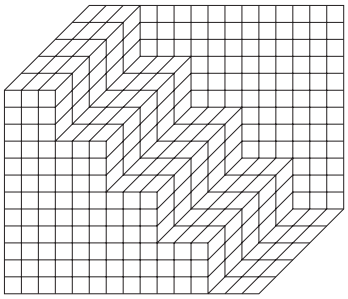

Buro Happold

010017 Watchet East Wharf

Water Resources and Ground Conditions Environmental Statement

February 2007

Revision 01

Buro Happold

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00	Draft ES Report	JRO	16.01.07	DB
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Contents

1 Introduction

Buro Happold has been commissioned by Urban Splash to undertake an assessment of the impact on water resources and ground conditions as a result of proposed land-based works associated with a mixed use development at Watchet Marina, Somerset. This report presents the findings of the water quality, geology and contamination assessment. The report will form part of the Environmental Statement for the proposed development, which is being co-ordinated by D2 Planning.

1.1 Watchet Harbour

1.1.1 Site Description

Watchet is located within the county of Somerset on the southern banks of the Bristol Channel. It has approximate National Grid Reference (NGR) of 307356 E, 143410 N.

The existing site map is shown in Figure 1—1.

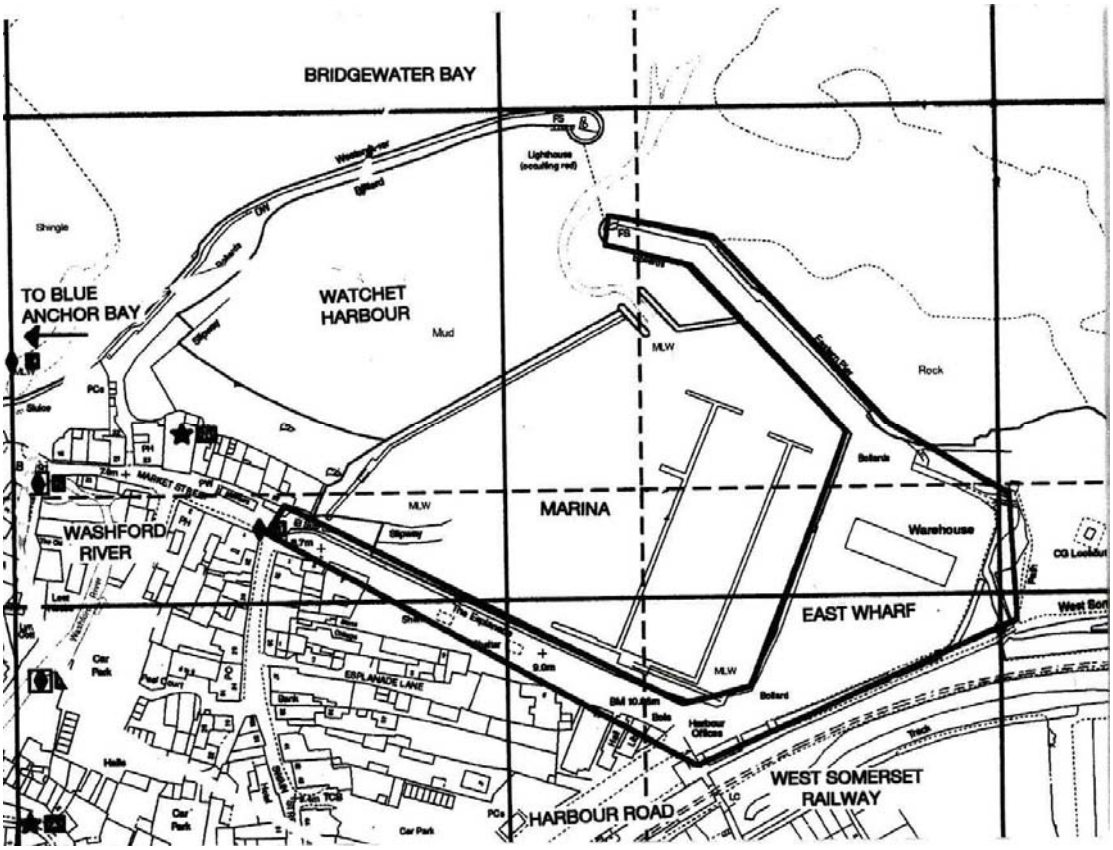

Figure 1—1 Site Map

The proposed East Wharf Development site is located on the eastern bank of Watchet Marina and is approximately 1.4 hectares in size. It is bounded to the north by the waters of the Bristol Channel, to the west by the waters of the Marina, and to the south-east by the West Somerset Railway. An Ordnance Survey (OS) benchmark is located on the wall of the existing library building, which is at the south-west end of the site, and gives an elevation of +10.06m OD. The site is generally level, but the adjacent ground slopes steeply upwards to the east and south-east.

The site is currently covered with hardstanding which is used for boat storage/maintenance and car parking as shown in Figure 1—2 and Figure 1—3. A warehouse is located approximately in the centre of the site and is showing signs of disrepair. Other buildings located within the site include a small sub-station, bunded waste oil disposal point, a library and the Watchet Harbour Office, all located towards the south of the site. The waste oil disposal point and Harbour Office are shown in Figure 1—4 and Figure 1—5. The site is accessed via the well maintained Harbour Road which runs from the south-west and enters the site between the library and Harbour office.

Figure 1—2 Hardstanding and Warehouse

Figure 1—3 Boat Storage Area

Figure 1—4 Waste Oil Disposal Point

Figure 1—5 Harbour Offices

The existing harbour walls are approximately 7.5m above the sea bed. The façade of the harbour walls generally comprises concrete and masonry. A 38m long section of wall has been repaired and faced with steel sheet piles. Anecdotal evidence indicates the wall collapsed during the Great Storm of 1920 (to be confirmed with visit to Watchet Museum).

Watchet Marina is fed via Watchet Harbour located immediately to the west of the Marina, which in turn is fed by the Bristol Channel. A tidal gate is located to the north-west of the Marina. This allows water levels to be maintained within the Marina during low tide. During higher tides the gate is submerged to allow water to pass over the top, as shown in Figure 1—6. Pontoons and berths are available within the Marina for approximately 250 boats. A floating fuelling station is located within the Marina close to the tidal gate.

Figure 1—6 Watchet Marina Tidal Gates

Figure 1—7 Blue Anchor to Lilstock SSSI

Mud flats are exposed within Watchet Harbour and the adjacent Bristol Channel during low tides. The coastline that runs between Blue Anchor Bay and Lilstock (to the west and east of the site respectively) is designated as a Site of Special Scientific Interest (SSSI) with respect to geological conservation. The SSSI, shown in Figure 1—7, is also known to be used by wintering waders and wildfowl.

The site is currently impermeable with no soft landscape areas. The majority of hardstanding surrounding the Marina, including the proposed East Wharf development site, currently drains into the Marina over the harbour walls with no prior treatment. Part of the area to the north of the warehouse drains into gullies, but it is likely that these too drain directly into the Marina. Areas of ponding within the proposed East Wharf development site were visible on the day of the site visit (10 January 2006).

There is a pay and display car park to the south of the site along the eastern verge of Harbour Road. Users of Watchet Marina would park here. Watchet Boat Museum is located at the southern end of the road. Harbour Road and the car parking areas are well maintained and positively drain to gullies. It is likely that the drainage

from this area discharges into the Marina, but it is not known whether flow passes through an interceptor prior to this.

1.1.2 Site History

Ordnance Survey (OS) historical maps covering the period between 1888 and 2005 were obtained as part of the Envirocheck report, dated 23 November 2006. These have been studied to determine historical development of the site and the immediate surrounding area. The main points of site development are summarised below:

- 1888 – Watchet Harbour has been constructed and the centre of Watchet is established. The Harbour comprises the western pier, eastern pier and eastern harbour wall. The West Somerset Railway is present with sidings that form the south-eastern boundary of the site. A crane is also visible along the eastern pier, which is shown as being a travelling crane in 1929-30. Railway tracks are present on the western pier. A breakwater forms the end of the western pier with a lighthouse positioned at the tip.
- 1929 – The wall of the western pier has been extended to replace the breakwater and reflects the current alignment. The tracks on the western pier have been removed. The tip of the eastern pier has also undergone slight changes to reflect the current alignment.
- 1972 – The railway sidings and travelling crane on the eastern pier and eastern harbour wall have been removed. A warehouse is shown in the centre of the site. This is the structure that currently exists on the site.
- 2005 – The Marina wall which forms Watchet Marina and splits the original harbour in two has been constructed. Pontoons and berths are also shown.

Records state that Watchet Marina was constructed in July 2001.

1.1.3 Underground Structures and Utilities

Given the site history, the following underground structures may exist beneath the site; crane bases and rails associated with the railway sidings, tie rods supporting quay walls, voids in walls to reduce quantity of backfill materials and temporary works associated with construction of the quay.

A utility search has been undertaken by Groundwise in November 2006. Records have been provided by utility companies which are known to have apparatus within the vicinity of the site. A summary of this information is provided below:

- Electricity: Western Power Distribution has identified that buried cables are located within the site in the vicinity of the existing warehouse. These cables have been marked as ‘abandoned’ but this must be confirmed prior to any excavation works. Live buried and overhead cables have been identified to the south of the site serving the Harbour Office, library and buildings along to the esplanade to the south of

the Marina. A small sub-station is located to the north of the Harbour Office. Buried cables are also located just outside of the eastern site boundary and serve the Coast Guard lookout.

- Gas: National Grid has identified that a low pressure distribution main runs within the western verge of Harbour Road to the south of the site, and terminates at the Harbour Office.
- Telecom: BT has identified that buried cables run within the western verge of Harbour Road and connect to the Harbour Office. Overhead cables are then shown to run from the Harbour Office along the south-east of the site and appear to connect to the existing warehouse.
- Potable water: Wessex Water has identified that a potable water supply serves the properties located to the south of the site, crosses Harbour Road just south of the Harbour Office, and runs within the esplanade south of the Marina.
- Foul water drainage: Wessex Water has identified a foul water sewer to the south-east of the site, running adjacent to the railway line. From here the sewer crosses Harbour Road just south of the Harbour Office and continues to run within the esplanade south of the Marina. A second foul water sewer serves the properties to the south of the site, crosses Harbour Road slightly further south of the Harbour Office, and connects into the first sewer run described above.
- Surface water drainage: Wessex Water has identified a surface water sewer to the south-east of the site, running adjacent to the railway line, parallel to the foul water sewer described above. The surface water sewer crosses into the site to the north of the Harbour Office and continue across the site to discharge into the south-east corner of the Marina.

The plans provided by the utility providers may not be accurate and are therefore for guidance only. The depth of buried apparatus is unknown.

The exact location of any utilities or buried structures would need to be confirmed via on-site survey before any excavation works could commence.

1.2 Requirement for an EIA

Environmental Impact Assessment is a structured process for identifying the potential environmental impacts of a development. It has formally been part of the UK planning system since 1988, when regulations implementing the provisions of a European Directive on 'The assessment of the effects of certain public and private projects on the environment' (Directive 85/337/EEC) were introduced. This directive was subsequently amended by EC Directive 97/11/EC and Regulations were introduced in March 1999 which implemented the requirements of the amended directive. This EIA has been undertaken in accordance with the requirements of these Regulations, known as the Town and Country Planning (Assessment of Environmental Effects) (England and Wales) Regulations 1999 (SI 1999 No 293)

Planning applications which are judged to have potentially significant environmental effects or those of a certain scale or nature are required to undertake an EIA. The ES is the written statement of this assessment and must be submitted with the planning application if an EIA is required.

The need for EIA is established by two schedules defining different types of development. Schedule 1 lists developments for which EIA is mandatory while Schedule 2 developments only require an EIA if, in the opinion of the determining authority, the project is likely to give rise to' significant effects' on the environment.

The proposed development does not fall into Schedule 1, but it is possible that it may fall within Schedule 2. West Somerset District Council undertook a screening opinion which determined the likelihood of the proposed development in having significant effects on the environment. This considers the characteristics of the development, its location, the likely impact, and whether cumulative impacts or irreversible effects are likely. West Somerset District Council concluded that the East Wharf development could have significant effects on the environment, therefore an EIA is required.

Knowing that the proposed East Wharf development required an EIA, West Somerset District Council issued a scoping opinion. This was completed in April 2001 and was used when assessing the impacts from the previous development proposals, discussed in the Environmental Statement for the Watchet East Wharf Development compiled by Royal Haskoning in December 2001. The same scoping opinion is being considered for this Environmental Statement for the revised proposals. The scope included:

- Flood defences: Impact in tidal risk. Coastal erosion.
- Environmental protection: Surface water – water quality issues.
- Site contamination: Site investigation and impacts on water environment.

These are the issues that will be discussed in detail in this report.

1.3 Methodology

The methodology adopted in this assessment for the water resources and geology and ground condition issues involved the following:

- Review of international, national, regional and local legislation, policy and guidelines.
- Review available background information including the previous Environmental Statement for the Watchet East Wharf Development compiled by Royal Haskoning in December 2001.
- Establish baseline conditions on and around the site through literature review and existing data obtained from the Environment Agency, British Geological Survey, Ordnance Survey, an Envirocheck report, and site walkover.
- Identification of sensitive receptors.

- Identification of risk from the proposed development and hence the likely impacts, magnitude of change and significance of impact during both the construction and operational phases.
- Develop mitigation strategies through consultation with the design team and Client.
- Identification of residual effects.

The methodology for impact prediction and mitigation is based on assessing both the magnitude of the changes expected and the sensitivity of the receptors. Table 1—1 and Table 1—2 detail how these factors are assessed.

Magnitude of Change	Criteria
Large	Water Resources: Wholesale changes to watercourse channel, route or hydrology. Changes to site resulting in an increase in runoff with flood potential, and also significant changes to soil erosion/sedimentation patterns. Major changes to the water chemistry of surface runoff and groundwater. Geology and Ground Conditions: Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Catastrophic damage to buildings/property and services. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem (as defined in Circular 01/2006 on Contaminated Land, DEFRA, 2006).
Medium	Water Resources: Some fundamental changes to the course and hydrology. Changes to site resulting in an increase in runoff within system capacity. Moderate changes to soil erosion/sedimentation patterns. Moderate changes to the water chemistry of surface runoff and groundwater. Geology and Ground Conditions: Chronic damage to human health ("significant harm" as defined in Circular 01/2006 on Contaminated Land, DEFRA, 2006). Significant damage to buildings/property and services. A significant change in a particular ecosystem, or organism forming part of such ecosystem (Circular 01/2006 on Contaminated Land, DEFRA, 2006).
Small	Water Resources: Minor changes to the water courses. Changes to site resulting in slight increase in run off well within the drainage system capacity. Minor changes to soil erosion/sedimentation patterns. Minor changes to the water chemistry of surface runoff and groundwater Geology and Ground Conditions: Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent effects to human health (easily preventable by means such as personal protective clothing etc). Easily reparable effects of damage to buildings, structures and services.
Negligible	Water Resources: No change to watercourses, run off and soil erosion and sedimentation patterns and water chemistry. Geology and Ground Conditions: No harm or damage to human health, structures or services.

Table 1—1 Magnitude of Change

Receptor Sensitivity	Receptors
High	Water Resources: Water body of very good chemical or biological quality. Includes: designated bathing waters, shellfish and salmonid fisheries. A source used for public water supply. SSSI, SPA/SAC, Ramsar site or highly sensitive aquatic ecosystem. Geology and Ground Conditions: Human health. Nearby structures. Groundwater flow
Moderate	Water Resources: Water body of high amenity value including areas of bathing and where water immersion sports are regularly practised. Water body of 'good or fairly good' chemical and biological quality and/or non-public water supply or cyprinid fishery. Water body of nature conservation importance at the regional level or a moderately sensitive aquatic ecosystem e.g. SNCI. Geology and Ground Conditions: None
Low	Water Resources: Water body of 'fair' chemical or biological quality. A source in close proximity to a source protection zone or abstraction point. Water body of moderate amenity value, including public parks, boating or where a popular footpath passes adjacent to the watercourse, or where the receiving water course passes through a housing development or town centre. Also non-contact water sports. Water body of particular local social/cultural/educational interest. Water body of low amenity value with only casual access, e.g. along a road. Geology and Ground Conditions: None
Negligible	Water Resources: Low sensitivity aquatic ecosystem. Water of 'poor' or 'bad' chemical or biological quality. Water body of no amenity value, seldom used for amenity purposes, in a remote or inaccessible area. Geology and Ground Conditions: None

Table 1—2 Receptor Sensitivity

The significance of a potential impact is derived by considering both the sensitivity of the feature and the magnitude of change. The method is shown in Table 1—3.

Receptor Sensitivity	**Magnitude of Change**			
	Large	Medium	Small	Negligible
High	Severe	Major	Moderate	Minor
Moderate	Major	Moderate	Minor	Minor
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Minor	Negligible	Negligible

Table 1—3 Impact Significance

Impacts to potential receptors are not always adverse and can be beneficial. For example; surface water flows off the site may be reduced by implementing a revised drainage scheme; contamination hot spots may be treated or removed.

2 Proposed East Wharf Development

The area proposed for the East Wharf development is located on the eastern harbour wall of Watchet Marina. The development is to be mixed use comprising residential, retail, leisure/tourism and commercial. The existing warehouse and harbour office will be demolished. An illustration of the proposed development is provided in Figure 2—1.

The boat shaped building to the far north of the site will contain a café, reception, meeting room and boat museum on the ground floor, and four storeys of residential accommodation above.

The buildings on the edge of the water front facing the Marina will have retail and commercial areas on the ground floor, along with the Marina reception and other Marina facilities, and two stories of residential accommodation above.

The buildings to the east of the development, behind those facing the Marina, will be progressively higher than those in front and be visible from the Marina. The ground floor of these blocks will comprise car parking and retail space. Above this will be two and three stories of residential accommodation, at the centre and most eastern edge of the development respectively.

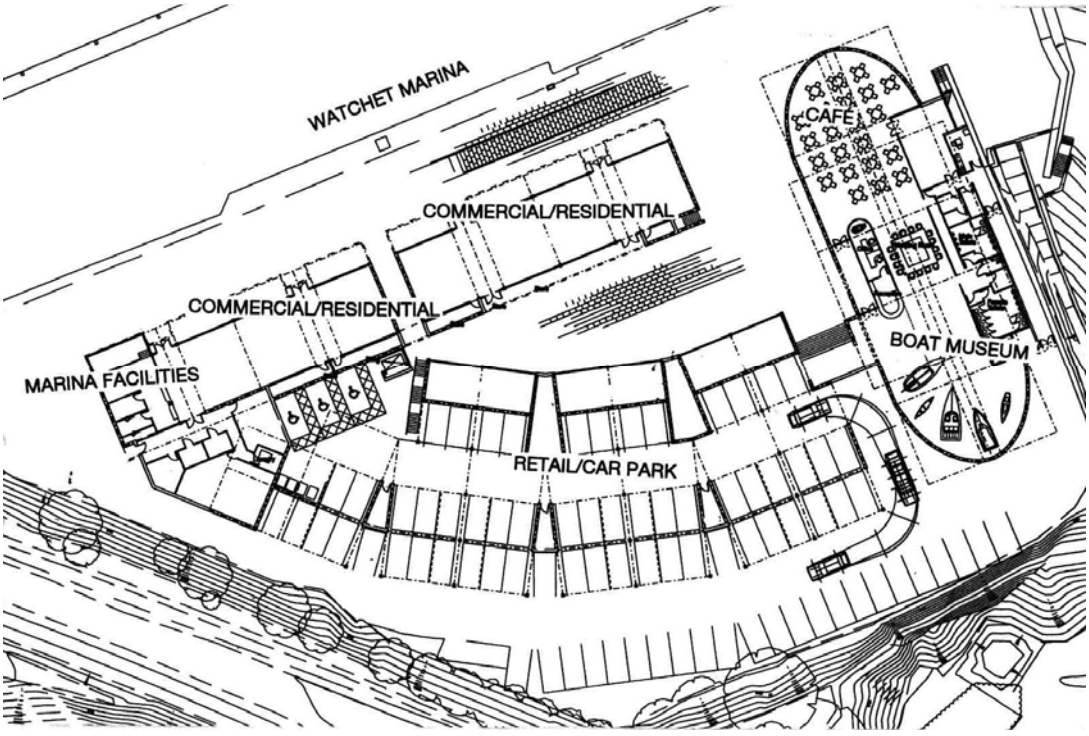

Figure 2—1 Proposed East Wharf Development

The car park below the residential blocks will accommodate approximately 60 cars and will be accessed from the eastern side of the development. Additional parking will be provided outside of the building footprint to the east, adjacent to the steep slopes that form the site boundary.

The land surrounding the proposed buildings, including that directly adjacent to the Marina, will be predominantly hard paved. The proposed development will be accessed by vehicles and pedestrians via Harbour Road to the south-east of the site, and also by pedestrians along the esplanade.

The car park, access roads and other hard paved areas will be drained by gullies into a piped gravity system. All water collected from these areas will pass through an oil separator before discharging into the Marina. Gullies will also have silt traps to remove silts and grits before discharge.

A green roof system is proposed for this development. Greens roofs can reduce the amount of rainwater run off by absorbing water into the substrate and drainage layers for plant use. Once these layers are saturated and have reached capacity, water will be collected by the conventional method of a piped gravity system and discharged into the Marina. No prior treatment to roof water will be required.

The boat storage area currently located on the proposed East Wharf development site will be relocated to the south of the development to the existing car parking area on the eastern verge of Harbour Road (Figure 2—2). The existing Watchet Boat Museum, which is being relocated to the new boat shaped building at the north of the development, will provide the location for a new boat workshop. During the summer months there will be car parking provision for approximately 48 cars. During the winter months more of the car park will be allocated for boat storage, leaving approximately 35 spaces for car parking. Drainage for this area may have to be updated to ensure that all surface water run off passes through an oil separator prior to discharge. It is likely that an area adjacent to the boat workshop will be designated for high risk boat maintenance activities such as engine changes or anti-fouling. Drainage from this area will discharge to a foul water network to prevent harmful chemicals entering the surface water network.

The proposed drainage strategy for the site is provided as a Technical Appendix.

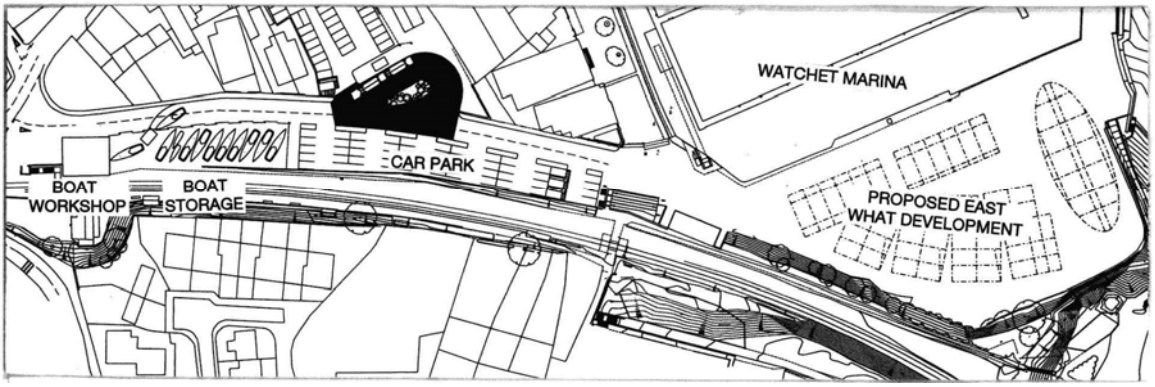

Figure 2—2 Car Park and Boat Storage Area

3 Legislation, Policies, Guidelines and Consents

3.1 Water Resources

The management of water resources is governed by a range of legislative guidance set out in international, national and regional policies and plans. This assessment has been prepared taking these plans and policies into account. As Watchet Marina is located within 200m of Washford River which discharges into the Bristol Channel adjacent to Watchet Harbour, consideration is given to legislation covering both fluvial and estuarine environments.

3.1.1 Administrative Arrangements

Coordination of policy for inland waterways, coastal and marine environments is managed by the Department of Environment, Food and Rural Affairs (DEFRA). Many quality standards are set at European level, which are then transposed into UK law. Enforcement of water quality standards in England is managed by the Environment Agency.

3.1.2 International

Making Space for Water – Developing a new government strategy for flood and coastal erosion risk management in England (consultation document (DEFRA July 2004) and the Government's first response to the consultation exercise (DEFRA March 2005))

Over the 20 year life time of the strategy the government aims to implement a more holistic approach to managing flood and coastal erosion risk in England. The main aims of the strategy are to reduce the threat to people and their property, and to deliver the greatest environmental, social and economic benefit consistent with the government's sustainable development principles.

European Commission Water Framework Directive (2000/60/EC)

The overall objective of the Water Framework Directive (WFD) is to bring about the effective co-ordination of water environment policy and regulation across Europe. The main aims of the legislation is to ensure all surface water and groundwater reaches 'good' status (in terms of ecological and chemical quality and water quantity as appropriate), promote sustainable water use, reduce pollution and contribute to the mitigation of flood and droughts. The WFD also contains provisions for controlling discharges of dangerous substances to water and includes a 'List of Priority Substances' (see EC Dangerous Substances Directive below). The WFD is implemented in England by the Environment Agency.

European Commission Bathing Water Directive (2006/7/EC)

The EC Bathing Water Directive sets water quality standards for designated bathing areas to protect the health of bathers and to maintain and improve overall water quality. Information on compliance with the Directive is used to determine which bathing areas pose a risk to human and environmental health, and to set priorities for water quality improvements. The directive requires regular monitoring of microbiological indicators of faecal contamination and classifies bathing waters based on a three-year trend established via monitoring. Bathing waters are classified into four categories; poor, sufficient, good and excellent. The Bathing Water Directive is implemented in England by the Environment Agency. Water quality is monitored at Blue Anchor Bay located approximately 4 miles to the west of Watchet. An assessment of the potential impacts of the proposed development at Watchet Marina on bathing water quality is provided in **Section XX.**

European Commission Dangerous Substances Directive (76/464/EEC)

This directive controls the release of dangerous substances to water. Various substances are listed in the Annex to the Directive as either List I or List II substances, with List I substances considered the most harmful to human health and the aquatic environment. The purpose of the directive is to eliminate pollution from List I substances and reduce pollution from List II substances. The directive will be integrated into the EC Water Framework Directive with List I substances replaced by a 'List of Priority Substances' included in the WFD. The rest of the Dangerous Substances Directive will remain in place until 2013 (transition period).

3.1.3 National

Planning Policy Statement 25: Development and Flood Risk (PPS 25)

Planning Policy Statement 25 (PPS 25) was published in December 2006 superseding PPG 25. The document identifies how new developments must take good account of climate change impacts. Using the sequential test to identify preferred locations, those not exposed to risk of flooding, as the principal step. Then, if development is necessary in a flood zone, depending on the severity, an exception test can be conducted through an appraisal of risk, and implementation of appropriate reduction and management measures.

PPS 25 incorporates potential climate change impacts, and the current scientific ambiguity, by incorporating a 'high emissions' extrapolation for sea level rise. Guidelines are also detailed to take account of increased storminess through increased rainfall, river flow, wind speed and wave heights.

Wildlife and Countryside Act 1981

In England SSSIs are notified by Natural England under the Wildlife and Countryside Act 1981 (amended 1985) to protect those sites which represent the country's best wildlife and geological sites. Natural England has powers to protect SSSIs from damage and to ensure they are managed appropriately. The Countryside and Rights of Way Act 2000 gives increased power to Natural England to prevent damage that is being made

through neglect or inappropriate management. In addition, there is a statutory duty on Local Authorities and other public institutions to further the conservation and enhancement of SSSIs whilst carrying out their operations and exercising their decision making functions (this includes making planning decisions).

Environment Agency General Quality Assessments

The Environment Agency (EA) conducts General Quality Assessments of river and estuary quality annually against four key aspects including biology, chemistry, nutrients and aesthetic quality. Based on the General Quality Assessment, rivers and estuaries are classified into the categories Good, Fair, Poor or Bad.

Rivers

Environmental quality standards (EQSs) have been established for some rivers setting concentrations of specified substances for the relevant waters. EQSs can be statutory or informal. For example, the Dangerous Substances Directive establishes statutory EQSs for listed substances. Informal EQSs have been set by the EA in the form of River Quality Objectives (RQOs).

The EA set RQOs for each stretch of river on the basis of a system known as the 'River Ecosystem (RE) Classification'. The purpose of the RQOs is to help protect and improve the quality of water in rivers in England and Wales. The objectives will generally be expressed in terms of quality grades which reflect the general health of the waters. They are used to plan the maintenance and improvement of river quality and provide a basis for the EA in setting discharge consent standards.

Estuaries

The EA reports on estuarine water quality every 5 years. The EA conducts an assessment of estuarine water quality in terms biological, chemical and aesthetic quality. Estuaries are then classified into categories Good, Fair, Poor or Bad. The estuary classification scheme is due to be improved in the near future with estuary quality reported to meet the requirements of the EC Water Framework Directive. This will classify the ecological status of estuaries using information on water quality, hydrology, plants, fish populations and benthic fauna.

Pollution Prevention Guidelines (PPGs)

Pollution Prevention Guidelines (PPGs) have been issued by the EA and a number of these guidelines are relevant to design and construction of the East Wharf development. In particular, PPG 1 provides practical advice on site drainage, and PPG 6 provides guidance on control of water pollution during construction and demolition stages of works. Compliance with these PPGs will need to be considered as part of the environmental management documentation developed for demolition, construction and operational phases of the development.

Water Resources Act 1991 (WRA 1991)

The Water Resources Act 1991 consolidated previous water legislation in respect of both the quality and quantity of water resources.

Under Section 85 of the WRA 1991 it is an offence to cause or knowingly permit polluting matter to enter into "controlled waters", that is rivers, estuaries, coastal waters or groundwaters, without permission. Permission is generally obtained as a discharge consent granted by the EA. The Agency sets conditions which may control volumes and concentrations of particular substances or impose broader controls on the nature of the effluent. Each consent is based on the objective (RQO) set by the Agency for the quality of the stretch of water to which the discharge is made as well as any relevant standards from EC Directives. The EA may also refuse an application for a discharge consent.

3.1.4 Regional

Regional Planning Guidance for the South West of England (RPG 10)

This regional planning guidance for the South West of England is provided by the Secretary of State for Transport, Local Government and the Regions. It aims to provide a regional spatial strategy within which local authority development plans in the South West should be prepared for the period 2016 and beyond. All parts of this guidance must be taken into account by local planning authorities in preparing their development plans and may be material to decisions on individual planning applications and appeals. Policies in relation to water resources and flooding are set out in Section 9 'Infrastructure and Natural Resources'.

Policy RE 1 of RPG 10 discusses water resources and water quality. The policy encourages local authorities and developers to protect and enhance river and coastal water quality, protect groundwater resources, take water related issues into account at an early stage and co-ordinate the timing of new development with the provision of sustainable water supplies, sewage treatment and discharge systems. It also promotes the adoption of Sustainable Urban Drainage Systems (SUDS).

Policy RE2 of RPG 10 encourages local authorities and developers to direct development away from land liable to flooding, and promote the use of Sustainable Urban Drainage Systems (SUDS). For development in flood plains the policy advises that development plans need to minimise the cumulative adverse impacts and secure enhancement of the floodwater storage and ecological role of flood plains.

3.1.5 Local

The Somerset and Exmoor National Park Joint Structure Plan

The Joint Structure Plan provides the strategic base for all land use planning in the combined area covered by Somerset and the Exmoor National Park for the period up to 2011. Management of water resources is discussed in Section 7 'Transport and Infrastructure' of the Joint Structure Plan.

Policy 59 'Safeguarding Water Resources' states that protection will be afforded to all surface, underground and marine water resources from development which could harm their quality or quantity. Reference is made to the Environment Agency, who have produced a document 'Policy and Practice for the Protection of Groundwater', for advice in respect of development and groundwater.

Policy 60 'Floodplain Protection' states that areas vulnerable to flooding should continue to be protected from development which would cause a net loss of flood storage area or interrupt the free flow of water or adversely affect their environmental or ecological value. In allocating land for development in local plans, consideration must be given to measures to mitigate the impact on the existing land drainage regime to avoid exacerbating flooding problems.

3.2 Geology and Ground Conditions

3.2.1 National

Planning Policy Statement 23: Planning and Pollution Control (PPS23)

Planning Policy Statement 23 (PPS23), issued by HM Government (2004) recognises in paragraph 16, that the redevelopment of previously developed sites is central to the Government's objective of sustainable development, as such action minimises the need to develop greenfield land; and in paragraph 26 that:

"Opportunities should be taken wherever possible to use the development process to assist and encourage the remediation of land already affected by contamination".

The guidance recognises that:

"Contamination of land may threaten public health and safety, the natural environment, the built environment and economic activities, through the impacts on users of the land, and on neighbouring users. Land contamination, or the possibility of it, is therefore a material planning consideration in the preparation of development plan documents and in taking decisions on individual planning applications. It remains the responsibility of the landowner/developer to identify land affected by contamination and ensure that remediation is undertaken to secure a safe development".

PPS23, in paragraph 8, states:

"Any consideration of the quality of land, air or water and potential impacts arising from development, possibly leading to an impact on health, is capable of being a material planning consideration, in so far as it arises or may arise from land use".

3.2.2 Regional

Regional Planning Guidance for the South West of England (RPG 10)

The principles of this regional guidance are discussed in **Section 3.1.4**. Policies in relation to minerals, waste management, and transportation are set out in Section 9 'Infrastructure and Natural Resources'.

Policy RE 4 of RPG 10 deals with issues related to the use and supply of aggregates. Local authorities and developers are encouraged to maximise the use of secondary and recycles aggregates, thereby reducing the reliance on primary aggregate sources.

Policy RE 1 of RPG 10 discusses the management and transportation of waste. The policy encourages local authorities and developers to minimise reliance on landfill disposal, and to have waste products handled as close to source as possible.

3.2.3 Local

The Somerset and Exmoor National Park Joint Structure Plan

The Joint Structure Plan provides the strategic base for all land use planning in the combined area covered by Somerset and the Exmoor National Park for the period up to 2011. Management of waste is discussed in Section 7 'Transport and Infrastructure' of the Joint Structure Plan.

Policy 68 'Use of inert waste arising from development' states that the potential and practicality of using inert wastes generated by development should be examined in order to reduce the demand on primary aggregate sources, volume of traffic, and demands for landfill facilities.

3.2.4 Other Policy & Guidance

Statutory guidance issued by the Department for the Environment, Transport and the Regions (circular 02/2000) under the Environmental Protection Act 1990 reinforces the earlier government principle of adopting the 'suitable for use' criteria for remediation of contaminated land and describes risk assessment methodology to be adopted in determining whether land is classed as contaminated.

The risk assessment methodology describes the identification of 'source', 'pathway' and 'target' and the identification of significant pollution linkage. The EPA requires that for land to be classified as contaminated, there exists a pollution linkage (that is all three elements described above exist) such that:

- Significant harm is being caused; or
- There is a significant risk of significant harm being caused; or
- Pollution of controlled waters is being, or is likely to be caused.

Under Section 85 of the Water Resources Act (WRA) 1991, it is an offence to cause or knowingly permit any poisonous, noxious or polluting matter to enter into controlled waters, which include groundwater and surface waters.

Under Section 161 of the WRA 1991, the Environment Agency has the power to serve a works order on a person where it appears that poisonous, noxious or polluting matter is likely to enter, or to be present in any controlled water. The works order will specify the actions to be taken to mitigate the risk and timescale for the works to be carried out.

Additional guidance regarding the management, investigation and reporting of contaminated land includes the flowing:

- CLR11 – Model Procedures for the Management of Land Contamination, *Environment Agency*, September 2004;
- BS10175 – Investigation of Potentially Contaminated Sites, Code of Practice, *British Standards Institute*, January 2001;
- BS 5930 – Code of Practice for site investigation. British Standards Institute. 1999;
- Guidance on Requirements for Land Contamination Reports, *Environment Agency,* July 2005.

4 Baseline Environmental Conditions

This section provides a description of the current baseline environmental conditions with respect to water environment and ground conditions. The area covered within the report includes the land within the site boundary, and any surrounding land which may impact the development or be susceptible to impact as a result of development.

4.1 Water Resources

There are a number of water features in close proximity to the site:

- Bristol Channel and Bridgewater Bay immediately to the north,
- Watchet Harbour and Marina immediately to the west,
- Washford River approximately 250m to the west,
- Blue Anchor Bay approximately 4 miles to the west, and
- Groundwater

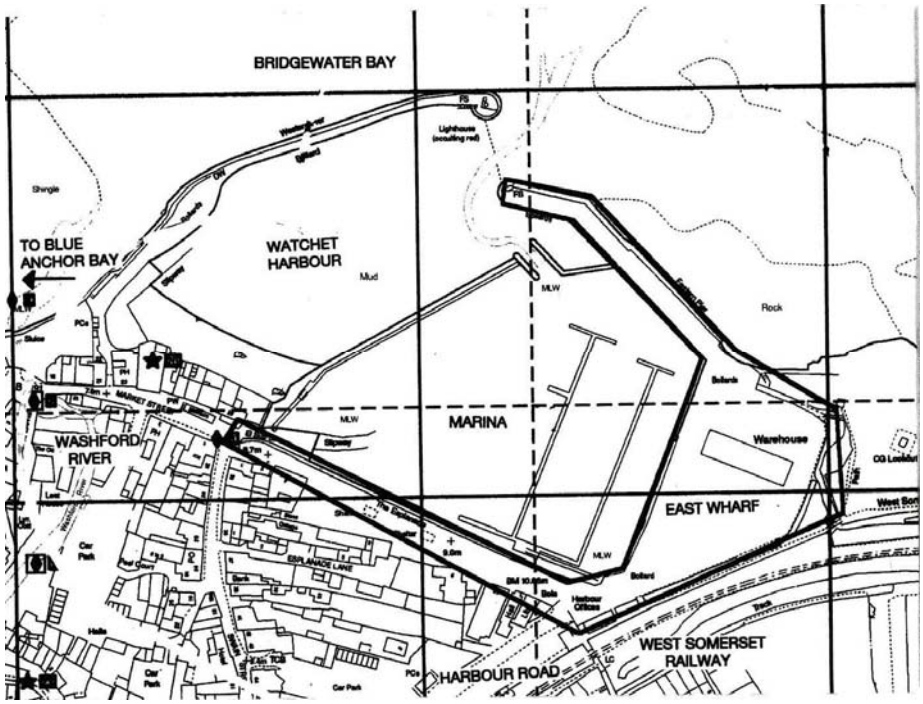

Figure 4—1 Proximity of Surface Water Features

4.1.1 Coastal Erosion and Flood Defence

The site is widely protected from erosion through the historic provision of seawalls and revetment and at a higher level, natural cliff. For periods of the tide, the shore protection adjacent to the proposed development is not exposed to wave action.

Erosion rates of the higher embankment cliff should be monitored to mitigate erosion risk and implement any remedial measures necessary.

4.1.2 River Water Quality

Washford River is located approximately 250m to the west of the site. It passes underneath Market Street via a culvert and drains into Bridgewater Bay, in the Bristol Channel, to the west of Watchet Harbour. Water quality in Washford River is monitored by the Environment Agency at two points in close proximity to the site. The first at the mouth of the river as it discharges into Bridgewater Bay, referred to as the Watchet – Sea river stretch, and the second is approximately 300m to the south-west of the Marina (approximately 150m from the mouth of the river), and is referred to as the Torre Fifa – Watchet river stretch.

Water quality is assessed against the River Quality Objectives (RGO). These are targets used to assess whether the river is of adequate quality to support a certain type of ecosystem. Each stretch of river is given a target from the River Ecosystem Classification scheme. These range from very good quality (suitable for all fish species) to poor quality (likely to limit fish species).

The results of tests performed between 1988 and 2005 and detailed monitoring results for the period 2003 to 2005 and 2002 to 2004 are provided as a Technical Appendix to this report. A summary of the latest results for the period 2003 to 2005 and 2002 to 2004 is shown in Table 4—1.

River Stretch	Year	Target	Compliance
Watchet - Sea	2003 - 2005	2 - good	Compliant
Watchet - Sea	2002 - 2004	2 - good	Compliant
Torre Fifa – Watchet	2003 - 2005	1 – very good	Compliant
Torre Fifa – Watchet	2002 - 2004	1 – very good	Compliant

Table 4—1 River Quality Objectives

Water quality is also assessed by looking at the chemical, biological and nutrient levels of the river stretch. This highlights whether there are any elevated pollutant levels that would need to be addressed and treated. Chemical and biological levels are graded between A (very good) to F (bad). Nutrient levels are analysed for

nitrates and phosphates. Levels are graded from 1 to 6, with 1 implying a very low presence of nutrients and 6 implying a very high presence of nutrients.

The chemical monitoring results for the period 2003 to 2005 and 2002 to 2004 are summarised in Table 4—2 below.

River Stretch	Year	Grade
Watchet - Sea	2003 - 2005	B - good
Watchet - Sea	2002 - 2004	A -very good
Torre Fifa – Watchet	2003 - 2005	A – very good
Torre Fifa – Watchet	2002 - 2004	A – very good

Table 4—2 Chemical Monitoring Results

The biological monitoring results for the period between 2000 and 2005 are summarised in Table 4—3 below.

River Stretch	Year	Grade
Watchet - Sea	2004	B - good
Watchet - Sea	2000	A – very good
Torre Fifa – Watchet	2005	A – very good
Torre Fifa – Watchet	2002	A – very good

Table 4—3 Biological Monitoring Results

The nutrient monitoring results for the period 2003 to 2005 and 2002 to 2004 are summarised in Table 4—4 below.

River Stretch	Year	Nitrate Level	Phosphate Level
Watchet - Sea	2003 - 2005	4 - high	2 - low
Watchet - Sea	2002 - 2004	4 - high	2 - low
Torre Fifa – Watchet	2003 - 2005	4 - high	2 - low
Torre Fifa – Watchet	2002 - 2004	4 - high	2 - low

Table 4—4 Nutrient Monitoring Results

A summary of the chemical, biological and nutrient monitoring results taken from 1993 to 2005 and details of the most recent monitoring results are provided as a Technical Appendix to this report.

Based on the data provided above, the water quality of Washford River within close proximity of the site is considered to be good.

Following discussions with the Environment Agency it has been confirmed that the Washford River in Watchet is a designated salmonid fishery.

Other available water quality information for Washford River indicated that there are no sewage works within the vicinity of the site which may affect a sensitive area.

The River in this location is covered by a Catchment Abstraction Management Strategy (CAMS). CAMS have been put in place to manage how much water is removed from particular areas. This may affect large water users such as agriculture or industry whereby licences can be suspended during periods of water shortage to ensure supply for domestic customers.

4.1.3 Bathing Water Quality

Blue Anchor Bay, located approximately 4 miles to the west of the proposed East Wharf development, is classified as a bathing water beach and therefore must comply with the standard set out in the EC Bathing Water Directive. Water quality results for the period 1988 to 2006 have been obtained from the Environment Agency. Twenty samples are taken throughout the peak bathing season of May to September. The samples are analysed for microbiological indicators of faecal contamination, in particular total coliforms, faecal coliforms and faecal streptococci. Bathing waters are classified into four categories; poor, sufficient, good an excellent. The results for the tests performed between 1988 and 2006 and detailed monitoring results for 2006 are provided as a Technical Appendix to this report. A summary of the results for the past three years is shown in Table 4—5.

Sampling Point	Year	Classification
Blue Anchor West	2006	Good
Blue Anchor West	2005	Excellent
Blue Anchor West	2004	Good

Table 4—5 Bathing Water Quality

The above monitoring results for 2004 to 2006 indicate that the water quality within Blue Anchor Bay is good.

4.1.4 Watchet Marina Water Quality

No water quality data is available for Watchet Marina. Surface water run off from the adjacent harbour walls discharges directly into the Marina with no prior treatment. The eastern harbour wall is used for car parking and boat maintenance and therefore hydro-carbons and chemicals, such as anti-foulants, may be present in the run off. Boats moored within the Marina may also impact on water quality due to oil/petrol leaks and other spillages. The floating fuelling station may also reduce water quality due to leaks and spillages. A public surface water sewer discharges into the south-east corner if the Marina. It is not known whether this flow passes through an interceptor prior to discharge. However, the Marina is subject to regular flushing from the Bristol Channel which would dilute any pollutants. The marina is also upstream of Blue Anchor Bay bathing beach and Blue Anchor to Lilstock SSSI. If the Marina did contain high levels of contamination this may be noticeable on the water quality of the bating beach and the quality of the SSSI. The water quality within the Marina has therefore been estimated as fair for the purpose of this report.

Water quality within the Marina can only be accurately determined through water quality sampling.

4.1.5 Groundwater

The Envirocheck report classifies the majority of the site as a 'Non Aquifer'. This implies negligible permeability and a formation which contains insignificant quantities of groundwater. However, groundwater flow through the rock formation present on site, although imperceptible, does take place and will need to be considered in assessing risk associated with persistant pollutants.

The southern part of the site (forming the esplanade) has been classified as a 'Minor Aquifer' with overlying soils of intermediate leaching potential which can possibly transmit a wide range of pollutants. It is possible that the aquifer provides a baseflow to the Washford River upstream of the site, but given the likely hydraulic gradients beneath the site, the aquifer is likely to discharge direct into the harbour.

Given the site comprises harbour walls and quays, any groundwater beneath the site within the fill material is anticipated to be in direct hydraulic continuity with the surrounding sea water and is therefore expected to show considerable diurnal variation in groundwater levels, mirroring the movements of the tide.

There are no groundwater abstractions within 500m of the site boundary. There are a number of groundwater abstraction points located between approximately 850m and 940m to the south-west of the site. These abstractions concern E J Burrell & Son, which relates to the abstraction of groundwater for general farming and domestic usage, and St. Regis Paper Co. Ltd, which relates to the abstraction of groundwater for paper making.

The Environmental Statement compiled by Royal Haskoning in December 2001 states that tests have been performed on groundwater within the site to determine its existing quality. The tests revealed that groundwater does not contain any elevated concentrations of contaminants, although sulphate concentration was high in one sample. A copy of the results from these tests is provided as a Technical Appendix to this report.

4.2 Geology and Ground Conditions

4.2.1 Geology

The Geological Survey of Great Britain (England and Wales) 1:50,000 Series, Sheet 294, Dulverton, Solid and Drift Edition geological map, and the Envirocheck geology report (see **Appendix XX**), indicate that the stratigraphic sequence is as summarised in Table 4—6.

Geological Period	Unit	Rock Type
Jurassic	Lower Lias	Mudstone and Limestone
Triassic	Mercia Mudstone Group	Mudstone and Halite

Table 4—6 General Geological Sequence

Superficial deposits are not shown on the available geological maps within the site boundary. Areas of alluvium associated with the Washford River are shown immediately to the south-west, undifferentiated head shown to the south and undifferentiated beach and tidal flats are shown to the east of the site. All of these deposits comprise a mixture of clay, silt, sand and gravel.

The geological map and the Envirocheck geology report indicate that the area has been subjected to faulting. One of the faults passes through the site in an east -west orientation and is evident from a cliff face exposure at the western end of Helwell Bay, approximately 500m east of the site. The exposed lithologies are summarised below:

- Lower Lias – this unit comprises dark grey MUDSTONE with bands of limestone. The fracture state of this material is highly variable. Where the fracturing is more severe, water was seen trickling from the rock face and causing significant weathering. The mudstone weathers to dark grey clay.

- Mercia Mudstone – this unit consists of red/orange brown MUDSTONE interbedded with light grey MUDSTONE/SILTSTONE. The Mercia Mudstone Group is also known to contain halite and gypsum bands. This material weathers to red brown clay.

In the cliff face exposure, the older Mercia Mudstone has been juxtaposed against the younger Lower Lias.

Nine borehole and two trial pit logs have been obtained from British Geological Survey. These exploratory holes were located in the Marina (i.e. below site level) and formed between December 1997 and January 1998, using rotary coring techniques and mechanical excavation. The logs indicate that the base of the Marina is covered by a layer of very soft grey CLAY that has been transported into the Marina and settled out in the low energy environment. This material is generally underlain by firm to very stiff dark grey and orange brown CLAY. This lower clay generally overlies mudstone of the same colour, indicating the presence of a weathered zone at the top of the rock.

Some of the boreholes show the grey Lower Lias as the upper rock unit, underlain by the orange brown Mercia Mudstone. However some boreholes only encountered the Mercia Mudstone. The plan layout of the encountered lithologies indicates the boundary between the Lower Lias and the Mercia Mudstone is located within the zone of the harbour wall that has been repaired.

The Environmental Statement for the Watchet East Wharf Development compiled by Royal Haskoning in December 2001 makes reference to a ground investigation carried out at the East Wharf in 1997. This investigation confirmed concrete and tarmac underlain by made ground which of thickness between 2.3m and 6.2m. The made ground comprised red-brown gravelly clay/clayey gravel, occasional fragments of mudstone, siltstone, concrete, wood and metal, and black sandy gravelly clinker, which may be derived from a former nearby gas works. The made ground is reported as overlying natural strata, which consists of weathered Lower Lias or Mercia Mudstone.

4.2.2 Contamination

The Royal Haskoning Environmental Statement compiled in December 2001 reports that chemical testing was carried out on selected soil samples and leachates and that the results were compared against the Intergovernmental Committee on the Redevelopment of Contaminated Land (ICRCL) threshold levels for domestic land use. When compared against the ICRCL threshold levels, elevated soil concentrations of arsenic, copper, lead, mercury and zinc were detected, primarily within the made ground. Elevated concentrations of arsenic were also detected within the natural strata. No elevated concentrations were detected within the leachates. It should be noted the ICRCL threshold levels have since been superseded by CLR11 – Model Procedures for the Management of Land Contamination, *Environment Agency*, September 2004. Ground gas monitoring was also carried out but no concentrations of methane or carbon dioxide, and no oxygen depletion were recorded.

4.3 Sensitivity of Receptors

Water Resources

In terms of flood risk and erosion, the key receptors are people and property, these are primary receptors with a high sensitivity that need to be considered thoroughly to fully mitigate potential impacts.

The coastline that runs between Blue Anchor Bay and Lilstock (to the west and east of the site respectively) is designated as a Site of Special Scientific Interest (SSSI) with respect to geological conservation. The SSSI is also known to be used by wintering waders and wildfowl. The sensitivity of this area is therefore considered high.

Given that Blue Anchor Bay is used for bathing, water quality of a very high standard must be maintained. The sensitivity of this area is therefore considered to be high.

The water quality of Washford River has been classified as good and is a designated salmonid fishery. The sensitivity is therefore classified as high. The river is upstream of the site and is unlikely to be significantly affected by any development, although it is possible that groundwater beneath the site provides a baseflow to the River.

Water quality in Watchet Marina is unknown, but it has been estimated as fair considering that the water in the Marina is moved regularly by the high tides of the Bristol Channel and sites downstream of the Marina include the SSSI and Blue Anchor bathing beach. However, it is also receives surface water run off from the adjacent hard paved areas which may contain hydrocarbons and other chemicals from standing cars and boat maintenance and boats moored within the Marina may also add other pollutants to the water such as oil and petrol from engines. Considering that the Marina is used for boating and not for bathing or water emersion sports, the sensitivity of the water within Watchet Marina is deemed to be low.

The majority of the site has been classed as a non-aquifer and therefore groundwater flows are likely to be low. The southern part of the site has been classed as a minor aquifer which implies that groundwater flow may be present and provide a baseflow to the Washford River. However, it is likely that the aquifer will discharge directly into Watchet Marina and Harbour. All water abstraction points are upstream of the site, with the nearest being approximately 850m from the site. The sensitivity of groundwater within the vicinity of the site is therefore considered to be low.

Geology and Ground Conditions

Site users are potential receptors for risks associated with contamination. Under the baseline conditions site users include members of the public visiting or passing through the Marina and employees working in the nearby buildings. During the construction phase site users will include those present under baseline conditions, construction workers and members of the public accessing areas adjacent to the construction site.

During the operational phase, baseline condition users, employees, residents and visitors to the new development, and maintenance workers will form the site users. Site users are considered to be high sensitivity receptors.

Nearby structures are potential receptors for risks associated with geology and include the harbour wall and buildings lining the access route for construction traffic. The harbour wall forms the western edge of the site and retains the ground onto which the new structures are to be built. The structures that line the access route are susceptible to the effects of construction traffic and the construction process. Nearby structures are considered to be high sensitivity receptors.

The groundwater regime is likely to be impacted by the development in terms of permeability and water flow. This could have an affect on the stability of structures, especially the harbour wall, which could generate knock-on effects as discussed. Furthermore, a change in the permeability of the ground could generate alternative water pathways which may adversely affect the surrounding environment. The overall sensitivity of this receptor is considered to be high.

4.4 Land Use and Potential Sources of Pollution

Discharge Consents

A number of discharge consents held by Wessex Water are located within 1km of the site. The majority of these relate to the discharge of storm sewage overflow from the public sewer network and discharge into the Washford River. Two of the Wessex Water discharge consents are for treated effluent. These are located approximately 300m and 900m to the west and south-west of the East Wharf site respectively. The first connects to an effluent pipe which extends into the Bristol Channel. The second discharges into Washford River.

St. Regis Paper Co Ltd hold a number of discharges consents related to paper making. These are located approximately 850m to the south-west of the site and discharge into Washford River.

Land Use

There are seven active contemporary trade directory entries (such as manufacturing industries) located within 1km of the site, although none of these fall within the site boundaries. Out of these seven entries, none of them are fuel stations.

The Envirocheck report, dated 23 November 2006, identifies one local authority recorded landfill site known as 'Limekiln' approximately 950m to the west of the site boundary. The last reported status of this landfill site indicated that it had been closed. The boundary quality has been recorded as moderate. No other information regarding the landfill site is provided within this entry.

The Envirocheck report has no record of any Contaminated Land Register Entries or Notices within 1km of the site boundary.

Pollution

The Envirocheck report has no record of any pollution incidents within 1km of the site boundary. Similarly there are no records of any hazardous substances being used or stored within 1km of the site boundary.

Other potential sources of pollution from current land uses on and adjacent to the site include the car parking and boat maintenance area to the east of the Marina. Surface water run off from these areas discharges directly into the Marina with no prior treatment and could contain hydro-carbons and other chemicals associated with boat maintenance.

Plans obtained from Wessex Water illustrate a surface water sewer discharging into the south-eastern corner of Watchet Marina. It is not known whether this flow is treated prior to discharge.

5 Impact Assessment

5.1 Water Resources

The proposed development has the potential to impact on surface water features within the area. The significance of any impact will depend on the importance of the water feature, the magnitude of any impact, and the design of the site drainage system. Where significant effects have been identified, mitigation measures to minimise negative effects have been recommended.

Potential impacts have been identified for the construction and operational phases of this development and have been assessed against the baseline conditions detailed in Section 4 Baseline Environmental Conditions.

5.1.1 Coastal Erosion

The scheme is not impacting on the coastal zone, and therefore not impacting on erosion processes. The shore defence structures have been provided with sufficient easement to allow maintenance and avoid surcharge. However, it is recommended that West Somerset continue their monitoring of coastal erosion so that any remedial measures may be implemented in a timely manner.

5.1.1.1 Mitigation Measures

No mitigation measures are necessary

5.1.2 Tidal Flood Risk

Although much of the site to be developed is located in category Zone 2 for flooding, key components are located in Zone 3a. The unmitigated plan is at risk from flooding at a number of locations and through a number of potential processes.

- The harbour side accessed retail units are at risk from elevated water levels and are accessed from Zone 3a. There is no safe egress from these units should a design event occur during occupation.
- There is a possible through flow, and therefore flood route, between the two blocks of harbour side retail / commercial units.
- Ground levels between the boat museum and the main block are low and fall within the flood Zone 3 category of risk.
- The proposed parking is accessed from a Zone 3a area, and therefore potentially at risk of flooding.

The building has been set back from the existing seawall to facilitate access, maintenance and minimise exposure of the building to overtopping, however, the calculations undertaken in the Flood Risk Assessment indicate that significant volumes of water may overtop the seawall during storms, leading to the following risks:

- Water overtopping the Eastern seawall may flood the boat museum.
- Water overtopping the seawall at Section B and C may generate a potentially significant impact force and could cause structural damage to the boat museum.
- Overtopping discharges over the seawall would be dangerous to the public during storms, both pedestrian and vehicular.
- Overtopping of the harbour arm will flow straight into the harbour, and is not considered problematic to the development
- Overtopping discharge will affect the hard standing area to the north of the building, potentially generating a water flow towards the harbour.

Considering 100 year development life, construction completed 2008:

Starting from the 1:200yr Still water Level in Table	7.42m AOD (2002)
2002 to 2025 @ 3.5mm/yr	+ 80.5mm
2025 to 2055 @ 8.0mm/yr	+ 240mm
2055 to 2085 @ 11.5mm/yr	+ 345mm
2085 to 2108 @ 14.5mm/yr	+ 333.5mm
Total Sea Level Rise Allowance =	999mm
PPS25 Still Water Design Level =	8.42m AOD

Considering that the recently published guidance from PPS 25 incorporates a ‘high emission’ allowance for climate change, it is considered to be at the upper boundary of likely impact. A freeboard allowance of 570mm has been incorporated into the design to provide security against scientific ambiguity and a safety factor against inundation of the building.

PPS25 Still Water Design Level =	8.42m AOD
Freeboard allowance	+ 570mm
Design Threshold allowance =	8.99m AOD

5.1.2.1 Mitigation Measures

The site is currently served by an existing flood defence which provides a standard of service less than required by the statutory authorities.

Still water, tidal, flooding and inundation through dynamic overtopping of the seawall have been assessed in the Flood Risk Assessment report and used as design parameters for mitigating associated risks.

An unmitigated scheme would represent a potential risk to pedestrians, vehicles and the building during storm events. To address this risk the building has been designed to take account of its environmental exposure. It is proposed that the current sea defence be augmented with a wave wall profile, increasing the standard of flood protection and protecting the development from tidal inundation and potential wave impact loads.

- The ground floor is raised, set at a level of 8.99m OD, taking account of the 1:200 year event (0.05 chance in any year), Sea Level Rise (0.999m), plus an additional freeboard allowance of 0.57m.
- A safe pedestrian access and egress route is provided.
- Plant rooms will be additionally designed for flood resilience.
- An augmented defence wall is provided to protect the building from potential wave impact loads, and direct overtopping discharge. Increasing the current standard of service provided by the current wall.
- Pedestrians and vehicles may be restricted from accessing the seafront during storm events through the operation of a gate or similar means.

5.1.3 Potential Effects on Groundwater and Water Quality during Construction

During construction potential impacts are likely to include:

- Clearance of land, excavation and backfilling resulting in elevated suspended sediment in site run off draining to nearby surface water, and potentially increasing sediment loads.
- Demolition of buildings potentially resulting in dust and debris entering watercourses.
- Leakage or accidental spillage of fuels or chemicals used on site during construction, potentially contaminating groundwater and nearby surface water, including cement material during construction of road infrastructure and buildings and dirty water from the construction site.
- Increased vehicular traffic from construction vehicles potentially resulting in hydro-carbons and oils entering the site drainage system, which discharges into Watchet Marina, or discharges directly over the Marina wall.
- On-site mixing of construction materials may potentially result in accidental spillage of oils, fuels, cement, sand and gravel.

- Leak or breakage of sewerage system from temporary toilet facilities resulting in crude sewage infiltrating ground water or being washed into the site drainage system, which discharges into Watchet Marina, or discharges directly over the Marina wall.

The potential impacts noted above are discussed in more detail below and summarised in Table 5—1. Mitigation measures which could be included in the design to avoid or minimise adverse effects are discussed in Section 5.1.3.1.

Increased Sediment Loads

One of the biggest risks to adjacent surface water bodies during construction is from site runoff containing elevated suspended sediment levels, increasing sediment loads. This can result from land clearance, excavation, movement of materials to and from the site and storage of materials on site. High sediment input can have direct adverse effects on adjacent surface watercourses through increasing turbidity (thus reducing light penetration and reducing plant growth), and by smothering vegetation and bed substrates, thus impacting on invertebrate and fish communities by destruction of feeding areas, refuges and breeding / spawning areas. Indirect adverse effects can also be associated with suspended sediments that have associated inorganic or organic contaminants (e.g. heavy metals and pesticides, respectively).

The magnitude of any impact will depend on the scale and nature of any potential incident and thus is difficult to predict.

Considering the predicted water quality of Watchet Marina, the magnitude of any impact may be considered to be medium adverse, with an overall impact significance of MINOR ADVERSE.

Blue Anchor to Lilstock SSSI has a high sensitivity and may be affected by increased sediment deposition via Watchet Marina and Harbour. The Marina and Harbour are likely to have some attenuation properties due to tidal flushing thereby minimising potential impacts on Blue Anchor to Lilstock SSSI. The resultant magnitude of any potential impact is therefore deemed to be small adverse with an overall significance of MODERATE ADVERSE.

Blue Anchor Bay is a bathing water beach and is therefore sensitive to any change. However, considering the distance between Blue Anchor Bay and the site, increased sediment would have been dispersed. The impact to Blue Anchor Bay would therefore be INSIGNIFICANT.

Washford River is considered to have a high sensitivity due to its good standard of water quality. The river lies upstream of Watchet Marina and therefore any impact is considered to be INSIGNIFICANT.

Dust and Debris

Demolition of existing buildings, such as the warehouse, and other structures have the potential to release dust and debris that may be blown into adjacent watercourses. Increased dust levels in watercourses may reduce

the levels of light reaching aquatic plant and animal species. Debris blown into watercourses can decrease the recreational and aesthetic quality of the resources.

The impact magnitude to Watchet Marina is considered to be small adverse, ensuing an impact significance of MINOR ADVERSE. .

Blue Anchor to Lilstock SSSI is likely to be more affected by debris than dust (due to some attenuation provided by Watchet Marina), although this is still likely to have little impact on the condition of the SSSI. The magnitude of potential impact is determined to be negligible. Therefore the overall significance of the effect is considered to be MINOR ADVERSE.

Blue Anchor Bay has a high sensitivity, but due to its proximity to the site it is unlikely to be affected by dust and debris. The impact is therefore considered to be INSIGNIFICANT.

Washford River also has a high sensitivity, but again due to its proximity to the site and sheltering by adjacent structures, the impact is considered to be INSIGNIFICANT.

Accidental Leaks and Spillages of Hazardous Substances

During construction, there is an elevated risk of potential leaks or accidental spillage of hazardous chemicals used on site infiltrating to groundwater or migrating to nearby surface watercourses and resulting in an adverse impact. For the most part it is only when large quantities of hazardous substances are spilled, or the spillage is directly into the watercourse, that a significant risk of acute toxicity will arise in the receiving water. This can present a specific risk to certain bottom-dwelling invertebrates and other aquatic invertebrates.

The magnitude of any impact will depend on the scale and nature of any potential incident and thus is difficult to predict.

Considering the predicted water quality of Watchet Marina, the magnitude of any impact may be considered to be medium adverse, with an overall impact significance of MINOR ADVERSE.

Blue Anchor to Lilstock SSSI has a high sensitivity and is in relative close proximity to the site. Although any leakage or spillage on the site would experience some attenuation and dilution within the harbour and Bristol Channel, hazardous substances could have a medium adverse impact, resulting in an overall impact significance of MAJOR ADVERSE.

Blue Anchor Bay is located approximately 4 miles to the west of the site, therefore any leakage or spillage on the site would experience some attenuation and dilution within the Bristol Channel. However, given the high sensitivity of this area, especially with regard to hazardous substances, the impact magnitude is considered to be medium adverse, with an impact significance of MAJOR ADVERSE.

Washford River is considered to have a high sensitivity due to its good standard of water quality. Contaminants which infiltrate groundwater could migrate towards the Washford River, although this is

considered unlikely. The impact magnitude is therefore considered to be negligible, which translates to an overall impact significance of MINOR ADVERSE.

The groundwater beneath the site is considered to have a low sensitivity due to the small amount of flow anticipated. However, considering that groundwater is hydraulically linked to the Marina and potentially the Washford River, the magnitude of any impact is deemed to be small, resulting in MINOR ADVERSE impact significance.

Disturbance of Contaminated Material

Made ground on site may contain areas of contamination. There is the potential for contaminated land to be disturbed and migrate towards Watchet Marina and other water features, either by infiltration into the groundwater or overland.

The impact magnitude to Watchet Marina is considered to be small, with an overall impact significance of MINOR ADVERSE. Although Blue Anchor to Lilstock SSSI, and Blue Anchor Bay have a high sensitivity, their proximity to the site will allow attenuation and dilution of contaminants within the Marina. The impact magnitude is therefore considered to be small adverse, with an overall impact significance of MODERATE ADVERSE.

Washford River has a high sensitivity, although its proximity to the site and low risk of groundwater providing a base flow to the River gives rise to a negligible impact magnitude. This translates to an overall impact significance of MINOR ADVERSE.

The impact magnitude on groundwater beneath the site is deemed to be small, considering the low flows anticipated. The overall impact significance is therefore MINOR ADVERSE.

Hydro-carbons and Oils

The release of hydro-carbons and oils into the on-site drainage system is likely to increase during the construction period due to a large number of vehicles, including heavy vehicles, accessing the site.

Oils and fuels may be washed from road surfaces into the drainage system, which discharges to Watchet Marina, or over the harbour wall and directly into the Marina. The potential magnitude of impacts on the water quality in Watchet Marina is considered to be medium adverse, resulting in an overall impact significance of MINOR ADVERSE.

The magnitude of change to the Blue Anchor to Lilstock SSSI would be less due to the attenuation and dilution provided in the Marina, and is therefore considered to be small adverse. This provides an impact significance of MODERATE ADVERSE.

Blue Anchor Bay, assessed as a sensitive receptor, would experience even more attenuation and dilution of any spilled hydro-carbons or oils. The impact magnitude is considered to be small adverse, with an impact significance of MODERATE ADVERSE.

Washford River is considered to have a high sensitivity due to its good standard of water quality. Hydro-carbons and oils which infiltrate groundwater could potentially migrate towards the River, although this is considered to be very unlikely. The impact magnitude is therefore considered to be negligible, which translates to an overall impact significance of MINOR ADVERSE.

The groundwater beneath the site is considered to have a low sensitivity due to the small amount of flow anticipated. However, it is hydraulically connected to Watchet Marina and is therefore considered to have an impact magnitude of small adverse. This provides an overall impact significance of MINOR ADVERSE.

Summary

Receptor	Receptor Sensitivity	Impact	Magnitude of Impact	Significance of Impact
Watchet Marina	Low	Increased sediment loads	Medium adverse	Minor adverse
		Dust and debris	Small adverse	Minor adverse
		Accidental leaks and spills of hazardous materials	Medium adverse	Minor adverse
		Disturbance of contaminated land	Small adverse	Minor adverse
		Hydro-carbons and oils	Medium adverse	Minor adverse
Blue Anchor to Lilstock SSSI	High	Increased sediment loads	Small adverse	Moderate adverse
		Dust and debris	Negligible	Minor adverse
		Accidental leaks and spills of hazardous materials	Medium adverse	Major adverse
		Disturbance of contaminated land	Small adverse	Moderate adverse
		Hydro-carbons and oils	Small adverse	Moderate adverse
Blue Anchor Bay	High	Accidental leaks and spills of hazardous materials	Medium adverse	Major adverse
		Disturbance of contaminated land	Small adverse	Moderate adverse
		Hydro-carbons and oils	Small adverse	Moderate adverse
Washford River	High	Accidental leaks and spills of hazardous materials	Negligible	Minor adverse
		Disturbance of contaminated land	Negligible	Minor adverse
Groundwater	Low	Accidental leaks and spills of hazardous materials	Small adverse	Minor adverse
		Hydro-carbons and oils	Small adverse	Minor adverse

Table 5—1 Summary of Impact Significance during Construction

5.1.3.1 Mitigation Measures

The construction methods discussed below will assist in avoiding, reducing and minimising the potential for contaminants migrating to water features and thus protect water quality and the ecosystems and fisheries they support.

The Contractor will be required to prepare a Construction Environmental Management Plan (CEMP), which will include mitigation measures to protect the water environment. This will set out how construction activities will be undertaken in accordance with the pollution prevention guidelines published by the Environment Agency, particularly PPG1 (General guide to the prevention of water pollution), PPG5 (Works in, near or liable to affect watercourses) and PPG6 (Working at construction and demolition sites), and other good construction guidance, such as Guidance on silt pollution and how to prevent it.

Monthly water monitoring is advised during the construction period, to ensure proposed mitigation measures are being effective in maintaining the existing surface water quality.

Providing correct working procedures are adopted and care is taken to avoid pollution of the watercourses, no significant residual effects are predicted for the construction phase of this development.

Increased Sediment Loads

The areas of exposed surface should be minimised and the gradient kept as shallow as possible to prevent large amounts of earth being washed into the Marina during periods of heavy rainfall. Any areas which are exposed should be re-seeded or surfaced as soon as practicable.

Tight control of site boundaries should be enforced by the contractor, including minimal land clearance and restrictions on the use of machinery adjacent to Watchet Marina. Wheel wash facilities should also be provided at all entry and exit points. The water from the wheel wash facilities will be disposed of and not discharged into the Marina.

Run off from site will be captured in perimeter cut-off ditches, settlement lagoons, and/or settlement tanks. These will allow run-off to be treated prior to discharge. Approval will be required from the Environment Agency for any discharges to controlled waters such as Watchet Marina.

Dust and Debris

Dust management procedures which are typically implemented for air quality management issues, such as damping down to suppress the creation of dust, could be applied to mitigate impacts from dust resulting from demolition and earthworks.

Good site practice, perimeter fences and tight control of materials and waste will minimise the risk of debris entering water courses.

Accidental Leaks and Spillages of Hazardous Substances

The Contractor will be required to prepare a Construction Environmental Management Plan (CEMP), which will include a detailed mitigation strategy to minimise the risk of accidental leaks and spillages of hazardous substances. This will set out how construction activities will be undertaken in accordance with the pollution prevention guidelines published by the Environment Agency, for example PPG2 (Above ground oil storage tanks).

Storage facilities and tanks will be provided and the re-fuelling of machinery will be conducted within bunded areas. The storage and bunded areas will be constructed of impervious floors and walls with the capacity for the contents of the storage tank and an additional 10% safety margin. Drip trays used for diesel pumps and standing plant will be regularly maintained to prevent leaks. Oil interceptors will also be installed in areas that may be used for temporary oil storage and refuelling. As a remedial measure, spill containment equipment such as absorbent materials will be stored on site.

Any mixing of construction materials, such as cement, will be conducted in designated areas located away from drainage lines and Watchet Marina.

The mitigation strategies implemented should be reviewed regularly to best suit the practices currently being undergone on site.

Disturbance of Contaminated Material

Any contaminated land or groundwater discovered on site during construction will be remediated, removed or avoided.

Hydro-carbons and Oils

Interceptors will be incorporated into the site drainage system at high risk areas, such as parking, unloading and refuelling areas, to remove hydro-carbons and oils from surface water prior to discharge. Other measures including drip trays, under equipment such as generators, and wheel washing facilities will also be implemented to minimise the risk of pollutants infiltrating groundwater or Watchet Marina.

5.1.4 Potential Effects on Groundwater and Water Quality during Operation

Potential effects on water quality, both adverse and beneficial, during the operational phase may result from:

- Improvement of discharges to Watchet Marina through improvements to existing surface water drainage systems.
- Any breakage/leak of the drainage system network resulting in untreated sewage or runoff discharging directly to adjacent surface water courses.
- Accidental spillages of hazardous materials stored and used on site.

- Use of herbicides and fertilisers in routine maintenance of landscaped areas, causing localised contamination of nearby surface waters.
- Use of anti-foulants and other chemicals used for boat maintenance (such as fuel and oil) which would discharge into the surface water drainage network.

The development will comprise primarily of residential dwellings, live/work space, leisure and retail, and commercial. New access routes for cars and pedestrians, and car parking for residents of the development, are also included. It is assumed that foul water will be discharged to the Wessex Water sewer located to the south of the site. Surface water runoff will be collected by a new surface water drainage system which will discharge into Watchet Marina.

The drainage strategy for the proposed development is provided as a Technical Appendix to this report**.**

Those effects during operation which are deemed significant are discussed in detail below and summarised in Table 5—2. Mitigation measures which could be included in the design to avoid or minimise adverse effects are discussed in Section 5.1.4.1,

Improvement to Surface Water Discharges

Surface water run off from the existing East Wharf currently discharges into Watchet Marina with no prior treatment. The area of hardstanding in the proposed development is similar to that in its existing state. There will be minimal change to the total volume of surface water run off, although the proposed green roof system will provide some attenuation to flow.

Surface water from building roofs will be collected in a piped gravity system and discharged into Watchet Marina. Flow from these areas will not require prior treatment.

Surface water from external hard landscaped areas, access roads and from the parking areas will be collected in a separate piped gravity system to that of the roof drainage. Gullies will have silt traps and all flow will be passed through an oil separator prior to being discharged into Watchet Marina to remove impurities. The existing drainage within the car park to the south of the site along Harbour Road may also be updated to ensure that run off from this area passes through an oil separator.

The impact of a new drainage system on the water quality within Watchet Marina is considered to be small beneficial, which provides an overall impact significance of MINOR BENEFICIAL.

Water within the Marina is hydraulically connected to the Bristol Channel, and therefore the Blue Anchor to Lilstock SSSI and Blue Anchor Bay, and also to Washford River. It is possible that an improvement in the water quality within the Marina would have a small beneficial impact on the SSSI, resulting in an impact significance of MODERATE BENEFICIAL. Considering the proximity of Blue Anchor Bay and Washford River to the Marina the impact is deemed to be INSIGNIFICANT.

Leakage from Sewerage or Surface Water Drainage System

Any risk associated with the breakage or leakage of the sewerage or surface water drainage system is considered to be low, given that new drains are to be constructed as part of the development within East Wharf. Should a break occur in the sewerage system however, this could migrate into the groundwater, and potentially Washford River, and Watchet Marina which links to the Blue Anchor to Lilstock SSSI and Blue Anchor Bay.

Sewage contains high levels of nutrients, organic matter (e.g. BOD), coliforms and suspended solids. This can result in nutrient enrichment and eutrophication, smothering of bottom-dwelling organisms and plants, and significantly reduced oxygen levels.

The magnitude of these potential impacts with regard to water quality within Watchet Marina is considered to be SMALL ADVERSE, with an overall significance of MINOR ADVERSE. Given the attenuation and dilution provided by the Marina, the magnitude of potential impacts with regard to the SSSI and Blue Anchor Bay is considered to also be SMALL ADVERSE, with an overall impact significance of MODERATE ADVERSE.

Washford River is upstream of the site and it is not thought likely that groundwater provides a baseflow to the River. It would therefore be difficult for contaminants within the ground to migrate towards the River and cause significant adverse effects. The impact magnitude is therefore considered to be negligible. However, given the high sensitivity of the River the overall impact significance is MINOR ADVERSE.

The groundwater beneath the site is considered to have a low sensitivity due to the small amount of flow anticipated. The magnitude of any impact is therefore considered to be small, resulting in MINOR ADVERSE impact significance.

Storage and Use of Hazardous Chemicals

Significant effects associated with the storage and use of hazardous chemicals on site is not expected. The predominant uses are for residential, offices, leisure and retail facilities and as such there is unlikely to be any significant volumes of hazardous chemicals stored on site. The waste oil disposal point currently located on the East Wharf development site will be relocated to the new boat workshop area. However, this will be bunded and, with an appropriate maintenance regime, should not breech the enclosure walls. Any impact is therefore considered to be INSIGNIFICANT.

Fertiliser and Herbicide Use on Landscape Features

Landscaped areas on site may be require the use of fertilisers, herbicides and other pesticides as part of their management. Proprietary fertilisers contain nitrates and phosphates, which can migrate to adjacent surface water bodies and cause eutrophication and subsequent deterioration in fish populations and aquatic ecology. Pesticides are by their nature biologically active chemicals that present a high risk of toxicity if they reach

receiving waters. Herbicides may present a particular threat as they are normally designed to be highly water soluble, and therefore are more vulnerable to run-off. Considering that the majority of the site is to be hard paved with few landscaped areas, and providing that fertilisers, pesticides or herbicides are used in accordance with current DEFRA and manufacture guidelines, any associated effects will be INSIGNIFICANT.

Anti-foulants and Other Boat Maintenance Chemicals

The drainage strategy for the boat maintenance area is currently being developed; current plans are detailed in the drainage strategy provided in the Technical Appendix. It is likely that a small area within the boat storage yard will be designated for high risk boat maintenance and it will be within this area that activities such as engine changes and anti-fouling will commence. The area will discharge to the foul sewer network to prevent harmful chemicals from entering the surface water sewer network, which may consequently discharge into a nearby water feature.

Summary

Receptor	Receptor Sensitivity	Impact	Magnitude of Impact	Significance of Impact
Watchet Marina	Low	Improvement to surface water discharge	Small beneficial	Minor beneficial
		Leakage from drainage systems	Small adverse	Minor adverse
Blue Anchor to Lilstock SSSI	High	Improvement to surface water discharge	Small Beneficial	Moderate Beneficial
		Leakage from drainage systems	Small adverse	Moderate adverse
Blue Anchor Bay	High	Leakage from drainage systems	Small adverse	Moderate adverse
Washford River	High	Leakage from drainage systems	Negligible	Minor adverse
Groundwater	Low	Leakage from drainage systems	Small adverse	Minor adverse

Table 5—2 Summary of Impact Significance during Operation

5.1.4.1 Mitigation Measures

In order to avoid, reduce and minimise adverse effects on surface water quality from development at Watchet Marina, mitigation controls must be considered from the beginning of the detailed design phase. This will enable mitigation to be embedded in the design and therefore minimise the need for active controls during operation. Suggested mitigation measures for the potential adverse impacts highlighted in Section 5.1.4 are discussed below.

Improvement to Surface Water Discharges

The impacts highlighted with regard to surface water discharge were deemed to be beneficial to the water quality of the surrounding water features. Surface water run off from hard paved areas, including roads and car parks, will be collected in gullies with silt traps and discharged through an oil interceptor to remove hydro-carbons. The water will then be discharged into Watchet Marina.

Roof drainage will be collected by a gravity piped system and also discharged to Watchet Marina. This will not require treatment prior to discharge. The green roof system will also provide a small amount of attenuation to flows.

Leakage from Sewerage or Surface Water Drainage System

A new sewerage system will be constructed to drain the proposed development. Regular monitoring and maintenance to ensure that the drainage system, and related equipment such as interceptors, does not become cracked or blocked will prevent contaminants from infiltrating groundwater and/or migrating towards Watchet Marina.

5.1.5 Residual Impacts

Residual risks from flooding are avoided, however, there is a management role incumbent on the marina operator to close any installed access restriction onto the seafront, and harbour arm. This potential risk is considered negligible, as the harbour authority will have a duty of care to implement the safety feature.

Impacts identified in Section 5.1.3 and Section 5.1.4 have been addressed and mitigation measures proposed to minimise the scale of the impact on the water environment.

The absence of a positive drainage network during the construction phase complicates the methods in which contaminants are contained and treated, primarily hydro-carbons and oils. However, mitigation measures will minimise these impacts, and considering that the impacts will be short term only, the residual impacts will generally be minor.

Mitigation measures have been proposed to treat and contain contaminated soils or pollutants from crude sewage entering the groundwater and/or being washed into Watchet Marina. Good site practice will also reduce the likelihood of accidental spillages of chemicals and fuels from entering the groundwater or site surface water run off.

Good site practice will reduce the likelihood of excess sedimentation in site surface water run off. There are still residual risks remaining, but the probability is low and the risks are short term only, therefore adverse residual impacts will be minor.

Mitigation measures proposed for the operational phase of the development are intended to avoid adverse impacts, rather than minimise. Residual impacts will therefore be negligible.

5.2 Geology and Ground Conditions

5.2.1 Site Users and Current Baseline Conditions

Available information indicates the presence of made ground on the site, some of which may be derived from a former nearby gas works. It is possible that the made ground may be contaminated. Results of chemical testing carried out as part of the ground investigation done in 1997 indicate elevated concentrations of arsenic, copper, lead, mercury and zinc (compared to ICRCL threshold levels for domestic land use). However, these threshold levels are no longer accepted comparators for human health risk assessment. Also, the vertical and horizontal extent of contamination is not known. The site is currently covered by hardstanding and tarmac thus there is no exposure pathway to site users. The risk to current site users under baseline conditions it therefore low to negligible. However, this should be confirmed with further ground investigation works.

5.2.2 Site Users during Construction Phase

A number of potential impacts on site users during the construction phase have been identified. These include:

- Contact with contaminated soils.
- Inhalation of dust arising from construction activities.
- Contact with hazardous materials e.g. fuels, chemicals, cement etc, during construction.
- Ground gas.

The implications of the impacts noted above are discussed in more detail below and summarised in Table 5—3. Mitigation measures which could be implemented to avoid or minimise adverse effects are discussed in Section 5.2.2.1.

Contact with Contaminated Soils

During the construction phase the excavation and removal of potentially contaminated soils will be required during the formation of foundations and substructure. These ground works could bring site users into direct contact with potentially contaminated soils and ground gas accumulations or allow release of contaminated dust or mud into adjacent areas. This is assessed to be a small magnitude adverse effect on a high sensitivity receptor, resulting in an impact significance of MODERATE ADVERSE.

Inhalation of Dust Arising from Construction Activities

Construction activities are likely to generate air-borne dust which could be inhaled by site users. This is assessed to be a small magnitude adverse effect on a high sensitivity receptor, resulting in an impact of MODERATE ADVERSE significance.

Contact with Hazardous Materials

Site users could come into contact with hazardous materials during the construction phase e.g. fuels, chemicals, cement etc, particularly if spillages occur. This is considered to be a small magnitude adverse effect on a high sensitivity receptor, resulting in an impact significance of MODERATE ADVERSE.

Ground Gas

Available information does not indicate any issues relating to ground gas. However, the number of monitoring points, frequency of visits and the length of the monitoring period are not known, and conditions at the site may have changed since the 1997 ground investigation was carried out. The presence of ground gas should be investigated further. If ground gas is found to be present, construction workers are likely to be the only affected parties during the construction phase. This is assessed to be a medium impact, potentially high impact, on a high sensitivity receptor. This gives an impact significance of MAJOR to SEVERE ADVERSE.

Summary

Receptor	Receptor Sensitivity	Impact	Magnitude of Impact	Significance of Impact
Site Users	High	Contaminated soils	Small adverse	Moderate adverse
		Air-borne dust	Small adverse	Moderate adverse
		Hazardous materials	Small adverse	Moderate adverse
		Ground gas	Medium/High adverse	Major/Severe adverse

Table 5—3 Summary of Impact Significance to Site Users during Construction

5.2.2.1 Mitigation Measures

An intrusive ground investigation with appropriate sampling and in situ and laboratory testing should be carried out in order to obtain sufficient information to improve the current understanding of the baseline conditions at the site, and for appropriate mitigation measures to be determined.

Contact with Contaminated Soils

The intrusive ground investigation should include chemical laboratory testing for a suitable suite of determinands, based upon the known site history. The results should be compared against current threshold levels e.g. CLEA Soil Guideline Values, to determine the location, size and concentration of any contaminated areas. Likely mitigation measures may include remediation or avoidance of proven contaminated land through to the use of appropriate Personal Protective Equipment (PPE) during construction activities.

Inhalation of Dust Arising from Construction Activities

Concentrations of air-borne dust are likely to be greatest at the source, with the effects of dispersion and dilution increasing with greater distance from the point of generation. It is therefore likely that members of the public and occupiers of nearby buildings will not be adversely affected by this issue. However, should dust generation be so great that members of the public are affected, likely mitigation measures which could be adopted include damping down to suppress the creation of dust. Construction workers should also use appropriate PPE.

Contact with Hazardous Materials

Hazardous materials e.g. fuels, oils, cement etc, should be stored in accordance with the manufacturers recommendations. Appropriate PPE should be used by all personnel handling any hazardous material. Measures should also be in place to deal with any spillages or leakages quickly and effectively to prevent the general public coming into contact with these materials.

Ground Gas

Although available information suggests that there are no issues relating to ground gas, this needs to be confirmed through further investigation. If ground gas is found to be present, construction workers are most at risk during the construction phase. Mitigation measures include ground gas monitoring as part of an intrusive ground investigation. This should also be done during the construction phase, particularly in confined spaces and areas of hot workings e.g. welding.

5.2.3 Site Users during Operational Phase

This section discusses the likely impacts of the development on site users during the operational phase. The discussion is summarised in Table 5—4.

The main risk to site users during the operational phase is coming into contact with contaminated soils. The proposed development will result in the majority of the site being covered either by the new structures or by hard landscaping. The exposure pathway between site users and contaminated land will be severed. This is considered to be a negligible impact on a high sensitivity receptor, resulting in an impact significance of MINOR ADVERSE.

During the operational phase ground gas can affect residents, visitors and employees in the new structures, as well as maintenance personnel. The effects of each gas are the same as during the construction phase. The impact is assessed as being medium, potentially high, on a high sensitivity receptor, which results in an impact significance of MAJOR to SEVERE ADVERSE. Mitigation measures will be required.

Summary

Receptor	Receptor Sensitivity	Impact	Magnitude of Impact	Significance of Impact
Site Users	High	Contaminated soils Ground gas	Negligible adverse Medium/High adverse	Minor adverse Major/Severe adverse

Table 5—4 Summary of Impact Significance to Site Users during Operation

5.2.3.1 Mitigation Measures

Based on the results of the intrusive ground investigation, including chemical testing, a source-pathway-receptor model should be derived to ensure that all potential mechanisms for site users coming into contact with contaminated soils are identified. During the operational phase, likely mitigation measures could involve the introduction of clean fill material where soft landscaping areas may be contaminated and the venting of ground gas from buildings/confined spaces. Hard covering from buildings, floor slabs, roads and car parking areas will sever the potential exposure pathway between proven contaminated soil and operational site users.

5.2.4 Adjacent Structures during Construction Phase

This section discusses the likely impacts of the development on adjacent structures during the construction phase. The discussion is summarised in Table 5—5**.** Mitigation measures which could be incorporated to avoid or minimise adverse effects are discussed in Section 5.2.4.1**.**

The harbour wall will be subjected to greater loading due to construction traffic etc. If the loading is too great for the wall to tolerate, the integrity of the structure and hence the stability of the site could adversely affected. This is assessed as being a potentially large adverse impact on a high sensitivity receptor resulting in an impact of SEVERE ADVERSE significance.

Nearby buildings are likely to be adversely affected by construction and vibrations associated with the construction process. This is considered to be a small adverse impact on a high sensitivity receptor resulting in an impact significance of MODERATE ADVERSE.

Summary

Receptor	Receptor Sensitivity	Impact	Magnitude of Impact	Significance of Impact
Adjacent Structures	High	Harbour wall	Large adverse	Severe adverse
		Nearby buildings	Small adverse	Moderate adverse

Table 5—5 Summary of Impact Significance to Adjacent Structures during Construction

5.2.4.1 Mitigation Measures

One of the aims of the site investigation should be to obtain as much information regarding the geometry, construction, backfill and history of the harbour wall as possible. The depth, length and form of the anchors to the wall should also be confirmed so that the stability of the wall can be determined. All of this information should be incorporated into the detailed design of the proposed structure and all of the construction processes e.g. temporary works and traffic management, to ensure that the stability of the harbour wall is not impaired. Monitoring of the wall should be carried out to ensure that deflections during the construction period remain within acceptable tolerances. Contingency measures should be put in place in case of excessive or abnormal wall deflections. Alternatively, the wall could be strengthened in some way to increase the load bearing capacity.

Nearby buildings a likely to be affected by the construction works. Mitigation measures that could be adopted include traffic management regimes and the use of banksmen during any reversing manoeuvres.

5.2.5 Adjacent Structures during Operational Phase

This section discusses the likely impacts of the development on adjacent structures during the operational phase. The discussion is summarised in Table 5—6**.**

The new structures will impose additional loads onto the back of the harbour wall. This is assessed as being a potentially large adverse impact on a high sensitivity receptor resulting in an impact of SEVERE ADVERSE significance. Mitigation measures will be required and these are discussed in Section 5.2.5.1.

Nearby buildings are only likely to be affected during the operational phase of the development as a result of increased traffic. This is considered to be a negligible impact on a high sensitivity receptor, giving an impact significance of MINOR ADVERSE.

Summary

Receptor	Receptor Sensitivity	Impact	Magnitude of Impact	Significance of Impact
Adjacent Structures	High	Harbour wall Nearby buildings	Large adverse Negligible	Severe adverse Minor adverse

Table 5—6 Summary of Impact Significance to Adjacent Structures during Operation

5.2.5.1 Mitigation Measures

The stability of the harbour wall is critical to the development. This should be incorporated into the detailed design of the structure to ensure that stability is maintained. The monitoring of the wall that should be undertaken during the construction phase could be continued during the operational phase to check that the wall is not being overstressed by the development. Contingency measures should be put in place to respond to any abnormal or excessive wall movements. The wall could also be strengthened in some way before any construction work is undertaken.

5.2.6 Groundwater during Construction Phase

This section discusses the likely impacts of the development on the groundwater regime during the construction phase. The discussion is summarised in Table 5—7. Mitigation measures which could be incorporated to avoid or minimise adverse effects are discussed in Section 5.2.6.1.

Excavation and filling could adjust the groundwater regime in the short-term, by providing alternative flow paths for the water to follow. This could lead to instability of the ground, particularly during excavation, which could affect human safety and the stability of nearby structures. This is considered to be a small impact on a high sensitivity receptor, resulting in an impact significance of MODERATE ADVERSE.

Summary

Receptor	Receptor Sensitivity	Impact	Magnitude of Impact	Significance of Impact
Groundwater regime	High	Ground instability	Small adverse	Moderate adverse

Table 5—7 Summary of Impact Significance to Groundwater Regime during Construction

5.2.6.1 Mitigation Measures

Further ground investigation works should be carried out to obtain a clearer understanding of the groundwater regime beneath the site. This should include the installation and monitoring of piezometers. The findings of

the additional investigation should be incorporated into the design of excavations and temporary works to reduce the risks associated with ground instability. Furthermore, contingency measures should be in place to reduce the effects of water inundation e.g. pumping. If pumping is adopted, the rate of pumping should not be so great that the effects of instability are exacerbated due to the migration of fine grained material.

5.2.7 Groundwater during Operational Phase

This section discusses the likely impacts of the development on adjacent structures during the operational phase. The discussion is summarised in Table 5—8, below. Mitigation measures which could be incorporated to avoid or minimise adverse effects are discussed in Section 5.2.7.1.

The long-term groundwater regime is likely to be affected by the nature of the materials that are put into the ground during the construction phase. There is the potential for any alteration in ground permeability to affect groundwater flow paths and the associated impacts on adjacent structures e.g. if less permeable material is placed behind the harbour wall, this could act to reduce the water pressures behind the wall. However, the groundwater could be forced to other parts of the site and the surrounding area, thereby increasing the water pressures there. This is considered to be a medium impact on a high sensitivity receptor, resulting in an impact significance of MAJOR ADVERSE.

Summary

Receptor	Receptor Sensitivity	Impact	Magnitude of Impact	Significance of Impact
Groundwater regime	High	Ground instability	Medium adverse	Major adverse

Table 5—8 Summary of Impact Significance to Groundwater Regime during Operation

5.2.7.1 Mitigation Measures

Further ground investigation works should be carried out to obtain a clearer understanding of the groundwater regime beneath the site. This should include the installation and monitoring of piezometers. The findings of the additional investigation should be incorporated into the design development to ensure that materials of an appropriate permeability are used in areas of filling. An assessment could also be carried out to determine the likely knock-on effects of any groundwater changes on other structures in the surrounding area.

5.2.8 Residual Impacts

Potential sources of contamination have been identified. These are primarily associated with made ground present on the site and due to the historical use of the site.

The range of results of chemical testing that is available have indicated the potential for elevated concentrations of arsenic, copper, lead, mercury and zinc. However, the available results have previously

been compared, by others, against ICRCL threshold values which have been superseded. There is also the potential for hydrocarbons to be present due to fuels and oils. It is understood that some of the made ground may be derived from a former nearby gas works. Contamination other than that which has been identified may therefore exist. Further investigation is required to determine the extent and nature of contamination with regards controlled waters and human health.

Residual impacts are considered in Table 5—9 overleaf. There are currently no specific measures envisaged for dealing with these impacts. This will be reviewed as further information becomes available from ground investigation works.

Table 5—9 Summary of Residual Impacts

Significant Residual Impacts	Hotspot of contamination detected by ground investigation or during construction and remediated, thereby reducing impacts on controlled waters.	As above but dependent on rainfall infiltration which is reduced during operation phase	Undetected contamination sources may exist or be generally present in made ground which could be causing pollution of controlled water independent of rainfall infiltration effects	Impact of materials used during filling activities on groundwater regime, which may have knock-on effects on adjacent structures
Importance of Receptor	Medium/ High	Medium/ High	Medium/ High	High
Magnitude of Change	Medium beneficial	Negligible beneficial	Negligible neutral	Moderate adverse
Duration	Permanent	Permanent	Permanent	Permanent
Nature	Indirect	Indirect	Indirect	Indirect
Significance	Unknown	To be determined based on results of further ground investigation	To be determined based on results of further ground investigation	To be determined based on results of further investigation
Level of Certainty	Uncertain	Uncertain	Uncertain	Uncertain

6 Findings and Conclusions

The work undertaken in preparation of this Environmental Statement has resulted in a number of potential environmental impacts being identified. These have been assessed in terms of the likely magnitude of the impact and the sensitivity of the receptor, giving an impact significance rating. Where appropriate, mitigation measures have been identified which, if implemented, would help to reduce the significance of these impacts. These findings are summarised in Table 6—1 and Table 6—2.

Parameter	Environmental Impact *Impact Significance*	Mitigation Measure *Residual Impact Significance*
Water Resources	Coastal erosion unaffected by the scheme	None
	Tidal flood risk	No ground floor residential. Raised floor levels and thresholds. Safe Pedestrian access / egress. Secondary Sea Defence
	Major Adverse	*Negligible*
	Increased sediment loads during construction	Minimise area and gradient of exposed surfaces. Boundary control. Wheel wash facilities. Treatment measures and interception measures.
	Moderate Adverse	*Minor adverse*
	Dust and debris	Dust management procedure, e.g. damping
	Minor adverse	*Negligible*
	Accidental leaks and spillages of hazardous materials	In accordance with EA's Pollution Prevention Guidance. Appropriate storage, interceptors and designated work areas.
	Major Adverse	*Negligible*
	Disturbance of contaminated land	Remediation or removal of contaminated ground prior to construction
	Moderate Adverse	*Negligible*
	Hydro-carbons and oils	Use of interceptors and drip trays.
	Moderate Adverse	*Minor adverse*
	Leaks from on-site drainage system	Adherence to routine inspection and maintenance.
	Moderate Adverse	*Negligible*

Table 6—1 Summary of Potential Environmental Impacts and Mitigation Measures for Water Resources

Parameter	Environmental Impact Impact Significance	Mitigation Measure Residual Impact Significance
Geology & Ground Conditions	Disturbance of contaminated soils with regards human health *Moderate adverse*	Additional ground investigation, remediation/capping/removal, PPE *Negligible*
	Dust generation with regards human health *Moderate adverse*	Damping down, PPE *Negligible*
	Ground gas with regards human health *Major/severe adverse*	Additional ground investigation, monitoring during construction, gas protection measures *Negligible*
	Contact with hazardous materials e.g. fuels *Moderate adverse*	Appropriate storage procedures, PPE *Negligible*
	Overloading of harbour wall *Severe adverse*	Additional ground investigation, detailed design of proposed structures and temporary works, monitoring, wall strengthening *Minor adverse*
	Noise and vibration effects on nearby buildings *Moderate adverse*	Traffic management *Minor adverse*
	Effects of development on groundwater regime with regards impacts on nearby structures and ground stability *Moderate/Major adverse*	Additional investigation, detailed design of temporary works (including need for pumping etc), choice of suitable fill materials *Minor adverse*

Table 6—2 Summary of Potential Environmental Impacts and Mitigation Measures for Geology and Ground Conditions

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