WITHYHEDGE LANDFILL
PERMIT. EPR MP3330WP

Waste Recovery Plan for use of soil in restoration and engineering

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Commissioned by
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1 INTRODUCTION

Withyhedge landfill site is situated 5.5 km to the north of Haverfordwest in Pembrokeshire, Wales. It has operated since the mid-1980s when it was first developed by the local authority for municipal refuse disposal. The site is now owned by Resources Management Limited (RML) a privately owned company that has recently been acquired by the Dauson Group. The site has planning permission issued originally by Dyfed County Council and an Environmental Permit (Number MP3330WP) issued by Natural Resources Wales (NRW), the waste regulator for Wales .

As part of the sustainable operation of the landfill, the operator seeks to use waste comprising of naturally occurring soils for restoration and engineering. Landfill restoration comprises the placement of an even layer of soil on top of the landfill above an engineered cap to return the land to beneficial use. Landfill engineering comprises the use of selected waste materials to construct elements of the landfill in accordance with strict engineering standards.

To enable the use of waste in restoration and engineering, NRW require that this activity must be separately authorised in the landfill permit. In this context, this Waste Recovery plan (WRP) sets out the framework that will need to be satisfied to demonstrate that the appropriate wastes are being recovered.

2 RECOVERY OF WASTE SOIL

2.1 Restoration Requirements

Landfilling within the Permit boundary is being undertaken in three phases. The first phase was in the east (Phase 1) whilst the current Phase 2 operations are central with Phase 3 on the west, as shown on Figure 2-1.

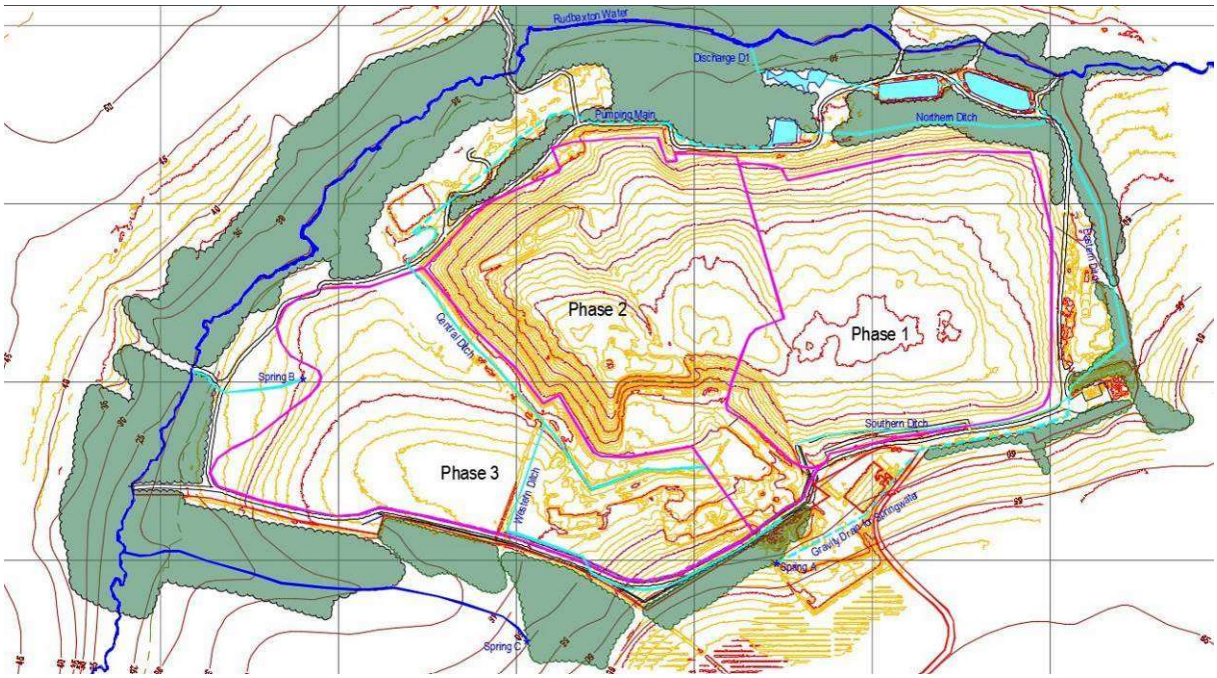

Figure 2-1 Phasing of landfill construction

Two thirds of the site have already been used for landfilling in Phases 1 and 2. Of these two thirds that have already been used for disposal operations, all but the western edge has been permanently capped with flexible membrane liner overlain with restoration soil. These capped areas are considered to be "completed" and closed and there are no proposals to dispose of further wastes in these areas of the landfill. All other areas of the site are currently temporarily capped.

The currently approved restoration plan for the whole site is shown below on Figure 2-2, a drawing originally referred to as WHV5.

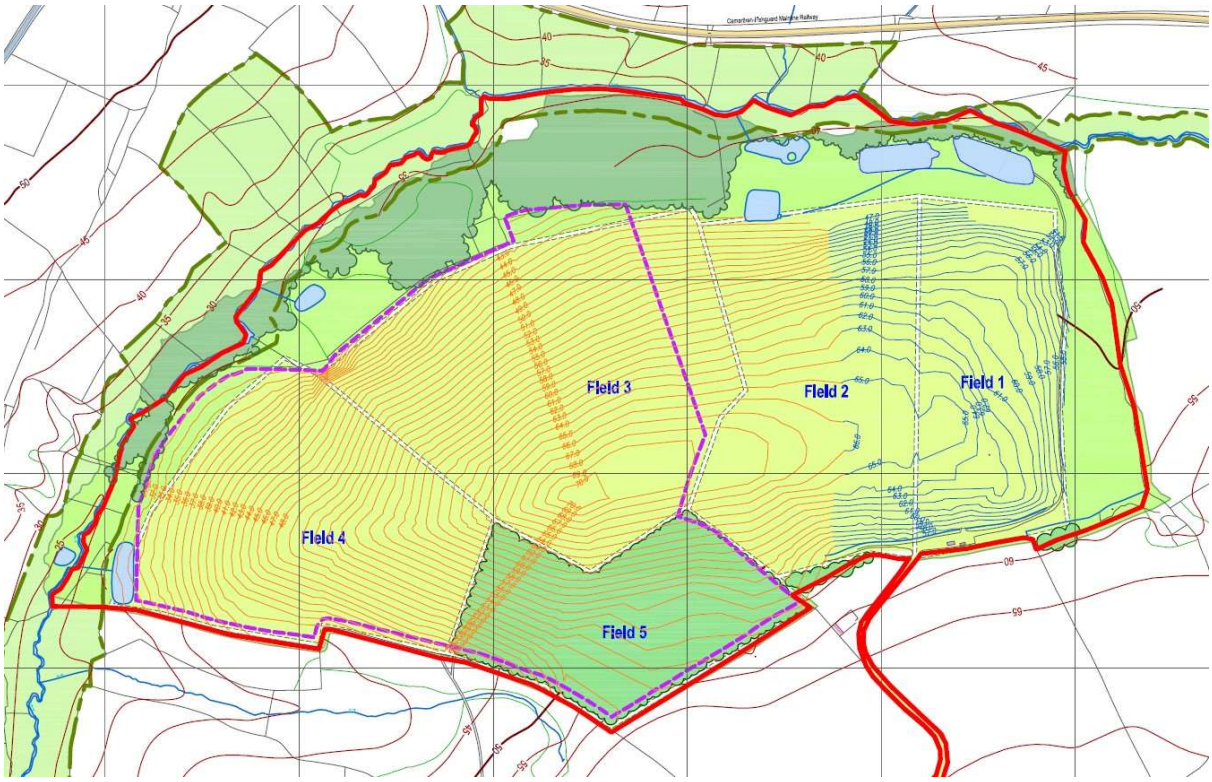

Figure 2-2 Approved Restoration Topography and Landscaping

The approved plan shows a whaleback profile, elongated west to east with the principal side slopes dropping to the north and south. The eastern edge of the contour lines are shown in blue and are visibly less regular than the brown contours elsewhere. It is thought that the blue contours represent the actual landform of the completed part of the site when the restoration plan was drafted in 2008, with the brown contours being proposed levels.

The current capped landfill extends over two thirds of the restoration surface shown on the approved plan. The completed area has an irregular western boundary following the eastern boundaries of Fields 4 and 5 shown on the plan.

Topographic surveys are currently carried out at quarterly intervals and are flown by drone to produce high resolution 3d images on the Propeller platform which is shared with NRW. A topographic contour plan of the site is shown below on Figure 2-3.

Figure 2-3 Contour Plan of Restored Area (east), Active Area (centre) and Undeveloped Area (west)

Detailed examination of the contour lines on Figures 2-2 and 2-3 reveals that they are not the same and this has led to the development of a new restoration plan. This plan has been developed following consultation with the Local Planning Authority (LPA) to take account of aspirations for the landscape, ecology and after-use of the site. This engagement has led to the revision to the proposed surface of the remaining part of the site shown in Figure 2-4 and is the subject of the substantial Variation application currently being determined by NRW.

The proposed restoration surface is shown on Figure 2-4, but the reader should note that the field boundaries and numbers have been changed from those on WHV5 (shown on Figure 2-2). The surface follows the existing contours over Fields 1 to 5 and the eastern parts of Fields 6 and 7. To the west of this the shape of the landform is different to the currently approved surface, as a comparison with Figure 2-2 shows. The landform is now more sinuous, with a broad shallow valley between Fields 6 and 10, a deep valley between Fields 9 and 10 and shallow more uniform slopes to the south and south west in Fields 8 and 9.

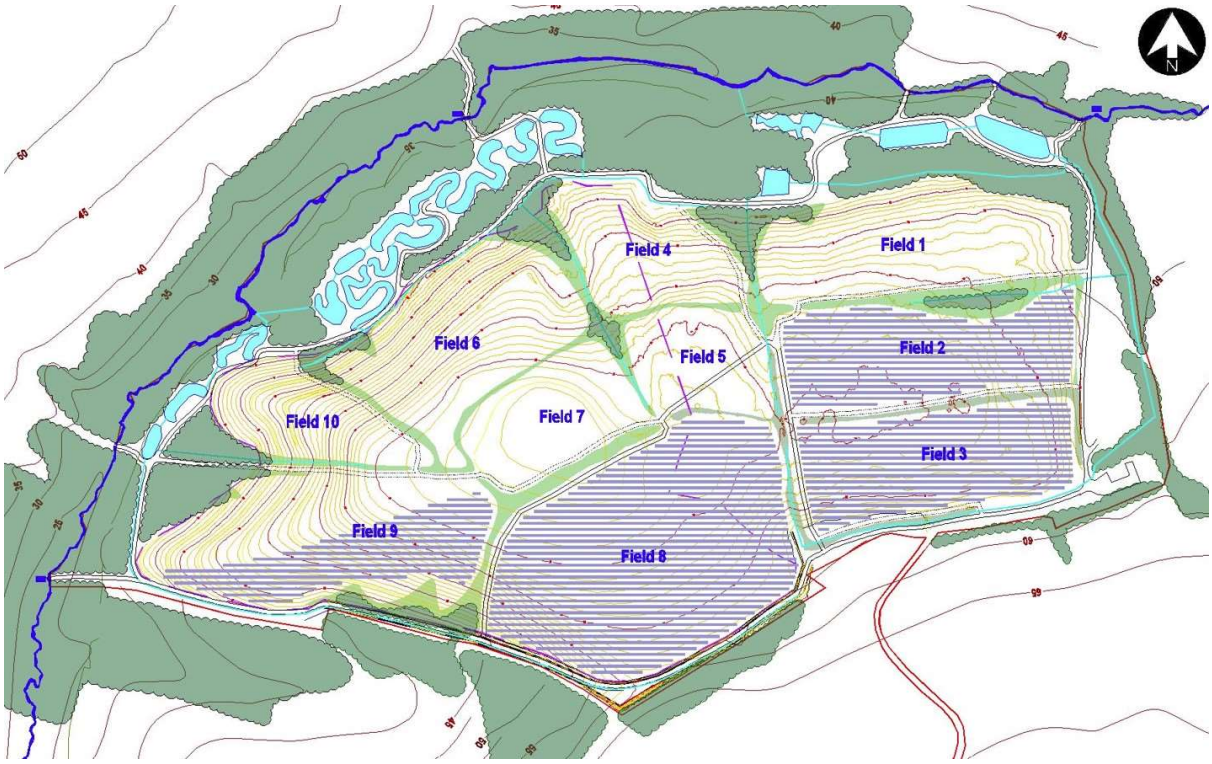

Figure 2-4 Proposed Restoration Profile

The revised plan takes ecological opportunities for the land by joining the top of the landform to the valley bottom with scrub and overgrown hedges. The scrubby field edges often contain surface water ditches that drain the cap. The valley between Fields 9 and 10 draws the toe of the landfill southward from the approved profile; this will avoid placing waste over an existing ephemeral spring. Tracks and landfill gas infrastructure follow the field boundaries where this is possible to allow maintenance with light machinery.

The after use for the landfill on the currently approved plan is low grade agricultural use for sheep grazing with little ecological opportunity. The proposed scheme provides wildlife corridors and divides the area into smaller fields for agricultural use on the northern slopes. The site is only overlooked from the north and therefore the scheme provides external views of small fields with scrubby edges linking down the landform into the wooded valleys. To the south, where the site is not overlooked from roads or properties, opportunities for solar energy will be explored.

The management of surface water at the site will follow the same strategy as is already approved with a series of ponds each with its own monitored discharge into Rudbaxton Water.

2.1.2 Soil for restoration

Withyhedge landfill is progressively restored, that is, upon completion of each cell it is contoured and then capped with a moisture barrier to prevent rainfall infiltration. To make an acceptable surface for agricultural and other post-closure uses a layer of soil is spread over the cap. The system used at this site comprises 800mm of sub-soil overlain by 200mm of topsoil to achieve the 1m thickness soil restoration layer. A typical cap cross section is shown on Figure 2-5.

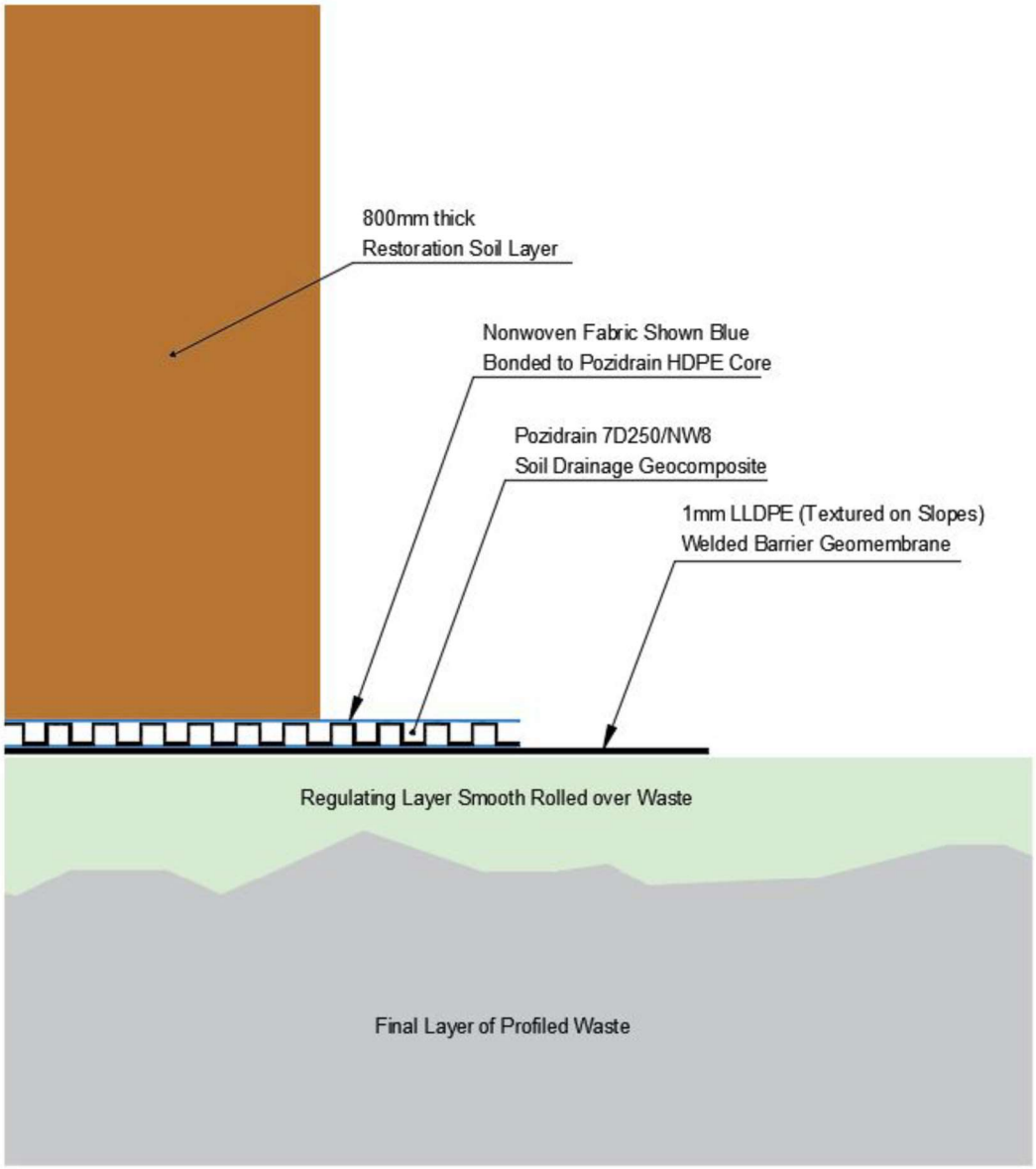

Figure 2-5 Schematic section through capping

Until recently, sub-soils for use in capping have been won from within the site, but this resource is now depleted although there is still a stockpile of topsoil. The operator therefore must source subsoil from off-site sources to complete the restoration works which is a requirement of the restoration plan, the Permit and planning permission.

The remaining areas that require capping are shown on Table 2-1. The plan areas for each of the cells is shown and when multiplied by the soil thickness the volume is calculated. An approximate time is also shown next to the capping areas so that a schedule of soil requirement by date can be shown. The annual requirement is estimated to be 33,197 tonnes based on a soil density of 1.9 t/m^3.

Capping Area	Area (m2)	Volume (m3)	Mass (t)	Date	Quantity p.a. (t)
Cell 8	19003	15202	28885	2026	28885
Cell 7/8 Valley	8693	6954	13213	2026	13213
Cell 9	29594	23675	44983	2025	44983
Cell 6&7/9 Valley	11670	9336	17738	2027	17738
Cell 10	25395	20316	38600	2028	38600
Cell 11	42183	33746	64118	2029-2032	21373
Cell 10/6 Valley	10061	8049	15293	2030	15293
Cell 11/5S Valley	10607	8486	16123	2033	16123
Remaining Area	83034	66427	126212	2033-2037	31553
Average Need		Total	365164.8	11 yrs	**33197**

Table 2-1 Restoration Soil Requirements

In order for any candidate waste soil to be considered acceptable for use as subsoil in the landfill restoration works, its performance has to be evaluated. Only materials able to meet the specification set out in the approved Construction Quality Assurance documentation would be proposed for the works and the use of these materials would have to be agreed by the Regulator during the review of pre-construction documentation. Soils to be used in restoration are routinely sampled and tested in accordance with the CQA Plan. The Plan has to first be approved by NRW before works can commence, so the sampling and testing regime for the pre-selected materials will already be defined before soils are used. This approach provides a robust means to control the use of waste soils and to ensure that they are fit for purpose.

2.2 Engineering Requirements

The HRA review has concluded that a 1m thick unsaturated zone needs to be maintained beneath the lining system for the purpose of attenuation. This is also an existing Permit condition and is not expected to change as a result of the variation application. As the site develops into each new area, the most recent groundwater monitoring data is used to establish the seasonal maximum groundwater level. Thus the precise groundwater surface used as the basis to design the shape of the basal tray is not available until the detailed design for that year's cell is being developed. The detailed level of the cell base will determine the ratio between those parts of the cell formation that have to be cut and those parts that have to be filled. The net result of this calculation is the shortfall or surplus form the cell formation works.

Recent cells have been constructed in an existing borrow pit, where fill materials were won for site use. Cell 11 is the next cell to be designed, though construction has not yet commenced. This large cell, with three years capacity has a net shortfall of ~30,811m^3 as shown by the cut/fill calculation in Table 2-2.

Future cells will occupy the low/lying ground in Field 3 where groundwater levels are relatively shallow. Further groundwater wells are being installed to get a more refined map of groundwater levels and the results of these plus the existing dataset will be used to set levels of future cells. Accordingly, there is no precise figure for fill requirements at present, though a basic model of formation based upon a 1.2m standoff from groundwater and the current ground levels indicates 51644m^3 over the remaining 7years of life for the site. Using this information, the average annual shortfall is shown in Table 2-2 and amounts to 15667 tonnes/year based on a material density of 1.9 t/m^3.

Basal Tray	Cut (m3)	Fill (m^3)	Shortfall (m^3)	Shortfall (tonnes)	Date	Quantity p/a
Cell 11	11759	42571	30812	58543	2026-2028	10271
Remaining cells	150515	202159	51644	98124	2029 - 2036	7378
Average need		**Total**		**156667**	**10yrs**	**15667**

Table 2-2 Cut and Fill Balances to Achieve Formation (Cell 11 Precise, Remaining Cells Estimated from Current Groundwater Model)

In the specification, the performance of the soils in terms of geotechnical properties and limits on the concentration of substances is defined. The design specifications are submitted as an appendix to the Construction Quality Assurance Plan for NRW review and acceptance before any proposed works can be undertaken.

In order for any candidate waste soil to be considered acceptable for use in the landfill engineering works, its performance therefore has to be evaluated. For geotechnical design this will include geotechnical laboratory testing and a review of these results against the design of the works. Only materials able to meet the specification and the Specification for Highway Works would be proposed for the works and the use of these materials would have to be agreed by the Regulator during the review of pre-construction documentation.

A similar safeguard is in place for the chemical compatibility of the soils. Waste soils would have been sampled and tested by the donor site and these data would be reviewed and compared against chemical criteria developed to be protective of the environment. Only if it can be shown that the soils present no risk to the local environment would their use be proposed as part of the CQA Plan.

Soils used in engineering works and restoration are routinely sampled and tested in accordance with the CQA Plan. The Plan has to be approved by NRW before works can commence, so the sampling and testing regime for the pre-selected materials will already be defined before soils are used. This approach provides a robust means to control the use of waste soils and to ensure that they are fit for purpose.

In the event that a material with geotechnical properties that are not equivalent to or better than those assumed in the SRA is proposed for the works, then any design proposal will have to be supported by re-running calculations made in the SRA. All materials used for engineering purposes will be verified to meet the engineering requirements of the SRA.

2.2.2 Other Wastes that Could Contribute to Engineering

The basal liner at Withyhedge includes a 500mm thick low permeability clay liner. The liner to date has been sourced from site won material and from a single off-site source. Whenever liner material is being considered the very high performance requirements of the liner require a full source evaluation and placement test pad to be undertaken, submitted to NRW and approved for use. So rare are opportunities to win basal liner clays that these are unlikely to form part of this 50,000t pa and instead will be considered on a case by case basis.

2.3 Overview of Waste Quantities

The analysis of fill requirements to build to formation results is an average annual estimate of 15,677tonnes. The restoration soil requirements for cells yet to be capped amounts to 33,197tonnes per annum. In combination the fill requirements amount to 48,864 tonnes per annum. The figures are preliminary figures for the remainder of the site as detailed design has not yet been undertaken. With a small allowance for bund construction and uncertainty in the future design quantities the 50,000t pa proposed as the annual limit for imported waste for construction seems appropriate. In any event, the engineering works carried out each year will be subject to a detailed design submission, quantifying the requirements precisely. The site has a separate designated area for suitable fill and restoration soil materials and also has the benefit of a weighbridge so that accurate tracking of quantities can be made.

3 IMPLEMENTATION OF WRP

As each aspect of landfill development must first be approved by NRW the implementation of the WRP and the use of soil will be tightly controlled at each stage of development. This will ensure that only the appropriate soil is used in appropriate quantities for specific uses.

3.1 Appropriate Waste Types

Available NRW guidance indicates that a large number of waste codes are potentially acceptable for recovery. However, this WRP is only focussed on those wastes considered likely to be required, as listed in Table 3-1.

However, the presence of a waste on the list does not mean it is suitable for recovery at this site, as it has to meet the approved Specification for the specific purpose. For example, soils for restoration must meet grading and chemical criteria set out in the Capping CQA Plan, clays for landfill lining have to meet the engineering specification criteria for strength, grading, permeability and clay content. The acceptance criteria for each proposed use is set out in a series of documents required to be submitted to the Waste Regulator for review prior to commencement of the works. These documents include the design and specification for the scheme, the Construction Quantity Assurance Plan and Source Evaluation Reports.

The Permit and the formal engineering management system controlled through Permit conditions means that the procedure of evaluating proposed waste materials against a Specification is tightly controlled by NRW. This provides a high degree of assurance that the soils will be suitable for the purpose, will cause no environmental harm or risk and will be fully recovered once used for the purpose. The use of soils in this way will ensure the substitution of natural resources from quarries and borrow pits.

EWC Code	Waste description	Restoration Soil	Soil for Engineering
17 01 02	Bricks		Y
17 01 01	Concrete		Y
19 12 12	Crushed bricks, tiles, concrete and ceramics, including mixtures of materials. This excludes metal from reinforced concrete and fines from treatment of any non-hazardous waste or gypsum from recovered plasterboard or residual fines from mechanical treatment of mixed waste at transfer stations		Y
19 12 09	Minerals (such as sand and stones) from the treatment of waste aggregates that are otherwise naturally occurring minerals. This excludes fines from treatment of any non-hazardous waste or gypsum from recovered plasterboard or residual fines from mechanical treatment of mixed waste at transfer stations	Y	Y
17 01 07	Mixtures of concrete, bricks, tiles and ceramics		Y
17 03 02	Road base and road planings other than those containing coal tar		Y
17 05 04	Soil and stones (topsoil, peat, subsoil and stones)	Y Only subsoil required	Y Only subsoil required
02 04 01	Soil from cleaning and washing beet	Y Only subsoil required	
17 01 03	Tiles and ceramics		Y
17 05 08	Track ballast, soil and stones other than those containing dangerous substances		Y

10 12 08	Waste ceramics, bricks, tiles and construction products (after thermal processing)		
01 04 08	Waste gravel and crushed rocks other than those containing dangerous substances		Y
01 04 09	Waste sand and clays		Y
01 01 02	Wastes from non metalliferous excavation		Y
* All relevant conditions, as set out in guidance, would fully apply to this WRP. All waste would be classified in accordance with WM3. Recovery would involve only small number of waste types from above list with specific waste codes and descriptions listed in relevant CQA documentation.			

Table 3-1 Waste types NRW normally accept for recovery*

3.2 Waste Acceptance

All waste accepted at Withyhedge landfill is subject to a series of checks to ensure that it is as described and can be accepted for disposal. The materials accepted for recovery will be no exception and will essentially follow the same series of checks commencing with pre-acceptance.

All procedures will be integrated to the documented management system and their implementation overseen by the Technically Competent Manager.

3.2.2 Pre-Acceptance

Pre-acceptance procedures will include assessment of the potential source and completion of a Waste Acceptance Form (WAF). The soils will only be from sites where there is no suspicion and demonstration of contamination i.e.

- Greenfield sites not subject to past contaminative use, or
- Brownfield sites where the natural soils have been extensively characterised and proven to be clean.

Prior to any import, any waste must be pre-assessed to determine whether the site can accept it without risk to human health or to the environment.

These documented assessments will include review of source characterisation reports that will need to include site history and chemical test results to demonstrate that the soil is naturally occurring and has a waste code and description that meets those listed in this WRP and relevant CQA documentation.

3.2.3 Acceptance

Materials imported onto the site will be tipped under the guidance of the trained site operatives to ensure materials comply with the description on the WAF form. The vehicle will go direct to

the site weighbridge office where the waste transfer note will be inspected. If appropriate for acceptance the vehicle will then be weighed and directed to the appropriate storage area; the operator has non-disposal areas already agreed with Welsh Revenue Authority.

Only permitted waste that conforms to the type and description in the CQA documentation and this WRP will be accepted. This will be initially determined through verification of the waste transfer note and visual inspection upon tipping and subsequent testing. Any non-conforming materials will be identified and dealt with in accordance with the site documented management system including use of quarantine area. All non-conforming materials will ultimately be returned to supplier. Importation of the waste stream from the supplier will be stopped pending evaluation of the cause of non-conformance and measures required to rectify.

All of these measures will be set out in the relevant CQA documentation.

4 ENVIRONMENTAL PROTECTION

The use of waste in a recovery operation must not cause pollution or any other environmental problems. To help demonstrate that the proposed use of waste is safe and sustainable the conceptual site model will be used to aid focus of the assessment of plausible risks at the time the specific Specification is compiled in the CQA documentation.

4.1 Conceptual Site Model

Restoration soils will be placed above impermeable capping membranes and soil for engineering will be placed below the basal lining systems.

As the after-use for the site is principally agricultural, there will be very limited direct human contact with the soils. Rather the restoration soils will provide a growing medium to support animal husbandry. In this context, there are very limited risks to human health due to the lack of receptors, their infrequent use of the land, use of machinery rather than hand-tools and the presence of vegetation limiting opportunity for direct contact. Rainfall landing onto the restoration soils will ultimately migrate under gravity drainage to the surface water collection ponds along the northern boundary of the site and this aspect is discussed further below. For this reason, the CQA documentation will ensure that only inert sub-soils are used for restoration and that they are free of any materials that could damage the underlying capping systems.

Unlike the restoration soils, the engineering soils will be below the basal lining system and waste mass. In such a position there is no possibility of human interaction, apart from during the construction phase, and very limited opportunity for contact with any water. In this context, the risks are negligible, and the focus of the specification set out in the CQA documentation will focus on the engineering properties that must be satisfied.

In all cases, the CQA documentation will set out that any soil must not be a source of odour and will not release any more dust than site won soils.

4.2 Surface Water Management

The surface water collection system is intended to receive surface water at its unattenuated runoff rate and then provide sufficient retention time to allow settlement of suspended solids before discharge to Rudbaxton Water via consented discharge. Recently, the existing ponds, which have been shown to be effective for many years, have been extended to provide additional retention capacity and wildlife habitat. The new system, comprising a series of sinuous ponds, is shown on Figure 4-1.

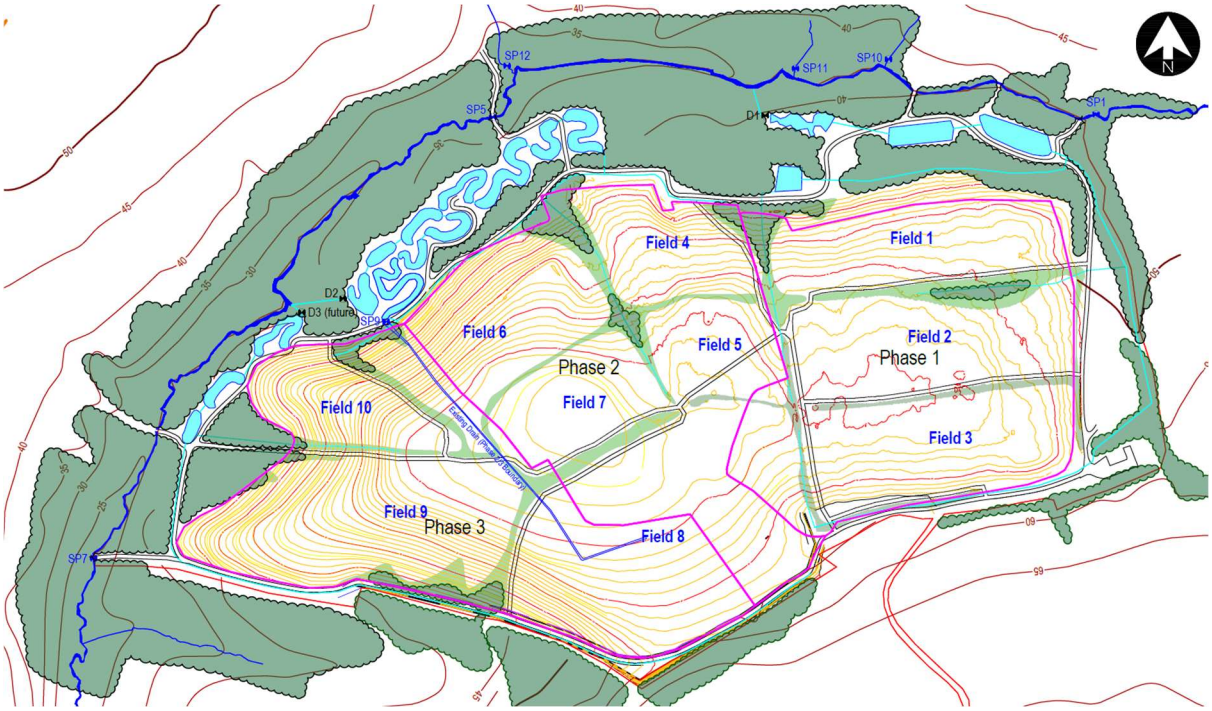

Figure 4-1 Surface Water Collection Ponds and Monitoring Points

The objective of the design of the ponds is to provide the same or greater capacity per unit area drained as the existing system which has proven to reliably collect and treat surface water from the site over many years of operation.

In this context, any particulates mobilized from the restoration soils will be collected in the surface water management system. To ensure the system is performing as expected the surface water quality is monitored with thresholds set in the Permit. As only inert soils will be utilized in restoration, this system will ensure that the use of waste will not detrimentally impact the environment. With the quality of the soil for restoration controlled through the CQA documentation and the surface water system closely managed and monitored, there is ample opportunity for control and intervention yet little risk of the proposed use of soil detrimentally impacting controlled water.

5 DEMONSTRATION OF WASTE RECOVERY

5.1 Recovery Test

The use of waste soils in restoration and for landfill engineering will result in the waste serving a useful purpose and avoid the use of primary materials. As the proposed activities are not disposal, the Landfill Directive standards do not apply.

Restoration and landfill engineering are key components of the sustainable operation of the landfill and are obligated by the planning permission, Permit and supporting technical documentation. To achieve the required restoration profile and after-use requires the placement of soil suitable for use. Similarly, landfill engineering requires the use of fill materials that meet the tight specifications set out in approved CQA documentation. There is therefore a clear obligation on the landfill operator to carry out these activities in a safe and stable configuration that protects the environment and human health. All aspects where waste is to be used will be set out in CQA plans and CQA Validation reports confirming that the works undertaken achieve the obligations and will document that the waste was used in the appropriate quantity and was suitable for use. Strict controls will apply, ensuring only the appropriate quantity of waste suitable for use is recovered. In this framework, the implementation of the Waste Recovery Plan is subject to ongoing scrutiny until the landfill ceases to operate and the land-form restored.

5.2 Certainty of Use

The site is subject to Permit and Planning conditions that require works to be carried out in accordance with the design and specification agreed by NRW and LPA. There is no means to avoid the construction of those elements that waste soils could be used for. Accordingly, there is a need for the soils in order for the site to operate. The operator is obligated to carry out restoration works and is able to use waste soils as an alternative to non-waste sources.

5.3 Financial Certainty

If the operator is able to use waste soils instead of non-waste soils a commercial advantage is secured. RML is well resourced by income from its disposal activities and therefore is able to pay for non-waste soil sources, however, the use of waste soils that meet the specification allow the required works to be carried out more economically. In the event that the operator was to find a shortage of waste soils it would purchase soils from other non-waste sources.

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