Assessment of the firewater storage arrangements on the Anaerobic Digestate lagoon

for

MATERIALS RECYCLING FACILITY

at

BRYN RECYCLING, GELLIARGWELLT FARM, GELLIGAER ROAD, GELLIGAER, CAERPHILLY

Prepared for:-

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Submitted by:-

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1 INTRODUCTION

JPCE Ltd have prepared a Fire Prevention and Mitigation Plan which describes the procedures that the Bryn group will adopt in the event of a fire occurring in any of the company's operational areas.

Should a fire occur, then it is possible that a large volume of "fire water" run-off will be generated, this water will be contaminated and cannot be allowed to be discharged to ground or surface water without appropriate treatment.

A potential storage area for this water has been identified by utilising the existing AD plant digestate storage lagoon.

1.2 Site location

1.2.1 *Site Address*

Bryn Recycling Ltd, Gelliargwellt Farm, Gelligaer, Hengoed, Mid-Glamorgan, Wales CF82 8FY.

The site is located east of the A470 which connects Cardiff with Merthyr Tydfil, approximately 20km northwest of Newport. Access to the site is via the site access road off the B4254 Gelligaer Road.

1.2.2 *Grid References*

OS TILE:	ST130961
NGR:	ST1296SW
E:	312470
N:	196473

A Site Location Plan is shown on drawing BRL-FPMP-2019-001revA.

1.3 Site description

The Bryn Group facility is located at Gelliargwellt Farm; as well as being a working dairy farm, the site also contains a permitted composting facility and an Anaerobic Digestion facility adjacent to the Mixed Recycling Facility (MRF). The Bryn Group also operate a working sandstone quarry. The present MRF has operated successfully for a number of years and is operated by Bryn Recycling Ltd.

The lagoon is constructed within land reclaimed from open cast mining activities which ceased over 40 years ago. In the immediate vicinity of the lagoon area ground levels at the site were raised to create to create a level stockyard with noise and visibility bunds. Beyond the site the land is used for agricultural grazing.

1.4 Environmental setting

The site is underlain by the solid geology of the Upper Westphalian Grovesend Formation, predominantly argillaceous, comprising mudstones and siltstones, with well-developed coals, (the upper seams of which have been extracted by opencast mining methods); minor lithic

("Pennant") sandstones and locally developed red mudstones in the type area. There are clay rich superficial drift deposits in the area.

The geological classification is of a Secondary Aquifer (permeable) - These are permeable layers of rock or drift deposits 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.

The site is not located within a groundwater source protection zone (SPZ) or an area at risk of flooding. The area is not located within a Nitrate Vulnerable Zone (NVZ).

There are no active ground or surface water abstractions within 1km of the site. The nearest natural surface water feature to the application area is approximately 20m to the south east. This water feature is a small unidentified stream that flows to the south before joining with another stream.

Nelson Bog, 1km south of the site is a designated Site of Special Scientific Interest (SSSI).

2 LAGOON CONSTRUCTION

The lagoon is a fully HDPE (High Density Polyethylene) lined structure partially cut into the existing ground and was constructed in circa 2014. The shape forms an elongated vessel of approximate dimensions 135m x 78.5m and has a maximum depth of approximately 9m. The accompanying plan referenced BRL-FPMP-2021-009 shows detailed cross-sections of the lagoon. The shape was excavated into the then existing ground profile, the excavated profile was prepared by rolling and smoothing off, prior to the basal liner being laid. The perimeter or containment is formed from either substantial earth bund walls or the natural contours of the pre-existing terrain.

We understand that the basal liner is formed from 2.0mm thick HDPE sheets with continuously welded joints and was installed by a recognized and experienced contractor who works on landfill lining using the same materials. The works were carried out by them to the same protocols as would be used in a landfill lining situation with all joints in adjacent sheets overlapped and continuously welded, we have seen evidence that the joints were tested to demonstrate their effectiveness. The basal sheets are retained by virtue of being installed into a perimeter trench, which was subsequently backfilled with the compacted excavated material.

A floating cover to the lagoon is installed forming a space between the basal liner and the cover into which the digestate from the AD is stored before it is abstracted for use in connection with inter-related farming activities. The purpose of this cover is to prevent rainwater entering the storage lagoon thus diluting and increasing the quantity of the digestate.

The material used to form the floating cover is a 1.0mm thick HDPE. The sheets were laid in long continuous strips across the shortest distance from bund wall to bund wall and, at the edges, are continuously welded to the underlying basal liner thus forming a watertight seal. Vents are present at discrete locations around the perimeter of the cover to allow the venting of any residual gas in the digestate. This form of construction allows the cover to effectively ‘float’ on the liquid digestate within the lagoon and the cover freely moves up and down depending on the volume of digestate in the lagoon at any one time.

As the cover sheet is fully welded to the underlying basal liner over the full perimeter and it is of sufficient size to follow the basal contours when the lagoon is empty it never becomes taut when there is no digestate in the lagoon. Therefore, as liquid enters the digestate lagoon and the cover begins to float on the liquid, ‘wrinkles’ in the cover will form. These wrinkles are the surplus material generated by the shortening of the effective length of the cover. These are clearly visible in the 2nd photograph below. As water is collected on the upper surface of the cover it will displace any underlying gaseous build-up and flatten the cover until it rests on and is thereby supported by the underlying liquid.

Photographs of the lagoon are shown below both before the placement of the cover and with the cover in place.

The base of the lagoon shortly after completion of the lining installation

The lagoon with the floating cover installed, lagoon is partially full with puddles of naturally collected rainwater.

3 THE PROPOSALS

The previously identified Fire Prevention and Mitigation Plan has identified that in the event of a fire, then some 2,988,000 litres of water may be required to fight a fire in the largest waste stack. It is unlikely that all this water would be generated as contaminated run-off as, some will be vaporized as steam and more may be absorbed by the waste itself. However, for the purposes of this assessment, the whole volume will be assumed to be transferred to the storage area.

The report identifies that there are existing underground storage tanks (UST's) where the firewater will collect after being used to firefight. Due to the existing contours of the wood and waste hard standing processing areas, this water will flow under gravity to the UST's. As these become full, pumps will be required to transfer this water to the firewater storage area, so filling of the area will be a gradual process governed by the pumping rate.

As previously identified above, the cover of the digestate storage lagoon naturally floats on the digestate. As part of the written operating and management procedures, the operator maintains the digestate at a level approximately 1.75m below the lowest level of the bund retaining walls. This procedure creates a freeboard which can be used as a storage volume for contaminated fire water within a fully lined lagoon.

The available volume has already been stated to range from 6,000,000 litres to 18,000,000 litres depending on the volume of digestate within the lagoon. Therefore, there is ample capacity above the cover to contain the 2.988Mlitres of fire water expected to require storage. However, as part of this assessment, a more detailed analysis of the available storage volume has been carried and is stated below.

4 AN ANALYSIS OF THE STORAGE VOLUMES AND AREAS

An analysis of the available volumes and areas has been carried out using the Digital Terrain Modelling (DTM) software LSS; this has confirmed the minimum storage volume above the maximum level of the cover sheet to be 7,519,205 litres whilst maintaining a 0.75m freeboard. The surface area of the liner at this level is 7,191m^2, this means that if 2,988,000 litres were placed on this area the depth of water would be circa 410mm or 0.41m, this means that the resulting total freeboard would be 1.34m.

5 EFFECTS OF STORAGE OF LIQUID ON THE COVER

It has been established that the HDPE cover to the AD storage lagoon floats on the stored liquid, the photograph included in Section 2 above clearly shows rainwater which has collected on the cover. As the cover is generally in intimate contact with the underlying digestate, the digestate effectively acts as a complete support to whatever is placed on it. Therefore, the storage of a liquid on top of a membrane which itself is supported by a liquid below the plane of the membrane imparts no additional stress on the membrane whatsoever.

This is a natural state as rainfall is collected on the cover and is periodically pumped away onto the surrounding farmland. As the digestate liquid level varies with time over the course of a year, then the surface of the cover also moves either upwards or downwards.

The technical department of Solmax GmbH who are the manufacturers of the HDPE material used for the cover have been consulted regarding this proposal and they have confirmed by email that there will no adverse effect to the material due to the proposals, see Appendix B.

6 CONCLUSION

The proposals to temporarily store water generated as a result of a firefighting at the nearby Bryn Recycling on top of the cover of the lagoon associated with the on-site Anaerobic Digestion facility are acceptable for the following reasons:

i) No additional stress will be imparted on the lagoon cover as there is sufficient surplus material to even out the existing wrinkles.

ii) Forces either side of the membrane are equalized as the downward force from the stored liquid is balance by the upward buoyant force, as established by the fundamental law of fluid dynamics, "Archimedes Principle".

iii) The 1.0mm HDPE cover is an extremely flexible material and is readily able to take up and undulations in any surface.

iv) We understand that it is proposed to store water on the cover for a short period, until such time as its removal can be organized. During this time, it is expected that the maximum volume of digestate produced would be 1,320m^3. This would equate to a gradual depth change in the digestate storage of 184mm.

v) Sufficient freeboard will be maintained by the operator to ensure that there is an available void on the cover to receive firewater should the need arise.

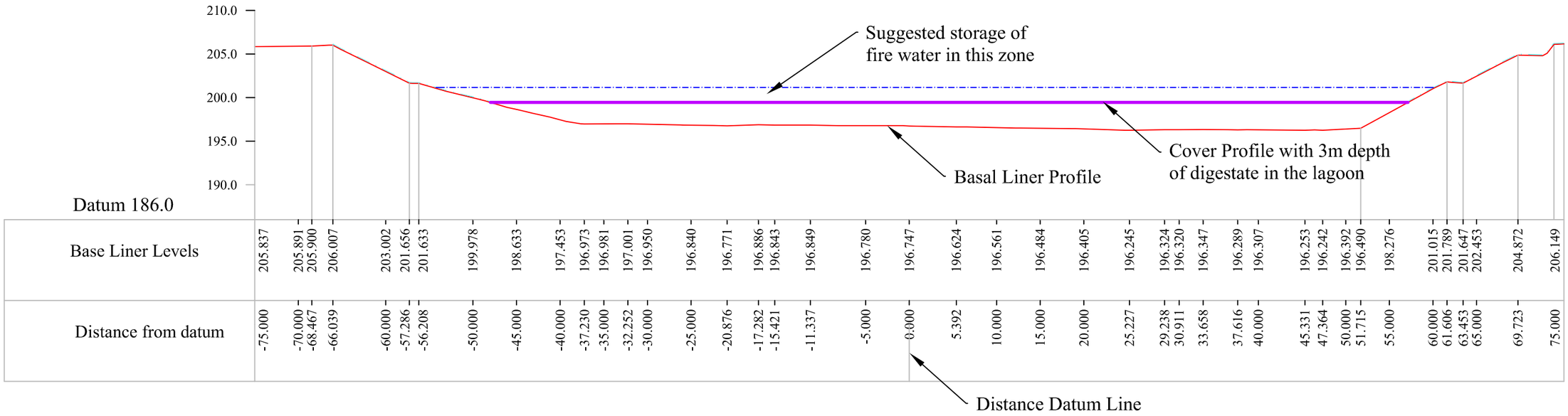
vi) It should be noted that, currently rainwater naturally falls on the cover without any cause for concern.

vii) In the unlikely event that the cover is damaged or fails as a result of storing firewater off the lagoon cover, the underlying basal geomembrane will act as secondary protection stopping the firewater escaping to the wider environment.

Prepared by: John Perkins BSc. CEng MICE

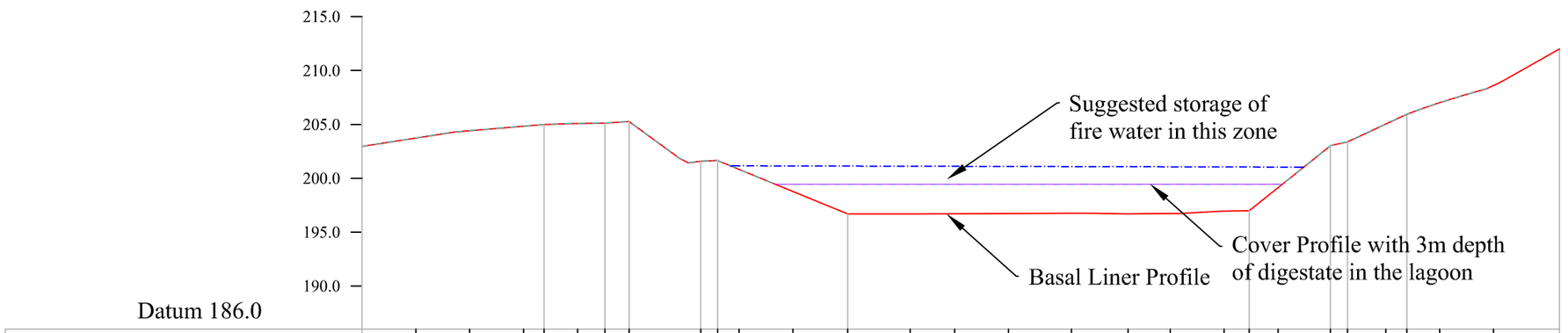
Signed: 

Dated: 3 February 2021.



Base Liner Levels	205.837	205.891	205.900	206.007	203.002	201.656	201.633	199.978	198.633	197.453	196.973	196.981	197.001	196.950	196.840	196.771	196.886	196.843	196.849	196.780	196.747	196.624	196.561	196.484	196.405	196.245	196.324	196.320	196.347	196.289	196.307	196.253	196.242	196.392	196.490	198.276	201.015	201.789	201.647	202.453	204.872	206.149
Distance from datum	-75.000	-70.000	-68.467	-66.039	-60.000	-57.286	-56.208	-50.000	-45.000	-40.000	-37.230	-35.000	-32.252	-30.000	-25.000	-20.876	-17.282	-15.421	-11.337	-5.000	0.000	5.392	10.000	15.000	20.000	25.227	29.238	30.911	33.658	37.616	40.000	45.331	47.364	50.000	51.715	55.000	60.000	61.606	63.453	65.000	69.723	75.000

Section Line 1



Base Liner Levels	202.955	203.735	204.415	204.831	204.989	205.085	205.126	205.273	201.577	201.635	200.820	198.768	196.694	196.691	196.709	196.733	196.759	196.687	196.724	196.955	196.983	199.120	203.022	203.386	205.036	205.942	207.016	208.603	212.004
Distance from datum	0.000	5.000	10.000	15.000	16.898	20.000	22.556	24.788	31.437	33.016	35.000	40.000	45.064	50.865	55.000	60.000	65.824	71.086	75.000	80.000	82.317	85.000	89.849	91.440	95.000	96.957	100.000	105.000	111.101

Section Line 2

REV'N	DATE	AMENDMENT

J P C E Limited

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DRAWING TITLE & SCHEME

FIRE PREVENTION & MITIGATION PLAN FOR THE MATERIALS RECYCLING FACILITY AT GELLIARGWELLT FARM, NELSON

Cross sections through AD storage lagoon

Drawing Number	Drawn By :
BRL-FPMP-2021-099	J PERKINS
Date : JANUARY 2021 / Scale 1:500@A3	Checked :