Buro Happold

# Queen Elizabeth Olympic Park

## Water Framework Directive Assessment

**031369**

31 March 2014

00

| Revision | Description | Issued by | Date | Checked |
|---|---|---|---|---|
| - | Draft | [redacted] | 28/11/13 | - |
| - | Draft – in preparation for review 22nd January | [redacted] | 09/01/2014 | - |
| - | Final Draft | [redacted] | 24/02/2014 | - |
| 00 | 1st Formal Issue | [redacted] | 31/03/2014 | [redacted] |

O:\031369 Queen Elizabeth Olympic Park Legacy Flood Risk Assessment\F34 Water\12 WFD Report\04 Reports - In progress\140331 [redacted] 031369 QEOP Water Framework Directive Assessment_Final without images.docx

This report has been prepared for the sole benefit, use and information of LLDC for the purposes set out in the report or instructions commissioning it. The liability of Buro Happold Limited in respect of the information contained in the report will not extend to any third party.

| | |
|---|---|
| author | [redacted] |
| date | **31st March 2014** |
| approved | [redacted] |
| signature | [redacted] |
| date | **31st March 2014** |

# Contents

# Glossary

| Term | Definition |
|---|---|
| AINA | Association of Inland Navigation Authorities |
| BOD | Biological Oxygen Demand |
| BW | British Waterways |
| C&RT | Canal and River Trust (formerly British Waterways) |
| CCHP | Combined Cooling, Heating and Power |
| CSO | Combined Sewer Overflow |
| CTRL | Channel Tunnel Rail Link |
| DO | Dissolved Oxygen |
| EA | Environment Agency |
| FRA | Flood Risk Assessment |
| LDA | London Development Agency |
| LLDC | London Legacy Development Corporation |
| LLV | Lower Lea Valley |
| ODA | Olympic Development Authority |
| OPLC | Olympic Park Legacy Company |
| PAH | Polyaromatic Hydrocarbons |
| PDZ | Planning Delivery Zone |
| QEOP | Queen Elizabeth Olympic Park |
| RBD | River Basin District |
| RBMP | River Basin Management Plan |
| RLFRC | River Lea Flood Relief Channel |
| RLN | River *Lee* Navigation |
| TBT | Tributyltin |
| TPH | Total Petroleum Hydrocarbons |
| WFD | Water Framework Directive |

# Executive Summary and EA signoff

In order to develop the Queen Elizabeth Olympic Park (QEOP), numerous enabling works and permanent alterations to the pre-existing waterways were conducted. These had the potential to impact upon the waterways' ecological, biological and chemical status. The 2000 European Water Framework Directive (WFD) sets out a new mandatory integrated approach to river basin management and planning. The Environment Agency (EA) is tasked with the regulation and implementation of this legislation through River Basin Management Plans (RBMP). The WFD became part of UK legislation in 2003 and as such was a relatively new piece of legislation at the time of the planning of the Games. It was therefore established by the London Legacy Development Corporation (LLDC) that a park-wide assessment was required. The purpose of this assessment is to demonstrate that all planned permanent works within the QEOP planning application site boundary carried out from early 2006 to the present day, or future works, are and will be undertaken with full consideration of the WFD objectives.

The study identifies four main water bodies in the vicinity of the QEOP, mainly:

- The *Lee (GB106038077852)*;
- The *Thames Middle (GB530603911402)*;
- The *Thames Lower (GB530603911401)* and
- The *South Essex Thurrock Chalk (GB40601G401100)* groundwater body.

The major works conducted on the QEOP to date are the following:  1) Loss of Pudding Mill River; 2) River bank enhancements; 3) Channel widening (including river wall replacement); 4) Dredging; 5) Three Mills Lock; 6) Floating navigation pontoons; 7)  F10B new bridge; 8) Walkway with support in waterway; 9)Emergency access platforms; 10) Wetland creation; 11) Channelsea Gorge culverting; 12) Hennicker's Ditch extension; 13) Site wide Drainage and 14) Removal of invasive species. In addition to these works, site wide water demand reduction and recycling measures were also implemented.

Buro Happold identified four key themes that underpin many of the WFD objectives; mainly Sustainable Water use; Habitats and Species; Water Quality and Flood Risk. The assessment summarises the Baseline condition of the pre-existing waterways for each of these themes and then goes on to assess the impact of the above works on the waterways' status, again for each of the four main WFD themes. Indicators of good status achieved under each theme are extracted from EA literature and WFD guidance and are referred to throughout the report.

The Baseline designation of the river *Lee* was a heavily modified water body due to flood protection and urbanisation requirements. Its baseline pre QEOP Ecological Potential was *Moderate* and the objective set out by the Thames RBMP is to achieve *good* ecological status by 2027.The *Lee*'s heavily modified hydromorphology supported emergent, floating and submerged aquatic vegetation. Key issues identified included presence of invasive species, such as Pennywort and Rigid Hornwort; excessive ammonia concentrations, high phosphate and polyaromatic hydrocarbon levels and low dissolved oxygen. The impoundment structures and sewage discharge aggravate these issues. Mitigation measures set out by the Thames RBMP (2009) include removal of barriers to fish passage; enhancement and restoration schemes; revised sediment management strategies; habitat management and flood risk management maintenance activities.

The tidal Thames is a Site of Metropolitan importance. The baseline designation of the *Thames Middle* was a heavily modified water body due to flood protection, coastal protection and navigation requirements. Its pre-QEOP ecological potential was *Moderate* and the objective set out within the Thames RBMP is to achieve *Good* ecological status by 2027. The *Thames Middle* waterways' hydromorphology supports some fish species and includes three sites of Borough Importance Grade 1. Key issues identified in the pre-QEOP condition included the high presence of invasive species (Japanese Knotwood and Himalyan Balsam and some Giant Hogweed); high levels of dissolved inorganic nitrogen, phosphate, ammonia and BOD; significant exceedances in arsenic, cadmium, nickel, lead, mercury, chromium, total petroleum hydrocarbons (THP), zinc and hydrocarbons. Sources of some of these pollutants may be traced back to antifouling paint, herbicides and sewage treatment works discharge. The River Lea drains a catchment of 1400km$^2$. Following the River Lea Flood Relief Channel and flood defences works, subsequent flood events occurred in the upper lea catchment but not as far as the QEOP. The mitigation measures set out by the Thames RBMP (2009) include vessel management; sediment management; preparation of a dredging strategy; enhancement of ecological value of marginal aquatic habitat. The mitigation measures also include operational and structural changes to locks, sluices and a weir and off-site mitigation measures.

The Baseline designation of the *Thames Lower* was a heavily modified water body due to flood protection and navigation requirements. Its pre-QEOP ecological potential was *Moderate* and the objective set out within the Thames RBMP is to achieve *Good* ecological status by 2027. The status of some of the biological and hydromorphological elements was not assessed in the 2009 Thames RBMP. Key issues identified in the water body are moderately high levels of dissolved inorganic nitrogen; significant exceedance sin arsenic, copper, cadmium, nickel, lead, mercury, chromium, zinc and hydrocarbons. The Mitigation measures set out by the Thames RBMP (2009) include vessel management; sediment management; preparation of a dredging disposal strategy; enhancement of ecological value of marginal aquatic habitat; on and off site mitigation measures.

The Baseline designation of the *South Essex Thurrock Chalk* was a groundwater body with a *Good* quantitative and set to be retained up to 2015 and a *Good* chemical status forecast to be retained up to 2027. The Chalk is a ground water body, therefore its ecological and biological status and ability to support habits and species is not required to be assessed under the WFD. In the pre-QEOP baseline, the Chalk failed to achieve good Drinking Water Protected Area status. The failure is thought to be caused by ammonia concentrations and contamination from point and or diffuse sources.

A preliminary screening assessment is undertaken to identify which works impact which water bodies. This assessment indicates that all works are deemed to have an impact on the *Lee*, the *Thames Middle* and the *South Essex Thurrock Chalk* water bodies. All water bodies that are affected by the works are progressed to Detailed Assessment. The *Thames Lower* has been screened out during the preliminary assessment as no works conducted within the QEOP planning boundary are deemed to have a significant positive or negative impact on the water body. A detailed assessment for the Thames Lower is therefore not conducted.

Detailed assessment tables are used to investigate and identify to what extent each typology of work has a positive or negative impact on each of the three water bodies.

A detailed assessment of Three Mills Lock (TML) will not be included within this WFD assessment, because these works are located geographically outside the LLDC QEOP works. A description of the analysis that should be carried out as part of the subsequent detailed assessment of the impact of the TML on the Thames Middle Water Body is summarised in Section 6.8.

Many of the works implemented within the QEOP are in line with the Mitigation Measures set out for the *Lee* and *Thames Middle* within the Thames River Basin Management Plan (2009) and the Draft 2015 TRBM and therefore the works are progressing water body status towards the objectives set out in the Plan.

The Detailed Assessments conducted for all QEOP works indicate that these works demonstrate no significant net impact on the *Lee* (Tottenham Locks to Thames Tideway) water body's Sustainable Water Use, Habitats and Species, Water Quality or Flood Risk status.

The detailed assessment of the works on the *Thames Middle* indicates an overall positive impact and improvement on the status of Habitats and Species, Water Quality and Flood Risk and no impact on the Sustainable Water Use of the water body.

The surface water drainage strategy also results in a considerable improvement in the Water Quality status of the South Essex Thurrock Chalk water body.

Therefore, this WFD Assessment demonstrates that the works conducted as part of the QEOP by the LLDC have apported an overall positive improvement to the Habitats and Species, Water Quality or Flood Risk status of the *Lee, Thames Middle* and *South Essex Thurrock Chalk* water bodies as prescribed in the WFD. The assessment concludes that the works do not compromise the ability of the water bodies to meet their WFD status objectives and do not cause a permanent exclusion or compromise achieving the WFD objectives in other bodies of water within the same RBD. The associated works instead contribute to the delivery of the Thames RBMP.

This WFD Assessment has been formally approved by the Environment Agency. A copy of their approval letter is provided opposite.

creating a better place

Environment Agency

London Legacy Development Corporation
Level 10
1 Stratford Place, Montfichet Road
London
E20 1EJ

Our ref: RSH/WFDLowerLee
Your ref: 031369

Date: 25 March 2014

FAO [redacted]

Dear Sirs,

**Queen Elizabeth Olympic Park (QEOP), Stratford, East London**
**Water Framework Directive Assessment - Letter of Compliance**

Further to your final submission of the attached document (Ref. 031369) and marking the end of our discussions on its content, I confirm:

1) Our acceptance of the appropriate assessment of all QEOP permanent works under the Water Framework Directive 2003 *("the Directive")* and,

2) That all works which have had a further assessment undertaken in this document are compliant with the Directive. This document shows that the combination of these works have progressed the relevant waterbodies towards 'Good' Status.

This work excludes full assessment of Three Mills Lock downstream of the QEOP.

Thank you for your completion of this work and the very positive dialogue throughout.

Yours faithfully,

[redacted]
**Area Environment Manager**

Telephone: [redacted]
Email : [redacted]@environment-agency.gov.uk

cc. [redacted] (LLDC)
[redacted] & [redacted] (Buro Happold Ltd)

Apollo Court, 2 Bishops Square Business Park, St Albans Road West, Hatfield, Herts, AL10 9EX.
Customer services line: 08708 506 506
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

INVESTOR IN PEOPLE

# 1 Introduction

## 1.1 The Queen Elizabeth Olympic Park

When London won the bid to host the 2012 Olympic and Paralympic Games in 2005 it was seen as an opportunity to transform and regenerate one of the most deprived and underdeveloped areas of the UK. Plans and designs for the park focused on delivering long-term improvements to the people and the communities living in this area with positive effects lasting long after the end of the Games.

The area of land chosen for the QEOP had to be cleaned and cleared before construction could start. For 150 years, up until World War II, the site had been little more than a rubbish dump, with chemicals, rubble and oil waste littered across the site. Unexploded ordnance presented additional risks.

In the enabling works for the construction of the park, 220 existing buildings were demolished. Hundreds of thousands of tonnes of contaminated soils were sent to the soil treatment centre within the QEOP for cleaning. The soil was washed free of contaminants such as oil, petrol, tar, cyanide, arsenic and lead and was used as clean material for the creation of new mounds, foundations and parklands. Over 2.3 million $m^3$ of soil was excavated with over 800 000$m^3$ cleaned of contaminants. In addition, more than 20 million gallons of contaminated groundwater were treated.

The site of the QEOP includes over 8km of waterways. As part of the works to create the park the waterways were dredged and many thousand cubic metres of contaminated silts and gravels were removed as well as large items of debris such as cars, tyres and shopping trolleys. Across the QEOP there are now 250 acres of parklands, which include 4,000 trees and 240,000 wetland plants, making it one of the largest urban parks to be built in Europe for 150 years. It is a unique transformation from derelict, unsafe wasteland to a green and integrated bustling hub of people and activities at the centre of the world's attention. The meandering waterways are at its core, framing the iconic venues and providing a tranquil space for people and wildlife.

## 1.2 The Water Framework Directive

The Water Framework Directive (WFD) came into force in 2000 and became part of United Kingdom (UK) law in December 2003. The primary purpose of the WFD is to provide an opportunity to plan and deliver a better water environment, focussing on ecology through effective river basin management planning.

The key objectives of the WFD are summarised as follows:

- No deterioration of current status of water bodies
- No preclusion of future attainment of good status
- No detrimental effect on downstream water bodies

The key areas addressed in Article 1 of the WFD are summarised as follows:

- Protect and enhance the status of aquatic ecosystems;
- Promote sustainable water use through long term protection of available resources;
- Improve aquatic environments through enhanced protection from hazardous substances;

- Progressively reduce and prevent pollution of groundwater; and
- Contribute to mitigating the effects of floods and droughts.

The WFD clearly defines good ecological, chemical and quantitative status and potential and provides additional guidance regarding the tools, parameters and methodologies which should be used to assess the status of water bodies.

The directive foresees the identification of Individual River Basin Districts (RBDs) and asks each Member State to coordinate the management of each RBD falling within its territory. The Environment Agency (EA) is the competent authority responsible for enforcing the Directive, in the UK, coordinating the efforts within each River Basin District and supporting the UK government in reporting progress back to the European Union (EU).

The WFD is enforced by the EA in the UK through the production of River Basin Management Plans (RBMPs) which establish environmental objectives for the water bodies within the identified river basins. These are reviewed every six years. The QEOP falls within the Thames River Basin and is therefore controlled by the Thames RBMP, which was produced in 2009 and is due to be updated in 2015. Within the river basins are water bodies, lakes, coastal waters, groundwater, rivers or stretches of river that are identified as separate units for the purpose of achieving the WFD objectives. This subdivision into water bodies takes into account the variability of rivers between the headwaters and the mouth of the river and the difference in management and environmental objectives that are necessary to improve conditions. Groundwater bodies have been delineated for similar purposes.

The overall environmental objective that has been set for the UK is to achieve at least *good status* or potential for all water bodies by 2015. This includes all waterways that are part of these water bodies. Where this is not possible, subject to the criteria set out in the WFD, the aim is to achieve *good status* by 2021 or 2027.

## 1.3 Drivers for a WFD Assessment

The Queen Elizabeth Olympic Park (QEOP) is located in Stratford, East London and was the principal site for the 2012 London Olympics. As part of the preparation of the site for the 2012 Games extensive remediation, infrastructure and structural works were undertaken and these not only had huge benefits in terms of regeneration of the area but also had the potential to impact the many waterways that intersect and define the site.

The WFD became part of UK law in December 2003 and as such was a relatively new piece of legislation at the time of planning for the 2012 Games. Whilst a number of small, finite WFD assessments were carried out for individual items within the Park, including the BMW Showcase and Park Live, no assessment has been carried out on a Park-wide scale.

As part of the WFD there is a requirement for member countries to report to the EU on key projects likely to have a significant impact on water bodies.

It has therefore been agreed between the London Legacy Development Corporation (LLDC) and the EA that a full, park-wide assessment be carried out that assesses the impacts of all permanent works associated with the Park since 2006.

The purpose of this WFD Assessment is to demonstrate that all planned or future works proposed within the QEOP planning boundary have been and will be undertaken with full consideration of the objectives set out in the WFD.

The assessment should therefore demonstrate that all risks to the water bodies and to the ecosystems associated with the proposed works have been assessed and that efforts have been made to mitigate potential adverse impact. Sufficient supporting information must be provided to the EA to give them the confidence that proposed works do not cause deterioration of the environment, do not limit the potential for future improvements and do not have negative impacts on downstream water bodies.

## 1.4 Contents

This section summarises how the WFD assessment has been carried out for the QEOP and key content included:

| | |
|---|---|
| Chapter 2 | **Scope of Assessment** - This section defines the period for the assessment, scope of works and the assessment boundary. |
| Chapter 3 | **Items of Work** - This section gives a brief description of the proposed works within the QEOP planning application boundary whose impact is being assessed. |
| Chapter 4 | **Assessment Methodology** – This section explains the approach and methodology adopted and identifies the key parameters used to assess impact with respect to the WFD objectives. |
| Chapter 4 | **Baseline** - This section introduces the water bodies affected by the works at the Queen Elizabeth Olympic Park and identifies their baseline conditions as of 2006 with regard to the identified WFD objectives: Sustainable Water Use, Habitats and Species, Water Quality and Flood Risk. |
| Section 5 | **Preliminary Impact Assessment** - The section will also identify which works have an impact on the water bodies' key quality parameters and therefore require a detailed impact assessment. |
| Section 6 | **Detailed Impact Assessment** - This section will assess in further detail the impact of critical works identified in section 5. Mitigation measures undertaken as part of these works and any residual impacts as of 2013 will also be taken into consideration in the assessment. |
| Section 7 | **Summary and Conclusions** - This section will evaluate to what extent the works achieved good status; ecologically, chemically and quantitatively for all water bodies concerned. The compliance will be assessed with regard to the four principal objectives of sustainable water use, habitats and species, Water Quality and flooding. |
| Section 8 | **Future use and revisions of WFD Assessment –** When this assessment should be revised in order to take into account of new works on the QEOP. |

# 2 Scope of Assessment

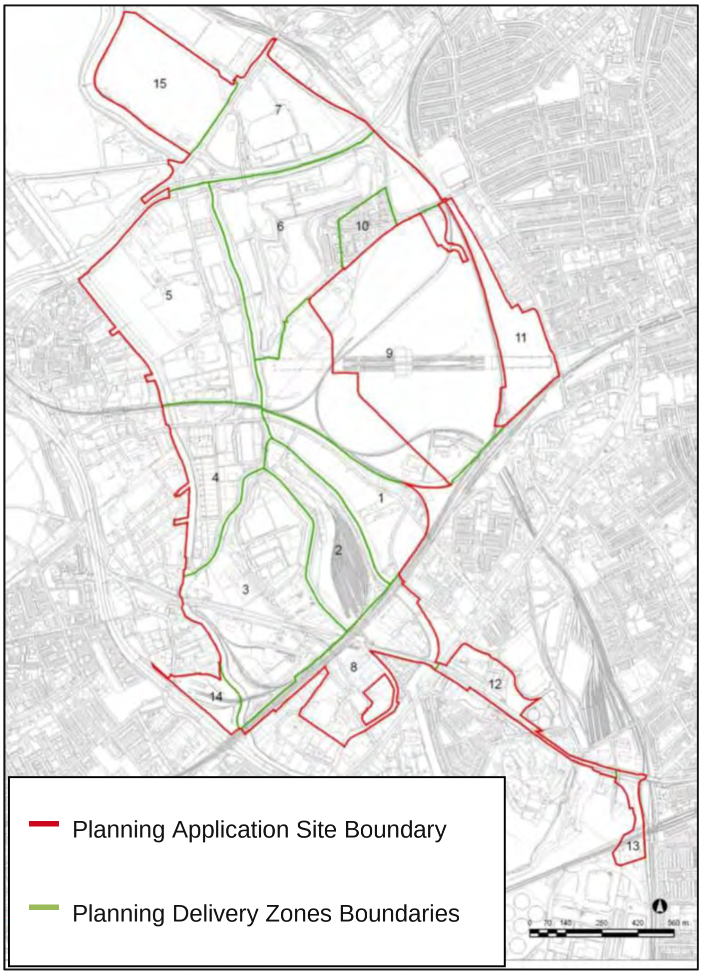
## 2.1 Period

The assessment considers the impact of all permanent works that have been carried out across the QEOP from early 2006, before works began on site, up to and including the present day.

## 2.2 QEOP Site Boundary

The QEOP planning application site boundary is shown in red below. The areas labelled 1 to 15 relate to Planning Delivery Zones (PDZs) of the QEOP and surroundings. It should be noted the QEOP works' can have an impact on the water bodies outside the QEOP site boundary and therefore the study area will be greater than the site boundary including all water bodies affected.

**Figure 1 - QEOP Planning Application Site Boundary and Planning Delivery Zone boundaries**



## 2.3 Water Bodies and Assessment Area

The QEOP is intersected by, and has the potential to impact upon, four water bodies. These are identified in the Thames RBMP (2009) as:

- *Lee* (Tottenham Locks to the Tideway) (GB106038077852)
- *Thames Middle* (GB530603911402).
- The downstream water body identified is *Thames Lower* (GB530603911401).
- Most of the QEOP overlays the *South Essex Thurrock Chalk* groundwater body (GB40601G401100).

A number of waterways are located within each water body. Within *Thames Middle* and *Lee* (Tottenham Locks to the Tideway), the local waterways are named in order to identify smaller sections of the water bodies. This means that on a water body scale there are only four units of assessment, but on a local scale there are several subdivisions of these water bodies that will be referred to by other names.

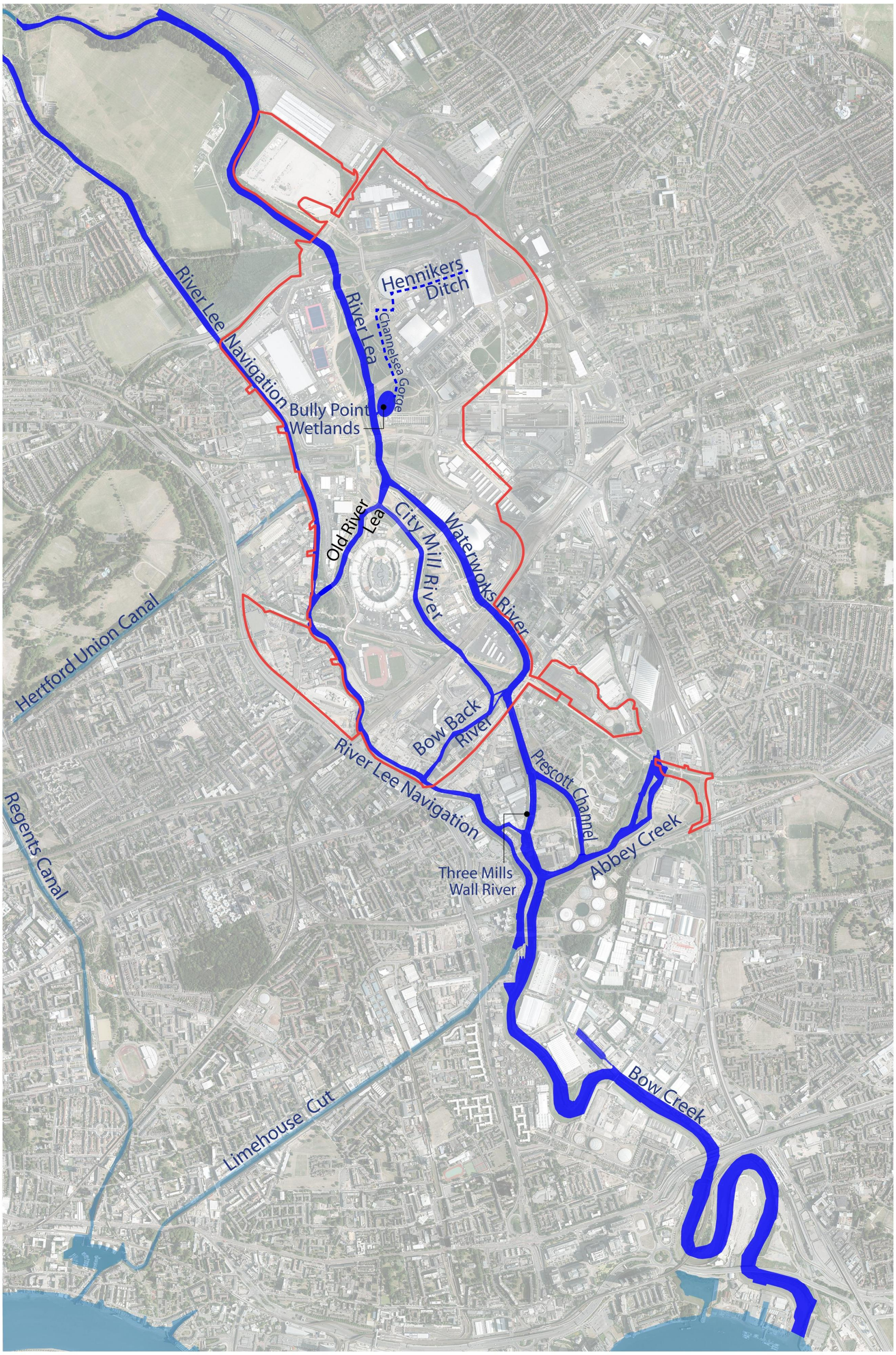
The subdivision of *Thames Middle* and the *Lee* into waterways are outlined below. These are given labels which will continue to be used throughout the report

**Table 1. Subdivision of water bodies between Lea Bridge Sluices and the confluence of Bow Creek and the Thames.**

| ***Lee* (Tottenham Locks to the Tideway)** | ***Thames Middle*** | ***Thames Lower*** | ***South Essex Thurrock Chalk*** |
|---|---|---|---|
| A) Pudding Mill River<br>B) Bow Back River<br>C) River *Lee* Navigation (RLN)<br>D) Old River Lea<br>E) City Mill River | F) Waterworks River<br>G) River Lea<br>H) Three Mills Wall River<br>I) Prescott Channel<br>J) Channelsea Gorge<br>K) Hennicker's Ditch<br>L) Abbey Creek<br>M) Bow Creek | Water body downstream of the Thames Middle; tidal. | N) Chalk underground aquifer |

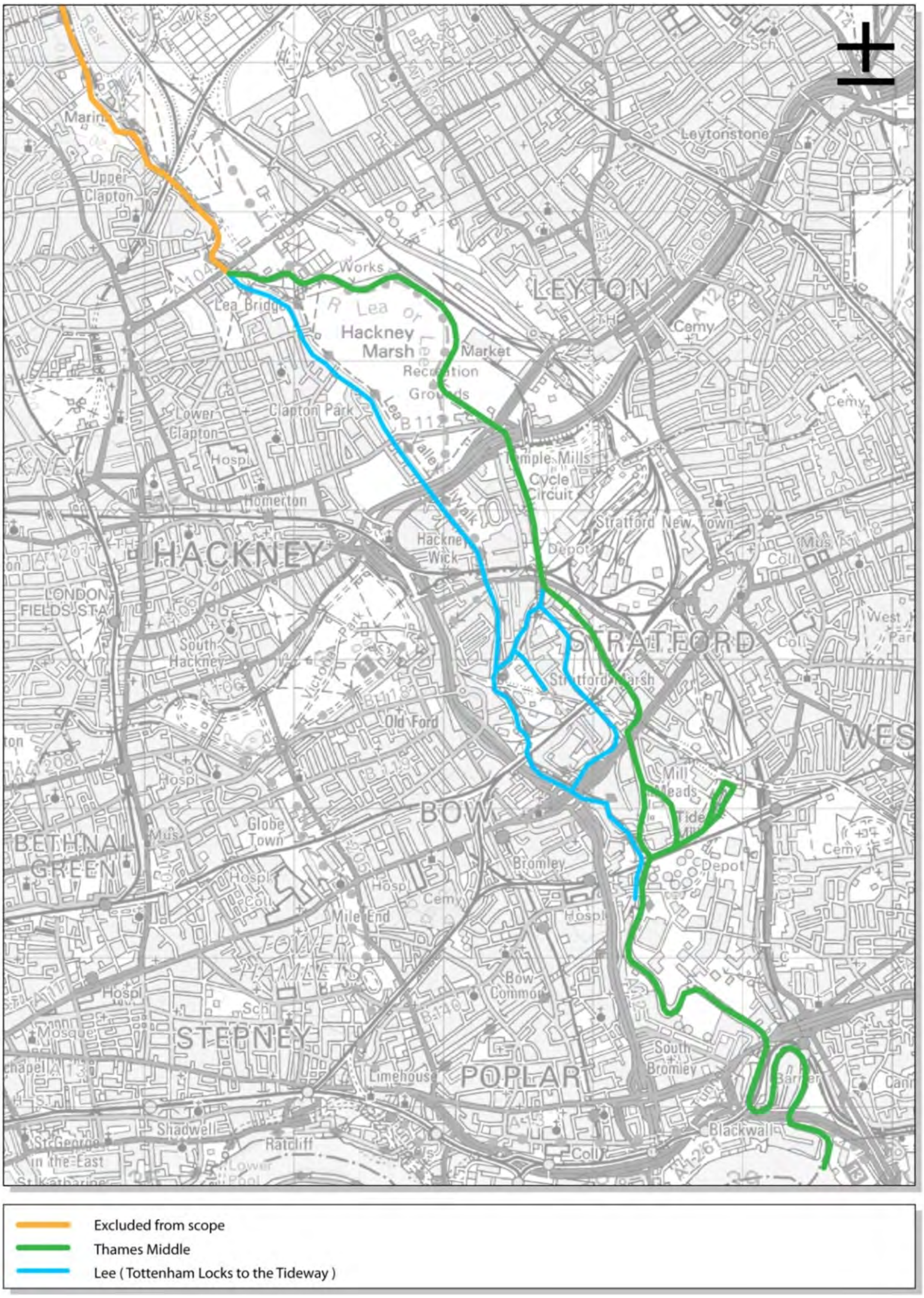
In case of waterway naming conflict with other sources of information the naming convention given in this document will be the ruling with regard to this WFD Assessment. It should be noted that the continuation of River *Lee* Navigation, downstream of the confluence with the Old River Lea, is still called River *Lee* Navigation. Both Abbey Creek and Channelsea Gorge may be called Channelsea River in other documents. This name will not be used. A delineation of water bodies within the QEOP for 2006 can be found below and in Appendix A.

**Figure 2 - Waterways within QEOP (also in Appendix A)**



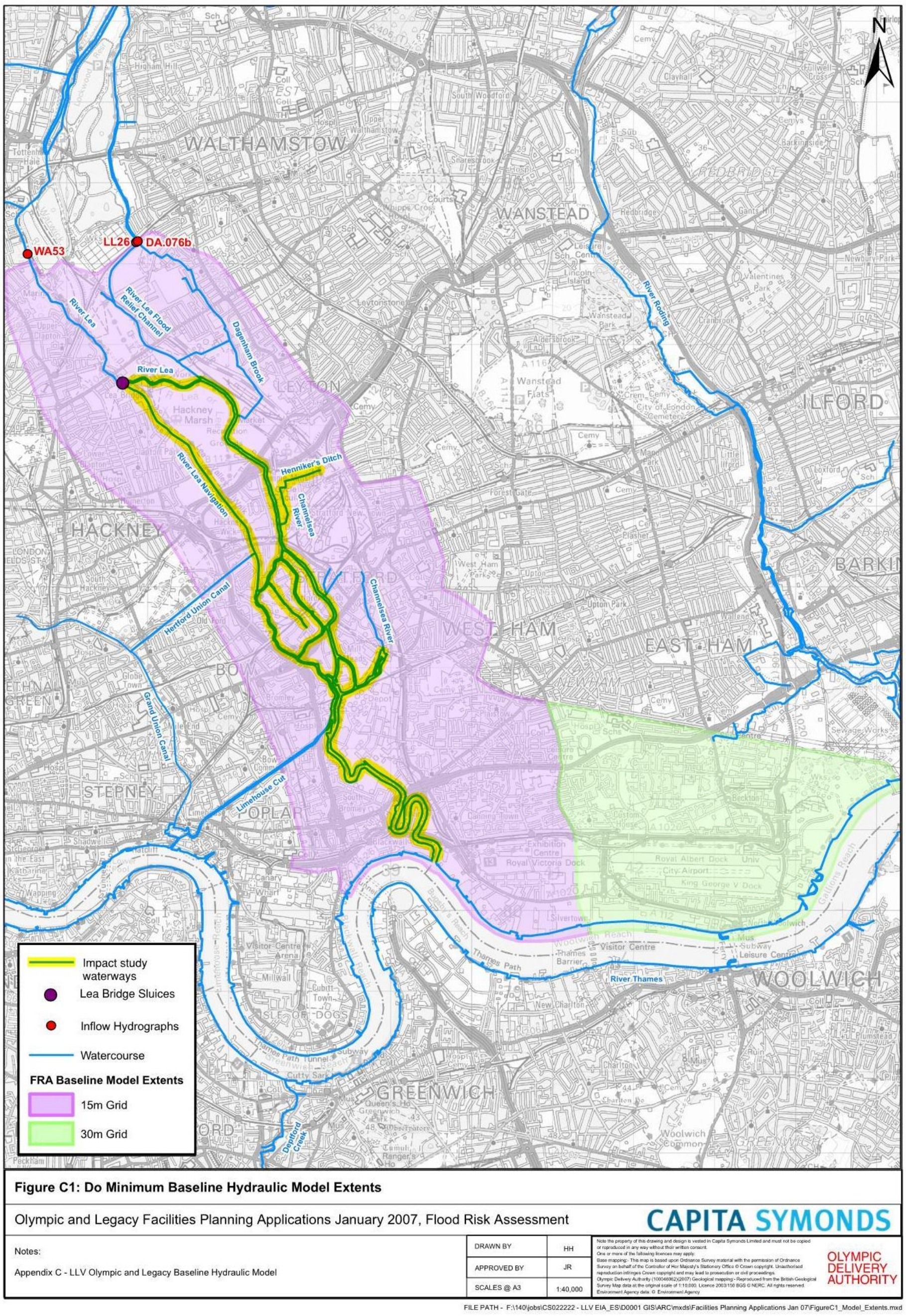
The distinction between the *Thames Middle* water body and the *Lee* water body within the Olympic Park and its vicinity are shown in Figure 3 below:

**Figure 3 - *Thames Middle* and *Lee* (Tottenham Locks to the Tideway) delineation (2006) from Lea Bridge Sluices to the confluence of Bow Creek and the Thames.**



Lea Bridge Sluice marks the northern, upstream, boundary of the *Thames Middle* water body in the baseline (2006) conditions. The northern boundary of the *Lee* (Tottenham Locks to the Tideway) water body is at Tottenham Lock about 2.5 miles north of Lea Bridge Sluices. The upstream water body is *Lee* (from Woolens Brook down to Tottenham Locks) (ID GB106038077851). It has not been considered in this assessment.

**Figure 4 - Flood Model extent and impact study area waterways between Lea bridge sluices and the confluence with the Thames.**




The River *Lee* Flood Relief Channel (RLFRC) and Dagenham Brook have been included in the flood risk modelling for the QEOP but will be excluded from all other aspects of the WFD assessment.

# 3 Items of work

## 3.1 Introduction

Since 2006, an enormous amount of remediation and transformation works have been carried out across the 2.5km$^2$ proposed site for the QEOP.

This section provides a summary of the principal works that were carried out across the site, focusing on those items of work that have the potential to have an impact in terms of this WFD assessment. The types of work assessed within this report include direct works on the water bodies as well as works that are likely to affect the water bodies identified. The works assessed include those works undertaken from 2006 as part of the Olympic and Legacy development and works that are currently planned by the LLDC as part of the Legacy transformation of the QEOP.

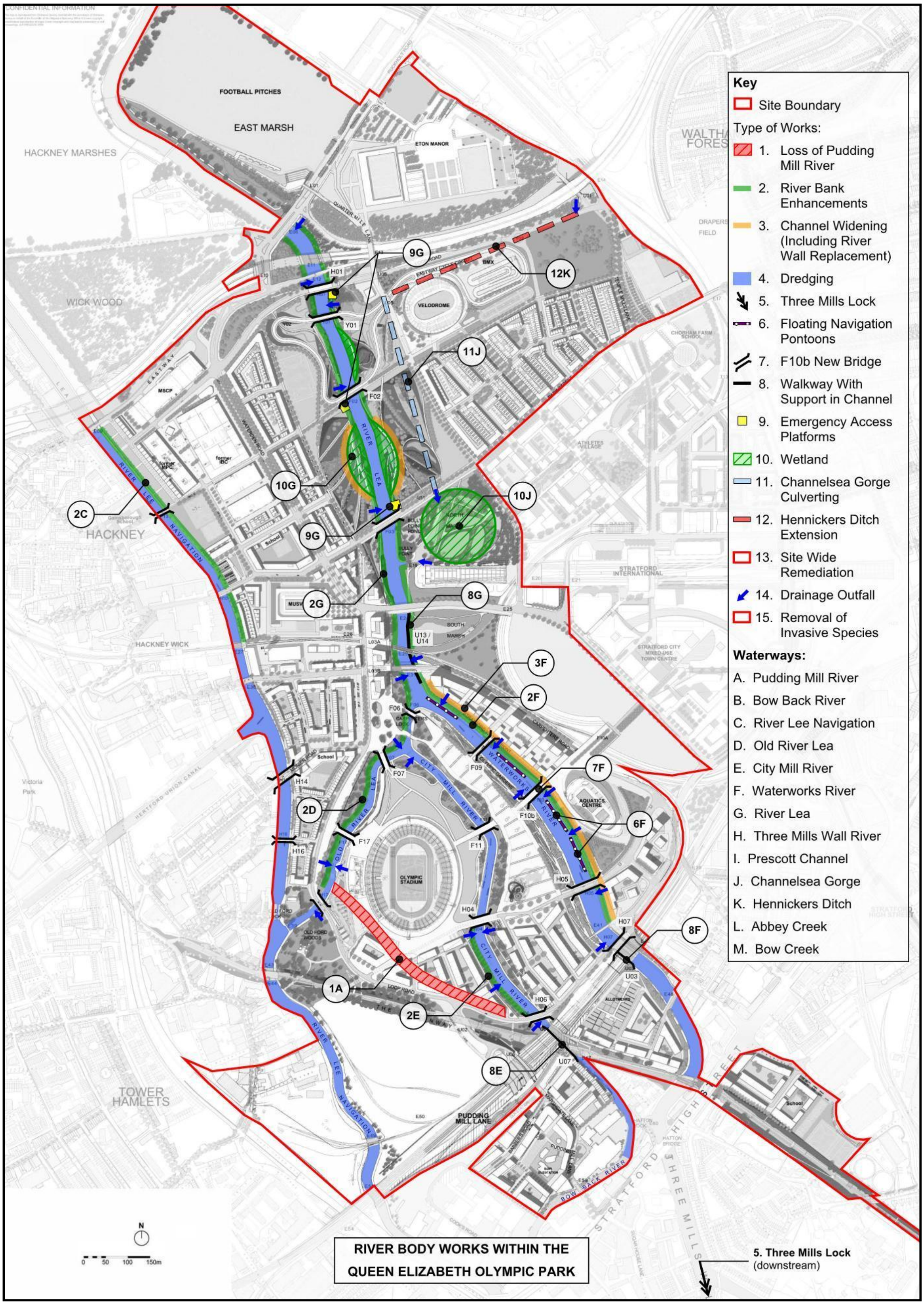
The works are described under the following sub-headings:

- *Lee*
- *Thames Middle*
- Site wide

The location of these works is shown on a schematic plan below and in an appending table.

Many of the works described in this section are shown in a short pictorial report prepared by BH called *The Olympic Park – Then and Now*, included within Appendix B.

**Figure 5 – Location of Principle QEOP Works (Also included in Appendix C)**



The type of works considered and their waterway location in the QEOP are detailed in the following Table.

**Table 2. Summary of works undertaken on waterways included in the QEOP WFD Assessment.**

| | | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Water Body** | **Work / Waterway** | **Loss of Pudding Mill River** | **River Bank Enhancements** | **Channel Widening (including River wall replacement)** | **Dredging** | **Three Mills Lock** | **Floating Navigation Pontoons** | **F10B New Bridge** | **Walkway with support in waterway** | **Emergency Access platforms** | **Wetland creation** | **Channelsea Gorge Culverting** | **Hennicker's ditch extension** | **Site Wide Remediation** | **Site wide Drainage** | **Removal of invasive species** |
| *Lee* | A. Pudding Mill River | **1A** | | | | | | | | | | | | | | **15A** |
| | B. Bow Back River | | | | | | | | | | | | | | | **15B** |
| | C. River *Lee* Navigation | | **2C (Canal Park)** | | **4C** | | | | | | | | | | | **15C** |
| | D. Old River Lea | | **2D.** | | **4D** | | | | | | | | | **13D** | **14D** | **15D** |
| | E. City Mills River | | **2E** | | **4E** | | | | **8E (U07)** | | | | | **13E** | **14E** | **15E** |
| | NA - Hennicker's Ditch | No works within or affecting this waterway | | | | | | | | | | | | | | |
| | NA - Limehouse Cut | No works within or affecting this waterway | | | | | | | | | | | | | | |
| Thames Middle | F. Waterworks River | | **2F** | **3F** | **4F** | **5F.** | **6F** | **7F.** | **8F (U03)** | | | | | **13F** | **14F** | **15F** |
| | G. River Lea | | **2G** | **3G** | | **5G** | | | **8G ( U13/U14)** | **9G** | **10G(Wetland Bowl)** | | | **13I** | **14G** | **15I** |
| | H. Three Mills Wall River | | | | | **5H** | | | | | | | | | | **15G** |
| | I. Prescott Channel | | | | | **5I** | | | | | | | | | | **15H** |
| | J. Channelsea Gorge | | | | | | | | | | **10J (Bully Point Wetlands)** | **11J (Channelsea Gorge Culverting)** | | **13J** | | **15J** |
| | K. Hennicker's Ditch | | | | | | | | | | | | **12K** | | | **15K** |
| | L. Abbey Creek | | | | | | | | | | | | | | | **15L** |
| | M. Bow Creek | | | | | | | | | | | | | | | **15M** |
| Chal k C | N. | | | | | | | | | | | | | | **14N.** | |

## 3.2 *Lee* Works

### 3.2.1 Loss of Pudding Mill River (1A)

The filling in of the Pudding Mill River was part of the Enabling Works that were carried out in 2007. The Pudding Mill River was an open channel with soft side slopes and bed. It provided no hydraulic connectivity between the watercourses of the Bow Backs and over the years it had suffered from significant dumping of waste.

**Figure 6 – The Pudding Mill River, circa 2006**


### 3.2.2 River Bank Enhancements (2C, 2D, 2E)

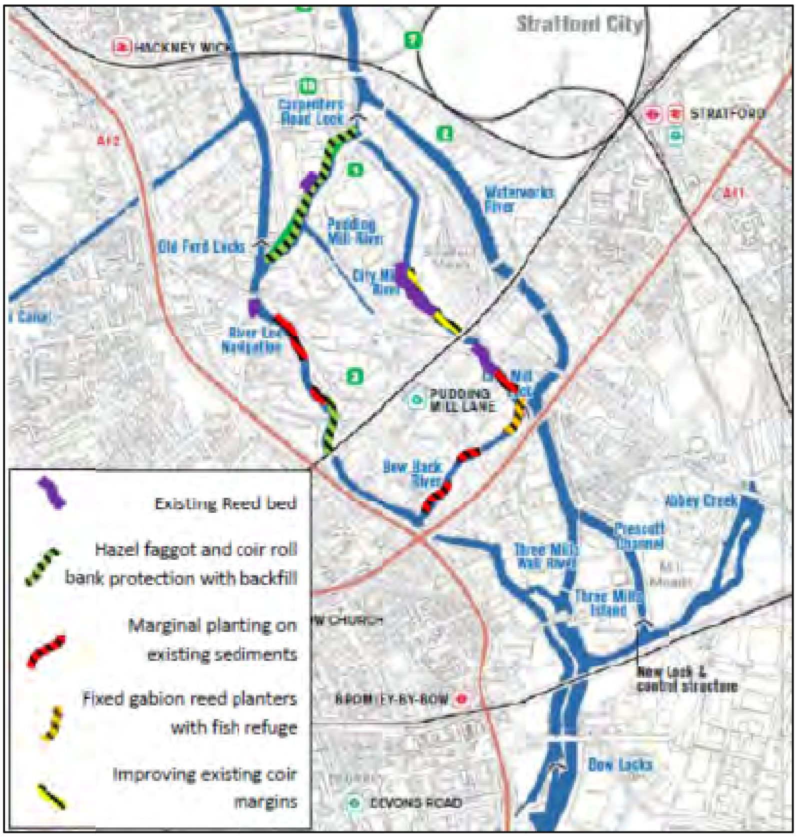
Extensive river bank works were carried out on the Old River Lea and the City Mill River where hard, vertical walls were removed and replaced with shallow sloping, planting river banks.

**Figure 7 - Soft river enhancements along the west bank of the City Mill River**

Extensive riverbank enhancements have been carried out throughout the Lee. The works included additional planting of trees and aquatic, marginal flora, hazel faggots, coir rolls, gabions and reed planters. Habitats for a wide range of fauna were created including otters, kingfisher, sand martins, fisheries and invertebrates.

The more localised enhancements works are shown on plan provided by the C&RT below:

**Figure 8 - Localised River Bank Enhancement Works**




In all, over 5km of riverbank were enhanced within the *Lee* and *Thames Middle.*

Canal Park includes proposed transformation works along the left bank of the River Lee Navigation between the A106 and approximately 50m south of Bridge H14. The works include landscape improvement works along the river bank next to iCity, excavating some areas and infilling others. It is proposed to retain a balance in the cut and fill volumes across the site in order to reduce the volume of material moved off or into the site. It is envisaged that these works will be carried out in 2014.

### 3.2.3 Dredging (4C, 4D, 4E)

The Canal & River Trust (C&RT), formerly British Waterways, has carried out a number of channel dredging operations throughout the Olympic watercourses.

The majority of works that were carried out in the *Lee* took place in 2012/13 and the table below summarises the volumes of excavated material:

**Table 3 - Volumes of dredging within the Lee**

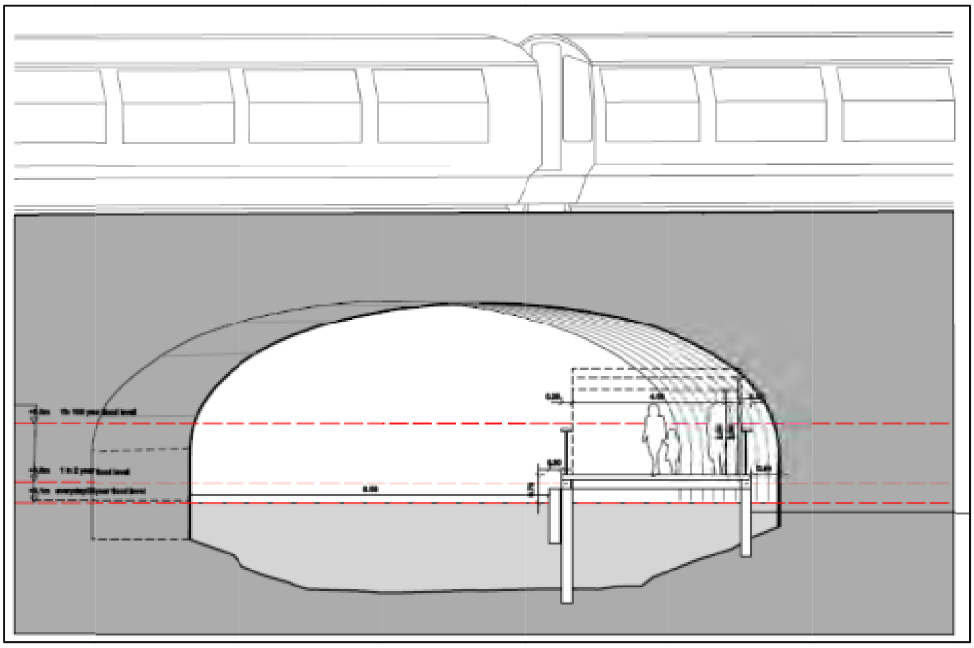
| Location | Dredged $m^3$ |
|---|---:|
| Old River Lea and City Mill River ('Stadium loop') | 9,618 |
| * Old River Lea, North Park | 5,033 |
| Lee Navigation plus City Mill River (St Thomas Creek section) | 3,453 |
| Additional dredge - City Mill Lock bypass channel | 247 |
| Additional dredge - Lee Navigation (Megg's Wharf and winding hole) | 298 |
| **Totals** | **18,649** |

The C&RT has a rolling programme that schedules surveys and further dredging works as appropriate and this is included within Appendix D.

### 3.2.4 U07 Walkway with support in waterway (8E)

U07 is an underpass that allows pedestrian access along the west bank of the City Mill River under the DLR and over ground railway lines near Pudding Mill Lane.

**Figure 9 - Indicative section through U07**



### 3.2.1 New Bridges

The table below summarises the new bridges within the *Lee*;

**Table 4- New bridges within Lee**

| Ref | Watercourse |
|---|---|
| F13 | River Lee Navigation |
| H14 | River Lee Navigation |
| H16 | River Lee Navigation |
| F07 | Old River Lea |
| F17 | Old River Lea |
| H17 | Old River Lea |
| F11 | City Mills River |
| H04 | City Mills River |
| H06 | City Mills River |
| U07 | City Mills River |

The above bridges are all clear span and have all been subject to formal flood risk assessment.

Under the Water Framework Directive some structures and works are exempt from the need for a detailed assessment. Permanent clear span bridges with abutments set-back from bank top are among the exempt works.

Therefore, there is no bridge within the Lee water body that will require a WFD assessment.

## 3.3 *Thames Middle Works*

### 3.3.1 River Bank Enhancements (2F, 2G)

New habitats have been created throughout the River Lea and Waterworks River with the planting of thousands of trees and native aquatic species flora, hurdles, spilling and reed beds. Specific habitat features include otter holts, kingfisher and sand martin nests, water vole, bats, swifts, sand martins, amphibians, reptiles and a range of invertebrates.

### 3.3.2 Channel Widening (including River Wall replacement 3F, 3G)

Channel widening was carried out in two principal locations; the wetlands bowl on the River Lea and the Waterworks River.

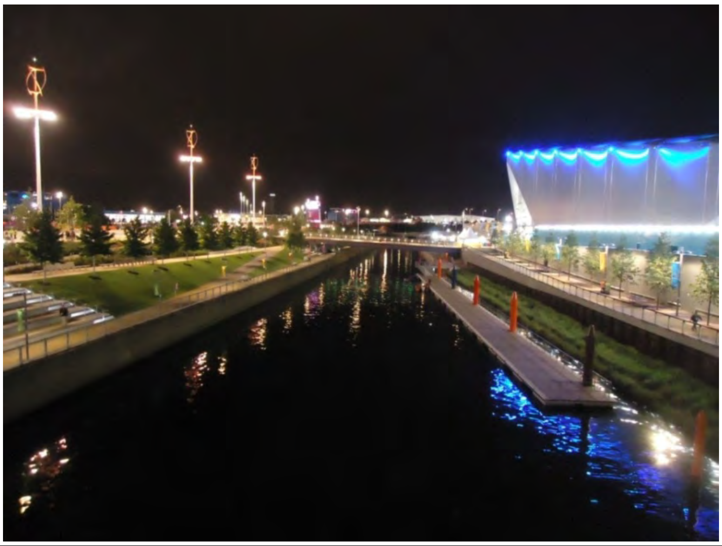
The Rive Lea was widened between bridges F02 and F03 for the primary purposes of creating the wetlands and reed beds areas. The bank profiling works also increased the flood storage and conveyance along the River Lea.

The Waterworks River was widened for the primary purposes of facilitating freight movements and increasing conveyance. The new wall consisted of steel sheet piling, concrete capping with a marginal aquatic planted terrace on the river side.

The marginal planting terrace is protected from mooring boats by the introduction of ship impact piles.

**Figure 10 - Steel sheet piling works along the Waterworks River**

**Figure 11 - Length of widened Waterworks River looking upstream (north), with marginal aquatic planting, ship impact piles and Scheme 2 pontoons.**



### 3.3.3 Dredging (4F)

The C&RT carried out a number of channel dredging operations on the Middle Thames watercourses from 2009 onwards.

In 2009/10 dredging was carried out on the Waterworks River for the primary reason of the Olympic freight route. A total of 27,000T of material was dredged, of which:

- 6,500T was re-used on the Park.
- 3,955 T was classified as hazardous due to hydrocarbon contamination and exported off-site.
- 16,545T was taken off-site to non-hazardous disposal sites at Hoo Island (Medway Estuary, 13,250 T, by water), and to the landfill site at Mucking, Essex, 3,855 T by road.

In 2011/12 further dredging was carried out on the Waterworks River in conjunction with mooring / marker pile installation and dolphin repairs. A total of 3,750 T of non-hazardous was exported off-site to the Cory landfill at Mucking, Essex.

A further 5,580m$^3$ of material was dredged in 2012/13 between the Waterworks River Bridgewater to Carpenters Lock. Of the total dredged material removed in 2012/13 along the Lee and *Thames Middle* 6,000 T was gravel and was washed for re-use, 690 T was classified as hazardous removed off-site, 70 T was scrap metal and was recycled and 21 T was dumped tyres.

The C&RT has a rolling programme that schedules surveys and further dredging works as appropriate and this is included within Appendix D.

### 3.3.4 Three Mills Lock (5F, 5G, 5H, 5I)

Three Mills Lock is a British Waterways, now C&RT, Project that open in June 2009. The primary purpose was to encourage the sustainable movement of construction materials and to improve opportunities for leisure craft upstream of the lock.

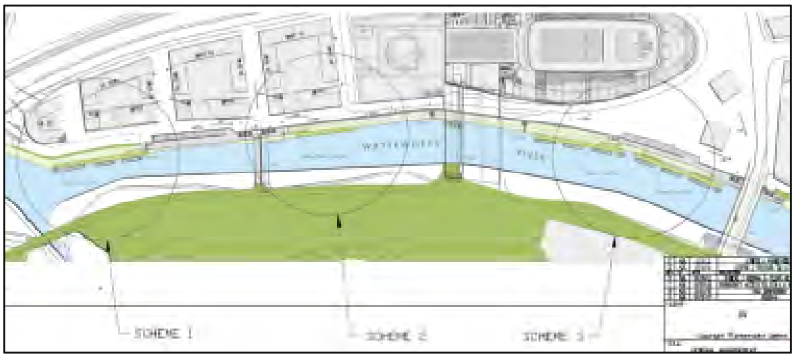
The creation of the lock means that the River Lea is no longer tidal between Sluice Bridge and Three Mills Lock.

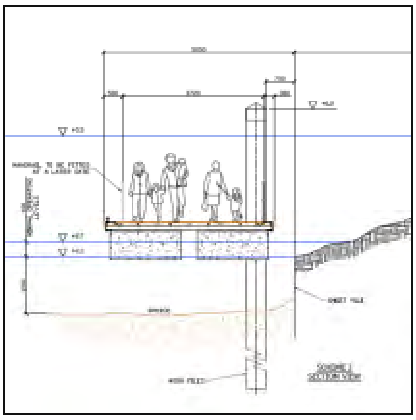
**Figure 12 - Three Mills Lock**

### 3.3.5 Floating Navigation Pontoons (6F)

A number of floating pontoon structures, for moorings, is proposed along the east (left) bank of the Waterworks River, in the vicinity of the Aquatics Centre. The works are referred to as Scheme 1, Scheme 2 and Scheme 3 pontoons. Scheme 2 pontoons were in place for the 2012 Games and Scheme 1 and 3 pontoons are expected to be in place during 2014.

**Figure 13 - Section through Scheme 2 pontoons**



### 3.3.6 F10B New Bridge (7F)

The table below summarises the new bridges within the *Thames Middle;*

**Table 5- New Bridges within Thames Middle**

| Ref | Watercourse |
|---|---|
| H01 | River Lea |
| Y01 | River Lea |
| F02 | River Lea |
| F03 | River Lea |
| U13 / 14 | River Lea |
| F09 | Waterworks River |
| F10b | Waterworks River |
| H05 | Waterworks River |
| H07 | Waterworks River |
| U03 | Waterworks River |

With the exception of Bridge F10b, which has one in-channel pier, all the bridges are clear span.

There is only one new bridge with supports in the waterway – F10B.

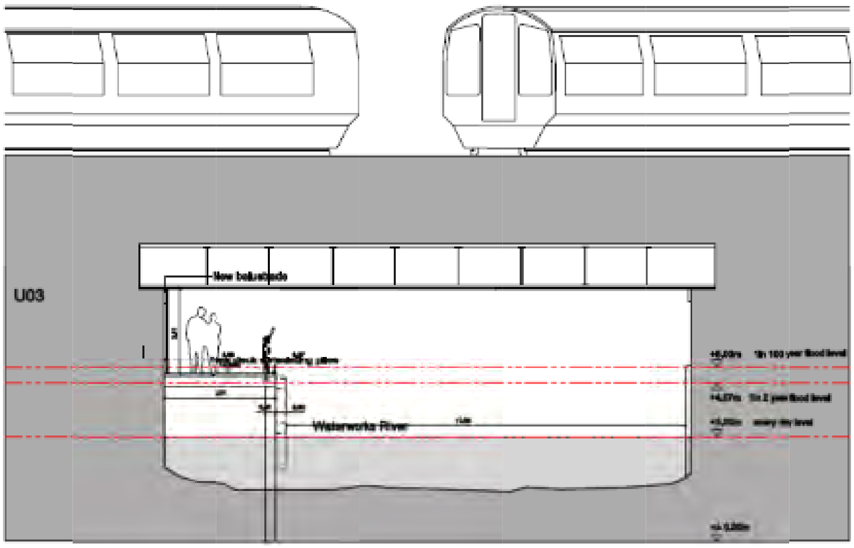
Under the Water Framework Directive some structures and works are exempt from the need for a detailed assessment. Permanent clear span bridges with abutments set-back from bank top are among the exempt works.

Therefore, the only bridge assessed under this QEOP WFD assessment will be F10B.

### 3.3.7 U03 and U13/U14 Walkway with support in waterway (8F and 8G)

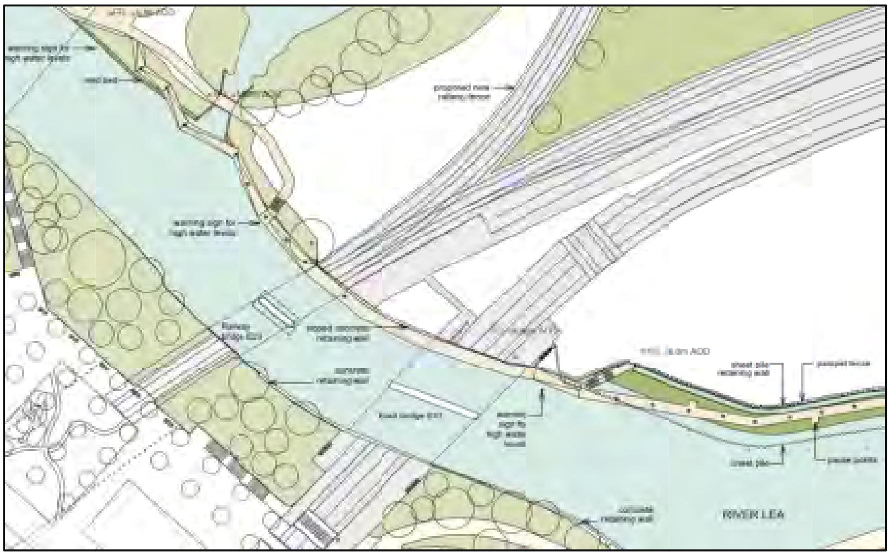
U03 is an underpass that allows pedestrian access along the west bank of the Waterworks River under the DLR and overground railway lines near Pudding Mill Lane.

**Figure 14- Indicative section through U03**




U13 /14 is a proposed underpass that will provide pedestrian access along the east bank of River Lea below bridge E29 and E31.

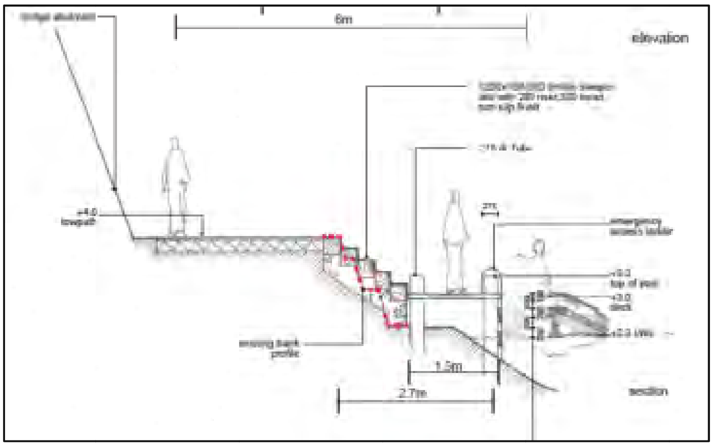
**Figure 15 - U13/14 Location Plan**



### 3.3.8 Emergency Access Platforms (9G)

Three number, fixed level wooden access platforms were installed along the River Lea for emergency river craft during the Games. The platforms are expected to remain in place.

**Figure 16 - Section through Emergency Access Platforms**




### 3.3.9 Wetland Creation (10G and 10J)

The Wetland Bowl in the north of the park on the River Lea contains two online reed beds. A total of over 5,000m$^2$ of reed beds are provided composed mainly of common reed Phragmites australis, a UK BAP priority habitat known to support an abundance of insect, amphibian and bird life.

Within the reed beds, wetland channels have been designed to increase habitat complexity, maximise reed edge extent and provide refuge for a range of fish species including eel Angulia, a London 2012 BAP priority species. An additional reed bed to the north of the bowl, on the east bank north of Bridge F02 provides a further 550m$^2$ of native reed bed.

**Figure 17 - Reed beds shortly after construction in 2011**

**Figure 18 - The Olympic Bowl wetlands on the east (left) bank of the River Lea.**

Two new wet woodlands, over an area of 4,000$m^2$, provide off-line river habitat, with excavated channels maintaining hydrological and ecological connectivity with the River Lea. These areas have been designed to retain waters from the Lea during periods of higher retained level as a result of Three Mills Lock. The wet woodland habitats have been planted with a mix of shade tolerant sedge species and typical wet woodland trees such as alder. Shallow depressions provide areas of standing water that provide a range of moisture gradients across the habitat. Marginal wetland flowering plants add further value to the area.

**Figure 19 - Wet woodland habitat at Bully Point**

Wetland planting is also being provided for three new amphibian ponds over an area of 2,000$m^2$. Each pond is fed by drainage water from the Park's concourse, with the largest having been designed with an adjustable feed from the River Lea to allow maintenance of a permanent water level. The maintained water body is planted with a range of plants including oxygenating submerged aquatics such as rigid hornwort, ceratophyllum demersum and species such as water forgetme-not Myosotis scorpioides to provide suitable egg laying sites for newts. A series of log walls installed alongside the ponds enhance the ecological value through the provision of habitat for invertebrates and hibernation sites for amphibians.

### 3.3.10 Channelsea Gorge Culverting (11J)

In 2009 Channelsea Gorge was culverted (3m x 2.75m) as part of the October 2008 Parklands & Public Realm application that included the wetland bowl and concourse works to the east of the River Lea.

**Figure 20 - new culverts ready to be placed (May 2009)**

### 3.3.11 Hennicker's ditch extension (12K)

At the same time of the culverting of Channelsea Gorge a second culvert (2 x 1m) was added to Hennicker's Ditch Extension to increase flow from the overland flow route to the River Lea, via U01.

## 3.4 Site Wide

### 3.4.1 Site Wide Remediation (13D, 13E, 13F, 13I, 13J)

Prior to construction works beginning on the Olympic Park existing buildings were demolished and remediation of site soils and groundwater was undertaken. Large amounts of rubbish, tyres, chemicals, rubble and oil waste were removed from the site surface and soil and groundwater contamination associated with the 150 years of historic site use was identified by the subsequent ground investigations. Approximately 200 buildings and industrial facilities were demolished on the site.

After the demolition and clearance works a total of 2.3 million $m^3$ of soil was excavated across the site and processed at the on-site Soil Hospital. Some of this excavation was to remove areas of contamination and some was to create the new development landforms. Of this a total of 800,000$m^3$ was cleaned and re-used as fill across the site. Areas of significant contamination were excavated and where required groundwater treatment systems put in place, this work significantly improved the environmental quality of the site. A total of 20 million gallons (90,000$m^3$) of groundwater were treated. In addition a capping layer of 600mm was placed over the existing site soil to separate site users from the underlying material.

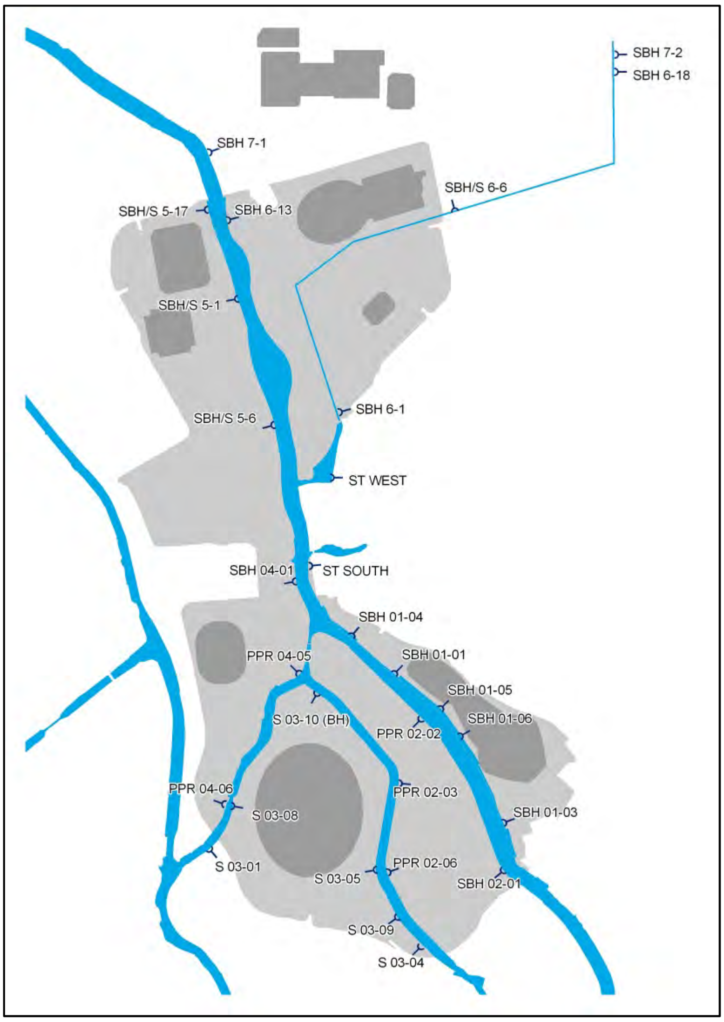
### 3.4.2 Site Wide Drainage (14D, 14E, 14F, 14I, 14N)

The site-wide drainage strategy prepared by BH consisted of the following fundamental principles:

1. All foul and surface water systems would be separate.
2. Surface water flows would be discharge directly, without attenuation, ahead of the peak flows in the Lower Lea Valley.
3. There would be no discharge to ground across the site. This policy was identified in order to mitigate the risk associated with mobilisation of contaminants within the groundwater.

The surface water outfalls within the Park are shown in the figure below. All surface water networks include pollution control mitigation measures including silt traps and oil interceptors.

**Figure 21 - Location of SWD Outfalls across QEOP**




### 3.4.3 Removal of Invasive Species (15A to 15M)

Throughout the Lee extensive works were carried out to remove significant colonies of invasive plant species including Japanese Knotweed, Giant Hogweed and Himalayan Balsam.

Throughout the *Thames Middle* extensive works were carried out to remove significant colonies of invasive plant species including Japanese Knotweed, Giant Hogweed and Himalayan Balsam.

### 3.4.4 Rainwater harvesting, filter backwash and site wide water demand reduction measures

The Queen Elizabeth Olympic Park (QEOP) planning condition OD.0.22 detailed the following requirements. *"In respect of each Planning Delivery Zone, all development, including buildings, landscape and public areas shall be designed so that, both for Games and as legacy facilities, the consumption of potable water and non-potable water is minimized, and water is recycled, reused in accordance with the objectives in the Outline Water Strategy. A 40% reduction in potable water use shall be achieved when compared to the 2006 industry standards."*

The QEOP development set out to reduce the whole life potable water consumptions by 40% against 2006 standards during the Games and set out to achieve a 40% potable water consumption reduction for legacy facilities during legacy. The 40% target was to be applied at a Park wide level rather than a venue or project development zone level.

Individual venue peak daily demands were estimated using the specific demand profiles shown below.

**Figure 22 - Irrigation daily water demand profile**

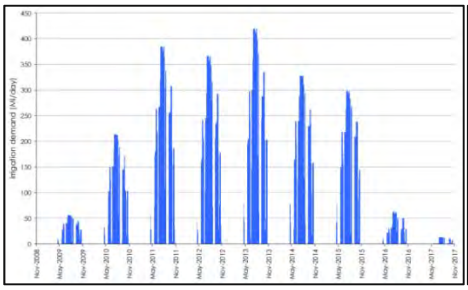


**Figure 23- Stadium daily water demand profile**

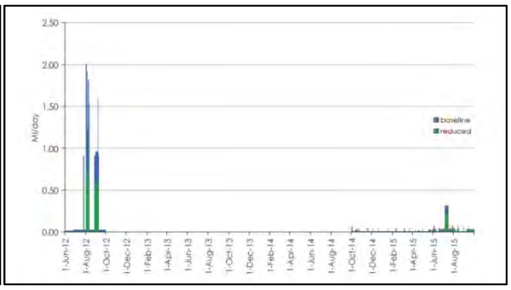


**Figure 24 - Handball daily water demand profile**

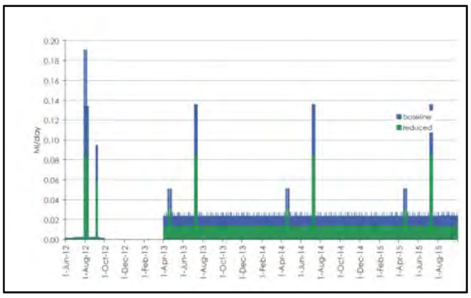
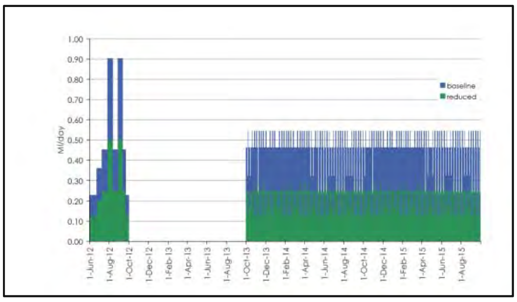


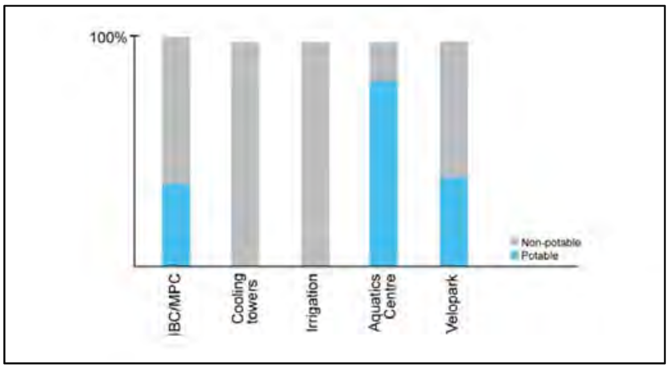
**Figure 25 - IBC MPC daily water demand profile**



All venues were fitted with water efficient fittings and, alongside highly efficient irrigation; this enabled an initial reduction in potable water consumed of 20% with respect to the 2006 standard baseline.

In order to achieve the 40% Park wide water reduction target, opportunities within each of the venues for substituting potable water supply with non-potable water were identified.

**Figure 26 - Venues suitable for non-potable water supply**




This helped to achieve a further 40% reduction in potable water consumed on site.

Therefore, the total Park wide reduction in potable water consumed achieved with respect to the 2006 baseline was 60%.

Various Park wide level water source substitution options were considered. These included the use of surface water from the River Lea and Lee Navigation and of Groundwater from either the Chalk or the River Terrace Deposits underlying the park. The latter could involve reusing existing boreholes on-site used by previous occupants. The construction of an MBR treatment plant and reuse of treated sewage effluent (TSE) was identified as the preferred non potable water source for the site alongside rainwater collection. The Old Ford Treatment Plant avoided conflicts of interest with Thames Water in the eventuality of a period of drought; was less carbon onerous than desalination and ensured a constant and consistent supply to the site.

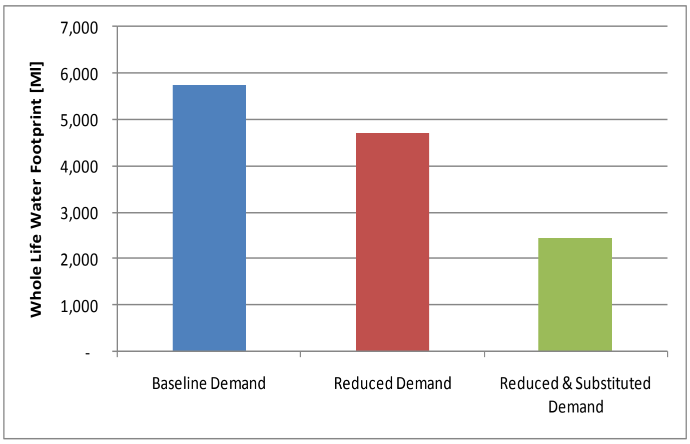
The following table details the works implemented on site in order to achieve these further savings and the expected savings achieved by each.

**Table 6 - Water Substitution Measures**

| Substitution measures | Expected overall demand reduction |
|---|---|
| **Aquatic Centre** - Toilet flushing from filter backwash water | 1.1% |
| **Handball Arena** – Toilet flushing using rainwater harvesting with top up from the water recycling plant | 0.2% |
| **Velopark** - Toilet flushing using rainwater harvesting with top up from the water recycling plant | 0.8% |
| **IBC/MPC** - Toilet flushing in the legacy MPC building using the water recycling plant | 5.7% |
| **Main Stadium** –Field of play and establishment irrigation using the water recycling plant | 3.1% |
| **Eton Manor** – Establishment irrigation and toilet flushing using the water recycling plant | 0.3% |
| **CCHP** – Substitution of cooling water demand using the water recycling plant | 26% |
| **Establishment irrigation** –Using the water recycling plant | 2.8% |
| **Total reduction** | **40%** |

A summary of the parkwide whole life potable water demand reduction achieved is summarised below.

**Figure 27 - Whole life water footprint (Ml)**



# 4 Assessment Methodology

## 4.1 Methodology

Assessments in accordance with the WFD are a relatively new requirement for developers and it is recognised by the EA that there is little in the way of established precedence for projects on the scale of the QEOP. As such there is no specific template for this exercise and this is an opportunity to define good practice in the assessment of compliance with the WFD.

BH has liaised with the LLDC and the EA throughout the study process. The key elements of the proposed methodology are summarised as follows:-

- Identify key elements and parameters which will be used to define successful works and measure progress;
- Review existing water body baseline data and information from major stakeholders;
- Understand how proposed works impact upon the key elements;
- Preliminary assessment of impacts from proposed works;
- Approval of preliminary assessment with EA;
- Detailed assessment of impacts from proposed works with significant potential impact;
- Identification of mitigation measures implemented;
- Assessment of residual effects after mitigation; and
- Overall assessment of compliance of scheme measures with WFD objectives

## 4.2 BH approach to WFD Assessments

Buro Happold has identified four key themes that underpin many of the objectives and quality elements defined by the WFD. These are the following.

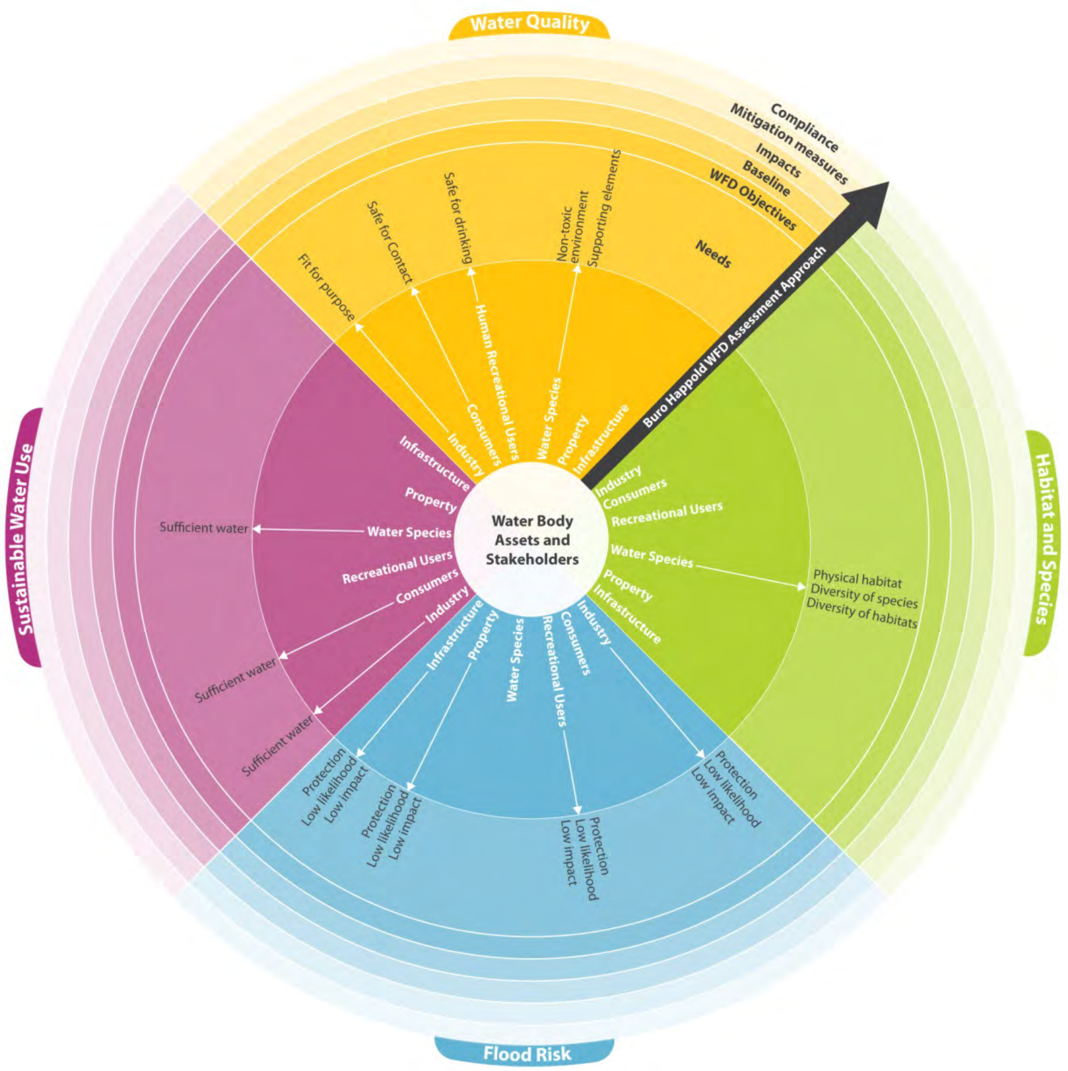
1. Sustainable Water Use
2. Habitats and Species
3. Water Quality
4. Flood Risk

The BH “wheel” in Figure 28 illustrates how at the WFD objectives and water quality elements can be traced back to the very specific needs of a range of stakeholders. The WFD assessment effectively aims to establish the extent to which work is being done to meet these needs, i.e. the works do not aggravate or reduce the ability to meet the required needs within and surrounding a given water body and the works do not limit the potential for future improvements. The WFD water quality elements are therefore the indicators which are used to define successful fulfilment of the stakeholders needs and assess progress.

The quality elements and sub-objectives presented in the WFD have been mapped on these four Themes. All quality QEOP proposed work will therefore be assessed for compliance with the WFD against each of the four themes.

Further details of how the assessment will be undertaken with regard to these four main headings are described further in this section.

**Figure 28 - Buro Happold WFD Assessment Approach**



## 4.3 Key Indicators Adopted

Numerous biological, hydromorphological and chemical and supporting elements are used as indicators to help assess whether the works have a positive or negative impact on the surrounding water body and environment. The RBMP identifies relevant elements appropriate for measuring different characteristics in different water bodies.

The following tables identify the indicators considered for the purpose of the QEOP WFD assessment. The different nature of the various water bodies being assessed means these elements will not be the same for all water bodies.

### 4.3.1 Sustainable Water Use Indicators

No specific sustainable water use quality elements are prescribed by the WFD. The sustainable water use theme takes into consideration effects of existing upstream abstractions on the water body. Water use for the operational phase of the development will be assessed with regard to established industry standard baselines and the adopted potable and non-potable water strategy for the QEOP. The impact of the QEOP development on sustainable water use will be assessed using parameters such as the following:

**Table 7 - Sustainable Water Use Indicators**

| Sustainable Water Use Indicators | Parameters / elements measured |
|---|---|
| Site wide – applies to *Lee* (from Tottenham lock to Tideway) and to *Thames Middle* (Transitional) | % saving in potable water demand achieved through DRM |
| | % treated waste water created |
| | % treated waste water reused |

### 4.3.2 Habitat and Species Indicators

The Habitat and species objectives within the WFD address the biology and hydromorphology of the waterways. Both *Thames Middle* and the *Lee* are classified as *Heavily Modified* Water Bodies. This means that the EA considers it unfeasible to improve the aquatic plants, invertebrates and fish populations to 'Good' status without impacting on the uses of the waterway. The aim, therefore, is for the fish, invertebrate and aquatic plant populations are to be as good as possible without compromising the uses.

The Heavily Modified designation identifies that the natural hydromorphology of the river has been historically compromised for human purposes, such as flood protection. This has consequences for the WFD assessment as the baseline modified conditions of the water body means that changes in hydromorphology due to the development cannot prevent the achievement of 'Good' Ecological Potential. However, these changes can still prevent or exacerbate deterioration and will therefore be assessed.

The typical indicators recommended by the EA as appropriate for the assessment of biological, hydrological and hydromorphological conditions are listed below. These are extracted from the WFD Annex V and the EA Method statement for the classification of surface water bodies v3 (2012). It should be noted the for groundwater bodies there is no explicit requirement to achieve ecological water elements requirement but only an indirect requirement to avoid preventing connecting surface water bodies from achieving good ecological quality. Groundwater specific habitats and species elements are therefore not presented below.

The preliminary and detailed assessments will be based on the relevant indicators from the list below.

**Table 8 - Habitats and Species indicators**

| | **WFD Annex V – Quality elements** - *Lakes and Transitional Water* | **EA 2012 Method for the classification of water bodies** – Biological, Hydrological and Morphological | **Rivers** | **Transitional Waters** |
|---|---|---|---|---|
| **BIOLOGICAL ELEMENTS** | Composition, abundance and biomass of phytoplankton | **Phytoplankton** - *Free floating microscopic plant. Sensitive to primarily nutrient enrichment* | | ✓ |
| | Composition and abundance of aquatic flora | **Diatoms (Algae)** - *Macrophytes and phytobenthos. Microscopic algae found on rock and plants Sensitive to primarily nutrient enrichment.* | ✓ | ✓ |
| | | **Macrophytes** – *Water plants visible to the naked eye, growing in the river. Sensitive to nutrient enrichment and morphological alterations* | ✓ | ✓ |
| | Composition and abundance of other aquatic flora | **Macroalgae** - *Seaweeds visible to the naked eye. Sensitive to nutrient enrichment, hazardous chemicals* | | ✓ |
| | | **Angiosperms** - *Sea grasses and saltmarsh plants. Sensitive to nutrient enrichment, morphological alterations* | | ✓ |
| | Composition and abundance of benthic invertebrate fauna | **Macro invertebrates** - *Insects, worms, molluscs Crustaceans etc. living on the river bed. Sensitive to organic enrichment, pollution by toxic chemicals, acidification, abstraction of water* | ✓ | |
| | | **Benthic invertebrates** - Worms, molluscs and crustaceans etc. living in or on the bed of the estuary or sea. Sensitive to organic pollution, hazardous chemicals and some morphological alterations | | ✓ |
| | Composition, abundance and age structure of fish fauna | **Fish** – including eel | ✓ | ✓ (Only those mostly in transitional waters) |
| **HYDRO LOGY** | Hydrological regime | **Quantity and dynamics of water flow** | ✓ | |
| | | **Connection to ground water bodies** | ✓ | |
| | Freshwater flow | **Freshwater flow** | | ✓ |
| **MORPHOLOGICAL ELEMETNS** | River continuity | **River continuity** | ✓ | |
| | River Depth and width variation | **River Depth and width variation** | ✓ | |
| | Structure and substrate of the river bed | **Structure and substrate of the river bed** | ✓ | |
| | Structure of the riparian zone | **Structure of the riparian zone** | ✓ | |
| | Depth variation | **Depth variation** | | ✓ |
| | Structure and substrate of the river bed | **Quantity, structure and substrate of estuarine bed** | | ✓ |
| | Structure of the intertidal zone | **Structure of the intertidal zone** | | ✓ |
| | Wave exposure | **Wave exposure** | | ✓ |

### 4.3.3 Water Quality Indicators

Water Quality includes chemical water quality and supporting elements as defined in the Thames RBMP, such as temperature, pH and pollutants outlined in Annex VIII of the WFD. Examples of the supporting elements considered for the *Thames Middle* and the *Lee* water bodies are summarised in Table below.

The typical indicators recommended by the EA as appropriate for the assessment of physiochemical and chemical conditions are listed below. These are extracted from the WFD Annex V and the EA Method statement for the classification of surface water bodies v3 (2012).

The preliminary and detailed assessments will be based on the relevant indicators from the list below.

**Table 9 - Water Quality Indicators**

| | **WFD Annex V – Quality elements** - *Lakes and Transitional Water* | **EA 2012 Method for the classification of water bodies** – Biological, Hydrological and Morphological | **Rivers** | **Transitional Waters** | **Ground Water** |
|---|---|---|---|---|---|
| **PHYSIO CHEMICAL SUPPORTING ELEMENTS** | Transparency | **Transparency** | | ✓ | |
| | Thermal conditions | **Temperature** | ✓ | | ✓ **(if ecosystem dependant on water)** |
| | Oxygenation conditions | **Dissolved Oxygen** – This is required in sufficient amounts by fish. Low levels can be caused by excessive sewage discharge | ✓ | ✓ | ✓ |
| | Salinity | **Salinity** | ✓ | ✓ | ✓ |
| | Acidification status | **PH** | ✓ | | ✓ |
| | Nutrient conditions | **Ammonia –** High levels are nocive to aquatic flora and fauna.<br>Can be caused by high levels of sewage discharge or land contamination and agriculture. | ✓ | | ✓ |
| | | **Phosphate –** can contribute to eutrophication if present in high levels. Can be caused by runoff from raod verges, detergents, and animal faeces. | ✓ **(reactive phosphorus)** | | ✓ **(if ecosystem dependant on water)** |
| | | **Dissolved inorganic nitrogen -**<br>Can contribute to eutrophication is present in high concentrations. | | ✓ | ✓ |
| | | **Copper**<br>Can be nocive to aquatic flora and fauna | ✓ | ✓ | |
| | | **Conductivity** | | | ✓ |
| **PRIORITY SUBSTANCESLO** | Priority Substances | **Annex Viii Pollutants** - Pollution by all priority substances identified as being discharged into the body of water | ✓ | ✓ | ✓ |
| | Other EU level dangerous substances | **Annex Viii Pollutants** -Pollution by other substances identified as being discharged in significant quantities into the body of water | ✓ | ✓ | ✓ |

### 4.3.4 Flood Risk Indicators

Flood risk is a principal theme within the WFD objectives. The works carried out as part of the QEOP include a suite of flood risk management measures that have provided significant benefits in terms of flood risk.

It is proposed that the issue flood risk is considered irrespective of water body (*Thames Middle* or *Lee*) and is assessed as a whole and on a park-wide basis. The results of pre-Olympic condition modelling and the latest park-wide FRA will be taken into account when assessing impacts on the WFD objective. The flood risk with regard to the WFD is proposed to take into account on the following:

**Table 10 - Flood Risk Indicators**

| Flood Risk Indicators | Parameters / elements measured |
|---|---|
| Site wide – applies to *Lee* (from Tottenham lock to Tideway) and to *Thames Middle* (Transitional) | Extent of flood envelope – Number of properties within flood envelope |
| | Severity of flood within envelope – depth of flooding |

## 4.4 Preliminary Assessment Methodology

The purpose of the preliminary assessment is to address the question *"Do these works have an impact the status of the water body or any surrounding water bodies?"*

The screening methodology used is to undertake preliminary research to quantify the impact of each civil work against each indicator. Each impact is categories as follows. It should be noted that all works with an impact, whether it be positive or negative, will require a detailed assessment.

**Table 11 - Preliminary assessment screening criteria**

| | Anticipated effect | Action required |
|---|---|---|
| ✓ | Significant potential positive impact identified | Detailed Assessment required |
| ✓ | Slight potential positive impact identified with regard to water quality elements | Detailed Assessment required |
| - | No/ minimal risk of impact on identified or downstream water body | Screened out from further assessment. |
| × | Identified potential negative effect on one objective or downstream water body. | Detailed Assessment required |
| × | Identified negative effect. The effect could potentially prevent attainment of future 'Good' Status or Potential. | Detailed Assessment required |
| × | Likely to cause a deterioration in Status or Potential and therefore require an Article 4.7 test. Likely to prevent future attainment of 'Good' Status or Potential. | Detailed Assessment required. Article 4.7 test to be prepared if the assessment is confirmed. |

## 4.5 Detailed Assessment Methodology

The purpose of the detailed assessment is to undertake further investigation into the works identified as having an impact within the Preliminary assessment. This assessment takes into consideration any mitigation measures which have been implemented and attempts to answer the question: *"Do these works have a significant residual negative impact on the status of the water body or any surrounding water bodies?"*

## 4.6 Sources of Information

The main sources of information have involved reports, studies, drawings and design briefs from the LDA, ODA, LLDC, Atkins, EDAW Consortium, the Canal & River Trust (formerly British Waterways) and the EA. A list of references is provided in Section 8 of this report.

# 5 Baseline

## 5.1 Introduction

This section provides detailed information with regard to the *Lee* and *Thames Middle* water bodies and a summary of the status of *Thames Lower* and *South Essex Thurrock Chalk*. For the *Lee* and *Thames Middle,* the baseline with regard to the WFD water quality elements is established. It should be noted that the WFD quality elements used to assess ecological and chemical water body status are different for non-tidal river and transitional tidal water bodies. An image illustrating the tidal and non-tidal water bodies in the Baseline QEOP condition are shown in Figure 30.

In addition, key water quality issues and mitigation measures outlined in the Thames RBMP are identified.

The chapter will summarise the baseline information for all water bodies by theme as follows:

Section 5.2 **Overview of water bodies**

Section 5.3 **Sustainable Water Use**

- *Lee*
- *Thames Middle*
- *Thames Lower*
- *South Essex Thurrock Chalk*

Section 5.4 **Habitats & Species**

- *Lee*
- *Thames Middle*
- *Thames Lower*
- *South Essex Thurrock Chalk*

Section 5.5 **Water Quality**

- *Lee*
- *Thames Middle*
- *Thames Lower*
- *South Essex Thurrock Chalk*

Section 5.6 **Flood Risk**

- Park-wide

Section 5.7 **Key Issues**

Section 5.8 **RBMP targets**

**Figure 29- The lower lea Valley before the QEOP**

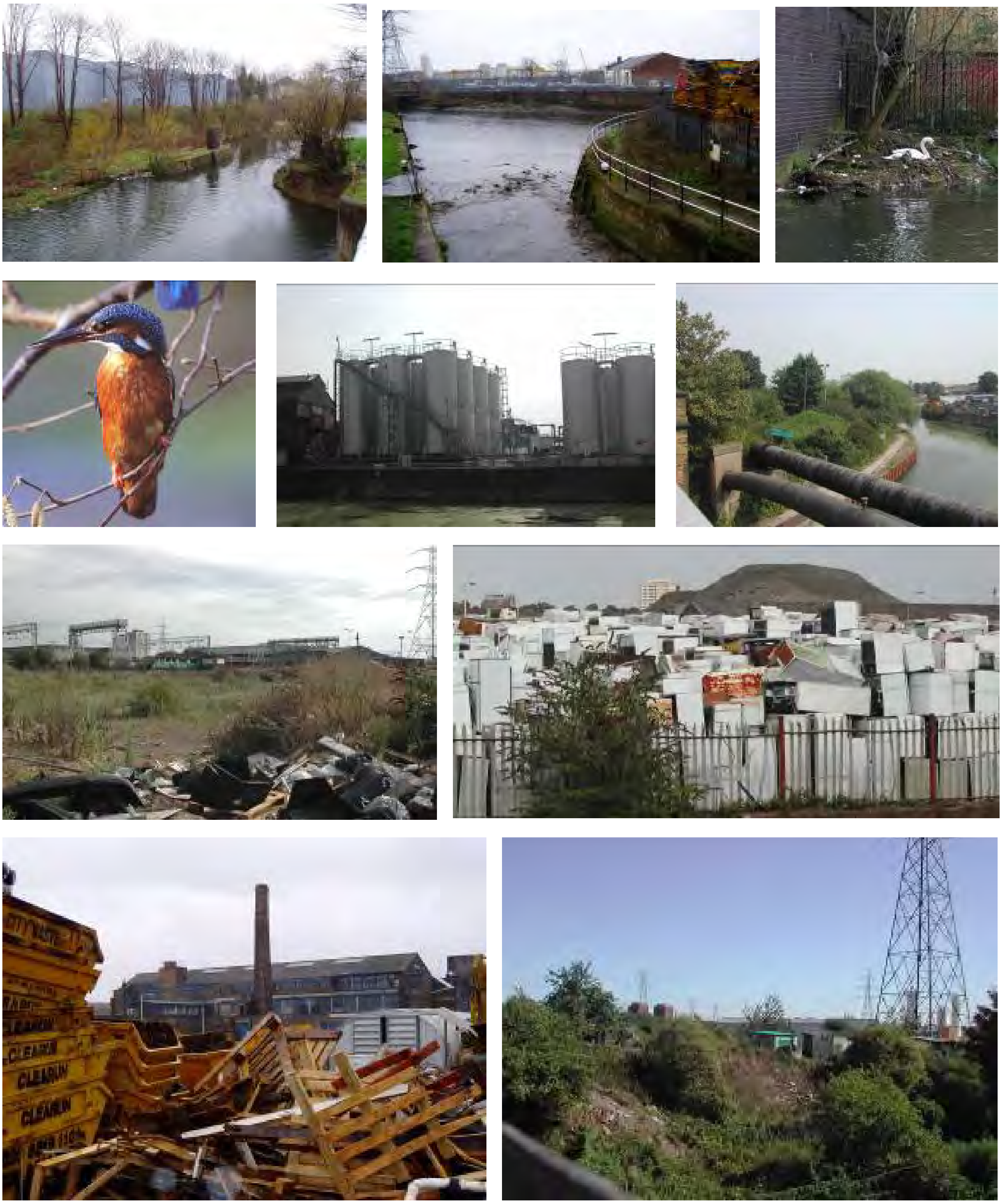
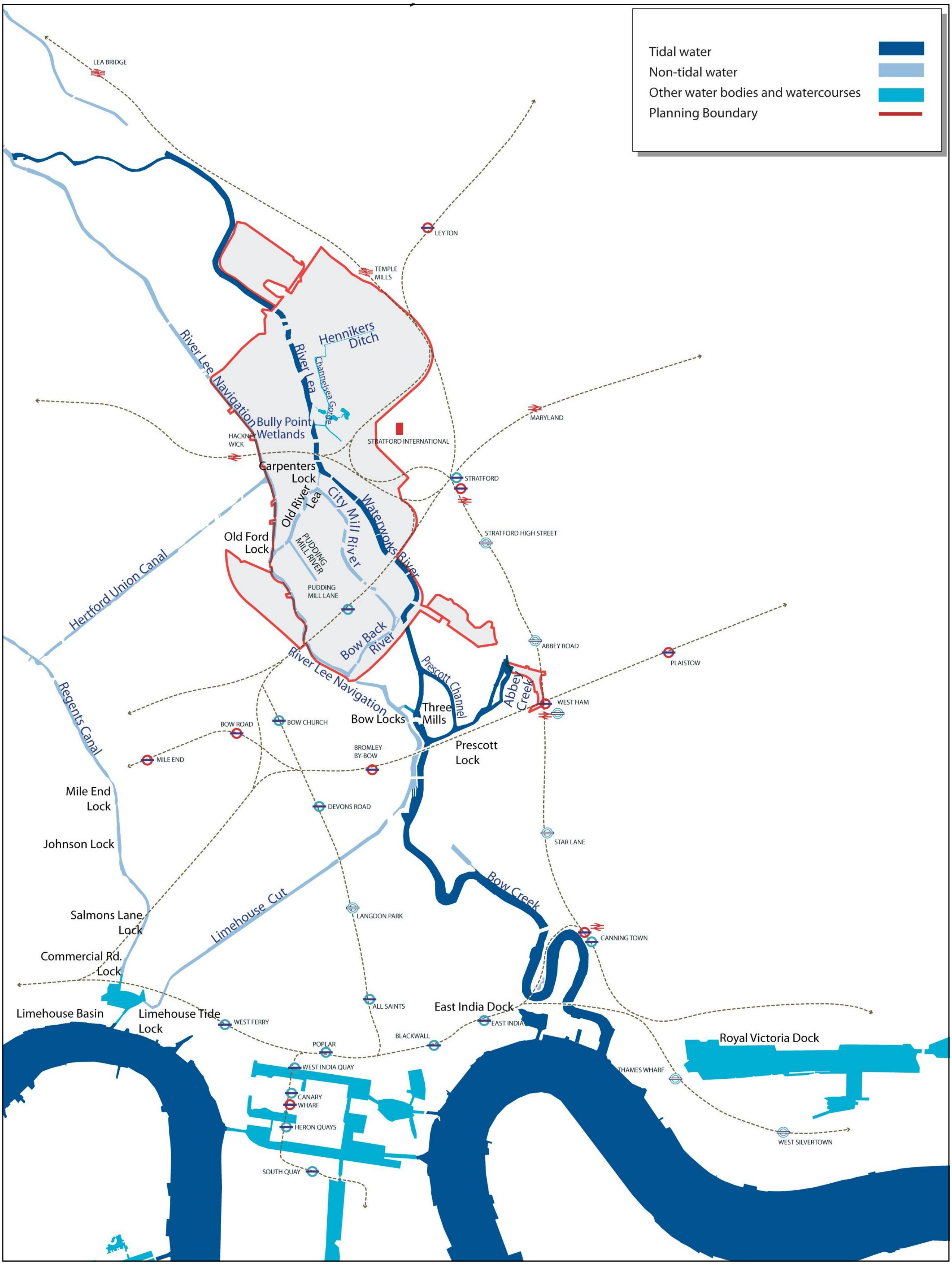


**Figure 30 - Baseline tidal and non-tidal waterways**



## 5.2 Overview of Water Bodies

### 5.2.1 *Lee* (Tottenham Locks to the Tideway) Overview

The River Lea catchment is approximately 1400 $km^2$ and the average catchment altitude is less than 200 m AOD. The Upper Lea has its source near Luton, from where it flows in a south-easterly direction, mainly through open countryside with arable farming and broad-leaved woodland. In the Upper Lea the catchment geology is relatively permeable, predominantly calcareous with some overlying clays. In the Lower Lea a majority of the catchment is underlain by impermeable London clay. However, in the lower reaches (including the QEOP) there are shallow gravel and alluvium deposits overlying this clay along the valley.

The *Lee* (from Tottenham Locks to the Tideway) comprises the River Lea downstream of Tottenham Locks in East London down to the confluence of the River *Lee* Navigation and the tidal section of the River Lea at Bow Locks. The *Lee* is a non-tidal water body with generally slow flow velocities. The catchment area of the Lower Lea is approximately 370 $km^2$.

**Table 12. *Lee* Water body baseline data - (RBMP, 2009. Annex B – p.346-347)**

| Water Body Name | Water Body ID | Water Body Type |
|---|---|---|
| *Lee* (Tottenham Lock to the Tideway) | GB530603911402 | River |
| **Current Ecological Potential (and certainty of less than good)** | **Ecological status objective and date objective to be achieved** | **Reasons for failure** |
| Moderate (Very certain) | Good by 2027 | Ammonia, dissolved oxygen, phosphate, PAH, Tributyltin |
| **Hydromorphological designation** | **Reason for hydromorphological designation** | **Waterways in water body within study area** |
| HMWB<br>(Heavily Modified Water Body) | Flood protection, urbanisation | River *Lee* Navigation (RLN), City Mill River, Bow Back River, Pudding Mill River, Old River Lea; Hertford Union Canal, Limehouse Cut |

Protected areas are described as relevant under the sub-headings of the chapter. No specific active point source of pollution or adverse impact has been identified within the Queen Elizabeth Olympic Park site boundary.

There are no designated areas within the study area. The closest Natura 2000 site is Walthamstow Reservoirs just south of Tottenham Locks but north of the Lea Bridge Sluices. It is designated as a site of special scientific interest (SSSI) and a part of the larger *Lee* Valley Special Protection Area (SPA) as designated under the EU Birds Directive. It contains a large concentration of breeding wildfowl and attracts nationally significant populations during winter.

Within the study area (from Lea Bridge Sluices to the confluence of the Bow Creek and the River Thames) there are no protected areas under the Freshwater Fish Directive, Natura 2000 or Bathing Water Directive.

The Freshwater Fish Directive is implemented through designated cyprinid fishery areas on the River Lea and *Lee* Navigation in the upstream water body north of Tottenham Locks.

### 5.2.2 *Thames Middle Overview*

The *Thames Middle* comprises the middle stretches of the tidal river Thames, from Cremorne Gardens to Stanford-le-Hope. It has fully mixed, predominantly brackish water (polyhaline,18-30 ppt) and tidal ranges of 4-6 metres. Within the study area the tidal influence is smaller; the River Lea is tidally influenced but not tidal throughout the study area up to Lea Bridge sluices north of the QEOP.

**Table 13. *Thames Middle* Water body baseline data - (RBMP, 2009. Annex B – p.977-978)**

| Water Body Name | Water Body ID | Water Body Type |
|---|---|---|
| *Thames Middle* | GB106038077852 | Transitional – Estuarine |
| **Current Ecological Potential (and certainty of less than good)** | **Ecological status objective and date objective to be achieved** | **Reasons for failure** |
| Moderate (Uncertain) | Good by 2027 | Dissolved inorganic nitrogen, dissolved oxygen, PAH, Tributyltin, diuron |
| **Hydromorphological designation** | **Reason for hydromorphological designation** | **Waterways in water body within study area** |
| HMWB<br>(Heavily Modified Water Body) | Flood protection, coastal protection, navigation | River Lea, Channelsea Gorge, Hennicker's Ditch, Abbey Creek, Bow Creek, Bully Point Wetlands, Prescott Channel, Three Mills Wall River, Waterworks River |

Protected areas are described as relevant under the sub-headings of the chapter. No specific active point source of pollution or adverse impact has been identified within the QEOP site boundary.

Within the study area (from Lea Bridge Sluices to the confluence of the Bow Creek and the River Thames) there are no protected areas under the Freshwater Fish Directive, Natura 2000 or Bathing Water Directive.

### 5.2.3 *Thames Lower*

The *Thames Lower* comprises the River Thames from Stanford Le Hope to the coastal limit. It has fully mixed, predominantly brackish water (polyhaline,18-30 ppt) and tidal ranges of 4-6 metres. The water body generally has a sand or mud substratum and extensive intertidal areas.

**Table 14. *Thames Lower* water body baseline data - (RBMP, 2009. Annex B – p.981-982)**

| Water Body Name | Water Body ID | Water Body Type |
|---|---|---|
| *Thames Lower* | GB530603911401 | Transitional – Estuarine |
| **Current Ecological Potential (and certainty of less than good)** | **Ecological status objective and date objective to be achieved** | **Reasons for failure** |
| Moderate (Quite certain) | Good by 2027 | Dissolved Inorganic Nitrogen, Copper, and Tributyltin. |
| **Hydromorphological designation** | **Reason for hydromorphological designation** | **Waterways in water body within study area** |
| HMWB<br>(Heavily Modified Water Body) | Flood protection, navigation | None. Water body downstream of *Thames Middle* . |

### 5.2.4 *South Essex Thurrock Chalk*

The groundwater body underlying most of the QEOP is the *South Essex Thurrock Chalk*. It is generally overlain by a thick layer of London Clay but pathways from surface water to the aquifer exist through permeable strata and disused boreholes.

**Table 15. *South Essex Thurrock Chalk* Water body baseline data - (RBMP, 2009. Annex B – p.966-967)**

| Water Body Name | Water Body ID | Water Body Type |
|---|---|---|
| *South Essex Thurrock Chalk* | GB40601G401100 | Groundwater |
| **Current Quantitative Status (and certainty of less than good)** | **Quantitative status objective and date objective to be achieved** | **Reasons for failure** |
| Good (Low) | Good by 2015 | Drinking Water Protected Area |
| **Current Chemical Status (and certainty of less than good)** | **Chemical status objective and date objective to be achieved** | **Groundwater body has an upward trend in pollutant concentrations** |
| Poor (Low) | Good by 2027 | Yes |

## 5.3 Sustainable Water Use Baseline Assessment

### 5.3.1 Sustainable Water Use in the *Lee*

Groundwater abstraction for public water supply in the upstream water body was reducing flow in the *Lee*. However, much of the abstracted water is returned to the *Lee* at Tottenham Locks where the Pymmes Brook joins the River Lea. Water was also transferred to feed the Limehouse Cut from the main fluvial channel at *Lee* Bridge Weir. The volume taken is estimated to be around 1 Ml/d and therefore is believed to be small compared with the other artificial impacts affecting the water body. There are no identified abstraction points within the QEOP planning boundary.

As the reach between Lea Bridge weir and the Olympic Park is not level managed, the flow quantity has a more significant impact on aquatic ecology. This stretch includes the Hackney Marshes upstream of the Olympic Park which contains many different habitats and is potentially sensitive to flow changes. It has been found that the flow required at Hackney Marshes to maintain suitable habitats for fish over 25% of the channel width is achieved 89 % of the time. However, the required minimum flow to maintain suitable habitats for fish over 50% of the channel width is only reached 50% of the time.

### 5.3.2 Sustainable Water Use in the *Thames Middle*

Flow in the study area of the *Thames Middle* is influenced by groundwater abstraction upstream of Lea Bridge Sluices. The *Thames Middle* water body as a whole is affected by abstraction of freshwater above Teddington weir.

### *5.3.3* Sustainable Water Use in the *Thames Lower*

The Thames Lower extends downstream of the QEOP. There is no abstraction known abstraction in the vicinity of the QEOP which is known to affect the Thames Lower on a water body scale.

### 5.3.4 Sustainable Water Use in *South Essex Thurrock Chalk*

As shown below the quantitative status of this water body is deemed good and expected to be retained up to 2015.

**Table 16. Status of quantitative elements for the *South Essex Thurrock Chalk*.**

| Quantitative Element | Element Current status (and confidence) | Predicted Status by 2015 |
|---|---|---|
| Impact on Wetlands | Good (High) | Good |
| Impact On Surface Waters | Good (Low) | Good |
| Saline Intrusion | Good (Low) | Good |
| Water Balance | Good (High) | Good |

## 5.4 Habitats and Species Baseline Assessment

### 5.4.1 *Lee* (Tottenham Locks to the Tideway) Habitats and Species Baseline Assessment

*Lee* Biological Elements

Along most of the length of the *Lee* it is impounded for the purpose of navigation. The quantity of flow is not therefore a significant influence on ecology as the environment is level managed. (EA RBMP report). According to the latest Thames RBMP (2009) from the EA the overall quantity and dynamics of flow supports good ecological potential (now and predicted in 2015 to be the same).

**Table 17. Status of Biological elements in the *Lee*.**

| Element | Current status (and certainty of less than good) | Morphology sensitive |
|---|---|---|
| Diatoms | Not assessed | No |
| Macrophytes | Not assessed | Yes |
| Macro invertebrates | Not assessed | Yes |
| Fish | Poor (Very certain) | Yes |

"Not assessed" indicates that the hydromorphological element was not assessed in the 2009 Thames RBMP.

The classification of the *Lee* as a heavily modified water body means that the EA considers it infeasible to improve the aquatic plants, invertebrates and fish populations to good status without impacting on the uses. Therefore the aim for the fish, invertebrate and aquatic plant populations is to be as good as possible without compromising the uses.

The main pressures on fish in this water body are physical modification, barriers to fish movement, lack of suitable habitat, poor water quality – especially low levels of dissolved oxygen and high levels of ammonia – and water abstraction. These pressures are present throughout the majority of the water body.

*Lee* Hydromorphology

The *Lee* is designated as a Heavily Modified Water Body (HMWB) for the purposes of flood protection and urbanisation. This means that activities such as dredging and structures such as river walls and other impoundments limit migration of fish and disrupt connections between accessible habitats. In-channel structures also influence the flow and sediment regime of the river which can restrict sediment movement and increase siltation of channels.

**Table 18 - Status of Hydromorphology in *Lee* - *(RBMP, 2009. Annex B – p.346)***

| Hydromorphological element | Current status (and certainty of less than good) |
|---|---|
| Quantity and dynamics of water flow | Supports Good |
| Connection to Groundwater | Not assessed |
| Structure and substrate of river bed | Not assessed |
| Structure of the riparian zone | Not assessed |
| River depth and width variation | Not assessed |
| River continuity | Not assessed |

“Not assessed” indicates that the hydromorphological element was not assessed in the 2009 Thames RBMP.

**Description of Habitats and Species indicators within *Lee* Waterways**

The existing conditions of the river banks as well as the current value of the ecology have been assessed for the waterways within the QEOP that have the potential to be affected by works undertaken. The waterways considered are:-

River *Lee* Navigation (RLN)

City Mill River

Bow Back River

Pudding Mill River

Old River Lea

**River *Lee* Navigation (RLN)**

The left (east) bank of the RLN mainly consists of sheet piles without a capping beam with some short stretches of concrete masonry wall. At the confluence of the Old River Lea and the RLN there is a mass concrete wall. The RLN flows in a southerly direction adjacent to the QEOP to the west. This watercourse is navigable and non-tidal upstream of Old Ford Locks. It is connected to the Hertford Union Canal by Carpenters Lock.

The RLN  supports emergent, floating and submerged aquatic vegetation types. Invasive species in the form of floating pennywort and rigid hornwort are present within this system. Perch were the only fish species recorded in this system in the 2006 fish survey.

The RLN is canalised, with low stream power and high levels of fine sediment deposition, particularly in association with reaches upstream of locks e.g. Old Ford Lock.

**City Mill River**

City Mill River flows to the east of the Olympic Stadium site having split from the Old River Lea just south of Carpenters Lock. The left (east) bank of the river consists of a mass concrete wall; the right (west) bank consists mainly of concrete planks with concrete capping beam as well as one short stretch of sheet piles without a capping beam and one stretch of timber. It is a modified, U-shaped channel, on average 23 m wide.

City Mill River contains emergent, free-floating and submerged vegetation type and also supports coarse fish populations. Invasive floating pennywort has been recorded. City Mill River is a designated Site of Borough Importance Grade 1. This means the waterway contains important wildlife habitats in a local context but not on a metropolitan scale.

**Bow Back River**

Bow Back River is the continuation of the City Mill River south of the City Mills Lock as the waterway changes direction to southwest and joins the continuation of the RLN. The right (north) bank consists of a sheet pile wall with concrete capping and sheet piles without a capping beam. The left (south) bank consists of a mass concrete wall. The Bow Back River is canalised and contains emergent, free-floating and submerged vegetation types. It also supports coarse fish populations. Bow Back River is a designated Site of Borough Importance Grade 1. This means the waterway contains important wildlife habitats in a local context but not on a metropolitan scale.

**Pudding Mill River**

This river runs south east from the old River Lea across the site for the Olympic Stadium and is lined by concrete planks with a concrete capping beam. It forms part of the canal system and is culverted throughout most of its course and doesn’t convey much flow. The visible part of the channel is choked with invasive floating pennywort but also contains some emergent marginal vegetation. No fish or macro invertebrate survey data are available for this site. Pudding Mill River is a designated Site of Borough Importance Grade 1. This means the waterway contains important wildlife habitats in a local context but not on a metropolitan scale.

**Old River Lea**

This river runs southwest after having split from City Mills River just south of Carpenters Lock. It takes some water to the RLN at Old Ford Locks. The left (east) bank is lined by concrete planks with a concrete capping beam. The right (west) bank is mainly soft bank but with a short stretch of mass concrete wall by the split of City Mills River and the Old River Lea. The Old River Lea is 19.5 m wide on average with low stream power and local deposition of silty, fine sediments.

Aquatic macrophytes are abundant in this section with submerged vegetation (e.g. rigid hornwort and fennel pondweed) types. Emergent and floating vegetation types are also present including the invasive floating pennywort. The gently sloping soft bank on the eastern side of the channel supports emergent vegetation. Six species of fish were recorded in the 2006 survey, including 6 tench, which are a species associated with the presence of abundant submerged aquatic vegetation.

### 5.4.2 *Thames Middle* Habitats and Species Baseline Assessment

***Thames Middle* Biological elements**

Biological elements comprise a range of organisms and are assessed with regard to what would be expected to be found under pristine conditions with no human impact.

**Table 19. Status of Biological elements in the *Thames Middle* .**

| Biological Element | Current status (and certainty of less than good) | Morphology sensitive |
|---|---|---|
| Phytoplankton | Not assessed | No |
| Macroalgae | High | No |
| Angiosperms | Not assessed | Yes (extent) |
| Benthic invertebrates | Moderate (uncertain) | Yes (extent) |
| Fish (transitional) | Not assessed | Yes |

"Not assessed" indicates that the biological element was not assessed in the 2009 Thames RBMP.

The classification of the *Thames Middle* as a Heavily Modified Water Body (HWMB) means that the EA considers it infeasible to improve the aquatic plants, invertebrates and fish populations to good status without impacting on the uses. Therefore the aim for the fish, invertebrate and aquatic plant populations is to be as good as possible without compromising the uses.

*Thames Middle* Hydromorphology

The WFD requires surface water to be managed in such a way as to safeguard hydrology and geomorphology so that ecology is protected.

The *Thames Middle* is designated as a Heavily Modified Water Body (HMWB) for the purposes of flood protection and navigation. This means that activities such as dredging and structures such as river walls, tidal sluices and other impoundments limit migration of fish and disrupt connections between accessible habitats. In-channel structures also influence the flow and sediment regime of the river which can restrict sediment movement and increase siltation of channels.

The *Thames Middle* downstream from *Lee* Bridge is subject to inputs of both tidal and fluvial sediment. This is likely to lead to a remobilisation and exchange of sediment deposited within tidal reaches.

**Table 20. Status of Hydromorphological elements in the *Thames Middle* .**

| Hydromorphological element | Current status (and certainty of less than good) |
|---|---|
| Freshwater flow | Does not support Good (Uncertain) |
| Depth variation | Not assessed |
| Quantity, structure and substrate of estuarine bed | Not assessed |
| Structure of the intertidal zone | Not assessed |
| Wave exposure | Not assessed |

"Not assessed" indicates that the hydromorphological element was not assessed in the 2009 Thames RBMP.

Description of Habitats and Species indicators within *Thames Middle* Waterways

The existing conditions of the river banks as well as the current value of the ecology have been assessed for the waterways within the QEOP that have the potential to be affected by works undertaken. The waterways considered are:-

- River Lea
- Channelsea Gorge
- Bully Point Wetlands
- Waterworks River
- Hennicker's Ditch
- Prescott Channel
- Three Mills Wall River
- Abbey Creek
- Bow Creek

**River Lea**

The River Lea splits from the River *Lee* Navigation just north of Hackney Marshes. The river was tidal up until the Lea Bridge Sluice north of Hackney Marshes in 2006. It has soft banks all the way down to Carpenters Lock where there is a short stretch of mass concrete wall followed by concrete planks with concrete capping beam. The flow type is glide up near Hackney Marshes and thereafter tidal in the rest of the waterway. The sediment dynamics are variable, but predominantly exchange with source, sink and transfer areas. The bed sediment coarse/fine gravel. The tidal Lea supports a moderately rich fish species assemblage with both estuarine and freshwater associated taxa represented. Species found include flounder (*Platichthys flesus),* smelt (*Atherina sp*.), common goby, gudgeon (*Gobio gobio*), three-spined stickleback (*Gasterosteus aculeatus*), and perch (*Perca* fluviatilis). Chinese Mitten Crabs (*Enocheir sinensis*), an invasive Crustacean, were observed during an ecological survey conducted in 2003.This species is now widespread within the Thames catchment.

**Channelsea Gorge**

Channelsea Gorge is a steep-sided, heavily shaded open channel with soft, incised, vegetated banks connected to Hennicker's Ditch in the north. It is 3.83 m wide on average. At its widest part (north end) it is approximately 20-25 metres across. Channelsea Gorge is choked with invasive species in the form of Japanese knotweed and Himalayan balsam, with patches of giant hogweed. Due to the homogenous channel and bed sediment structure it is unlikely to be of aquatic ecological value.

**Bully Point wetlands**

Bully Point wetlands are connected to Channelsea Gorge and the River Lea and comprise open wetland with soft edges. It hosts a locally significant population of newts.

**Waterworks River**

Waterworks River is the continuation of River Lea downstream of Carpenters Lock. It's a highly modified waterway along the entire extent with vertical river walls and a trapezoidal channel. The east bank consists of a sheet piled wall with concrete capping down to the railway crossing. Downstream of the railway bridge both banks consist of concrete planks with a concrete capping beam. Upstream of the railway bridge the west bank consists of a mass concrete wall. It is modified with a trapezoidal shape and an average width of 33.33 m. The flow type is tidal and the sediment dynamics mainly sink, with a short stretch of transfer.

Bed sediment is predominantly tidal, with coarse/fine gravels immediately south of Carpenters Lock. Waterworks River has a lesser tidal influence reducing higher up the channel. High levels of fine sediment deposition are present on the channel bed and at bank toes. In particular, sediment deposition is observed in areas of low stream power and associated with fly-tipped material. The Waterworks River channel contains intertidal mudflats exposed at low tide but where fine sedimentation is prevented by flow, patches of gravel are evident. There are no valuable intertidal mudflats but macro fauna present is likely to benefit from the reduced tidal influence and salinity as it shows greater richness and density than more tidal parts of the system. The system is still species poor in character.

There are few brackish or marine species present in the Waterworks River; only flounder (*Platchthys flesus*) and eel(*Anguilla Anguilla*) have been recorded. Common goby was the only species recorded in the 2006 fish survey. There are currently no aquatic plants, but emergent plants are present at various locations. Waterworks River is a designated Site of Borough Importance Grade 1. This means the waterway contains important wildlife habitats in a local context but not on a metropolitan scale.

**Hennicker's Ditch**

Hennicker's Ditch is a narrow, artificial v-shaped ditch that receives surface water inflows connecting to the north end of Channelsea Gorge via twin 1.5 m diameter culverts. It has soft, steep-sided banks and is heavily shaded by invasive Japanese Knotweed and Himalayan Balsam. Hennicker's Ditch is often dry and supports no marginal aquatic vegetation. The stream bed is composed of silt and gravel. No aquatic surveys are available for this watercourse but it is likely to be of low ecological value.

**Prescott Channel**

Prescott Channel is a trapezoidal shaped conduit formed from concrete slabs. The shape is uniform with a smooth finish and there is no mural vegetation. The flow type is tidal and the sediment dynamics mainly sink, with a short stretch of transfer. Bed sediment is predominantly tidal. The depth of the water level of the Prescott Channel fluctuates (twice daily) with a tidal range between about 3.8 metres and almost nothing (a small depth of base flow is left in the Prescott Channel when the tide goes out.)

The conduit bed has little exposed sediment, no permanent intertidal mudflats and no emergent vegetation. The macro fauna present in exposed, mobile sediments are limited in richness and density.

There are few brackish or marine species present in Prescott Channel; only flounder (*Platchthys flesus*) and eel(*Anguilla Anguilla*) have been recorded. Intertidal invertebrates are present but there are no records of aquatic Macrophytes. Prescott Channel is a designated Site of Borough Importance Grade 1. This means the waterway contains important wildlife habitats in a local context but not on a metropolitan scale.

**Three Mills Wall River**

The Three Mills Wall River connects the Waterworks River to Bow Creek. The majority of the channel walls are composed of vertical pre-cast concrete up-rights, topped by a deep concrete slab. The channel section is trapezoidal. The flow type is tidal and the sediment dynamics mainly sink, with a short stretch of transfer. Bed sediment is predominantly tidal. Substantial banks of fine sediment deposition are present and exposed at low tide. Some artificially created raised platforms with established emergent vegetation are present. During high tide, ingress of fine, tidal sediment and remobilisation of deposited fines occurs with resultant high turbidity. There are few brackish or marine species present in the Three Mills Wall River; only flounder (*Platchthys flesus*) and eel(*Anguilla Anguilla*) have been recorded. There are areas of consolidated mudflats but the macro fauna present is limited in richness and density. There are no aquatic plants but an emergent fringe with a variety of species.

Three Mills Wall River is a designated Site of Borough Importance Grade 1. This means the waterway contains important wildlife habitats in a local context but not on a metropolitan scale.

**Abbey Creek**

Abbey Creek is trapezoidal in section. The flow type is tidal and the sediment dynamics mainly sink, with a short stretch of transfer. Bed sediment is predominantly tidal. The bed sediments are fine and support invertebrate populations. No aquatic survey data is available for an observable tidal section of Abbey Creek, but due to the homogenous channel and bed sediment structure it is unlikely to be of aquatic ecological value.

**Bow Creek**

Bow Creek is trapezoidal in section. Substantial banks of fine sediment deposition are present and exposed at low tide. During high tide, ingress of fine, tidal sediment and remobilisation of deposited fines occurs with resultant high turbidity.

Ten fish surveys on the tidal River Lea (from the confluence of the Thames to Lea Bridge Sluices) have confirmed that 18 species of fish use these habitats, including freshwater, marine, anadromous and catadromous species (smelt and eel). Larval and juvenile catches were also present. Most of these species were present in Bow Creek downstream of Prescott Channel. Bow Creek forms a part of River Thames and Tidal Creeks site of Metropolitan Importance for Nature Conservation.

**Table 21. Fish species present recorded in the tidal River Lea, mainly Bow Creek – Ecological Survey in 2003**

| Species | Adult | Larval/ juvenile |
|---|---|---|
| Roach *Rutilus rutilus* | ✓ | ✓ |
| Dace *Leuciscus leuciscus* | | ✓ |
| Silver bream *Abramis bjoerkna* | | ✓ |
| Common Bream *Abramis brama* | | ✓ |
| Bleak *Alburnus alburnus* | ✓ | ✓ |
| Rudd *Scardinius erythrophthalmus* | ✓ | |
| Perch *Perca fluviatilis* | ✓ | ✓ |
| Pike *Esox lucius* | | ✓ |
| Three-spined stickleback *Gasterosteus aculeatus* | ✓ | ✓ |
| Nine-spined stickleback *Pungitius pungitius* | ✓ | |
| Eel *Anguilla anguilla* | ✓ | |
| Bass *Dicentrarchus labrax* | | ✓ |
| Mullet *Mugilidae spp.* | ✓ | ✓ |
| Smelt *Osmerus eperlanus* | ✓ | |
| Flounder *Platichthys flesus* | ✓ | ✓ |
| Sand goby *Pomatoschistus minutus* | ✓ | ✓ |
| Tench *Tinca tinca* | ✓ | |
| Chub *Leuciscus cephalus* | ✓ | |

### 5.4.3 *Thames Lower* Habitats and Species Baseline Assessment

Biological Elements

Biological elements comprise a range of organisms and are assessed with regard to what would be expected to be found under pristine conditions with no human impact.

**Table 22. Status of biological elements for *Thames Lower*.**

| Biological Element | Current status (and certainty of less than good) | Morphology sensitive |
|---|---|---|
| Phytoplankton | Not assessed | No |
| Macroalgae | High | No |
| Angiosperms | Not assessed | Yes (extent) |
| Benthic invertebrates | Moderate (uncertain) | Yes (extent) |
| Fish (transitional) | Not assessed | Yes |

“Not assessed” indicates that the biological element was not assessed in the 2009 Thames RBMP.

The classification of the *Thames Lower* as a Heavily Modified Water Body (HWMB) means that the EA considers it infeasible to improve the aquatic plants, invertebrates and fish populations to good status without impacting on the uses. Therefore the aim for the fish, invertebrate and aquatic plant populations is to be as good as possible without compromising the uses.

Hydromorphology

The *Thames Middle* is designated as a Heavily Modified Water Body (HMWB) for the purposes of flood protection and navigation. This means that activities such as dredging and structures such as river walls, tidal sluices and other impoundments limit migration of fish and disrupt connections between accessible habitats. In-channel structures also influence the flow and sediment regime of the river which can restrict sediment movement and increase siltation of channels.

The *Thames Middle* downstream from *Lee* Bridge is subject to inputs of both tidal and fluvial sediment. This is likely to lead to a remobilisation and exchange of sediment deposited within tidal reaches.

**Table 23. Status of Hydromorphological elements for *Thames Lower*.**

| Hydromorphological element | Current status (and certainty of less than good) |
|---|---|
| Freshwater flow | Not assessed |
| Depth variation | Not assessed |
| Quantity, structure and substrate of estuarine bed | Not assessed |
| Structure of the intertidal zone | Not assessed |
| Wave exposure | Not assessed |

“Not assessed” indicates that the hydromorphological element was not assessed in the 2009 Thames RBMP.

### 5.4.4 *South Essex Thurrock Chalk* Habitats and Species Baseline Assessment

The monitoring of biological, hydrological and morphological conditions does not apply to ground water bodies under the WFD.

## 5.5 Water Quality

### 5.5.1 *Lee* (Tottenham Locks to the Tideway) Water Quality Baseline Assessment

**Supporting and Chemical Elements**

Water Quality includes both the supporting elements of the water body and the chemical elements posing a threat to aquatic life. Chemical water quality in the *Lee* is measured through a wide variety of indicators and the results are outlined below.

**Table 24.Status of supporting elements for the *Lee* (Tottenham Locks to the Tideway)**

| Element | Current status (and certainty of less than good) | Predicted Status by 2015 |
|---|---|---|
| Ammonia (Phys-Chem) | Moderate (Quite Certain) | Moderate |
| Dissolved Oxygen | Poor (Very Certain) | Poor |
| pH | High | High |
| Phosphate | Bad (Very Certain) | Poor |
| Temperature | High | High |
| Ammonia (Annex 8) | Moderate (Quite Certain) | Moderate |

As can be seen, the main issues associated with biochemical indicators are ammonia, phosphate and dissolved oxygen. It is known that the high phosphate levels are causing an eutrophication which is having a negative impact on the water body and on the levels of dissolved oxygen.

**Table 25. Status of chemical elements for the *Lee* (Tottenham Locks to the Tideway)**

| Element | Current status (and certainty of less than good) | Predicted Status by 2015 | WFD priority hazardous substance |
|---|---|---|---|
| 1,2-dichloroethane | High | High | |
| Hexachlorobenzene | High | High | ✓ |
| Hexachlorobutadiene | High | High | ✓ |
| Hexachlorocyclohexane | Moderate (Uncertain) | High | ✓ |
| Pentachlorophenol | High | High | |
| Trichlorobenzenes | High | High | |
| Trichloromethane | High | High | |
| Aldrin, Dieldrin, Endrin & Isodrin | High | High | |
| Carbon Tetrachloride | High | High | |
| para-para DDT | High | High | |
| Tetrachloroethylene | High | High | |
| Trichloroethylene | High | High | |
| **Chemical Status** | **Fail (uncertain)** | | |

Routine sampling of *Lee* at Carpenters Road has also found four different polyaromatic hydrocarbons (PAH) at levels which exceed acceptable limits for chemical status under the Water Framework Directive. These are:

- Fluoranthene
- Benzo(ghi)perylene and indeno(123-cd)pyrene (benzo-indeno) (combined)
- Benzo (k) and (b) fluroanthene (benzofluoranthene)

Tributyltin (TBT) is also failing to achieve good status at the *Lee* at Carpenters Road sample point.

**Description of Water Quality Indicators in *Lee* Waterways**

**River *Lee* Navigation (RLN)**

The RLN exhibits a generally poor water quality, mainly driven by low DO and high ammonia concentrations. Nitrate concentrations are lower in the *Lee* Navigation canal than in the tidal River Lea, but still higher than recommended levels. Phosphate levels are very high and nitrite consistently exceeds recommended standard.

Ammoniacal nitrogen and TPH standards are also exceeding thresholds. Sediment samples consistently show exceedances of TPH, cadmium, chromium, copper, nickel, lead, mercury, and zinc standards, with some exceedances of the total aliphatics, total aromatic, extractable hydrocarbons and total hydrocarbons.

**City Mill River**

Surface water and sediment samples collected in 2006 show high orthophosphate concentrations and occasional exceedance of ammoniacal nitrogen and nitrite. Significant exceedances of the TPH, arsenic, cadmium, chromium, copper, nickel, lead, mercury, zinc, total aliphatic and total hydrocarbon standards were observed.

**Pudding Mill River**

Samples taken exceeded the threshold for orthophosphate as well as for ammoniacal nitrogen and TPH.

**Old River Lea**

High concentrations of orthophosphate as well as some exceedances of the ammoniacal and TPH standards. Chromium, copper and zinc exceedance has been observed as well as cyanide and nitrate concentrations. Sediment samples showed exceedances of TPH, total aliphatics, extractable hydrocarbons and total hydrocarbons standards as well as exceedance of total aromatics and two of the volatile hydrocarbons thresholds. All samples also indicate high levels of arsenic, cadmium, copper, nickel, lead, mercury and zinc standards, and most exceeded the chromium standard.

**Designated areas**

The area east of the River Lea is designated as a Surface Water Nitrates Vulnerable Zone under the Nitrates Directive. This includes the entirety of the study area from Lea Bridge Sluices through the Queen Elizabeth Olympic Park to the confluence of Bow Creek and the Thames. The zones mainly affect farmers on areas of land draining into those zones who have to follow mandatory rules to tackle nitrate loss from agriculture.

The River Lea and the *Lee* Navigation, as well as the Walthamstow reservoirs and Warwick Reservoir north of Lea Bridge Sluices are designated as sensitive areas (eutrophic) under the Urban Waste Water Treatment Directive.

### 5.5.2 *Thames Middle* Water Quality Baseline Assessment

**Supporting and Chemical Elements**

Water Quality includes both the supporting elements of the water body and the chemical elements posing a threat to aquatic life. Chemical water quality in the *Thames Middle* is measured through a wide variety of indicators and the results are outlined below.

**Table 26. Status of supporting elements of the *Thames Middle***

| Element | Current status (and certainty of less than good) | Predicted Status by 2015 |
|---|---|---|
| Dissolved Inorganic Nitrogen | Moderate (uncertain) | Moderate |
| Dissolved Oxygen | Moderate (uncertain) | Moderate |
| 2,4-dichlorophenol | High | High |
| 2,4-dichlorophenoxyacetic acid | High | High |
| Arsenic | High | High |
| Copper | High | High |
| Dimethoate | High | High |
| Iron | High | High |
| Linuron | High | High |
| Mecoprop | High | High |
| Permethrin | High | High |
| Toluene | High | High |
| Un-ionised ammonia | High | High |
| Zinc | High | High |

The main issues associated with biochemical indicators are dissolved inorganic nitrogen and dissolved oxygen. Dissolved inorganic nitrogen contributes to eutrophication of the water body which influences the level of dissolved oxygen negatively.

**Table 27. Status of chemical elements of the *Thames Middle***

| Element | Element Current status (and certainty of less than good) | Predicted Status by 2015 | WFD priority hazardous substance |
|---|---|---|---|
| 1,2-dichloroethane | High | High | |
| Atrazine | High | High | |
| Benzene | High | High | |
| Benzo (a) and (k) fluoranthene | High | High | ✓ |
| Benzo (ghi) perelyene and indeno (123-cd) pyrene | Moderate (Uncertain) | Moderate | ✓ |
| Benzo(a)pyrene | High | High | ✓ |
| Cadmium and its compounds | High | High | ✓ |
| Diuron | Moderate (Uncertain) | High | |
| Fluoranthene | High | High | |
| Hexachlorobenzene | High | High | |
| Hexachlorobutadiene | High | High | ✓ |
| Hexachlorocyclohexane | High | High | ✓ |
| Lead And Its Compounds | High | High | ✓ |
| Mercury and its compounds | High | High | ✓ |
| Napthalene | High | High | |
| Nickel and its compounds | High | High | |
| Pentachlorophenol | High | High | |
| Simazine | High | High | |
| Tributyltin Compounds | Moderate (Quite Certain) | Moderate | ✓ |
| Trichlorobenzenes | High | High | |
| Trichloromethane | High | High | |
| Trifluralin | High | High | |
| Aldrin, Dieldrin, Endrin & Isodrin | High | High | |
| Carbon Tetrachloride | High | High | |
| DDT Total | High | High | |
| para - para DDT | High | High | |
| Tetrachloroethylene | High | High | |
| Trichloroethylene | High | High | |
| **Chemical Status** | **Fail (certain)** | | |

## Description of Water Quality indicators within *Thames Middle* waterways

**River Lea, Prescott Channel and Three Mills Wall River**

The River Lea has consistently low DO levels and very high nitrate concentrations. High BOD and ammonia concentrations as well as high phosphate concentrations influence water quality. Copper and tributyltin (TBT) and total PAH. Sediment samples showed significant exceedances in arsenic, cadmium, nickel, lead, mercury, and zinc concentrations and some exceedance of TPH.

**Bully Point Wetlands**

Limited data is available, but exceedances of PAH and ammonia have been recorded, as well as exceedance of the phenol standard.

**Waterworks River**

Orthophosphate as well as nitrite, ammoniacal nitrogen and Total Petroleum Hydrocarbons (TPH) exceed thresholds. Sediment samples showed exceedance in TPH, arsenic, cadmium, chromium, copper, nickel, lead, mercury and zinc standards.

**Hennikers Ditch**

Limited water quality data is available, but surface water samples collected showed exceedances for ammonia and TPH standards.

**Abbey Creek**

Limited water quality data is available, but ammoniacal nitrogen, TPH and PAH have shown to exceed thresholds. Sediment samples exceed TPH, arsenic, cadmium, copper, nickel, lead, mercury and zinc standards as well as several exceedances of the chromium, total aliphatics, extractable hydrocarbons and total hydrocarbons.

### 5.5.3 *Thames Lower* Water Quality Baseline Assessment

**Supporting and Chemical Elements**

Water Quality includes both the supporting elements of the water body and the chemical elements posing a threat to aquatic life. Chemical water quality in the *Thames Lower* is measured through a wide variety of indicators and the results are outlined below.

**Table 28. Status of supporting elements for *Thames Lower***

| Element | Current status (and certainty of less than good) | Predicted Status by 2015 |
|---|---|---|
| Dissolved Inorganic Nitrogen | Moderate (Uncertain) | Moderate |
| Dissolved Oxygen | High | High |
| 2,4-dichlorophenol | High | High |
| 2,4-dichlorophenoxyacetic acid | High | High |
| Arsenic | High | High |
| Copper | Moderate (Quite certain) | High |
| Dimethoate | High | High |
| Iron | High | High |
| Linuron | High | High |
| Mecoprop | High | High |
| Permethrin | High | High |
| Toluene | High | High |
| Un-ionised ammonia | High | High |
| Zinc | High | High |

The main issues associated with biochemical indicators are dissolved inorganic nitrogen and copper. Dissolved inorganic nitrogen contributes to eutrophication of the water body which influences the level of dissolved oxygen negatively. Copper is toxic to aquatic flora and fauna.

**Table 29. Status of chemical elements for *Thames Lower*.**

| **Element** | **Element Current status (and certainty of less than good)** | **Predicted Status by 2015** | **WFD priority hazardous substance** |
|---|---|---|---|
| 1,2-dichloroethane | High | High | |
| Atrazine | High | High | |
| Benzene | High | High | |
| Benzo (a) and (k) fluoranthene | High | High | ✓ |
| Benzo (ghi) perelyene and indeno (123-cd) pyrene | Moderate (Quite Certain) | Moderate | ✓ |
| Benzo(a)pyrene | High | High | ✓ |
| Cadmium and its compounds | High | High | ✓ |
| Diuron | Moderate (Uncertain) | High | |
| Fluoranthene | High | High | |
| Hexachlorobenzene | High | High | |
| Hexachlorobutadiene | High | High | ✓ |
| Hexachlorocyclohexane | High | High | ✓ |
| Lead And Its Compounds | High | High | ✓ |
| Mercury and its compounds | High | High | ✓ |
| Napthalene | High | High | |
| Nickel and its compounds | High | High | |
| Pentachlorophenol | High | High | |
| Simazine | High | High | |
| Tributyltin Compounds | Moderate (Very Certain) | Moderate | ✓ |
| Trichlorobenzenes | High | High | |
| Trichloromethane | High | High | |
| Trifluralin | High | High | |
| Aldrin, Dieldrin, Endrin & Isodrin | High | High | |
| Carbon Tetrachloride | High | High | |
| DDT Total | High | High | |
| para - para DDT | High | High | |
| Tetrachloroethylene | High | High | |
| Trichloroethylene | High | High | |
| **Chemical Status** | **Fail (certain)** | | |

### 5.5.4 *South Essex Thurrock Chalk* Water Quality Baseline Assessment

**Table 30. Status of chemical elements for the *South Essex Thurrock Chalk*.**

| Chemical Element | Element Current status (and confidence) | Predicted status by 2015 |
|---|---|---|
| Drinking Water Protected Area | Poor (Low) | Poor |
| General Chemical Test | Good (Low) | Good |
| Impact on Wetlands | Good (High) | Good |
| Impact On Surface Waters | Good (Low) | Good |
| Saline Intrusion | Good (Low) | Good |

The failure is caused by ammonia and the groundwater body is suspected to be contaminated from point and diffuse sources, potentially from land contamination and agriculture. Until the sources have been confirmed and the relationship to the relevant receptors (using a conceptual source-pathway-receptor model) better understood, the identification and application of measures to reduce the pollution is not possible. An extended deadline for achieving good chemical status is therefore required.

## 5.6 Baseline Site wide Flood Risk Assessment

### 5.6.1 Flood Risk Overview

This chapter describes the River Lea catchment, history of flooding and flood defences in the Lower Lea up to the 2006, pre- QEOP baseline.

### 5.6.2 The River Lea Catchment

The River Lea flows from Leagrave at the edge of Luton through Bedfordshire, Hertfordshire and London in a south easterly direction draining into the River Thames at Canning Town, just upstream of the Thames Barrier. The river drains a catchment area of approximately $1400km^2$. The upper reaches of the river and its tributaries drains predominantly rural land much of which is arable farming. The headwaters spring from the Upper Cretaceous chalk with some overlying clays. The geology changes to boulder clay overlying the greatly impermeable London Clay in the lower reaches. Areas of shallow gravel and alluvium deposits overlie the clay along parts of the valley.

The upper catchment is considered relatively permeable whereas the lower reaches are impermeable and are characterised by high runoff rates.  Urbanisation was expected to exacerbate this high runoff and lead to the ‘flashy’ response in river flows during intense rainfall events.

The QEOP area lies within the Lower Lea catchment. This catchment is approximately 370km2 between Fieldes Weir, immediately downstream of the confluence between the Rivers Lea and Stort, and the River Thames. Within the Lea Valley are five reservoirs and conservation areas.

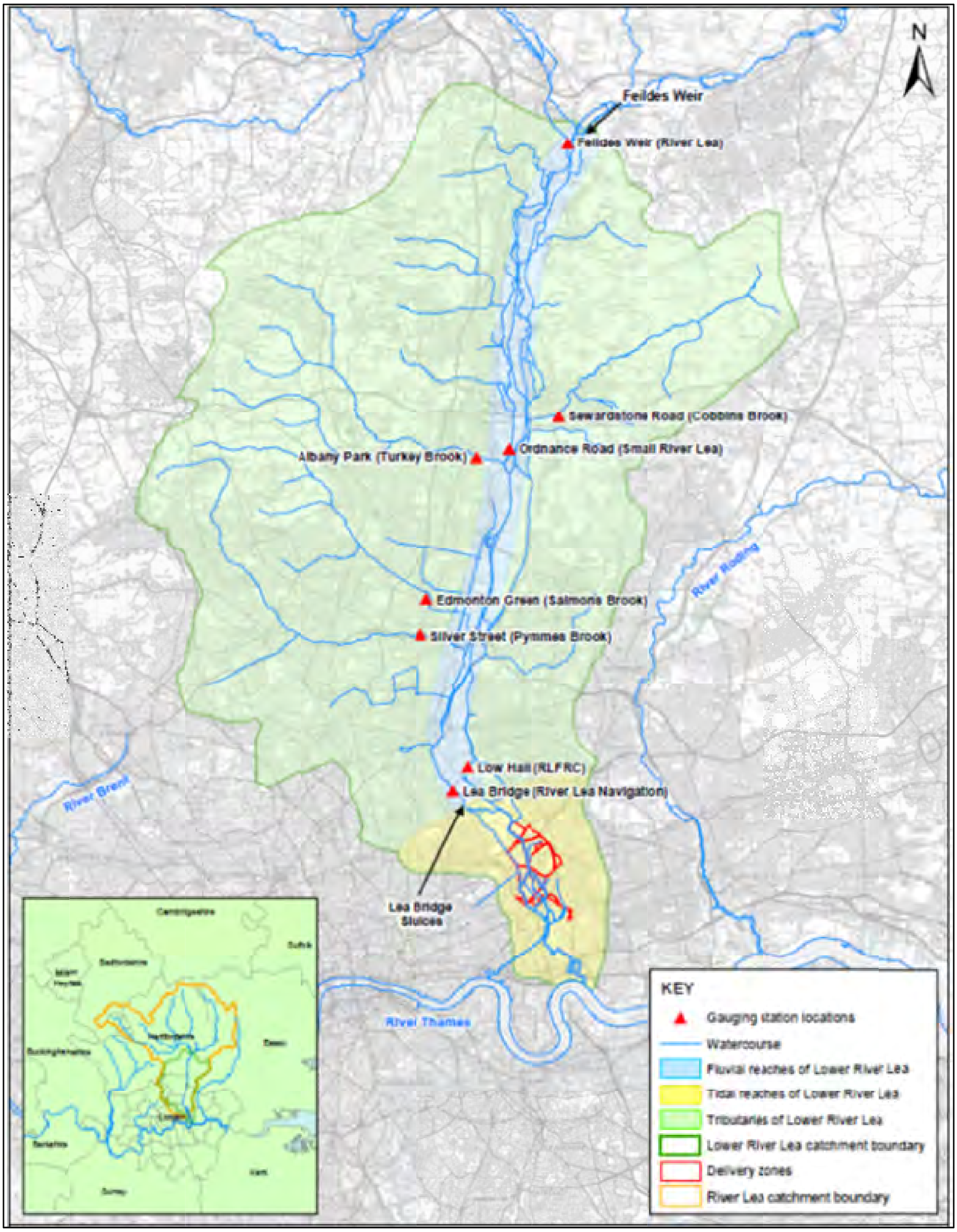
Refer to Figure 31 for a catchment plan of the Lower Lea.

### 5.6.3 History of Flooding

The greatest flood event recorded in the Lea catchment was in March 1947 as a result of snow melt combined with rainfall. This event affected nearly all the main rivers in the south-east of England.

Following this event, the River Lea Flood Relief Channel and flood defences were constructed in the Lower Lea. Subsequent flood events occurred in the Upper Lea catchment but not as far south as the QEOP.

**Figure 31 - Lower Lea Catchment – extracted from Olympics FRA 2007**



### 5.6.4 Watercourses within the QEOP and Legacy Communities Scheme Area

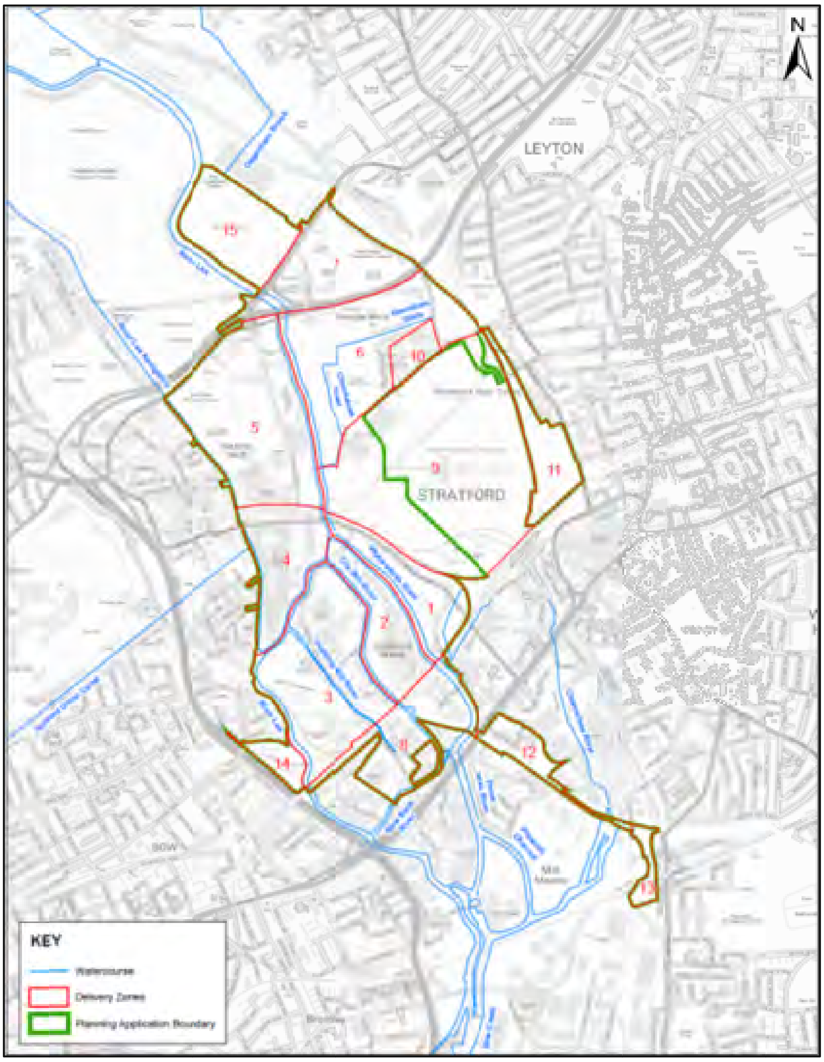
Water flows into the Lower Lea catchment through three watercourses; the River Lea, the River Lea Flood Relief Channel and the Dagenham Brook. At Lea Bridge Sluice the River Lee Navigation splits from the River Lea and runs south along the western boundary of the Olympic Park.

The River Lea Flood Relief Channel and the Dagenham Brook enter the study area from the north, combining with the River Lea downstream of Lea Bridge Sluice and upstream of the Olympic Park.

The Waterworks River flows through the lower reaches of the Olympic Park, separated from the City Mills River, Old River Lea and Bow Back Rivers, which are supplied from the River Lee Navigation at Old Ford Lock to the west.

Refer to Figure 32 below for a plan showing the watercourses running through the QEOP.

**Figure 32 - Watercourses within the Olympic Park – extracted from FRA 2007. (Note: Channelsea River and Henniker's Ditch are now culverted as part of the ODA's mitigation measures put in place prior to the Olympic Games.)**



### 5.6.5 Tidal Influence

The lower reaches of the Lower Lea Valley (LLV) are affected by the tide from the English Channel through the River Thames. During a flood event, water levels in the Lower Lea Valley are tidally influenced along the Waterworks River and River Lea up to Lea Bridge Sluice. Under normal flow conditions, the water level control structures at Three Mills and in the Prescott Channel to the south of the QEOP prevent tidal incursion into the Lower Lea Valley.

### 5.6.6 Baseline Flood Protection in the Lower Lea Valley and Olympic Park

The River Lea Flood Relief Channel (RLFRC) was completed in 1976 significantly improving flood defence in the LLV. For most of its length it flows parallel to the River Lea/Lee Navigation and several control structures between the two keep the water level in the relief channel constant. During times of flood, water is discharged.

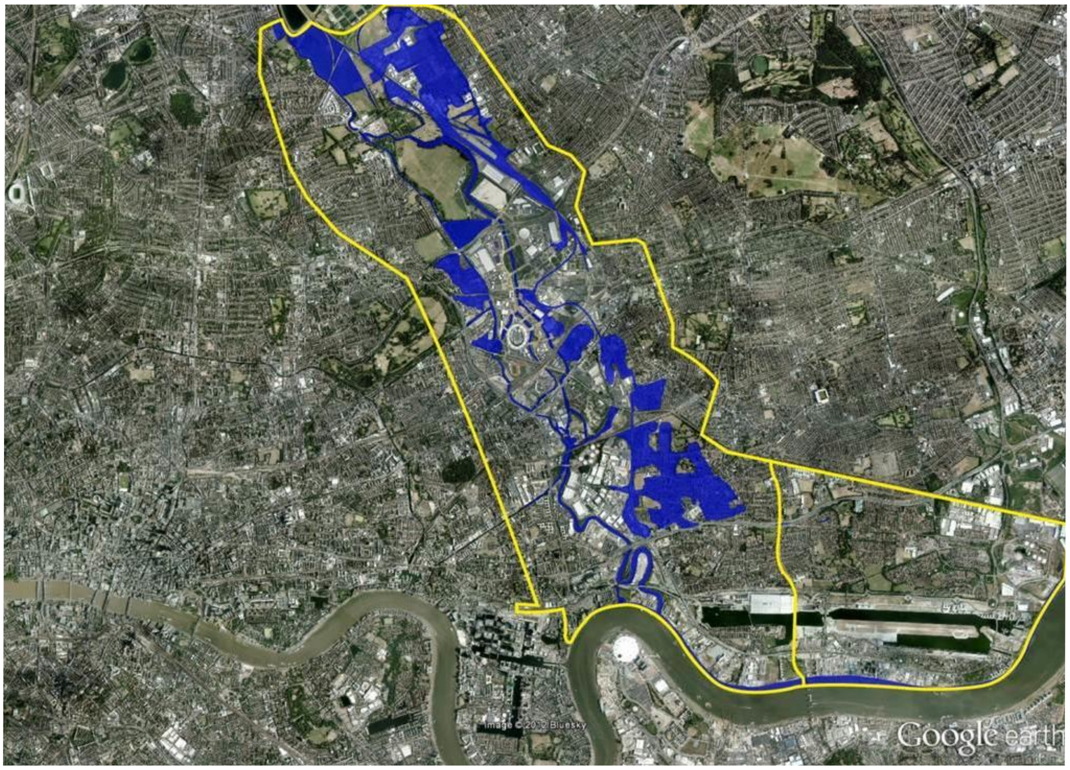
The River Lea Flood Relief Channel was designed with a capacity for the 1 in 70 year event, running almost full in the storms of October 1987, 1993 and 2000.

Tidal flood events up to a 1 in 200 year return period are protected against through a system of tidal defences. The Thames Barrier forms part of this system and became operational in 1982. This level of protection is estimated to decrease to 1 in 1000 year return period by 2030.

### 5.6.7 Flood Risk Summary

The flood extent for the design Flood Event of 1 in 100 years plus an allowance for climate change for the pre-Olympic 2006 condition is shown below:

**Figure 33 - Baseline Flood Risk**



## 5.7 Thames RBMP Mitigation Measures and Recommended Actions

The Thames River Basin Management Plans outline actions which need to be put 'in place' in order to achieve 'Good Ecological Potential'.

This section summarises the key mitigation measures which are proposed by the latest RBMP for each of the water bodies being assessed.

### 5.7.1 *Lee* RBMP Mitigation Measures

The baseline mitigation measures assessment holds a current status of 'Moderate'. No specific mitigation measures with defined Ecological Potential are identified for the water body according to the Thames RBMP.

It is assumed that the physical modification of the waterway due to urbanisation and flood protection is causing the failure of the ***Lee***, but the exact cause of the morphological pressure is unknown.

Morphological pressures may derive from a complex combination of multiple physical modifications and/or management activities each of which may have a different impact on water body biology. It is not technically feasible to implement appropriate improvement measures until the cause of the adverse impact has been determined. (Annex E of RBMP).

**Table 31. Mitigation measures for the *Lee* (Tottenham Locks to the Tideway) – (Draft 2015 RMBP)**

| Mitigation Measure | RBMP (2015) |
|---|---|
| Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution | Not In Place |
| Protect and enhance ecological value of marginal aquatic habitat, banks and riparian zone | Not In Place |
| Protect and restore historic aquatic habitats | Not In Place |
| Operational and structural changes to sluices and weirs | Not In Place |
| Install fish passes | Not In Place |
| Removal of structure | Not In Place |
| Retain marginal aquatic and riparian habitats | Not In Place |
| Increase in-channel morphological diversity, e.g. install in stream features; 2 stage channels | Not In Place |
| Re-opening existing culverts | Not In Place |
| Alteration of channel bed | Not In Place |
| Re-opening existing culverts | Not In Place |
| Alteration of channel bed | Not In Place |
| Set-back embankments (a type of managed retreat) | Not In Place |
| Improve floodplain connectivity | Not In Place |
| Sediment management strategies (develop and revise) which could include a) substrate reinstatement, b) sediment traps, c) allow natural recovery minimising maintenance, d) riffle construction, e) reduce all bar necessary management in flood risk areas | Not In Place |
| Appropriate vegetation control regime e.g. a) minimise disturbance to channel bed and margins, b) selective vegetation management for example only cutting from one side of the channel, c) providing/reducing shade, d) seasonal maintenance | Not In Place |
| Educate landowners on sensitive management practices | Not In Place |
| Appropriate techniques to align and attenuate flow to limit detrimental effects of these features | Not In Place |
| Management of the risks to fish entrainment | Not In Place |
| Appropriate water level management strategies, including timing and volume of water moved | Not In Place |

### 5.7.2 *Thames Middle* RBMP Mitigation Measures

The baseline mitigation measures assessment holds a current status of moderate. Flood and coastal erosion protection measures are in place in the *Thames Middle* and it is known that they have a biological impact, but the most effective measures to mitigate that impact are unknown. Mitigation measures with a defined ecological potential for *Thames Middle* and their status with regard to implementation are outlined below.

**Table 32. Mitigation measures for *Thames Middle – (RMBP, 2009)***

| Mitigation Measure with Defined Ecological Potential | RBMP (2009) |
|---|---|
| Vessel Management | In Place |
| Modify vessel design | In Place |
| Manage disturbance | In Place |
| Site selection (dredged material disposal) (e.g. avoid sensitive sites) | In Place |
| Sediment management | In Place |
| Alter timing of dredging / disposal | In Place |
| Reduce sediment re-suspension | In Place |
| Reduce impact of dredging | In Place |
| Prepare a dredging / disposal strategy | Not in Place |
| Avoid the need to dredge (e.g. minimise under-keel clearance; use fluid mud navigation; flow manipulation or training works) | Not in Place |
| Indirect / offsite mitigation (offsetting measures) | Not In Place |
| Operational and structural changes to locks, sluices, weirs, beach control, etc. | Not In Place |
| Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone | Not In Place |
| Managed realignment of flood defence | Not In Place |
| Remove obsolete structure | Not In Place |

The feasibility of potential additional mitigation measures have to be considered before they can be implemented to ensure cost-effective and efficient management of the water body.

At the current time there is low confidence that abstraction is adversely affecting the ecological status of the *Thames Middle*. It is therefore disproportionately expensive to require changes to the current abstraction regime at this time. The only practicable lower-cost actions to reduce the impact of abstraction are those that reduce water demand and promote efficient use.

### 5.7.3 *Thames Lower* RBMP Mitigation Measures

The baseline mitigation measures assessment holds a current status of *moderate*. Flood and coastal erosion protection measures are in place in the *Thames Lower* and it is known that they have a biological impact, but the most effective measures to mitigate that impact are unknown. Mitigation measures with a defined ecological potential for *Thames Middle* and their status with regard to implementation are outlined below.

**Table 33. Mitigation measures for *Thames Lower* – (RMBP, 2009)**

| Mitigation Measure with Defined Ecological Potential | RBMP (2009) |
|---|---|
| Manage disturbance | In Place |
| Site selection (dredged material disposal) (e.g. avoid sensitive sites) | In Place |
| Alter timing of dredging / disposal | In Place |
| Reduce impact of dredging | In Place |
| Prepare a dredging / disposal strategy | In Place |
| Avoid the need to dredge (e.g. minimise under-keel clearance; use fluid mud navigation; flow manipulation or training works) | In Place |
| Operational and structural changes to locks, sluices, weirs, beach control, etc. | Not In Place |
| Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone | Not In Place |
| Structures or other mechanisms in place and managed to enable fish to access waters upstream | Not In Place |
| Managed realignment of flood defence | Not In Place |
| Bank rehabilitation/re-profiling | Not In Place |
| Increase in-channel morphological diversity | Not In Place |
| Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution | Not In Place |
| Remove obsolete structure | Not In Place |

The feasibility of potential additional mitigation measures have to be considered before they can be implemented to ensure cost-effective and efficient management of the water body.

### 5.7.4 *South Essex Thurrock Chalk* RBMP Mitigation Measures

There are no known mitigation measures proposed under the current RBMP for the chalk.

## 5.8 RBMP Water Body Objectives

### 5.8.1 *Lee* RBMP Water Body Objectives

The objectives for the *Lee* are to achieve Good Ecological Potential by 2027 and Good Chemical Status by 2015. The overall ecological potential of the *Lee* is 'Moderate' and not expected to improve to 'Good' by 2015. The main justifications for the need for an increased deadline are:

- Low confidence that the standards had failed;
- Disproportionate costs of action in comparison to environmental benefits;
- Unknown sources or pathways for pollutants and adverse impacts;
- Insufficient evidence to support improvement actions.

The focus of the EAs work is therefore to conduct further studies in order to confirm failures, sources and pathways to devise cost-efficient mitigation measures for the *Lee*.

According to the latest Thames RBMP (2009) from the EA the overall quantity and dynamics of flow supports good ecological potential (now and predicted in 2015 to be the same).

The use of TBT in antifouling paints was banned in 2008 but there is potential for people to still be applying antifouling paint containing TBT. There is an overall decline in the concentrations of TBT measured in the water. Therefore no action is recommended, except further long term passive monitoring to confirm the declining concentration of TBT.

In 2012, phosphate stripping was introduced at Deephams STW to reduce the amount of phosphate reaching the river. The data following the implementation of phosphate stripping very clearly shows a significant decrease in phosphate concentration. It also shows a corresponding increase in dissolved oxygen saturation. There has also been a change in the ammonia concentrations recorded. Continuation of phosphate stripping should ensure further reduction in phosphate concentrations and improvement in dissolved oxygen saturation.

The EA is working with Thames Water to investigate possible misconnected areas that are causing pollution of the *Lee*. By April 2012, 339 misconnections had been identified in the Moselle Brook catchment and 91 had been rectified.

### 5.8.2 *Thames Middle* RBMP Water Body Objectives

The two main objectives are Good Chemical Status and Good Ecological Potential by 2027. The current ecological potential of the *Thames Middle* is 'moderate' and not expected to improve to 'good' by 2015. The tidal regime and freshwater flow do not currently support a good ecological potential and are not predicted to improve by 2015. The main justifications for an extended deadline are:

- Insufficient evidence to confirm the need to control eutrophication;
- Uncertainty of failure of dissolved oxygen;
- Disproportionate cost of action in comparison to environmental benefits;
- Low confidence that abstraction is affecting ecological status;

### 5.8.3 *Thames Lower* Water Body Objectives

The two main objectives are Good Chemical Status and Good Ecological Potential by 2027. The current ecological potential of the *Thames Lower* is 'Moderate' and not expected to improve to 'Good' by 2015. The main justifications for an extended deadline are:

- Disproportionate cost of action in comparison to environmental benefits;
- Insufficient evidence to confirm the need to control eutrophication;
- Uncertain source of failure for Benzo (ghi) perelyene, indeno (123-cd) pyrene and Benzo(a)pyrene;
- Uncertain source of failure for TBT.

### 5.8.4 *South Essex Thurrock Chalk* Water Body Objectives

No Thames RBMP is known to have been set to date.

## 5.9 Key issues

### 5.9.1 *Lee* Key issues

The key issues identified with the failure of the *Lee* to achieve 'Good' ecological potential are:-

- Physical modification;
- Sewage Discharge (continuous);
- Drainage mixed;
- Sewage Discharge (diffuse);
- Point-source Sewage Discharge;
- Tributyltin;
- Polyaromatic Hydrocarbons (PAHs);
- Groundwater Abstraction.

**Physical Modification**

There are a number of impoundments, locks and weirs which are used to maintain the water level. This causes the water to be slow moving and have an increased residence time. Other interventions include sheet piled banks, concrete channels, setbank embankment, culverts and obsolete structures. The Thames RBMP mitigation measures for *Lee* include the proposed removal of hard bank reinforcement and revetment and replacement with soft engineering solutions; these measures are listed in Table 31.

**Sewage Discharge (continuous)**

Discharge from Deephams sewage treatment works re-enters the River Lea downstream from *Lee* bridge weir. This higher temperature of the sewage effluent can also have high ammonia content and contributes to the failure of dissolved oxygen. The elevated water temperature also promotes bacterial activity which leads to an increased oxygen demand. In addition, impoundments affect fish by preventing their migration.

Deephams Sewage Treatment Works (STW) continuously discharges a significant amount of effluent containing elevated levels of phosphate – mainly from household sources. In the *Lee*, approximately 60-80 % of the overall phosphate load originates from the STW according to a source appointment model run by the EA (WFD report). Sewage effluent also influences ammonia concentration as well as DO concentration through an increase in BOD.

**Drainage mixed**

Due to the heavily urbanised nature of the *Lee* catchment, there a contribution to elevated phosphate levels in the water from surface runoff. During rainfall, phosphate can be washed into the river through runoff from road verges, detergents and animal faeces as well as through runoff of chemicals and pollutants from light industry, roads, houses and commercial areas. It is estimated that 0-20 % of the phosphate load on the *Lee* originates from these sources.

Due to the large number of locks on the *Lee*, a low energy water environment is created. This enables settlement of suspended sediments that have been washed into the river from runoff. Sediment containing a high level of organics can greatly increase the oxygen demand of the water column. This occurs especially when the sediments are disturbed and nutrients re-suspended in the water.

**Sewage Discharge (diffuse)**

Misconnections of plumbing causes foul water from households to be directed into surface water drains. This ultimately causes untreated sewage to be discharged into rivers and streams. In 2006 there were many unidentified misconnections, in particular discharging into Moselle Brook which is a tributary to the *Lee*. In the baseline condition these misconnections were a reason for high levels of phosphate and ammonia as well as low levels of DO.

**Point-source Sewage Discharge**

Combined Sewage Overflows (CSOs) are known to cause high levels of phosphate and ammonia as well as low levels of DO in the *Lee*. CSOs release untreated sewage into the water courses as a result of high rainfall and are considered a significant pressure on water quality in the catchment.

Dual manholes are manholes where foul water and surface water from a property are directed through a common chamber. The foul sewer is fitted with a removable rodding cap which – if removed and not replaced – causes foul water to overspill into the surface water pipe in case of blockage of the foul sewer. There are known dual manhole areas within the catchment and therefore they are a source of intermittent untreated sewage discharges into the river and of high phosphate and ammonia levels and low levels of DO.

**Tributyltin**

Tributyltin (TBT) has been found at concentrations exceeding acceptable limits. A suspected reason for failure for TBT in this water body is the use of antifouling paint to protect the hulls of boats. In 2006 this use was still legal and a continuous source of TBT.

TBT is persistent in sediment and it is therefore possible that historic TBT is leaching from the sediment into the water column when disturbed and contributes to the high levels found within the *Lee*.

**Polyaromatic Hydrocarbons (PAHs)**

Benzofluroanthene, benzo-indeno and fluroanthene have been found at levels which exceed acceptable limits. The main sources of polyaromatic hydrocarbon (PAH) are thought to be emissions from car engines, industrial processes and coal and wood burning.

The reasons for the PAH failures within this water body are suspected incidents, probable urban diffuse pollution and suspected contaminated sediments.

**Groundwater Abstraction**

Groundwater abstraction upstream reduces flow in the *Lee* which impacts the ecology. The reaches along Hackney Marshes are identified as particularly sensitive. It is currently disproportionately expensive to address this issue.

### 5.9.2 *Thames Middle* Key Issues

- Tributyltin;
- PAH - Benzo (ghi) perelyene and indeno (123-cd) pyrene;
- Diuron;
- Dissolved inorganic nitrogen;
- Dissolved Oxygen.
- Physical Modification

**Physical Modification**

The Thames RBMP also refers to the removal of obsolete structures as a mitigation measure with Defined Ecological Potential for the Thames Middle water body. Physical modification of the *Thames Middle* has also been confirmed to be a key issue determining the by the Environment Agency as a critical issue associated to this water body. Thames Middle RBMP Mitigation measures are also listed in Table 32.

**Tributyltin**

At the time of the baseline, TBT was still allowed in anti-fouling paint used on boat hulls to protect from encrusting organisms. It also used to be in products such as wood preservatives as a UV stabiliser in PVC. It is very toxic to marine invertebrates, and can also negatively impact marine mammals. Some of the possible sources of TBT in the *Thames Middle* come from the Sewage Treatment Works, drainage, and potentially from some historical sources from previous industry on the tidal Thames.  (Thames21 report)

**PAH**

Benzo (ghi) perelyene and indeno (123-cd) pyrene was found in concentrations exceeding acceptable limits at the baseline conditions. Some of the possible sources of PAH's in the tidal Thames comes from large Sewage Treatment Works, road run off, and potentially from some historical sources from industry previously on the tidal Thames. Specific sources and their relative contributions are not known and an extended deadline for achieving good ecological and/or chemical status is therefore required. The sources of the pollution are not known in sufficient detail to be able to identify and appraise measures.  (Thames 21 and RBMP Annex E)

**Diuron**

Diuron was present in herbicides and was often used to control weed growth on highways and in public areas. By 2006, the use was banned due to its harmful impact on the environment, particularly impacting aquatic invertebrates. Use of diuron in both urban areas and as a marine biocide can lead to high levels in nearby systems, but the exact source of the high concentration is not known.

There is currently no monitoring of diuron on the tidal Thames, but it is thought that there would be a declining trend in its presence similar to that seen in the rivers that are flowing into the tidal Thames. This needs to be investigated further in order to be confirmed.

**Dissolved Inorganic Nitrogen**

Dissolved inorganic nitrogen (DIN) is usually a result of runoff from farmland and contributes to eutrophication of the water body. However, high levels of DIN do not necessarily cause ecological impacts, and overall DIN is not causing ecological impact and the *Thames Middle* water body as a whole is not at risk of eutrophication. The development of eutrophication depends on physical factors as well as the presence of nutrients like DIN. Factors such as the substrate, flow rate of waters, shading and turbidity, depth, temperature and turbulence are also important.

**Dissolved Oxygen**

A failure in dissolved oxygen can be a result of the upstream Deepham Sewage Treatment Works and Combined Sewage Overflows (CSOs) during rainfall events. However, the EA does not have the statistical confidence that the standard is failed. Thus, at the water body scale the levels of dissolved oxygen may be within acceptable limits and measures to increase dissolved oxygen concentration are considered disproportionately expensive at this stage.

### 5.9.3 *Thames Lower* Key issues

The status of some of the biological and hydromorphological elements was not assessed in the 2009 Thames RBMP. Key issues identified in the water body are moderately high levels of dissolved inorganic nitrogen; significant exceedances in arsenic, copper, cadmium, nickel, lead, mercury, chromium, zinc and hydrocarbons.

### 5.9.4 *South Essex Thurrock Chalk* Key issues

The only key issue identified in the Chalk is the failure to achieve Good Drinking Water Protected Area status due to Ammonia levels and diffuse and point pollution.

### 5.9.5 Summary of Key issues

The QEOP contains four surface water bodies of which two, the *Lee* (Tottenham Locks to the Tideway) and the *Thames Middle* , are heavily modified for human purposes.

The *South Essex Thurrock Chalk* underlying the QEOP is generally confined by an impermeable layer of London clay, but with some downward migration pathways such as disused boreholes and areas of permeable strata. The groundwater body has good quantitative status but poor chemical status. The exact source of the lower chemical quality is not fully understood.

The chemical quality of the surface waters across the study area is poor, with widespread pollution both in water column and sediments of the surface water bodies. The hydromorphological diversity is generally low with slow flow velocities and sink areas for sedimentation. The tidal areas of the site show exchange of sediments as a result of incoming and outgoing tide. Some areas of valuable marginal vegetation and habitat are identified but invasive species such as floating pennywort and Chinese mitten crabs are present throughout a majority of the waterways and the general species diversity is low. The area nonetheless supports populations of macro-invertebrates and coarse fish species that both feed and spawn in the water bodies identified.

# 6 Preliminary Impact Assessment

## 6.1 Summary of Proposed Works

The purpose of this section is to assess whether the following QEOP proposed works impact upon in any way the status of the *Lee*, *Thames Middle* , *Thames Lower* and South Essex Chalk Water bodies.

These works have been grouped by typology of civil work and are mainly:

**Table 34 - Summary of proposed works**

✓ - Works constructed on the water body; ✘ - Works which have not been constructed on water body.

| | Typology of works | Lee Water Body | *Thames Middle* Water Body | *Thames Lower* Water Body | Chalk Water Body |
|---|---|---|---|---|---|
| 1 | **Loss of Pudding Mill River** | ✓ Pudding Mill River (A) | ✘ | ✘ | ✘ |
| 2 | **River Bank Enhancements** | ✓ River Lee Navigation ( C)<br>Old River Lea (D)<br>City Mills River (E) | ✓ Waterworks River (F)<br>River Lea (G) | ✘ | ✘ |
| 3 | **Channel Widening (including River wall replacement)** | ✘ | ✓ Waterworks River (F)<br>River Lea (G) | ✘ | ✘ |
| 4 | **Dredging** | ✓ River Lee Navigation (C)<br>Old River Lea (D)<br>City Mills River (E) | ✓ Waterworks River (F)<br>River Lea (G) | ✘ | ✘ |
| 5 | **Three Mills Lock** | ✘ | ✓ Waterworks River (F)<br>River Lea (G)<br>Three Mills Wall River (H)<br>Prescott Channel (I) | ✘ | ✘ |
| 6 | **Floating Navigation Pontoons** | ✘ | ✓ Waterworks River (F) | ✘ | ✘ |
| 7 | **F10B New Bridge** | ✘ | ✓ Waterworks River (F) | ✘ | ✘ |
| 8 | **Walkway with support in waterway** | ✓ City Mills River (E) | ✓ River Lea (G) | ✘ | ✘ |
| 9 | **Emergency Access platforms** | ✘ | ✓ River Lea (G) | ✘ | ✘ |
| 10 | **Wetland Creation** | ✘ | ✓ River Lea (G)<br>Channelsea Gorge (J) | ✘ | ✘ |
| 11 | **Channelsea Gorge Culverting** | ✘ | ✓ Channelsea Gorge (J) | ✘ | ✘ |
| 12 | **Hennicker's ditch extension** | ✘ | ✓ Hennicker's Ditch (K) | ✘ | ✘ |
| 13 | **Site Wide Remediation** | ✓ | ✓ | ✘ | ✘ |
| 14 | **Site wide Drainage** | ✓ Old River Lea (D)<br>City Mills River (E) | ✓ Waterworks River (F)<br>River Lea (G) | ✘ | ✓ |
| 15 | **Removal of invasive species** | ✓ | ✓ | ✘ | ✘ |

## 6.2 Impact Rationale

As shown in the methodology section the preliminary impact assessment was conducted in line with the following criteria.

All works which impact one or more of the indicators and parameters used to assess good water body status will be further assessed in the detailed assessment.

**Table 35. Impact Rationale for Preliminary Impact Assessment.**

| | Anticipated effect | Action required |
|---|---|---|
| ✓ | Significant potential positive impact identified | Detailed Assessment required |
| ✓ | Slight potential positive impact identified with regard to water quality elements | Detailed Assessment required |
| - | No/ minimal risk of impact on identified or downstream water body | Screened out from further assessment. |
| × | Identified potential negative effect on one objective or downstream water body. | Detailed Assessment required |
| × | Identified negative effect. The effect could potentially prevent attainment of future 'Good' Status or Potential. | Detailed Assessment required |
| × | Likely to cause a deterioration in Status or Potential and therefore require an Article 4.7 test. Likely to prevent future attainment of 'Good' Status or Potential. | Detailed Assessment required. Article 4.7 test to be prepared if the assessment is confirmed. |

**Notes**

1. Both water bodies are classified as Heavily Modified according to Thames RBMP (2009). This means that hydromorphological pressures cannot prevent the water body from obtaining good potential. Hydromorphological impacts are only used to inform biological effects.

2. Only operational stage impact has been considered with regard to obtaining future good ecological status or preventing deterioration. CoCP implemented for construction activities.

## 6.3 Preliminary Assessment of Impact on *Lee* (Tottenham Locks to the Tideway)

| | |
|---|---|
| **Water Body Name** | Lee (Tottenham Locks to the Tideway) |
| **Water Body ID** | GB106038077852 |
| **Water Body Designation** | HMWB |
| **Current Potential** | Moderate |

| **WFD Water Quality Elements** | | **Type of Works** | | **1. Loss of Pudding Mill River** | **2. River Bank Enhancements** | **3. Channel widening (including River wall replacement)** | **4. Dredging** | **5. Three Mills Lock** | **6. Floating Navigation Pontoons** | **7. F10B New Bridge** | **8. Walkway with support in waterway** | **9. Emergency Access Platforms** | **10. Wetland Creation** | **11. Channelsea Gorge Culverting** | **12. Hennickers ditch extension** | **13. Site Wide Remediation** | **14. Site Wide Drainage** | **15. Removal of invasive species** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sustainable Water Use** | **Sustainable Water Use** | - | - | - | - | *NA* | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | - | - | - |
| **Habitat and Species** | **Biological Elements** | | | | | | | | | | | | | | | | | |
| | Diatoms | - | - | - | - | *NA* | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | - | - | - |
| | Macrophytes | - | X | × | ✔ | *NA* | × | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | - | × | ✔ |
| | Macroinvertebrates | - | X | × | ✔ | *NA* | × | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | - | × | ✔ |
| | Fish | Poor | X | × | ✔ | *NA* | × | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | - | × | ✔ |
| | **Hydromorphological elements** | | | | | | | | | | | | | | | | | |
| | Quantity and dynamics of water flow | Supports Good | X | × | × | *NA* | × | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | - | × | - |
| | Connection to Groundwater | - | X | - | - | *NA* | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | - | - | - |
| | Structure and substrate of river bed | - | X | × | × | *NA* | × | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | - | × | - |
| | Structure of the riparian zone | - | X | × | ✔ | *NA* | × | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | - | - | - |
| | River depth and width variation | - | X | × | ✔ | *NA* | × | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | - | - | - |
| | River continuity | - | X | - | ✔ | *NA* | ✔ | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | - | - | - |
| **Water Quality** | **Physico-chemical elements** | | | | | | | | | | | | | | | | | |
| | Dissolved Oxygen (DO) | Poor | - | - | ✔ | *NA* | × | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | ✔ | × | - |
| | pH | High | - | - | - | *NA* | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | = | - | - |
| | Ammonia (Total as N) | Moderate | - | - | ✔ | *NA* | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | = | × | - |
| | Phosphate | Bad | - | - | ✔ | *NA* | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | = | × | - |
| | **Annex VIII Pollutants** | | | | | | | | | | | | | | | | | |
| | Annex VIII Pollutants | Fail | - | ✔ | × | *NA* | × | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | ✔ | ✔ | - |
| | Temperature | High | - | ✔ | - | *NA* | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | = | - | - |
| **Flood Risk** | **Flood Risk** | | | | | | | | | | | | | | | | | |
| | Flood Hazard | - | - | × | - | *NA* | × | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | - | ✔ | - |
| | Flood Extent | - | - | × | × | *NA* | × | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | - | - | - |

## 6.4 Preliminary Assessment on Impact on *Thames Middle*

It should be noted that a detailed assessment of the Three Mills Lock (TML) will not be included within this WFD assessment, because these works are located geographically outside the LLDC QEOP works and secondly, it is considered that the assessment of the QEOP is independent of the outcome of the assessment of the TML. The impacts that relate to the QEOP have been mitigated within the QEOP and are considered in this assessment. The impacts of the TML beyond the QEOP require consideration in a future, separate detailed WFD assessment (see section 6.8)

| | |
|---|---|
| **Water Body Name** | Thames Middle |
| **Water Body ID** | GB530603911402 |
| **Water Body Designation** | HMWB |
| **Current Potential** | Moderate |

| WFD Water Quality Elements | | Type of works | | 1. Loss of Pudding Mill River | 2. River Bank Enhancements | 3. Channel widening (including River wall replacement) | 4. Dredging | 5. Three Mills Lock | 6. Floating Navigation Pontoons | 7. F10B New Bridge | 8. Walkway with support in waterway | 9. Emergency Access Platforms | 10. Wetland Creation | 11. Channelsea Gorge Culverting | 12. Hennickers ditch extension | 13. Site Wide Remediation | 14. Site Wide Drainage | 15. Removal of invasive species |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sustainable Water Use** | **Sustainable Water Use** | - | - | *NA* | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Habitat and Species** | **Biological Elements** | | | | | | | | | | | | | | | | | |
| | Phytoplankton | - | - | *NA* | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Macroalgae | High | - | *NA* | ✓ | × | × | × | × | × | × | × | ✓ | × | - | - | × | ✓ |
| | Angiosperms | - | × (extent) | *NA* | - | - | - | - | - | - | - | - | - | - | - | - | × | - |
| | Benthic invertebrates | Moderate | × (extent) | *NA* | ✓ | × | × | × | × | × | × | × | ✓ | × | - | - | × | ✓ |
| | Fish (transitional) | - | × | *NA* | ✓ | × | × | × | × | ✓ | ✓ | × | ✓ | × | - | - | × | - |
| | **Hydromorphological elements** | | | | | | | | | | | | | | | | | |
| | Freshwater flow | Does not support Good | × | *NA* | - | - | - | - | - | - | - | | - | - | | | - | - |
| | Depth variation | - | × | *NA* | ✓ | - | × | × | - | - | - | - | ✓ | - | - | - | - | - |
| | Quantity, structure and substrate of estaurine bed | - | × | *NA* | ✓ | × | × | × | × | × | × | × | ✓ | × | - | - | × | - |
| | Structure of the intertidal zone | - | × | *NA* | - | - | × | × | × | × | × | × | - | - | - | - | - | - |
| | Wave exposure | - | × | *NA* | - | - | - | - | - | - | - | | - | - | | | - | - |
| **Water Quality** | **Supporting elements** | | | | | | | | | | | | | | | | | |
| | Dissolved Inorganic Nitrogen (DIN) | Moderate | - | *NA* | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Dissolved Oxygen (DO) | Moderate | - | *NA* | ✓ | × | × | × | - | - | - | - | ✓ | - | - | ✓ | × | - |
| | **Chemical elements** | | | | | | | | | | | | | | | | | |
| | Annex VIII Pollutants | Fail | - | *NA* | × | × | ✓ | × | × | | - | - | × | - | - | ✓ | × | - |
| **Flood Risk** | **Flood Risk** | | | | | | | | | | | | | | | | | |
| | Flood Hazard | - | - | *NA* | - | ✓ | × | × | - | × | × | × | ✓ | × | × | - | ✓ | - |
| | Flood Extent | - | - | *NA* | × | ✓ | × | × | - | × | × | × | ✓ | - | ✓ | - | - | - |

## *6.5* Preliminary Assessment of Impact on *Thames Lower*

It is not anticipated that the impact on the tidal prism in the Thames Middle water body will be so significant that it will affect the Thames Lower water body. This is due to the significant size of the Thames Middle and the likely effects being contained to the Lower Lee part of this water body, although this in itself could be significant for this water body.

| | |
|---|---|
| **Water Body Name** | Thames Lower |
| **Water Body ID** | GB530603911401 |
| **Water Body Designation** | HMWB |
| **Current Potential** | Moderate |

| **WFD Water Quality Elements** | | **Type of works** | | **1. Loss of Pudding Mill River** | **2. River Bank Enhancements** | **3. Channel widening (including River wall replacement)** | **4. Dredging** | **5. Three Mills Lock** | **6. Floating Navigation Pontoons** | **7. F10B New Bridge** | **8. Walkway with support in waterway** | **9. Emergency Access Platforms** | **10. Wetland Creation** | **11. Channelsea Gorge Culverting** | **12. Hennickers ditch extension** | **13. Site Wide Remediation** | **14. Site Wide Drainage** | **15. Removal of invasive species** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sustainable Water Use** | **Sustainable Water Use** | - | - | *NA* | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Habitat and Species** | **Biological Elements** | | | | | | | | | | | | | | | | | |
| | Phytoplankton | - | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | Macroalgae | High | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | Angiosperms | - | X (extent) | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | ` | Moderate | X (extent) | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | Fish (transitional) | - | X | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | **Hydromorphological elements** | | | | | | | | | | | | | | | | | |
| | Freshwater flow | - | X | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | Depth variation | - | X | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | Quantity, structure and substrate of estaurine bed | - | X | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | Structure of the intertidal zone | - | X | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | Wave exposure | - | X | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| **Water Quality** | **Supporting elements** | | | | | | | | | | | | | | | | | |
| | Dissolved Inorganic Nitrogen (DIN) | Moderate | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | Dissolved Oxygen (DO) | High | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | **Chemical elements** | | | | | | | | | | | | | | | | | |
| | Annex VIII Pollutants | Fail | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| **Flood Risk** | **Flood Risk** | | | | | | | | | | | | | | | | | |
| | Flood Hazard | - | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | Flood Extent | - | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |

## 6.6 Preliminary Assessment of Impact on *South Essex Thurrock Chalk*

| | |
|---|---|
| **Water Body Name** | South Essex Thurrock Chalk |
| **Water Body ID** | GB40601G401100 |
| **Overall Status** | Poor |
| **Quantitative Status** | Good |
| **Chemical Status** | Poor (DWPA) |

| | **WFD Water Quality Elements** | **Type of works** | | **1. Loss of Pudding Mill River** | **2. River Bank Enhancements** | **3. Channel widening (including River wall replacement)** | **4. Dredging** | **5. Three Mills Lock** | **6. Floating Navigation Pontoons** | **7. F10B New Bridge** | **8. Walkway with support in waterway** | **9. Emergency Access Platforms** | **10. Wetland Creation** | **11. Channelsea Gorge Culverting** | **12. Hennickers ditch extension** | **13. Site Wide Remediation** | **14. Site Wide Drainage** | **15. Removal of invasive species** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sustainable Water Use** | **Quantitative Elements** | | | | | | | | | | | | | | | | | |
| | **Impact on Wetlands** | Good (High) | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | **Impact On Surface Waters** | Good (Low) | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | **Saline Intrusion** | Good (Low) | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | **Water Balance** | Good (High) | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | × | *NA* |
| **Habitat and Species** | **Biological Elements** | | | | | | | | | | | | | | | | | |
| | NA | - | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | **Hydromorphological elements** | | | | | | | | | | | | | | | | | |
| | NA | - | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| **Water Quality** | **Supporting elements** | | | | | | | | | | | | | | | | | |
| | Dissolved Inorganic Nitrogen (DIN) | | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | **Chemical elements** | | | | | | | | | | | | | | | | | |
| | Drinking Water Protected Area | Poor (Low) | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | General Chemical Test | Good (Low) | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | ✓ | *NA* |
| | Impact on Wetlands | Good (High) | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | Impact On Surface Waters | Good (Low) | | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| | Saline Intrusion | Good (Low) | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |
| **Flood Risk** | **Flood Risk** | | | | | | | | | | | | | | | | | |
| | Risk of flooding from Groundwater | - | - | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* | *NA* |

## 6.7 Conclusion

Following the preliminary assessment it can be seen that all works are deemed to have an impact on the water quality elements of the waterways within the four key water bodies assessed.

The works which upon an initial screening are identified as having the potential to impact the waterways ecological and chemical status negatively are mainly:

- Pudding Mill River Loss
- Channel Widening
- Dredging
- Three Mills Lock
- Floating Navigation Pontoons
- F10b New Bridge
- Walkway with support in waterway
- Emergency access boat platforms
- Channelsea Gorge Culverting
- Henniker's ditch extension

As a result of the preliminary assessment, the following water bodies have been screened out of the detailed assessment.

- The *Thames Lower* has been screened out from a detailed assessment as no works with a significant positive or negative impact on the water body was identified.

## 6.8 Recommendations for analysis required for detailed assessment of the Three Mills Locks impact on the Thames Middle

In order to establish the impact of the Three Mills Lock on the Thames Middle water body and therefore complete a subsequent detailed WFD assessment of the impact of these works, the following analysis is deemed to be necessary.

- A Tidal Prism Analysis which outlines the downstream morphological impacts of the Three Mills Lock. The results of the Prism Analysis should be used to assess the impacts on the water bodies ecology and maintenance requirements associated to ensuring navigability.

- Impacts on the 'special' habitats of the Middle Thames Water Body should also be considered. The 'special habitats include creeks, intertidal mud flats, sub-tidal gravels and fringing brackish reed beds. An assessment outlining the percentage lost in the Middle Thames is likely to be sufficient.

- The impact of the structure on water quality will be needed; this should include an assessment of water quality upstream and downstream of the structure and consider a variety of flow conditions including low, normal and high flow conditions.

- An assessment of the ecological impact of the Lock should be conducted using pre and post monitoring surveys.

- The analysis should assess the effectiveness of the Fish Pass and the operation of the structure.

# 7 Detailed Impact Assessment

## 7.1 Impact Rationale

As discussed in the methodology section, all works that are identified as having an impact, positive or negative, on the elements and key indicators chosen to represent and monitor good water body status are assessed in further detail in this section.

Table 36. Impact Rationale for Detailed Impact Assessment.

| | Anticipated effect | Action required |
|---|---|---|
| ✓ | Significant positive impact identified | No further action required |
| ✓ | Slight positive impact identified with regard to water quality elements | No further action required |
| - | No/ minimal risk of impact on identified or downstream water body | No further action required |
| × | Identified negative effect on one objective or downstream water body. | Mitigation measures to be identified and implemented |
| × | Identified negative effect. The effect could potentially prevent attainment of future 'Good' Status or Potential. | Mitigation measures to be identified and implemented |
| × | Deterioration in Status or Potential and therefore require an Article 4.7 test. Likely to prevent future attainment of 'Good' Status or Potential. | Article 4.7 test to be prepared if the assessment is confirmed. |

Notes

1. Both water bodies are classified as Heavily Modified according to Thames RBMP (2009). This means that hydromorphological pressures cannot prevent the water body from obtaining good potential. Hydromorphological impacts are only used to inform biological effects.

2. Only operational stage impact has been considered with regard to obtaining future good ecological status or preventing deterioration. CoCP implemented for construction activities.

## 7.2 *Lee* (Tottenham Locks to the Tideway) Detailed Impact Assessment

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Lee (Tottenham Locks to the Tideway) | Negative Impact Identified | X | ✓ | Significant positive impact identified |
| **Water Body ID** | GB106038077852 | Positive impact Identified | √ | ✓ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Loss of Waterway | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | Pudding Mill River | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

## Pudding Mill River Loss — Length: 250m

| WFD objective | Description of Impact of Works | Parameter | X | √ | Residual impact | References |
|---|---|---|---|---|---|---|
| | **Water Use Elements** | | | | | • • LDA Appendix B Flood Risk Assessment Earthworks and Remediation Marshgate lane Area Stratford, London (Construction Zone 3a) November 2006<br>• ODA (2008) Biodiversity Action Plan BAP<br>• From Atkins Phase 1 report Atkins, Olympic Park Infrastructure Design, Geomorphological Assessment and Monitoring, Phase 1: Lower River Lee Fluvial Audit, 24 November 2008.<br>• ODA London Learning Legacy: Translocation of habitats and species within the Olympic Park, December 2011<br>• ODA, Volume 12D - Environmental Statement Part 3 – Topic Environmental Assessments OLY-GLB-ACC-DOC-ENV-01D – Environmental Statement |
| **Sustainable water use** | - | Potable water demand | - | - | No | |
| | | Non-potable water demand | - | - | No | |
| | | **Total** | - | - | No | |
| **Habitat and Species** | **Biological indicators** | | | | | |
| | X - Physical habitat loss of approximately 250m of narrow, steep-sided river with invasive species present. However loss of physical length of habitat type not considered significant on a water body scale.<br><br>√ - Fish translocated to adjacent waterways. Amphibians translocated to Waterworks Nature Reserve. | Diatoms | - | - | - | |
| | | Macrophytes | X | - | X | |
| | | Macro invertebrates | X | - | X | |
| | | Fish | X | √ | X Net | |
| | | **Total** | **X** | √ | **X Net** | |
| | **Hydromorphology** | | | | | |
| | X - Loss of 250m of waterway. Waterway of low geomorphological diversity and value prior to filling in. | Quantity and dynamics of water flow | X | - | X | |
| | | Structure and substrate of river bed | X | - | X | |
| | | Structure of the riparian zone | X | - | X | |
| | | River depth and width variation | X | - | X | |
| | | River continuity | - | - | No | |
| | | **Total** | **X** | - | **X** | |
| **Water Quality** | **Supporting Elements** | | | | | |
| | - | Dissolved Oxygen | - | - | No | |
| | | pH | - | - | No | |
| | | Ammonia (Total as N) | - | - | No | |
| | | Phosphate | - | - | No | |
| | | **Total** | - | - | **No** | |
| | **Chemical Elements** | | | | | |
| | √ - Pudding Mill River was a heavily polluted watercourse, therefore its removal resulted in marginal local benefit. | Annex VIII Pollutants | √ | - | √ | |
| | | **Total** | - | - | √ | |
| **Flooding** | **Flood Elements** | | | | | |
| | There is no measurable increase in flood extent as a result of the loss of Pudding Mill River and virtually no change in flood depth as a result of the loss of flood storage at Pudding Mill River during the 1 in 100 year + 20 % allowance for climate change event. | Flood hazard | - | - | No | |
| | | Flood extent | - | - | No | |
| | | **Total** | - | - | **No** | |

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Lee (Tottenham Locks to the Tideway) | Negative Impact Identified | X | ✔ | Significant positive impact identified |
| **Water Body ID** | GB106038077852 | Positive impact Identified | √ | ✔ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | River Bank Soft enhancement | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | River Lee Navigation ( C); Old River Lea (D); City Mills River ( E) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

**River Bank Enhancement** — **Length: 3.3 km**

| WFD objective | Description of impact/mitigation measure | Parameter | X | √ | Residual impact | References |
|---|---|---|---|---|---|---|
| | **Water Use Elements** | | | | | • ODA: Olympic Park and Site Wide Infrastructure Design and Master Planning, Waterways Concept design, Ref. REP-BUR-CW-ZZZ-WAT-ZZZ-000001, May 2007 • ODA: Olympic Park and Site Wide Infrastructure Design and Master Planning, Waterways Design Brief – Delivery Zone 4, Ref. REP-BUR-CW-04Z-WAT-ZZZ-Z-0001, March 2007. • ODA: Olympic Park and Site Wide Infrastructure Design and Master Planning, Waterways Design Brief – Delivery Zone 3, Ref. REP-BUR-CW-03Z-WAT-ZZZ-Z-0001, March 2007. • ODA: The Olympic Park – Towards a 10 Year Landscape Management and Maintenance Plan, February 2010. • ODA, Volume 12D - Environmental Statement Part 3 – Topic Environmental Assessments OLY-GLB-ACC-DOC-ENV-01D – Environmental Statement • Atkins, Olympic Park Infrastructure Design, Geomorphological Assessment and Monitoring, Phase 1: Lower River Lee Fluvial Audit, 24 November 2008. • AINA: Management Strategies and Mitigation Measures for the Inland Navigation Sector in Relation to Ecological Potential for Inland Waterways – Appendix B, Mitigation Measures and Management Strategies Sheets, March 2008 |
| **Sustainable water use** | - | Potable water demand | - | - | No | |
| | | Non-potable water demand | - | - | No | |
| | | **Total** | - | - | No | |
| | **Biological indicators** | | | | | |
| **Habitat and Species** | X - Potential for colonisation by invasive species.<br>√ - Planting of mature vegetation to increase rate of bank consolidation and reduce risk of invasive species.<br>√ - 2Km canal park; 0.5km sof bank enhancement on the Old River Lea; 0.8km on the city mills river. and Longitudinal ecological connectivity improved through more than 2.5km soft bank planted with wetland species. New soft bank on City Mills River south of Stadium planted with emergent vegetation. Increased connectivity between riparian habitat, marginal vegetation and aquatic habitat.<br>√ - Soft banks provide spawning grounds and essential habitat for invertebrates. | Diatoms | - | - | No | |
| | | Macrophytes | - | √ | √ | |
| | | Macro invertebrates | - | √ | √ | |
| | | Fish | - | √ | √ | |
| | | **Total** | - | √ | √ | |
| | **Hydromorphology** | | | | | |
| | X - Naturalisation increases the potential for sediment to be generated via channel bank erosion banks as a result of an increase in the surface area of naturalised reaches. Stream power and velocity very low and sediment deposition high so the risk of erosion of the new soft bank is low under normal flow conditions.<br>√ - Erosion protection measures have also been put in place, to protect the slope in the eventuality of outfall flows exceeding 1.2 m/s.<br>√ - Planting of mature vegetation also helps stabilise the bank and reduce erosion. Riparian planting also traps silt from greenfield runoff.<br>√ - Increase in geomorphological diversity through channel cross section, planform type, bank type and flow variation along the river. | Quantity and dynamics of water flow | X | - | No | |
| | | Structure and substrate of river bed | X | √ | √ Net | |
| | | Structure of the riparian zone | - | √ | √ | |
| | | River depth and width variation | - | √ | √ | |
| | | River continuity | √ | - | No Net | |
| | | **Total** | **X** | **√** | **√ Net** | |
| | **Supporting Elements** | | | | | |
| **Water Quality** | X - None identified<br>√ - Vegetation can intercept and utilise nutrients from surface runoff and prevent eutrophication of the waterway which may have a marginal positive impact on DO levels as well as phosphate and nitrate concentration | Dissolved Oxygen | - | √ | No significant Net | |
| | | pH | - | - | No | |
| | | Ammonia (Total as N) | - | √ | No significant Net | |
| | | Phosphate | - | √ | No significant Net | |
| | | **Total** | - | √ | No significant Net | |
| | **Chemical Elements** | | | | | |
| | X - Naturalisation of banks may create preferential pathways to surface water receptors from contaminated soil and groundwater. Potential negative impact from migration of contaminated shallow groundwater. Litter may get caught in marginal vegetation.<br>√ - Marginal planting will improve downstream water quality though the removal of contaminants in the water. Litter issues addressed in the draft 10-year Landscape Management and Maintenance Plan for the QEOP. | Annex VIII Pollutants | X | √ | No Net | |
| | | **Total** | **X** | **√** | No Net | |
| | **Flood Elements** | | | | | |
| **Flooding** | X - Potential increase in flood extent due to removal of hard defences.<br>√ - Increase in storage area and changes in river edges accounted for in flood model to ensure no residual impact. | Flood hazard | - | - | No | |
| | | Flood extent | X | √ | No | |
| | | **Total** | **X** | **√** | No Net | |

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Lee (Tottenham Locks to the Tideway) | Negative Impact Identified | X | ✔ | Significant positive impact identified |
| **Water Body ID** | GB106038077852 | Positive impact Identified | √ | ✔ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Dredging | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | River Lee Navigation ( C); Old River Lea (D); City Mills River ( E) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

**Dredging** — **Volume dredged: 18,649 m3**

| WFD objective | Description of Impact | Parameter | X | √ | Residual impact | References |
|---|---|---|---|---|---|---|
| | **Water Use Elements** | | | | | • Lower Lea Valley Olympic Applications, Environmental Statement Part 3, Chapter 16-18, 52. Surface Water; Chapter 19-21, 53. Soil Conditions, Groundwater and Contamination, January 2004.<br>• ODA Surface Water Drainage Technical Design Strategy, July 2008<br>• ODA Olympic Park Water Management Plan, February 2009<br>• Olympic Park and Site Wide Infrastructure London 2012 Design and Master Planning Report: REP-BUR-CD-ZZZ-ZZZ-XXX-O-000002. Site Wide Surface Water Drainage Concept Design Report and Brief for Detailed Designers, April 2007<br>• Legacy Masterplan Framework (Kath Markey), Quick Guide to Olympic Park Surface Water Drainage, March 2008<br>• LMF Output E – Sustainable Water Resource Management Strategy (Draft): REP-BUR-CW-ZZZ-ZZZ-ZZZ-L-0001, 10 July 2009<br>• EA WFD Method statement for the classification of surface water bodies v3 (Jan 2013) |
| **Sustainable water use** | - | Potable water demand | - | - | No | |
| | | Non-potable water demand | - | - | No | |
| | | **Total** | - | - | **No** | |
| **Habitat and Species** | **Biological indicators** | | | | | |
| | X - Direct loss of habitat, especially for benthic species and submerged macrophytes.<br><br>X - Habitats downstream can be destroyed and the mortality of fish and invertebrates can increase due to the re-suspension of fine sediment. Suspended sediments can directly affect fish's respiratory systems and feeding success as well as smother spawning grounds and fish fry.<br><br>√ - Dredging was conducted outside fish spawning season to reduce impact on aquatic fauna. | Diatoms | - | - | No | |
| | | Macrophytes | X | - | X | |
| | | Macro invertebrates | X | - | X | |
| | | Fish | X | √ | X Net | |
| | | **Total** | **X** | **√** | **X Net** | |
| | **Hydromorphology** | | | | | |
| | X - High risk of increased future siltation due to high sediment load, low stream power and reduced bed stability.<br><br>X - Dredging can destabilise naturalised banks by compromising fixing points of pre-planted coir rolls and through bankside erosion. The water body is heavily modified and no significant change in general channel profile is deemed to have occurred.<br><br>X - Destabilisation of existing channel bed and sediment deposits can also cause remobilisation of sediment and downstream deposition.<br><br>√ - Dredging was conducted from a float to avoid bank-side damage.<br><br>√ - Low-impact dredging techniques employed to minimise impact on siltation.<br><br>√ - Dredging contemporarily increases the under keel clearance which reduces re-suspension of channel bed sediments, turbidity and associated negative impacts. | Quantity and dynamics of water flow | X | - | No Net | |
| | | Structure and substrate of river bed | X | - | X | |
| | | Structure of the riparian zone | X | √ | X Net | |
| | | River depth and width variation | X | - | X | |
| | | River continuity | √ | - | No Net | |
| | | **Total** | **X** | **-** | **X Net** | |
| **Water Quality** | **Supporting Elements** | | | | | |
| | X - Transfer of fine sediment, with potentially high BOD downstream, potentially negatively affecting DO.<br><br>√ - Dredging leads to a reduction of excessive nutrients within the dredged sediments leading to less eutrophication and higher DO. | Dissolved Oxygen | X | √ | No Net | |
| | | pH | - | - | No | |
| | | Ammonia (Total as N) | - | - | No | |
| | | Phosphate | - | - | No | |
| | | **Total** | **X** | **√** | **No Net** | |
| | **Chemical Elements** | | | | | |
| | X - Transfer of fine sediment and identified associated contaminants – oils and heavy metals – downstream. Leaching of contaminants to water column through re-suspension of sediments.<br><br>√ - Dredging leads to a reduction of excessive nutrients and removed contaminants within the dredged sediments. Contaminated sediments bioremediated off-site to avoid re-contamination.<br><br>√ - Reduced re-suspension through increased under keel clearance reduces the risk for contaminant leaching to the water column. | Annex VIII Pollutants | X | √ | √ Net | |
| | | **Total** | **X** | **√** | **√ Net** | |

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Lee (Tottenham Locks to the Tideway) | Negative Impact Identified | X | ✓ | Significant positive impact identified |
| **Water Body ID** | GB106038077852 | Positive impact Identified | √ | ✓ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Flooding | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | River Lee Navigation ( C); Old River Lea (D); City Mills River ( E) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

**Dredging**

| | **Flood Elements** | | | | | **References** |
|---|---|---|---|---|---|---|
| **Flooding** | X - Future silt deposition can compromise flood conveyance capacity.<br>X - Dredging could reduce passive pressure on river walls and reduce bank stability and therefore protection provided.<br>√ - Dredging increases conveyance and reduces flood extent and hazard both locally and elsewhere.<br>√ - Canal and River Trust dredging management plans are in place to maintain necessary flood risk design standard. | Flood hazard | X | √ | √ Net | |
| | | Flood extent | X | √ | √ Net | |
| | | **Total** | **X** | **√** | **√ Net** | |

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Lee (Tottenham Locks to the Tideway) | Negative Impact Identified | X | ✔ | Significant positive impact identified |
| **Water Body ID** | GB106038077852 | Positive impact Identified | √ | ✔ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Surface Water Drainage system / Outfall | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | Old River Lea (D); City Mills River ( E) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

**Surface Water Drainage system / Outfall** — **Area: 250 ha**

| WFD objective | Description of Impact | Parameter | X | √ | Residual impact |
|---|---|---|---|---|---|
| | **Water Use Elements** | | | | |
| **Sustainable water use** | - | Potable water demand | - | - | No |
| | | Non-potable water demand | - | - | No |
| | | **Total** | - | - | **No** |
| | **Biological indicators** | | | | |
| **Habitat and Species** | X - Surface water outfalls will discharge sediments in runoff which can smother vegetation and fish eggs.<br>X - High levels of sediment from runoff can also cause damage to fish gills which in turn can reduce fitness or result in death.<br>X - High levels of sediment from runoff can reduce the rate of photosynthesis and impact benthic communities.<br>√ - Silt traps at outfalls are installed to reduce sediment load. Site landscaping strategy limits the size of bare earth areas not covered by landscaping or planting which drain to the CSOs. No agricultural areas within the park. | Diatoms | - | - | No |
| | | Macrophytes | X | - | No Net |
| | | Macro invertebrates | X | - | No Net |
| | | Fish | X | - | No Net |
| | | **Total** | **X** | **-** | **No Net** |
| | **Hydromorphology** | | | | |
| | X - Low risk of silt deposition at outfalls as well as scour of river bed/soft banks due to erosion. This can change the structure of the river bed.<br>√ - All surface water drainage outfalls south of Carpenters Road have a maximum velocity of 0.3 m/s at the outfalls. All surface water drainage outfalls north of Carpenters Road are designed for an outfall velocity of 1.2 m/s or less. If those velocities were unable to be met, erosion protection measures have been put in place. | Quantity and dynamics of water flow | X | - | No |
| | | Structure and substrate of river bed | X | √ | No Net |
| | | Structure of the riparian zone | - | - | No |
| | | River depth and width variation | - | - | No |
| | | River continuity | - | - | No |
| | | **Total** | **X** | **√** | **No Net** |
| | **Supporting Elements** | | | | |
| **Water Quality** | X - Phosphate, nitrogen, bacteria and organic matter can be washed into the water bodies from roofs, green surfaces and roads. This can lead to an increase in the BOD of the water bodies and a subsequent drop in DO.<br>√ - Separated surface water and foul water drainage reduces the load on combined sewers during rainfall events. This reduces the number of CSOs and thus the level of biological contamination reaching the water bodies. This reduces the BOD of the water body and positively affects the level of DO. | Dissolved Oxygen | X | √ | No Net |
| | | pH | - | - | No |
| | | Ammonia (Total as N) | X | √ | No Net |
| | | Phosphate | X | √ | No Net |
| | | **Total** | **X** | **√** | **No Net** |
| | **Chemical Elements** | | | | |
| | X - Hydrocarbons, heavy metals, chloride, glycol, cyanide, cadmium and MTBE can be washed into the water bodies from hard surfaces such as roofs, car parks, de-icing activities, roads and atmospheric deposition as well as through contaminated groundwater migration. This leads to an increase in pollutant load on the water bodies.<br>√ - Remediation of contaminated soils and groundwater during development in accordance with a Site Specific Remediation Strategy reduces the long term sources of contamination.<br>√ - Installation of Human Health Separation Layer in the top 600 mm of heavily contaminated areas of the site help reduce pollutant load in runoff.<br>√ -There is no discharge of surface water directly to ground, nor any designed surface water infiltration. This reduces the risk of contaminant mobilisation and leaching during rainfall events.<br>√ - Reduction of industrial uses in the area removes potential point sources of pollution. | Annex VIII Pollutants | X | √ | √ Net |
| | | **Total** | **X** | **√** | **√ Net** |

**References**

- Lower Lea Valley Olympic Applications, Environmental Statement Part 3, Chapter 16-18, 52. Surface Water; Chapter 19-21, 53. Soil Conditions, Groundwater and Contamination, January 2004.
- ODA Surface Water Drainage Technical Design Strategy, July 2008
- ODA Olympic Park Water Management Plan, February 2009
- Olympic Park and Site Wide Infrastructure London 2012 Design and Master Planning Report: REP-BUR-CD-ZZZ-ZZZ-XXX-O-000002. Site Wide Surface Water Drainage Concept Design Report and Brief for Detailed Designers, April 2007
- Legacy Masterplan Framework (Kath Markey), Quick Guide to Olympic Park Surface Water Drainage, March 2008
- LMF Output E – Sustainable Water Resource Management Strategy (Draft): REP-BUR-CW-ZZZ-ZZZ-ZZZ-L-0001, 10 July 2009
- EA WFD Method statement for the classification of surface water bodies v3 (Jan 2013)

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Lee (Tottenham Locks to the Tideway) | Negative Impact Identified | X | ✓ | Significant positive impact identified |
| **Water Body ID** | GB106038077852 | Positive impact Identified | √ | ✓ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Flooding | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | Old River Lea (D); City Mills River ( E) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

**Surface Water Drainage system / Outfall**

| | Flood Elements | | | | | References |
|---|---|---|---|---|---|---|
| **Flooding** | √ - Surface water is released to the water body prior to the Old River Lea and City Mills River peak hydrograph. This reduces the depth of water at the time of concentration and the downstream flood depths associated with fluvial flooding. | Flood hazard | - | √ | √ | |
| | | Flood extent | - | - | No | |
| | | **Total** | - | √ | √ | |

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Lee (Tottenham Locks to the Tideway) | Negative Impact Identified | X | ✔ | Significant positive impact identified |
| **Water Body ID** | GB106038077852 | Positive impact Identified | √ | ✔ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Removal of Invasive Species | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | All Lee Waterways | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

**Removal of Invasive Species** — **Length: 3.8km**

| WFD objective | Description of Impact | Parameter | X | √ | Residual impact | References |
|---|---|---|---|---|---|---|
| | **Water Use Elements** | | | | | |
| **Sustainable water use** | - | Potable water demand | - | - | No | |
| | | Non-potable water demand | - | - | No | |
| | | **Total** | - | - | **No** | |
| | **Biological indicators** | | | | | |
| **Habitat and Species** | X - Eradication of invasive species may locally and temporarily negatively affect existing flora. )<br><br>√ - Along Lee Navigation, 1.4km; 0.8 on Old River Lea; 1.6 on the city Mills River. Corridors along waterways are especially sensitive to colonisation. Site-wide removal improves riparian vegetation and potential for marginal habitats. Regular harvesting of floating pennywort increases the abundance of submerged vegetation as they often out compete native species when present. Japanese Knotweed outcompete other riparian vegetation and reduce native diversity; Himalayan Balsam can shade out rarer species.<br><br>√ - Weed prevention fabrics have also been employed to cap the sub-soil layer to ensure no invasive species can emerge. These weed initial prevention methods will ensure a minimum invasive species population.<br><br>√ - Ongoing management strategies for removal in place. | Diatoms | - | - | No | |
| | | Macrophytes | X | √ | √ Net | |
| | | Macro invertebrates | - | √ | √ | |
| | | Fish | √ | - | No Net | |
| | | **Total** | **X** | **√** | **√ Net** | |
| | **Hydromorphology** | | | | | |
| | X - None identified<br><br>√ - None identified | Quantity and dynamics of water flow | - | - | No | |
| | | Structure and substrate of river bed | - | - | No | |
| | | Structure of the riparian zone | - | - | No | |
| | | River depth and width variation | - | - | No | |
| | | | | | | |
| | | **Total** | - | - | **No** | |
| | **Supporting Elements** | | | | | |
| **Water Quality** | X - None identified<br><br>√ - None identified | Dissolved Oxygen | - | - | No | |
| | | pH | - | - | No | |
| | | Ammonia (Total as N) | - | - | No | |
| | | Phosphate | - | - | No | |
| | | **Total** | - | - | **No** | |
| | **Chemical Elements** | | | | | |
| | X - None identified<br><br>√ - None identified | Annex VIII Pollutants | - | - | No | |
| | | **Total** | - | - | **No** | |
| | **Flood Elements** | | | | | |
| **Flooding** | X - None identified<br><br>√ - None identified | Flood hazard | - | - | No | |
| | | Flood extent | - | - | No | |
| | | **Total** | - | - | **No** | |

### *7.3 Thames Middle Detailed Impact Assessment*

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Thames Middle | Negative Impact Identified | X | ✔ | Significant positive impact identified |
| **Water Body ID** | GB530603911402 | Positive impact Identified | √ | ✔ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | River Bank Enhancement | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | Waterworks river ( F); River Lea (G) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

| **River Bank Enhancement** | | | | | | **Length: 4.2km** |
|---|---|---|---|---|---|---|
| **WFD objective** | **Description of impact** | **Parameter** | **X** | **√** | **Residual impact** | **References** |
| | **Water Use Elements** | | | | | • Atkins, Olympic Park Infrastructure Design, Geomorphological Assessment and Monitoring, Phase 1: Lower River Lee Fluvial Audit, 24 November 2008.<br>• Atkins, London 2012 Parkland & Public Realm Geomorphological Assessment and Monitoring: Phase 2: Post-impoundment fluvial audit, ODA reference REP-ATK-CW-ZZZ-WAT-ZZZ-Z-0021, 23 February 2010<br>• Atkins, Delivering wetland biodiversity in the London 2012 Olympic Park, In Practice – Bulletin of the Institute of Ecology of Environmental Management, December 2010.<br>• Atkins, London 2012 Parkland and Public Realm Technical Note: River Level Analysis, June 2009<br>• Atkins, Olympic Park Infrastructure Design In-bank Water Level Regime, June 2008<br>• ODA, Lessons learned from the London 2012 Games construction project: Promoting biodiversity in the Olympic Parklands, 2012<br>• ODA Olympic Park Biodiversity Action Plan, PDT Submission, October 2008.<br>• ODA: The Olympic Park – Towards a 10 Year Landscape Management and Maintenance Plan, February 2010.<br>• Buro Happold, Wetland Bowl – Engineering Design Criteria, July 2007<br>• EDAW Consortium, Olympic Park and Site Wide Infrastructure London 2012 Parklands and Public Realm: Olympic Bowl Options Study, Wetland Bowl Planting Table Revised, August 2008<br>• EDAW Consortium, Olympic Park and Site Wide Infrastructure London 2012 Parklands and Public Realm: Olympic Bowl Options Study, ODA Reference REP-EDW-AL-ZZZ-OLP-ZZZ-Z-0006 V1.0 August 2007<br>• EDAW Consortium, Olympic Park and Site Wide Infrastructure London 2012 Parklands and Public Realm: Channelsea Gorge and Bully Point Wetlands Options Study, ODA Reference REP-EDW-AL-ZZZ-OLP-ZZZ-Z-0007 V2.00, August 2007<br>• ODA London Learning Legacy: Translocation of habitats and species within the Olympic Park, December 2011<br>• ODA, Volume 12D - Environmental Statement Part 3 – Topic Environmental Assessments OLY-GLB-ACC-DOC-ENV-01D – Environmental Statement |
| **Sustainable water use** | - | Potable water demand | - | - | No | |
| | | Non-potable water demand | - | - | No | |
| | | **Total** | - | - | **No** | |
| | **Biological indicators** | | | | | |
| **Habitat and Species** | X - Potential for colonisation by invasive species.<br><br>√ - River Lea 2km enhancements; Waterworks River 2.2km. Mature vegetation planted to increase rate of bank consolidation and reduce risk of invasive species.<br><br>√ - Increased connectivity between riparian habitat, marginal vegetation and aquatic habitat.<br><br>√ - Soft banks provide spawning grounds and essential habitat for invertebrates. | Phytoplankton | - | - | No | |
| | | Macroalgae | - | √ | √ | |
| | | Benthic Invertebrates | - | √ | √ | |
| | | Fish (Transitional) | - | √ | √ | |
| | | **Total** | - | √ | √ | |
| | **Hydromorphology** | | | | | |
| | X - Naturalisation increases the potential for sediment to be generated via channel bank erosion banks as a result of an increase in the surface area of naturalised reaches.<br><br>√ - Riparian planting does help to trap silt from greenfield runoff.<br><br>√ - Increase in geomorphological diversity through channel cross section, planform type, bank type and flow variation along the river.<br><br>√ - Banks stabilised through planting of mature vegetation to reduce erosion. Stream power and velocity very low and sediment deposition high so the risk of erosion of the new soft bank is low under normal flow conditions. | Depth variation | - | - | No | |
| | | Quantity, structure and substrate of estuarine bed | X | √ | √ Net | |
| | | Structure of the intertidal zone | - | - | No | |
| | | **Total** | **X** | **√** | **√ Net** | |
| | **Supporting Elements** | | | | | |
| **Water Quality** | X - None identified<br><br>√ - Vegetation can intercept and utilise nutrients from surface runoff and prevent eutrophication of the waterway which may have a marginal positive impact on DO levels as well as phosphate and nitrate concentration | Dissolved Oxygen | - | √ | √ | |
| | | **Total** | - | √ | √ | |
| | **Chemical Elements** | | | | | |
| | X - Naturalisation of banks may create preferential pathways to surface water receptors from contaminated soil and groundwater. Potential negative impact from migration of contaminated shallow groundwater. Litter may get caught in marginal vegetation.<br><br>√ - Marginal planting will improve downstream water quality though the removal of contaminants in the water. Litter issues addressed in the draft 10-year Landscape Management and Maintenance Plan for the QEOP. | Annex VIII Pollutants | X | √ | **No Net** | |
| | | **Total** | **X** | **√** | **No Net** | |
| | **Flood Elements** | | | | | |
| **Flooding** | X - Potential increase in flood extent due to removal of hard defences.<br><br>√ - Increase in storage area and changes in river edges accounted for in flood model to ensure no residual impact. | Flood hazard | - | √ | No | |
| | | Flood extent | X | √ | No | |
| | | **Total** | **X** | √ | **No** | |

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Thames Middle | Negative Impact Identified | X | ✓ | Significant positive impact identified |
| **Water Body ID** | GB530603911402 | Positive impact Identified | √ | ✓ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Channel Widening (Including river wall replacement) | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | Waterworks river ( F); River Lea (G) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

## Channel Widening (Including river wall replacement)

**Length: 1km**

| WFD objective | Description of Impact | Parameter | X | √ | Residual impact | References |
|---|---|---|---|---|---|---|
| **Sustainable water use** | **Water Use Elements** | | | | | • ODA, Volume 12D - Environmental Statement Part 3 – Topic Environmental Assessments Ref: OLY/GLB/ACC/DOC/ENV/01D – Environmental Statement<br>• LDA, Planning Explanatory Statement: River Wall Works and Associated Remediation, land along alignment of Waterworks River, Stratford, London, June 2006<br>• LDA, Appendix C: Flood Risk Assessment River Wall Works and Associated Remediation, land along alignment of Waterworks River, Stratford, London, June 2006<br>• LDA, Site Specific Remediation Strategy for Waterworks River (Carpenters Road) River Wall (Construction Zone 1a), June 2006<br>• Atkins, London 2012 Parkland & Public Realm Geomorphological Assessment and Monitoring: Phase 2: Post-impoundment fluvial audit, ODA reference REP-ATK-CW-ZZZ-WAT-ZZZ-Z-0021, 23 February 2010<br>• Atkins, Olympic Park Infrastructure Design, Geomorphological Assessment and Monitoring, Phase 1: Lower River Lee Fluvial Audit, 24 November 2008.<br>• AINA: Management Strategies and Mitigation Measures for the Inland Navigation Sector in Relation to Ecological Potential for Inland Waterways – Appendix A, Pressures and Impact Sheets, March 2008<br>• AINA: Management Strategies and Mitigation Measures for the Inland Navigation Sector in Relation to Ecological Potential for Inland Waterways – Appendix B, Mitigation Measures and Management Strategies Sheets, March 2008 |
| | - | Potable water demand | - | - | No | |
| | | Non-potable water demand | - | - | No | |
| | | **Total** | - | - | **No** | |
| **Habitat and Species** | **Biological indicators** | | | | | |
| | X - No loss of riparian habitat: the river wall that was previously in place was identified as being of low ecological value. No change from soft bank to hard bank.<br>√ - Channel widening on the the Waterworks River over 600m and 400m over the river Lea. Mitigation measures including new riparian habitat provided as part of channel widening work in conjunction with the new river wall.<br>√ - Increase in bankside and channel habitat through a 5m wide terrace sloping into the waterway with marginal planting providing a habitat of variable depth. | Phytoplankton | - | - | No | |
| | | Macroalgae | X | - | No Net | |
| | | Benthic Invertebrates | X | √ | √ Net | |
| | | Fish (Transitional) | X | - | No Net | |
| | | **Total** | **X** | **√** | **√ Net** | |
| | **Hydromorphology** | | | | | |
| | X - No loss of hydromorphological diversity ; waterway previously straight , modified trapezoidal uniform shape.<br>X - The increase in channel width will potentially reduce flow velocities which in turn will increase sedimentation. However the reduction in stream power is not deemed to be significant.<br>X - There is also the potential for destabilisation of deposited sediments, which would lead to further remobilisation and deposition of fine sediments.<br>√ - Increased variation in channel edges through a 5m habitat terrace sloping into the waterway. | Depth variation | - | - | No | |
| | | Quantity, structure and substrate of estuarine bed | X | √ | No Net | |
| | | Structure of the intertidal zone | - | - | No | |
| | | **Total** | **X** | **√** | **No Net** | |
| **Water Quality** | **Supporting Elements** | | | | | |
| | X - Risk of re-suspension of riverbed sediments, with potentially high BOD. However this is not expected to be have a significant impact on water body DO level. | Dissolved Oxygen | X | - | X | |
| | | **Total** | **X** | - | **X** | |
| | **Chemical Elements** | | | | | |
| | X - Potential spread of contamination to Waterworks River due to water flow through contaminated soil.<br>X - Risk of re-suspension of riverbed sediments, potentially with high contaminant load.<br>√ - Old river wall retained below river bed level to attenuate groundwater flow. New sheet pile wall further reduces groundwater flow and controls the direct pathway. | Annex VIII Pollutants | X | - | X | |
| | | **Total** | **X** | - | **X** | |
| **Flooding** | **Flood Elements** | | | | | |
| | X - Potential for new river wall to exacerbate flooding elsewhere.<br>√ -Structure included in subsequent flood models to ensure no negative impact on flood extent or hazard.<br>√ - The 8m set-back from existing alignment of the replacement defences provides additional channel conveyance capacity in the Waterworks River, and thus a reduction in flooding extent and depth at the edge of the floodplain. | Flood hazard | - | √ | √ | |
| | | Flood extent | - | √ | √ | |
| | | **Total** | - | √ | √ | |

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Thames Middle | Negative Impact Identified | X | ✔ | Significant positive impact identified |
| **Water Body ID** | GB530603911402 | Positive impact Identified | √ | ✔ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Dredging | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | Waterworks river ( F); River Lea (G) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

**Dredging** — **Volume: Approx. 25,000-30,000 m3**

| WFD objective | Description of Impact | Parameter | X | √ | Residual impact |
|---|---|---|---|---|---|
| **Sustainable water use** | **Water Use Elements** | | | | |
| | - | Potable water demand | - | - | No |
| | | Non-potable water demand | - | - | No |
| | | **Total** | - | - | **No** |
| **Habitat and Species** | **Biological indicators** | | | | |
| | X - Direct loss of habitat, especially for benthic species and submerged macrophytes.<br><br>X - Habitats downstream can be destroyed and the mortality of fish and invertebrates can increase due to the re-suspension of fine sediment. Suspended sediments can directly affect fish's respiratory systems and feeding success as well as smother spawning grounds and fish fry.<br><br>√ - Dredging was conducted outside fish spawning season to reduce impact on aquatic fauna. | Phytoplankton | - | - | No |
| | | Macroalgae | X | - | X |
| | | Benthic Invertebrates | X | - | X |
| | | Fish (Transitional) | X | √ | X Net |
| | | **Total** | X | √ | X Net |
| | **Hydromorphology** | | | | |
| | X - High risk of increased future siltation due to high sediment load, low stream power and reduced bed stability.<br><br>X - Dredging can destabilise naturalised banks by compromising fixing points of pre-planted coir rolls and through bankside erosion. The water body is heavily modified and no significant change in general channel profile is deemed to have occurred.<br><br>X - Destabilisation of existing channel bed and sediment deposits can also cause remobilisation of sediment and downstream deposition.<br><br>√ - Dredging was conducted from a float to avoid bank-side damage.<br><br>√ - Low-impact dredging techniques employed to minimise impact on siltation.<br><br>√ - Dredging contemporarily increases the under keel clearance which reduces re-suspension of channel bed sediments, turbidity and associated negative impacts. | Depth variation | X | - | X |
| | | Quantity, structure and substrate of estuarine bed | X | - | X |
| | | Structure of the intertidal zone | X | √ | X Net |
| | | **Total** | X | √ | **X Net** |
| **Water Quality** | **Supporting Elements** | | | | |
| | X - Transfer of fine sediment, with potentially high BOD downstream, potentially negatively affecting DO.<br><br>√ - Dredging leads to a reduction of excessive nutrients within the dredged sediments leading to less eutrophication and higher DO. | Dissolved Oxygen | X | √ | No Net |
| | | **Total** | X | √ | **No Net** |
| | **Chemical Elements** | | | | |
| | X - Transfer of fine sediment and identified associated contaminants – oils and heavy metals – downstream. Leaching of contaminants to water column through re-suspension of sediments.<br><br>√ - Dredging leads to a reduction of excessive nutrients and removed contaminants within the dredged sediments. Contaminated sediments bioremediated off-site to avoid re-contamination.<br><br>√ - Reduced re-suspension through increased under keel clearance reduces the risk for contaminant leaching to the water column. | Annex VIII Pollutants | X | √ | √ Net |
| | | **Total** | X | √ | **√ Net** |

**References**

- Atkins, London 2012 Parkland & Public Realm Geomorphological Assessment and Monitoring: Phase 2: Post-impoundment fluvial audit, ODA reference REP-ATK-CW-ZZZ-WAT-ZZZ-Z-0021, 23 February 2010
- Atkins, Olympic Park Infrastructure Design, Geomorphological Assessment and Monitoring, Phase 1: Lower River Lee Fluvial Audit, 24 November 2008.
- AINA: Management Strategies and Mitigation Measures for the Inland Navigation Sector in Relation to Ecological Potential for Inland Waterways – Appendix A, Pressures and Impact Sheets, March 2008
- AINA: Management Strategies and Mitigation Measures for the Inland Navigation Sector in Relation to Ecological Potential for Inland Waterways – Appendix B, Mitigation Measures and Management Strategies Sheets, March 2008

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Thames Middle | Negative Impact Identified | X | ✓ | Significant positive impact identified |
| **Water Body ID** | GB530603911402 | Positive impact Identified | √ | ✓ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Flooding | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | Waterworks river ( F); River Lea (G) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

**Dredging**

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Flood Elements** | | | | | **References** |
| **Flooding** | X - Future silt deposition can compromise flood conveyance capacity.<br><br>X - Dredging could reduce passive pressure on river walls and reduce bank stability and therefore protection provided.<br><br>√ - Dredging increases conveyance and reduces flood extent and hazard both locally and elsewhere.<br><br>√ - Canal and River Trust dredging management plans are in place to maintain necessary flood risk design standard. | Flood hazard | X | √ | No Net | |
| | | Flood extent | X | √ | No Net | |
| | | **Total** | X | √ | **No Net** | |

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Thames Middle | Negative Impact Identified | X | ✔ | Significant positive impact identified |
| **Water Body ID** | GB530603911402 | Positive impact Identified | √ | ✔ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Floating Navigation Pontoons | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | Waterworks River (F ) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

**Floating Navigation Pontoons** — **Total Length: Approx. 200m**

| WFD objective | Description of Impact | Parameter | X | √ | Residual impact | References |
|---|---|---|---|---|---|---|
| **Sustainable water use** | **Water Use Elements** | | | | | • OPLC, H08 Replacement Study, General Arrangement, October 2011<br>• Buro Happold, U13U14 photo H08 Link replacement – proposed, October 2011<br>• ODA, North Park Legacy Transformation E06 to H01 Footpath/MTB trail Option 2 Boardwalk, drawing no. 0241-LCI WCW-C-DDE-0006 Draft, February 2011<br>• OPLC, Towpath Under Carpenters Road Feasibility Study Brief, 11 October 2011<br>• AINA: Management Strategies and Mitigation Measures for the Inland Navigation Sector in Relation to Ecological Potential for Inland Waterways – Appendix A, Pressures and Impact Sheets, March 2008 |
| | - | Potable water demand | - | - | No | |
| | | Non-potable water demand | - | - | No | |
| | | **Total** | - | - | **No** | |
| **Habitat and Species** | **Biological indicators** | | | | | |
| | X - Increase in navigation may result in an increase in disruption of species utilising the waterway, including loss of marginal vegetation and transfer and establishment of invasive species.<br><br>√ - Increase in disruption likely to be insignificant on a water body scale. Piles for foundations and pontoons provide refuge for fish and invertebrates as well as providing potential growth areas for macrophytes. Pontoons also protect soft banks from wash erosion through dissipating wave energy. | Phytoplankton | - | - | No | |
| | | Macroalgae | X | √ | No Net | |
| | | Benthic Invertebrates | X | √ | No Net | |
| | | Fish (Transitional) | X | √ | No Net | |
| | | **Total** | **X** | **√** | **No Net** | |
| | **Hydromorphology** | | | | | |
| | X – Risk of wash erosion and subsequent associated sediment deposition due to waterway traffic, especially in naturalised reaches. Turbulence caused by hull passage and propeller action can disturb sediments, and high magnitude, short duration turbidity spikes can occur due to boat movement.<br><br>√ - Speed limit of 4 mph. Floating pontoons reduce the impact of boat movement on bank erosion. Ship Impact piles ( SPI metal piles) installed along Waterworks River to protect marginal planting from direct impact and reduce scour.<br><br>√ - Pontoons installed away from bank to minise on bank. | Depth variation | - | - | No | |
| | | Quantity, structure and substrate of estuarine bed | X | √ | No Net | |
| | | Structure of the intertidal zone | X | √ | No Net | |
| | | **Total** | **X** | **√** | **No Net** | |
| **Water Quality** | **Supporting Elements** | | | | | |
| | X - None identified.<br><br>√ - None identified | Dissolved Oxygen | - | - | No | |
| | | **Total** | **-** | **-** | **No** | |
| | **Chemical Elements** | | | | | |
| | X - Potential increasing concentration of oils and fuels as well as leaching of tributyltin from hull paint due to an increase in boat traffic and potential re-suspension of sediments.<br><br>√ - Tributyltin in paint banned in 2008. Increase in boat traffic unlikely to cause significant change in oil and fuel spills. Dredging considered separately with regards to removal of contaminated sediments but is likely to have a positive impact. | Annex VIII Pollutants | X | √ | No Net | |
| | | **Total** | **X** | **√** | **No Net** | |
| **Flooding** | **Flood Elements** | | | | | |
| | X - Pontoons can reduce conveyance of the channel under flood conditions and increase the risk of bank overtopping or flood extent elsewhere in the catchment.<br><br>√ - Pontoons included in flood risk assessment for the site to ensure no negative impact on flood hazard or extent. | Flood hazard | - | √ | No Net | |
| | | Flood extent | - | √ | No Net | |
| | | **Total** | **-** | **√** | **No Net** | |

| Water Body Name | Thames Middle | Negative Impact Identified | X | ✓ | Significant positive impact identified |
|---|---|---|---|---|---|
| Water Body ID | GB530603911402 | Positive impact Identified | √ | ✓ | Slight positive impact identified with regard to water quality elements |
| Water Body Designation | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| Current Potential | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| Works Assessed | F10B New Bridge | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| Location(s) | Waterworks River (F ) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

| F10B New Bridge | | | | | Units: 1 Nr | |
|---|---|---|---|---|---|---|
| **WFD objective** | **Description of Impact** | **Parameter** | **X** | **√** | **Residual impact** | **References** |
| **Sustainable water use** | **Water Use Elements** | | | | | • OPLC, H08 Replacement Study, General Arrangement, October 2011<br>• Buro Happold, U13U14 photo H08 Link replacement – proposed, October 2011<br>• ODA, North Park Legacy Transformation E06 to H01 Footpath/MTB trail Option 2 Boardwalk, drawing no. 0241-LCI WCW-C-DDE-0006 Draft, February 2011<br>• OPLC, Towpath Under Carpenters Road Feasibility Study Brief, 11 October 2011<br>• AINA: Management Strategies and Mitigation Measures for the Inland Navigation Sector in Relation to Ecological Potential for Inland Waterways – Appendix A, Pressures and Impact Sheets, March 2008 |
| | - | Potable water demand | - | - | No | |
| | | Non-potable water demand | - | - | No | |
| | | **Total** | - | - | **No** | |
| **Habitat and Species** | **Biological indicators** | | | | | |
| | X - No sensitive habitats affected by the bridge have been identified. Land take for supports in waterway not considered significant on a water body scale.<br>√ - Support in waterway provide refuge for fish an invertebrates and potential growth areas for macrophytes. | Phytoplankton | - | - | No | |
| | | Macroalgae | X | √ | No Net | |
| | | Benthic Invertebrates | X | √ | No Net | |
| | | Fish (Transitional) | X | √ | No Net | |
| | | **Total** | **X** | **√** | **No Net** | |
| | **Hydromorphology** | | | | | |
| | X - Piling in waterway might change channel hydraulics leading to erosion and accretion of sediments and disturbance to benthic communities.<br>√ - Low flow velocities likely to limit the extent of erosion under normal flow conditions. Disturbance of benthic communities will be localised and temporary and not significant on a water body scale. | Depth variation | - | - | No | |
| | | Quantity, structure and substrate of estuarine bed | X | √ | No Net | |
| | | Structure of the intertidal zone | X | √ | No Net | |
| | | **Total** | **X** | **√** | **No Net** | |
| **Water Quality** | **Supporting Elements** | | | | | |
| | X - None identified.<br>√ - None identified | Dissolved Oxygen | - | - | No | |
| | | **Total** | - | - | **No** | |
| | **Chemical Elements** | | | | | |
| | X - None identified.<br>√ - None identified | Annex VIII Pollutants | - | - | No | |
| | | **Total** | - | - | **No** | |
| **Flooding** | **Flood Elements** | | | | | |
| | X - Reduced conveyance in flood conditions.<br>√ - Park-wide flood model to be updated and will include all new and proposed works.<br>√ - Pier in line with the flow which minises the hydraulic disruption. | Flood hazard | X | √ | No Net | |
| | | Flood extent | X | √ | No Net | |
| | | **Total** | **X** | **√** | **No Net** | |

| Water Body Name | Thames Middle | Negative Impact Identified | X | ✓ | Significant positive impact identified |
|---|---|---|---|---|---|
| Water Body ID | GB530603911402 | Positive impact Identified | √ | ✓ | Slight positive impact identified with regard to water quality elements |
| Water Body Designation | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| Current Potential | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| Works Assessed | Walkway with support in waterway | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| Location(s) | River Lea (G) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

**Walkway with support in waterway** — **Length: Approx. 250m**

| WFD objective | Description of Impact | Parameter | X | √ | Residual impact |
|---|---|---|---|---|---|
| Sustainable water use | **Water Use Elements** | | | | |
| | - | Potable water demand | - | - | No |
| | | Non-potable water demand | - | - | No |
| | | Total | - | - | **No** |
| Habitat and Species | **Biological indicators** | | | | |
| | X - No sensitive habitats affected by the walkway have been identified. Land take for supports in waterway not considered significant on a water body scale.<br>√ - Support in waterway provide refuge for fish an invertebrates and potential growth areas for macrophytes. Walkway 3m wide to ensure limited encroachment on waterway width. | Phytoplankton | - | - | No |
| | | Macroalgae | X | √ | No Net |
| | | Benthic Invertebrates | X | √ | No Net |
| | | Fish (Transitional) | X | √ | No Net |
| | | Total | X | √ | **No Net** |
| | **Hydromorphology** | | | | |
| | X - Piling in waterway might change channel hydraulics leading to erosion and accretion of sediments and disturbance to benthic communities.<br>√ - Low flow velocities likely to limit the extent of erosion under normal flow conditions. Disturbance of benthic communities will be localised and temporary and not significant on a water body scale. | Depth variation | - | - | No |
| | | Quantity, structure and substrate of estuarine bed | X | √ | No Net |
| | | Structure of the intertidal zone | X | √ | No Net |
| | | Total | X | √ | **No Net** |
| Water Quality | **Supporting Elements** | | | | |
| | X - None identified.<br>√ - None identified | Dissolved Oxygen | - | - | No |
| | | Total | - | - | **No** |
| | **Chemical Elements** | | | | |
| | X - Runoff from walkway is not likely to result in a change in water quality.<br>√ - None identified | Annex VIII Pollutants | - | - | No |
| | | Total | - | - | **No** |
| Flooding | **Flood Elements** | | | | |
| | X - Reduced conveyance in flood conditions.<br>√ - Park-wide flood model to be updated and will include all new and proposed works. | Flood hazard | X | √ | No Net |
| | | Flood extent | X | √ | No Net |
| | | Total | X | √ | **No Net** |

**References**

- OPLC, H08 Replacement Study, General Arrangement, October 2011
- Buro Happold, U13U14 photo H08 Link replacement – proposed, October 2011
- ODA, North Park Legacy Transformation E06 to H01 Footpath/MTB trail Option 2 Boardwalk, drawing no. 0241-LCI WCW-C-DDE-0006 Draft, February 2011
- OPLC, Towpath Under Carpenters Road Feasibility Study Brief, 11 October 2011
- AINA: Management Strategies and Mitigation Measures for the Inland Navigation Sector in Relation to Ecological Potential for Inland Waterways – Appendix A, Pressures and Impact Sheets, March 2008

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Thames Middle | Negative Impact Identified | X | ✓ | Significant positive impact identified |
| **Water Body ID** | GB530603911402 | Positive impact Identified | √ | ✓ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Emergency Access Boat Platforms | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | River Lea (G) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

**Emergency Access Boat Platforms** — **Unit: 3 Nr**

| WFD objective | Description of Impact | Parameter | X | √ | Residual impact |
|---|---|---|---|---|---|
| **Sustainable water use** | **Water Use Elements** | | | | |
| | - | Potable water demand | - | - | No |
| | | Non-potable water demand | - | - | No |
| | | **Total** | - | - | **No** |
| **Habitat and Species** | **Biological indicators** | | | | |
| | X - Increase in navigation may result in an increase in disruption of species utilising the waterway, including loss of marginal vegetation and transfer and establishment of invasive species.<br><br>√ - Increase in disruption likely to be insignificant on a water body scale. Piles for foundations provide refuge for fish and invertebrates as well as providing potential growth areas for macrophytes. Platforms also protect soft banks from wash erosion through dissipating wave energy. | Phytoplankton | - | - | No |
| | | Macroalgae | X | √ | No Net |
| | | Benthic Invertebrates | X | √ | No Net |
| | | Fish (Transitional) | X | √ | No Net |
| | | **Total** | X | √ | **No Net** |
| | **Hydromorphology** | | | | |
| | X – Risk of wash erosion and subsequent associated sediment deposition due to waterway traffic, especially in naturalised reaches. Turbulence caused by hull passage and propeller action can disturb sediments, and high magnitude, short duration turbidity spikes can occur due to boat movement.<br><br>√ - Speed limit of 4 mph. Platforms are only 2-3m wide and expected to have close to no impact on a waterbody scale SPI (metal piles) installed along Waterworks River to protect marginal planting from direct impact and reduce scour. | Depth variation | - | - | No |
| | | Quantity, structure and substrate of estuarine bed | X | √ | No Net |
| | | Structure of the intertidal zone | X | √ | No Net |
| | | **Total** | X | √ | **No Net** |
| **Water Quality** | **Supporting Elements** | | | | |
| | X - None identified.<br><br>√ - None identified | Dissolved Oxygen | - | - | No |
| | | **Total** | - | - | **No** |
| | **Chemical Elements** | | | | |
| | X - Potential increasing concentration of oils and fuels as well as leaching of tributyltin from hull paint due to an increase in boat traffic and potential re-suspension of sediments.<br><br>√ - Tributyltin in paint banned in 2008. Increase in boat traffic unlikely to cause significant change in oil and fuel spills. Dredging considered separately with regards to removal of contaminated sediments but is likely to have a positive impact. | Annex VIII Pollutants | X | √ | No Net |
| | | **Total** | X | √ | **No Net** |
| **Flooding** | **Flood Elements** | | | | |
| | X - Platforms can reduce conveyance of the channel under flood conditions and increase the risk of bank overtopping or flood extent elsewhere in the catchment.<br><br>√ - Platforms included in flood risk assessment for the site to ensure no negative impact on flood hazard or extent. | Flood hazard | X | √ | No Net |
| | | Flood extent | - | √ | No Net |
| | | **Total** | X | √ | **No Net** |

**References**

- Lower Lea Valley Olympic Applications, Environmental Statement Part 3, Chapter 16-18. Surface Water.
- Atkins, Olympic Park Infrastructure Design, Geomorphological Assessment and Monitoring, Phase 1: Lower River Lee Fluvial Audit, 24 November 2008.
- Atkins, London 2012 Parkland & Public Realm Geomorphological Assessment and Monitoring: Phase 2: Post-impoundment fluvial audit, ODA reference REP-ATK-CW-ZZZ-WAT-ZZZ-Z-0021, 23 February 2010
- British Waterways, River Lea North Park Emergency Access Platforms – 001, Drawing, 8 February 2012.
- British Waterways, River Lea Emergency Access Proposed, Study area, 8 February 2012.
- British Waterways, Scheme 2 Emergency Exit, Drawing ref. INT09_047-001-11 F, 31 October 2011.
- British Waterways, Scheme 2 General Arrangement Drawing ref. INT09_047-002-02 F, 31 October 2011.
- British Waterways, Bridge General Arrangement Drawing ref. INT09_047-002-04 F, 31 October 2011.
- British Waterways, General Arrangement Drawing ref. INT09_047-002-09 F, 31 October 2011.
- British Waterways, Section view Scheme 2 Drawing ref. INT09_047-002-10 F, 31 October 2011.
- AINA: Management Strategies and Mitigation Measures for the Inland Navigation Sector in Relation to Ecological Potential for Inland Waterways – Appendix A, Pressures and Impact Sheets, March 2008
- AINA: Management Strategies and Mitigation Measures for the Inland Navigation Sector in Relation to Ecological Potential for Inland Waterways – Appendix B, Mitigation Measures and Management Strategies Sheets, March 2008

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Thames Middle | Negative Impact Identified | X | ✔ | Significant positive impact identified |
| **Water Body ID** | GB530603911402 | Positive impact Identified | √ | ✔ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Wetland creation | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | River Lea (G ), Channelsea Gorge (J) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

## Wetland creation

**New Reed Bed Area: 5,000 m2 ; New pond area: 2,000 m2 (3Nr)**

| WFD objective | Description of impact | Parameter | X | √ | Residual impact | References |
|---|---|---|---|---|---|---|
| | **Water Use Elements** | | | | | • Atkins, Olympic Park Infrastructure Design, Geomorphological Assessment and Monitoring, Phase 1: Lower River Lee Fluvial Audit, 24 November 2008.<br>• Atkins, London 2012 Parkland & Public Realm Geomorphological Assessment and Monitoring: Phase 2: Post-impoundment fluvial audit, ODA reference REP-ATK-CW-ZZZ-WAT-ZZZ-Z-0021, 23 February 2010<br>• Atkins, Delivering wetland biodiversity in the London 2012 Olympic Park, In Practice – Bulletin of the Institute of Ecology of Environmental Management, December 2010.<br>• Atkins, London 2012 Parkland and Public Realm Technical Note: River Level Analysis, June 2009<br>• Atkins, Olympic Park Infrastructure Design In-bank Water Level Regime, June 2008<br>• ODA, Lessons learned from the London 2012 Games construction project: Promoting biodiversity in the Olympic Parklands, 2012<br>• ODA Olympic Park Biodiversity Action Plan, PDT Submission, October 2008.<br>• ODA: The Olympic Park – Towards a 10 Year Landscape Management and Maintenance Plan, February 2010.<br>• Buro Happold, Wetland Bowl – Engineering Design Criteria, July 2007<br>• EDAW Consortium, Olympic Park and Site Wide Infrastructure London 2012 Parklands and Public Realm: Olympic Bowl Options Study, Wetland Bowl Planting Table Revised, August 2008<br>• EDAW Consortium, Olympic Park and Site Wide Infrastructure London 2012 Parklands and Public Realm: Olympic Bowl Options Study, ODA Reference REP-EDW-AL-ZZZ-OLP-ZZZ-Z-0006 V1.0 August 2007<br>• EDAW Consortium, Olympic Park and Site Wide Infrastructure London 2012 Parklands and Public Realm: Channelsea Gorge and Bully Point Wetlands Options Study, ODA Reference REP-EDW-AL-ZZZ-OLP-ZZZ-Z-0007 V2.00, August 2007<br>• ODA London Learning Legacy: Translocation of habitats and species within the Olympic Park, December 2011<br>• ODA, Volume 12D - Environmental Statement Part 3 – Topic Environmental Assessments OLY-GLB-ACC-DOC-ENV-01D – Environmental Statement |
| **Sustainable water use** | - | Potable water demand | - | - | No | |
| | | Non-potable water demand | - | - | No | |
| | | **Total** | - | - | **No** | |
| | **Biological indicators** | | | | | |
| **Habitat and Species** | √ - New reed bed habitat of over 5,000m$^2$, mainly planted with Common reed Phragmites australis, as part of 2.3 ha wetland (BAP habitat).<br><br>√ - The wetlands provide spawning areas and refuge for fish during periods of high flow, including eel Angulia Angulia, (London 2012 BAP priority species).<br><br>√ - Wetland channels also provide feeding areas for waterfowl.<br><br>√ - 2.5km soft bank planted with wetland species to provide ecological connectivity between the Wetland Bowl and Bully Point. These include potential habitats for water vole.<br><br>√ - At Bully Point, two new wet woodlands, totalling 0.4ha provide off main river habitat. Shallow depressions hold standing water to provide a range of moisture gradients.<br><br>√ - 40 wetland plant species (approximately 300,000 wetland plants in total) were selected to cope with a daily fluctuating water level of up to 1500mm. Water plants were also chosen to withstand submergence, dredging, siltation and access.<br><br>√ - Three new ponds, summing to 0.2 ha, are also included. Log walls alongside the ponds provide invertebrate habitats, with plants providing egg-laying sites for newts.<br><br>√ - Artificial nesting sites for kingfisher and sand martin adjacent to wetland habitats link nesting and necessary feeding locations.<br><br>√ - A draft 10-year Landscape Management and Maintenance Plan for the QEOP was developed to ensure Reed Beds are periodically managed and do not experience gradual drying out, colonisation of scrub or gradual succession towards woodlands.<br><br>√ - Within the reed beds, sinuous channels have been designed to provide backwater habitat for fish. These channels add habitat complexity and maximise reed edge extent. | Phytoplankton | - | - | No | |
| | | Macroalgae | - | √ | √ | |
| | | Benthic Invertebrates | - | √ | √ | |
| | | Fish (Transitional) | - | √ | √ | |
| | | **Total** | - | √ | √ | |
| | **Hydromorphology** | | | | | |
| | X - The development of two wetlands and naturalisation of river edges in the River Lee increases the potential for sediment to be generated via channel bank erosion during construction. Sediment build-up is likely in the wetlands as stream power is low and sediment supply is high.<br><br>√ - Hazel fascines are in place in order to protect the wetland channel banks from the risk of increased sediment delivery caused by the increased surface area of new banks. In addition, they afford stability to the design of the channel network.<br><br>√ - Wetland Bowl online reed beds are in direct hydrological connectivity to the river Lea. Bully Point wet woodlands located off main river, with excavated channels, maintain hydrological and ecological connectivity with the River Lee.<br><br>√ - The three new amphibian ponds, 0.2 ha in total, are fed by drainage waters from the Park's concourse. The largest pond is designed with an adjustable feed from the River Lee to help maintain a permanent water level.<br><br>√ - The wetland, wet woodland and pond areas increase the geomorphological diversity through channel cross section, platform type, bank type and flow variation along the river. | Depth variation | - | √ | √ Net | |
| | | Quantity, structure and substrate of estuarine bed | X | √ | √ Net | |
| | | Structure of the intertidal zone | - | - | - | |
| | | **Total** | X | √ | **√ Net** | |

`

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Thames Middle | Negative Impact Identified | X | ✔ | Significant positive impact identified |
| **Water Body ID** | GB530603911402 | Positive impact Identified | √ | ✔ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Wetland creation | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | River Lea, Bully Point Wetlands | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

## Wetland creation

| **WFD objective** | **Description of impact** | **Parameter** | **X** | **√** | **Residual impact** | **References** |
|---|---|---|---|---|---|---|
| **Water Quality** | **Supporting Elements** | | | | | |
| | X - None identified<br><br>√ - Oxygenating submerged aquatics, e.g. rigid hornwort Ceratophyllum demersum, were included in the planting scheme to improve DO levels. | Dissolved Oxygen | - | √ | - | |
| | | **Total** | - | √ | - | |
| | **Chemical Elements** | | | | | |
| | X - Naturalisation of banks include the risk of creation of preferential pathways to surface water receptors from contaminated soil and groundwater. Potential negative impact from migration of contaminated shallow groundwater.<br>Litter deposition due to low stream power and trapping by vegetation can cause local contamination.<br><br>√ - Wetlands and marginal planting will improve downstream water quality though the removal of contaminants in the water. Litter issues addressed in the draft 10-year Landscape Management and Maintenance Plan for the QEOP. | Annex VIII Pollutants | X | √ | No net | |
| | | **Total** | X | √ | **No Net** | |
| **Flooding** | **Flood Elements** | | | | | |
| | X - None identified.<br><br>√ - An increase in flood storage volume of 50,000m³ obtained in the wetland bowl, totalling a capacity of approximately 80,000m³ for the 1 in 100 year event with an allowance for possible future climate change. | Flood hazard | - | √ | √ | |
| | | Flood extent | - | √ | √ | |
| | | **Total** | - | √ | √ | |

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Thames Middle | Negative Impact Identified | X | ✓ | Significant positive impact identified |
| **Water Body ID** | GB530603911402 | Positive impact Identified | √ | ✓ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Channelsea Gorge Culverting | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | Channelsea Gorge (J ) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

## Channelsea Gorge Culverting

**Length: Approximately 400m**

| WFD objective | Description of impact | Parameter | X | √ | Residual impact |
|---|---|---|---|---|---|
| | **Water Use Elements** | | | | |
| **Sustainable water use** | - | Potable water demand | - | - | No |
| | | Non-potable water demand | - | - | No |
| | | **Total** | - | - | **No** |
| | **Biological indicators** | | | | |
| **Habitat and Species** | X - The loss of approximately 400 m of Channelsea Gorge meant the loss of habitat for fish and some loss of marginal vegetation. Channelsea Gorge had a homogenous channel and bed sediment structure and was of low aquatic ecological value. The loss of habitat is not significant on a water body scale.<br><br>√ - The loss of fish was minimised through relocation of fish to adjacent water courses prior to culverting construction.<br><br>√ - Channelsea Gorge was planted over with species rich grassland, trees and scrubs. | Phytoplankton | - | - | No |
| | | Macroalgae | X | √ | X Net |
| | | Benthic Invertebrates | X | - | X Net |
| | | Fish (Transitional) | X | √ | X Net |
| | | **Total** | **X** | **√** | **X Net** |
| | **Hydromorphology** | | | | |
| | X - Loss of approximately 400 m of Channelsea River - Channelsea Gorge had a homogenous channel and bed sediment structure and was of low geomorphological value.<br><br>√ - Culverting of Channelsea Gorge enabled the construction of gentler slopes down to the wetlands and the development of a larger area of reed beds. This increased the cross-section and planform variation of the water body. It also opened up of a length of culvert on Moselle Brook , a tributary to the Lee in the upstream water body, to obtain positive impact on upstream water body. | Depth variation | - | - | No |
| | | Quantity, structure and substrate of estuarine bed | X | √ | X Net |
| | | Structure of the intertidal zone | - | - | No |
| | | **Total** | **X** | **√** | **X Net** |
| | **Supporting Elements** | | | | |
| **Water Quality** | X - None identified | Dissolved Oxygen | - | - | No |
| | √ - None identified | **Total** | - | - | **No** |
| | **Chemical Elements** | | | | |
| | X - None identified | Annex VIII Pollutants | - | - | No |
| | √ - None identified | **Total** | - | - | **No** |
| | **Flood Elements** | | | | |
| **Flooding** | X - The introduction of the culvert in an areas where water levels fluctuate due to impoundment, also introduces the risk of groundwater intrusion into the culvert.<br><br>√ - Culvert designed to convey the design flows (1 in 100 years + climate change) and to not increase the risk of flooding elsewhere. Non-return gate installed between Channelsea culvert and Bully Point.<br><br>√ - Debris management, including pre-event management, is outlined in the draft 10 Year Landscape Management and Maintenance Plan and help prevent risk of increase in flood hazard due to debris. | Flood hazard | X | √ | √ Net |
| | | Flood extent | - | √ | √ |
| | | **Total** | **X** | **√** | **√ Net** |

**References**


- ODA London Learning Legacy: Translocation of habitats and species within the Olympic Park, December 2011
- Commission for a Sustainable London 2012: "Sustainable? Naturally" - A review of biodiversity across the London 2012 programme, November 2010.
- Atkins, London 2012 Parkland & Public Realm Geomorphological Assessment and Monitoring: Phase 2: Post-impoundment fluvial audit, ODA reference REP-ATK-CW-ZZZ-WAT-ZZZ-Z-0021, 23 February 2010
- EDAW Consortium, Olympic Park and Site Wide Infrastructure London 2012 Parklands and Public Realm: Channelsea Gorge and Bully Point Wetlands Options Study, ODA Reference REP-EDW-AL-ZZZ-OLP-ZZZ-Z-0007 V2.00, August 2007
- ODA, Earthworks and Remediation, Eastway Cycle Circuit, Stratford, London (Construction Zone 6a), Appendix B, Flood Risk Assessment, November 2006.
- LLDC, Phil Askew: Queen Elizabeth Olympic Park Transformation, 2013.
- ODA: The Olympic Park – Towards a 10 Year Landscape Management and Maintenance Plan, February 2010.
- EDAW Consortium Technical Note: Channelsea Gorge Culvert, July 2008.
- ODA, Volume 12D - Environmental Statement Part 3 – Topic Environmental Assessments Ref: OLY/GLB/ACC/DOC/ENV/01D – Environmental Statement

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Thames Middle | Negative Impact Identified | X | ✓ | Significant positive impact identified |
| **Water Body ID** | GB530603911402 | Positive impact Identified | √ | ✓ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Hennicker's Ditch Extension | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | Henniker's Ditch (K) | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

## Hennicker's Ditch Extension

## Length: Approximately 420m

| WFD objective | Description of impact | Parameter | X | √ | Residual impact |
|---|---|---|---|---|---|
| | **Water Use Elements** | | | | |
| **Sustainable water use** | - | Potable water demand | - | - | No |
| | | Non-potable water demand | - | - | No |
| | | **Total** | - | - | **No** |
| | **Biological indicators** | | | | |
| **Habitat and Species** | X - The extension by 420 m of Henniker's Ditch. The waterway was already culverted prior to the Olympics and was of marginal value. | Phytoplankton | - | - | No |
| | | Macroalgae | - | - | No |
| | | Benthic Invertebrates | - | - | No |
| | | Fish (Transitional) | - | - | No |
| | | **Total** | - | - | **No** |
| | **Hydromorphology** | | | | |
| | X - Loss of 420 m of Henniker's Ditch - Henniker's Ditch was an artificial V-shaped channel of negligible geomorphological value and little fluvial input. | Depth variation | - | - | No |
| | | Quantity, structure and substrate of estuarine bed | - | - | No |
| | | Structure of the intertidal zone | - | - | No |
| | | **Total** | - | - | **No** |
| | **Supporting Elements** | | | | |
| **Water Quality** | X - None identified | Dissolved Oxygen | - | - | No |
| | √ - None identified | **Total** | - | - | **No** |
| | **Chemical Elements** | | | | |
| | X - None identified | Annex VIII Pollutants | - | - | No |
| | √ - None identified | **Total** | - | - | **No** |
| | **Flood Elements** | | | | |
| **Flooding** | X - There is the risk of trash screens at the entrance of the culvert inlet to Hennicker's ditch and at the outlet into the Bully Point causing local surface water flooding. This could increase flood risk in surrounding areas.<br><br>X - The extension of the culvert in an areas where water levels fluctuate due to impoundment, also introduces the risk of groundwater intrusion into the culvert.<br><br>√ - Debris management, including pre-event management, is outlined in the draft 10 Year Landscape Management and Maintenance Plan and help prevent risk of increase in flood hazard due to debris. | Flood hazard | X | √ | √ Net |
| | | Flood extent | - | √ | √ |
| | | **Total** | **X** | **√** | **√ Net** |

**References**


• ODA London Learning Legacy: Translocation of habitats and species within the Olympic Park, December 2011
• Commission for a Sustainable London 2012: "Sustainable? Naturally" - A review of biodiversity across the London 2012 programme, November 2010.
• Atkins, London 2012 Parkland & Public Realm Geomorphological Assessment and Monitoring: Phase 2: Post-impoundment fluvial audit, ODA reference REP-ATK-CW-ZZZ-WAT-ZZZ-Z-0021, 23 February 2010
• EDAW Consortium, Olympic Park and Site Wide Infrastructure London 2012 Parklands and Public Realm: Channelsea Gorge and Bully Point Wetlands Options Study, ODA Reference REP-EDW-AL-ZZZ-OLP-ZZZ-Z-0007 V2.00, August 2007
• ODA, Earthworks and Remediation, Eastway Cycle Circuit, Stratford, London (Construction Zone 6a), Appendix B, Flood Risk Assessment, November 2006.
• LLDC, Phil Askew: Queen Elizabeth Olympic Park Transformation, 2013.
• ODA: The Olympic Park – Towards a 10 Year Landscape Management and Maintenance Plan, February 2010.
• EDAW Consortium Technical Note: Channelsea Gorge Culvert, July 2008.
• ODA, Volume 12D - Environmental Statement Part 3 – Topic Environmental Assessments Ref: OLY/GLB/ACC/DOC/ENV/01D – Environmental Statement

| | |
|---|---|
| **Water Body Name** | Thames Middle |
| **Water Body ID** | GB530603911402 |
| **Water Body Designation** | HMWB |
| **Current Potential** | Moderate |
| **Works Assessed** | Site Wide Drainage |
| **Location(s)** | Water woeks River (f) ; River Lea (G) |

| | | | |
|---|---|---|---|
| Negative Impact Identified | X | ✔ | Significant positive impact identified |
| Positive impact Identified | √ | ✔ | Slight positive impact identified with regard to water quality elements |
| | | - | No/ minimal risk of impact on identified or downstream water body |
| | | × | Identified negative effect on one objective or downstream water body. |
| | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

## Site Wide Drainage

**Area: 250 ha**

| WFD objective | Description of Impact | Parameter | X | √ | Residual impact |
|---|---|---|---|---|---|
| | **Water Use Elements** | | | | |
| **Sustainable water use** | - | Potable water demand | - | - | No |
| | | Non-potable water demand | - | - | No |
| | | **Total** | - | - | **No** |
| | **Biological indicators** | | | | |
| **Habitat and Species** | X - Surface water outfalls will discharge sediments in runoff which can smother vegetation and fish eggs.<br>X - High levels of sediment from runoff can also cause damage to fish gills which in turn can reduce fitness or result in death.<br>X - High levels of sediment from runoff can reduce the rate of photosynthesis and impact benthic communities.<br>√ - Silt traps at outfalls are installed to reduce sediment load. Site landscaping strategy limits the size of bare earth areas not covered by landscaping or planting which drain to the CSOs. No agricultural areas within the park. | Phytoplankton | - | - | No |
| | | Macroalgae | X | - | X |
| | | Benthic Invertebrates | X | - | X |
| | | Fish (Transitional) | X | - | X |
| | | **Total** | **X** | - | X |
| | **Hydromorphology** | | | | |
| | X - Low risk of silt deposition at outfalls as well as scour of river bed/soft banks due to erosion. This can change the structure of the river bed.<br>√ - All surface water drainage outfalls south of Carpenters Road have a maximum velocity of 0.3 m/s at the outfalls. All surface water drainage outfalls north of Carpenters Road are designed for an outfall velocity of 1.2 m/s or less. If those velocities were unable to be met, erosion protection measures have been put in place. | Depth variation | - | - | No |
| | | Quantity, structure and substrate of estuarine bed | X | √ | No Net |
| | | Structure of the intertidal zone | - | - | No |
| | | **Total** | **X** | **√** | No Net |
| | **Supporting Elements** | | | | |
| **Water Quality** | X - Phosphate, nitrogen, bacteria and organic matter can be washed into the waterway from roofs, green area and roads. This can increase the BOD and decrease the DO.<br>√ - Separated surface water and foul water drainage reduces the load on combined sewers during rainfall events. This reduces the number of CSOs and thus the level of biological contamination reaching the water bodies. This reduces the BOD of the water body and positively affects the level of DO. | Dissolved Oxygen | X | √ | √ Net |
| | | **Total** | **X** | **√** | **√ Net** |
| | **Chemical Elements** | | | | |
| | X - Hydrocarbons, heavy metals, chloride, glycol, cyanide, cadmium and MTBE can be washed into the water bodies from hard surfaces such as roofs, car parks, de-icing activities, roads and atmospheric deposition as well as through contaminated groundwater migration. This leads to an increase in pollutant load on the water bodies.<br>√ - Remediation of contaminated soils and groundwater during development following a Site Specific Remediation Strategy reduces the long term sources of contamination.<br>√ - Installation of Human Health Separation Layer in the top 600 mm of heavily contaminated areas of the site help reduce pollutant load in runoff.<br>√ -There is no discharge of surface water directly to ground, nor any designed surface water infiltration. This reduces the risk of contaminant mobilisation and leaching during rainfall events.<br>√ - Reduction of industrial uses in the area removes potential point sources of pollution. | Annex VIII Pollutants | X | √ | √ Net |
| | | **Total** | **X** | **√** | **√ Net** |
| | **Flood Elements** | | | | |
| **Flooding** | √ - Surface water is released to the water body prior to the River Lea peak hydrograph. This reduces the depth of water at the time of concentration and the downstream flood depths associated with fluvial flooding. | Flood hazard | - | √ | √ |
| | | Flood extent | - | - | No |
| | | **Total** | - | **√** | **√** |

**References**

• Lower Lea Valley Olympic Applications, Environmental Statement Part 3, Chapter 16-18, 52. Surface Water; Chapter 19-21, 53. Soil Conditions, Groundwater and Contamination, January 2004.
• ODA Surface Water Drainage Technical Design Strategy, July 2008
• ODA Olympic Park Water Management Plan, February 2009
• Olympic Park and Site Wide Infrastructure London 2012 Design and Master Planning Report: REP-BUR-CD-ZZZ-ZZZ-XXX-O-000002. Site Wide Surface Water Drainage Concept Design Report and Brief for Detailed Designers, April 2007
• Legacy Masterplan Framework (Kath Markey), Quick Guide to Olympic Park Surface Water Drainage, March 2008
• LMF Output E – Sustainable Water Resource Management Strategy (Draft): REP-BUR-CW-ZZZ-ZZZ-ZZZ-L-0001, 10 July 2009
• EA WFD Method statement for the classification of surface water bodies v3 (Jan 2013)

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Thames Middle | Negative Impact Identified | X | ✓ | Significant positive impact identified |
| **Water Body ID** | GB530603911402 | Positive impact Identified | √ | ✓ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Removal of Invasive Species | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | All Thames Middle Waterways | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

| **Removal of Invasive Species** | | | | | | **Length: 4.2km** |
|---|---|---|---|---|---|---|
| **WFD objective** | **Description of Impact** | **Parameter** | **X** | **√** | **Residual impact** | **References** |
| | **Water Use Elements** | | | | | |
| **Sustainable water use** | - | Potable water demand | - | - | No | |
| | | Non-potable water demand | - | - | No | |
| | | **Total** | - | - | **No** | |
| | **Biological indicators** | | | | | |
| **Habitat and Species** | X - Eradication of invasive species may locally and temporarily negatively affect existing flora. )<br>√ - Corridors along waterways are especially sensitive to colonisation. Site-wide removal improves riparian vegetation and potential for marginal habitats. Regular harvesting of floating pennywort increases the abundance of submerged vegetation as they often out compete native species when present. Japanese Knotweed outcompete other riparian vegetation and reduce native diversity; Himalayan Balsam can shade out rarer species.<br>√ - Weed prevention fabrics have also been employed to cap the sub-soil layer to ensure no invasive species can emerge. These weed initial prevention methods will ensure a minimum invasive species population.<br>√ - Ongoing management strategies for removal in place. | Phytoplankton | - | - | No | |
| | | Macroalgae | X | √ | √ Net | |
| | | Benthic Invertebrates | - | √ | √ | |
| | | Fish (Transitional) | - | - | No | |
| | | **Total** | **X** | **√** | **√ Net** | |
| | **Hydromorphology** | | | | | |
| | X - None identified<br>√ - None identified | Depth variation | - | - | No | |
| | | Quantity, structure and substrate of estuarine bed | - | - | No | |
| | | Structure of the intertidal zone | - | - | No | |
| | | **Total** | - | - | **No** | |
| | **Supporting Elements** | | | | | |
| **Water Quality** | X - None identified<br>√ - None identified | Dissolved Oxygen | - | - | No | |
| | | **Total** | - | - | **No** | |
| | **Chemical Elements** | | | | | |
| | X - None identified<br>√ - None identified | Annex VIII Pollutants | - | - | No | |
| | | **Total** | - | - | **No** | |
| | **Flood Elements** | | | | | |
| **Flooding** | X - None identified<br>√ - None identified | Flood hazard | - | - | No | |
| | | Flood extent | - | - | No | |
| | | **Total** | - | - | **No** | |

## *7.4 South Essex Thurrock Chalk Detailed Impact Assessment*

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | South Essex Thurrock Chalk | Negative Impact Identified | X | ✓ | Significant positive impact identified |
| **Water Body ID** | | Positive impact Identified | √ | ✓ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Status** | Poor | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Surface Water Drainage system / Outfall | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | Site-wide | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

**Surface Water Drainage system / Outfall** — **Area: 250 ha**

| WFD objective | Description of Impact | Parameter | X | √ | Residual impact |
|---|---|---|---|---|---|
| | **Water Use Elements** | | | | |
| Sustainable water use | X - Surface water drainage strategy does not allow the discharge to ground across the QEOP site and therefore could have a negative impact on local groundwater levels by reducing the groundwater recharge rate. | Groundwater level | x | - | x |
| | | Non-potable water demand | - | - | |
| | | **Total** | X | - | **X** |
| Habitat and Species | **Biological indicators** | | | | |
| | - | Diatoms | - | - | No |
| | | Macrophytes | X | - | - |
| | | Macro invertebrates | - | - | No |
| | | Fish | X | - | No |
| | | **Total** | **X** | **-** | **No** |
| | **Hydromorphology** | | | | |
| | - | Quantity and dynamics of water flow | - | - | No |
| | | Structure and substrate of river bed | - | - | No |
| | | Structure of the riparian zone | - | - | No |
| | | River depth and width variation | - | - | No |
| | | **Total** | **-** | **-** | **No** |
| Water Quality | **Supporting Elements** | | | | |
| | X - Phosphate, nitrogen, bacteria and organic matter can be washed into the water bodies from roofs, green surfaces and roads. This can lead to an increase in the BOD of the water bodies and a subsequent drop in DO.<br><br>√ - Biomembrane installed to separate 600mm of cleaned soil and underlaying in situ contaminated soil. This prevents surface water from flowing through contaminated underlaying soil and possibly transporting existing contamination into the ground water body.<br><br>A total of over 20 million gallons of contaminated groundwater were treated.<br><br>Approx. 90,000m3 | Dissolved Oxygen | X | √ | √ |
| | | pH | X | √ | √ |
| | | Salinity | X | √ | √ |
| | | Conductivity | - | √ | √ |
| | | Ammonia (Total as N) | X | √ | √ |
| | | Phosphate | - | √ | √ |
| | | **Total** | **X** | **√** | **√** |
| | **Chemical Elements** | | | | |
| | X - Hydrocarbons, heavy metals, chloride, glycol, cyanide, cadmium and MTBE can be washed into the water bodies from hard surfaces such as roofs, car parks, de-icing activities, roads and atmospheric deposition as well as through contaminated groundwater migration. This leads to an increase in pollutant load on the water bodies.<br><br>√ - Remediation of contaminated soils and groundwater during development in accordance with a Site Specific Remediation Strategy reduces the long term sources of contamination. Installation of Human Health Separation Layer in the top 600 mm of heavily contaminated areas of the site help reduce pollutant load in runoff. There is no discharge of surface water directly to ground, nor any designed surface water infiltration. This reduces the risk of contaminant mobilisation and leaching during rainfall events. Reduction of industrial uses in the area removes potential point sources of pollution. Combined surface water and highways drainage designed to Highways Authority and Thames Water requirements. | Annex VIII Pollutants | X | √ | √ |
| | | **Total** | **X** | **√** | **√** |
| Flooding | **Flood Elements** | | | | |
| | - | Flood hazard | - | - | - |
| | | Flood extent | - | - | - |
| | | **Total** | | | |

**References**

- Lower Lea Valley Olympic Applications, Environmental Statement Part 3, Chapter 16-18, 52. Surface Water; Chapter 19-21, 53. Soil Conditions, Groundwater and Contamination, January 2004.
- ODA Surface Water Drainage Technical Design Strategy, July 2008
- ODA Olympic Park Water Management Plan, February 2009
- Olympic Park and Site Wide Infrastructure London 2012 Design and Master Planning Report: REP-BUR-CD-ZZZ-ZZZ-XXX O-000002. Site Wide Surface Water Drainage Concept Design Report and Brief for Detailed Designers, April 2007
- Legacy Masterplan Framework (Kath Markey), Quick Guide to Olympic Park Surface Water Drainage, March 2008
- LMF Output E – Sustainable Water Resource Management Strategy (Draft): REP-BUR-CW-ZZZ-ZZZ-ZZZ-L-0001, 10 July 2009
- EA WFD Method statement for the classification of surface water bodies v3 (Jan 2013)

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | South Essex Thurrock Chalk | Negative Impact Identified | X | ✓ | Significant positive impact identified |
| **Water Body ID** | GB40601G401100 | Positive impact Identified | √ | ✓ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | Ground water body | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Status** | Poor | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Site Wide Remediation | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | Site-wide | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

## Site Wide Remediation

| WFD objective | Description of Impact | Parameter | X | √ | Residual impact | References |
|---|---|---|---|---|---|---|
| **Sustainable water use** | **Water Use Elements** | | | | | • Lower Lea Valley Olympic Applications, Environmental Statement Part 3, Chapter 16-18, 52. Surface Water; Chapter |
| | - | Groundwater level | - | - | No | |
| | | Non-potable water demand | - | - | No | |
| | | **Total** | - | - | **No** | |
| **Habitat and Species** | **Biological indicators** | | | | | |
| | √ - Large quantities of existing soil have been decontaminated and reused as inert fill free of any invasive species seeds. | Diatoms | - | - | No | |
| | | Macrophytes | - | - | No | |
| | | Macro invertebrates | - | - | No | |
| | | Fish | - | - | No | |
| | | **Total** | - | - | **No** | |
| | **Hydromorphology** | | | | | |
| | - | Quantity and dynamics of water flow | - | - | No | |
| | | Structure and substrate of river bed | - | - | No | |
| | | Structure of the riparian zone | - | - | No | |
| | | River depth and width variation | - | - | No | |
| | | **Total** | - | - | **No** | |
| **Water Quality** | **Supporting Elements** | | | | | |
| | √ - Minimal risk of mobilisation of organic ground contaminants. | Dissolved Oxygen | - | √ | √ | |
| | | pH | - | √ | √ | |
| | | Salinity | - | √ | √ | |
| | | Conductivity | - | √ | √ | |
| | | Ammonia (Total as N) | - | √ | √ | |
| | | Phosphate | - | √ | √ | |
| | | **Total** | - | √ | √ | |
| | **Chemical Elements** | | | | | |
| | √ - Site-side and site-specific remediation strategies along with site-wide surface water drainage strategy decreased the level of pollution in the soil on site as well as reduction in the risk of leaching through groundwater movement.<br><br>√ - Site specific remediation strategy detailing clean-up of contaminated soils. Surface water drainage strategy implemented (considered in separate work). | Annex VIII Pollutants | - | √ | √ | |
| | | **Total** | - | √ | √ | |

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | South Essex Thurrock Chalk | Negative Impact Identified | X | ✔ | Significant positive impact identified |
| **Water Body ID** | GB40601G401100 | Positive impact Identified | √ | ✔ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | Ground water body | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Status** | Poor | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Site Wide Remediation | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | Site-wide | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

| WFD objective | Description of Impact | Parameter | X | √ | Residual impact | References |
|---|---|---|---|---|---|---|
| **Flooding** | **Flood Elements** | | | | | |
| | - | Flood hazard | - | - | - | |
| | | Flood extent | - | - | - | |
| | | **Total** | **-** | **-** | **-** | |

## 7.5 Site Wide Works Detailed Impact Assessment

| | | | | | |
|---|---|---|---|---|---|
| **Water Body Name** | Thames Middle | Negative Impact Identified | X | ✔ | Significant positive impact identified |
| **Water Body ID** | GB530603911402 | Positive impact Identified | √ | ✔ | Slight positive impact identified with regard to water quality elements |
| **Water Body Designation** | HMWB | | | - | No/ minimal risk of impact on identified or downstream water body |
| **Current Potential** | Moderate | | | × | Identified negative effect on one objective or downstream water body. |
| **Works Assessed** | Site Wide Remediation | | | × | Identified negative effect. Could prevent future 'Good' Status/Potential. |
| **Location(s)** | All QEOP and Waterways | | | × | Deterioration in Status or Potential. Require an Article 4.7 test. |

| **Site Wide Remediation** | | | | | | **Area; 250ha** |
|---|---|---|---|---|---|---|
| **WFD objective** | **Description of Impact** | **Parameter** | **X** | **√** | **Residual impact** | **References** |
| **Sustainable water use** | **Water Use Elements** | | | | | • OPLC, H08 Replacement Study, General Arrangement, October 2011<br>• Buro Happold, U13U14 photo H08 Link replacement – proposed, October 2011<br>• ODA, North Park Legacy Transformation E06 to H01 Footpath/MTB trail Option 2 Boardwalk, drawing no. 0241-LCI WCW-C-DDE-0006 Draft, February 2011<br>• OPLC, Towpath Under Carpenters Road Feasibility Study Brief, 11 October 2011<br>• AINA: Management Strategies and Mitigation Measures for the Inland Navigation Sector in Relation to Ecological Potential for Inland Waterways – Appendix A, Pressures and Impact Sheets, March 2008 |
| | - | Potable water demand | - | - | No | |
| | | Non-potable water demand | - | - | No | |
| | | **Total** | **-** | **-** | **No** | |
| **Habitat and Species** | **Biological indicators** | | | | | |
| | √ - Large quantities of existing soil have been decontaminated and reused as inert fill free of any invasive species seeds. | Phytoplankton | - | √ | √ | |
| | | Macroalgae | - | √ | √ | |
| | | Benthic Invertebrates | - | √ | √ | |
| | | Fish (Transitional) | - | √ | √ | |
| | | **Total** | **-** | **√** | **√** | |
| | **Hydromorphology** | | | | | |
| | X - None identified<br><br>√ - None identified | Depth variation | - | - | No | |
| | | Quantity, structure and substrate of estuarine bed | - | - | No | |
| | | Structure of the intertidal zone | - | - | No | |
| | | **Total** | **-** | **-** | **No** | |
| **Water Quality** | **Supporting Elements** | | | | | |
| | X - None identified<br><br>√ - None identified | Dissolved Oxygen | - | - | No | |
| | | **Total** | **-** | **-** | **No** | |
| | **Chemical Elements** | | | | | |
| | √ - Site-side and site-specific remediation strategies along with site-wide surface water drainage strategy decreased the level of pollution in the soil on site as well as reduction in the risk of leaching through groundwater movement.<br><br>√ - Site specific remediation strategy detailing clean-up of contaminated soils. Surface water drainage strategy implemented (considered in separate work). | Annex VIII Pollutants | | √ | √ | |
| | | **Total** | | **√** | **√** | |
| **Flooding** | **Flood Elements** | | | | | |
| | - | Flood hazard | - | - | No | |
| | | Flood extent | - | - | No | |
| | | **Total** | **-** | **-** | **No** | |

# 8 Mitigation Measures

## 8.1 Mitigation Measures implemented in the Lee (Tottenham Locks to the Tideway)

The RBMP mitigation measures implemented on the *Lee* as part of the works on the QEOP Park are identified in the table below:

**Table 37 - QEOP Lee Mitigation Measures Implemented**

| Mitigation Measure | RBMP (2015) | Implemented on QEOP |
|---|---|---|
| Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution | Not In Place | YES |
| Protect and enhance ecological value of marginal aquatic habitat, banks and riparian zone | Not In Place | YES |
| Protect and restore historic aquatic habitats | Not In Place | |
| Operational and structural changes to sluices and weirs | Not In Place | |
| Install fish passes | Not In Place | |
| Removal of structure | Not In Place | |
| Retain marginal aquatic and riparian habitats | Not In Place | YES |
| Increase in-channel morphological diversity, e.g. install in stream features; 2 stage channels | Not In Place | YES |
| Re-opening existing culverts | Not In Place | |
| Alteration of channel bed | Not In Place | |
| Re-opening existing culverts | Not In Place | |
| Alteration of channel bed | Not In Place | |
| Set-back embankments (a type of managed retreat) | Not In Place | |
| Improve floodplain connectivity | Not In Place | YES |
| Sediment management strategies (develop and revise) which could include a) substrate reinstatement, b) sediment traps, c) allow natural recovery minimising maintenance, d) riffle construction, e) reduce all bar necessary management in flood risk areas | Not In Place | YES |
| Appropriate vegetation control regime e.g. a) minimise disturbance to channel bed and margins, b) selective vegetation management for example only cutting from one side of the channel, c) providing/reducing shade, d) seasonal maintenance | Not In Place | YES |
| Educate landowners on sensitive management practices | Not In Place | |
| Appropriate techniques to align and attenuate flow to limit detrimental effects of these features | Not In Place | YES |
| Management of the risks to fish entrainment | Not In Place | |
| Appropriate water level management strategies, including timing and volume of water moved | Not In Place | |

## 8.2 Mitigation Measures implemented in the Thames Middle

The RBMP mitigation measures which were implemented on the *Thames Middle* as part of the works on the QEOP Park are identified in the table below:

**Table 38. QEOP Thames Middle Mitigation Measures Implemented**

| Mitigation Measure | RBMP (2009) | Implemented on QEOP |
|---|---|---|
| Vessel Management | In Place | |
| Modify vessel design | In Place | |
| Manage disturbance | In Place | YES |
| Site selection (dredged material disposal) (e.g. avoid sensitive sites) | In Place | |
| Sediment management | In Place | |
| Alter timing of dredging / disposal | In Place | YES |
| Reduce sediment re-suspension | In Place | YES |
| Reduce impact of dredging | In Place | YES |
| Prepare a dredging / disposal strategy | Not in Place | YES |
| Avoid the need to dredge (e.g. minimise under-keel clearance; use fluid mud navigation; flow manipulation or training works) | Not in Place | |
| Indirect / offsite mitigation (offsetting measures) | Not In Place | YES |
| Operational and structural changes to locks, sluices, weirs, beach control, etc. | Not In Place | |
| Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone | Not In Place | YES |
| Managed realignment of flood defence | Not In Place | |
| Remove obsolete structure | Not In Place | |

## 8.3 Mitigation Measures implemented in the South Essex Thurrock Chalk

No mitigation measures have been set for the South Essex Chalk. However improved interventions which could be classified as mitigation measures are the following:

**Table 39**

| Mitigation improvements | RBMP (2009) | Implemented on QEOP |
|---|---|---|
| Removal of pollutant and control of infiltration to ground water aquifers | Not specified | YES |

# 9 Summary and Conclusion

## 9.1 Summary of Assessment Results

### 9.1.1 *Lee* (Tottenham Locks to the Tideway)

The Lee contains no designated areas within the study area. Water flow in the Lee is reduced by abstraction in upstream water bodies, however there are no identified abstraction points within the QEOP. The Lee did not always achieve the minimum flows required to maintain suitable habitats for fish. Baseline status of biological elements before the QEOP was not assessed, however only marginal improvement will be possible without affecting its uses as a heavily modified water body. The Lee's baseline Hydromorphology supports emergent, floating and submerged aquatic vegetation with some records of Pennywort and Rigid hornwort.

The Lee's waterways are partly canalised with stretches lined by mass concrete walls or sheet piles. Key issues relating to pollution are high Ammonia concentrations, low dissolved oxygen and high phosphate levels. The levels of different polyaromatic hydrocarbons were also found to exceed allowable WFD chemical limits. The waterway's impoundment structures aggravate these levels by slowing down flows and increasing residence time. Sewage discharge is deemed to be among the main causes for Phosphate levels.

The proposed works included the following mitigation measures in line with some of the objectives set out by the RDMP.

- Fish translocated to adjacent waterways.
- Habitat creation and bank rehabilitation on Old River Lea providing refuge and fish spawning areas.
- Bank rehabilitation on Old River Lea to increase geomorphological diversity.
- Changes to channel cross section to increase in geomorphological diversity through channel cross section, planform type, bank type and flow variation along the river.
- Increase in storage area and changes in river edges accounted for in flood model to ensure no residual impact.
- Low impact dredging techniques. Dredging location limited to outside fish spawning areas and conducted by floats to avoid bank-side damage
- Dredging management plans in place to maintain necessary flood risk design standard.
- Silt traps at outfalls to reduce sediment load.
- Limited size and runoff from of bare earth areas not covered by landscaping or planting.
- No agricultural areas within the park.
- Riparian planting to trap silt from greenfield runoff.
- Erosion protection measures have been put in place in the eventuality that maximum outfall velocities of 1.2 m/s or less are exceeded.

- Separated surface water and foul water drainage reduces the load on combined sewers during rainfall events. This reduces the number of CSOs and thus the level of biological contamination.
- Contaminated sediments bio-remediated off-site to avoid re-contamination.
- Remediation of contaminated soils and groundwater during development in accordance with a Site Specific Remediation Strategy reduces the long term sources of contamination. Reduction of industrial uses in the area removes potential point sources of pollution. Combined surface water and highways drainage designed to Highways Authority and Thames Water requirements.

The table below summarises the impact of the proposed works and mitigation measures on the Lee water body

| **BH Approach Objective** | ***Lee* (Tottenham Locks to the Tideway)** |
|---|---|
| *Baseline Status:* | *Combination of concrete plank, sheet piles, soft banks and mass concrete banks.*<br>*Generally emerging floating and submerged aquatic vegetation present. With some floating pennywort and rigid hornwort intrusive species. Generally coarse fish population with the Old River Lea water way having 6 species. Parts are canalised, parts have low stream power and some waterways are Imported Grade 1 sites.* |
| *Main works:* | *Loss of Pudding Mill River;*<br>*Bank Rehabilitation; Dredging;*<br>*SWD system and City Mill river outfalls* |
| Sustainable Water Use | ***No*** |
| Habitat and Species | ✓ ***Net Slightely Positive***<br>• Removal of Pudding Mill River and Dredging works result in 250m + loss of habitat due to dredging.<br>• Mitigation measures such as fish translocation to adjacent waterways, creation of new habitats with fish refuge and spawning areas and increase in geomorphological diversity compensate for habitat loss.<br>• 3.3km bank rehabilitation - 2km along canal park; 0.5 soft bank enhancement on Old River Lea and 0.8km on the City Mills River.<br>• Removal of invasive species across 3.8km of bank also improves habitat across water body. |
| Water Quality | ✓ ***Net Positive***<br>• The Pudding Mill River was heavily contaminated and considered to be a source of pollution. Therefore, in terms of water quality, its removal results in an improvement in water quality through the reduction of pollutants.<br>• Dredging overall is deemed to have resulted in overall reduction in excessive nutrients and removal of contaminated sediments which were cleaned off site.<br>• Although dredging can encourage transfer and remobilisation of fine sediments it also helps reduce turbidity and associated negative impacts.<br>• Bank rehabilitation vegetation can indirectly help sustain availability of supporting elements by enabling plants to prevent eutrophication.<br>• Naturalised bank rehabilitation and surface water outfalls could provide pathways for phosphates, nitrogen and Annex Viii pollutants to be washed into the Lee water body. A separate foul and surface water flow system reduces Combined Sewage Overflow contamination and helps sustain supporting elements. Site SWD strategy treated top 600mm soil and prevents leaching of contaminates to water table by allowing no surface water discharge to ground. |
| Flood Risk | ✓ ***Net Positive***<br>• No measurable increase in flood extent due to loss of Pudding Mill River; removal of hard defences could increase flood extent however to compensate an increase in storage area implemented.<br>• Overall dredging is expected to increase conveyance reducing flood risk.<br>• Canal and River Trust dredging management plans are in place to maintain necessary flood risk design standard.<br>• Surface water strategy enables the early release of runoff into the Water body prior to the River peak hydrograph therefore reducing the depth of water at time of concentrations |

### *9.1.2 Thames Middle*

The Thames Middle ’s waterways includes three sites of Borough Importance grade 1 and Bow Creek forms a part of a River Thames and Tidal Creeks site of Metropolitan importance for nature conservation. The Thames Middle ’s flow in the QEOP area is influenced by groundwater abstraction upstream of Lea Bridge Sluices. Baseline status of biological elements before the QEOP was not assessed for all Biological elements, however only marginal improvement will be possible without affecting its uses as a heavily modified water body. The Thames Middle ’s waterways hydromorphology supports some fish species and there was a high presence of invasive species (Japanese Knotwood and Himalyan Balsam and some Giant Hogweed).

The Thame Middle waterway hydromorphology includes a combination of soft banks, sheet piles walls, vertical river walls, trapezoidal channels and artificial v-shaped ditches.

Key issues related to Water Quality are high levels of dissolved inorganic nitrogen, phosphate, ammonia and BOD; significant exceedances in arsenic, cadmium, nickel, lead, mercury, chromium, Total Petroleum Hydrocarbons (THP) zinc and hydrocarbons. Sources of some of these pollutants may be traced back to antifouling paint, herbicides and the sewage treatment works. The River Lea drains a catchment of 1400km2. Following the River Lea Flood Relief Channel and flood defences works subsequent flood events occurred in the upper lea catchment but not as far as the QEOP.

The proposed works included the following mitigation measures in line with some of the objectives set out by the RDMP .

- Sediment management;
- Canal and Rivers Trust preparation of a dredging strategy;
- River Bank enhancements of ecological value of marginal aquatic habitat on Waterworks and River Lea;
- Creation of new habitats through wetland creation and  soft bank stabilisation.
- Removal of invasive species.
- Low impact dredging techniques. Dredging location limited to outside fish spawning areas and conducted by floats to avoid bank-side damage
- Dredging management plans in place to maintain necessary flood risk design standard.
- Silt traps at outfalls to reduce sediment load.

The table below summarises the impact of the proposed works and mitigation measures on the *Thames Middle* water body.

| **BH Approach Objective** | ***Thames Middle*** |
|---|---|
| *Baseline Status:* | *Combination of soft banks, mass concrete, concrete planks and sheet piles banks.*<br>*Moderately rich fish species in River Lea and population of newts in Bully Point wetlands. Some brackish or marine species in Waterworks river and three mills wall river*<br>*Invasive species in Channelsea Gorge which is not deemed of high ecological value*<br>*Some intertidal mudflats in Waterworks river*<br>*Low stream power in Waterworks river.*<br>*Scarce aquatic plants in Waterworks river and no marginal aquatic vegetation in Hennicker's ditch*<br>*Waterworks river, Three Mills river and Prescott Channel are designated Site of Borough importance Grade 1.* |
| *Main works:* | *Wetland and Flood Storage Area creation and Riparian zone rehabilitation; Culverting of Hennicker's Ditch and Channelsea Gorge; Navigation along River Lea and Waterworks River; Waterworks River channel widening; Dredging along Three Mills River and Waterworks River ; Outfalls and SWD strategy; Replacement of River Wall along Waterworks River; Prescott Lock and impact on Prescott channel and Three Mills River and ; Walkway planned along River Lea; Site wide removal of invasive species* |
| Sustainable Water Use | No impact |
| Habitat and Species | ✓ ***Net Positive***<br>Net Positive Impact taking into consideration mitigation measures, riparian zone rehabilitation and wetland and wet woodland creation<br>• The loss of 420m of Hennicker's Ditch and extension by 200m of Channelsea gorge meant the loss of marginal vegetation and some habitat for fish. This is not deemed significant on a water body scale (less than 0.45%).<br>• Dredging also results in the direct loss of habitat for benthic species and submerged macrophytes.<br>• In total 4.2km of river bank enhancement were provided on River Lea (2km) and Waterworks River (2.2km)<br>• Channel widening along 1km length was mitigated by creation of new 5m riparian habitat sloping into the waterway.<br>• 5,000m$^2$ of new reed bed area and 3nr new pond areas totalling 2,000m$^2$ were provided and 2.5km soft bank planted with wetland species to provide ecological connectivity between the Wetland Bowl and Bully Point.<br>• 40 wetland plant species (approximately 300,000 wetland plants in total) were selected to cope with a daily fluctuating water level<br>• Wetlands provide fish spawning areas, refuge areas in periods of high flow, feeding areas for waterfowl, off main river habitat, resilience to changing water levels, invertebrates habitats, artificial nesting for kingfisher, egg laying sites for newts, backwater habitat for fish and 10yr landscape management and maintenance plan.<br>• Invasive species were also removed over 4.2km of banks.<br>• Although wetlands could introduce risk of channel bank erosion and consequent sediment built up, mature vegetation is planted to consolidate banks and reduce the risk of invasive species. Riparian planting also helps trap silt.<br>• Increases in channel width and dredging could also increase sedimentation and destabilisation of deposited sediments or remobilisation of suspended sediments which can negatively affect fish and invertebrate mortality rates, respiratory, feeding and spawning mechanisms, photosynthesis rates and benthic communities. However numerous measures were adopted to help reduce the risk of increase disturbance and excess sediment. These include:<br>  - Dredging outside fish spawning season<br>  - Dredging from floats using lo impact techniques<br>  - Silt traps on surface water outfalls<br>  - Limited bare earth areas discharging to Surface water drainage outfall<br>  - Maximum surface water drainage runoff velocity of 0.3 m/s south of Carpenters road and 1.2 m/s or less, north of Carpenters Road.<br>• Overall wetlands and other works provide net positive impact on hydrological connectivity to the river Lea, sustained permanent water level, and geomorphological diversity. |

| | |
|---|---|
| Water Quality | ✓ ***Net Positive***<br>• Net positive impact due to dredging, surface water drainage strategy, riparian zone rehabilitation and wetland creation<br>• Vegetation can intercept and utilise nutrients from surface runoff and prevent eutrophication of the waterway which may have a marginal positive impact on DO levels as well as phosphate and nitrate concentration<br>• Dredging overall is deemed to have resulted in overall reduction in excessive nutrients and removal of contaminated sediments which were cleaned off site.<br>• Surface water drainage strategy including installation of Human Health Layer in the top 600mm will significantly reduce infiltration and pollutant load in runoff therefore improving water body water quality. |
| Flood Risk | ✓ ***Net Positive***<br>• The creation of Wetlands and channel widening is estimated to increase flood storage by 80,000 $m^3$ for the 1 in 100 year event with an allowance for possible future climate change.<br>• The Channelsea gorge culvert has also been designed to convey the 1 in 100 + climate change flow and therefore does not increase the risk of flooding elsewhere.<br>• A 10 year landscape management and maintenance plan has also been drafted to help prevent debris increasing the risk of flooding.<br>• The surface water outfalls enable the early release to the water body prior to the River Lea peak hydrograph therefore reducing downstream depths at time of concentration. |

### *9.1.3 South Essex Thurrock Chalk*

The only key issues identified in the Chalk are the failure to achieve Good Drinking Water Protected Area status due to Ammonia levels and diffuse and point pollution.

Key mitigation measures implemented as part of the works is the site wide remediation and removal of contaminated soil and Installation of a Human Health Separation Layer.

| **BH Approach Objective** | ***Thames Middle*** |
|---|---|
| *Baseline Status:* | *Failed to achieve Good Status Chemical Status and Drinking Water Protected Area Status due to Ammonia and diffuse or point pollution. Good Quantitative status.* |
| *Main works:* | *Surface water drainage strategy and site wide remediation affect this water body* |
| Sustainable Water Use | The drainage strategy prevents the discharge to ground across the QEOP. This could result in a minor decrease in aquifer recharge however this is deemed to be insignificant on a water body scale. |
| Habitat and Species | Not Applicable |
| Water Quality | ✓ ***Net Positive***<br>The site wide remediation and removal of contaminated soils reduces the risk of groundwater pollution. Installation of a Human Health Separation Layer in the top 600mm of heavily contaminated areas to reduce pollutant runoff and infiltration to ground water table. |
| Flood Risk | Not Applicable |

## 9.2 Summary Impact Assessment Table

| BH Approach Objective | Lee (Tottenham Locks to the Tideway) | *Thames Middle* | South Essex Thurrock Chalk |
|---|---|---|---|
| Sustainable Water Use | No | No | Only minor X (surface water drainage) |
| Habitats and Species | X Net (pudding Mill, dredging)<br>√ (river bank enhancement, SW outfalls, removal of invasive species) | X (dredging, culverting of Channelsea gorge)<br><br>√ (river bank enhancement, channel widening, wetland and habitat creation, site wide remediation, removal of invasive species | - |
| Water Quality | √ (river bank enhancement, Surface water strategy) | X (Channel widening, dredging)<br>√ (site wide remediation, surface water drainage strategy | √ (surface Water Drainage) |
| Flood Risk | √ (surface water strategy) | √ (river bank enhancement, channel widening, culverting of Channelsea gorge, Hennicker's ditch extension, surface water drainage strategy | - |

## 9.3 Statement of Compliance

| WFD Objective | Compliance Summary |
|---|---|
| The QEOP and associated works do not cause deterioration in status of the biological elements of the water body | Yes |
| The QEOP and associated works do not compromise the ability of the water body to meet its WFD status objectives | Yes |
| The proposed scheme does not cause a permanent exclusion or compromise achieving the WFD objectives in other bodies of water within the same RBD. | Yes |
| The QEOP and associated works will contribute to the delivery of the Thames RBMP | Yes |
| Overall: Statement of Compliance | Yes |

# 10 Future use and revisions of WFD Assessment

## 10.1 When will this Queen Elizabeth Olympic Park (QEOP) Water Framework Directive (WFD) Assessment report need to be revised?

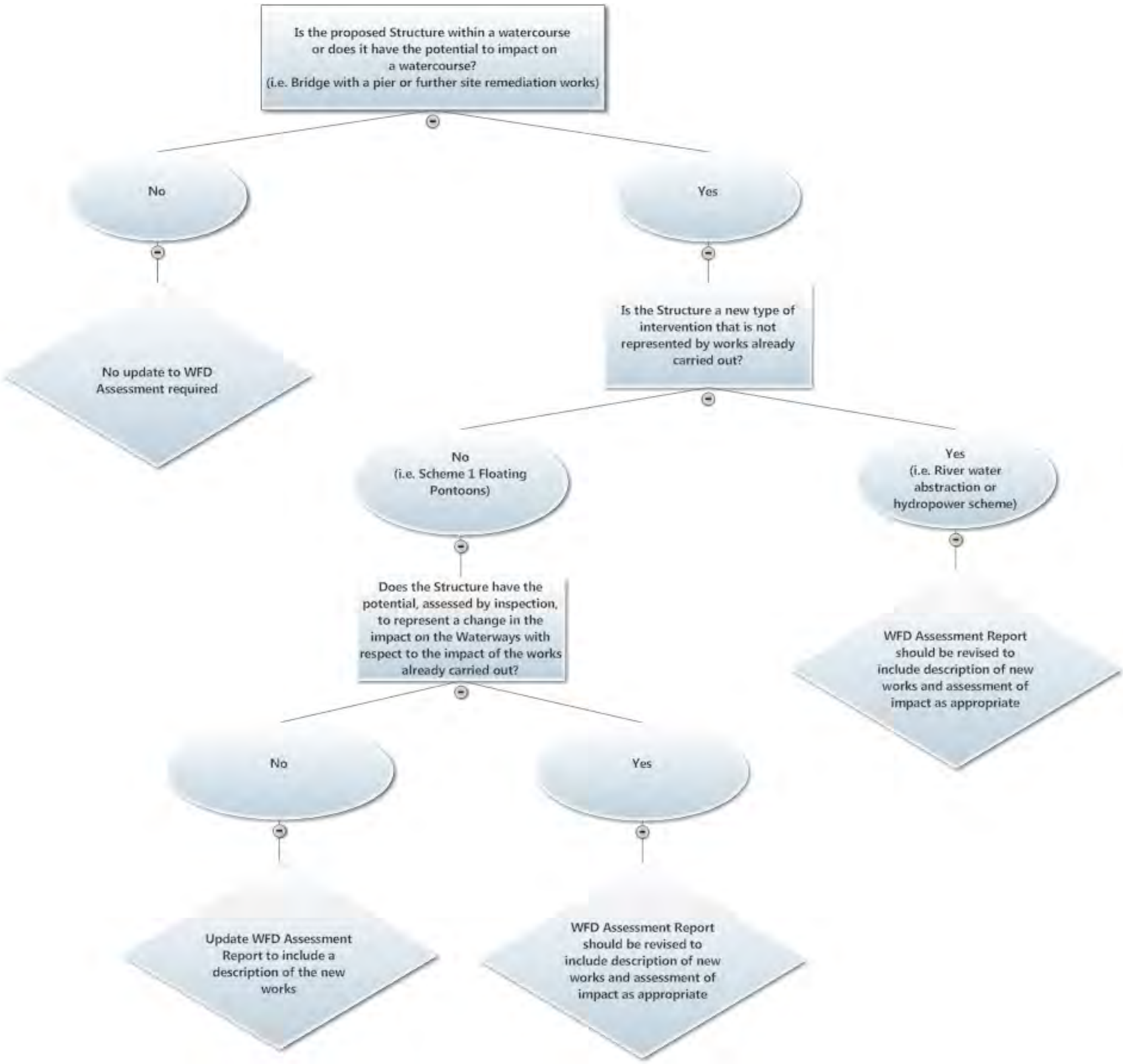
The decision flow chart below illustrates how the existing WFD Assessed report may be used to support the approval of future works and when, instead, the assessment will need to be revised or updated.

In summary, this WFD assessment is deemed to sufficiently assess the impact of new works affecting the QEOP which are of comparable type and scale to the works completed to date.

It is expected that the WFD Assessment Report will need to be revised when the new interventions proposed are either a new type of structure, which is not already present on site, or where the new structure is deemed to have the potential to have significantly different or greater impact on the waterways than the works already carried out.

A sample template which can be used to update the WFD assessment report is also included.

**Figure 34 - Future use and revisions of WFD**



| | | |
|---|---|---|
| **SCOPE OF WORK ITEM NO.** | | |
| | | |
| **LLDC QEOP WFD AMMENDED BY:** | | |
| | | |
| **DATE OF REVISION:** | | |
| | | |
| **TITLE OF NEW WORKS XXXX** | | |
| Work type: | | |
| Extent: | | |
| Planned date of completion: | | |
| Water Body ID: | | |
| **Is the proposed structure within a watercourse or does it have the potential to impact on the watercourse?** | *Yes? (Review guidance below)* | *No? ( No further action required)* |
| | | |
| **If Yes - Is the structure a new type of intervention (i.e. is not already represented by works already carried out )?** | *Yes? (WFD report revised)* | *No? (Review guidance below)* |
| | | |
| **If No, Does the structure have the potential, assessed by inspection to represent a change in the impact on the waterways with respect to the impact of the works already carried out?** | *Yes? (WFD report revised)* | *No? (No further action required)* |
| | | |
| **Does WFD report need to be updated?** | *Yes? (Proceed as advised below to review WFD report)* | *No? (No further action required)* |
| | | |
| **SUPPLEMENT SECTION IS UPDATE TO WFD REQUIRED** | | |
| **Supplement to Section 3.2 items of work ( if update to WFD report required)** | | |
| Supplement section No: | | |
| Title of Works: | | |
| Approved? | | |
| Description of works: | | |
| **Supplement to Section 6 Preliminary assessment completed? Section 6.XXX** | *Yes?* | *No?* |
| | | |
| **Supplement to Section 7.x Detailed Assessment Completed if required?** | *Yes?* | *No?* |
| | | |
| **Update Tables 37-38-39 in Section 8.XX Mitigation Measures completed?** | *Yes?* | *No?* |
| | | |
| **Update Section 9.XX summary and conclusion completed?** | *Yes?* | *No?* |
| | | |
| **REV. XXXX OF LLDC QEOP APPROVED BY:** | INSERT NAME | |
| **SIGNATURE:** | | |
| **DATE:** | | |

# 11 References

## 11.1 Atkins


Atkins, Olympic Park Infrastructure Design, Geomorphological Assessment and Monitoring, Phase 1: Lower River *Lee* Fluvial Audit, 24 November 2008.

Atkins, London 2012 Parkland & Public Realm Geomorphological Assessment and Monitoring: Phase 2: Post-impoundment fluvial audit, ODA reference REP-ATK-CW-ZZZ-WAT-ZZZ-Z-0021, 23 February 2010

Atkins, Delivering wetland biodiversity in the London 2012 Olympic Park, In Practice – Bulletin of the Institute of Ecology of Environmental Management, December 2010.

Atkins, London 2012 Parkland and Public Realm Technical Note: River Level Analysis, June 2009

Atkins, Olympic Park Infrastructure Design In-bank Water Level Regime, June 2008

Atkins, Technical Note: London 2012 Parkland and Public Realm River Level Analysis, ODA reference REP-ATK-CW-ZZZ-WAT-ZZZ-Z-0010, 17 June 2009


## 11.2 Canal & River Trust / British Waterways


British Waterways, River Lea North Park Emergency Access Platforms – 001, Drawing, 8 February 2012.

British Waterways, River Lea Emergency Access Proposed, Study area, 8 February 2012.

British Waterways, Scheme 2 Emergency Exit, Drawing ref. INT09_047-001-11 F, 31 October 2011.

British Waterways, Scheme 2 General Arrangement Drawing ref. INT09_047-002-02 F, 31 October 2011.

British Waterways, Bridge General Arrangement Drawing ref. INT09_047-002-04 F, 31 October 2011.

British Waterways, General Arrangement Drawing ref. INT09_047-002-09 F, 31 October 2011.

British Waterways, Section view Scheme 2 Drawing ref. INT09_047-002-10 F, 31 October 2011.

British Waterways, Prescott Channel Water Control Structure Project – Explanatory Statement, August 2006.


## 11.3 Environment Agency


Environment Agency, Assessments of Thames Tideway Combined Sewer, July 2011.

Environment Agency, Dr D J Solomon: Eel passage at tidal structures and pumping stations, September 2010

Environment Agency, Prescott Channel Water Control Structure Defra and EA Opinions, ppt presentation, January 2006.

Environment Agency, Thames River Basin Management Plan (2009) including Appendices

Environment Agency, WFD Investigation (draft) (June 2013)

## 11.4 EDAW Consortium

EDAW Consortium, Olympic Park and Site Wide Infrastructure London 2012 Parklands and Public Realm: Channelsea Gorge and Bully Point Wetlands Options Study, ODA Reference REP-EDW-AL-ZZZ-OLP-ZZZ-Z-0007 V2.00, August 2007

EDAW Consortium, Olympic Park and Site Wide Infrastructure London 2012 Parklands and Public Realm: Olympic Bowl Options Study, Wetland Bowl Planting Table Revised, August 2008

EDAW Consortium, Olympic Park and Site Wide Infrastructure London 2012 Parklands and Public Realm: Olympic Bowl Options Study, ODA Reference REP-EDW-AL-ZZZ-OLP-ZZZ-Z-0006 V1.0 August 2007

EDAW Consortium, Olympic Park and Site Wide Infrastructure London 2012 Parklands and Public Realm: Channelsea Gorge and Bully Point Wetlands Options Study, ODA Reference REP-EDW-AL-ZZZ-OLP-ZZZ-Z-0007 V2.00, August 2007

EDAW Consortium, Technical Note: Water Level Control Structure and Lock Proposal at Prescott Lock and Three Mills – Effect on Olympic Waterways Construction Methodology REP-ODA-CW-ETN-WAT-ZZZ-XX0003, August 2006.

EDAW Consortium Technical Note: Channelsea Gorge Culvert, July 2008.

## 11.5 London Development Authority

LDA Appendix B Flood Risk Assessment Earthworks and Remediation Marshgate lane Area Stratford, London (Construction Zone 3a) November 2006

LDA, Appendix C: Flood Risk Assessment River Wall Works and Associated Remediation, land along alignment of Waterworks River, Stratford, London, June 2006

LDA, Issues Paper on Proposed Impoundment of River Lea, January 2006.

LDA, Planning Explanatory Statement: River Wall Works and Associated Remediation, land along alignment of Waterworks River, Stratford, London, June 2006

LDA, Site Specific Remediation Strategy for Waterworks River (Carpenters Road) River Wall (Construction Zone 1a), June 2006

## 11.6 Olympic Development Authority

ODA, Earthworks and Remediation, Eastway Cycle Circuit, Stratford, London (Construction Zone 6a), Appendix B, Flood Risk Assessment, November 2006.

ODA, Environmental Statement Annexure Volume 14A and 14B, Flood Risk Assessment (2007). Document reference OLY-GLB-ACC-DOC-FRA-01.

ODA, Environmental Statement Annexure Volume No. 7A: Revised Flood Risk Assessment (2007). Document reference OLY/GLB/ACC/DOC/FRA/01A

ODA, Eradicating invasive weeds during the construction of the Olympic Park, October 2011

ODA, Lessons learned from the London 2012 Games construction project: Promoting biodiversity in the Olympic Parklands, 2012

ODA, London Learning Legacy: Translocation of habitats and species within the Olympic Park, December 2011

ODA, North Park Legacy Transformation E06 to H01 Footpath/MTB trail Option 2 Boardwalk, drawing no. 0241-LCI-WCW-C-DDE-0006 Draft, February 2011

ODA, Olympic Park and Site Wide Infrastructure Design and Master Planning, Waterways Concept design, Ref. REP-BUR-CW-ZZZ-WAT-ZZZ-000001, May 2007

ODA, Olympic Park and Site Wide Infrastructure Design and Master Planning, Waterways Design Brief – Delivery Zone 4, Ref. REP-BUR-CW-04Z-WAT-ZZZ-Z-0001, March 2007.

ODA, Olympic Park and Site Wide Infrastructure Design and Master Planning, Waterways Design Brief – Delivery Zone 3, Ref. REP-BUR-CW-03Z-WAT-ZZZ-Z-0001, March 2007.

ODA, Olympic Park Biodiversity Action Plan, PDT Submission, October 2008.

ODA, Olympic Park Water Management Plan, February 2009

ODA, Olympic Park Waterspace Masterplan (22 July 2008)

ODA, Promoting biodiversity in the Olympic Parklands, October 2011

ODA, Surface Water Drainage Technical Design Strategy, July 2008

ODA, The Olympic Park – Towards a 10 Year Landscape Management and Maintenance Plan, February 2010.

ODA, Towards a 10 Year Landscape Management and Maintenance Plan for the Olympic Park, October 2011

ODA, Treating Japanese Knotweed on the Olympic Park, October 2011

ODA, Volume 12D - Environmental Statement Part 3 – Topic Environmental Assessments Ref: OLY/GLB/ACC/DOC/ENV/01D – Environmental Statement

## 11.7 Miscellaneous

AINA, Management Strategies and Mitigation Measures for the Inland Navigation Sector in Relation to Ecological Potential for Inland Waterways – Appendix A, Pressures and Impact Sheets, March 2008

AINA, Management Strategies and Mitigation Measures for the Inland Navigation Sector in Relation to Ecological Potential for Inland Waterways – Appendix B, Mitigation Measures and Management Strategies Sheets, March 2008

Apem Aquatic Scientists, Fisheries Survey of the Tidal River *Lee* Final report, ODA Reference REP-ATK-CW-ZZZ-WAT-ZZZ-Z-0003, July 2008

Buro Happold, U13U14 photo H08 Link replacement – proposed, October 2011

Buro Happold, Wetland Bowl – Engineering Design Criteria, July 2007

Commission for a Sustainable London 2012: "Sustainable? Naturally" - A review of biodiversity across the London 2012 programme, November 2010.

Department for Environment, Food and Rural Affairs data on designated areas http://archive.defra.gov.uk/environment/quality/water/waterquality/fwfish/

Existing and Proposed Water Depths in Prescott Channel July 2006.

Hackney Marshes User Group, Conservation & Ecology. The Old River Lea, Hackney Marshes News Sheet, October 2009.

[redacted].: Squeezing the most out of existing literature: a systematic re-analysis of published evidence on ecological responses to altered flows, Freshwater Biology (2013)

Joint Nature Conservation Committee and data on protected areas (http://jncc.defra.gov.uk/page-2047)

Legacy Masterplan Framework ([redacted]), Quick Guide to Olympic Park Surface Water Drainage, March 2008

LLDC, [redacted]: Queen Elizabeth Olympic Park Transformation, 2013.

LMF Output E – Sustainable Water Resource Management Strategy (Draft): REP-BUR-CW-ZZZ-ZZZ-ZZZ-L-0001, 10 July 2009

Lower Lea Valley Olympic Applications, Environmental Statement Part 3, Chapter 16-18, 52. Surface Water; Chapter 19-21, 53. Soil Conditions, Groundwater and Contamination, January 2004.

Olympic Park and Site Wide Infrastructure London 2012 Design and Master Planning Report: REP-BUR-CD-ZZZ-ZZZ-XXX-O-000002. Site Wide Surface Water Drainage Concept Design Report and Brief for Detailed Designers, April 2007

OPLC, H08 Replacement Study, General Arrangement, October 2011

OPLC, Towpath Under Carpenters Road Feasibility Study Brief, 11 October 2011

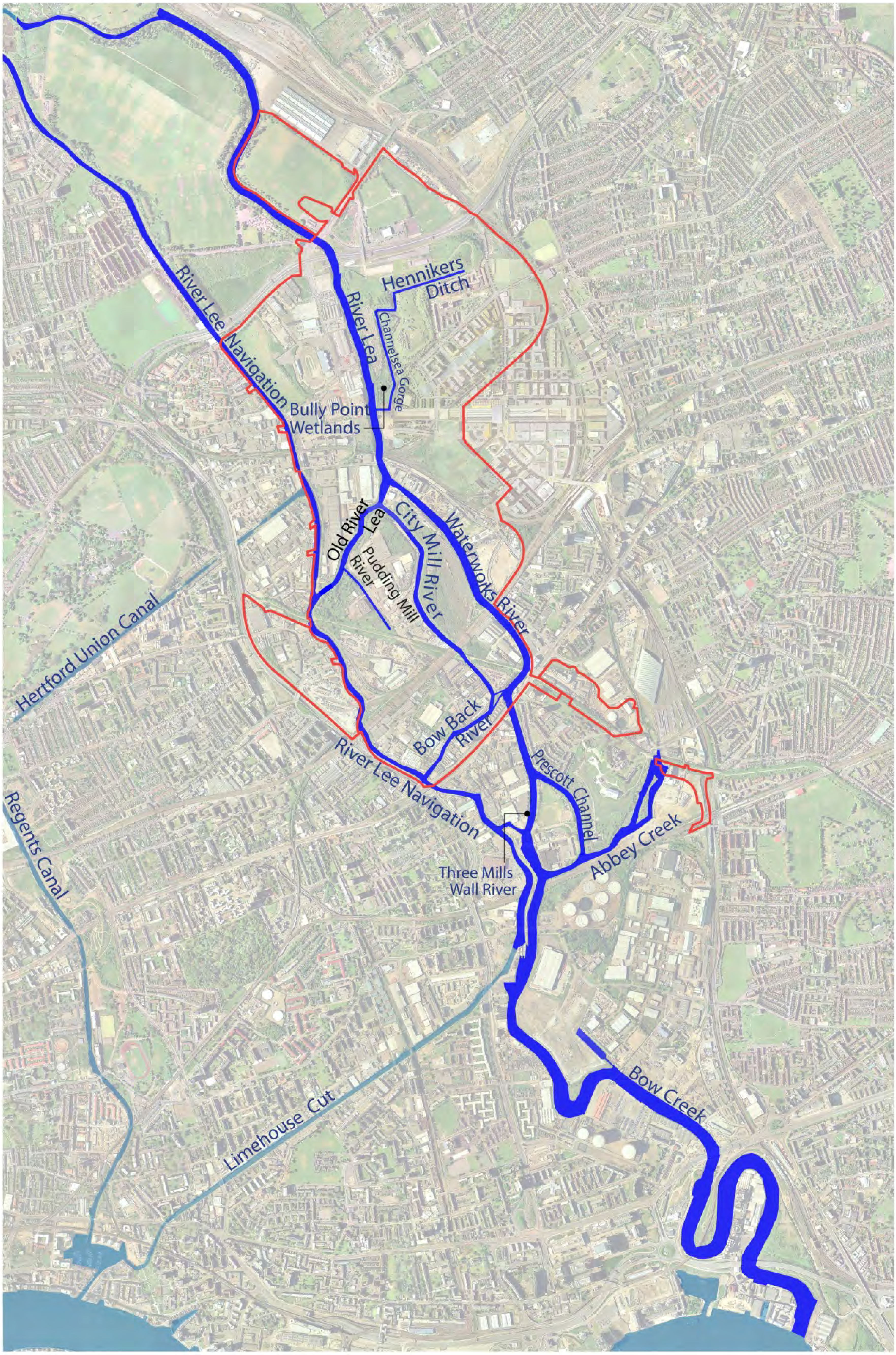
Snook & Whitehead: Water Quality and Ecology of the River *Lee*: mass balance and a review of temporal and spatial data, Hydrology and Earth System Sciences 8(4), *636-650* (2004)

Thames 21: A Water Quality Analysis of the River *Lee* and major tributaries within the perimeter of the M25, from Waltham Abbey to Bow Locks (2011)

Thames Water, Why does London need the Thames Tunnel, July 2011.

Thames21 Tidal Thames Pilot Project – Your Tidal Thames (2012)

# Appendix A - Waterways within QEOP


River Lee Navigation
River Lea
Hennikers Ditch
Channelsea Gorge
Bully Point Wetlands
Old River Lea
Pudding Mill River
City Mill River
Waterworks River
Hertford Union Canal
Bow Back River
River Lee Navigation
Prescott Channel
Three Mills Wall River
Abbey Creek
Regents Canal
Limehouse Cut
Bow Creek

# Appendix B - Collection of “Then and Now” Photos of QEOP

The “Then and Now” presentation was produced in 2013.

It includes photos taken before the works starteg in 2006 (“Then”) and photos taken after the works were largely completed in 2012.

# Olympic Waterways – Then and Now

**Buro Happold**


**Description**: Looking North along the River Lea, upstream of Carpenters Road.

**Then:** Undergrounding works removed pylons in background (north of A12). Vegetation around Bully Point and the Channelsea River visible.

**Now:** Fully transformed Rail Bridge (blue). Olympic Village in the background (East).

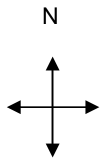
# Olympic Waterways – Then and Now



**Description:** River Lea looking upstream in the north of the Park.

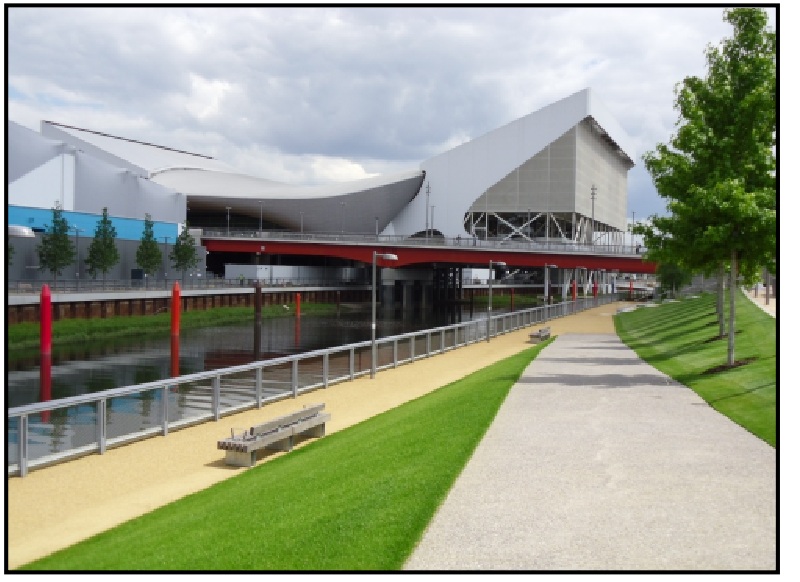
**Then:** Bus depot along on west bank. High water silt marks visible.

**Now:** Reed beds on the west bank part of the Wetland Bowl. Riverside Stadium (Hockey) in background left. F02 in background.

# Olympic Waterways – Then and Now

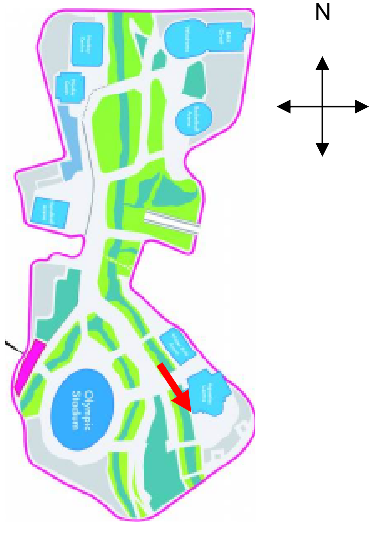




**Description**: Waterworks River, looking south.

**Then**: Highly contaminated Brownfield land on east bank, previous scrap metal and car servicing. Poor wall piling was worsened by tidal influence.

**Now:** Aquatics Centre and Water Polo Arena in foreground. Note British Waterways mooring posts in front of riverside planting on far bank.




N

# Olympic Waterways – Then and Now



**Description**: Looking North along the line of Channelsea Gorge.

**Then**: Channelsea Gorge along line of trees/shrubs on the left hand side, infested by Japanese knotweed. Site of the Lea Valley cycle path.

**Now**: Channelsea Gorge now culverted and landscaped over. Velodrome in background.

# Olympic Waterways – Then and Now

**Description**: Difluence of City Mills River (left) and the Old River Lea (right), located North of Zone 3.

**Then:** High voltage overhead lines, cables now buried in tunnels underground as part of the enabling works.

**Now:** The triangles of the structure of the Olympic Stadium replace the triangles of the pylons. Restored green bridge, north of the stadium, spans the head of the City Mills River.

# Olympic Waterways – Then and Now

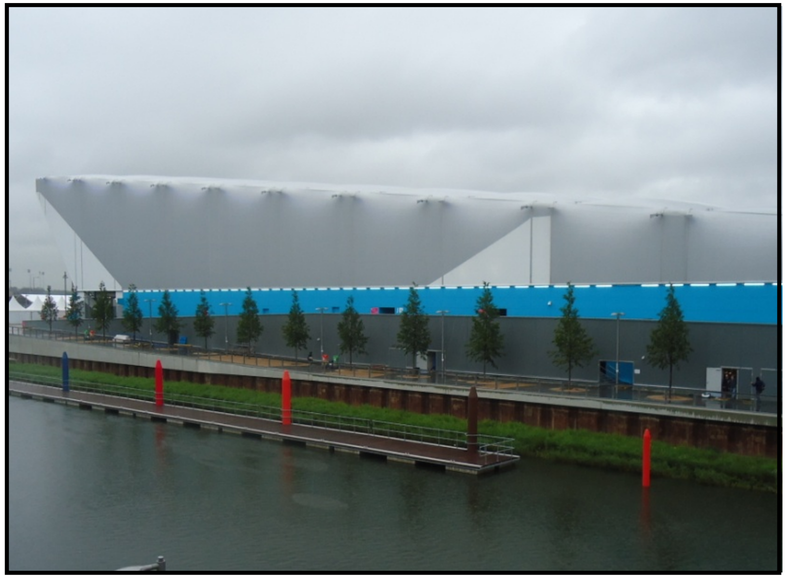
**Description**: Carpenters Road Lock, looking north along the River Lea.

**Then:** Carpenters Lock in state of disrepair and no longer in use. Important in that it retained the Bow Back Rivers level from the Waterworks River**.**

**Now:** The large land bridge built over the lock with rubber footpath (pictured right) on top lies just north of the Olympic Stadium.

# Olympic Waterways – Then and Now

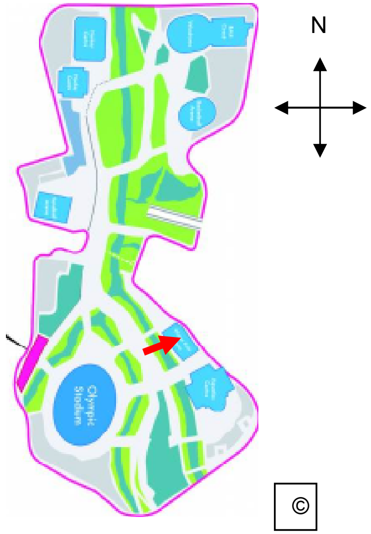




**Description**: View across the Waterworks River to Zone 1.

**Then:** Contaminated site with poor quality pile cap and unsightly silt.

**Now:** Water Polo Arena (Temporary structure) and BW ship impact protection posts and mooring pontoon.



# Olympic Waterways – Then and Now



**Description**: Looking upstream along the River Lea.

**Then:** Travellers site and warehousing adjacent to the bus depot built on war-time bomb damaged material.

**Now**: Riverside Stadium (Hockey) on west bank with new footbridge, Y01, across the River Lea.

# Olympic Waterways – Then and Now

**Description**: Looking towards the west bank (right) of the River Lea.

**Then:** The bus depot, the river bank showing signs of significant slip circle damage.

**Now**: Landscaping along right bank and “affordable housing” for Sand Martins.

# Olympic Waterways – Then and Now



**Description:** City Mills River looking upstream.

**Then:** Chemical works with highly contaminated ground conditions behind a river wall/flood defence in very poor condition.

**Now:** Soft landscaping on west bank in place of the chemical works. Olympic Stadium in the background.

# Olympic Waterways – Then and Now

**Buro Happold**

**Description:** City Mills River, looking downstream.

**Then:** The chemical works and industrial land site on the west bank of the City Mills River. East bank river wall showing signs of rotational failure.

**Now:** Main Stadium area "back of house" along the west bank.

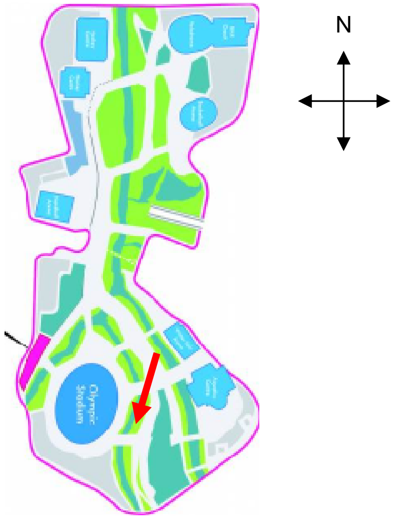
# Olympic Waterways – Then and Now

**Buro Happold**

**Description:** City Mills River looking downstream.

**Then:** Sun Wharf site on the west bank.

**Now**: New bridge, F11, across the river in front of the 115m high ArcelorMittal Orbit (Architect: Anish Kapoor) and the Olympic Stadium on the right, in place of Sun Wharf.



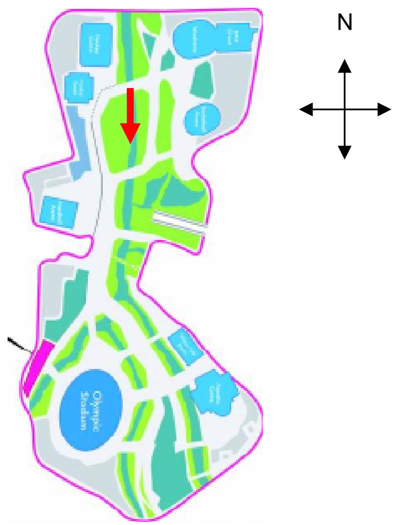
# Olympic Waterways – Then and Now

**Buro Happold**

**Description**: The River Lea looking downstream in north of Park.

**Then:** Photo viewed from the Lea valley cycle track. The bus depot is visible on the west bank.

**Now**: The BA Live Site in the Wetland Bowl. ArcelorMittal Orbit and the Aquatics Centre (left) in the background.



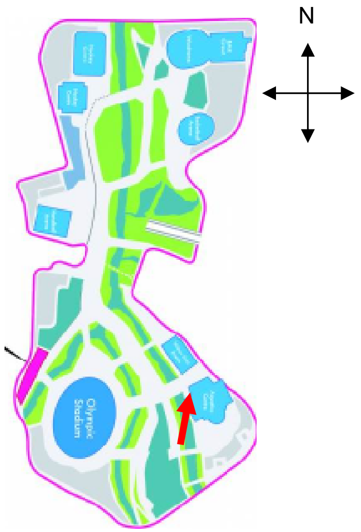
# Olympic Waterways – Then and Now



**Description**: Waterworks River looking upstream.

**Then:** Network Rail Thornton Fields train sidings produced contaminated land. Waterworks River tidally influenced. Viewed at low tide.

**Now:** One of the Aquatics Centre seating wings (temporary) on the east bank with Bridge F10b and Water Polo Arena (temporary) in the background.



# Olympic Waterways – Then and Now

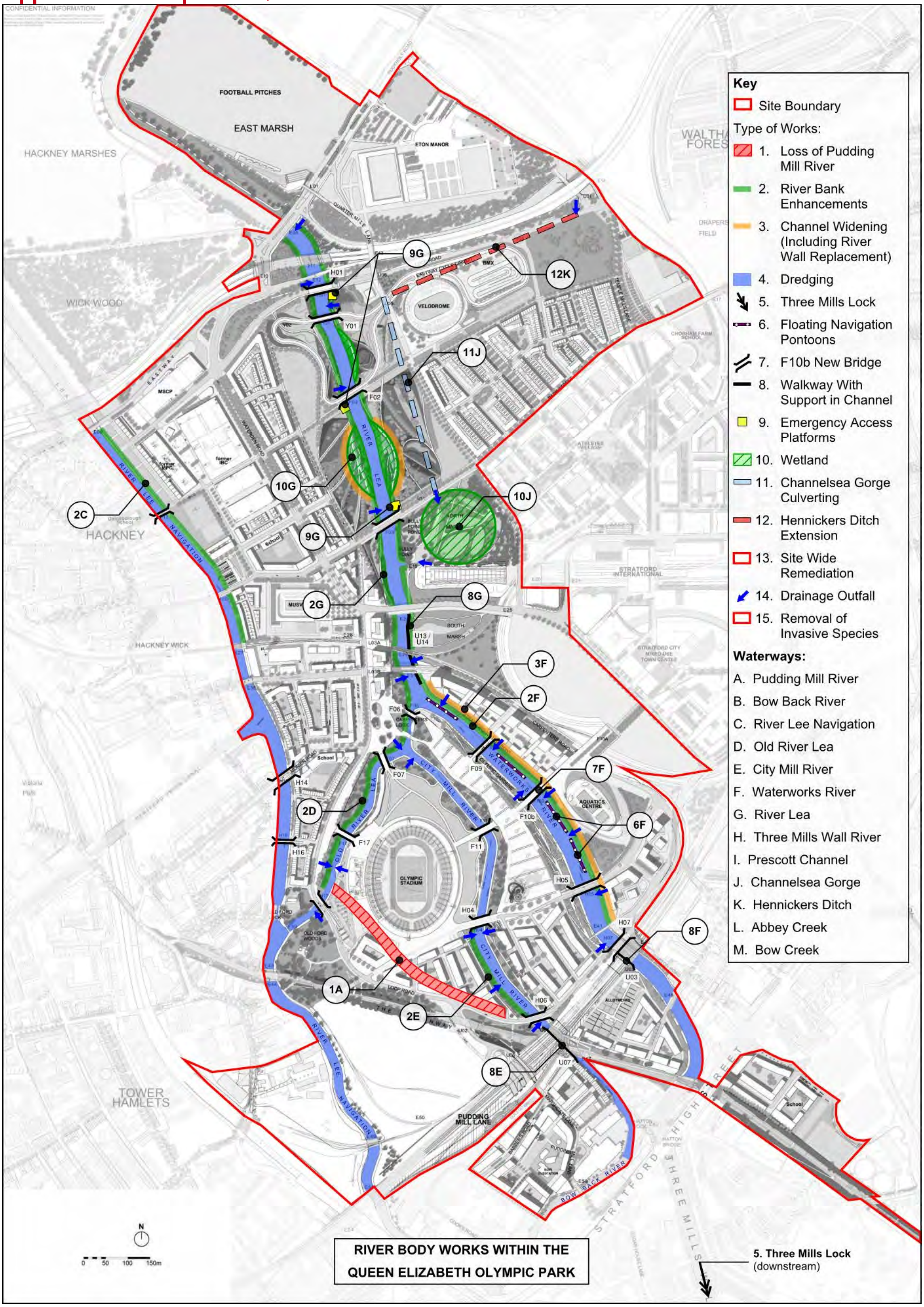
**Buro Happold**

**Description:** Waterworks River looking upstream from southern end of Zone 1.

**Then:** Footbridge, E41, in poor condition and west bank river walls unsightly. East bank showing signs of slope instability.

**Now:** Waterworks River, now non-tidal, flows past the Aquatics centre on right east bank.

# Appendix C - Proposed QEOP works



# Appendix D - Canal & River Trust's Dredging Strategy

s40 [redacted]

Canal & River Trust

# The Trusts Dredging Strategy
## Current Review – Why Now?

- Previous practices not always well defined
- Processes – required greater clarity
- The need to apply asset management rigour to decisions in line with the requirements of AMP12/PAS55 – risk management

# The Trusts Dredging Strategy

**Dredging methods**

- Traditional excavation using floating plant and hoppers - normal
- Land based excavators possible if access allows - rare
- Water Injection Dredging (Rivers, G&S)
- Cutter Suction Dredging - rare
- Hoeing and Raking – Rivers, and occasional for weed and debris removal
- Spot dredging – often high unit costs due to site set up

**Treatment & Disposal**

- On-site treatment to lower water content by vacuum, centrifuge, lime, mixing, spreading, drying – expensive, laborious and may increase disposal volumes.
- Disposal as on-site backfill to piles or bank protection - preferred
- Disposal to local agricultural land – environmental legislation
- Disposal to licensed Trust owned tip – few left with adequate capacity
- Disposal to licensed waste site – few available in UK, large transport costs

# The Trusts Dredging Strategy

Canal & River Trust

**COSTS**

- Expensive – generally £100k/km to +£500k/km
- Waste Regs. making this increasingly expensive (doubled 2003 to 2006)
- Series of Acts and Regulations 1998 to 2005 – still continuing – Trust not exempt in any way
- Traditional disposal to landfill or to banks and behind bank protection preferred
- Liquid waste now banned so pre-treatment required - lime, centrifuge, PFA

Canal & River Trust

# The Trusts Dredging Strategy
## Identification - Hydrographic Survey

## 8 year cycle – full network

### Single Point Sonar surveys

- GPS Controlled Single Point echo sounding - for reservoir, dock and tidal surveys.
- Survey output - contour bed plan, digital terrain model, enables volume calculations for dredging and reservoir capacity.

### Scanning Sonar Profiler surveys

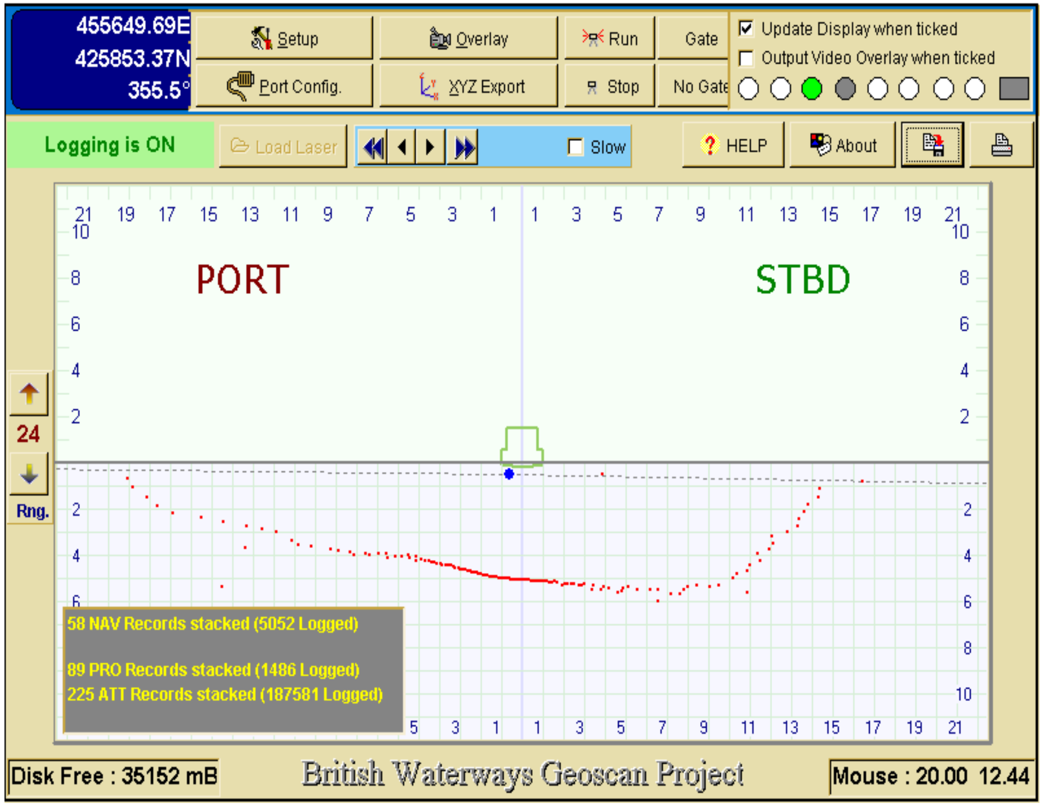
- GPS Controlled Scanning profiler - collects a ‘swathe’ of data across the canal bed.  Many 1000’s of points.
- Allows extraction of cross sections extracted at any point
- Cross section data used to calculate Dredging Priority Trigger (DPT) compliance

Canal & River Trust

# The Trusts Dredging Strategy
## Onboard Display

River Aire –
Section location


British Waterways Geoscan - 13:15:09 12-May-2008

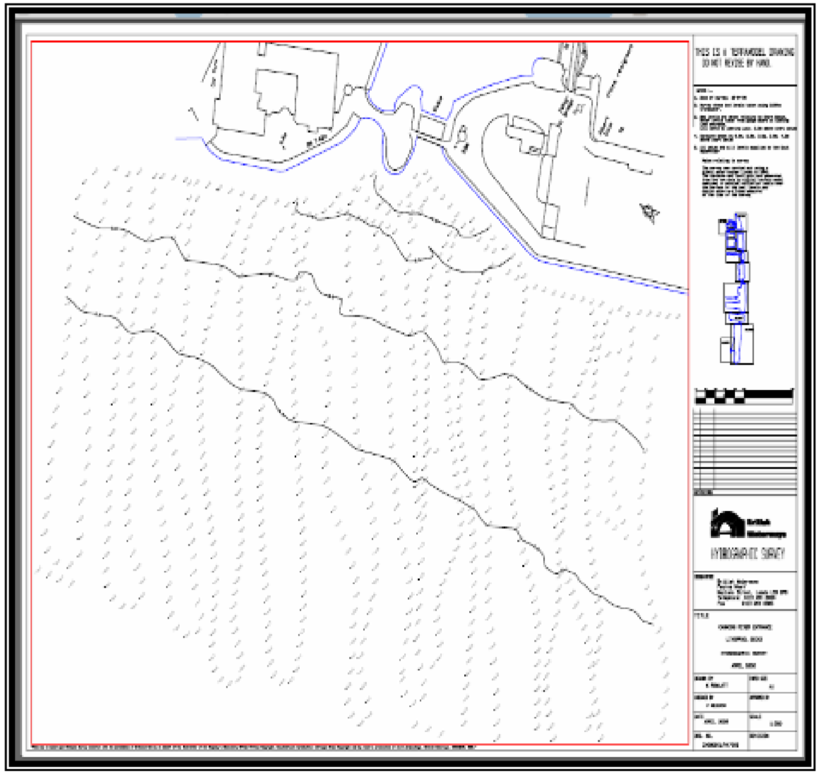



On-board display of section of River Aire

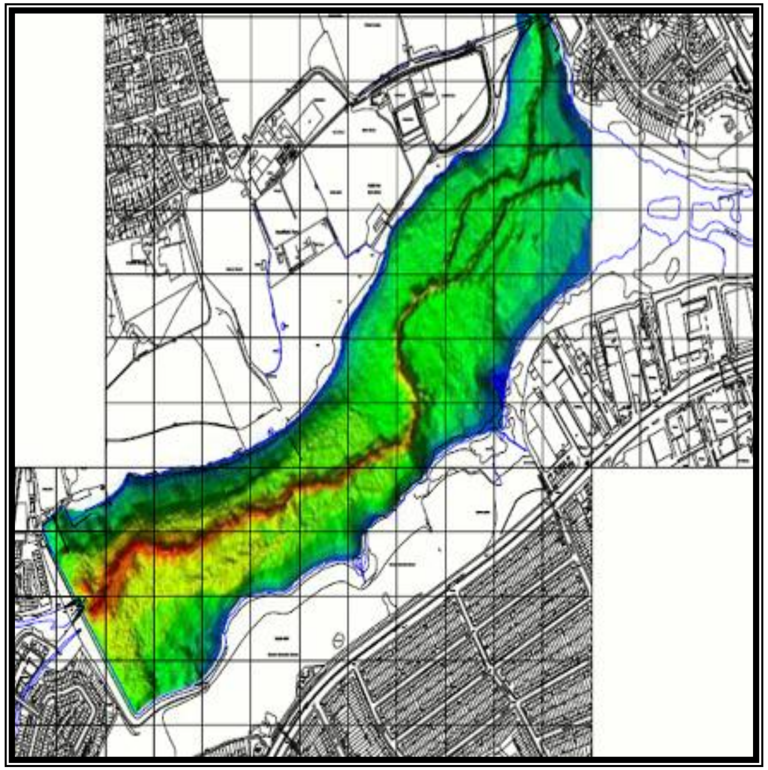
Canal & River Trust

# The Trusts Dredging Strategy
## Survey Report Outputs

Contour chart and 'run line' survey of the River Mersey at Liverpool Docks approach



Colour DTM of Brent Reservoir showing relic river channel running through centre of reservoir



Canal & River Trust

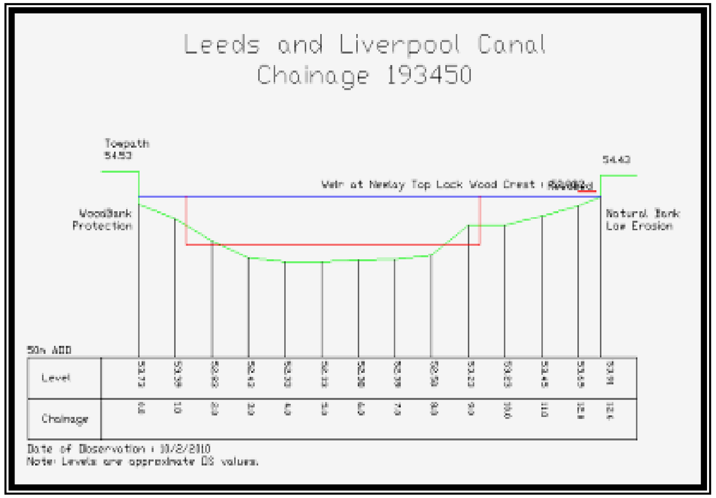
# The Trusts Dredging Strategy
## Establishing Normal Water Level

- Controlling water level established to ensure accuracy and repeatability of survey.
- GPS height and position found on controlling weir, to accuracy of <20mm.
- Currently levelling all the weirs across the network. 958 so far.

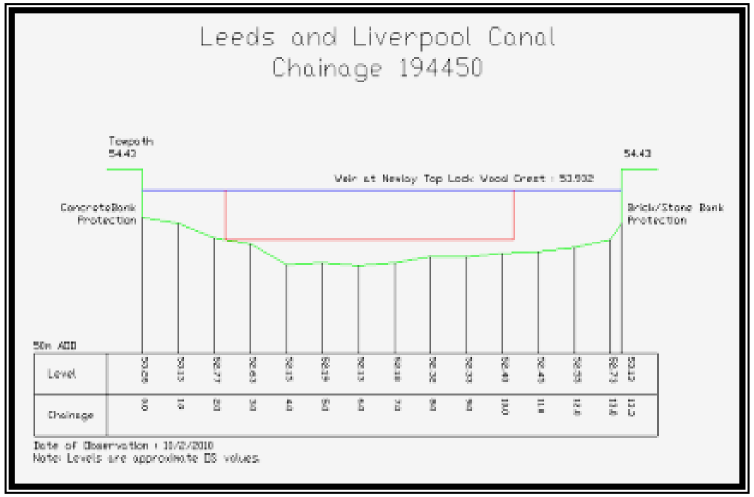
# The Trusts Dredging Strategy
## Cross Section Analysis

- MOC 'trigger' box sections developed in late 1990's. Terminology confusing
- Now changing to **Dredging Priority Trigger (DPT) box**
- Cross sections extracted from survey data every 50m and DPT box 'driven' over each cross section
- 95% of DPT box must be clear from silt blockage at the 'best-fit' location.
- Formerly 70% of cross sections in each km must meet the DPT requirement to be compliant - changed to 90% - much tougher test

*Failing Section*

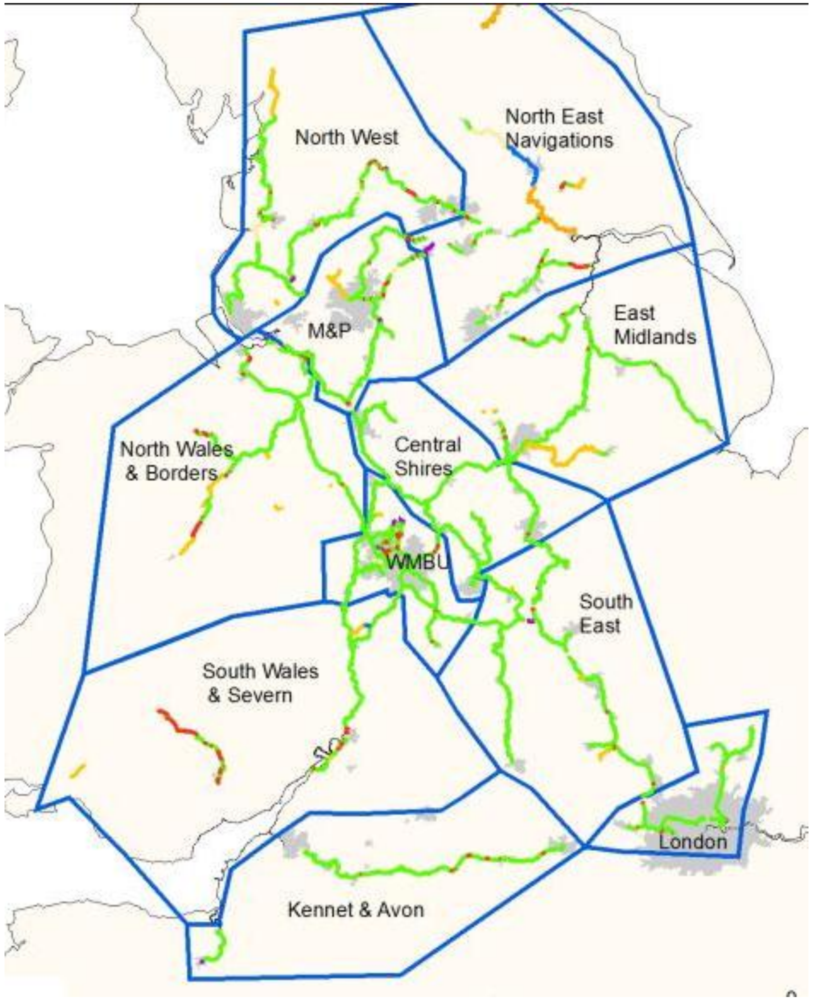



*Passing Section*



Canal & River Trust

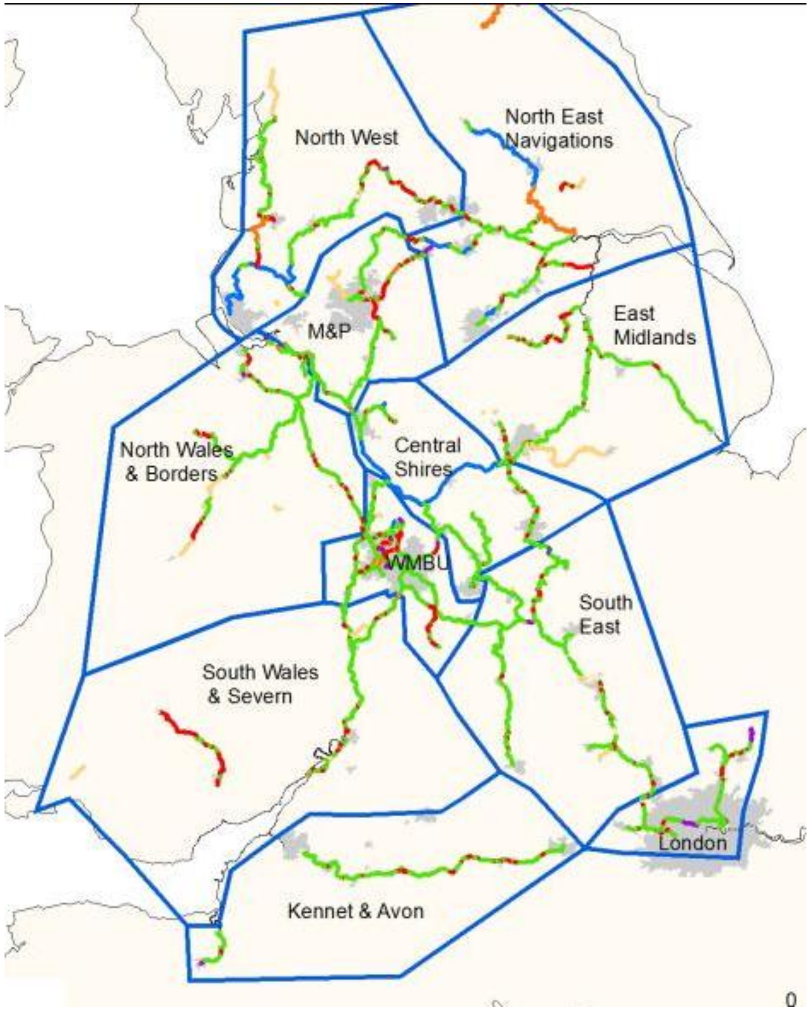
# The Trusts Dredging Strategy
## Current 70/30 DPT Compliance Map




- Visual display of DPT
- Passing lengths shown in green, failing lengths in red.
- At 70/30 ratio 217km (7%) of 3078km of canal and river fail – 93% pass
- Time to increase threshold to target better customer service

Canal & River Trust

# The Trusts Dredging Strategy
## 90/10 DPT Compliance Map




- At a 90/10 ratio 488km (16%) of 3078km canal and river fail – 84% pass
- Doubles the number of failing lengths
- Better match with customer complaint data
- Target to achieve 90% pass

Canal & River Trust

# The Trusts Dredging Strategy
## Ranking - The Dredging Matrix Score

### Dredging score matrix

Sections of canal that are identified as ‘failing’ DPT initiates further analysis:

- Traffic type – is the waterway commercial or leisure use?
- Boat usage – what are the annual lockage figures for the canal?
- Water Management – has the pound the ability to act as reservoir storage if dredging was carried out (usually deemed as over 5km long).

Calculation results in a **Matrix Score**

### Dredging Priority

- Matrix score together with customer complaints allows ranking and priority list for dredging
- Planning for dredging work commences.

# The Trusts Dredging Strategy
## Project Delivery

- National dredging team
- Potential dredging projects considered alongside other asset repairs on risk basis
- Term Contract with Land & Water Services
- Minimum throughput agreed, when achieved results in contract discount

# The Trusts Dredging Strategy

## Annual Dredging Expenditure

| | |
|---|---|
| 1998/99 | £500,000 |
| 1999/00 | £1,685,000 |
| 2000/01 | £2,778,000 |
| 2001/02 | £3,773,000 |
| 2002/03 | £6,817,000 |
| 2003/04 | £4,950,000 |
| 2004/05 | £2,230,000 |
| 2005/06 | £4,649,000 |
| 2006/07 | £5,132,000 |
| 2007/08 | £4,770,000 |
| 2008/09 | £2,978,000 |
| 2009/10 | £3,453,000 |
| 2010/11 | £3.546,000 |
| 2011/12 | £3,742,000 |

**Current 10 year Average = £4m/year**

**(excludes approx. £0.75m to £1.0m/year spot dredging)**

# The Trusts Dredging Strategy
## New Strategy

- Strategy and methodology to be published
- DPT boxes logically defined and published.
- Failing length threshold reduced to10% from 30%
- Increase ratio of spot dredging to main-line dredging over next 3 years  - Cycles analysed and implemented
- Total dredging expenditure to rise steadily from around £5m (2012/13) to £10m (2021/22) - but kept under review for efficiencies
- £80m investment over 10 years – and possibly more depending on Trust risk profile
- Better communication of programme and designs to NAG, Waterway Partnerships, stakeholders.

# The Trusts Dredging Strategy

Canal & River Trust

**2013/14 Planned Dredging – HEALTH WARNING! - £6m**

- G&S/River Severn
- Mon& Brec
- Ribble Link
- Weaver
- Selby
- Shropshire Union
- Slough Arm
- River Trent Lock tail
- Ellesmere/Chester
- Ashton
- Erewash
- Birmingham Main Line – spot
- GU summit – spot
- T&M – spot
- HNC – spot
- Harecastle/Macc – spot
- Daw End/Rushall – spot
- Various other spot locations under review

[redacted]
Buro Happold Limited
17 Newman Street
London
W1T 1PD
UK

Telephone: +44(0) [redacted]
Facsimile: +44(0) [redacted]
Email: Click here to enter text.