority Habitat Inventory sites within 250m of the site boundary (all associated with Deciduous Woodland).

4.0 Classification

4.1 Introduction

C736 Figure 5.1 provides a methodology for assessing and classifying existing containment structures against the guidance. This methodology has been followed and is summarised in the following sections.

4.2 Risk assessment and classification of secondary containment systems.

C736 Section 2 provides a risk assessment methodology to support the three-tier risk-based classification system for secondary containment systems. This methodology has been applied to the inventory stored within the facility to provide a baseline against which the existing containment measures can be assessed.

The risk assessment is based on the commonly adopted source-pathway-receptor model with the aim of the containment being to eliminate the pathway between the source, the inventory, and potential receptors such as groundwaters, surface waters and environmentally sensitive habitats.

4.2.1 Site hazard rating

A low, medium or high hazard is ascribed to the source, pathway and receptor and these are combined to produce the site hazard rating.

Source

The nature of the source for the majority of the liquids being stored on site are essentially a large volume of milk, dairy effluent or strong acids or alkalis, these have the potential to cause pollution manly due to the likelihood of eutrophication as a result of release of high BOD and COD liquid to the environment.

The extent of any pollution incident could be up to several kilometres from the point of releases, particularly if a significant volume of material were to be lost from containment in a short period of time. High BOD liquids also have the potential to cause 'sewage fungus' infestations of waterways if low but persistent volumes are allowed to leak to the environment.

However, this type of environmental harm is quickly resolved if the source of the high BOD leakage is stopped. There is little potential for long term bioaccumulation or persistence of pollutants in the environment from a release of the inventory stored at the site. The effects of releasing high or low pH liquids would be damaging in the short term but again would be quickly reduced through dilution and neutralisation the environment with little long-term effects.

Smaller volumes of diesel and oil are also stored on site, these too would have damaging effects if released to the environment and the effects would be longer lived relative to that caused by release of dairy products or effluents.

Water stored on site for use in sprinkler systems would pose no risk to the environment if released.

Therefore, the source hazard should be considered as follows:

- For the main bulk dairy products and related effluents and cleaning chemicals (low pollutant concentration but potentially high volumes): **Moderate**;
- For oils and diesel (high pollutant concentration but relatively lower volumes): **Moderate**; and
- For sprinkler system water: **None**, no longer considered in the review as no source risk.

Pathway

There are a number of factors that should be considered when considering the pathway hazard and these are summarised in Table 4-1.

Table 4-1: Path Hazard Assessment

Factor	Comment
Proximity of receptors	As discussed in Section 3.3 the site is distant from any surface water receptor, but the underlying groundwater is classified as being vulnerable. Should a spill occur the first receptor is likely to be local surface water ditches or the ground around the southwestern corner of the site should the kerbline be overtopped. Sewers and storm drains etc in the public highway are unlikely to be affected.
Site layout and drainage	As discussed in Section 3.2.3 inventory may reach a receptor via the following pathways; • Discharge off site in sewer effluent; • Direct to ground, particularly to the southwest corner of the site; • Overland flow to groundwater via overtopping of kerbs to southwest of site; and • Discharge to surface waters via contamination of site surface water drainage systems (most notable associated with the southwest corner of the site discharging to the northwest corner off-site discharge point)
Topography, geology and hydrogeology	The facility is essentially flat with a slight fall towards the southern perimeter. As discussed in Section 3.2.1, the superficial alluvial deposits underlying the facility have limited permeability, however, the presence of potential pathways through more permeable layers or lenses within the till draining to groundwater and surface water ditches (albeit that the Wall Brook is distant from the site) should not be discounted.
Climatic conditions	Significant rainfall has the potential to overwhelm drainage systems resulting in overland offsite flow paths developing. If the site drainage system were to be overwhelmed, it is likely that excess flow would drain to land to the southwest of the site.
Firefighting water	Firefighting water not retained within the facility would follow a similar overland flow path to that described for surface water runoff.
Treatment plants	Site effluent (CIP water, spills, any potentially contaminated surface waters) is passed through a ETP prior to discharge to the foul sewer to remove essentially fats, oils and grease. The plant is under the direct management of trained site staff, so it is unlikely that significant uncontrolled release via this route is possible.
Mitigating effects	The key mitigating effects when considering potential pathways are the: • the provision of a concrete (presumed to be reinforced) bund to the ETP and Tank Farm 1 (containing the bulk chemical stores); • Localised bunding of the two main bulk chemical storage tanks within the ETP; • Localised, lockable, covered bunding to smaller chemical storage vessels throughout the site; • Sealed concrete or asphalt surface to the factory floors and roadways (with the exception of a few areas of made ground) that drain to either effluent storage and

Factor	Comment
	treatment systems or surface water drainage systems complete with raised kerbs that enable some water to be retained on site prior to discharge; • Manually controlled surface water drainage systems that retain water on site for testing prior to release where contamination is most likely, manually controlled final discharge points so that the whole site can be sealed closed from discharge for a limited time should continuation be suspected; • the provision of a tertiary containment hardstanding tanker bay preventing migrating to ground and groundwaters of any potentially contaminating liquids during offloading; • the location of all tanks, pipework, pumps and liquid waste processing within either the bunded or tertiary contained areas of the site; and • the treatment of effluent prior to discharge to the foul sewer.
Factors affecting transport potential	These factors have been addressed above.

Having considered the potential pathways discussed in Table 4-1, overall it is considered the Pathway Hazard is **Medium**.

Receptors

Given that potential significant receptors (the nearest local surface water body, surface waters that road drains may discharge to and the local sewage treatment works) are distant and not reached by direct flow from the facility, but that underlying groundwater is classified as vulnerable and that whilst environmentally designated sites do exists they are not particularly susceptible to the type of pollution that would result from a spill at the site, the Receptor Hazard is considered **Medium**.

4.2.2 Overall site hazard rating

C736 Box 2.1 provides a suggested means of combining the source, pathway and receptor hazard ratings to give the overall site hazard rating, this methodology is summarised below;

Possible combination of ratings	Suggested overall site hazard rating
HHH or HHM or HMM	HIGH
HHL or MMM or HML	MODERATE
MML or HLL or MLL or LLL	LOW

Following this guidance results in a **Moderate** site hazard rating for the facility (employing the highest source hazard assessment of ‘medium’).

4.2.3 Site Risk Rating

The site hazard rating is combined with the likelihood of an event leading to the release of inventory to provide the overall site risk rating. C736 Table 2.3 provides a suggested means of correlating the risk of a loss of containment with the annual probability of loss of containment per site.

The risk of loss of containment is determined through the consideration of:

- identification of all the events that are capable of causing loss of containment, and,

- assessment of the likelihood of occurrence of each event.

C736 identifies the potential failures and the reasons of failure as including:

- operational failures, such as failure of plant, or human failure by operators;
- shortfalls in design, lack of alarms and fail-safe devices;
- structural failure – materials, components, detailing, corrosion or when exposed to heat and flame;
- abuse – inappropriate chance of use or other misuse;
- impact, e.g. from a vehicle;
- vandalism, terrorism, force majeure etc;
- flood, fire or explosion;
- geological factors – subsidence etc; and
- ageing or deteriorating assets / sub-components.

Presented below is a consideration of these potential failure factors with respect to the Facility under review:

1. Operational failures, such as failure of plant, or human failure by operators;

   All storage tanks at the site were installed (as new) at the earliest in 2009 and so are all less than 20 years old. All tanks are made from suitably robust materials which for the most part is stainless steel. The exceptions to this are, the site effluent sump (which is GRP lined concrete), the two bulk chemical stores at the ETP (which are HDPE), the sprinkler tanks (which are galvanised steel) and the diesel / oil tanks (that are painted steel). All pipework is either in stainless steel (for the dairy factory) or in suitable drainage material such a Polyethylene for effluent and surface water drainage. All steel pipework is constructed using welded or bolted flange joints.

   All tanks and pipework appear in good condition and for production tanks are subject to an annual non-destructive test (NDT) testing regime to confirm their structural integrity by a specialist tank inspection company. Tanks associated with chemical storage, effluent storage, diesel and oil storage and storage of water etc however are not subject to formal specialist NDT tests. The site drainage systems (surface water and effluent) are CCTV surveyed on a 2 yearly basis. The main below ground effluent sump is drained and inspected every 18 months. All tanks and above ground interconnecting pipework, pumps valves and ancillary systems are included in site engineer inspection regimes. This includes a formal visual inspection on a daily basis for leaks and any sign of damage and then increasingly formal inspection and maintenance on weekly, monthly and bi-annual frequencies as part of site wide preventative maintenance regime.

   It is considered unlikely that tanks or pipework will fail structurally.

   All liquid loading and unloading takes place in the southwestern corner of the site either via the formal milk offloading point or more locally to the specific tanks involved for chemical and sludge transport. All of these activities take place on sealed roadways that fall within the catchment of the southwest corner of the site where the Penstock valve is kept closed until accumulated water is tested and proven to be uncontained prior to release from site. The Bauer connection point associated with the 200m^3 effluent storage tank is however located over an area of made ground.

   Trained operators are on site to undertake all works, a substantial formal set of site operating procedures and risk assessments exist.

   The main point of risk would appear to be the full loss of containment from one of the larger 200m^3 tanks. Such an event would likely need to be via a human operator failure rather than an undiscovered material failure of the tanks or transmittal equipment due to the high level of inspection and maintenance taking place on site and the high level of protection afforded against impact from vehicles. The most likely loss of containment would be tank overtopping, but this would likely not result in the loss of 200m^3 of inventory. The highest point of risk is from loss of the full inventory of the Effluent tank as in all other circumstances the effluent tank itself would be available to allow spilt material to be pumped from the effluent sump (where it would collect) into the effluent tank for storage and treatment, thus protecting the site from loss of containment by overwhelming of the kerb line or accidental release via the surface water discharge systems.

2. Shortfalls in design, lack of alarms and fail-safe devices;

Tanks associated with the ETP, and Tank Farm 1 are located within local poured in-situ concrete bunds with concrete slab floors. These appear to be in good condition and a visual inspection indicates they are not suffering from any signs of instability or subsidence. However, their detailed construction design (for example reinforcement type) is not known so it is assumed to be of reinforced concrete. Jointing details are also not known (presence or absence or type of water bars not known). At Tank Farm 1 there are a number of penetrations though the base where pipework enters and leaves the main dairy factory building. The ETP and Tank Farm 1 bunds are understood to be suitably sized (see Section 6.5). The Diesel and Oil storage tanks have a minimum secondary containment capacity of 110% of the inner tank and are covered so do not need to accommodate rainfall (these tanks are understood to conform to the Oil Storage Regulations and are suitably protected from impact damage). All other tanks at the site are un-bunded and inspection had demonstrated that retrospective installation of a suitable containment bund is not possible without making substantial and costly major alterations to the layout and structure of the whole facility. Instead, tanks are located on suitable concrete bases in sealed surfaced areas (external to the site adjacent to roadways or internal to the site on concrete floored areas). All tanks are surrounded by slot drains to capture spills and all drainage falls to the south of the site to either the sealed effluent systems or via overground flow to the southern surface water system, where it is currently retained for testing prior to release by the manual opening of Penstock Valve 2 (see Section 2.2).

All the milk storage tanks, bulk chemical tanks and tanks associated with the effluent systems are installed with a main level reading device (radar) with high, low and alarm set points. All tanks also benefit from back-up high- and low-level float switches. All tanks are fitted with overflow systems that pipe any overflows directly into the sites effluent systems.

- Overall, cascade failure of all tanks is not considered to be a credible failure scenario as interlinking tanks is not normally the case and is difficult to achieve without specialist knowledge and intent. Non-flammable liquids are stored in tank farms so cascade failure due to a pool file is not considered possible;
- Catastrophic failure of a single tank (largest is 200m^3) is not deemed to be a credible failure scenario as tanks are well maintained and frequently inspected and tanks are well protected from impact damage
- Loss of a full tanks content is considered a remote possibility due to human error or damage to pipework. However, this would be quickly noticed, and facilities are in place (multiple valves on lines, access to on-site engineers etc) to quickly prevent on-going loss of inventory; and
- Loss of containment due to tank overtopping / overfilling is considered a possibility albeit that tanks are fitted with high level control systems and spills etc would be quickly noted by site operatives.

3. Structural failure – materials, components, detailing, corrosion or when exposed to heat and flame;

As discussed above, due to the use of high quality and appropriate primary containment materials and the high frequency of high-quality inspection and maintenance regimes, catastrophic structural failure of primary containment systems is not considered to be a credible scenario. Similarly, misconnection leading to two or more tanks being connected together is not considered to be a credible scenario due to the control systems that are in place (password protection on computer control systems and key-fob protection on physical access to connecting pipework systems). Cascade failure of tanks due to fire damage is also not considered a credible scenario due to the fact that with the exception of the diesel and oil storage systems no potentially flammable inventory is stored. The diesel and oil storage tanks are isolated from all other storage tanks and are OSR compliant vessels.

For Class 2 and 3 bunds jetting needs to be considered. Jetting can occur when a rupture or hole in a tank wall allows escape of a jet of liquid with sufficient force to project over the bund wall. Jetting is highly unlikely in a concrete tank but is more likely in tanks constructed from materials such as steel. Even in steel tanks, as long as they are subject to regular inspection and maintenance the risk is small, but not zero.

The CIRIA C736 guidance contains a calculation that relates tank height to bund height and the distance required between the two to contain a jet. Clearly changes to any one of these parameters can cause the required geometry to change. The calculation presented in the CIRIA guide is as follows[3]:

Figure 4-1: Jetting Distance Calculation

For a small diameter sharp edged discharge orifice, it can be demonstrated that:

$$l^2 = 4\,C_v^{\,2}\,(z-h)\,(H-z)$$

where C_v = coefficient of velocity

In practice, $C_v \cong 0.99$. Assuming $C_v = 1$ leads to the conservative solution:

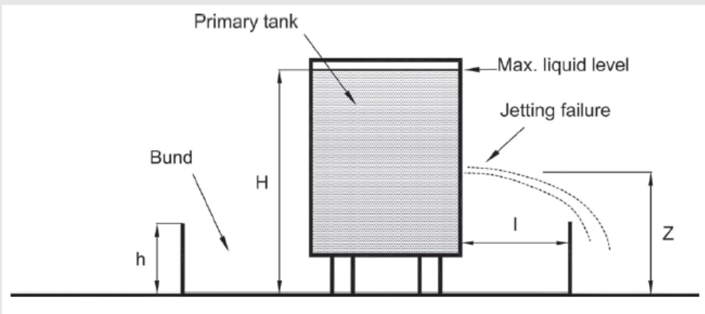
$$l^2 = [4(z-h)(H-z)]^{0.5}$$

For a given value of h, it may be shown the l is a maximum when:

$$z = 0.5H + 0.5h$$

which leads to the solution:

$$\boldsymbol{l_{max} = H-h}$$



Where bunding is in place (at the ETP and Tank Farm 1) tanks are very close to the bund walls and so jetting is a potential issue. Clearly where bunding is not present (Tank Farms 2 and 3 and the tanks within the factory itself) jetting is also possible. The following mitigation is in place:

- ETP – whilst tanks are close to bund walls, and bund walls are low, the likelihood of jetting is small due to the materials of construction of the tanks themselves (HDPE for the chemical tanks and steel for the sludge tank) and the inspection regimes that are in place at the site make the unnoticed development of a pinhole unlikely. Also, jetting from the sludge holding tank would only be possible outside of the bund towards the roadway nearby to Penstock Valve 2. At this location tertiary containment is provided by the roadway, kerb system and closure of Penstock 2. Both the bulk chemical stores are also adjacent to the bund wall and jetting could take place should the primary storage tank wall fail above the height of the integral bunding for each tank. However, again this is unlikely as the most likely cause of a failure that would lead to jetting would be a vehicle impact and both tanks are not accessible to road vehicles.

[3] Box 6.1 from CIRIA, C736. 'Containment Systems for the Prevention of Pollution, Secondary, Tertiary and Other Measures for Industrial and Commercial Premises'. 2014.

- Tank Farm 1 – vertical steel storage tanks are adjacent to the bund walls. However, all tanks are encased in an outer metal skin. Whilst this outer skin does not provide any form of secondary containment it does act as an effective baffle to any jetting from the inner tank, so any leak from the tank would be deflected by the outer skin and would fall to the base of the bund.
- Tank Farm 2 and 3 – tanks in these locations do not benefit from secondary containment and secondary containment cannot be realistically retro-fitted. Similarly to Tank Farm 1, jetting is not likely from these tanks as they have a metallic outer skin that would deflect any leakage from the primary tank to ground. Any such leak would then be picked up during site inspections and the tank drained, leak pinpointed and repaired. Containment of any such jetting or leak from these tanks would be within in the tertiary containment provided by the roadway, kerb and closure of Penstock 2.
- Diesel and Oil Storage Tanks – as previously described, these are double skinned OSR compliant tanks where the inner tank is entirely encased in an outer tank. As such jetting from the inner tank is not possible.

All tanks appear to be in good condition and are regularly inspected by site maintenance engineers, including inspection for leaks and signs of failure / corrosion. In addition, for milk storage tanks, specialist tank inspection contractors complete NDT testing on an annual basis. Pipework, valves, pumps and other associated equipment also appears to be in good condition and is subject to regular maintenance. The bunds that do exist (ETP and Tank Farm 1 plus the outer skins of the diesel and oil storage tanks) appear to be in good condition and do not show any signs of failure.

The effluent sump (below ground) is understood to be constructed as a Glass Reinforced Plastic (GRP) lined concrete sump and is also subject to regular inspection from specialist contractor (every 18 months). The underground interceptors are also regularly inspected as part of the two-yearly CCTV inspection regime for all drainage systems.

4. Abuse – inappropriate chance of use or other misuse

   The site is well secured and manned at all times. All control of valves etc is via password protected computerised control systems to which only a limited number of specifically trained personnel have access. Physical access to tanks and valves is controlled by a site wide security key-fob systems that only grants access to specific areas of site to specific personnel. Abuse or vandalism is not considered to be a credible scenario. Accidental misuse / error is a more likely scenario and the greatest point of risk in this regard is the unloading of tankers. Here there is a potential for loss of inventory due to misconnections, failure of pipes or failure of pump equipment at critical times. Whilst suitable training, documented systems of work and maintenance are all in place, error is possible. These activities take place within a tertiary containment area which can hold up to 90m^3 of spilt inventory up to the overtopping level of the kerb at its low point (behind Penstock Valve 2 location) before it breaches and allows inventory to escape to the ground to the southwest of the site. The majority of such a spill would be captured in the sites effluent systems including slot drains around the tanker loading locations (see Drawing 01) which provide 210m^3 of effluent storage (200m^3 in the effluent tank and 10m^3 in the effluent sump). Therefore, loss of inventory from the site is possible but is unlikely.

5. Impact, e.g. from a vehicle;

   Tanks and interconnecting pipework are located both externally to the main factory building and within the building itself, all associated with the western half of the facility. Vehicles such as HGV's, domestic cars and vans and forklift trucks are able to drive around the external access roads and yards associated with the site. Within the factory building vehicle access is restricted to forklift trucks. Whilst not all located within bunds, tanks are located on raised concrete plinths, behind raised kerb lines or behind robust bollard or barrier systems.

Uncontrolled vehicle manoeuvring that would be needed to cause damage to primary containment systems is unlikely, but not impossible. Protection systems that are in place would reduce any consequence of such uncontrolled manoeuvring to the point that damage from vehicle impact is considered to be unlikely.

6. Vandalism, terrorism, force majeure etc;

   As above for Point 4, this is considered to be unlikely due to the high level of security at the site.

7. Flood, fire or explosion;

   As discussed in Section 3.2.2 the risk from flooding is considered to be low at the facility. There is however a risk of fire as the diesel and oil storage tank store potentially flammable liquids. However, these do not share bunds with other tanks and are located in isolated locations at the site. Risk associated with the storage of flammable materials is understood and acknowledged on site and suitable controls on ignition sources are believed to be in place (DSEAR Risk Assessment and Controls).

8. Geological factors – subsidence etc;

   Information presented in Appendix 02 and discussed in Section 3.2.1 indicates that there is a negligible risk of subsidence.

9. Ageing or deteriorating assets / sub-components.

   As discussed above, the plants tanks are less than 15 years old and are regularly inspected and maintained and from visual inspection are seen to be in good condition. As long as this regime of inspection and maintenance is continued there is no reason to suspect that plant will fail due to aging.

Overall, cascade failure of all tanks is not considered to be a credible failure scenario as interlinking tanks is not normally the case and is difficult to achieve without specialist knowledge and intent. Non-flammable liquids are stored in tank farms so cascade failure due to a pool file is not considered possible.

Catastrophic failure of a single tank (largest is 200m^3) is not deemed to be a credible failure scenario as tanks are well maintained and frequently inspected and tanks are well protected from impact damage.

Loss of a full tanks content is considered a remote possibility due to human error or damage to pipework. However, this would be quickly noticed, and facilities are in place (multiple valves on lines, access to on-site engineers etc) to quickly prevent on-going loss of inventory.

Loss of containment due to tank overtopping / overfilling is considered a possibility albeit that tanks are fitted with high level control systems and spills etc would be quickly noted by site operatives.

Overtopping of tanks is one of the most common causes of loss of containment. However, the tanks are all fitted with level readers and alarm / auto isolation systems. This is a robust means of preventing tank overtopping as each tank has at least one back-up level detection system in all tanks capable of being overtopped. Due to the continuously manned nature of the site and the frequency of site inspections, any such overtopping incident would be quickly recognised and rectified.

The plant is well staffed and well operated and is located within a secure and fenced compound. Therefore, it is unlikely that any deliberate acts of vandalism could give rise to a loss of containment so it would be unlikely to happen and would be quickly observed and rectified it was to occur. Similarly, the most likely cause of loss of containment is through operator error during repair and maintenance activities but again this is considered unlikely and would be quickly recognised and rectified.

Whilst there is some theoretical vulnerability to impact damage giving rise to loss of containment the plant is in general well protected from impact damage and any issue would quickly be dealt with by site staff.

The plant has tertiary containment and control of spills is possible via manual systems. At the most vulnerable point (Penstock 2) the valve is normally kept closed and is only opened should accumulated water be shown to be uncontaminated.

In the absence of any quantitative information on the likely loss of containment, a **Medium** risk has been adopted that assumes an annual probability of between 1% (1 in 100) and 0.001% (1 in 1 million). This is due to the need for a number of events to occur in sequence for a loss of containment to be realised, essentially meaning that a 100% full effluent balance tank failure needs to take place for loss of inventory to the environment to take place.

The C736 guide details that for an overall site risk rating the site hazard rating (in this case assessed as being **Moderate**) and the Risk of Loss of containment (in this case being **Moderate**) is assessed as follows:

Possible combination of ratings	Suggested overall site hazard rating
HH or HM or MM	HIGH
MM or HL or LH	MODERATE
LL or ML or LM	LOW

Therefore, with refence to C736 Box 2.2, the site risk rating would be considered **Moderate**.

4.3 Containment Classification

C736 Section 2.6 advises that for a **Moderate** site risk rating, **Class 2** containment should be provided.

5.0 Credible Scenarios

Consideration of the compliance of the secondary and tertiary containment facilities within the facility should be based on credible failure scenarios.

During the site visit, these were discussed, and the outcome are summarised in Table 5-1.

Table 5-1: Credible Scenarios

Source	Potentially Flammable	Identified Credible Risk	Scenario
Full loss of containment of Effluent tank at Tank Farm 1.	No	Mistake / misconnection during maintenance	Cascade failure effects are unlikely as milk effluent, CIP wash and chemicals are not flammable and spilt material would not interact with adjacent stored inventory due to topography of internal factory drainage, external tank bases, tank farms, roadways etc. If a full 200m^3 tank loss occurred, spilt inventory would be mainly directed to the site effluent sump where it would be attempted to be returned to the failed effluent tank. Eventually spilt material would collect in the roadway storage and could overtop the kerb at this location. Loss of 200m^3 of effluent from the Effluent storage tank, whilst unlikely to occur, is the most likely way in which contamination would escape the site due to the removal of 200m^3 of effluent storage that such an incident implies.
Loading Bay	No	Mistake / misconnection during loading	Cascade failure effects are unlikely as milk is not flammable and spilt material would not interact with adjacent stored inventory due to topography of external roadways and tank farms etc. Spilt inventory would be collected in the southwestern corner of site at below the overtopping height of the kerb and would only be likely to overtop or leak through surfaces if left to accumulate with rainfall for a number of days, this being considered to be highly unlikely given the manned nature of the facility. However, spillage from tanker loading activities is considered to be the most likely cause of loss of primary containment at the site.
Full loss of containment of bulk chemical or product (milk) storage tanks housed at Tank Farm 1, 2 or 3 or within the factory building	No	Mistake / misconnection during maintenance	Cascade failure effects are unlikely as milk and stored chemicals are not flammable* and spilt material would not interact with adjacent stored inventory due to topography of internal factory drainage, external tank bases tank farms, roadways etc. Spilt inventory would be mainly directed to the site effluent system and storage tank (effluent tank, sump and roadway storage is in excess of any single other tank volume) and any residual contamination held

Source	Potentially Flammable	Identified Credible Risk	Scenario
			within the southwestern corner of site at below the overtopping height of the kerb. Only likely to overtop the kerb or leak through surfaces if left to accumulate with rainfall for a number of days, this being considered to be highly unlikely given the manned nature of the facility.
Partial loss of containment of effluent tank at Tank Farm 1.	No	Mistake / misconnection during maintenance or overtopping	Cascade failure effects unlikely as milk effluent, CIP wash and chemicals are not flammable and spilt material would not interact with adjacent stored inventory due to topography of internal factory drainage, external tank bases tank farms, roadways etc. Loss volume would be substantially less than a full 200m^3 tank loss and so would be mainly directed to the site effluent sump where it would be returned to the effluent tank. Eventually spilt material would collect in the roadway storage. Site alarms and inspections would likely pick up this issue quickly and it would be resolved before any overtopping of kerbs of loss from site.
Partial loss of containment of bulk chemical or product (milk) storage tanks housed at Tank Farm 1, 2 or 3 or within the factory building	No	Mistake / misconnection during maintenance or overtopping	Cascade failure effects unlikely as milk and stored chemicals are not flammable* and spilt material would not interact with adjacent stored inventory due to topography of internal factory drainage, external tank bases tank farms, roadways etc. Spilt inventory would be mainly directed to the site effluent system and storage tank and any residual contamination held within the southwestern corner of site at below the overtopping height of the kerb. Site alarms and inspections would likely pick up this issue quickly and resolve before any overtopping of kerbs of loss from site.

Note: * Both acids and alkalis are stored within the same bund and so have the potential to mingle and react if both were to leak. Whilst storing reactive chemicals in the same bund is not considered best practice, a leak of both at the same time in any significant volume is unlikely and any effects such as generation of high temperatures would be unlikely to cause ignition or physical weakening of primary containment structures.

6.0 Containment Requirements

6.1 Introduction

For the credible scenarios set out in Table 5-1, the worst-case containment volume requirement can be estimated. With reference to C736 Section 4.3, this should consider:

- Volume of spilled inventory;
- Rainfall;
    - 24 hour 10% Annual Exceedance Probability (AEP)[4] storm preceding the event;
    - Rainfall during the event;
    - 8 day 10% AEP storm following the event; and
- Firefighting Water.

6.2 Volume of Spilled Inventory

As a cascade or multi-tank loss of containment is not considered to be a credible scenario, for tanks within the ETP bund and Tank Farm 1 bund, a scenario should be considered where the single, largest tank inventory volume is lost.

For tanks within the remainder of the site, the largest volume of spilt inventory to be considered is the largest tank volume held at the site. In addition, a scenario should be considered where the tank that fails is the effluent tank, so reducing the available secondary containment volume by 200m^3. The volume of spilled inventory based on the credible scenarios set out in Table 5-1 and referred to above is as follows:

- ETP Bund: 28m^3 (gross volume);
- Tank Farm 1 Bund: 30m^3 (gross volume); and
- Whole Site: 200m^3 (gross volume).

6.3 Rainfall

Rainfall amounts have been obtained from the Flood Estimation Handbook Web Service[5]. Both the 10% (1 in 10) AEP and the 100% (1 in 1) rainfall depths have been obtained for comparison. An 8-day duration assessment period has been selected to account for rainfall prior to, during and in the aftermath of a loss of containment event. This time period has been selected as Muller Telford have pre-existing arrangements with effluent tankering and disposal companies and so removal and disposal of any spilt material could be quickly introduced to the facility should an emergency occur. However, some additional time has been allowed for events that take place on or around bank holiday and weekend periods when disposal outlets may not be immediately available and/or when disruption such as weather events, which may temporarily make transport difficult, leading to restricted access to off-site disposal. It should also be remembered that the site itself benefits from an ETP designed to treat any dairy related effluent to a quality that would allow disposal off site to the sewer systems.

[4] AEP: The chance or probability of a natural hazard event (usually a rainfall or flooding event) occurring annually and is usually expressed as a percentage. Bigger rainfall events occur (are exceeded) less often and will therefore have a lesser annual probability.
[5] https://fehweb.ceh.ac.uk/

Even in the event of a major loss of containment from one of the main storage tanks at the facility, disposal to sewer should not be disrupted and any spilt material could be pumped by temporary means to the ETP systems.

For the facility at Telford the following rainfall values have been used:

- 8-day 100% AEP event: 62.8mm; and
- 8-day 10% AEP event: 97.87mm.

The catchment areas over which these rainfall values have been calculated is as follows;

- The total area of the ETP bund has been calculated at 225m^2;
- The total area of the Tank Farm 1 bund has been calculated at 105.6m^2; and
- The total area open to rainfall that would drain to the southwest corner of the site (controlled by Penstock Valve 2) has been calculated at: 1,500m^2.

See Table 6-1 for area calculations.

[4] Assumes 4 hour duration event and 4 day clean up for bund and 1 day clean up for tanker bay

6.4 Firefighting Water

The inventory stored in the facilities tanks is not flammable and the vessels and associated infrastructure themselves are also not made of flammable materials. As such containment of firefighting water has not been deemed part of the credible scenario for the storage tanks at the site.

6.5 Containment Requirement for Credible Scenarios

For each of the credible scenarios set out Table 5-1, the total containment volume (secondary and tertiary) is summarised in Table 6-1.

Drawing 02 shows the rainfall catchment area that would drain to the southwestern corner Penstock 2 controlled area, bund dimensions have been taken from Drawing 01 layout and on-site measurement.

Table 6-1 shows that for bunds supplied to the ETP and for Tank Farm 1 are of sufficient volume. However, the tertiary containment provided by keeping Penstock Valve 2 closed is insufficient, particularly if it is the Effluent balance tank that is the tank to fail. It is this latter scenario that is of the most concern as full loss of containment of the Effluent balance tank content would immediately overwhelm the low point in the kerbline to the southwest of the site and allow inventory to escape the site

Table 6-1: Worst Case Credible Scenario Required Containment Volumes (m³) - Current

Item	Element	Parameter	Units	ETP value	Tank Farm 1 value	Overtop height at 111.93mAOD (existing top of kerb at Penstock 2)	
						Tank Farm 2, 3 and tanks in building*	Tank Farm 2, 3 and tanks in building**
Rainfall	Site	8 day 100% AEP (mm)	mm	62.8	62.8	62.8	62.8
		8 day 10% AEP (mm)	mm	97.87	97.87	97.87	97.87
Gross Containment	Main Bund	Length	m	15	8.8	-	-
		Width	m	15	12	-	-
		Area	m^2	225	105.6	1500	1500
		Depth	m	0.2	1	-	-
		Volume	m^3	45	105.6	90	90
	SUMP	Volume	m^3	30	0	10	210
Rainfall Volume Generated	Main Bund	100% AEP Rainfall Volume over bund	m^3	14.1	6.6	94.2	94.2
		10% AEP Rainfall Volume over bund	m^3	22.0	10.3	146.8	146.8
Occupying Containment	Chemical tanks, plinth only, base elevated above floor)	Diameter	m	2.4	4	-	-
		Radius	m	1.2	2	-	-
		π	#	3.14	3.14	-	-
		Depth	m	0.2	0.3	-	-
		Volume	m^3	1.8	22.6	0	0
		Length	m	1	-	-	-

Item	Element	Parameter	Units	ETP value	Tank Farm 1 value	Overtop height at 111.93mAOD (existing top of kerb at Penstock 2)	
						Tank Farm 2, 3 and tanks in building*	Tank Farm 2, 3 and tanks in building**
	1 x embayment in bund	Width	m	2	-	-	-
		Area	m^2	2	-	-	-
		Depth	m	0.2	-	-	-
		Volume	m^3	0.4	0	0	0
Net (usable) bund volume			m^3	72.8	83.0	100.0	300.0
Largest tank in bund volume			m^3	28	30	200	200
Net bund volume as % of largest tank volume			%	260%	277%	50%	150%
Spare Volume			m^3	44.8	53.0	-100.0	100.0
Spare above 8 day 10% AEP			m^3	22.8	42.6	-246.8	-46.8
Spare volume as freeboard			mm	101	404	-165	-31
Notes:	*	If the Effluent tank is the tank to fail (i.e. effluent balance tank volume not available)					
	**	If a tank other than the Effluent tank fails (i.e. effluent balance tank volume available)					
	(green)	Acceptable under c736					
	(amber)	More than the minimum required but short of the ideal in c736					
	(red)	Insufficient under c736					

7.0 Gap Analysis

7.1 Introduction

As set out in Section 4.0, Class 2 secondary containment should be provided for the inventory stored within the Facility.

Guidance on the requirements for Class 2 in-situ concrete secondary containment bunds are set out C736 Sections 4, 6 and 7. This Section therefore completes a gap analysis against the existing secondary containment measures provided within the Facility based on the observations made during the site inspection of 29th April 2022.

Compliance against the guidance for Class 2 containment is reported for the assessment against the key design requirements as follows:

Category	Compliance Assessment
R	Non-compliant
A	Requires further assessment
G	Compliant
	Not applicable

7.2 Storage Tanks

Note that the Diesel and Oil Storage tanks are deemed to be adequate due to their OSR compliant design and housing on hardstanding that is part of the tertiary containment systems for the site.

Requirement	Compliance	Category
C736 Chapter 4 Containment System Capacity		
Fire duration	Diesel and oil storage tanks are OSR compliant. All other tank inventory is non-flammable and so not deemed to be necessary to accommodate fire water.	
Secondary containment	For the ETP secondary containment bunding is provided locally to the tanks.	G
	For Tank Farm 1 secondary containment bunding is provided locally to the tanks.	G
	For the remaining Tank Farms (2 and 3) and the tanks housed within the main diary factory building, no secondary containment is provided.	R
Site wide (tertiary) capacity	See Section 7.4.	R
C736 Chapter 6 Introduction to bunds		
Height of wall	For the ETP there is an external bund wall comprising poured in-situ monolithic concrete. The overall height of the wall is circa 0.2m.	G
	For Tank Farm 1 there is an external bund wall comprising poured in-situ monolithic concrete. The overall height of the wall is circa 1.0m.	G
	For the remaining Tank Farms (2 and 3) and factory internal areas no bund walls exist.	R

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Requirement	Compliance	Category
Freeboard	For the ETP containment bunding is calculated as having 101mm of freeboard above the 100% inventory plus 8-day 10% AEP rainfall volume.	G
	For Tank Farm 1 containment bunding is calculated as having 404mm of freeboard above the 100% inventory plus 8-day 10% AEP rainfall volume.	G
	For the remaining Tank Farms (2 and 3) and factory internal areas no secondary containment walls exist.	R
Proximity to bund wall	The main storage tanks housed within the ETP bund are close to / abutting the bund walls.	R
	The main storage tanks housed within the Tank Farm 1 bund are close to / abutting the bund walls.	R
	For the remaining Tank Farms (2 and 3) and factory internal areas no secondary containment walls exist.	R
Jetting	The main storage tanks housed within the ETP bund are close to / abutting the bund walls and so are within jetting distances. Jetting is unlikely however due to materials of construction, inspection of tanks, protection from impact, integral bunding (bulk chemical tanks) and tertiary containment (sludge tank).	A
	The main storage tanks housed within the Tank Farm 1 bund are close to / abutting the bund walls and so are within jetting distances. However, they are supplied as stainless-steel tanks and have outer skins that also act as baffles to any jetting.	G
	For the remaining Tank Farms (2 and 3) and factory internal areas no secondary containment walls exist and so are within jetting distances. However, they are supplied as stainless-steel tanks and have outer skins that also act as baffles to any jetting.	G
Leakage Detection	As all the tank bodies are supported to be clear of the ground and tank inspections take place on a daily basis leakage from the base of the tank should not go unnoticed at all locations across the facility.	G
Drainage from bunds	For the ETP bund, rainwater drains have to be manually pumped from the bunds and is pumped to the effluent treatment system for disposal as if contaminated.	G
	For the Tank Farm 1 bund, rainwater drains have to be manually pumped from the bunds and is pumped to the effluent treatment system for disposal as if contaminated.	G
	For the remaining Tank Farms (2 and 3) and factory internal areas no secondary containment exists. Tank farm bases are installed with drainage that drains localised rainfall to the effluent treatment systems. Rainwater that falls to the southwestern corner of the site is held on road surfaces by the normally closed Penstock 2 and is only released after testing to demonstrate it is clean. If contaminated it is either pumped to the effluent treatment systems using temporary pump arrangement or tankered from site for disposal. The containment provide by this area is discussed in Section 7.4.	A
Pipework	For the ETP bund there are no penetrations through the bund floors or walls.	G
	For the Tank Farm 1 bund there are penetrations through the bund floors allowing pipework to enter the factory building.	A

Requirement	Compliance	Category
	For the remaining Tank Farms (2 and 3) and factory internal areas no secondary containment exists. Tertiary containment is provided by factory floors and external roadways. These have manhole covers to buried surface water and effluent drainage systems. The containment provide by this area is discussed in Section 7.4. However, the buried systems etc either discharge to the effluent system (and so do not lead to off-site contamination) or to the surface water system kept normally closed by Penstock 2.	R
Impermeability	For the ETP bund, from a visual inspection at the time of the visit, the bund wall appeared in good condition with no obvious defects. The concrete surfacing appeared to be in reasonable condition with no significant cracking or spalling.	G
	For the Tank Farm 1 bund, from a visual inspection at the time of the visit, the bund wall appeared in good condition with no obvious defects. The concrete surfacing appeared to be in reasonable condition with no significant cracking or spalling.	G
	For the remaining Tank Farms (2 and 3) and factory internal areas no secondary containment is provided. Tertiary containment is provided by storage of spills in the roadway areas by the normally closed Penstock 2, this area is discussed in Section 7.4	R
Structural independence	For the ETP bund, storage tank bases are structurally independent from the bund floor and wall.	G
	For the Tank Farm 1 bund, storage tank bases are structurally independent from the bund floor and wall.	G
	For remaining Tank Farms (2 and 3) and factory internal areas no secondary containment is provided. Tertiary containment is provided by storage of spills in the roadway areas by the normally closed Penstock 2. Tank bases are structurally independent of the Tertiary containment.	G
C736 Chapter 7 In-situ reinforced concrete and masonry bunds		
Competence	Design of the ETP bund was carried out by suitably competent designers.	G
	Design of the Tank Farm 1 bund was carried out by suitably competent designers.	G
	Design of the Tank Farms (2 and 3) and factory internal areas tank bases etc was carried out by suitably competent designers, but not necessarily with bunding as the design intent.	A
Design	The design of the ETP bund appears to be adequate for Class 2 containment as it looks to be constructed from reinforced concrete. However, no records have been reviewed to determine the design of any reinforcement.	A
	The design of the Tank Farm 1 bund appears to be adequate for Class 2 containment as it looks to be constructed from reinforced concrete. However, no records have been reviewed to determine the design of any reinforcement.	A
	Design of the Tank Farms (2 and 3) and factory internal areas tank bases etc appears to be adequate for Class 2 containment as it looks to be constructed from reinforced concrete. However, no records have been reviewed to	A

Requirement	Compliance	Category
	determine the design of any reinforcement, but not necessarily with bunding as the design intent.	
Joints	For all areas, concrete jointing of concrete is in place, but details of the presence or type of any water bar features is not known.	A
Kicker joints	For the ETP and Tank Farm 1 bunds It is believed that the concrete bund wall was fixed to the underling concrete slab via a suitable kicker joint, but no records have been reviewed to determine the detail of this design.	A
General condition	Whilst the general condition appeared in very good condition, i.e., in a general good state of repair, the form of construction is not fully understood for all detailed design elements.	G

7.3 Tanker offloading and loading

C736 Section 10.6.2 provides guidance on managing the risk of the release of inventory from tanker offloading and loading operations. Any potential spillage should be managed to ensure there is no risk to vulnerable receptors.

The assessment accounts for the potential spillage volume and the same rainfall and, if applicable, firefighting water criteria used in assessing containment volumes.

This is considered in Section 7.4.

7.4 Tertiary Containment

Requirement	Compliance	Category
C736 Chapter 4 Containment System Capacity		
Fire duration	Diesel and oil storage tanks are OSR compliant. All other tank inventory is non-flammable and so not deemed to be necessary to accommodate fire water.	G
Site wide (tertiary) containment	As highlighted in the earlier sections of this report, secondary containment exists only for tanks at the ETP, at Tank Farm 1 and for the Diesel and Oil storage tanks. All other tanks on site (except the Effluent balance tank) are provided with secondary containment via the effluent drainage, sump and balance tank along with an allowance for water to pond on roadway surfaces to the southwest of the site and retained due to the normal closure of Penstock Valve 2 (the tertiary containment). For the Effluent balance tank itself the only containment is provided by the tertiary containment created in the southwestern corner roadway by the normal closure of Penstock Valve 2. Calculations presented in Table 6-1 indicate that for loss of containment of the largest tank (200m^3) the combination of Effluent system storage and tertiary containment storage is insufficient to contain the spilt inventory volume plus and 8-day 10% AEP rainfall volume over the catchment area. For a failure of the 200m^3 Effluent balance tank, the combination of remaining Effluent system storage and tertiary containment storage is insufficient to contain the spilt inventory.	R
C736 Chapter 6 Introduction to bunds (*not applicable*)		
C736 Chapter 7 In-situ reinforced concrete and masonry bunds		

Requirement	Compliance	Category
Competence	Design of the Tank Farms (2 and 3) and factory internal areas tank bases etc was carried out by suitably competent designers, but not necessarily with bunding as the design intent.	A
Design	Design of the Tank Farms (2 and 3) and factory internal areas tank bases etc appears to be adequate for Class 2 containment as it looks to be constructed from reinforced concrete. However, no records have been reviewed to determine the design of any reinforcement, but not necessarily with bunding as the design intent.	A
Joints	For all areas, concrete jointing of concrete is in place, but details of the presence or type of any water bar features is not known.	A
Kicker joints	These are not present for the Tertiary containment; edging is provided by kerbs	R
General condition	Whilst the general condition appeared in very good condition, i.e., in a general good state of repair, the form of construction is not fully understood for all detailed design elements.	G
C736 Chapter 10 Transfer systems		
Catchment area design	The tertiary containment relies on the integrity of the hardstanding as defects provide a potential direct pathway to the Ingrebourne River. For Class 3 Containment reinforced concrete surfacing is recommended. The integrity of the surfacing is particularly important in areas where rainwater and spilled inventory is likely to pond following an incident. The roadway is in a generally good condition, but manhole covers exist that allow liquid to drain to underlying systems (effluent and surface water drainage). Due to the closure of the Penstock 2 the surface water system will flood with spilt inventory during an indecent. Similarly, the pipework associated with the effluent system would also flood in the same circumstance. The condition of underground drainage and discharge structures (the interceptor) is regularly inspected and is understood to be in good condition, However, it is acknowledged that neither were designed as sealed systems capable of retaining liquids under pressure (even from a relatively minor head of liquid). Similarly, the kerb line is not a sealed edge and if water were allowed to accumulate against them kerb have the potential to leak to the environment.	R

7.5 Proposed Interim Solution

As can be seen from the calculations presented in Table 6-1 and the discussions in Sections 7.2, 7.3 and 7.4, adequate secondary containment is not present for the majority of tanks present on the site. Muller have recognised this issue and have provided as much tertiary containment as possible by the normal closing of Penstock Valve 2 and instigating emergency responses to close the final discharge Penstock Valves from the site to the off-site surface water discharge points at the northeast and northwest of the site in the event of an incident.

However, currently this would still provide inadequate storage volumes in the event of a loss of containment from the Effluent balance tank.

Muller have investigated the potential to install suitable secondary containment bunds around the existing tank farms where they are present and also to create a seal to the perimeter of the factory so that tanks within the factory are provided with secondary containment. Due to the complexity of pipework and other services within the main factory building and tank farms and the lack of space around the external tank farms, retrofitting such secondary containment is not practically possible. It would essentially require the complete shutdown of the facility and a significant and substantial reengineering of the civil and process engineering.

Instead, Muller have proposed to follow a programme of improvements that initially looks to ultilise existing site infrastructure to extend the capacity of tertiary containment that could be provided and will eventually look to construct remote secondary containment at a suitable location on site.

In this section, calculations are presented to incorporate the storage volume available in the Attenuation Tank installed beneath the carpark to the northwest of the site (see Drawing 040, intended to be used as a means of flow balancing storm runoff from the site prior to discharge to surface waters. In the event of a spill emergency this storage volume could, by use of an automated Penstock Valve system in surface water discharge chamber S10, be mobilised to provide temporary storage of spills and contaminated water to prevent overwhelming of the kerbline at the location of Penstock Valve 2 or loss to the environment by discharge through the surface water systems to off-site receptors. Presented below as Table 7-1 is the same calculation of required storage volumes as presented in Table 6-1 but with the additional 340m^3 of storage that could be provided by the attenuation tank. This calculation has been completed on the basis of an enlarged catchment area that could be created by the addition of a sleeping policeman installed across the site access roadway, tied into kerblines, to prevent any risk of contaminated waters running to the east of the site towards the SUDs lagoon system associated with the new extension to the site (see Drawing 03).

This work indicates that such a solution would provide sufficient storage for spilt inventory plus an allowance for accumulated rainwater over an 8-day 10% AEP storm event for an enlarged catchment of 2,200m^2. However, it is acknowledged that this is still not an ideal solution as it is reliant on the use of infrastructure (roadways, drainage systems etc) that were not originally designed to act as liquid containment features and so may not be fully watertight, particularly over longer period of time. It is also acknowledged that should surface water drainage and storage systems be used to hold contaminated liquids then these systems will need to be thoroughly cleaned before being put back into use. Such an activity will need to be included in site procedures and would represent significant disruption to the normal activities of the facility at Telford if it ever needed to be used and then subsequently cleaned.

In recognition of this Muller intend to investigate options to develop the next best option to retrofitting local secondary containment to all tanks (which, as described above, is practically impossible due to the engineering challenges it would represent), this being construction of remote secondary containment (lagoons or tanks) and a conveying system to transfer any spills to a storage vessel reserved for this purpose only. However, such a system will take time (in the order of years rather than months) to develop.

Table 7-1: Worst Case Credible Scenario Required Containment Volumes (m^3) - Interim

Item	Element	Parameter	Units	ETP value	Tank Farm 1 value	Overtop height at 111.93mAOD (existing top of kerb at Penstock 2)	
						Tank Farm 2, 3 and tanks in building*	Tank Farm 2, 3 and tanks in building**
Rainfall	Site	8 day 100% AEP (mm)	mm	62.8	62.8	62.8	62.8
		8 day 10% AEP (mm)	mm	97.87	97.87	97.87	97.87
Gross Containment	Main Bund	Length	m	15	8.8	-	-
		Width	m	15	12	-	-
		Area	m^2	225	105.6	2200	2200
		Depth	m	0.2	1	-	-
		Volume	m^3	45	105.6	90	90
	Sump	Volume	m^3	30	0	10	210
	Attenuation Tank	Volume	m^3	0	0	340	340
Rainfall Volume Generated	Main Bund	100% AEP Rainfall Volume over bund	m^3	14.1	6.6	138.2	138.2
		10% AEP Rainfall Volume over bund	m^3	22.0	10.3	215.3	215.3
Occupying Containment	Chemical tanks, plinth only, base elevated above floor)	Diameter	m	2.4	4	-	-
		Radius	m	1.2	2	-	-
		π	#	3.14	3.14	-	-
		Depth	m	0.2	0.3	-	-
		Volume	m^3	1.8	22.6	0	0

Item	Element	Parameter	Units	ETP value	Tank Farm 1 value	Overtop height at 111.93mAOD (existing top of kerb at Penstock 2)	
						Tank Farm 2, 3 and tanks in building*	Tank Farm 2, 3 and tanks in building**
	1 x embayment in bund	Length	m	1	-	-	-
		Width	m	2	-	-	-
		Area	m^2	2	-	-	-
		Depth	m	0.2	-	-	-
		Volume	m^3	0.4	0	0	0
Net (usable) bund volume			m^3	72.8	83.0	72.8	83.0
Largest tank in bund volume			m^3	28	30	28	30
Net bund volume as % of largest tank volume			%	260%	277%	260%	277%
Spare Volume			m^3	44.8	53.0	44.8	53.0
Spare above 8 day 10% AEP			m^3	22.8	42.6	22.8	42.6
Spare volume as freeboard			mm	101	404	101	404

Noes:	*	If the Effluent tank is the tank to fail (i.e. effluent balance tank volume not available)
	**	If a tank other than the Effluent tank fails (i.e. effluent balance tank volume available)
	(green)	Acceptable under c736
	(amber)	More than the minimum required but short of the ideal in c736
	(red)	Insufficient under c736

8.0 Summary and Recommendations

8.1 Summary

SLR has been retained to review the containment facilities serving Mullers Dairy Facility at Donnington Wood Business Park, Telford. The review was informed by a site visit and detailed topographic site survey and information on the operation of the Facility provided by Muller.

The Facility deals principally with the production of cream and yoghurt consumer products produced from bulk milk importation, delivered to the site by road tanker. Raw ingredients and then the effluents generated in the manufacturing process (principally off spec materials, CIR washes but also spills) are stored in a number of tanks, some of which are located internally to the factory building and some externally. Storage of large volumes of liquid inventory are restricted to the 'old' western half of the facility.

A limited quantity of flammable inventory is stored in OSR compliant Diesel and Oil storage tanks, isolated form the main tank farms on site.

The source-pathway-report model advocated by good practice guidance, C736, has been used to determine that Class 2 containment should be provided for the Facility.

The Facility has been reviewed in terms of credible worst-case scenarios. The scenarios estimated the volume of containment that would be required to manage spilled inventory and rainfall before, during and after the event. The need to consider firefighting water has not been considered necessary in the context of secondary containment of tanks as the inventory stored is not flammable (with the exception of the Diesel and Oil storage tanks, which are OSR compliant).

A formal gap analysis has then been completed for each identified source against the requirement for Class 2 containment and the volume of containment that would be required.

This assessment has identified that adequate secondary containment has not been provided for a number of the external tanks and all of the internal tanks. Only tanks associated with the ETP and housed within Tank Farm 1 have a secondary containment bund. Discussion with site engineering teams has highlighted that retrospective installation of secondary containment to tanks that do not currently benefit from it is not realistically possible at the facility.

As such, Muller have tried to provide the best level of protection possible by attempting to create tertiary containment for these tanks by closing off Penstock 2 in the southwestern corner, allowing surface water systems and the roadway in this area to act as temporary tertiary containment.

Review of the required storage volumes for the worst-case failure scenario, loss of containment of a full 200m^3 of effluent stored in the Effluent tank, shows that even this arrangement results in an inadequate storage volume.

8.2 Recommendations

A number of key issues have been identified; these are summarised in Table 8.1.

Table 8-1: Key Issues

Source	Key Issues
ETP	1. The bulk chemical storage tanks are too close to the bund wall, if possible, these should be moved away from the bund wall so that jetting is not possible. However, there is a low risk of jetting being an issue as vehicle access close to

Source	Key Issues
	these tanks (the only way a significant jet would be likely to develop is via vehicle impact); 2. The detailed design of the ETP bund needs to be understood and confirmation sought that: • The design was suitably competent; • Concrete is suitably reinforced; • Slab joints include a water bar; • A kicker joint exists with a suitable water bar; and • Suitable impermeability testing was carried out on completion of construction.
Tank Farm 1	3. The detailed design of the Tank Farm 1 bund needs to be understood and confirmation sought that: • The design was suitably competent; • Concrete is suitably reinforced; • Slab joints include a water bar; • A kicker joint exists with a suitable water bar; and • Suitable impermeability testing was carried out on completion of construction, including pipeline penetrations through the floor slab.
Site Wide	4. Ensure site procedures are in place, up to date and suitably detailed to deal with the following: • Spill events (to include operation of valves, tankering arrangements, provision of temporary on-site pumping arrangements [provision of sump pump, electrical cabling and hose for emergency use], post event clean up etc); • Tank and bund inspections compliant with CIRIA C736 guidance (see Appendix 03); • Sampling / testing of tertiary containment waters and actions on results (when to release to surface water, when and how to clean up if contaminated); • Maintenance of sufficient spare capacity in the Effluent balance tank, this should be maintained with less than $50m^3$ of effluent within it except in the event of a major site spill when controls should be overridden to allow the full volume of the tank to be used. 5. Add all tanks with a capacity of >$10m^3$ (with the exception of the sprinkler water tanks) to the site NDT regime. 6. Provide impermeable surfacing to areas of the site associated with or adjacent to the catchment area highlighted in Drawing 03, in particular surfacing is needed under the Bauer connection point highlighted in Plate 10, Appendix 01.

Source	Key Issues
	7. Undertake design and construction works to mobilise 340m^3 of tertiary storage capacity in the attenuation tank below the carpark on the northwest corner of the site. The design and installation work should consider the following: • The need to automatically open the Penstock 2 valve prior to kerb overtopping height (11.93mAOD) whilst simultaneously shutting the final off site Penstock Surface Water at S10 so that the liquid fills the attenuation tank and is not discharged to surface water. This may be facilitated by a level sensor at Penstock 2 kerbline, and an automated motor closure fitted to the surface water Penstock valve at S10. This system should also be incorporated into the site Building Management System (BMS) to raise alarms to relevant operators when the system is triggered. A manual Penstock Valve may also need to be fitted to the inlet to S10 from surface water systems draining the northern half of the western part of the facility to ensure that rainwater does not fill the attenuation tank when in use as tertiary containment; • Updated spills, tankering and spills clean up procedures will need to be written and staff provided with training on completion of the works to include the attenuation tank in the tertiary containment systems; • The need for the Surface Water Penstock Valve in SW10 to automatically close (and raise an alarm to the BMS) if potential contamination is found in the water being discharged, this should incorporate automated detection of dairy effluent and out of range pH, detection of potential contamination should result in closure of the automated valve and alarm to the BMS. • Improve sealing of kerbs and manhole covers in the area associated with the catchment area highlighted in Drawing 03; 8. Consider closing of the Penstock valve associated with the slot drain running diagonally through the stocking yard and inclusion of a sleeping policeman to close off the roadway at kerb height to the east of the turn into the stocking yard so that any spills associated with the storage of the fruit concentrate kegs would be captured by the tertiary containment system described above in Key Issue 7. and not drain to the surface water systems to the east of the site. 9. Design and install an emergency spill remote secondary containment tank / lagoon. This should be capable of containing a similar volume of spilt inventory as the attenuation pond and should be maintained empty for such an event. The system should incorporate a suitable conveying system such that, should a major loss of containment occur (200m^3) spilt liquid can be rapidly removed from the roadway to the secondary containment storage area. Any such storage tank or lagoon should be constructed itself Class 2 secondary containment and be sized to accommodate lost inventory and rainfall as per the recommendations of CIRIA c736.

As a result of the gap analysis and summary of observations from the site visit, along with knowledge of Mullers plans for further development at the facility, the issues highlighted in Table 8-1) have been allocated into short, medium and long terms recommendations to bring the facility up to a standard consistent with the 'As Low As Reasonably Practicable' (ALARP) requirements in C736 for existing facilities;

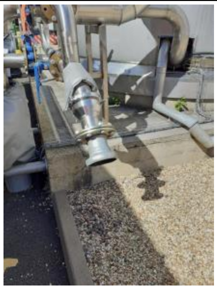
- Short Term (within 12 months): Key Issues 1, 2, 3, 4 and 5;
- Medium Term (within 24 months): Key Issues 6, 7 and 8; and
- Long Term (within 48 months): Key Issue 9.

DRAWINGS

APPENDIX 01

Photographic Plates

Plate 1 ETP showing good quality concrete bunding containing IBC's of dosing chemicals.		Plate 2 ETP showing DAF tank and bulk chemical storage tanks.	
Plate 3 Small packaged chemical stores adjacent to ETP.		Plate 4 Surface water isolation point (Penstock) 2, southwest corner of storage tank and tanker loading area.	
Plate 5 Tanker loading bay also showing tank farm in background and good quality tarmac surface in foreground.		Plate 6 Example bulk chemical storage tank and base for additional tank.	
Plate 7 Door through tank shroud into below tank void space.		Plate 8 Tank controls in space below tank (this example is the effluent tank).	

Plate 9 Spare tank bases (foreground) in preparation for new tank installations.		Plate 10 Effluent tank tanker loading/offloading point (over made ground).	
Plate 11 Example manhole access into underlying effluent drainage system.		Plate 12 Example chemical storage system with collision protection. Store is self bunded.	
Plate 13 Ingredient loading / offloading area with central slot drain.		Plate 14 Oil storage (bunded) associated with chiller plant.	
Plate 15 Waste oil storage (bunded) associated with chiller plant.		Plate 16 Example of bollarding / impact protection use on site.	

APPENDIX 02

Groundsure Information

APPENDIX 03

Suggested C736 Inspection/Monitoring/Management Regime

Section 5.2 of CIRIA C736 highlights that recognised good practice for existing bunds is that the following inspections should be carried out and recorded by personnel such as site Operational staff:

- Daily:
  - Walk round the site, identify and clear up any waste materials;
  - Remove any excess water from loading bay and sump(s);
  - Check drip trays and pans (if used) and empty if necessary;
  - Note signs of any deterioration of tanks or surroundings;
  - Note any small leaks or spills, fix them and clean them up immediately;
  - Check the bund sump(s) and pumps to ensure they are operating correctly; and
  - Inspect the tank bund alarm (if fitted).
- Weekly:
  - Check that drain covers/grids are clear of debris; and
  - Check any leak detection systems installed for secondary containment systems.
- After Rainfall:
  - Check that any excess water from loading bays and bund sump(s) has been efficiently removed.

Further assessments should be carried out and recorded on an annual basis by a works engineer or similar suitably qualified manager:

- **Annually**, a thorough review of the tanks, pipework, loading bay and other systems for examples of:
  - Visual signs of leaks (from primary and secondary containment, cracks in concrete, spalling of concrete or brickwork, signs of corrosion, misalignment of tank or bund walls, slumping or settlement);
  - Failure of flexible seals, failure of seals or joints, aging of sealants (parting of sealants from joints etc);
  - Damage caused by animals or plants;
  - Integrity of secondary containment systems (failure of paintwork, evidence of corrosion, torn or damaged liners, deterioration of coatings / de-bonding of surfaces etc);
  - Instruction signs should be in good repair;
  - Essential equipment, such as valves, pumps, floats and alarms, should be checked to ensure they are in place, in good condition and are all operable; and
  - The location of any faults or defects should be recorded on a plan and linked to maintenance records of the actions taken to remediate them.

CIRIA then states that good practice is to undertake a formal review of the containment systems entailing a review of the site risk assessment and containment classification periodically, but at least every five years, or where:

- There are any modifications made to the primary, secondary or tertiary containment;
- The volume of material in the primary containment is increased;
- The nature of the material in the primary containment is changed;

- The nature of the material is reclassified; or
- The potential pathways and/or receptors have changed.

This should be completed by a suitably qualified assessor and should encompass an updated review of the site risk assessment, as a recap this should include elements such as;

- Locations of storage infrastructure;
- Number of tanks;
- Volume of tanks;
- Age of tanks;
- Expected design life of infrastructure;
- What materials are stored;
    - Compositional analysis;
    - COSHH sheets;
- Details of potential pathways for inventory escape;
- Details of receptors;
- Completion a basic Source/Pathway/Receptor Risk assessment,
- Detail existing controls;
- Details of any secondary containment in place;
- Details of any level control and/or alarm devices;
- Details of inspection regimes; and
- Review of maintenance plan and completion of maintenance tasks.

Where pipework is buried and is not provided with adequate secondary containment and leak detection systems, the following should be completed and recoded;

- Pressure testing of distribution pipework.

Note that where reliance is placed on Tertiary containment systems all of the inspection and maintenance regimes discussed apply equally to the Tertiary containment systems too.

Less Frequent (for example 10 Yearly)

Depending on the materials of construction and recommendation of the tank supplier, further inspections of specific elements of the tank or bund design may be required on a less frequent basis.

- For example, some steel tanks require wall thickness testing on a periodic basis;
- Some coated surfaces require tank drain down and visual inspection by a specialist contractor
- Some lining systems may need to be re-tested for leaks periodically.

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