ETP Containment

Risk Assessment

Project William

Dove Valley Park, Derbyshire

PREPARED BY:	FOR:	DATE:	REFERENCE:
Jubb Consulting Engineers Ltd.	MEG Derby Ltd	Feb 2022	19270-ETPC-RA-01

Contents

1 Project Information 2
1.1 Project Information 2
1.2 Project Details 2
1.3 Report Details 2
1.4 Project Authorisation 2
2 Introduction 3
2.1 Commission 3
2.2 Brief 3
2.3 Containment Plan Overview 4
3 Risk Assessment 5
3.1 Methodology 5
3.2 Source 5
3.3 Pathway 5
3.4 Receptors 6
3.5 Overall Site Hazard Rating 7
3.6 Frequency of Loss of Containment 8
3.7 Overall Site Risk 9
4 Proposed Containment 10
4.2 Leak Detection 10
4.3 Local Containment 10
4.4 Earth Bunds 10
4.5 Transfer System 11
4.6 Sacrificial Areas 11
4.7 Remote Secondary Containment 11
4.8 Recommendations of C736 11
5 Collection Capacity 12
5.1 Volume of Inventory 12
5.2 Rainfall 12
5.3 Firefighting agents 14
5.4 Firefighting Water 14
5.5 Containment Volume 14
5.6 Overall Volume Assessment 15
6 Conclusions 17
7 Areas for Further Work 18
Appendix A: ETP Containment Risk Assessment Plan 19

1 Project Information

1.1 Project Information

Client	MEG Derby Ltd

1.2 Project Details

Project Name	Project William
Location	Dove Valley Park, Derbyshire
Jubb Project Number	19270

1.3 Report Details

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1.4 Project Authorisation

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01	11.02.22	Draft Issue	MB	--
02	14.02.22	Approval Issue	MB	RH

2 Introduction

2.1 Commission

2.1.1 This Risk Assessment has been commissioned on behalf of MEG Derby Ltd to support an Environmental Permit Application for a proposed new Effluent Treatment Plant (ETP) as part of a new production facility on land at Dove Valley Park in Derbyshire.

2.1.2 This report is for the private and confidential use of MEG Derby Ltd, to whom alone is owed a duty of care and their professional advisers and consultants in connection with the current development proposals for the site.

2.1.3 This report may not be relied upon or reproduced by any third party for any use without the written agreement of Jubb Consulting Engineers Ltd.

2.1.4 This report has been produced using design drawings from FLI Cap Technology and Sidel.

2.2 Brief

2.2.1 The brief for this report is to produce a risk assessment based on the comments received from the EA following the initial EPR application. The comments received are as follows:

- 'Provide your proposals for containment (impermeable surfacing/bunding etc) around the site and specifically the ETP to demonstrate the site will be in line with the guidance on controlling and monitoring emissions at installations- see 'emission to water' and 'Leaks from containers' sections particularly.'
- 'You must provide containment (bunding) for underground pipework, sumps and storage vessels' (this includes your ETP and the 'separate below ground drainage networks proposed to serve external yard areas and roof areas'). Bunding is usually required for storage vessels as any catastrophic failure would rush over a kerb/gully though you may provide evidence that your measures offer equivalent protection.

2.2.2 This Risk Assessment will review the ETP tank capacity, risk of leaks or failure, and the system in place at point of failure.

2.2.3 Standards and guidance used in this report include CIRIA C736 Containment Systems for the Prevention of Pollution and GOV.UK Control and Monitor Emissions for Environment Permit guidance (specifically Emission to Water).

2.3 Containment Plan Overview

2.3.1 The key aim of this risk assessment is to review the Effluent Treatment Plant (ETP) as designed by FLI Cap Technology and how it fits with the rest of the site.

2.3.2 Primary containment is provided by above round tanks fitted with leak detection. Summary of the containment provided for the ETP. Linear drainage channel collects small amounts of leakage and discharges it back into the ETP system. Secondary containment is provided locally in the form of earth bunds that prevent large spills from leaving site. Large spills are directed to remote secondary containment in the form of the lined site attenuation basin. Leak detection sensors are connected to the automated shutoff valve downstream of the basin.

2.3.3 There are a number of tanks across the site, with reference to Sidel drawing 100270 GC 01 M the site tanks are summarised as follows:

- Water tanks
  - There is no risk associated with these as they are understood to only contain water, therefore consideration of these tanks has been excluded.
- Liquid Nitrogen
  - It is understood that a leak of nitrogen would boil off, therefore consideration of these tanks has been excluded.
- Carbon Dioxide
  - It is understood that a leak of carbon dioxide would boil off, therefore consideration of these tanks has been excluded.

3 Risk Assessment

3.1 Methodology

3.1.1 The following risk assessment is as per the C736 guidance. As per European Law, hazard is defined as the property of a substance with a potential to damage people or the environment, and risk is defined as a combination of consequence and likelihood.

3.1.2 The methodology involves a 'three-tier risk-based classification system' for the proposed containments, with 'Class 1' containment system the lowest risk rating and 'Class 3' the highest rating. The role of the containments is to prevent the 'pathway' between 'source' and 'receptor'.

3.2 Source

3.2.1 In this case the source refers to:

- Inventory
- Rainwater
- Firefighting agents
- Firefighting water

3.2.2 For the purposes of this report the Source Hazard rating has been assumed to be **HIGH**. This is based on Figure 2.6 of C736.

3.3 Pathway

3.3.1 Small amounts of escaped inventory would be captured by the ETP drainage system.

3.3.2 In the event of a large spillage, escaped inventory could potentially make its way into the ground via soft landscaped areas on site. The Ground Conditions Assessment compiled for the site carried out soakaway testing during which an infiltration rate could not be obtained and testing could not be completed. This means the underlying ground is effectively impermeable. This suggests that the risk of contaminated runoff reaching groundwater is LOW.

3.3.3 The alternative pathway from the ETP would follow the hard paved site access road to the south, travelling via the road surface and the surface water drainage. Runoff would enter the attenuation basin. If allowed to discharge freely it would continue off site via the sewer network and make its way to the existing Dove Valley Park attenuation pond, however a pollution control valve is included in the design, meaning in the event of a spillage the surface water drainage system can be sealed preventing the escape of pollutants. Given that there is a drain (albeit with a shutoff valve) that could connect the site to a receptor we suggest the pathway hazard rating should be MODERATE.

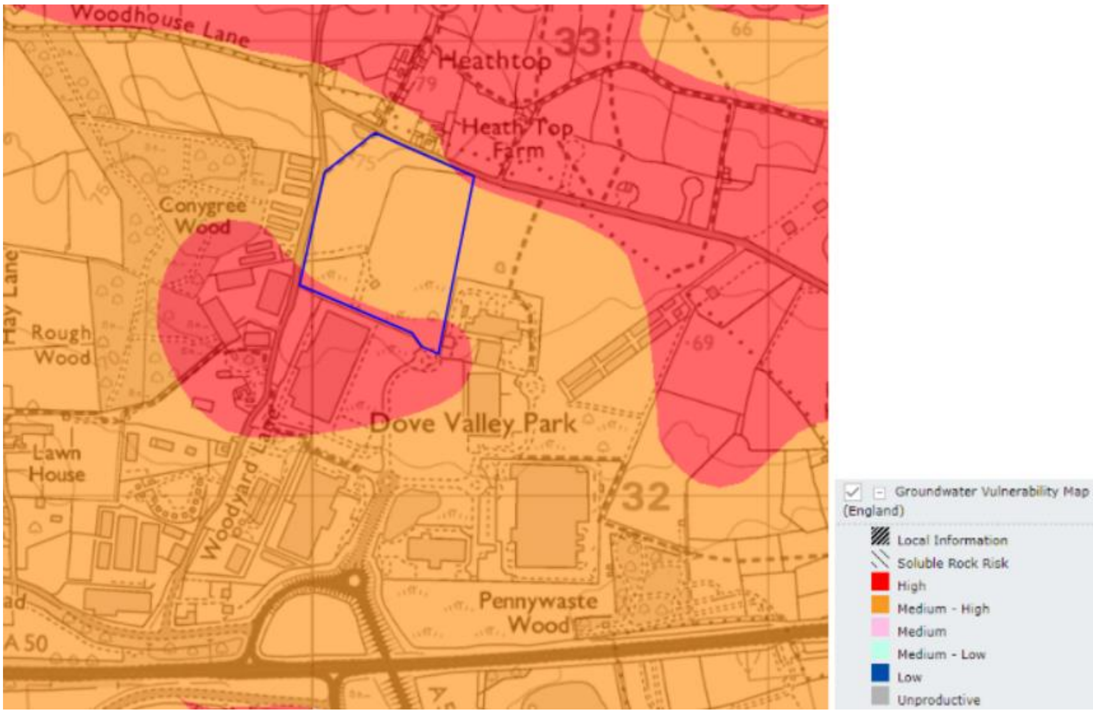
3.3.4 The pathway hazard rating is therefore considered to be **MODERATE** (C736 Section 2.3.2) due to the factors noted above.

3.4 Receptors

3.4.1 The key receptors considered are:

- Groundwater
- Existing Dove Valley Park attenuation pond and the wate environment beyond
- Sewage Treatment Works

3.4.2 Groundwater vulnerability is shown as high on the southern boundary of the site, therefore the receptor hazard rating is considered to be HIGH. Defra Magic Map extract included below.



3.4.3 Situated downstream of site is the existing Dove Valley Park attenuation pond. This pond is likely to support a wide variety of flora and fauna that would be adversely affected by a spillage from the ETP. This is a non-designated site, so the receptor hazard rating is assessed to be LOW.

3.4.4 Sewage treatment works. Under normal operating conditions the ETP would discharge at a restricted rate to the sewage treatment works via the public foul sewer. Hazard rating associated with this receptor is considered to be LOW.

3.4.5 Receptor hazard rating is assumed to be considered as **HIGH**.

3.5 Overall Site Hazard Rating

3.5.1 Based on C736 Box 2.1 the combination of HMH for source, pathway and receptor respectively suggests an overall site hazard rating of **HIGH** should be applied.

Box 2.1 Suggested combinations of hazard ratings to give overall site hazard rating

Environmental hazard ratings

H = High rating

M = Moderate rating

L = Low rating

Source	**Pathway**	**Receptor**
(hazard rating)	(transport potential)	(damage potential)
May be H, M or L	May be H, M or L	May be H, M or L
Possible combination of ratings:		**Suggested consequent overall site hazard rating:**
HHH or HHM or HMM		**HIGH**
HHL or MMM or HML		**MODERATE**
MML or HLL or MILL or LLL		**LOW**

3.5.2 While a conservative position has been assumed within this report, the inclusion of an automated system that connects leak detection to the site drainage shutoff valve supports the argument that the pathway hazard could be rated as LOW. This would result in an overall site hazard rating of MODERATE. Extract from C736 above shows the combination of risk ratings and the consequent overall site hazard rating, in this case the combination would be HLH instead of HMH.

3.6 Frequency of Loss of Containment

3.6.1 Consider the events that could lead to a release of inventory:

- Identify events that could cause loss of containment
- Assess the likelihood of occurrence of each event

3.6.2 Likely events that could lead to a loss of containment:

- Operational failure / human error
  - With the correct management processes in place (beyond the scope of this report) this could realistically be considered to be LOW.
- Lack of alarms / fail-safe devices
  - Leak detection on primary containment suggests that the risk from this event could be considered LOW.
- Structural failure
  - Tanks are designed by a specialist, which would suggest a LOW rating associated with this event.
- Misuse
  - With the correct management processes in place (beyond the scope of this report) this could realistically be considered to be LOW.
- Vehicular impact
  - This could be considered medium, however the position of the balance tank relative to the road and the low site speed limit suggests this could be considered LOW.
- Vandalism/terrorism
  - With the correct management processes in place (beyond the scope of this report) this could realistically be considered to be LOW.
- Flood, fire or explosion
  - The site is not in an area of flood risk.
  - With the correct management processes in place (beyond the scope of this report) this could realistically be considered to be LOW.
- Subsidence or other geological factor
  - Ground has been improved beneath the ETP, base slabs have been designed in reinforced concrete for the specific loads from the tanks, therefore the risk of this event is considered LOW.
- Ageing or deteriorating assets
  - With the correct management processes in place (beyond the scope of this report) this could realistically be considered to be LOW.

3.6.3 Frequency of loss of containment is therefore considered to be **LOW**.

3.7 Overall Site Risk

3.7.1 Combining the Site Hazard Rating (HIGH) with the Frequency of Loss of Containment (LOW) suggests that an overall site risk of **MODERATE** (C736 Box 2.2 – see extract below) should be applied.

Box 2.2 ***Overall site risk rating as defined by combining ratings of site hazard and probability of containment failure***

Site hazard ratings

May be high (H), moderate (M) or low (L) (see Box 2.1)

Frequency of loss of containment

May be high (H), moderate (M) or low (L)

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

3.7.2 In accordance with C736 section 2.6.1 suggests containment type **CLASS 2** should be considered appropriate.

3.7.3 With reference to para 3.5.2 above, revising the site hazard rating to MODERATE would result in an ML combination instead of HL, which would mean Class 1 containment would be applicable.

4 Proposed Containment

4.1.1 It is proposed to use a combined system to contain escaped inventory on site in the unlikely event of a catastrophic tank failure. This consists of limited local containment, earth bunds, transfer system, sacrificial areas and remote secondary containment.

4.1.2 Refer to Appendix A for a plan showing the ETP location and proposed containment for the site.

4.2 Leak Detection

4.2.1 The plant control logic will allow for notification of rates of level change beyond normal operations which could otherwise signify a loss of integrity to any tank structure. The control logic can then be configured to allow for an alarm and/or automatic closure of the final discharge valve in the attenuation pond.

4.2.2 This is important as it removes the need for someone to close the valve via push button in the event of a tank failure.

4.3 Local Containment

4.3.1 Small leaks are proposed to be captured on the ETP reinforced concrete slabs. These are designed with falls to direct runoff back into the ETP system rather than discharging to the surface water drainage.

4.3.2 The drainage discharges by gravity to a sump where it is pumped into the ETP.

4.4 Earth Bunds

4.4.1 Despite catastrophic tank failure being rare, consideration is given to the dynamic effects of failure of a tank in the ETP. Table 4.7 (shown below) is taken from C736 and highlights extra allowance that should be given when considering surge allowance:

Table 4.7 Surge allowance (in the absence of detailed analysis)

Type of structure (see Part 3)	Allowance
In situ reinforced concrete and blockwork bunds	250 mm
Secondary containment tanks	250 mm
Earthwork bunds	750 mm

4.4.2 As the combined containment includes earth bunds an allowance for 750mm freeboard should be considered in sizing them.

4.4.3 In a catastrophic tank failure scenario the contents of the tank would spread out in all directions. The simplified plan area immediately surrounding the ETP is 2000m^2. In reality there is a much larger area in this location where inventory could spread to if the tank failed, so this approach is considered conservative. 1650m^3 spread over 2000m^2 equates to 0.825m depth. Adding 0.75m to this gives 1.575m minimum earth bund height. The bund provided is 2.3m high, i.e. it has an additional 0.725m over and above the recommendation in C736.

4.5 Transfer System

4.5.1 Escaped inventory from the ETP would be able to spread to the area around the ETP facility. It would runoff onto the hard paving where some of it would overtop the kerbs (refer to following section regarding sacrificial areas) the rest of it would follow the road to the south as dictated by the surface falls.

4.5.2 There is a dropped kerb adjacent to the attenuation basin at the low point of the road, this allows the runoff to overtop directly into the attenuation basin. The road is almost flat in this area, which means the runoff velocity would be very low at this point.

4.5.3 Some of the escaped inventory would make its way into the surface water drainage. This drainage is designed and constructed as a sealed system. If there were to be a small leak from the below ground drainage, this would be captured in the trench that the pipework runs in, since the existing ground below the site has been identified as impermeable.

4.6 Sacrificial Areas

4.6.1 The catastrophic failure of a tank in the ETP would result in a deluge that could potentially overrun roads and kerbs and soak into areas of soft landscaping. Given that the underlying strata is effectively impermeable the risk to groundwater receptors in this situation is considered very low.

4.6.2 In the unlikely scenario where this happened, the site operator would need to excavate the soft landscaping that was affected and either clean it or remove it and replace it. As discussed previously the site is underlain by impermeable strata, meaning only the made ground in this area would need to be removed. This area is not intended to capture large volumes of spilled inventory, only that which overtops the adjacent kerbs.

4.7 Remote Secondary Containment

4.7.1 The site levels direct runoff over a dropped kerb and into the attenuation basin.

4.7.2 This attenuation basin is at a relatively high elevation when compared to the existing ground levels, it has therefore been designed with an impermeable liner to prevent water discharging to ground.

4.8 Recommendations of C736

4.8.1 This section covers the key performance requirements recommended in C736 for Class 2 Containment.

4.8.2 Pumps*, valves, couplings, delivery nozzles and other items associated with the operation of a primary container to be located inside the bund or within a separately bunded area. These are located within the ETP area that is connected to a separate drainage system. Minor drips and spills will therefore be contained. The ETP system has been designed to include rainwater runoff from the associated slabs.

4.8.3 Penetrations of the bund wall to be avoided. The earth bund to the west of the ETP does not have any openings, pedestrian routes or roads etc. It forms a continuous barrier for an appropriate distance north and south of the ETP, such as to prevent runoff escaping site in the unlikely event of a tank failure.

4.8.4 No provision for rainwater draw-off via a valved outlet in bund wall. Due to the type of containment proposed this recommendation is not strictly applicable. It is worth noting that the local containment system does not drain to surface water, this recommendation is therefore deemed to be met with an equivalent proposal.

4.8.5 Take account of possible jetting failure. Jetting failure could potentially spray inventory from the ETP. It is considered unlikely to occur spontaneously in well maintained tanks. The key risk of jetting failure is considered to be from fork-lift strike or similar. In this instance the only direction a fork lift could approach from would be the site side, meaning the jet would project into site where it can be dealt with as part of the combined containment system.

5 Collection Capacity

5.1 Volume of Inventory

5.1.1 The volume of inventory is taken as the larger of 110% of the largest tank or 25% of the overall tank volume. The total tank volume is approximately 2000m^3 with the largest tank comprising 1500m^3.

5.1.2 The volume of inventory to be considered is therefore 1500 x 1.1 = 1650 m^3.

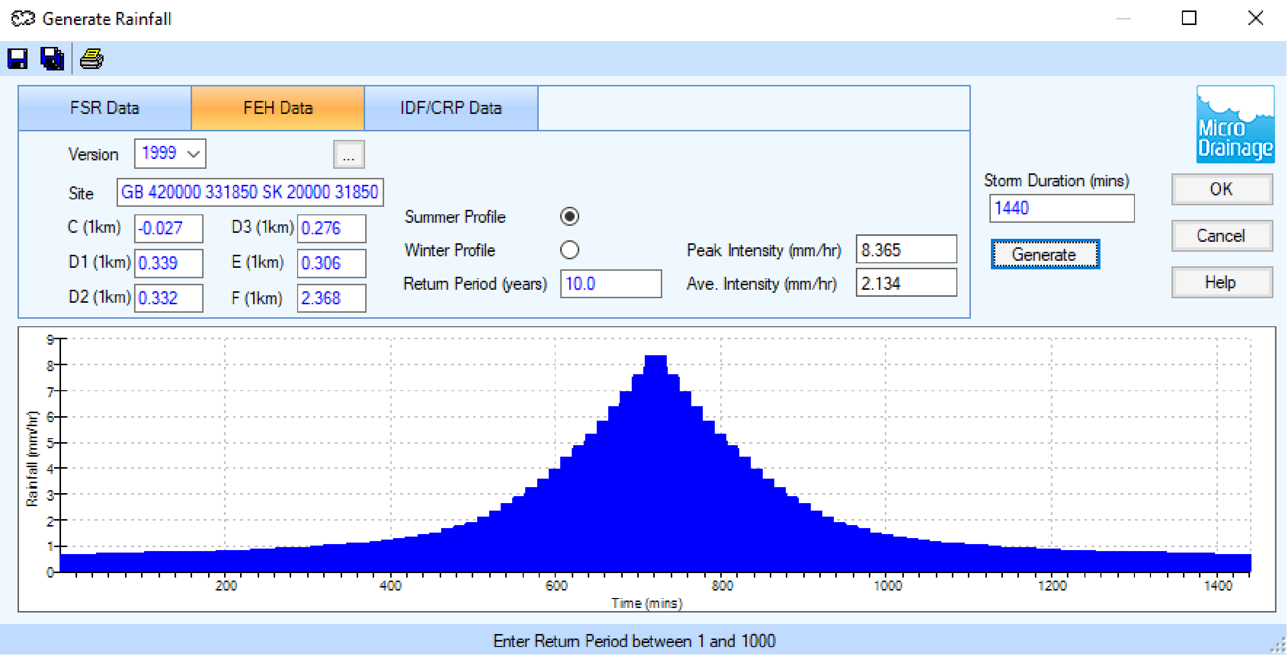
5.2 Rainfall

5.2.1 As the containment area is not covered, rainfall could potentially collect in areas where containment is to be provided.

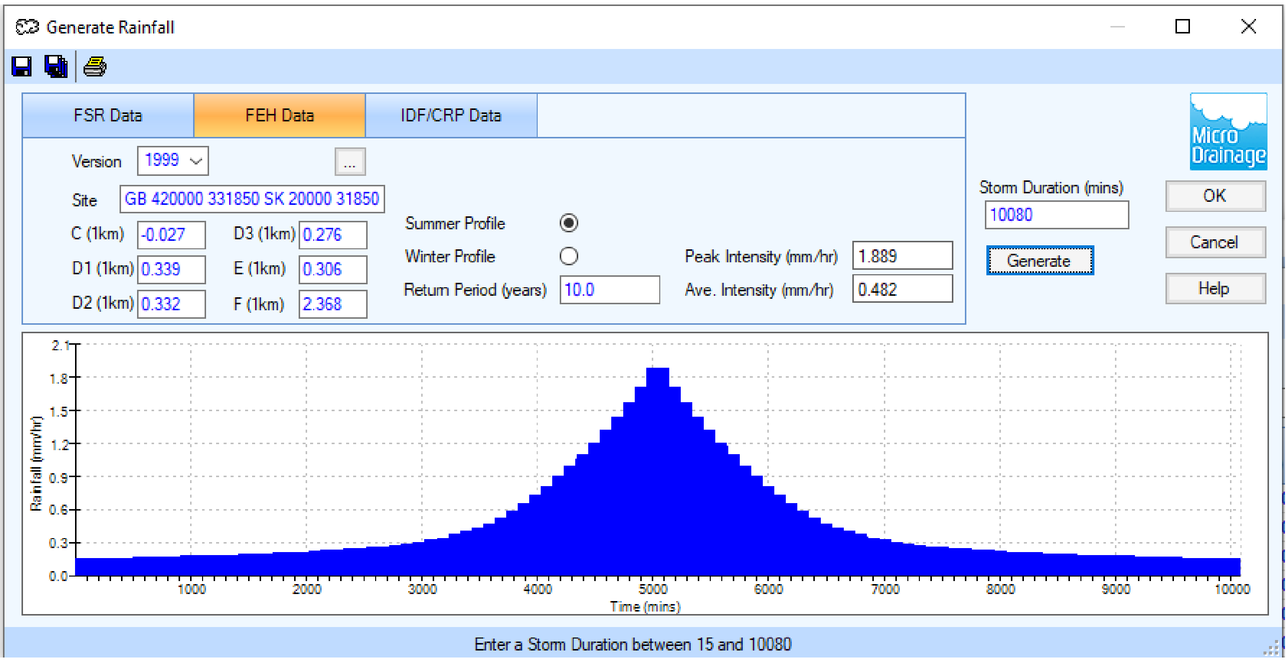
5.2.2 The total site impermeable catchment associated with the attenuation basin is 74,700m^2.

5.2.3 The prescribed rainfall allowance is based on a 1 in 10 year return period storm event using the Flood Estimation Handbook (FEH) model (C736 Page 43-46). Extract below from Generate Rainfall feature in Microdrainage shows the 10 year. From reference to C736 two scenarios have been considered (in isolation not combination):

- 24 hour storm duration
- 1 Week storm duration (microdrainage limits maximum storm duration to 1 week rather than 8 days, this figure is considered an appropriate substitute given the low probability of catastrophic tank failure coinciding with such a large rainfall event).



5.2.4 **24 hour** storm duration data shown above. The average rainfall intensity of 2.134mm/hr is the equivalent of 51.2mm total rainfall. Based on the stated site area this would generate **3825m^3** of rainfall.



5.2.5 **1 week** (168 hour) storm duration data shown above. The average rainfall intensity of 0.482mm/hr is the equivalent of 81mm total rainfall. Based on the stated site area this would generate **6050m^3** of rainfall.

5.2.6 According to C736 the containment capacity should allow for rain collected over the containment area 24 hours before, during and 8 days after an incident. Since the containment area forms part of the surface water drainage system the requirement to consider rain collected over the previous 24 hours is deemed to not be applicable, i.e. rainfall will not be sat in a sealed bund but instead will be draining right up until the shut off valve is operated.

5.3 Firefighting agents

5.3.1 Firefighting agents need to be accounted for in the estimation of containment capacity by allowing for adequate freeboard in the proposed earth bunding behind and opposite the ETP. The amount of freeboard needs to be agreed with the Fire and Rescue Service but should be no less than 100mm.

5.3.2 The plan area of the basin is 5260m^2 therefore the equivalent volume for 100mm would be 526m^3.

5.4 Firefighting Water

5.4.1 Since the contents of the balance tank is mostly a very dilute solution of CIP cleaning chemicals, neutralised to a pH acceptable for sewer discharge, the tank failure scenario where the full balance tank discharged is unlikely to coincide with a fire event that would require significant amounts of firefighting water.

5.5 Containment Volume

5.5.1 The site surface water drainage system consists of separate yard and roof drainage networks. The yard networks discharge through interceptors into an attenuation basin to the south of the site.

5.5.2 During normal operation the attenuation basin discharges to the public surface water sewer via hydrobrake. Downstream of the flow control there is a toggleblok isolation valve that can be operated remotely at the touch of a button. In the event of a power outage the unit will close.

5.5.3 The attenuation basin provides 5210m^3 of storage.

5.5.4 The drainage network itself is estimated to hold about 100m^3. This is a conservative estimate, with the actual total likely to be in the region of 200-300m^3. Detailed calculation of network volume has not been undertaken as it does not affect the principle of the overall volume assessment.

5.6 Overall Volume Assessment

5.6.1 The total volumes of runoff for consideration are shown in the following table:

	Volume (m^3)	
Scenario	24Hr	1 Week
Inventory (110%)	1650	1650
Rainfall	3825	6050
Firefighting Foam	526	526
Total	**6001**	**8226**
Basin	5210	5210
Drainage Network (est.)	100	100
Total	**5310**	**5310**
Difference	**691**	**2916**

5.6.2 The two scenarios both show a shortfall in storage by up to 2916m^3. In both instances the shortfall is not related to the capture of inventory itself but rather the 10 year rainfall volumes. This means the gradual build up of rainfall over 24 hours or 1 week is where the overtopping would occur.

5.6.3 This volume of rainfall is considered extremely unlikely to occur in conjunction with a catastrophic tank failure, however it has been considered and can be dealt with in a practical manner.

5.6.4 Considering the 110% inventory volume and the firefighting foam without the rainfall gives a total volume of 2176m^3. This volume could be accommodated twice in the attenuation.

5.6.5 Given that the ETP discharges to the foul sewer under normal circumstances it is reasonable to assume that the runoff could be overpumped to the foul sewer in such a scenario. This solution would be benefitted by the fact that the balance tank contents would have seen dilution of 2-3.75 times the 110% volume depending on the scenario considered. It is also important to recognise that the probability of this level of rainfall coinciding with a catastrophic tank failure is so low it is unlikely it would ever happen.

5.6.6 Overpumping like this could potentially incur additional costs associated with breach of Trade Effluent consent, therefore it is suggested that this strategy should be reviewed with respect to the TE consent agreed with Severn Trent Water (beyond the scope of this report).

5.6.7 In the 24 hour storm scenario overtopping would occur after 21 hours. This is considered sufficient time to organise emergency equipment to overpump. In the 1 week storm scenario the overtopping would occur after 4.5 days.

5.6.8 In this scenario it is considered safe to assume that operation of the facility would have ceased in order to undertake a significant clean-up. Therefore, additional process water would not be generated and any additional rainfall would only serve to further dilute the spilled inventory while the clean-up was undertaken.

6 Conclusions

6.1.1 The overall site hazard rating is high and the frequency of loss risk is low resulting in a moderate overall site risk rating.

6.1.2 Leak detection system linked to drainage shutoff valve proposed, to remove the need for human intervention in a tank failure scenario.

6.1.3 Given the automation of leak detection linked to the shutoff valve, there is a potential argument for the pathway hazard rating to reduce from moderate to low. Revising this to low would result in the overall site risk rating dropping to low, suggesting a Class 1 containment system would be applicable.

6.1.4 Local secondary containment for small spills is via concrete surfacing falling to channel drainage that connects to the ETP system, keeping it separate from the surface water drainage.

6.1.5 Remote secondary containment is proposed as contingency for catastrophic tank failure.

6.1.6 Earth bunding prevents tank contents leaving site in the unlikely event of a catastrophic tank failure.

6.1.7 The underlying strata has been tested and is effectively impermeable. No infiltration is used on site for surface water drainage. All impermeable areas (except roofs) discharge to an attenuation basin via interceptors.

6.1.8 Sacrificial areas are identified where runoff can overtop kerbs in a large spill scenario. These may require extensive clean up in the unlikely event of a large spill.

6.1.9 The site attenuation basin can capture the volume from 110% of the largest ETP tank with an allowance for firefighting foam.

6.1.10 Considering 10 year rainfall events of 24 hours and 1 week duration shows that the storage capacity available would be exceeded, however this would be mitigated through overpumping to the foul system. It is noted that the probability of a catastrophic tank failure coinciding with a 10 year rainfall event is remote.

6.1.11 Underground drainage is via sealed system, underlying soils are effectively impermeable.

6.1.12 The current site design could accommodate the catastrophic failure of a tank within the site infrastructure with ALARP risk to receptors.

7 Areas for Further Work

7.1.1 An inspection and maintenance strategy should be prepared by the client in order to detail the long term measures for keeping the ETP in safe working order. This should include inspections of the hard standings in and around the ETP, the road adjacent and between the ETP and the basin. The basin itself should also be inspected at this time.

7.1.2 An incident response strategy should be formulated with liaison with the Fire and Rescue Service. This should be reviewed periodically throughout the lifetime of the facility, to ensure it reflects any changes to site operations.

7.1.3 Detailed review of Trade Effluent consent to verify proposal to overpump to foul in the extreme scenario of a catastrophic tank failure coinciding with a 10 year rainfall event.

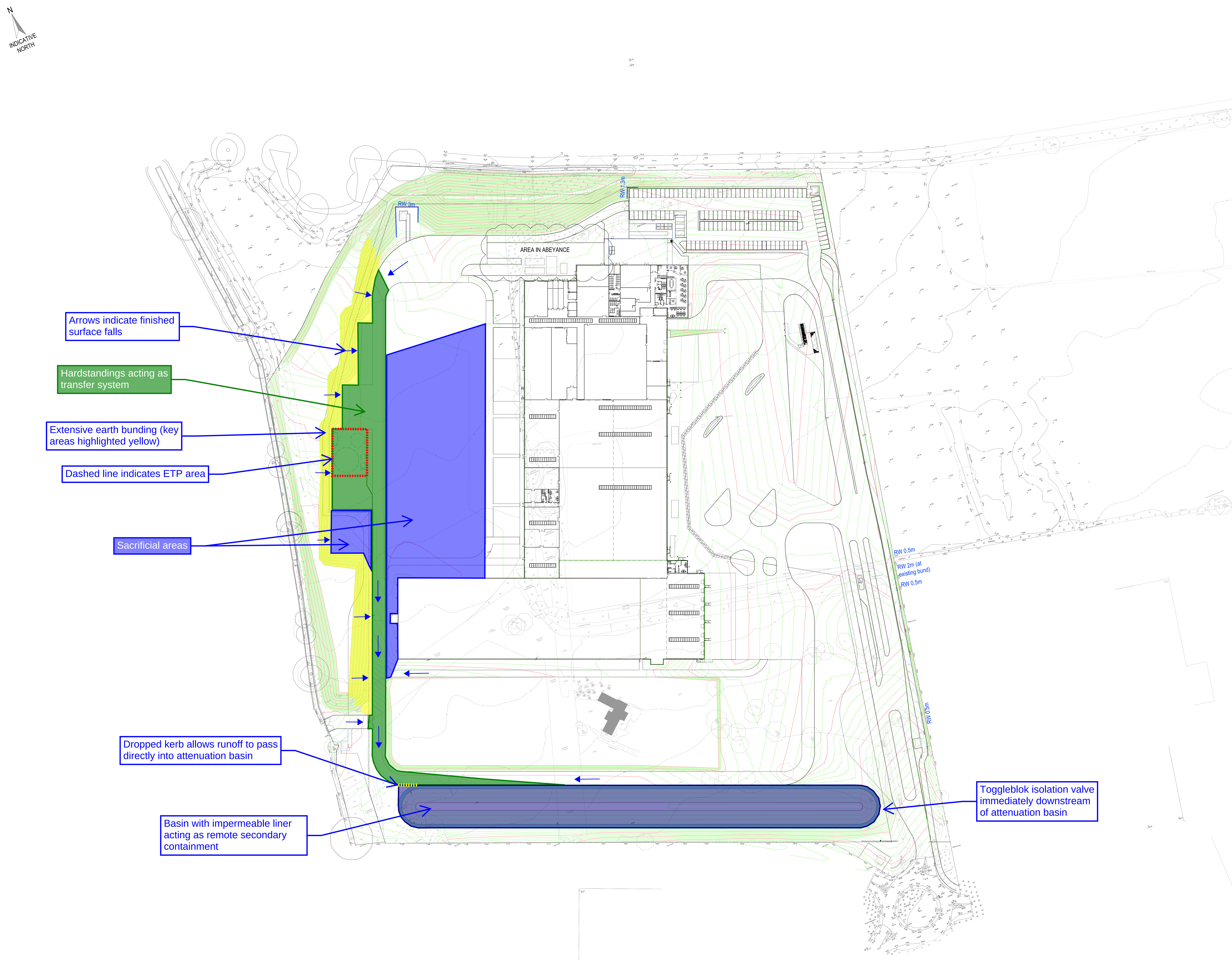
Appendix A: ETP Containment Risk Assessment Plan

Responsibility is not accepted for errors made by others in scaling from this drawing.
All construction information should be taken from figured dimensions only.

0mm 50mm 100mm

LEGEND

Major contour @ 500mm intervals
Minor contour @ 100mm intervals
Retaining wall (height above ground)



Drawing Number

FACILITY | PROJECT | ORIGINATOR | PHASE | DESCRIPTION | DESIGNATION | TYPE | LEVEL | NUMBER

STATUS	REV	DATE	DESCRIPTION

STATUS f : APPROVED

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