17.0 WATER QUALITY AND HYDROLOGY

17.1 INTRODUCTION

This section deals with the assessment of the potential impacts of the proposed development on water quality and hydrology in the study area. The study area is defined as that within a 1 km radius of the site, although a number of issues are considered at the river catchment level.

The assessment of effects encompasses surface water and groundwater quality, surface water and groundwater resources (in terms of water quantity) and flooding.

17.2 POLICY CONTEXT

17.2.1 European Legislation

With regard to the protection of specific water resources, permissible water quality standards and related policy are set out in the following European legislation:

- EC Water Framework Directive (2000/06/EC);
- EC Surface Water Abstraction Directive (75/440/EEC);
- EC Bathing Water Directive (76/160/EEC);
- EC Freshwater Fish Directive (78/659/EEC);
- EC Shellfish Directive (79/923/EEC);
- EC Dangerous Substances Directive (76/464/EEC);
- EC Groundwater Directive (80/68/EEC);
- EC Urban Waste Water Treatment Directive (91/271/EEC); and
- EC Nitrate Directive (91/676/EEC).

17.2.2 National Legislation and Policies

The aim of water policy in England is to protect both public health and the environment by maintaining and improving the quality of natural waters. These include surface water bodies (e.g. rivers, streams, lakes, ponds) and groundwater.

The Department of the Environment, Food and Rural Affairs (DEFRA) is responsible for all aspects of water policy in England. Management and enforcement of water policy is the responsibility of the Environment Agency (EA). A summary of relevant UK water legislation is provided below:

- *Environmental Protection Act* (1990): sets out a range of provisions for environmental protection, including integrated pollution control for dangerous substances;

- *Water Resources Act* (1991): consolidated previous water legislation with regard to both the quality and quantity of water resources;

- *Water Industry Act* (1991): consolidated previous legislation relating to water supply and the provision of sewerage services;

- *Environment Act* (1995) established a new body (the Environment Agency) with responsibility for environmental protection and enforcement of legislation. This Act introduced measures to enhance protection of the environment including further powers for the prevention of water pollution;

- *Anti-Pollution Works Regulations* (1999): provides powers to the EA to stop any activity (e.g. construction) that gives rise or is likely to give rise to environmental pollution or to adequately enforce pollution control measures; and

- *Water Act* (2003) extends the provisions of the Water Resources Act (1991) and the Environment Act (1995) with regard to abstractions and discharges, water conservation and pollution control.

At the national planning policy level, there are two key Planning Policy Statements (PPS) that are directly relevant:

- PPS 23 – Planning and Pollution Control; and
- PPS 25 – Development and Flood Risk.

17.3 ASSESSMENT METHODOLOGY

17.3.1 Baseline Data

This assessment has been undertaken in accordance with current Government guidance on EIA[1] and has involved a review of the following sources of baseline data:

- Landmark Envirocheck data for the site and a 1 km radius; providing data on surface water and groundwater discharges and abstractions, river quality, baseline hydrogeology, groundwater vulnerability and pollution incidents;
- EA data records on groundwater Source Protection Zones (SPZs), chemical and biological river quality and the location of the indicative floodplain (www.environment-agency.gov.uk);
- consultation with the EA; and
- consultation with Northwest Water via the project engineers (WA Fairhurst and Partners).

Site visits have been undertaken as part of the Flood Risk Assessment (FRA) and Phase II site investigation. Data on river quality has been acquired from the EA and from the Phase II site investigation work.

The findings of the Phase I and Phase II Site Investigations provided sufficient data on the site geology and hydrogeology; the specific methodology for these studies has been summarised in *Section 14* - Soils, Geology and Contamination.

A stand alone FRA has been completed in accordance with PPS 25, which formed the basis of the hydrological assessment within this chapter and is included as a separate document within the planning application package. The FRA is included as *Appendix 17.1* of this ES report.

17.3.2 Identification of Impacts

The effects on water quality and hydrology likely to arise from the construction and operational phases of the proposed development are principally the following:

- effects related to the discharge of construction site runoff during earthmoving and general construction works;
- the potential disruption of groundwater flows from piling and the dewatering of excavations;
- effects related to the discharge of routine site runoff on local land drainage and water quality; and
- potential impacts arising in relation to water demand and foul drainage capacity.

17.3.3 Assessment and Evaluation of Effects

The assessment of effects has involved the following general approach:

- the sensitivity of aquatic receptors has been established on the basis of their use, proximity to the site, existing quality or resource value and consideration of potential pathways;
- evaluation of the significance of the potential changes in water quantity and quality and assessment of the sensitivity of the resource to the predicted changes;
- the potential effects have been classified, prior to mitigation, as minor, moderate or major (either positive or negative) as described in Section 4.3; and

[1] Environmental Impact Assessment – A Guide to Procedures, DETR, November 2000.

- where the predicted effects are considered to be significant, mitigation measures have been incorporated to eliminate or reduce the impacts to an acceptable level. The residual effects (post mitigation) are discussed in the final subsection of this chapter.

17.4 BASELINE ENVIRONMENTAL CONDITIONS

17.4.1 Surface Water Quality

The two nearest surface watercourses to the development area are Ditton Brook and Steward's Brook. Ditton Brook flows adjacent to the south-western boundary of the Foundry Lane site and to the south of the Reclamation site. Steward's Brook is classified by the EA as a main river and flows between the Reclamation site and the West Bank Dock site (in the north) and flows between the Reclamation site and the adjacent HEDCO landfill site in the south.

Both Ditton and Steward's Brook are tidal. The normal tidal limit for Ditton Brook is upstream of the bridge, near the northern entrance to the Foundry Lane site. The normal tidal limit for Steward's Brook is approximately half way between the access road connecting the Reclamation Site with the West Bank Dock Site and the confluence of Ditton Brook and Steward's Brook.

Information provided by Landmark Envirocheck shows there have been four pollution incidents to controlled waters associated with the study site, the details of which are summarised in *Table 17.1*. Two of these were minor incidents on Ditton Brook and related to rubble/litter or chemicals. The two incidents on Steward's Brook were due to leachate from the Reclamation Site. One was a minor incident and the other one was a significant incident. However, there have been no reported pollution incidents since July 1996. The Reclamation Site was remediated at this time, which may explain why there have been no recorded pollution incidents since 1996.

TABLE 17.1: POLLUTION INCIDENTS TO CONTROLLED WATERS

Date	*Location*	*Receiving water*	*Pollutant*	*Category of incident*
19/01/93	Reclamation site	Ditton Brook.	Rubble/Litter	Minor Incident (Category 3)
12/03/94	Foundry Lane site	Ditton Brook	Chemicals – Paints/Dyes	Minor Incident (Category 3)
24/05/95	Reclamation site	Steward's Brook.	Tip leachate	Minor Incident (Category 3)
31/07/96	Reclamation site	Steward's Brook.	Tip leachate	Significant Incident (Category 2)

It is understood from anecdotal evidence that there may have been five discharge consents associated with the proposed site itself. However, the EA have no record of this and such discharge consents do not appear to exist.

Based on the site survey, there are six known storm water outfall locations for the three sites; three to Ditton Brook, two to Steward's Brook and one to Marsh Brook. However, there are no obvious discharges from the site and the outfalls that can be seen appeared to be dry at the time of the site visits associated with this project.

Details of sewage and trade effluent discharge consents in the area have also been provided by the EA (*Table 17.2*). Four of these discharges are to Ditton Brook, five to Marsh Brook, one to Steward's Brook and three direct to the River Mersey.

Table 17.2: Details of Discharges Consents

Consent No.	*Grid Ref*	*Address*	*Details*	*Watercourse*
106982995	SJ48778472	United Utilities Water PLC	Storm Sewage effluent combined sewer overflow	Ditton Brook US Railway line
016920500	SJ48958465	United Utilities Water PLC	Storm and emergency overflow outlet to Ditton Brook	Ditton Brook at Railway line
016991285	SJ49408400	Betz Dearborn	Sewage effluent	Ditton Brook
016992284	SJ49108460	Tilcon Ltd	Tarmac Vehicle Washing Plant	Ditton Brook
016820396	SJ50418400	United Utilities Water PLC	Storm Overflow outlet to Stream River Mersey Estuary	Marsh Brook
016990652	SJ50448410	Marsh Maintenance Ltd	Sewage effluent outlet	Marsh Brook
016990653	SJ50468418	Marsh Maintenance Ltd	Sewage effluent outlet	Marsh Brook
016990654	SJ50518442	Marsh Maintenance	Sewage effluent outlet	Marsh Brook

Table 17.2: Details of Discharges Consents				
Consent No.	*Grid Ref*	*Address*	*Details*	*Watercourse*
		Ltd		
016990655	SJ50308445	Marsh Maintenance Ltd	Sewage effluent outlet	Marsh Brook
016990216	SJ50108480	McKechnie Chemicals Ltd	Trade effluent sampling manhole	Steward's Brook US Railway line
016921000 A	SJ50398399	United Utilities Water PLC	Storm sewage overflow manhole, West Bank Dock Estate	R Mersey
016990602	SJ50408400	Granox Ltd	Treated Sewage effluent Barber Drain River Mersey estuary	R Mersey
016990656	SJ49308380	Croda Colloids	Drain to R Mersey W Ditton Bk	R Mersey

Source: Landmark Envirocheck

There are no identified surface water abstractions within a 2 km radius of the site.

Both Ditton and Steward's brooks have been classified by the EA under the General Quality Assessment (GQA) and this data is presented in *Table 17.3*. Marsh Brook lies to the east of the West Bank Dock Site and is unclassified.

TABLE 17.3: CHEMICAL AND BIOLOGICAL QUALITY		
Water Quality Variable	***Ditton Brook***	***Steward's Brook***
Chemical Quality	2004 to 2006 – Grade F (bad)	2004 to 2006 – Grade F (bad)
Biological Quality	2000 – Grade F (bad)	2006 – D (fair)
River Quality Targets	2004-2006 – Target 4 Significant failure (This watercourse has not achieved its target since 1992, earlier records are unavailable)	2004-2006 – Target 4 Significant failure (This watercourse has not achieved its target since 1991, earlier records are unavailable)

In addition to the water quality information provided by the EA, sampling was undertaken by ENVIRON on Steward's Brook and Ditton Brook in November 2004. The sampling points were selected to provide a 'snap shot' of the conditions encountered on-site and were restricted to accessible and safe locations due to the nature of the site, the watercourses and therefore appropriate health and safety measures were employed.

The sampling methodology comprised using a dedicated plastic bailer with string for each sampling point. The samples were then decanted into clean sterile glass jars, appropriate for the type of analysis intended.

Specifically the sample locations were as follows:

- Sample 1 – Ditton Brook - Bridge at Foundry Lane;
- Sample 2 – Confluence of Ditton Brook, Steward's Brook and the mouth of the River Mersey;
- Sample 3 – Steward's Brook - located approximately half way along the mound; and
- Sample 4 – Steward's Brook – located upstream at the northern boundary of the site.

The samples were analysed by an independent UKAS and MCERTS accredited laboratory for a range of chemical determinands. The analytical results were compared with UK Environmental Quality Standards (EQS) for Coastal and Estuarine waters for List 1 and List 2 dangerous substances as prescribed by the EC Dangerous Substances Directive (76/464/EEC). In the absence of EQS limits, UK Water Supply (Water Quality) Regulations 2000 were used to provide an indication of the relative magnitude of contaminants present within the surface watercourses. These are often referred to as the Drinking Water Quality guidelines (DWQ) and implement the EC Drinking Water Directive (98/83/EC). No guideline values are currently available for total hydrocarbons within water and therefore a tentative comparison has been made with the Dutch Intervention Value (Dutch Ministry of Housing circular DBO/1999226863) for Mineral Oil.

The analytical regime comprised the following suite:

- pH, sulphate, sulphide, chloride, and total cyanide;
- a range of dissolved metals (As, Cd, Cr, Pb, Hg, Se, Cu, Ni, Zn and Fe);
- nitrate as N, ammonia as N, total organic carbon and alkalinity as $CaCO_3$;
- major ions (Na, K, Ca and Mg);
- speciated polyaromatic hydrocarbons (PAH's), monohydric phenol and total petroleum hydrocarbons (TPH); and
- Volatile Organic Compounds (including Chlorinated Organic Compounds).

The analytical results were compared with UK EQS and DWQ standards and the interpretation is summarised in *Table 17.4*.

Table 17.4: SUMMARY OF MAJOR IONS (IN SURFACE WATER) ANALYTICAL RESULTS (µg/L)				
Determinant	***No. Analysed***	***No. Equal to or exceeding Guideline***	***Max. Conc. Detected (Sample Ref.)***	***Guideline Values UK DWQ (µg/L)***
Chloride	4	4	130,000 [Sample 2]	250
Nitrate as N	4	-	61,000 [Sample 3]	ND
Ammonia as N	4	4	11,000 [Sample 4]	500
Alkalinity as $CaCO_3$ (mg/L)	4	-	210 [Sample 1]	ND
Sodium	4	4	130,000 [Sample 4]	200
Potassium	4	-	22,000 [Sample 4]	ND
Calcium	4	-	230,000 [Sample 4]	ND
Magnesium	4	0	28,000 [Sample 4]	50,000

Results Summary

The results show pH values were slightly acidic-neutral (in the range 4.1-7.8).

Sulphate was detected at a maximum concentration of 1,900 mg/L (Sample 3 – Steward's Brook) and 1,300 mg/L (Sample 4 – Steward's Brook). The samples obtained from Ditton Brook were significantly lower, 91 mg/L and 98 mg/L from Sample 1 and 2 respectively.

Total cyanide was not detected above their laboratory detection limits, and therefore below relevant guidelines.

Concentrations of dissolved metals (chromium, cadmium, lead, mercury, selenium and copper) were below their respective analytical detection limits.

Arsenic was recorded above the laboratory detection limits in all four water samples. Samples 3 & 4 (Steward's Brook) recorded the highest with 67 and 190 µg/L respectively. Samples obtained from Ditton Brook recorded 5 and 13 µg/L, which are below the EQS of 25 µg/L for Coastal and Estuarine waters.

Sulphide was recorded in all four samples and ranged from 0.14 µg/L to 8.0 µg/L. The maximum concentration was recorded in Sample 4 (Steward's Brook).

Nickel was not recorded within the samples obtained from Ditton Brook (Samples 1 & 2) and had a maximum concentration of 9 µg/L recorded in Sample 3. All results are below the EQS limit of 30 µg/L for Coastal and Estuarine waters.

Zinc was recorded below the EQS of 40 µg/L for Coastal and Estuarine waters from the samples obtained from Ditton Brook (Samples 1 & 2). The maximum concentration was recorded in Sample 3 (Steward's Brook) at a concentration of 590 µg/L, which significantly exceeds the EQS limit.

Iron was recorded below the EQS of 1,000 µg/L for Coastal and Estuarine waters from the samples obtained from Ditton Brook (Samples 1 & 2). Both samples from Steward's Brook exceeded the EQS with a maximum concentration of 2,300 µg/L recorded at Sample 3.

Individual ions were generally detected at significantly elevated concentrations. All of the samples analysed for chloride recorded concentrations that significantly exceeded the UK DWQ standard for this parameter, with concentrations ranging from 53,000 (Sample 3) to 130,000 µg/L (Sample 2). Ammonia as N concentrations were all recorded at concentrations in excess of the guideline value of 500 µg/L, with concentrations ranging from 1,100 µg/L (Sample 3) to 11,000 µg/L (Sample 4). None of the samples recorded concentrations of magnesium above the 50,000 µg/L guideline value as set by the UK DWQ standard. All of the samples recorded sodium concentrations in excess of the guideline value (200 µg/L) with the maximum recorded in Sample 4 (Steward's Brook) at 130,000 µg/L.

There are no set guideline criteria for nitrate, alkalinity, potassium or calcium; however, concentrations of each of the compounds were detected within each of the water samples.

All four samples were analysed for monohydric phenol. Sample 4 was the only sample that exceeded the detection limit with a concentration of 68 µg/L.

All four samples were analysed for speciated polyaromatic hydrocarbons (PAH), which records the sixteen most commonly occurring compounds. Only Naphthalene currently has an EQS for Coastal and Estuarine waters, with an EQS of 5 µg/L. Only Sample 4 recorded a concentration above this value (7.2 µg/L), which slightly exceeds the EQS limit. The maximum concentration of Total PAH was recorded in Sample 4, at a concentration of 8.8 µg/L.

All four samples were analysed for Volatile Organic Compounds (VOCs). No VOCs were recorded in Sample 3 and only trace concentrations of chloroform [1 µg/L] were recorded in Samples 1 and 2. Trace compounds were recorded in Sample 4 and with the exception of tetrachloroethene [EQS 10 µg/L] at 22 µg/L, were all below their respective EQS limits, where applicable.

There is currently no EQS limit or DWQ standard for total petroleum hydrocarbons (TPH) therefore the Dutch Intervention Value (600 µg/L) was used for comparison. All four samples were analysed for TPH by GC-FID for carbon band ranges C10 – C40. Only Sample 4 recorded a concentration above the laboratory detection limit (10 µg/L) at 200 µg/L, which is described as *'…the sample chromatogram contains a hump of unresolved complex material overlain by a series of peaks consistent with kerosene standard'*. The sample does not exceed the Dutch Intervention Value; however, it is indicative of the presence of light distillate fractions within the watercourse.

Conclusions of Surface Water Sampling

The sampling of Ditton Brook on the site's western boundary and Steward's Brook, which flows through the site has indicated that several chemical species exceed the EQS limits for Coastal and Estuarine waters, particularly Sample 4 obtained upstream in Steward's Brook. Concentrations were noted to be reduced downstream and generally lower concentrations were recorded within Ditton Brook.

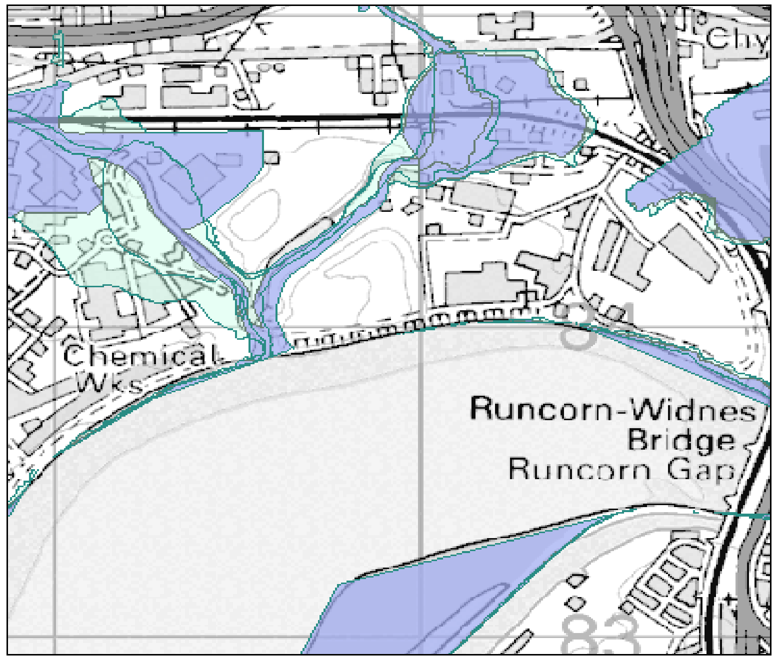
The source of the elevated concentrations with respect to the various guidelines [EQS, DWQ and Dutch I] is believed to be the contaminating surrounding land use and particularly, historical deposition of galigu in the area and the HEDCO landfill site, which forms part of the eastern boundary of Steward's Brook. Notably, the site upstream of Steward's Brook (St Michael's Golf Course) is currently undergoing remediation due to elevated metal species within the shallow ground, and measures are being undertaken with respect to contaminated discharges to the surface watercourse. It is also anticipated that there will be an active leachate management and control system on the HEDCO site in the future which will collect leachate currently believed to be issuing to Steward's Brook and send it for off-site treatment.

It is recognised that although the golf course and HEDCO site are likely to be the main contributors to contamination of Steward's Brook, there may be some infiltration and leaching of contaminants from the development site that is adding to the pollution loading. It should be noted, however, that the reclamation mound (which also comprises galigu) is unlikely to be a pollution source for the Brook because a wall of sheet piling was installed to prevent cross-connection of groundwater beneath the reclamation mound with the water in Steward's Brook.

17.4.2 Hydrology and Flood Risk

The EA's floodplain map for Ditton (Figure 17.1) suggests that a large part of the Foundry Lane Site, and a small part of the West Bank Site, may be affected by tidal flooding, whilst the Reclamation Site is above these flood levels. However, the EA's floodplain map assumes that no flood defences are present. There is in fact a flood defence wall adjacent to the Foundry Lane area.

Figure 17.1: EA Indicative Floodplain Map



The calculation of flood levels and the effectiveness of these defences are described in detail in the FRA (see *Appendix 17*) and are summarised below:

- probability analysis suggests a 200 year tidal flood level at the site of 7.3 mAOD. Allowing for a 4 mm/yr sea level rise to account for climate change, the 200 year flood level is predicted to be approximately 7.5 mAOD by 2050;

- the Foundry Lane development area has a minimum ground level of 6.35 m AOD but is protected by a flood defence wall of 7.7 mAOD. The Reclamation Site and West Bank Dock Site have ground levels above 8.5 mAOD;

- the EA advise that there has been one major flood event on Ditton Brook in February 1990, when the Golden Triangle complex on Ditton Road was flooded due to a tidal water level of 7.03 mAOD. There is no available historical or anecdotal evidence relating to flooding of the development site itself;

- therefore, most of the site lies above the estimated flood level for the 1 in 200 year flood by 2050 and suitable protection is provided by the existing flood defence wall. Overtopping of this wall could occur if wave heights are greater than 200 mm, or more extreme events occur by 2050, hence it is recommended that where possible all finished floor levels include a minimum freeboard of 600 mm above the 2050 200 year tide levels, i.e. at 8.1 mAOD; and

- the existing flood wall and natural lie of the land provide a measure of flood defence to an appropriate standard although regular inspections and maintenance of the flood wall are recommended.

17.4.3 Hydrogeology and Groundwater Quality

An intrusive Phase II Environmental Assessment of the site has been carried out by ENVIRON (2004) to provide supporting information for the EIA, with a number of window samples and boreholes being excavated. The objective of the investigation was to provide information on the current environmental condition of the soils and groundwater underlying the site. This was used to determine if significant risk and/or liabilities are associated with land contamination at the site in its current condition and in terms of potential risks for the proposed future end uses.

According to the British Geological Survey (BGS) Solid and Drift Map for Runcorn (Sheet 97, Scale 1:50,000), the site is directly underlain by recent Marine and Estuarine Alluvium (the River Mersey is tidal within this area). This is further underlain by the Upper Mottled Sandstone of the Triassic Sherwood Sandstone Group at depths ranging from 12 metres below ground level (mbgl) to over 35 mbgl. The Sherwood Sandstone Group is underlain by Permian sandstones and further underlain by the Carboniferous Coal Measures.

Estuarine alluvial deposits commonly comprise soft dark grey clays, silts and occasional sands, which may be organic and contain shelly material. The Sherwood sandstone group comprises sandstones which are typically red in colour, occasionally mottled with yellow and white patches. The fine grained sandstone bedrock is variably weathered and is encountered in varying forms of compaction from loose sand to hard rock.

The site investigation data found drift deposits present across the site, generally comprising alluvium over sands with interbedded glacial clay with sand horizons below. The thickness of the drift deposits vary across the site from east to west with depth to rock head recorded as varying between 14 mbgl [BH8] to 37.5 mbgl [BH31] in the eastern section. This significant variation appears to coincide with a conjectured palaeo-channel which is present in the vicinity of the site but may be explained also by the undulating unconformable sandstone bedrock, infilled rock head hollows or an unrecorded fault line.

A summary of the general site geology is provided in *Table 17.5*.

Table 17.5: General Summary of the Site's Geology

Site	Strata	Description	Depth Encountered (mbgl)	Thickness (m)
Foundry Lane Site	Made Ground	Limestone chippings, concrete or soil / clay matrix.	From ground level	Generally between 0.3-1.5
		Variable brown/grey, clay/sand or dense black ash with fragments of gravel brick and occasional inclusions of metal slag and cinder.	0.3-5.0	0.6-3.7
	Alluvium	Soft to firm grey/brown silty CLAY or clayey SILT with occasional	2.0-10.5	1.2-7.5

Site	Strata	Description	Depth Encountered (mbgl)	Thickness (m)
		inclusions of peat.		
	Glacial Till	Firm to stiff, brown/reddish brown silty or sandy CLAY with occasional gravel deposits.	4.0-12.8	1.0-8.8
	Sandstone	Weak / moderately weak, poorly cemented, red/brown, medium/coarse grained SANDSTONE.	10.5	Not proven in excess of 5.0
Reclamation Site - southern section of the mound	Made Ground	Grass over topsoil	From ground level	Generally between 0.3-0.7
		Variable soft to firm, brown/grey, silty/sandy clay with fragments of gravel, brick, wood and inclusions of reinforced wire, plastic and organic matter.	0.3-3.6	Generally between 2.0-3.2
		Galligu chemical waste.	2.7-5.3	Not proven in excess of 5.3
Reclamation Site - northern section of the mound	Made Ground	Limestone chippings or a soil / clay matrix.	From ground level	Generally between 0.3-0.9
		Soft to firm brown/grey, sandy silty clay/clayey silt or dense black ash with fragments of gravel brick, concrete, reinforced wire and plastic.	0.3-2.5	Generally between 1.1-1.9
		Galligu chemical waste.	1.5-7.0	Generally between 4.1 and 4.5
		Soft to firm, black silt with an odour reminiscent of gas works waste.	5.6-10.5	Generally between 1.8-3.5
	Alluvium	Medium, dense, fine grey / brown silty SAND	10.5-15.0	Approx. 4.5
	Glacial Till	Firm to stiff brown silty / sandy CLAY with sand and gravel deposits	7.4-30.5	Generally between 4.4 m (BH14 and 15.5 m (BH23)
	Sandstone	Weak / moderately weak, poorly cemented, red/brown, medium/coarse grained SANDSTONE.	From 11.8 (BH14) to 30.5 (BH23)	Not proven in excess of 5.0

Table 17.5: General Summary of the Site's Geology

Site	Strata	Description	Depth Encountered (mbgl)	Thickness (m)
West Bank Dock Site	Made Ground	Limestone chippings, concrete or soil / clay matrix.	From ground level	Generally between 0.2-1.0
		Variable brown/grey/black sand, silt or clay or dense black ash with fragments of gravel brick, concrete, metal slag and occasional pieces of wood reinforced with wire, ceramic tiles, plastic, organic matter and coal.	0.2-6.5	Generally between 0.6-5.5
		Galligu chemical waste.	0.7-10.0	Generally between 4.2-9.3
	Alluvium	Soft to firm grey/brown/black silty CLAY, clayey SILT or SAND	8.0-19.4	Generally between 7.6-9.6
	Glacial Till	Firm to stiff brown silty / sandy CLAY with sand and gravel deposits	15.6-38.8	Generally between 15.7-22.9
	Sandstone	Very weak to weak, poorly cemented red/brown fine grained SANDSTONE.	33.3	Not proven in excess of 8.0

The site investigation included sampling of the soil and groundwater for a number of parameters including:

- a range of dissolved metals (As, Cd, Cr, Pb, Hg, Se, Cu, Ni, Zn and Fe);
- pH, sulphate, sulphide, chloride, and total cyanide;
- nitrate as N, ammonia as N, total organic carbon and alkalinity as CaCO3;
- major ions (Na, K, Ca and Mg);
- speciated PAHs, monohydric phenol and TPH; and
- VOCs including Chlorinated Organic Compounds.

The site investigation concluded that the nature and level of contaminants identified across the site were substantial and that the soil contamination is providing an ongoing source of contamination to groundwater.

Resting groundwater levels were monitored following the installation of the wells and prior to purging and sampling. The resting groundwater levels provide a more accurate representation of groundwater levels across the site compared to inflow depths. From a topographic survey conducted at the site, the groundwater levels were calculated in relation to ordnance datum, as shown in *Table 17.6*.

Table 17.6: Groundwater Levels

Position	Date	Groundwater Level	Ground Elevation	Groundwater Level
		(m bgl)	(m AOD)	(m AOD)
BH8	24.11.04	1.43	6.672	5.242
	10.01.05	1.32	6.672	5.352
BH9	24.11.04	4.57	6.346	1.776
	10.01.05	4.35	6.346	1.996
BH11	29.11.04	0.8	6.362	5.562
	10.01.05	0.78	6.362	5.582
BH12	03.12.05	2.88	6.828	3.948
	10.01.05	4.17	6.828	2.658
BH14	30.11.04	2.57	9.669	7.099
	10.01.05	2.58	9.669	7.089
BH15	03.12.04	5.32	6.373	1.053
	10.01.05	4.36	6.373	2.013
BH23	02.12.04	9.26	11.127	1.867
	10.01.05	8.21	11.127	2.917
BH31	06.12.04	9.59	11.217	1.627
	10.01.05	8.25	11.217	2.967
BH34	06.12.04	6.15	11.177	5.027
	10.01.05	6	11.177	5.177
BH43	07.12.04	4.72	13.089	8.369
	10.01.05	4.66	13.089	8.429
BH51	30.11.04	Dry	16.173	----
	10.01.05	Dry	16.173	----
BH55	30.11.04	7.62	14.244	6.624
	10.01.05	11.07	14.244	3.174
WS4	26.11.04	3.43	11.616	8.186
	10.01.05	3.41	11.616	8.206
WS6	26.11.04	3.09	11.2	8.11
	10.01.05	3.07	11.2	8.13
WS11	26.11.04	Dry	15.47	---
	10.01.05	Dry	15.47	---
WS16	26.11.04	Dry	13.4	---
	10.01.05	Dry	13.4	---

m AOD = m Above Ordnance Datum

m bgl = m below ground level

BH14, BH34, BH43 and BH51 installed with a 50 mm diameter standpipe within the Made Ground deposits.

WS4, WS6, WS11 and WS16 installed with a 19 mm diameter piezometer within the Made Ground deposits.

BH8, BH9, BH11 and BH15 installed with a 50 mm diameter standpipe within the alluvial drift deposits.

BH31and BH23 installed with a 50 mm diameter standpipe within the sand and gravel deposits within the Glacial Till horizon.

BH12 and BH55 installed with a 50 mm diameter standpipe within the clay deposits within the Glacial Till horizon.

The shallow groundwater encountered beneath the site, appears to be perched within the made ground. The made ground is underlain by alluvial drift deposits, which are further underlain by Glacial Till and then Fluvio-Glacial Sands and Gravels, which are all water bearing and would be sensitive to mobile site-derived contamination. Equally, the possibility exists that the underlying major sandstone aquifer is in hydraulic continuity with the groundwater encountered within the alluvial deposits and may therefore also be sensitive to site derived contamination.

The site investigation has focused on assessing shallow soil and groundwater conditions and has not been designed to include the assessment of the groundwater within the underlying Sandstone Series. However, the glacial clay overlying the sandstone is likely to restrict the vertical migration of mobile contaminants into the sandstone to an extent, although the clay layer is not reported to be continuous across the site. Overall, the risk to groundwater from site-derived contamination is considered to be moderate as there is the potential for contaminants to leach from the soils into the groundwater bodies, which may be interconnected.

The groundwater vulnerability map for West Cheshire (Sheet 16, scale 1:100,000) shows the site to be located on a minor aquifer, relating to the superficial drift deposits. These are variably permeable formations and can be fractured or potentially fractured rocks or other formations of variable permeability. They seldom produce large quantities of water for abstraction, but may support local abstractions and are important in supplying base flow to rivers. The underlying Sherwood Sandstone Group is considered to be a major aquifer.

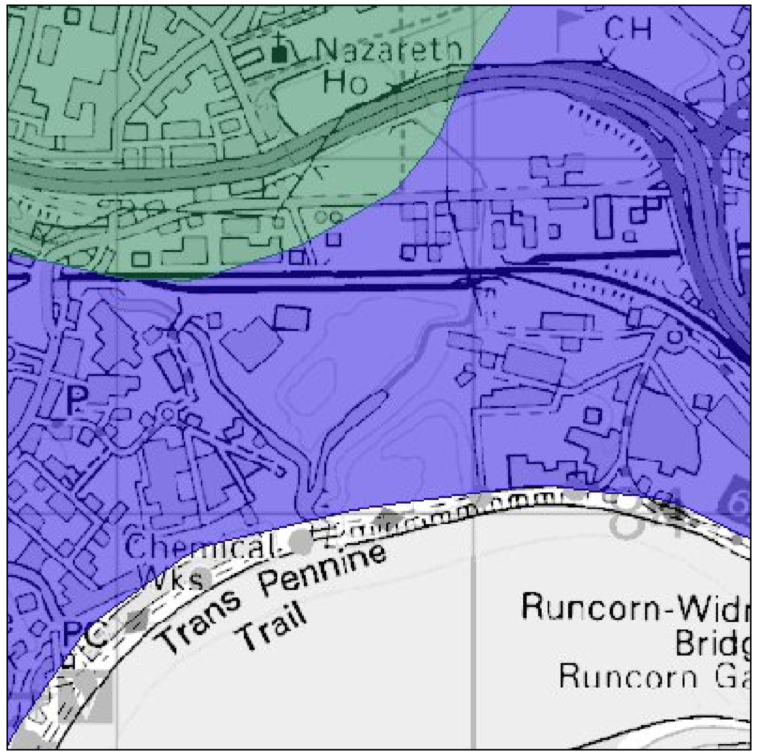
It is anticipated that groundwater levels beneath the site would be tidally influenced by the River Mersey and may be saline.

As the site is within an urban area, any underlying soils are automatically classified as having high leaching potential (HU), i.e. they have little ability to diffuse source pollutants and liquid pollutants have the potential to move rapidly into underlying strata (it should be noted that all soils within urban areas are classified according to the worst case scenario).

The site does not lie within a Nitrate Vulnerable Zone (NVZ). However, according to the EA the site does lie within Zone 3 of a Groundwater Source Protection Zone (SPZ) (Figure 17.2). The EA use the zones to show the risk of contamination from any activities that might result in groundwater pollution. The maps show three main zones (inner, outer and total catchment). The EA defines the zones accordingly:

- **Zone 1 (Inner Protection Zone):** any pollution that can travel to the borehole within 50 days from any point within the zone is classified as being inside zone 1;
- **Zone 2 (Outer Protection Zone):** the outer zone covers pollution that takes up to 400 days to travel to the borehole, or 25% of the total catchment area – whichever area is the biggest; and
- **Zone 3 (Total Catchment):** the total area needed to support removal of water from the borehole, and to support any discharge from the borehole.

Figure 17.2: Groundwater Source Protection Zone



The EA records indicate there are three private groundwater abstractions near the site. Two are registered to Croda Colloids Ltd, and located approximately 127 m and 136 m to the south-west of the Foundry Lane site and one to Granox Ltd (now PDM), approximately 152 m to the south of the West Bank Dock site. Information relating to these sources and the purpose of the abstractions has not been provided.

None of these abstractions is likely to affect or be affected by the proposed development, because there will be no groundwater abstraction or contaminated discharges to groundwater from the site.

17.5 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

17.5.1 Contamination Arising from General Construction Drainage

The Phase II Environmental Assessment concluded that the nature and level of contaminants identified across the site were substantial and that the soil contamination is providing an ongoing source of contamination to groundwater. The remediation strategy for the site is provided in more detail in *Section 14* – Soils, Geology and Contamination but is likely to include the stabilisation of the galligu and the provision of a clean 'break-layer' of 0.5 m top soil areas for the areas of landscaping, which will protect vegetation from phytotoxic effects of contaminants such as copper and zinc. Any imported fill material used on site will be inert, uncontaminated material and will not lead to any impact or degradation of the soil and groundwater quality underlying the site.

The operation of construction vehicles and general construction activities give rise to the potential for surface runoff to become contaminated with hydrocarbons, silt or other construction materials. This may in turn lead to a contamination event should site drainage be allowed to enter surface watercourses or the ground untreated.

Depending on meteorological conditions, excavations may require dewatering (of accumulated rainfall or runoff) during construction. In such circumstances, care will be taken to ensure the quality of this water is sufficiently high to allow discharge onto the surrounding site. Ponded water from excavations will be pumped into settling tanks to remove suspended sediments. If oil is detected in the water from the excavation sites, it will be diverted through temporary oil interceptors prior to being discharged into the settling ponds. Water from the settling tanks will be discharged to Steward's Brook, which will require a discharge consent from the EA.

Interceptors will be regularly inspected, cleaned and maintained. Full records will be kept of inspections, maintenance works and measures undertaken to sustain equipment performance. These provisions should ensure no significant impacts occur on water quality. The use of settlement facilities will aid the removal of any potentially contaminated material that might be derived from construction materials.

All site works will be undertaken in accordance with the EA's Pollution Prevention Guidance Note 6 *'Working at Construction and Demolition Sites'*. Construction vehicles will be properly maintained to reduce the risk of hydrocarbon contamination and will only be active when required. Construction materials will be stored, handled and managed with due regard to the sensitivity of the local aquatic environment and thus the risk of accidental spillage or release will be minimised. Construction contractors will also take full account of the requirements of the EA's General Guide to the *Prevention of Pollution of Controlled Waters* (PPG1) and guidance set out in PPG2 (*Above Ground Oil Storage Tanks*) and PPG3 (*The Use and Design of Oil Separators*).

In accordance with the *Control of Pollution (Oil Storage) (England) Regulations 2001*, any tanks storing more than 200 litres of oil will have secondary bunding. Bunding will be specified having a minimum capacity of "not less than 110% of the container's storage capacity or, if there is more than one container within the system, of not less than 110% of the largest container's storage capacity or 25% of their aggregate storage capacity, whichever is the greater." Above ground storage tanks will be located on a designated area of hardstanding. No underground storage tanks will be used during the construction period. Storage of liquids such as degreasers, solvents, lubricants and paints would be in segregated, bunded enclosures.

The construction drainage system will be designed and managed to comply with BS6031:198 "The British Standard Code of Practice for Earthworks", which details methods that should be considered for the general control of drainage on construction sites. Further advice is also contained within the British Standard Code of Practice for Foundations (BS8004, 1986).

Furthermore, these mitigation measures will be incorporated into a Construction Environmental Management Plan (CEMP), which will set out measures for the control of site drainage, reducing the risk of accidental spillages and the storage and handling of materials.

Residual impact after mitigation: Negligible

17.5.2 Realignment of Steward's Brook

The site is presently bisected by Steward's Brook. The Brook is known to be contaminated from discharges and leaching of chemicals from galigu deposits upstream of the site. In order to meet both the site development requirements and EA policy with respect to culverting of a main river, a number of options for diverting Steward's Brook have been evaluated. The two most obvious routes are into Ditton Brook or into Marsh Brook. Ditton Brook has been ruled out, however, as the site levels do not allow for gravity flow to the West. This leaves a number of options for re-routing Steward's Brook to Marsh Brook to the east. These options have been evaluated using the following guiding criteria:

- there must be no net loss of open (unculverted) water course associated with the development;

- the banks of the diverted watercourse must be sealed to prevent exposure of the water flowing within it from site-based soil pollutants (i.e. contaminated groundwater leaching from the galigu and other soil contaminants into Steward's Brook);

- the new channel must not be sized such that it could lead to upstream flooding that would not otherwise have occurred;

- the section of Marsh Brook that receives flow from Steward's Brook must be enhanced and improved to ensure that it can be classed and adopted as main river by the EA;

- allowance needs to be made for a suitable buffer zone to enable the EA access for maintenance and other works along the open channel;

- the diversion of Steward's Brook must not increase the risk of flooding on the development site or the land bordering Marsh Brook as a result of the diverted flows; and

- the proposed diversion must be capable of implementation within a reasonable timescale (within the development process timescale) and must be practically achievable and technically deliverable.

Based upon these assumptions and an examination of site levels, infrastructure requirements and physical constraints, a workable solution has been developed (refer to site layout drawing - in *Section 3* of this report). The basic premise of the design is that Steward's Brook will be collected where it presently enters the site and conveyed for a short distance in a culvert which has been designed to handle flows based on a 1 in 100 year flood risk (+20% to allow for climate change related increases in precipitation). This culvert will convey the Brook along the eastern gable of the proposed new building until it reaches the southern end of that building. From there the Brook will be diverted easterly in an open channel until it reaches Marsh Brook where it will again flow south and into the River Mersey.

As a temporary measure during the construction of the new channel and upgrade and remediation of Marsh Brook, it will also be necessary to have an additional length of temporary culvert that will continue to take the diverted Steward's Brook water around the south side of the new building and back into the old Steward's Brook channel. Once the new open section of channel is completed and ready to receive the water, the temporary culvert will be grouted and the water directed into the new open channel as the permanent new course of Steward's Brook.

There are a number of advantages to this proposed approach to the diversion of Steward's Brook as follows:

- To compensate for the culverted section of Steward's Brook along the first section of the new channel, the new open course of Steward's Brook that extends from it will be approximately 370 m in length. This is around 120 m longer than the current open section of Steward's Brook it replaces so even with the culverted initial section, there will be a net increase of the open length of the Brook on the site compared to the situation that exists now or which was previously granted approval;

- The provision of a temporary extension of this culvert into the open remaining section of the old Steward's Brook allows the flow of Steward's Brook to continue unhindered by the construction works whilst the new channel and Marsh Brook is properly designed, constructed and en-mained. This enables the development (including the new channels) to proceed on programme;

- The new course of Steward's Brook (whichever route it took) will pass at substantial depth through contaminated soils and groundwater that will not be treated (stabilised) as part of the development works so remains as a pollution source. The sealed sections that will form the new channel will break any pollutant linkage between the residual contaminants in the surrounding ground and Steward's Brook and thus will protect the water quality of Steward's Brook from further deterioration as currently occurs (or could occur with earth banks);

- The site levels will be increased as part of the overall cut and fill balance. Given this, mimicking the current trapezoidal brook sections across new areas of the site, with an additional allowance of an 8m buffer zone will translate to a very large land-take effectively making the project untenable. This will not be the case with steeper sided lined linear channel sections as now proposed which allows the same volume and hydraulic flow but is structurally more robust and takes up less land (although there will still be options for some landscaping enhancement);

- The additional depth of the new channel (due to the increased site levels) will provide sufficient additional cross sectional area for the channel section compared to the wider but shallower trapezoidal section of the former Steward's Brook course. As such there will be no net loss in flow capacity or volumetric storage capacity between the existing situation and the new situation;

- The en-maining of Marsh Brook as part of the proposed diversion works allows an opportunity and provides resources to clean-up Marsh Brook, which has received polluting inputs for many decades (now ceased), and enhance the value of this watercourse;

- The diversion of Steward's Brook away from the HEDCO landfill reduces the prospect of releases of contaminated leachate worsening the water quality in the Brook and removes an odour nuisance (caused by the mixing of chemicals already in the Brook with those in the leachate issuing from the HEDCO landfill).

- The re-engineering of Steward's Brook to provide a new channel may allow opportunities for the creation of bed roughness and cascades to enhance aeration of the water flowing through Steward's Brook and improve its quality before discharge into the River Mersey.

Therefore, overall, there is a net environmental benefit to this approach that compensates for the relatively short section of culverting that will be necessary to facilitate this development and in the absence of any ability to culvert the existing watercourse in its original alignment. The precise details of the newly constructed channel are still being developed and will be furnished to the EA for approval imminently.

Residual impact after mitigation: Minor Positive

17.5.3 Potential Groundwater Interruption during Construction

The site investigation found four different groundwater bodies at the site within the depth range of the site investigation. These comprise:

- perched water located within the made ground horizon above the alluvial deposits. Perched groundwater was encountered in three (BH14, BH34 and BH43) of the four boreholes, which were installed to capture this water bearing strata, and was encountered at shallow depths of between 1.5 m and 5.9 m bgl. Perched water within the made ground is generally due to infiltration from un-surfaced ground and site drainage, which is known to be in a poor state of repair;

- water bearing silt/sand lenses within the Alluvium. Four boreholes (BH8, BH9 BH11 and BH15) located on the Foundry Lane site were installed to capture this water bearing strata, which is believed to be tidally influenced and is possibly in continuity with the lower groundwater body;

- water bearing silt/sand lenses within the clay deposits encountered in the Glacial Till; and

- Groundwater within the underlying Sherwood Sandstone strata.

Therefore, during construction, dewatering of excavations may be required. Surface waters generated in this manner will be controlled, treated and discharged as described in *Section 13.4.1* for general site drainage.

The proposed development will require piling to depths of 12-20 m. A Piling Risk Assessment will be undertaken in accordance with the guidance will set out in the EA document "Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention". The risk assessment will identify the best environmental solution to the development, whilst minimising the risk of creating a pathway. A detailed Method Statement will be agreed with the EA and will set out the piling technique and protection methods that will be employed. Further details on piling are provided in *Section 14* – Soils, Geology and Contamination.

Residual impact after mitigation: Minor Negative.

17.6 OPERATIONAL IMPACTS AND MITIGATION MEASURES

17.6.1 Flood Risk

As discussed in *Section 17.4*, the EA's floodplain map for Ditton suggests that a large part of the Foundry Lane Site, and a small part of the West Bank Site, may be affected by tidal flooding, whilst the Reclamation Site is above these flood levels. However, the EA's floodplain maps assume no flood defences are present.

ENVIRON have undertaken a Flood Risk Assessment (FRA) for the site in accordance with PPS 25 – Development and Flood Risk. The FRA aimed to establish the nature and extent of the flood zones for the site and is included as *Appendix 17.1* of this report.

The FRA concluded the following:

- the Foundry Lane development area has a minimum ground level of 6.35 mAOD and is protected by a flood defence wall of 7.7 mAOD. The Reclamation site and West Bank Dock site have ground levels above 8.5 mAOD;

- probability analysis suggests a 200 year flood at the site of 7.3 mAOD. Allowing for a 4 mm/yr sea level rise to account for climate change, the 200 year level is predicted to be 7.5 mAOD by 2050. Therefore, most of the site lies above the 200 year 2050 estimated water level and suitable protection is provided by the existing flood defence wall. Overtopping of this wall could occur if wave heights are greater than 200 mm, or more extreme events occur by 2050, hence it is recommended that, where possible, all finished floor levels include a minimum freeboard of 600 mm above the 2050 200 year tide levels, i.e. at **8.1 mAOD**. The existing flood wall and natural lie of the land therefore provide a measure of flood defence to an appropriate standard although regular inspections and maintenance of the flood wall are recommended; and

- the area is protected by an existing flood defence alongside the Mersey estuary, which varies in height, and currently provides protection to above the 200 year level at around 9 mAOD.

Further details of flooding issues are provided in the FRA report.

17.6.2 Surface Runoff Measurements

Flood Estimation Handbook (FEH) modelling software has been used for assessing the surface water runoff on the site. FEH modelling software generates statistical data on rainfall events and river flows and provides an estimation of these parameters for any specified return period.

Results were obtained using:

- the FEH method to establish rainfall depths for a range of return periods;

- FEH to determine catchment descriptors, such as annual average rainfall;

- the Wallingford Procedure to determine values for soil index (SOIL) and urban catchment wetness index (UCWI);

- the Modified Rational Method to calculate storm runoff volumes for each return period. The percentage impermeable surface was taken as 65% for the application site which, using the Wallingford Procedure, equates to a percentage runoff (PR) value of 51.8%; and

- peak discharges for the 30 minute storm were determined from storm volumes using the standard hydrograph approach.

Rainfall intensities (in mm/hr) for the 2, 5, 10, 25, 50 and 100 year return period (30 minute duration) storms have been derived using FEH. These rainfall levels have been used to derive rainfall-runoff rates and volumes using the Modified Rational Method, the formula of which is given below:

$$Qp = 2.78\,C\,i\,A$$

Where,
Qp = Peak flow rate (l/s);
C = Runoff coefficient (dimensionless);
i = Rainfall intensity (mm/hr); and
A = Area of site (ha).

The site has approximately 65% hardstanding, comprising buildings, lorry yards and internal access roads.

It is understood that the site has an existing drainage system, the drainage system for the three component sites making up the development area is summarised below:

- the Foundry Lane Site is covered with hard standing or limestone chippings. The hard standing drains to Ditton Brook and is thought to be in poor condition with no interceptor, which may be a requirement, given the nature of the material stored and vehicle movements across the site. A significant part of the site is covered by limestone chippings, particularly the areas used for car parking and outdoor storage. The northern part of the site is drained by a 100 - 300 mm piped network, which has partially collapsed in places. The middle part of the site includes a 100 – 225 mm network and the southern site a 150 – 750 mm network. All three systems drain to the Ditton Brook and are thought to be in poor condition;

- the Reclamation Site was used for the large scale disposal of wastes up to the late 1990's including galligu and other waste materials. The County Council undertook remediation of the site which included: installing marginal sheet piling along Steward's Brook and Ditton Brook; the installation of a 1 m thick clay cap, overlain by 1.5 m of sub soil at the centre of the site and 0.4m to 1.0m in other areas; and the planting of 18,000 trees. Surface water drains have been installed in the clay cap of the Reclamation site and discharge directly to Ditton Brook via the culverted channel between the site and Foundry Lane; and

- the West Bank Dock Site includes 27 buildings (as surveyed by Atkins in 2000) and other structures including gas oil, oil, and fuel storage tanks. The majority of the site is covered with hard standing although this is in poor condition in the north eastern part of the site. The site drainage systems include two outfalls to Steward's Brook and one to Marsh Brook, which were unable to be located.

It is understood that there are currently no measures in place to reduce or attenuate surface runoff from the site.

Using the methodology set out above and a percentage impermeable area of 65%, the estimated surface runoff rates for the existing development have been calculated and are presented in *Table 17.7.*

TABLE 17.7: EXISTING RUNOFF RATES

Return Period Yrs	Modified Rational Method Calculations[1]		
	30 min FEH Storm Depth (mm)	Storm Volume V (m^3)	Peak Flow Q (l/s)
2	10.9	2895.97	1610.16
5	15.4	4091.55	2274.90
10	19.3	5127.72	2851.01
25	25.8	6854.67	3811.20
50	31.9	8475.35	4712.29
100	39.5	10494.55	5834.97

[1] FEH parameters used: Site area = 39.42 ha % impermeable surface area (PIMP) = 65%; SOIL = 0.45; and Urban Catchment Wetness Index (UCWI) = 95.

Therefore, the existing runoff rate for the 100 year return period storm has been estimated to be 5835 l/s and this can be reasonably taken as the peak flow for that storm event arising from the existing site use.

The new development proposal comprises a number of warehouse units with associated car parking and internal access roads. The proposed area of impermeable surface is estimated as 81% of the site area. The proposed development plan shows that approximately 19% of the site by area will comprise landscaped areas which will function as though they were Greenfield.

The results of the rainfall-runoff calculations for the proposed development are presented in *Table 17.8*.

TABLE 17.8: PROPOSED DEVELOPMENT RUNOFF RATES

Return Period (yrs)	Modified Rational Method Calculations		
	30 min FEH Storm (mm)	Storm Volume V (m^3)	Peak Flow Q (l/s)
2	10.9	3618.35	2011.80
5	15.4	5112.16	2842.36
10	19.3	6406.79	3562.18
25	25.8	8564.52	4761.87
50	31.9	10589.47	5887.74

TABLE 17.8: PROPOSED DEVELOPMENT RUNOFF RATES			
	Modified Rational Method Calculations		
Return Period (yrs)	**30 min FEH Storm (mm)**	**Storm Volume V (m³)**	**Peak Flow Q (l/s)**
100	39.5	13112.35	7290.47

The runoff rates presented in *Table 17.8* show an estimated runoff rate for the 100-year storm of 7290 l/sec compared to the existing rate of 5835 l/sec (estimated in Table 17.7 above). Therefore, the proposed development will lead to an increase in surface runoff due to the increase in impermeable surface area.

In addition, PPS25 requires that an assessment of the impacts of climate change is undertaken for the operational lifetime of the development. In accordance with the data set out in Table B.2 of PPS25, an increase of 20% is required on existing rainfall intensities to compensate for the effects of climate change in the next 60 years. Therefore, climate change corrected runoff rates for the development are the 2006 rates plus 20% (i.e. 8748 l/sec).

The FRA included a SUDS feasibility assessment which concluded that there were a limited number of SUDS techniques (attenuation) that would be suitable given the contaminated nature of the soil and groundwater and the limited surface space available for attenuation systems. The discharges would, however, comprise clean rainwater run-off which would provide beneficial dilution of the heavily contaminated water in Steward's Brook and could also provide periodic water input to the remaining section of the old course of Steward's Brook. Therefore, the most appropriate option in this instance is to provide for direct discharge of clean incident rainfall to the new course of Steward's Brook and the remainder of the old channel. It is understood that a land Drainage Consent will be required from the EA to discharge into Steward's Brook.

Residual impact after mitigation: Negligible

17.6.3 Contamination of Surface Water or Groundwater from Routine Site Drainage

The majority of the site will be covered in hardstanding which will reduce infiltration rates on site which has the potential to reduce the potential for percolating rainwater leaching contaminants from the saturated zone into the unsaturated zone. In addition, in the landscaped areas a clean break-layer of top soil will be placed to a depth of 0.5 m, which will avoid cross contamination impacts on the planting. Any imported fill material used on site will be inert, uncontaminated material and will not lead to any impact or degradation of the soil and groundwater quality underlying the site.

For a more detailed analysis of ground conditions please refer to *Section 14* - Soils and Geology Chapter.

Therefore, following the removal / capping of the contaminated soil, the principal source of contamination from routine operation of the site is hydrocarbon contamination from vehicles parked on site. The proposed development will provide an internal road and a substantial area of car parking space with oil/water interceptor systems at strategic locations. Therefore, routine site drainage will have a low risk of contamination, especially given the generally benign nature of the occupiers' activities.

Residual impact after mitigation: Minor Positive

17.6.4 Increased Water Consumption

Water efficiency measures can reduce consumption by 20-25% (EA). Therefore, water minimisation and conservation measures are important considerations for the proposed development, to minimise the increase in water demand. Water demand will be reduced as far as possible, by the incorporation of appropriate water saving devices, wherever practicable. The buildings are designed to maximise water efficiency through low water use sanitary appliances, optimising hot water use, dual flush toilets and low flow and aeration taps in appropriate locations. Given that the site is effectively being completely redeveloped, the entire water supply infrastructure and uses will be new and more efficient than the ad-hoc systems that currently exist.

Fairhurst has consulted Northwest Water regarding mains water supply for the site. Their consultation response is awaited.

Residual impact after mitigation: Minor Negative

17.6.5 Foul Drainage Capacity

In the absence of a suitable foul drainage connection for the site, the development will include the provision of a package treatment plant with discharges entering Steward's Brook. A discharge consent will need to be obtained from the EA for any discharges entering Steward's Brook from the treatment plant. The details of this plant are not yet available, but the technology and operation of such plants is well tested and reliable.

17.7 OVERALL SUMMARY AND CONCLUSIONS

A summary of the key impacts and mitigation measures is provided below:

- the development will have a minor positive impact on the surrounding area because it will assist in reducing the risk of contamination to the wider area through remediation of the site;
- all construction activities will be carried out in accordance with the EA's pollution prevention guidelines, notably PPG 6 'Working at Construction and Demolition Sites'. This will reduce the risk of surface water or groundwater contamination during construction;
- the exact details of the realignment of Steward's Brook will be assessed at a later stage and will be developed in consultation with the EA. However, in principle the realigned watercourse will be constructed to have at least the same capacity as the existing channel. A method statement will be provided outlining the details of the realignment works and will provide details of the cross-sections and hydraulic modelling. The statement will also provide information on how the watercourse will be constructed;
- a Piling Risk Assessment will be undertaken in accordance with the guidance set out in the EA document "Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention". The risk assessment will identify the best environmental solution to the development, whilst minimising the risk of creating a pathway;
- most of the site lies above the 1 in 200 year return period flood level estimated for 2050 and suitable protection is provided by the existing flood defence wall. Overtopping of this wall could occur if wave heights are greater than 200 mm, or more extreme events occur by 2050, hence it is recommended that, where possible, all finished floor levels include a minimum freeboard of 600 mm above the 2050 200 year tide levels, i.e. at **8.1 mAOD**. The existing flood wall and natural lie of the land provide a measure of flood defence to an appropriate standard although regular inspections and maintenance of the flood wall are recommended. The proposed finished floor levels of the developed site are above this so flooding of the site once developed is unlikely;
- the surface runoff from the site will be released to the cut off section of Steward's Brook to the south of the site and to the new channel. The run-off will be from a newly developed site with no pollution loading from site contaminants, however, so although the volume will increase, so will the water quality. This has additional benefits of diluting contaminants already in Steward's Brook. A Land Drainage Consent will be obtained from the EA to discharge into Steward's Brook. The re-aligned channel has been designed to ensure that there are no increased upstream or site flood risks associated with the diverted channel. The proposals will also enable the substantial upgrade and improvement of Marsh Brook which well be en-mained ;
- the redevelopment of the site will increase the number of site users which will cause an increase in water demand to meet the needs of the new occupants. These increases will be offset by the adoption of a variety of water-saving devices in the buildings and more efficient delivery and management of the supplied water; and
- similarly, the redevelopment will increase the site's low foul drainage requirements. However, a package treatment plant will be built on site to handle foul drainage prior to discharge into Steward's Brook.

In conclusion, given the location and nature of the nearest sensitive receptors, the overall environmental impact of the proposed development in relation to water quality and hydrology is considered to be **Minor Positive**.