

CARDIGAN TIDAL FLOOD RISK MANAGEMENT SCHEME

Volume 1: Environmental Statement Chapter 11 – Land Use and Soils

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11. Land Use and Soil

11.1 Introduction

This chapter assesses the likely significant effects from construction and operation of the Scheme, with respect to Land Use and Soil. This chapter details the baseline environment, assessment of likely significant effects and, where necessary, mitigation measures to avoid, reduce or minimise significant effects are proposed.

This chapter should be read in conjunction with the following topic chapters due to potential interactions between topics:

- Chapter 5: Population and Human Health
- Chapter 6: Biodiversity and Nature Conservation
- Chapter 7: Historic Environment
- Chapter 10: Water Environment
- Chapter 12: Cumulative Effects

11.2 Competent expert evidence

Technical Lead Benjamine Tucker is a Principal Geotechnical and Geo-environmental Engineer with over 19 years' experience across the full range of geotechnical and full range of geoenvironmental deliverables, including authoring EIA sections for Soils and Controlled Waters on several projects. Ben has experience as author and technical lead for Soils and Land as well as Materials and Waste topics on large scale Nationally Significant Infrastructure Projects (NSIPs) requiring a Development Consent Order (DCO).

Technical Author Stephanie Rebours-Smith is a Senior Geotechnical Engineer with over 11 years' experience in the full range of geoenvironmental deliverables, including authoring EIA sections for Soils and Land, and Groundwater Resources on small scale and large scale NSIPs.

11.3 Planning policy and legislative context

This section describes the relevant legislation, policy and guidance that has been considered in developing the Scheme design, and in the assessment of effects with respect to Land Use and Soil. This legislation, policy and guidance has been reviewed and where applicable has informed the assessment through the identification and categorisation of sensitive receptors, requirements for mitigation, and the scope and/or method of assessment.

11.3.1 International and National Policy

- The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (SI 2017/572) (EIA Regulations, HM Government, 2017a). The EIA Regulations provide a framework for assessing the impact of a development on the environment in which it will exist.

- The Marine Works (Environmental Impact Assessment) (Amended) Regulations 2017 (HM Government, 2017b). Addresses the steps required when a proposed activity such as the Scheme has the potential to impact the marine environment.
- Control of Asbestos Regulations (CAR) (HM Government, 2012). Legislation regarding the control of asbestos is relevant due to the presence of asbestos containing material in the foreshore. The reuse or disposal options for asbestos containing soil and silt would be controlled through the CAR.
- The Environmental Protection Act (EPA) 1990 Part 2A, supplemented by the Contaminated Land (England) (Amendment) Regulations 2006 (HM Government, 2012). Part 2A of the EPA provides the framework for approaching land affected by contamination. This legislation sets out the source-pathway-receptor (SPR) model under which is used for all assessment of land for contamination. We have developed our methodology for this ES to be compliant with this legislation, for example by considering the pollutant linkages between sources, pathways, and existing receptors. In developing our methodology for this ES, we have applied the risk-based source-pathway-receptor model to ensure compliance, evaluating contaminant linkages between potential sources, transport pathways, and existing receptors. Mitigation measures are then developed to prevent spread of contamination during construction and operation activities in order to protect receptors from harm.
- Welsh Government Contaminated Land Statutory Guidance 2012 (Welsh Government, April 2012). Describes how the Welsh Government requires local authorities to approach land potentially affected by contamination and implement Part 2A of the EPA 1990.
- Welsh National Marine Plan (Welsh Government, 2019) Addresses the marine environment in Wales, including provision to minimise pollution to air or water. Relevant here to demonstrate the need to control pollution from entering surface waters.
- HM Government. The Water Resources Act 1991, as amended by the Water Act 2003 and the Water Resources (Abstraction and Impounding) Regulations 2006. This describes methods to be undertaken to protect water, including groundwater.
- Water Framework Directive (WFD) 2000 (European Parliament, 2000). This describes methods to be undertaken to protect water, including groundwater. It has been maintained following the UK departure from the European Union in England and Wales as the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.

11.3.2 Local Policy

Ceredigion Local Development Plan (LDP1), 2007 – 2022 (Adopted 2013) (Ceredigion County Council, 2021). This plan was due to be updated; however, COVID and additional information regarding phosphate in rivers (NRW 2021) means that it remains current and the update to LDP2 has been paused. This plan sets forth the approach to growth in the Ceredigion council area.

Development of Land Affected by Contamination: A Guide for Developers (Welsh Local Government Association & Environment Agency Wales, 2012). Sets out expectations of

developers with regard to Preliminary Risk Assessment (Desk Study) and Intrusive Site Investigations prior and during the planning process.

11.4 Assessment guidance

The following guidance documents were used in this assessment, as described in the Methodology.

- IEMA (2022) A New Perspective on Land and Soil in Environmental Impact Assessment. Industry guidance on assessing effects on soils and land in EIA. The Soils and Land methodology and assessment complies with the principles set out within this document in order to follow good practice.
- The Land Contamination Risk Management (LCRM) guidance (The Environment Agency, 2023). This guidance delineates the preferred approach towards investigating for potential contamination linkages as established in Part 2A and Welsh Government, April 2012.
- Eurocode 7. Engineering guidance for geotechnical works and site investigation, This provides best practice in ground investigation.
- BS 1377-2:2022 (British Standards Institution, BSI, 2022). Methods of test for soils for civil engineering purposes. Classification tests and determination of geotechnical properties. Used to inform soil testing methods that provide relevant characteristics for permeability and groundwater flow estimates at the site.
- BSI (2020) BS EN ISO 21365:2020 Conceptual site models for potentially contaminated sites. British standard for conceptual site models. Provides additional guidance on different methods to create a CSM.
- BS 8500:2023 Concrete – Complimentary British Standard to BS EN 206 (BSI, 2023). Includes a methodology for assessing how to specify concrete for different exposure classes, strength classes, and durability requirements in chemically aggressive environments.
- BS 5930:2015+A1:2020 Code of Practice for ground investigations. Informed the ground investigations undertaken for the Scheme.
- BS 10175:2011+A2:2017(BSI, 2017) Investigation of potentially contaminated sites: Code of Practice. Informed the ground investigations undertaken for the Scheme.
- Contaminated Land: Applications in Real Environments (CL:AIRE, 2016) - Control of Asbestos Regulations 2012: Interpretation for Managing and Working with Asbestos in Soil and Construction & Demolition materials: Industry Guidance. Control of Asbestos Regulations 2012: Interpretation for Managing and Working with Asbestos in Soil and Construction & Demolition materials: Industry Guidance (shortened name CAR-SOIL™). Guidance note addressing how to approach the risk of asbestos in soil at brownfield sites such as the Scheme.
- CL:AIRE (2011) The Definition of Waste: Development Industry Code of Practice (DoWCoP) (CL:AIRE, 2011). The approach adopted in the UK to reuse surplus soil in an environmentally safe manner.

- CL:AIRE (2025). Piling and Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. Guidance on piling through contaminated land. Includes approaches to assessing the risk and describes methods to prevent creating additional pathways during ground improvement works, such as the sheet piled walls proposed as part of the Scheme.
- Construction Industry Research and Information Association(CIRIA) C552 (2001) Contaminated Land Risk Assessment – A Guide to Good Practice. Risk assessment with respect to potential contamination is based heavily on Ciria C552.
- CIRIA C741 (2015) Environmental Good Practice on Site Guide (4th edition). Guidance that informed mitigation.
- Defra (2011) Code of practice for the sustainable use of soils on construction sites
- (Defra, 2018). Guidance on preventing degradation of soils during construction.
- EA (2009). Updated technical background to the CLEA model. Technical guidance on the theory behind the Contaminated Land Exposure Assessment (CLEA) model, which is the UK standard method for determining what exposure limits to set for various chemicals depending on receptor. This guidance document provides a framework for developing generic assessment criteria, which was then used to develop a baseline understanding of contamination in the Scheme Area.
- NRW (February 2018) Guidance for Pollution Prevention 5: Works and maintenance in or near water (version 1.2) Guidance that informed mitigation.
- Water Framework Directive – United Kingdom Advisory Group (WFD-UKTAG) (July 2014). UKTAG River & Lake Assessment Method Specific Pollutants (Metals) Metal Bioavailability Assessment Tool (M-BAT). Guidance on understanding fate and bioavailability of certain metals in the environment.

11.5 Consultation

Chapter 2: Project Development contains consultations in more detail, and the broader engagement with stakeholders.

Specific to the land use and soils topic, Ceredigion Council (Pollution Protection team and Petroleum Officer/Trading Standards) have been approached for historical information regarding ground investigation and risk assessment, landfill records, mining activities, pollution incidents or consent exceedances, and tanks within or near the Scheme Area.

Responses have not yet been received to the date of issue of this document.

During the statutory pre-application consultation period, feedback was received from NRW Development Planning Advice Service and this chapter has been updated accordingly. This includes clarity on the development of a groundwater and surface water quality monitoring plan/ strategy. For full details see the Pre-Application Consultation Report.

11.6 Scoped in receptors and potential effects

The only affected receptor explicitly scoped in for assessment is the Teifi Estuary.

It is implied in the Scoping Opinion that the standard identification of receptors as outlined in LCRM (EA, 2023) should be undertaken; therefore, additional receptors have also been considered.

The full list of receptors considered in this assessment are as follows:

- Human health;
- Controlled surface water (Teifi Estuary);
- Controlled groundwater (Secondary undifferentiated bedrock and superficial aquifers); and
- Onsite buildings and structures, and construction materials.

The potential effect identified at scoping is mobilisation of contaminants from sediments into the Teifi Estuary.

The Scoping Opinion implied that other effects should be considered; the full list of effects considered in this assessment are the viable pollution linkages identified in the conceptual site model. These are:

- Migration of contamination to on-site receptors from off-site sources.
- Creation of new pathways between on-site sources (including but not limited to river sediments disturbed by the piling works) and on and off-site receptors (including but not limited to the Teifi Estuary).

Scoped out are all effects related to the operational phase of the project.

The assessment of impacts on other soil functions have also been scoped out; meaning that, unless they could be harmed by contamination, we are not considering effects related to:

- agricultural impacts,
- mineral resource impacts,
- contribution to archaeological preservation, and
- biological soil functions (such as supporting the carbon and nitrogen cycles, as a component of the hydrological cycle, and supporting ecological habitats).

11.7 Methodology

The purpose of this section is to describe how likely significant effects relating to Land Use and Soil have been assessed. A more general explanation of assessment methodology used throughout the EIA is provided in Chapter 4: EIA Methodology.

The overall approach has been to gather baseline information about the Scheme Area and its surroundings, then assess that with respect to the potential for significant possibility of significant harm using the standard approach outlined in LCRM.

In the UK a risk-based approach is taken to assess the significance of contamination present within a study area. In a regulatory sense, for land to be deemed as contaminated land under Part 2A of the Environmental Protection Act 1990, or for there to be a significant 'risk' of contamination, there must be clearly identifiable pollutant linkages. Land contamination and risk management guidance documentation (e.g. Statutory Guidance to Contaminated Land (Defra, 2012) and Land Contamination Risk Management (LCRM), EA 2023) sets out the process for risk assessment as previously noted. The following contaminant linkage definitions apply for assessments:

- Contaminant source: contamination that has the potential to cause unacceptable negative effects to a receptor. It may comprise chemical, biological, or physical agents.
- Pathway: a route whereby a contaminant may come into contact with the receptor. Examples include human ingestion of contaminated soil and leaching of contaminants from soil and migrating into water resources.
- Receptor: a target that may be affected by contamination. Examples include human occupants or users of the Scheme, surface or groundwater bodies, or structures.

These definitions informed a Conceptual Site Model (CSM) which assesses the likelihood of pre-existing contamination being encountered during the construction phase such that it could cause significant negative effects on identified receptors.

We have assessed the effects that could arise due to the disturbance of land affected by pre-existing contamination. We have also evaluated the potential for contamination to infiltrate into groundwater should a pathway already exist or if there is a possibility of one or more new pathways being created (e.g. through excavation or pre-augering and piling through Made Ground or riverbed sediments).

Based on this assessment, we have established the likelihood of any significant effects from contamination upon identified receptors in the future and identified the necessary control measures.

11.7.1 Definition of Study Area

The Study Area for Chapter 11: Land Use and Soils, is the Scheme Area plus a 500m radius buffer, as indicated on Figures 11.1 and 11.2.

11.7.2 Baseline information

Baseline information regarding contamination was gathered following the methodology set out in LCRM Stage 1 Tier 1 (Contamination Preliminary Risk Assessment) and Tier 2 (Generic Quantitative Risk Assessment (GQRA) following intrusive site investigations). This includes the following:

- Groundsure Enviro+Geo Insight report (reference GS-SQR-C8M-SGX-TC2, Groundsure, 2024);
- Topographical Maps (Ordnance Survey, obtained via Groundsure, 2024);
- BGS GeoIndex (BGS, 2025);

- England and Wales Geological Map 1:50,000 scale Sheet 193 Cardigan and Dinas Island Solid and Drift Geology (BGS, 2003) (BGS, 2024);
- DataMap Wales (2025);
- Aerial and Street View Photography (Google Earth, 2024; Google, 2024);
- Unexploded Ordnance (UXO) (Zetica, 2024); and
- Flood Records (NRW, 2024).

Existing information has also been collated from reports produced by Binnies and others; the contents of which are assumed to be an accurate representation of the prevailing conditions at the Scheme. The following reports have been provided and reviewed to inform this ES:

- Ground Investigation Report by WYG Environment Planning Transport Ltd for Natural Resources Wales (WYG, 2015).
- Ground Investigation Report by CJ Associates on behalf of Binnies UK Ltd for Natural Resources Wales (CJ Associates, 2022).
- NRW NGF Cardigan Tidal Flood Risk Management Scheme (FRMS) Ground Investigation Report and Seepage Assessment by Binnies UK Ltd for Natural Resources Wales (Binnies, 2022).
- Cardigan Contamination Preliminary Risk Assessment by Binnies UK Ltd for Natural Resources Wales (Binnies, 2026).
- Cardigan Land Contamination Risk Assessment Report by Binnies UK Ltd for Natural Resources Wales (Binnies, 2026).
- Cardigan TFRMS Sediment Survey - Technical Note (Binnies, 2026).
- Cardigan TFRMS Water Framework Directive Assessment by Binnies UK Ltd for Natural Resources Wales (Binnies, 2025).

11.7.3 Significance

Our evaluation of significance and analysis of consequences is based on established EIA assessment approaches and expert professional judgement. We have relied on industry approved standards, guidelines, and current legislation to support the assessment. The potential exists for a variety of likely significant effects on soil and land to arise from the construction of the Scheme. We have assessed these effects according to relevant guidance as discussed in section 11.3.

11.7.4 Sensitivity

The criteria used to assess receptor sensitivity is provided in Table 11-1.

Table 11-1 Receptor sensitivity criteria

Sensitivity	Criteria
Very High	All direct exposure pathways on human health receptors. Land supporting internationally designated ecological site, e.g. Ramsar, Special Area of Conservation (SAC). Inner groundwater source protection zones (SPZ1), public reservoir, or potable water supply for public consumption and the geology supporting these.
High	Indirect exposure pathways in residential areas, schools, recreational areas, allotments. Nationally designated ecological sites e.g. Sites of Special Scientific Interest (SSSI) and the land supporting these. Principal aquifer, surface waters of high quality (using Water Framework Directive definition) and the geological units supporting these. Areas with geodiversity designation, e.g. Regionally Important Geological and Geomorphological Sites (RIGS).
Moderate	Indirect exposure pathways to places of work and public open space e.g. retail/shopping parks. Locally designated ecological sites e.g. Local Nature Reserve and the land that supports these. Outer and total catchment groundwater source protection zones (SPZ2 and SPZ3), or Secondary aquifer and the geological units that support these.
Low	Indirect exposure pathways to commercial/industrial developments. Areas mainly covered by hard surfacing. Building fabric. No sites of significant ecological value. Unproductive aquifer.
Negligible	As for low sensitivity, but with no clear connection between sources of impact and soil function. Broken SPR linkage.

11.7.5 Magnitude of change

To determine the magnitude of change, the nature of the change (positive or negative) and characteristics (i.e. whether direct or indirect, secondary, cumulative, short or long-term, permanent or temporary, reversible or irreversible) were assessed and classified as high, moderate, low, very low, or negligible. The magnitude of change is its severity or scale. The magnitude of a change on a receptor reflects consideration of information and analysis relating to the spatial extent (localised/isolated versus widespread with potential secondary effects); the extent (type and quantity of receptor affected); and the duration (short, medium or long-term). Short term duration is considered during the construction and maintenance period up to

nominally two years, medium term is considered less than ten years, and long-term or permanent changes are considered for any change lasting ten years or more.

Table 11-2 defines these criteria with relation to potential for land contamination.

Table 11-2 Criteria for the magnitude of change

Magnitude	Criteria
High	Exceedance of statutory guidance or legislation. A high probability of creating a source-pathway-receptor (SPR) linkage such that the most sensitive receptors within the Scheme would encounter contamination at concentrations capable of causing harm to living organisms, disrupting ecological functions, or negatively affecting property.
Moderate	A moderate probability of creating an SPR linkage such that the most sensitive receptors within the Scheme would encounter contamination at concentrations capable of causing harm to living organisms, disrupting ecological functions, or negatively affecting property.
Low	A low probability of creating an SPR linkage such that the most sensitive receptors within the Scheme would encounter contamination at concentrations capable of causing harm to living organisms, disrupting ecological functions, or negatively affecting property.
Very Low	A very low probability of creating an SPR linkage such that the most sensitive receptors within the Scheme would encounter contamination at concentrations capable of causing harm to living organisms, disrupting ecological functions, or negatively affecting property.
No Change	No SPR linkage identified. Negligible likelihood of creating SPR linkage such that the most sensitive receptors within the Scheme would encounter contamination at concentrations capable of causing harm to living organisms, disrupting ecological functions, or negatively affecting property.

The assessment of environmental effects has used the criteria as shown in the matrix in Table 11-3. After establishing the sensitivity of the receptor using criteria within Table 11-1 and assessing the magnitude of change using the criteria within Table 11-2, the effect to the receptor has been determined as either significant (major or moderate effects) or not significant (minor or negligible effects).

Table 11-3 Significance of effect matrix

	Very high sensitivity	High sensitivity	Moderate sensitivity	Low sensitivity	Negligible sensitivity
High magnitude	Major (significant)	Major (significant)	Major (significant)	Moderate (significant)	Minor
Moderate magnitude	Major (significant)	Major (significant)	Moderate (significant)	Minor	Negligible
Low magnitude	Moderate (significant)	Moderate (significant)	Minor	Negligible	Negligible
Very low magnitude	Minor	Minor	Negligible	Negligible	Negligible
No change	None	None	None	None	None

11.8 Baseline environment and likely future evolution

The section below describes the baseline environment and its likely future evolution. The current baseline environment scenario refers to the current state of environmental characteristics within the Scheme Area. This section is a summary of the LCRM Stage 1 Tier 1 (Contamination Preliminary Risk Assessment) and Tier 2 Contamination Risk Assessment, which are included as Appendix 11.1 and 11.2, respectively. This also includes information from the Technical Note on contamination in the sediments (Appendix 11.3).

11.8.1 Description of existing baseline environment

Geology

Made Ground is mapped throughout the Scheme and extends along the riverbank to the west and east of the site, as well as further north into Cardigan Town. Given the distribution of Made Ground along the banks of the River Teifi (Afon Teifi) it is anticipated that the site is situated on reclaimed land.

Superficial deposits (Figure 11.1) underlying the Made Ground comprise Tidal River or Creek Deposits with Till at depth. The northern half of the Northern Compound is indicated to be entirely underlain by Till.

Bedrock (Figure 11.2) is comprised of Mudstone belonging to the Nantmel Mudstone Formation.

Recent intrusive ground investigations confirmed ground conditions expected from publicly available records (BGS mapping and borehole records).

No geologically designated area is located within 1km of the Study Area.

Risks associated with ground stability are classified as negligible to low. Two landslips (defined as mass movement deposits, primarily superficial deposits that have moved down slope under gravity) are recorded within the Study Area. The first was located approximately 130m to the southwest of the Scheme and the second approximately 260m to the northeast of the Scheme; however, the topography is such that unstable ground at the Scheme is not considered likely.

Faults are noted in the vicinity of the Scheme (the Ogof Cadno fault approximately 250m to the north of Northern Compound and the Newport Sands fault approximately 200m to the south of the Southern Compound). As these are at a distance from the Scheme they are not likely to pose a risk and there have not been considered further.

Hydrology and hydrogeology

The nearest surface water body is the Teifi Estuary, located within the Scheme near the southern border. This has a WFD rating of Moderate overall and is classed as a SAC and SSSI.

The superficial aquifer at the Scheme is classified as Secondary Undifferentiated. Two 'Secondary A' superficial aquifers are located within 200m of the Scheme Area, to the northwest and southeast. The bedrock aquifer beneath the Scheme Area is classified as Secondary B. Groundwater quality is rated as 'Poor' overall by the WFD.

Groundwater vulnerability is mapped in the Groundsure report as one kilometre grid squares. The Study Area is located near the intersection of four of these kilometre-squares and as such, it is shown to range from low to high, with high vulnerability in both bedrock and superficial aquifers in the southeast and low vulnerability in the superficial aquifer in the north. Given the site setting and history of land use, it is considered likely that groundwater at the Scheme is of high vulnerability in superficial aquifers and medium vulnerability in bedrock aquifers.

No surface or groundwater abstractions are recorded within 2km of the Scheme and the Scheme is not located within a source protection zone (SPZ).

Depth to groundwater has been recorded as varying from 0.6mOD (low tide) to +2.5mOD (high tide), with the water table encountered in the Made Ground deposits at high tide and the cohesive Alluvium. No clear aquiclude exists in the Alluvial layers.

11.8.2 Historical development

The main Scheme Area was developed by the earliest map editions, primarily into residential use. On-site former industrial land uses include a smithy, known as "The Old Foundry".

The Southern Compound was formerly part of the railway terminus, then redeveloped to be open land associated with an off-site pumping station in the 1960s. There is no evidence of previous development at the Northern Compound location.

Mapping showing the historical land uses at the Scheme is provided in Appendix 11.1.

11.8.3 Other environmental issues

Made Ground

Made Ground is mapped throughout the Scheme Area and it is understood that the Scheme is situated on reclaimed land. The Southern Compound is indicated to be on landscaped ground, presumably associated with the redevelopment of the former railway station. This is confirmed by the ground investigations, which found up to 5.3m thickness of Made Ground comprising a highly variable mix of gravel sized fragments of concrete and brick, and clay with gravel of mudstone and anthropogenic origins (e.g. slate, brick, and/or ceramic fragments).

Landfilling

One historical landfill was recorded within the Study Area, located 475m to the north of the Scheme Area. This was first recorded in 1910 with no record of closure, and accepted inert, industrial, commercial, and household waste. This was observed on the historical maps from 1889 to 1953 (when it was indicated to be embankments).

Potential contaminative land uses

Current industrial activities within the Scheme Area are related to mooring and unloading facilities (slipway) in Area 4 and licenced discharges associated with a pumping station at the eastern end of Area 1.

11.8.4 Environmental setting

Teifi Estuary is classified as a Site of Special Scientific Interest (SSSI). The designation covers the Teifi from headwaters to coast including four Teifi Estuary Woodland and Marshes areas within 2km upstream of the Scheme Area. The Scheme is located within the Afon Teifi / River Teifi SAC defined as areas best representing the range and variety within the European Union of habitats and (non-bird) species. Relevant features of interest leading to this designation include rivers with floating vegetation, brook lamprey, river lamprey, Atlantic salmon, bullhead and otter.

11.8.5 Baseline summary

This information was used to inform a Contamination Preliminary Risk Assessment and form the Conceptual Site Model for the Scheme (included in the Contamination Risk Assessment report in Appendix 11.2).

Sources identified are as follows:

- Extensive Made Ground on-site following land reclamation, assumed to be in hydraulic continuity with the surrounding area.
- Industrial units (bathroom supply shop & old forge crafts, a former smithy) in Area 3.
- Industrial land use in Cardigan Town (including petrol filling stations 90-120m north of the site, hospital and ambulance station with associated tanks 5-160m east of the site, and a landfill 475m north of the site).
- River sediments understood to have been affected historically in the area by industrial land uses alongside and upstream of the Afon Teifi, including a foundry, sawmill, and timber yard on the southern side (left bank) of the river.

Contamination receptor groups are summarised in Table 11-4.

Table 11-4 Summary of receptors at different phases of the Scheme

Receptor	Sensitivity	Baseline	Construction	Post development
Human health (construction workers and future site users)	High to very high	Potentially present	Potentially present	Potentially present
Teifi Estuary (SSSI and SAC)	High	Potentially present	Potentially present	Potentially present

Receptor	Sensitivity	Baseline	Construction	Post development
Bedrock aquifers	Moderate	Potentially present	Potentially present	Potentially present
Superficial aquifers	Moderate	Potentially present	Potentially present	Potentially present

Identified pathways and the construction phase in which they apply are summarised in Table 11-5.

Table 11-5 Pathways and at which phases of the Scheme they are present

Pathway	Baseline	Construction	Post development
Direct contact with construction workers and/or site users, and incidental ingestion and inhalation of particles. Direct contact between aggressive ground and infrastructure.	Potentially present	Potentially present	Potentially present
Migration of contaminants in the soil leachate.	Potentially present	Potentially present	Potentially present
Vertical and lateral migration of contaminated groundwater.	Potentially present	Potentially present	Potentially present
Disturbing and mobilising river sediments during construction.	n/a	Potentially present	n/a
Exposed river sediments (potentially containing contaminants) becoming inundated by rising tide waters during an emergency event (e.g. when works have suspended due to unforeseen circumstances such as machine breakdown, safety incident, or encountering unexpected archaeological material or UXO).	n/a	Potentially present	n/a

11.8.6 Future baseline evolution

The baseline is not expected to change significantly from the current baseline. New potential sources of contamination are considered unlikely to occur which would be the primary mechanism for the baseline to change in the future.

New receptors may be introduced through developments in the vicinity of the Scheme; these are discussed in detail in Chapter 12: Cumulative Effects. Although several new residential developments are proposed, they are up hydraulic gradient from the Scheme and in keeping with other off-site human health receptors. Therefore, the future baseline would be materially the same as the current baseline.

11.9 Assessment of effects

This section describes the outcomes of the assessment, identifying the likely significant effects on Land Use and Soil. Where likely significant effects are reported, additional mitigation is described in section 11.10 with the residual effects described in section 11.11. These likely significant effects (prior to mitigation) are included in Table 11-6.

Minor and negligible effects (which are found to be those related to Made Ground in contact with the superficial aquifer) have not been considered further in this assessment.

Table 11-6 Likely significant effects without implementation of mitigation

Effect No.	Description of effect	Receptor and sensitivity	Magnitude and reasoning	Significance without mitigation
11-01	The proposed works within the intertidal zone (construction platform and probing or pre-excavation for buried obstructions ahead of sheet piling) would disturb riverbed sediments. This leads to the potential for metals or hydrocarbons (encountered in very low concentrations in river sediments) to mobilise and enter the Teifi Estuary.	Teifi Estuary. Very high Sensitivity.	Low. A low proportion of on-site soil samples (a total of 3 out of the 30 samples tested from recent and historical ground investigations) exceeded conservative published Generic Assessment Criteria focused on human health (that for Public Open Space park land); two of these samples recorded slightly elevated PAHs only (with the remaining sample exceedance relating to asbestos). Recent foreshore sediment leachate testing analysis (see Cardigan TFRMS Sediment Sampling Technical Note, Binnies, 2026) indicated only slight exceedances of conservative published transitional (estuaries) and coastal waters Environmental Quality Standards (EQS) for two heavy metals at localised areas within the Scheme Area. However, a site-specific assessment using bio-accessibility assessment tools produced by WFD-UKTAG indicates that the two metal concentrations measured are unlikely to have any negative effects on the Teifi Estuary.	Moderate Negative
11-02	Made Ground is in hydraulic connectivity with the river, and the potential exists for it or industrial activity onsite to have leached contamination into shallow groundwaters. The design of the Scheme would reduce groundwater and leachate flows to Teifi Estuary but the pollution linkage would not necessarily be broken by the Scheme. During construction, there is the potential for Made Ground to have an increased contact with the river in Area 4 (Gloster Row car park) only (where the flood defence would be set back to allow for the establishment of estuarine /	Teifi Estuary. Very high Sensitivity.	To gain an indicative understanding of risk to the marine environment, the analytical results were also compared against results against Water Framework Directive (WFD) standards and Centre for Environment, Fisheries and Aquaculture Science (CEFAS) Action Levels. Whilst there were some exceedances of heavy metals and PAH's above the most stringent CEFAS Action Level 1 (meaning the sediment would not be suitable for disposal to a marine environment), there were no significant water quality risks identified with respect to WFD standards, and so the overall risk that an SPR linkage would be realised from contaminated sediments in the Scheme Area is likely to be low.	Moderate Negative

Effect No.	Description of effect	Receptor and sensitivity	Magnitude and reasoning	Significance without mitigation
	riverine habitats). Contact with groundwater remains unchanged.			
11-03	Should excavations be left open in the intertidal zone (e.g. if works have suspended due to unforeseen circumstances such as machine breakdown, safety incident, or encountering unexpected archaeological material or UXO) the loosened sediments could potentially be inundated at high tide, entering the water with any sorbed contaminants.	Teifi Estuary. Very high sensitivity.	Low As per effect 11-01. Additionally, emergency / unforeseen events are unlikely and very infrequent on a well managed construction site with contingency plans in place, so the likelihood of occurrence is, at most, low.	Moderate Negative
11-04	During construction, site operatives may be in direct contact with Made Ground or with localised contamination associated with industrial activity on site (both current and historical), or with contamination that has migrated on-site from off-site sources. This may then mobilise to human health receptors via inhalation and ingestion of soil/dust, or through direct contact.	Human Health, Very high sensitivity	Low. A low proportion of on-site soil samples (a total of 3 out of the 30 samples tested from recent and historical ground investigations) exceeded conservative published Generic Assessment Criteria focused on human health (that for Public Open Space park land), two of these samples recorded slightly elevated PAHs only (with the remaining sample exceedance relating to asbestos). A low proportion of samples (1 of 30 soil samples from historical and recent investigation) identified an exceedance for asbestos (cement debris, 2.116%); two other detections were below the laboratory detection limit. Suspected asbestos containing material (ACM) was also observed on the foreshore surface at one location in the form of cement sheeting, and in the Made Ground in one borehole at c5m comprising black fibrous material. Further asbestos/ ACM may be encountered during excavations in the Scheme Area but based on ground investigations are likely to be localised, primarily cement bound, and within partially saturated soils, minimising the risk of free fibres becoming airborne.	Moderate Negative

All other pollutant linkages are considered to have an effect in the operational phase of the Scheme only, which has been scoped out.

11.10 Mitigation measures

Mitigation measures to be employed during the Scheme development are as follows:

- The use of an intervention method such as bubble or silt curtains (correctly installed to manufacturer's recommendations) to minimise sediments entering Teifi Estuary (standard practice).
- If trenches are to be excavated in Made Ground to remove obstructions ahead of sheet piling, they should be backfilled with suitable clean fill (i.e. inert material of an appropriate grain size to allow sheet piling to progress unhindered, free from anthropogenic content or chemical constituents in excess of generic screening values) and excavated material removed and recycled/disposed of appropriately off-site.
- Formal monitoring of Made Ground and natural soils, and groundwater for potential contamination. Monitoring should include the use of Rapid Screening Methods using field test kits or portable instruments (e.g. Photo-Ionisation Detector (PID) for volatile organic compounds and X-Ray Fluorescence (XRF) for heavy metals), and formal sampling of soils and groundwater for laboratory testing should indications of contamination be observed or detected.
- Establish baseline groundwater and surface water quality on and around the Scheme Area, and upstream and downstream of the Scheme in the Afon Teifi by controlled water sampling and laboratory testing. This should be conducted several months before construction commences to have a baseline data set to compare with during and post construction data.
- During construction, monitoring surface water quality could include the use of automated river water quality instruments (measuring several parameters at short intervals such as turbidity, dissolved oxygen, and temperature) both upstream and downstream of the works area with trigger limit alerts to determine whether construction activities are negatively impacting the Afon Teifi estuary. If limits are exceeded then works in the river should be suspended until conditions recover. It is anticipated that acceptable limits would be provided in the Flood Risk Activity Permit (FRAP) from the local NRW Fisheries team to understand trigger action limits.
- Any visual or olfactory evidence of contamination encountered during construction works should be further investigated to determine spatial extents and concentrations (it is likely that works would need to be stopped during this investigation into unexpected contamination).
- Standard practices for protecting the water environment should be adhered to (e.g. bunded fuel storage, use of plant nappies, suitable spill kits with trained personnel, silt fencing) in accordance with current good practice guidance including NRW Guidance for Pollution Prevention 5: Works and maintenance in or near water (version 1.2 February 2018), and CIRIA C741: Environmental Good Practice on Site Guide (4th edition, 2015).

- Standard practice to protect existing soil and land quality at the Northern and Southern Compounds (e.g. stripping and stockpiling topsoil for future reinstatement, protecting against spills), should also be undertaken.
- Contingency plan for excavations in the intertidal zone to be covered/protected if they cannot be backfilled within a single low tide event (before the next high tide inundation).
- Risks posed to workers from contamination in the partially saturated soil and water can be mitigated by appropriate PPE (to be used at all times) and good personal hygiene using well maintained site welfare facilities. Where desiccated soils are disturbed during construction such that dust could be created, then mitigation to control dust (e.g. damping down soils) should be in place.
- Given the presence of asbestos, an asbestos in soils construction risk assessment should be undertaken in accordance with relevant guidance (including the Control of Asbestos Regulations 2012) to ensure risks from asbestos exposure are adequately assessed and controlled measures are implemented as necessary during the works, including removal of surface ACM fragments identified along the foreshore prior to construction.
- Appropriate management strategies should be in place to deal with potentially contaminated soils (including asbestos) if they are encountered during construction. These should include measures to ensure the safety of construction workers, to prevent further contamination of the environment, and an appropriate storage, testing and disposal strategy if contaminated soils are to be removed from the Scheme Area.
- A remediation options appraisal and remediation strategy is required for the landscaped areas of the Scheme where site end-users may come into contact with contaminated Made Ground soils. Successful remediation (followed by verification) would eliminate the source-pathway-receptor linkage, thereby reducing the risk to an acceptable level.
- The mattress of rock rolls covered by imported / reused clean soil proposed for bank stability in Area 4 would likely also break any potential contamination pathway between the Made Ground and future site users and maintenance workers.
- The suitability for reuse of site won topsoil would be assessed as part of the remediation strategy once design has finalised. This has the potential to reduce the volume of clean soil imported.

The above should be included in the Pollution Prevention Plan for the construction phase of the Scheme.

11.11 Significance and duration of residual effects

Residual effects are any effects remaining after all proposed mitigation measures have been implemented. In essence, they are effects which cannot be avoided. The effects detailed in section 11.9, Table 11-6, have been reevaluated following the application of the above mitigation measures as presented in Table 11-7. The residual effects are, at most, minor negative effects (i.e. no longer significant). These would have a temporary duration.

Table 11-7 Residual effects with mitigation implemented

Effect No.	Description of effect	Receptor and sensitivity	Residual effect with mitigation implemented and reasoning	Duration of residual effect
11-01	The proposed works within the intertidal zone (construction platform and probing or pre-excavation for buried obstructions ahead of sheet piling) would disturb riverbed sediments. This leads to the potential for metals or hydrocarbons (present in very low concentrations in river sediments) to mobilise and enter the Teifi Estuary.	Teifi Estuary. Very high sensitivity.	Minor neutral. The use of silt or bubble curtains (standard practice to minimise movement of sediments into controlled waters) would also minimise movement of any contaminants contained within the sediments.	Temporary short term-construction period only
11-02	Made Ground is in hydraulic connectivity with the river, and the potential exists for it or industrial activity onsite to have leached contamination into shallow groundwaters. The design of the Scheme would reduce groundwater and leachate flows to Teifi Estuary but the pollution linkage would not necessarily be broken by the Scheme. During construction, there is the potential for Made Ground to have an increased contact with the river in Area 4 (Gloster Row car park) only (where the flood defence would be set back to allow for the establishment of estuarine / riverine habitats). Contact with groundwater remains unchanged.	Teifi Estuary. Very high sensitivity.	None. Very low levels of metals and hydrocarbons have been found in soil samples to date, localised slight PAHs identified typically have very low water solubility indicating they are unlikely to be dissolved into groundwater and become mobile. Leachate test results from sediment samples also showed no exceedances of published and site-specific EQS with bioavailability assessment, indicating no significant risk to controlled waters. Testing groundwater and surface water samples collected prior to construction would confirm whether the potential sources have been realised. Whilst unlikely, if significant concentrations of contamination are present in the groundwater, the pollution linkage would need to be broken through undertaking an options appraisal and developing and implementing a suitable remediation strategy followed by verification. If negligible concentrations of contaminants are present within the groundwater / surface water, then it would be confirmed that there is no pollution linkage and no further action is required.	Not applicable
11-03	Should excavations be left open in the intertidal zone (e.g. if works have suspended due to unforeseen circumstances such as machine breakdown, safety incident, or encountering unexpected archaeological	Teifi Estuary. Very high Sensitivity	Minor negative. Emergency / unforeseen events are unlikely and very infrequent on a well managed construction site. Mitigation in	Temporary short term-

Effect No.	Description of effect	Receptor and sensitivity	Residual effect with mitigation implemented and reasoning	Duration of residual effect
	material or UXO) the loosened sediments could potentially be inundated at high tide, entering the water with any sorbed contaminants.		the form of good practice and having contingency plans for emergencies would reduce magnitude to very low.	construction period only
11-04	During construction, site operatives may be in direct contact with Made Ground or with localised contamination associated with industrial activity on site (both current and historical), or with contamination that has migrated onsite from offsite sources. This may then mobilise to human health receptors via inhalation and ingestion of soil/dust, or through direct contact.	Human Health, Very high sensitivity	Minor negative. Standard PPE, good personal hygiene and welfare facilities, procedures in place to manage dust and localised contamination (e.g. hydrocarbons, asbestos) would reduce exposure to a minimum, mitigating against the risk to construction workers.	Temporary short term-construction period only

11.12 Monitoring

Data gaps in some areas of the Scheme mean that additional soil sampling would be required if the soil is being removed from the Scheme Area. In keeping with standard practice, hazardous waste classification and Waste Acceptance Criteria (WAC) sampling and testing of excavated soil from Area 4 would occur near the start of the works.

A watching brief comprising monitoring of Made Ground, natural soils and groundwater for signs of potential contamination shall be maintained as part of the Pollution Prevention Plan. Monitoring should include the use of appropriate Rapid Screening Methods as well as visual and olfactory observation. Should indications of contamination be observed, formal sampling and chemical analysis of soils and groundwater should be conducted.

Groundwater and surface water quality monitoring would be undertaken to demonstrate that the water environment is not negatively impacted by the Scheme. This would be at appropriate up-gradient and down-gradient locations. Monitoring would commence as part of the pre-start works and be conducted at appropriate intervals throughout the construction phase and following completion. The intervals for water quality monitoring and associated trigger levels will need to be determined as part of a later monitoring plan and agreed with the local planning authority (as part of an anticipated planning condition relating to contamination and controlled waters).

Continuous surface water quality monitoring conducted during the construction phase would provide reassurance that construction activities do not have a negative impact on the Afon Teifi.

11.13 Difficulties and uncertainties

11.13.1 Difficulties

Existing information has been collated from reports produced by others; the contents of which are assumed to be an accurate representation of the prevailing site conditions.

It has been assumed that the sheet piled wall does not cut off groundwater flow to the river and the two would remain in hydraulic connectivity following completion of the Scheme.

Soft landscaping areas would be capped with a minimum thickness of clean imported fill. Alternatively, should site-won material be considered for reuse, a sampling and analysis programme to determine its suitability would be undertaken during the construction phase. Analysis would be to ensure that the soil meets WFD guidance.

11.13.2 Uncertainties

Information on baseline groundwater quality should be obtained prior to the start of the works. Previous investigations did not include groundwater quality information, so while it can be inferred from the low levels encountered in the soils that there is not a significant quantity of contamination in the groundwater, this has yet to be proven and would be proven through groundwater monitoring at the commencement of the Scheme. Sediment sampling in the estuary foreshore adjacent to the Scheme Area at a 100m spacing indicates low levels of contamination.

No sampling regime would guarantee that all contamination present on the site is detected. Not all areas were accessible at time of ground investigation (Bathroom centre showroom yard in Area 2). A watching brief for overt signs of contamination would be maintained during construction.

11.14 Summary of assessment

Four effects related to soil and land contamination have been identified in association with the Scheme. Following implementation of mitigation measures to be employed during construction of the Scheme, none of these are considered to have a significant effect on the relevant receptors.

11.15 References

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