

London 2012 Olympic Park

Enabling Works (Stage 1) Consolidated Validation Report – Planning Delivery Zone 8

July 2012

Notice

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Contents

Section	Page
List of Figures	ii
List of Drawings	ii
List of Appendices	iii
List of Tables	iii

PART I

1. Introduction	1
1.1 Objectives	1
1.2 Report Objectives	1
1.3 Relevant Planning Conditions	4
1.4 Outstanding Works	4
1.5 Limitations/Exclusions	5
2. Basis of Remedial Design	6
2.1 Site Location	6
2.2 Olympic and Legacy End Use	7
2.3 Site History	7
2.4 Site Investigation	8
2.5 Geology	9
2.6 Hydrogeology	10
2.7 Hydrology	10
3. Development of Remediation Design	12
3.1 Human Health Design	14
3.2 Controlled Waters Design	15

PART II

4. Implementation of Design – Site Preparation (Enabling Works)	19
4.1 Summary of Works Undertaken	19
4.2 Unsaturated Zone (Combined Human Health and Controlled Waters)	21
4.3 Saturated Zone	26
4.4 SSRS Groundwater Monitoring	28
4.5 Other Matters	28
4.6 Sampling and Analytical Testing	30
4.7 Waste Management	31
4.8 Health, Safety and Environment	31
5. Conclusions	32
5.1 Further Work	32
6. References	38

List of Figures

- Figure 1: Location of Planning Delivery Zone 8
- Figure 2: Olympic End Use for Planning Delivery Zone 8
- Figure 3: Legacy End Use Planning for Delivery Zone 8
- Figure 4: Site Investigation Locations for Planning Delivery Zone 8
- Figure 5: Sub Grade Level for Planning Delivery Zone 8
- Figure 6: Sub Formation Level for Planning Delivery Zone 8
- Figure 7: Enabling Works Formation Level for Planning Delivery Zone 8
- Figure 8: Extent of Marker Layer and Human Health Separation Layer for Planning Delivery Zone 8
- Figure 9: Non Remediated Areas within Planning Delivery Zone 8
- Figure 10: Summary of Exceedances requiring Action by Follow On Projects
- Figure 11a: Spatial Coverage of the Human Health Validation Reports within Planning Delivery Zone 8
- Figure 11b: Spatial Coverage of the Unsaturated Zone and Groundwater Validation Reports within Planning Delivery Zone 8

Shape files shall be presented in the Stage II CVR

List of Drawings

- SKE-ATK-XX-ZZZ-OLP-XXX-O-0003: Sub Zone Remediation Areas (including areas anticipated as no remediation)
- ENW-ATK-8a-SP1-DR-Y-3-H11-0517 Schematic Conceptual Site Model for CZ8a Human Health Assessment
- ENW-ATK-8a-SP1-DR-Y-3-H11-0518: Controlled Waters Conceptual Site Model SSRS CZ8a
- 2DD-ATK-CM-08b-OLP-XXX-E-0013: Schematic Conceptual Site Model for CZ8b Human Health Assessment
- 2DD-ATK-CM-08b-OLP-XXX-E-0014: Schematic Controlled Waters QRA Conceptual Model for CZ8b
- ENW-ATK-8c-SP1-DR-Y-3-H11-0566 8c North Human Health QRA Schematic Conceptual Site Model
- ENW-ATK-8c-SP1-DR-Y-3-H11-0567 8c North Controlled Waters QRA Schematic Conceptual Site Model
- ENW-ATK-8c-SP1-DR-Y-3-H11-0517 8c South Human Health QRA Schematic Conceptual Site Model
- ENW-ATK-8c-SP1-DR-Y-3-H11-0518 8c South Controlled Waters QRA Schematic Conceptual Site Model
- 2DD-ENL-CK-08a-OLP-SP1-E-0397: CZ8a Hotspot 20 – Exceedances of the Legacy Commercial Land Use Human Health SSAC Sheets 1 and 2.

- ENW-ATK-8a-SP1-DR-Y-3-H11-0521: SSRS CZ8a Location of Zones used in Controlled Waters DQRA
- ENW-ATK-8c-SP1-DR-Y-3-H11-0511: SSRS CZ8c South Site Plan showing Human Health QRA Zones
- ENW-ATK-8c-SP1-DR-Y-3-H11-0515: SSRS CZ8c South Controlled Waters Risk Assessment Zoning
- ENW-ATK-8c-SP1-DR-Y-3-H11-0565: SSRS CZ8c North Controlled Waters Risk Assessment Zoning
- 2DD-ENL-CK-ZZZ-OLP-SP1-E-0419: Olympic Park South: Areas that require vapour mitigation measures or further vapour assessment.

List of Appendices

- Appendix A: Glossary of Terms and Definitions
Appendix B: Schedule of Key Documentation (including summary of contents)
Appendix C: Key Parties
Appendix D: Retained Areas within PDZ8
Appendix E: Permit to Proceed Protocol (CD only)

List of Tables

- Table 1.1: PDZ8 Validation Reporting Structure
Table 1.2: Validation Related Planning Conditions to be discharged by this Report
Table 2.1: Summary of PDZ8 Site History
Table 2.2: Summary of exploratory holes in PDZ8 (during the Site Investigation Phase only)
Table 2.3: Summary of PDZ8 Geology
Table 4.1: Number of Unsaturated Zone Defined Hotspots in PDZ8
Table 4.2: PDZ 8 Unsaturated Zone Fill Volumes, Sampling Frequency and Corrective Actions
Table 5.1: Outstanding Works transferred to the Follow On Projects, Restrictions on Future Works and some key aspects for the Follow On Projects to consider as part of their works

PART I

1. Introduction

1.1 Objectives

The aim of this Enabling Works Consolidated Validation Report (CVR) is to provide a high level commentary on the approved remediation related documentation pertaining to Planning Delivery Zone 8 (PDZ8). These remediation works were completed as part of the Olympic Delivery Authority (ODA) redevelopment of the London 2012 Olympic Park in Stratford, London. On the basis that the individual remediation reports have previously been approved by the Local Planning Authority (Olympic Delivery Authority Planning Decisions Team (PDT)) this Enabling Works CVR will not reproduce or re-evaluate any of the detailed testing, results, or assessments that have been previously reported and are contained therein.

This Enabling Works CVR has been prepared to gain PDT's partial discharge to the ODA's remediation work carried out by the Enabling Works project under Condition 35 of the Olympic, Paralympic and Legacy Transformation Planning Applications: Site Preparation Planning Application⁽¹⁾. However it is acknowledged that a further 12 month groundwater monitoring period is required across PDZ8 as it falls within the 'Southern Plume'. This groundwater monitoring will commence as soon as reasonably practicable post Games in order to establish long term trends in contaminant chemical concentrations in the River Terrace Deposits within the CZ3a Banner and Southern Plume areas. As a result this groundwater monitoring and any associated remedial actions represent a residual remediation item, which until its completion to the satisfaction of the Regulator/PDT, means Condition 35 of the Olympic, Paralympic and Legacy Transformation Planning Applications: Site Preparation Planning Application⁽¹⁾ can only be partially discharged.

1.2 Report Objectives

The focus of this report is to discharge the ODA's responsibilities under the relevant Planning Conditions in the following principal Planning Applications. The CVRs prepared by the ODA shall be issued to the PDT for approval in two stages to provide clarity and ensure progressive regulatory approval is achieved. This two stage process, which covers the ODA's work, is set out as follows, but it should be noted that additional reporting stages may be required should third parties, such as LOCOG, be required to validate their works:

- **Stage 1** will comprise Part I (Background) and Part II (Implementation of Design – Site Preparation (Enabling Works)). Part I sets out the remediation works within the context of the preceding remedial design. Part II shall concisely discuss the implementation and validation works completed by the Enabling Works Team. The objective of this CVR (Stage 1) is to obtain a partial discharge from PDT for the remediation work carried out under Condition 35 of the Olympic, Paralympic and Legacy Transformation Planning Applications: Site Preparation Planning Application⁽¹⁾. However it is acknowledged that a further 12 month groundwater monitoring period is required within the River Terrace Deposits across PDZ8 as it falls within the

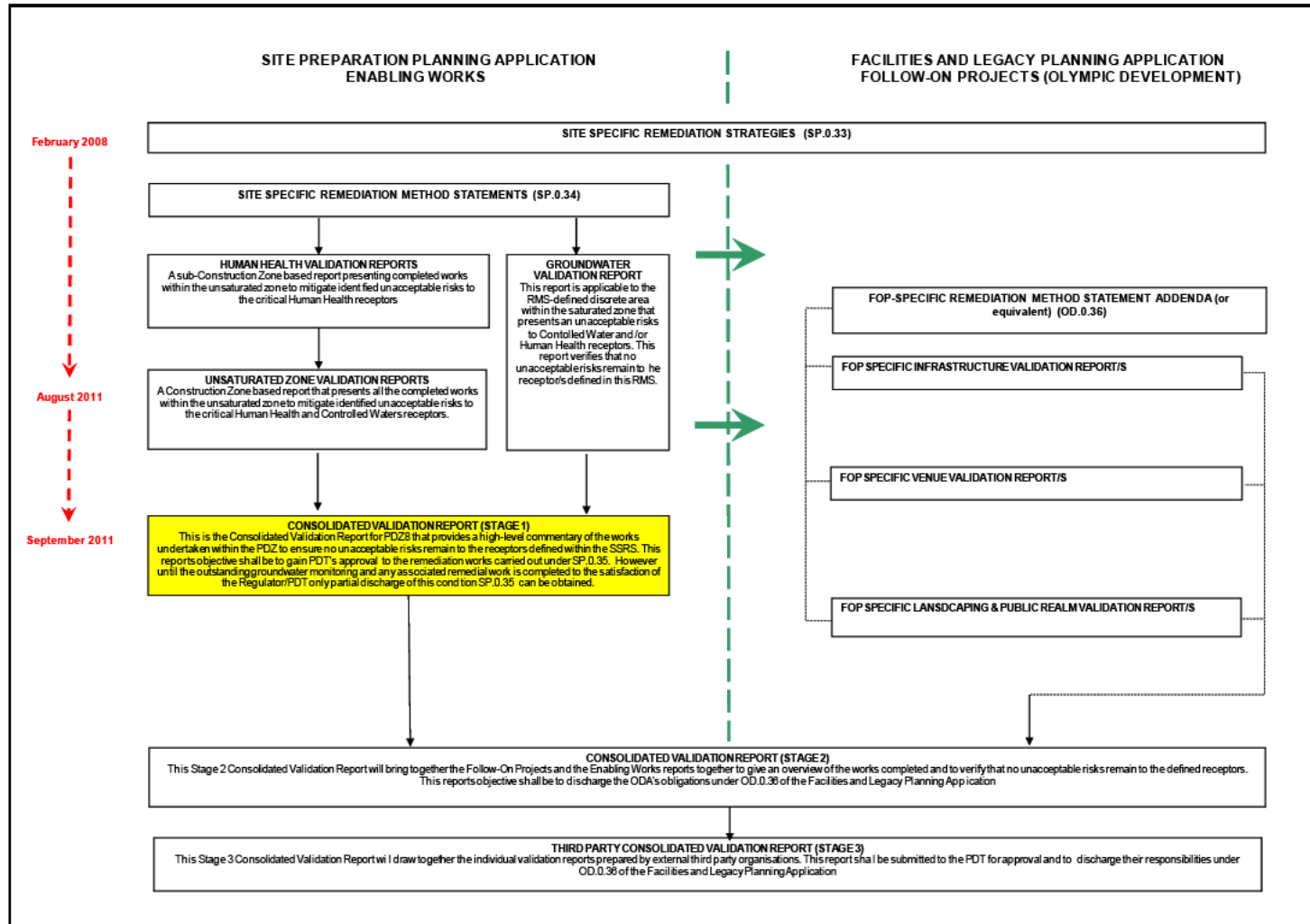
'Southern Plume'. Until this monitoring and any associated remedial action is completed to the satisfaction of the Regulator/PDT then full discharge of Condition 35 cannot be achieved.

- **Stage 2** will comprise only Part III (Implementation of Design – Olympic Development (Follow-on Projects)). Part III presents the completed construction and remediation works as required to facilitate the development aspects of the works i.e. infrastructure, venues and landscaping. The same CVR issued with completed Part III will be submitted to discharge the ODA's obligation under Condition 36 of the Olympic, Paralympic and Legacy Transformation Planning Applications: Facilities and Their Legacy Transformation Planning Application⁽²⁾ and subsequent applicable Slot-In Planning Conditions relating to construction variations.
- **Stage 3** may be required in instances where the Human Health Separation Layer and other overlay / completion works will be carried out by external third party organisations, most notably the London Organising Committee of the Olympic and Paralympic Games (LOCOG). In such circumstances, it will be the responsibility of these third parties to prepare, submit and obtain PDT approval of their works by way of separate Validation Reports. As a consequence of these separate validation reports, it is currently envisaged that another CVR (Stage 3) will require submittal under Condition 36 of the Olympic, Paralympic and Legacy Transformation Planning Applications: Facilities and Legacy Transformation Planning Application⁽²⁾. If such a Stage 3 CVR is required this will be prepared and submitted by a third party organisation.

Liaison will be undertaken with LOCOG to understand not only the areas of their work which require the production of a Stage 3 CVR, but also the timing of this report production. The findings from these discussions will be conveyed in the Stage 2 CVR.

The PDZ8 validation reporting sequence, presenting these three stages of Consolidated Validation Reporting, is illustrated in Table 1.1 below.

Table 1.1: PDZ8 Validation Reporting Structure



Note: Please refer to Appendix B for a summary of each report and the development of the remedial design, implementation and validation that is covered by this Stage 1 CVR.

1.3 Relevant Planning Conditions

The reporting boundary for this CVR is presented on Figure 1. The document is submitted to the PDT for partial discharge of the Planning Conditions listed in Table 1.2 below.

Table 1.2 - Validation Related Planning Conditions to be discharged by this Report

<u>Site Preparation Planning Application (No. 07/90011/FUMODA)</u>		
<i>SP.0.35</i>	<i>Remediation Validation</i>	Stage 1 submitted for Discharge
SP.0.35	<p>Remediation validation Validation of the Remediation Works for the purposes of human health protection must be provided within one month of completion of the Enabling Works Protection Layer within any Planning Delivery Sub-Zone. When all Remediation Works necessary for the protection of human health are completed within any particular Planning Delivery Zone, a consolidated Validation Report drawing together the Planning Delivery Sub-Zone validations shall be submitted to the Local Planning Authority. This shall include detailed topographic mapping of the as-built ground levels. Validation of the Remediation Works for the protection of controlled waters shall be undertaken on completion of the relevant Remediation Works relating to controlled waters and a Validation Report shall be submitted to the Local Planning Authority for the whole of each Planning Delivery Zone.</p> <p>Reason: To ensure that all Remediation is properly validated and recorded.</p>	

1.4 Outstanding Works

As part of the outstanding works in PDZ8 it is acknowledged that a further 12 month groundwater monitoring period will commence as soon as reasonably practicable post Games in order to establish long term trends in contaminant chemical concentrations and the potential requirement for additional remedial works.. This monitoring will specifically target the presence of the main contaminants of concern in the River Terrace Deposits within the CZ3a Banner and Southern Plume areas. The contaminants to be monitored includes vinyl chloride, chlorinated ethanes, dissolved ethanes, methane, arsenic (total and dissolved), and total organic content determinants such as sulphate, iron and chloride. In addition the presence or absence of non-aqueous phase liquids (NAPL) will also be recorded. The monitoring works and any additional that may be required will be undertaken to the satisfaction of the Regulator/PDT. This 12 month monitoring and any associated remediation works represent a residual remediation item, which until completed to the Regulator/PDT satisfaction means that Condition 35 of the Olympic, Paralympic and Legacy Transformation Planning Application: Site Preparation Planning Application⁽¹⁾ can only be partially discharged.

In PDZ8 within the Enabling Works scope, there is one site wide report currently “in consultation” with PDT that affects PDZ8. Consequently, the latest version of this site wide Retained Areas Risk Assessment report has been used.

The CVR Stage 1 and Retained Areas Risk Assessment report represent the site condition at the end of the Enabling Works phase of the development, while the CVR Phase 2 will consider the site condition from the end of the Enabling Works phase through to the completion of the FoP works. Notwithstanding this the CVR stage 1 will be updated to reflect the approval of the Retained Areas Risk Assessment report.

1.5 Limitations/Exclusions

This CVR is based on third party information made available to the ODA from the sources listed as key supporting data and references and the information is assumed to be accurate and complete.

This CVR does not present new information or re-evaluate any of the data previously assessed within the approved documents summarised herein.

This CVR should be read in light of the legislation, statutory requirements and/or industry good practice applicable at the time of the works being undertaken. Any subsequent changes in this legislation, guidance or design may necessitate the findings to be reassessed in the light of these circumstances.

2. Basis of Remedial Design

The Enabling Works Project primarily comprised site clearance, demolition, earthworks and remediation works to deliver a platform upon which the infrastructure and venues for the London 2012 Olympic Park could be constructed. These works were implemented by the Enabling Works Tier 1 Contractor (BAM Nuttall Limited (BNL)). The objective of the Enabling Works was also to ensure the site was remediated to a standard protective of both human health and controlled waters receptors as defined by the Olympic and Legacy Masterplans (see Section 2.2).

The Global Remediation Strategy (GRS) was prepared by Capita Symonds for the project as a high level roadmap that was further developed by the construction zone specific Site Specific Remediation Strategies (SSRS). In addition, the SSRS were informed by the investigation works completed in accordance with the Intrusive Investigation Method Statement (IIMS) that presents a framework and provides a generic specification for undertaking contamination intrusive investigations across the London 2012 Olympic Park. For the purposes of risk assessment and remediation, the PDZ8 Site Specific Remediation Strategies were divided into Construction Zone 8a (CZ8a)^(3a), Construction Zone 8b (CZ8b)^(3b) and Construction Zone 8c (CZ8c)^(3c) due to their physical separation, vacant possession and the earthworks programme.

These construction zones were further sub-divided according to Legacy land use and Designer defined remediation areas and phasing of the works due to handover dates (to others).

2.1 Site Location

PDZ8 comprises three portions of land, each separated by the existing road network. In combination these site have a total site area of approximately 10 hectares, which is presented on Figure 1. Reference should also be made to Drawing SKE-ATK-XX-ZZZ-OLP-XXX-O-0003 (Sub Zone Remediation Areas (including areas anticipated as no remediation)), which illustrates areas in PDZ8 that could not be remediated as they were covered by existing roads or buildings that were to be retained. Additionally rivers also flowed through PDZ8, which also prevented remediation from being undertaken at certain locations in PDZ8. In the case of CZ8c, works were completed up to the physical site boundary, which was beyond the Construction Zone Boundary. The Olympic Park Development is present to the north, north-west and east (of CZ8c), and residential and commercial buildings are present to the south and south-west.

2.2 Olympic and Legacy End Use

The Olympic and Legacy end use as defined by the Designers is as follows:

Olympic Mode (Figure 2): The majority of PDZ8 will comprise of hardstanding. CZ8a will comprise a car park. CZ8b an “Accreditation Checking Area” with a small area in the north designated as an internal shuttle bus terminal. Similarly, CZ8c will also contain an accreditation area along with spectator services.

Legacy Mode (Figure 3): CZ8a will include office building with commercial/employment land uses such as amenities for the surrounding employment premises. The northern portion of CZ8b will comprise an area designated for the Crossrail DLR expansion and the remainder of the site will be used for office buildings and a car park. CZ8c will consist of residential mixed use development, which may also comprise areas of Soft and Hard Landscaping. The Crossrail DLR expansion of Pudding Mill Station lies to the north west of CZ8c.

There have been no significant land use changes within PDZ8, for example, venue movements or changes in topography. In the latter case, these topographical changes were reviewed and assessed (where appropriate) in SSRS and RMS addenda respectively. The Masterplan figures should be read in conjunction with Drawing SKE-ATK-XX-ZZZ-OLP-XXX-O-0003 (Sub Zone Remediation Areas (including areas anticipated as no remediation)).

2.3 Site History

The London 2012 Olympic Park has had an extensive industrial legacy of potentially contaminative land uses ranging from, but not limited to, petrol stations, glue factories, match works, uncontrolled landfills, garages and fish processing. A summarised site history is presented below in Table 2.1. Further details, Primary contaminants of concern identified, can be obtained from the individual SSRs^(3a-c)..

Table 2.1: Summary of previous land uses in PDZ8

Construction Zone	Historical Land Use
CZ8a	Brickfield, Chemical Works, Bow Power Station and associated infrastructure (boiler houses), railway sidings, mobile cranes, offices and more recently, unlabelled 'works' including Maryland Plastics, motor garages, warehouses, car park, scrap yard and storage areas.
CZ8b	Brush, mat and fibre works, printing ink manufacturer, rope works, Brewing works, stamping mills, sack works, bottle works, Part of Queen Mary College, Faculty of Engineering and unidentified warehouses
CZ8c	Light engineering works, electricity substation, large tank, depots, works, motor accessories, railway line, printing and publishing works

2.4 Site Investigation

As part of the site investigation scoping exercise a review of the historical (and current) site usage via walkover surveys, review of trade directories, aerial photographs and pertinent environmental data sources was used to design a technically robust and pragmatic site investigation. This has resulted in several stages of site investigation and associated ground gas and groundwater monitoring/sampling being undertaken both prior to and as part of ODA redevelopment of the site. The exploratory holes carried out during the Site Investigation phase are presented on Figure 4 and summarised below in Table 2.2 (in terms of the stratum the exploratory hole was terminated), noting this excludes exploratory holes carried out during the remediation phase.

Table 2.2: Summary of exploratory holes in PDZ8 (during the Site Investigation Phase only)

Number & Stratum	Made Ground	Alluvium	River Terrace Deposits	Lambeth Group	Thanet Sands	Chalk
Exploratory Holes	51	0	40	16	12	4

2.5 Geology

In general, the ground conditions encountered during site investigations carried out prior to and during the Enabling Works comprised Made Ground overlying Alluvium, which in turn overlay the River Terrace Deposits (RTD). The solid strata comprised the Lambeth Group overlying the Thanet Sand Formation, with the White Chalk present at depth. A more detailed description of each geological stratum is given in Table 2.3 below.

Table 2.3: Summary of PDZ8 Geology

Stratum	Generalised Description	Approximate Thickness Range (m)	Aquifer Classification
Made Ground	Dark brown, slightly clayey gravelly fine to coarse sand with concrete, brick, flint and clinker with frequent fragments of wood, metal, ash, ceramic materials, glass, plastic, organic material and slag.	up to 7.5	Not Classified
Alluvium	Firm to stiff grey/green/brown, slightly silty and gravelly in some places clay with frequent organic material. Lenses of peat were also encountered in some places, where present.	up to 3.5	Non-Productive
River Terrace Deposits (RTD)	Grey brown, slightly clayey/silty and sandy in some places, gravel.	1.5 to 5.5	Secondary (Minor)
Lambeth Group	Variable lithologies consisting of laminated clays, silts and sands and loosely cemented black flint gravel in grey, clayey sand matrix.	14.0 to 26.0	Non-Productive
Thanet Sand	Very dense, grey/brown speckled black slightly gravelly clayey, sometimes silty sand.	10.5 to 15.0	Secondary (Minor)
Upper Chalk	Very weak, slightly sandy, clayey chalk. Micritic limestone with flint nodules and inter-bedded calcareous mudstone in lower part.	>5	Principal (Major)

2.6 Hydrogeology

The SSRS^(3a-c) classifies the ground directly underlying the site (understood to relate to the RTD) as a Secondary (Minor) Aquifer. The Thanet Sands are generally in continuity with the Chalk and are classed as a Secondary (Minor) aquifer, with the Upper Chalk classified as a Principal (Major) aquifer (see Table 2.3 above).

Discontinuous water encountered within the Made Ground is referred to as perched water, groundwater within the RTD is referred to as shallow groundwater and groundwater within the Thanet Sand and the Upper Chalk is referred to as deeper groundwater.

The shallow groundwater within the RTD was identified as flowing southwards towards the Waterworks River, which becomes the Three Mills River in its downstream section. Where the Alluvium is absent, the shallow groundwater is locally unconfined and considered to be in continuity with the perched water. The difference in head between the perched water and shallow groundwater suggests that the Alluvium, where present, acts as an aquitard.

The Lambeth Group is generally considered to behave as an aquitard across the majority of the Olympic Park, limiting downward migration to the Thanet Sands and Upper Chalk, due to the presence of clays and silts of relatively low permeability interbedded with sand lenses of greater permeability.

2.7 Hydrology

Bow Back River borders the southern boundary of CZ8a, and the northern, eastern and southern boundary of CZ8b. In CZ8c, the northern, eastern and southern portions of the site are bordered by the Waterworks/Three Mills River. All waterways flow in a southerly direction, towards the River Thames.

2.7.1 Impoundment

The Impoundment Scheme is a British Waterways, London, led project involving the construction of additional locks to improve the navigation of the River Lea and its tributaries. The details and potential effects of the impoundment works on the River Lea, its tributaries and groundwater levels are reported in the Capita Symonds Groundwater Modelling Study⁽⁴⁾. Principally, the study addressed two main areas:

- potential changes in contaminant migration pathways in the aquifers; and
- the increased risk of groundwater related flooding.

Given the impoundment scheme was completed in 2008, the Enabling Works in this zone was completed according to post-impoundment conditions. It was therefore required that

further assessment of the interaction between the river and the shallow groundwater be undertaken to determine any changing conditions. This study concluded that there would be a theoretical 'change point' in surface water levels approximately 2.4km upstream of the Prescott Channel impoundment structure (adjacent to CZ6d). Downstream (south) of this change point, surface water levels would be increased to above the previous mid-tide river levels.

Therefore, in relation to PDZ8, the proposed impoundment was considered to maintain surface water elevations slightly above mid-tide levels. According to the findings of the numerical groundwater model prepared by Capita Symonds⁽⁴⁾ groundwater flow from the River Terrace Deposits into the Waterworks River will continue along the CZ8c boundary. It was considered unlikely that a significant effect will be observed on the groundwater elevations within PDZ8 once impoundment has taken place.

3. Development of Remediation Design

The development of remedial design for these three individual construction zones commenced progressively from early 2008 culminating in a series of Site Specific Remediation Strategies for CZ8a^(3a), CZ8b^(3b) and CZ8c^(3c). The physical completion of the Enabling Works scope was in mid-2010. The objective of these SSRs was to design a reflective remediation strategy to practicably minimise the risks to the identified human health and controlled waters receptors.

The risk assessment and remediation for PDZ8 was divided into CZ8a, CZ8b and CZ8c as a result of vacant possession and the construction programme. Consequently, the Conceptual Site Model (CSM) was developed on an individual Construction Zone basis. These CSMs are presented and discussed in detail within the SSRs, and present potential sources of contamination, human health and controlled waters receptors, and pathways representing pollutant linkages between the sources and receptors. These are schematically presented on Drawings ENW-ATK-8a-SP1-DR-Y-3-H11-0517 Schematic Conceptual Site Model for CZ8a Human Health Assessment; ENW-ATK-8a-SP1-DR-Y-3-H11-0518: Controlled Waters Conceptual Site Model SSRS CZ8a; 2DD-ATK-CM-08b-OLP-XXX-E-0013: Schematic Conceptual Site Model for CZ8b Human Health Assessment; 2DD-ATK-CM-08b-OLP-XXX-E-0014: Schematic Controlled Waters QRA Conceptual Model for CZ8b; ENW-ATK-8c-SP1-DR-Y-3-H11-0566 8c North Human Health QRA Schematic Conceptual Site Model; ENW-ATK-8c-SP1-DR-Y-3-H11-0567 8c North Controlled Waters QRA Schematic Conceptual Site Model; ENW-ATK-8c-SP1-DR-Y-3-H11-0517 8c South Human Health QRA Schematic Conceptual Site Model and ENW-ATK-8c-SP1-DR-Y-3-H11-0518 8c South Controlled Waters QRA Schematic Conceptual Site Model.

The SSRs used a two-tiered approach to risk assessment, incorporating Generic Quantitative Risk Assessment (GQRA) and Detailed Quantitative Risk Assessment (DQRA). GQRA was undertaken using screening values outlined in the Global Remediation Strategy (GRS), unless otherwise indicated. If ground conditions were found to exceed GQRA screening values, further assessment and DQRA was undertaken and Site Specific Assessment Criteria (SSAC) and Site Specific Remediation Targets (SSRTs) were derived. SSAC illustrate the individual contaminant concentrations protective of either controlled waters or human health, while SSRTs are the chemical criteria above which remedial corrective action is likely to be required. Representative concentrations for soil and groundwater data were derived through statistical analysis and where this representative concentration exceeds the respective SSAC remedial action or further delineation was required⁽³⁾.

The risk assessment process identified unacceptable risks to both human health legacy and controlled waters receptors in CZ8a, 8b and 8c that required excavation, treatment and/or further investigation/delineation^(3&5).

The remedial design was developed in tandem with remedial works in PDZ8 as more data from further site investigation became available. In accordance with good practice and to ensure a robust CSM was maintained, the design documentation was further refined to ensure the remedial works were reflective of the encountered ground conditions. A summary of the ten principal changes to the conceptual site model design are presented within Appendix B. These changes primarily related to the collection of additional ground data as well as further studies to examine the direct pathway to the adjacent surface watercourses. In both instances it was found that the river walls acted as a barrier for lateral migration. This new data then enabled refinement of the CSM, which in turn allowed the SSACs to be altered. These amendments are summarized below:

CZ8a

- A further study of the perched water in CZ8a showed that the perched water no longer required to be remediated, but the underlying RTD still required to be remediated.
- A direct pathway was not proven to be in existence between the Southern portion of CZ8a and the Bow Back River as a result of improvements to the riverwall.
- A further investigation of the CZ8a RTD was undertaken by WSP in order to produce a remedial design for the treatment of the RTD groundwater.
- The marker layer placed by Enabling Works is considered 'redundant' as the hardstanding placed by the Follow On Projects will act as a substitute for the separation layer. As such, the materials placed by Enabling Works above the marker layer have been referred to as 'upper' general fill within this report rather than human health separation layer.

CZ8b

- A corrigendum to the CZ8b SSRS was produced in order to bring the CZ8b conceptual site model into line with the adjacent sites to ensure consistency.
- An addendum was produced for CZ8b following access being granted to the Murphy's Yard area of the site. This addendum confirmed that there were no hotspots present, but Marker Layer and Separation Layer would have to be installed
- The marker layer placed by Enabling Works is confirmed to be 'redundant', with the materials placed by Enabling Works above the marker layer have been referred to as 'upper' general fill within this report rather than human health separation layer. It must be noted that material above the redundant marker layer has not been verified to human health separation layer criteria.

CZ8c

- Confirmation was received that the the riverwall in CZ8c north prevented migration of perched water to the adjacent river, which meant that Scenario 1a was not in operation.
- A similar confirmation to the point above was derived for CZ8c south, which again meant that Scenario 1a was not in operation.
- The Southern Plume assessment confirmed the revised receptor point for this plume of contamination and the ecological screening criteria that would be utilised to determine the compliance of certain chlorinated solvents.

Following production of the SSRs, the Enabling Works Tier 1 Contractor – BAM Nuttall Limited issued a series of Construction Zone specific Remediation Method Statements (RMS)⁽⁵⁾ to the PDT for their approval. These RMSs specify how the design will be implemented with the intention of:

- supporting ground contamination management, including the basis upon which validation would be achieved;
- summarising additional ground investigation data completed after approval of the SSRs (and subsequent SSRs Addenda) and assessing whether the additional information supported the existing CSM;
- defining the extent of the remediation required by the current design;
- providing an outline of the remedial measures proposed;
- outlining the environmental monitoring procedures in place to protect against potential impacts from the works; and
- discharge of the relevant planning conditions relating to ground contamination.

For validation reporting purposes the project developed a structured receptor-based approach to demonstrating compliance with the SSRs via the Human Health, Unsaturated Zone and Groundwater Validation Reports. This is schematically presented as a flow chart in Table 1.1 and graphically in Figure 11.

3.1 Human Health Design

The remediation design allows for placement of a Human Health Separation Layer (HHSL) or hardstanding in the proposed Olympic and Legacy end uses within PDZ8. These measures reduced the Human Health pathways such as dermal contact, ingestion and dust inhalation to acceptable levels^(3a-c). The general remedial profile adopted across the Park is presented in Appendix A.

For the purpose of risk assessment and remediation design protective of human health receptors CZ8a, CZ8b and CZ8c North were each assessed as one zone. However, CZ8c South was sub-divided into four zones according to legacy land use and Drawing ENW-ATK-8c-SP1-DR-Y-3-H11-0511 illustrates these four zones.

The placement of a minimum of 600mm HHSL (or less should hardstanding be used) is designed to result in the underlying General Fill materials having to comply with less stringent Human Health remedial targets. The HHSL (the base of which is demarcated by a brightly coloured Marker Layer) and General Fill are required to be validated to demonstrate compliance with the Human Health and Controlled Waters Site Specific Assessment Criteria (SSACs).

The remedial strategy is based on a number of assumptions and/or limitations, which are further identified in Table 5.1, although the primary assumption is highlighted below:

- No private gardens or vegetable growing areas are proposed for Legacy end use thus reducing risks associated with the ingestion pathway.

Given the remedial works have been completed based on the information contained within the remedial design, should the assumptions set out in these documents change then a re-assessment may be considered necessary.

3.2 Controlled Waters Design

The Lower Lea Valley Groundwater Model by Capita Symonds⁽⁴⁾ was used as the basis of controlled waters modelling within the PDZ8 remedial strategies.

The primary controlled water receptor was initially considered to be the Waterworks River and City Mills River to the east and south-east of PDZ8 through shallow groundwater migration. The Bow Back River has also been identified as a receptor through perched water migration from CZ8b. The Environment Agency has confirmed the shallow (RTD) aquifer is considered to represent a source and/or pathway for contaminants, but not a receptor⁽³⁾. The Upper Chalk Aquifer and Thanet Sand was not considered further as a receptor based on the proven thickness of the Lambeth Group beneath the site.

Unsaturated zone soils in CZ8a, CZ8b and CZ8c were identified to be impacted by varying levels of both inorganic and organic contaminants, which were considered to be the primary source of contamination⁽³⁾.

The primary objectives of the remediation design across PDZ8 were as follows⁽³⁾:

- excavation of unsaturated soils (including hotspots) and its replacement with chemically acceptable backfill materials (as defined by the Designers SSAC⁽³⁾);
and
- further assessment of RTD and perched water in PDZ8a.

Given the above and the three individual construction zones, the relevant controlled waters receptors are discussed further below.

3.2.1 CZ8a

Two primary model scenarios were considered to derive SSAC for soil, leachate and perched water sources^(3a) and Drawing ENW-ATK-8a-SP1-DR-Y-3-H11-0521 illustrates these scenarios :

- Scenario 1 – contamination within the Made Ground leaching directly into the perched water was originally considered to be in continuity with adjacent the Bow Back River^(3a). Following further investigations, utilising groundwater data loggers to monitor the perched water and Bow Back River levels it was subsequently demonstrated that the the perched water in the Made Ground at the south of CZ8a and the adjacent Bow Back River were not connected and so Scenario 2 applies^(5a). It was on this basis that the treatment of the perched water for the protection of human health and controlled waters was no longer considered necessary.
- Scenario 2 was further separated into contamination in the Made Ground^(2a) and Alluvium^(2b). It was considered the contamination is leaching downwards through the unsaturated zone into the River Terrace Deposits to laterally migrate to the Three Mills River.

The Tier 2 Groundwater Remediation contractor, WSP, undertook further ground investigation in order to delineate and design a groundwater remediation system to deal with elevated concentrations of trichloroethene, cis 1,2-dichloroethene and vinyl chloride associated with the former Maryland Plastics factory in the southeast portion of CZ8a^(5a). Elevated arsenic concentrations have also been consistently recorded across CZ8a, but it has been agreed that arsenic in the shallow groundwater is associated with the up-gradient sources collectively known as the Southern Plume and therefore further remediation for this analyte was not required (see Section 3.2.4). WSP proposed a groundwater remediation treatment involving the direct push injection of the proprietary reagent EHC-M™ at 38 locations in order to reduce the concentrations of the contaminants present. Details of the remediation are discussed further in Section 4.3.1.

3.2.2 CZ8b

Similarly conditions to those encountered within CZ8a were also observed within CZ8b. However, in addition to the Three Mills River receptor, a pathway to the Bow Back River was identified^(3b).

Based on the assumed soil, perched water and groundwater sources and potential receptors above, the following pathways were considered applicable at the site:

- For the soil source: soil leaching and vertical migration from the unsaturated soils within the Made Ground and Alluvium to shallow groundwater within the River Terrace Deposits. From here lateral migration within the River Terrace Deposits may occur to the City Mill River and Bow Back River at their closest points and directly down groundwater hydraulic gradient of the site.

- For the groundwater source: lateral migration of contaminated shallow groundwater within the River Terrace Deposits to the City Mill River and Bow Back River at its closest points and directly down hydraulic gradient.

However for the purpose of controlled waters modelling this was considered as one SSAC zone.

3.2.3 CZ8c

Since a significant proportion of the site is adjacent to the most-sensitive controlled water receptor (Waterworks River), the SSRS has divided the site into two zones; Zone 1, which includes all land within 25m of the river and Zone 2, the remainder of the site. The purpose of this was to reflect the different pathway distances for contaminants to the Waterworks River and to recognise that perched water identified in the vicinity of the river wall may come into direct contact with surface water in the river. As such, the following controlled water pathways to the Waterworks River were identified in the CSM^(3c) and the two zones are illustrated in Drawings ENW-ATK-8c-SP1-DR-Y-3-H11-0565 and 0515 for CZ8c North and South respectively:

- Scenario 1a – unsaturated soils, leachate and perched water in Made Ground in Zone 1, assuming direct contact with the Waterworks River and no vertical migration through the Alluvium to the River Terrace Deposits.
- Scenario 1b – unsaturated soils, leachate and perched water in Made Ground in Zone 2, assuming vertical migration through the Alluvium to the River Terrace Deposits and subsequent dilution and transport to the Waterworks River.
- Scenario 1c – unsaturated soils, leachate and perched water in Made Ground in Zone 1, assuming vertical migration through the Alluvium, followed by dilution in the River Terrace Deposits in direct contact with the Waterworks River.
- Scenario 2a – soils and leachate originating from the Alluvium in Zone 1, with dilution in the River Terrace Deposits in direct contact with the Waterworks River.
- Scenario 2b – soils and leachate originating from the Alluvium in Zone 2, with subsequent dilution in the River Terrace Deposits and transport to the Waterworks River.

Subsequent investigation^(5c) recognised that the riverwall is a competent barrier to perched water migration from the Made Ground to the adjacent Waterworks River and therefore Scenario 1c and its associated criteria will prevail over Scenario 1a with regard to both excavation and backfill validation.

3.2.4 Southern Plume

Upon completion of the majority of the SSRS programme in the south of the Olympic Park, it became apparent that an area of contaminated groundwater was present within the RTD

across several southern PDZs, including the southern part of PDZ8. This affected area was subsequently referred to as the 'Southern Plume'. The former Banner Chemicals Area of CZ3a was identified as the primary source of a southward migrating diffuse plume consisting mainly of cis 1,2-dichloroethene, vinyl chloride, and arsenic^(6a&6b).

Assessment of data collected from the Southern Plume considered that natural attenuation is occurring and is likely to continue to occur. Removal and treatment of unsaturated soils in several locations in the southern Olympic Park has resulted in the removal of the majority of the identified sources and whilst it is anticipated that the residual groundwater contamination will decline over time.. Following completion of a twelve month period of groundwater monitoring^(6a&6b) it was acknowledged that another period of groundwater monitoring will be required to confirm that both the natural degradation of organic contaminants and subsequent reduction in both organic and inorganic contaminant trends are continuing. As a result a further 12 month period of groundwater monitoring will commence as soon as reasonably practicable post Games in order to establish long term trends in contaminant chemical concentrations.

As a result this groundwater monitoring and any associated remedial actions represent a residual remediation item, which means until its completion to satisfy the Regulator/PDT requirements, Condition 35 of the Olympic, Paralympic and Legacy Transformation Planning Applications: Site Preparation Planning Application⁽¹⁾ can only be partially discharged.

PART II

4. Implementation of Design – Site Preparation (Enabling Works)

4.1 Summary of Works Undertaken

Remediation works within PDZ8 began in March 2008 on the basis of the prevailing remedial design developed in the SSRs and RMSs as the remediation works progressed (as discussed above). The majority of the physical earthworks Enabling Works scope was completed in 2010, with the Southern Plume groundwater monitoring programme ceasing in late 2011. A detailed summary of all changes to the remedial design is available within the approved PDZ8 RMS and Validation Reports, which are summarised in Appendix B.

In addition to the remediation works undertaken to date, which are described below, it is acknowledged that further groundwater monitoring is required to be undertaken over a twelve month period. This monitoring shall commence as soon as reasonable practicable post Games and further details on the monitoring requirements are given in Section 4.3.2.

4.1.1 Significant Land Use Changes

There have been no significant land use changes within PDZ8 that has varied the legacy end use from that defined within the respective SSRs.

4.1.2 Hotspots

Table 4.1: Number of Unsaturated Zone Defined Hotspots (presented in the SSRS & RMS) in PDZ8

Document	No. of hotspots	Comments		
Site Specific Remediation Strategies (including subsequent addenda)	8a	4 (HH)	Based on Scenario 1 being active	
		11 (CW)		
	8b	2 (HH)		
		7 (CW)		
	8c:	1 (HH)	CZ8c South: 9 CW locations & 1 HH location CZ8c North: 6 CW locations Based on Scenario 1a.	
		15 (CW)		
Remediation Method Statement (including subsequent addenda)	8a	4 (HH)	The initial RMS had 14 locations, but this was because BNL had utilised a more conservative screening criteria. The RMS addenda No.1 but has seven Human Health and eleven controlled waters outliers for removal, which was produced in response to the Main SSRS being issued. Improvements to the river-wall were undertaken beyond those envisaged by the SSRS. This intercepted the direct pathway to Bow Back River (Scenario 1). and thus, scenario 2 applies reducing the number of CW locations from eleven controlled waters to seven controlled waters hotspots.	
		7 (CW)		
	8b	2 (HH)		The RMS confirmed the hotspots for soil and perched water would be undertaken as defined by the SSRS.
		7 (CW)		
	8c	0 (HH)		The initial CZ8c South RMS required 4 hotspots to be removed 1for human health and 3 for controlled waters. However confirmation that Scenario 1c applies followed determination that the river wall is competent. The reassessment has reduced the remedial requirement so that in CZ8c South there was now only 2 hotspots for CW, while for CZ8c north there are no hotspots defined. .
		2 (CW)		
Validation Reports (including subsequent addenda)	8a:	4 (HH)	During the earthworks, hotspots merged to form five remediation areas each representing unacceptable risk to HH and CW.	
		7 (CW)		
	8b:	5 (HH)		A total of five hotspots were excavated in CZ8c. One hotspot which had been previously been defined as requiring removal as part of the earlier SSRS/RMS process was commenced before a change of a scenario meant that it was no longer required to be removed. Two hotspots that were specified as apt of the latest RMS were removed, whilst another two hotspots were found as part of the sub-grade validation works.
		5 (CW)		
	8c	0 (HH)		
		5 (CW)		

NB: Hotspot numbers are not cumulative

On the basis of the information provided with the pertinent human health and unsaturated zone validation reports and their associated addendums it is considered that all soil hotspots have been appropriately actioned so that they no longer represent an unacceptable risk to either human health or controlled waters receptors.

4.2 Unsaturated Zone (Combined Human Health and Controlled Waters)

All of identified SSRS/RMS defined remediation zones were excavated and validated within PDZ8 as noted in Table 4.1. In addition to these SSRS/RMS defined hotspots; there were a number of outliers recorded as part of the chemical validation testing of backfill materials. These outliers were then subsequently delineated, removed, validated and backfilled with complaint materials. In the limited number of cases where this was not the case, due to agreements with the Follow On Projects, these are recorded in Table 5.1 and Figure 10.

The total volume of soil excavated and backfilled with General Fill and HHSL during the Enabling Works activities totalled approximately 90,000m³ (CZ8a – 18,000m³; 8b – 32,000m³; CZ8c – 40,000m³). The HHSL has been placed over a brightly coloured Marker Layer comprising orange Terram geotextile or geogrid, which serves as a visual indication of this boundary. The base of the excavation (subgrade), depth of marker layer (subformation) and the EWFL is illustrated on Figures 5 to 7 respectively Table 4.2 confirms the sampling and testing frequency that has been undertaken on both the separation layer and general fill materials in PDZ8.

It was agreed with PDT that the marker layer placed by Enabling Works for CZ8a^{(7a(i))} and CZ8b^{(7b(i))} should be considered 'redundant' as the Follow-On Projects will be placing hardstanding which will form the separation layer at the site. As the Enabling Works marker layer is 'redundant', the materials placed by Enabling Works above the marker layer have been referred to as 'upper' general fill within respective reports rather than human health separation layer. It should be noted that material above the "redundant" marker layer has not been verified to Human Health Separation Layer criterion. It is for these reasons that suitable measures should be undertaken by future contractors/projects when excavating at the site.

As a part of the earthworks and remediation design there was a requirement for a minimum of 600mm separation layer (human health protective material) to be placed unless specifically agreed with PDT that an alternative such as hard standing could be utilised. In addition, it has been agreed in certain circumstances that the thickness of/or presence of the HHSL/Marker Layer can be varied to suit the incoming Follow on Projects scope of works. These agreements were made to facilitate earlier workings and for the benefit of the Programme. Such circumstances were discussed and formally agreed with the incoming Project Team and are detailed in the specified Validation Reports and presented in Figure 8.

During the earthworks in CZ8b, elevated organic concentrations were identified along the southern site boundary. The historical maps indicate the presence of former tanks

associated with the adjacent (off-site) former glue factory were located off-site immediately adjacent to the southeast site boundary to CZ8b and NBHCZ8b-610. Given this, Enabling Works applied a precautionary approach and installed a cohesive barrier which was founded in the alluvium. The purpose of the barrier was to separate clean fill placed within the site and unremediated land associated with the third party boundary and to mitigate potential contamination migration onto the site.

Table 4.2: PDZ 12 Unsaturated Zone Fill Volumes, Sampling Frequency and Corrective Actions

Construction Zone	Material Type	Material Description	Origin	Volume (m ³)	Number of samples	Frequency of sampling	Exceedances
CZ8a	General Fill	Processed Made Ground	Olympic Park	15,600	103	1 sample per 151 m ³	No exceedances were noted for human health, but 8 exceedances were noted associated with controlled waters. However via a combination of further sampling and risk assessment these exceedances were proven not to represent an unacceptable risk.
	Upper General Fill	Lime stabilised Thanet Sand	Olympic Park	3,500	32	1 sample per 109 m ³	No human health exceedances were noted, but again two exceedances were noted for controlled waters criteria. However additional risk assessment was undertaken that showed that these samples would not represent an unacceptable risk.
		Crush brick, concrete and soil washed gravels	Olympic Park				
		Import natural quarry sand and crushed concrete	Import				No exceedances were noted.
	Separation Layer	Lime stabilised Thanet Sands	Olympic Park	160	2	1 sample per 80 m ³	No exceedances were noted.
		Limestone aggregate	Import	160	As imported virgin aggregate no sampling was required to be undertaken.		

Construction Zone	Material Type	Material Description	Origin	Volume (m ³)	Number of samples	Frequency of sampling	Exceedances
CZ8b	General Fill	Processed Made Ground	Olympic Park	27,000	134	1 sample per 201 m ³	No exceedances were noted.
	Upper General Fill	Crushed brick,, concrete and soil washed sand and gravels	Olympic Park	4,300	28	1 sample per 154 m ³	No exceedances were noted.
	Separation layer	Crushed concrete	Import from off-site	400	4	1 sample per 100 m ³	No exceedances were noted.
Lime stabilised Thanet Sand		Import from Stratford City					
CZ8c	General Fill	Process Made Ground,	Olympic Park	23,520	43	1 sample per 547 m ³	1 sample exceeded the 0.1% asbestos criteria, but a review of the source stockpile above 0.1% criteria so the material is deemed acceptable.
	Separation Layer	Horticultural sub-soil	Import from Bournemouth Sand and Gravel Quarry in Kent	2160	12	1 sample per 180 m ³	One sample exceeded the TPH criteria but was not proven to represent a risk.

4.2.1 Vapour Assessment

Following the completion of the remediation, two areas within CZ8a were identified as containing residual concentrations of volatile organic compounds (VOCs) in excess of their SSRT at the further practicable extent of remediation. Further assessment identified that the exceedances were of the human health-based SSAC component of the SSRT. To further assess these theoretical risks, five dual level vapour wells were installed at these locations.

The vapour results identified at these locations identified exceedances above the vapour specific criterion based on the Legacy end use. It was therefore agreed with the landowner (OPLC) that this risk to human health in Legacy will be mitigated by the installation of a vapour membrane into future buildings in this area^{(7a(i))}(2DD-ENL-CK-08a-OLP-SP1-E-0397).

4.2.2 Perched Water

The CZ8a SSRS^(3a&5a) specified perched water remediation to mitigate potential risks to controlled waters and human health. However, the collection of additional site investigation data enabled the CSM to be refined. This refinement demonstrated that a direct pathway does not exist between the perched water in the Made Ground at the south of CZ8a and the adjacent Bow Back River as discussed previously. In addition, the potential risk to human health from perched water was also verified not to present an unacceptable risk to the human health of site end users^(5a).

As noted above in Table 4.1 the improvements to the riverwalls that were undertaken in both CZ8a and CZ8b have had an impact on the number of hotspots that have had to be removed within both Cz8a and Cz8b. This is because the improvements to the riverwalls were greater than expected in the original SSRSs covering these areas and this reduced the potential for perched water to enter the adjacent rivers. Indeed the CZ8a SSRS assumed that the 50m of riverwall in a fair condition would be retained, whilst the adjacent 60m that was in a poor condition would be repaired and refurbished. In actual fact although the 50m of riverwall in a fair condition was retained, the 60m in a poor condition was completely replaced. In addition riverwall refurbishments were also undertaken in CZ8b, which again upgraded the condition of the wall.

4.3 Saturated Zone

4.3.1 CZ8a River Terrace Deposit Groundwater Remediation

The Tier 2 specialist contractor (WSP) was contracted by BAM Nuttall to further investigate, delineate, and treat the RTD groundwater in CZ8a for elevated concentrations of trichloroethene, cis 1,2-dichloroethene and vinyl chloride potentially located within the former Maryland Plastics factory in the southeast portion of CZ8a^(5a). Elevated arsenic concentrations have also been consistently recorded across CZ8a and have remained relatively consistent in each monitoring well, with the highest noted adjacent to the northeast and southeast site boundaries. However, it has been agreed that arsenic in the shallow groundwater is associated with the up-gradient sources collectively known as the Southern Plume (see Section 3.2.4 and 4.3.2).

In-situ groundwater treatment of the RTD was undertaken in August 2010 to reduce the elevated dissolved phase contaminants to less than the respective SSAC or to background concentrations. Following the injection of the reagent, groundwater monitoring was carried out for 12 months to demonstrate compliance with the remedial objectives^(5a).

The monitoring identified two locations as exceeding the trichloroethene controlled waters SSAC and four locations exceeding the vinyl chloride controlled waters SSAC. However, by applying the Southern Plume controlled waters assessment criteria, noting the Southern Plume impact area includes CZ8a, it can be demonstrated that there are no unacceptable risks to controlled waters with regard to cis-1,2-dichloroethene and vinyl chloride. It is currently considered that the elevated concentrations of chlorinated solvents are potentially associated with the recorded unsaturated zone soil source in the third party easements (high voltage cable or at the third party boundary located up gradient of the treatment area), which is further discussed in Section 4.2.1^(7a).

In addition, exceedances of the human health SSAC were recorded in two locations, with one location remaining above the SSAC in the final two monitoring rounds. Given the landowner (OPLC) has already confirmed that vapour protection measures will be included in any redevelopment in this area due to unsaturated zone exceedances at the practical extent of the excavation, utilising the soft landscaping GAC to demonstrate outdoor vapour exposure, there are no exceedances of the human health screening criteria. Therefore the site is also validated with respect to human health^(7a).

4.3.2 Southern Plume

The Southern Plume Position Paper and RMS^(6a&b) specified an ongoing groundwater monitoring strategy across the southern part of the site. The aim of this monitoring network is to determine whether degradation of the chlorinated ethenes and arsenic occurs over time given the extensive remedial works undertaken in both the unsaturated zone across the South Park and discrete in-situ groundwater remediation in the source area within the former Banner Chemicals Area in PDZ3.

Following completion of the groundwater monitoring, the validation report^(6c) concluded that complete dechlorination was occurring. The evidence for this was through decreasing concentrations of tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cDCE) and vinyl chloride which were less than the SSAC. The recorded arsenic concentrations were compliant with the wider plume objectives, which is primarily as a result of source removal. In summary, this report confirms via monitoring, the Southern Plume COCs do not represent an unacceptable to risk to Human Health and/or Controlled Waters. However, following review of this report, the PDT and the Regulator have requested that monitoring be extended both in its geographical extent (as monitoring wells in CZ3a Banner are now included), duration (monitoring to be undertaken for a further 12 months commencing as soon as reasonably practicable post Games based on monthly monitoring for the first six months and thereafter at such a frequency to be agreed with the PDT/Regulator), and utilise the monitoring well network that has been previously agreed with both the PDT and the Regulator.

In addition to the discrete fluctuation of cDCE and Vinyl Chloride in NBHCZ3a-1043 and NBHCZ3a-889 in the final two rounds of the initial groundwater monitoring regime, the PDT requested continuation of groundwater monitoring to further understand the stability of the arsenic plume following in-situ remedial works. It is considered that this additional monitoring will enable the longer term assessment of these contaminant trends and hence a further 12 month groundwater monitoring period is required across PDZ8 as it falls within the 'Southern Plume'. This groundwater monitoring will commence as soon as reasonably practicable post Games in order to establish long term trends in contaminant chemical concentrations. As a result this groundwater monitoring and any associated remedial actions represent a residual remediation item, which until its completion to satisfy the Regulator/PDT requirements, means Condition 35 of the Olympic, Paralympic and Legacy Transformation Planning Applications: Site Preparation Planning Application⁽¹⁾ can only be partially discharged. This monitoring will specifically target the presence of the main contaminants of concern in this area, which includes vinyl chloride, chlorinated ethanes, dissolved ethanes, methane, arsenic (both total and dissolved), and total organic content determinants such as sulphate, iron and chloride. In addition the presence or absence of non-aqueous phase liquids (NAPL) will also be recorded.

4.4 SSRS Groundwater Monitoring

Groundwater monitoring has been undertaken for a number of purposes with different monitoring and sampling requirements. One of these groundwater monitoring strands ('Validation') aims to validate the remediation works by monitoring/sampling the underlying aquifers within this PDZ before, during and after the bulk remediation works. This requirement originated from the SSRS, where the Designers required the groundwater data gathered as part of the Enabling Works to be assessed to determine the presence or absence of any adverse effects. As such, this data has been utilised as a line of evidence to demonstrate the aquifers conditions within the PDZ has not significantly varied from the conditions at pre-commencement (of earthworks) phase.

Exploratory locations were installed as monitoring wells into the underlying geology, with specific reference to the RTD and Chalk, to record the hydrogeological conditions. The hydrogeochemical data collected prior to, during and following completion of the remedial works has shown there to be no consistent upward trend. It is on this basis that these monitoring wells were appropriately decommissioned in line with Project Documentation⁽¹⁰⁾ (which is based on the applicable Environment Agency guidance) prevailing at the time as reported in the applicable unsaturated zone validation reports^(7a, b & c). However, as noted in Section 4.3.2 above, groundwater monitoring for a further 12 month period will be undertaken to confirm that the groundwater results are not showing an upward trend.

4.5 Other Matters

4.5.1 Non Remediated Areas

A number of discrete areas within PDZ8 have been retained across the Olympic Park in accordance with approved Planning Application conditions and/or due to operational constraints. Within these areas full site investigation coverage has not been possible due to the presence of particular features that had to be retained. Typical retained features include retained buildings and services, third party boundaries, retained roads and other areas of hardstanding, batter exclusion zones and areas of retained vegetation (either confirmed or aspirational). These discrete areas in PDZ8 are discussed further in the Unsaturated Zone Validation Reports⁽⁷⁾ and are presented on Figure 9.

To further support these non-remediated areas, the Designers have submitted a site wide retained areas risk assessment report⁽⁸⁾ to the PDT for the approval. This report qualitatively assesses potential risks to human health and controlled waters arising from potentially contaminated land beneath those areas. The assessment considers the nature of the retained features, contamination presence identified in the nearby area, and the final land use and receptors. Relevant extracts from the latest Retained Areas Risk Assessment Report are presented in Appendix D.

4.5.2 Unexploded Ordnance

An Olympic Park wide risk assessment for German air-dropped unexploded ordnance (UXO) was conducted by BAE Systems in advance of the project. The objective of this document was to assess the potential to encounter UXO during the project, to evaluate implications of such an occurrence and to determine whether risk mitigation measures would be necessary. The assessment considered there to be a low to moderate (for open land) likelihood of encountering existing UXO's in PDZ8⁽⁹⁾, although it does appear that the surface waterways surrounding PDZ8 were excluded from this assessment, but noting these same waterways were considered to have a high likelihood upstream of PDZ8. As a consequence, site staff were briefed in the types of ordnance that may be encountered and the procedures when suspected objects were encountered. No suspect objects were found during the earthworks/remediation works^(7a,b & c).

4.5.3 Pathogens

Pathogens were analysed in samples collected from locations where the site history indicated the use or production of animal based products. Whilst no animal remains were encountered, selective samples from the subgrade were subjected to pathogen analysis which comprised anthrax (*Bacillus anthracis*), enterobacteriaceae, faecal streptococci, faecal coliforms, listeria and total coliforms. The majority of the results were less than the Laboratory Method Detection Level, although in instances where they were not, it was not considered to pose an unacceptable risk to Human Health given the sample is located at depth beneath general fill and/or separation layer^(7a,b & c).

4.5.3 Radiological Material

The SSRs⁽³⁾ did not present any evidence to suggest the presence of radiological material in the PDZ8 in-situ soils. There were no reported incidents in CZ8a and CZ8b where areas, isolated or otherwise, exceeded the background level of radiation. The results of the surveys in CZ8a and CZ8b have been summarised by Nuvia in the respective Unsaturated Zone Validation Reports^(7a&b).

During the removal of hardcover at CZ8c, elevated readings above background were recorded in a localised area from concrete spoil. The elevated readings were identified to be associated with concrete adjacent to the Network Rail boundary. This concrete amounted to 187m³ and was moved to a temporary holding facility in PDZ2 before appropriate removal off-site. Following its removal Nuvia conducted a clearance survey of the subgrade and recorded activity levels below background^(7c).

The temporary holding facility in PDZ2 was constructed in May/June 2009 consisting of two individual cells. These cells were constructed to receive radioactive materials classified as Exempt (in accordance with the *Radioactive Substances [Phosphatic Substances, Rare Earths etc] Exemption Order 1962* made pursuant to the *Radioactive Substances Act 1993*) of materials encountered in PDZ2 and elsewhere on the Olympic Park. These temporary cells held a total volume of 193m³ of 'exempt' materials and were removed from site in August 2009 to an appropriately licensed off-site facility. Following off-site disposal a clearance survey of the temporary holding area was conducted by the specialist sub-contractor. All survey results were comparable with background levels and no further action was considered necessary⁽¹¹⁾.

4.5.4 Unexpected Contamination

No unexpected contamination was identified within PDZ8.

4.5.5 Methodology for Assessing Asbestos

The assessment for asbestos and criterion in the HHSL and the below marker layer materials was further developed as the works progressed. This development gave rise to a Site Wide SSRS that revised the SSACs and its assessment methodology^(3d).

4.6 Sampling and Analytical Testing

TES Bretby, or ESGL as they are currently known, was selected to undertake the chemical analysis of the soils and groundwaters at their off-site laboratory. Bretby's Method Detection Levels were generally able to detect the determinands listed in the SSRS and are suitably accredited through MCerts and UKAS (where appropriate). Further details pertaining to the sampling strategy and frequency are presented in the respective Unsaturated Zone Validation Reports⁽⁷⁾.

The Planning Application required all validation samples to be collected in-situ. However, in order to reduce the potential for placing non-compliant soils (general fill and separation layer) whilst maintaining the programme, Enabling Works commissioned an on-site chemical laboratory and used field analytics to aid real-time decision making on soil reuse through further characterisation. The on-site chemical laboratory was UKAS accredited (where appropriate) for the main chemical tests on soils. However, these results were not typically utilised in the validation reporting, although they were occasionally used as a secondary line of evidence.

The frequency of sampling and testing for hotspots, subgrade and backfill materials (general fill and separation layer quality materials) were undertaken to acceptable standards in accordance with the Site Preparation Planning Application.

4.7 Waste Management

The Enabling Works in PDZ8 was completed under Olympic Development Authority [ODA] Environmental Permit (issued as a Waste Management Licence) for the Olympic Park (South) [Reference: EAWML80790 and subsequent Notice of Variation, Modification Number: M0597]. This Environmental Permit enables the ODA to use site-won materials, suitable for use after treatment, but classified as either hazardous or non-hazardous waste, to be used as fill to create the landform required for the redevelopment. This Environmental Permit enables the placed materials to be “recovered”, and as such they cease to be a waste, which minimises disposal to landfill and serves a useful purpose in replacing materials that would otherwise have had to be imported to construct the scheme.

The permit also covers the import and use of waste materials from an alternative source whose works are directly associated with the potential Olympic Park redevelopment. These fill materials can be utilised where they are deemed suitable for use and a need for these materials has been demonstrated. ‘Suitable for use’ will be proved in accordance with the Memorandum of Understanding (MoU) which is an agreement between the ODA and the Environment Agency covering Waste Licensing Issues. The ODA will seek to discharge this upon approval of the Stage 2 CVR.

4.8 Health, Safety and Environment

Remediation works were completed in accordance with Construction (Design and Management) (CDM) Regulations. As CDM Co-ordinator, Arup were responsible for producing the Health and Safety file for PDZ8, in conjunction with the Contractor, Project Manager and Client. A Permit to Work system was in operation for the duration of remediation works. Staff wore suitable Personal Protective Equipment (PPE), with gloves, helmets, boots, eye protection and hi-vis clothing required at all times as a minimum. Occupational and environmental monitoring was undertaken throughout the remediation works⁽⁷⁾. Environmental monitoring comprising fugitive emissions, air quality, noise, dust (including PM10), nitrogen dioxide and odours was carried out at the site throughout the works, which were progressively presented on a monthly basis in the Tier 1 Environmental Monitoring Monthly Reports^(7a, b& c).

5. Conclusions

The PDZ8 Validation Reports⁽⁷⁾ conclude that neither the soils nor groundwater in PDZ8 pose an unacceptable risk to the SSRS defined critical controlled waters and human health receptors. However, further monitoring for 12 months is required to assess whether and to what extent contaminants from an up-gradient source have migrated and whether they have had a detrimental impact on the conditions beneath PDZ8. This monitoring data will also inform an assessment of the long term trends in groundwater contaminant concentrations beneath PDZ8. It is on this basis that this PDZ8 Consolidated Validation Report seeks to gain partial discharge from PDT for the ODA's works under Condition 35 of the Site Preparation Planning Application.

However, it is noted that the separation layer has not been completed at the time of producing this report and it remains the responsibility of the Follow On Project that, as a minimum, they complete the separation layer to a thickness of no less than 600mm, unless otherwise agreed with the PDT. It is only upon the appropriate completion and validation of the Separation Layer that the Separation Layer works will be considered to be complete. The incoming Project Teams shall be cognisant of the SSRS underlying assumptions of the SSRS and the items noted in Section 5.1 and Table 5.1 below.

As noted above it is acknowledged that a further 12 month groundwater monitoring period is required across PDZ8 as it falls within the 'Southern Plume'. This groundwater monitoring will commence as soon as reasonably practicable post Games in order to establish long term trends in contaminant chemical concentrations. As a result this groundwater monitoring and any associated remedial actions represent a residual remediation item, which until its completion to satisfy the Regulator/PDT requirements, means Condition 35 of the Olympic, Paralympic and Legacy Transformation Planning Applications: Site Preparation Planning Application⁽¹⁾ can only be partially discharged.

5.1 Further Work

Table 5.1 records the outstanding physical works that were within Enabling Works scope that has been transferred to the Follow On Projects to complete and validate (see Figure 10) and restrictions on future works. This table seeks to update similar tables presented in the individual Validation Reports referenced herein⁽⁷⁾.

In addition, Table 5.1 records some key aspects for the Follow On Projects to consider as part of their works. This table does not in anyway alleviate the incumbent Project Teams from complying with the full requirements of the remediation documentation, their legal, regulatory and contractual obligations.

Table 5.1: Outstanding Works transferred to the Follow On Project, Restrictions on Future Works and some key aspects for the Follow On Projects to consider as part of their works

GENERAL			
No.	Title	Description	Action By
1	Completion of groundwater monitoring for the Southern Plume	Southern Plume' groundwater monitoring across the southern part of the Olympic Park shall continue for a period of 12 months (commencing as soon as reasonably practicable Post Games).The groundwater monitoring results and any associated remedial works will be subject to Regulator/PDT approval.	Enabling Works (novated to Olympic Park Legacy Company (OPLC)
2	No excavation of soils at the Site	The Permit To Proceed Protocol (Appendix E) must be implemented for all below ground works. A review of available data relating to the condition of the soils at the Site should be undertaken prior to any excavation and appropriate precautions must be undertaken. The Validation Reports prepared by Enabling Works base their assessments on long-term risks to the end-user assuming the Legacy end use stated in the SSRS and does not consider risks to construction or maintenance workers when validating the site. Any risks to construction workers can safely mitigated through PPE and suitable engineering precautions. Reference should also be made to the Health & Safety File.	Follow-on Project / Future land owners
3	Restrictions to remediation	Restrictions to remediation exist in defined areas of PDZ8 as shown on Figure 9. If these areas are developed in the future, an assessment will be required to determine if remediation is required. In the meantime, any construction adjacent to the areas should consider available evidence from samples taken at the limits of the remediation works. In addition should development take place than gas and vapour risks should be considered as outlined in Item 6 below.	Follow on Project/ Future land owners
4	Suitable infrastructure design	Structures should be designed recognising the chemical and other characteristics of the stratum in which they are founded. Sections in contact with potentially contaminated materials may need to be resistant to chemical attack, particularly by sulphates. In addition consideration should also be given to gas and vapour risk as outlined in Item 6 below.	Follow-on Project
5	Suitable methods to protect pathways	Consideration of design and construction methods (for example, choice of suitable pile design and construction methods) to avoid creation of pathways to lower aquifers.	Follow-on Project

No.	Title	Description	Action By
6	Ground and gas vapour assessments	Assessment of soil gas and soil vapour hazard and appropriate design and construction. Gas membranes or positive venting may be needed in the construction of any inhabited or enclosed spaces.	Follow-on Project
7	Protection of monitoring and groundwater remediation installations and facilities	Undertake any required measures to protect monitoring and groundwater remediation installations and facilities at the Site. Any damage to such installations or facilities is to be reported to the PtP team as soon as practicable so that remedial works / decommissioning (as appropriate) can be undertaken.	Follow-on Project
8	Future land use	Should any variations to this land use be proposed for either the Olympic or Legacy phase, then the risk assessment in the SSRS must be revisited and the requirement for any additional remediation be assessed. The areas designated for different land uses shall not be amended without reassessment of the soil conditions. Notwithstanding this any development should consider gas and vapour risk as outlined in Item 6 above. The Site shall not be used for residential use, growing edible crops or for private gardens.	Follow On Project / Future land owners
9	Changes in final level	Changes to final levels reducing them at all will need a reassessment of the underlying soil and potentially additional investigation or remediation. End use Final Finished Levels (FFL) envisaged by the SSRS design are a minimum of 600mm and a nominal 800mm above the 'redundant' marker layer installed during the Enabling Works.	Follow On Project / Future land owners
10	Final validation report	Produce and gain approval of final validation report on completion of overall construction or of construction required to complete the necessary remediation requirements.	Follow-on Project

CONSTRUCTION ZONE 8A SPECIFIC			
No.	Title	Description	Action By
8a-1	Placement of marker layer and separation layer if hardstanding is excavated and / or partially removed	<p>In accordance with the RMS addendum No.2 the hardcover to be placed by Follow-On Projects for Olympic land use at the site is considered to form a suitable substitute to the separation layer and marker layer. It was therefore agreed that the marker layer placed across CZ8a by Enabling Works is 'redundant' and that material above the redundant marker layer has not been verified to human health separation layer criteria. Should Follow-On Projects necessitate any change in the extent of hardcover, they shall seek approval from the PDT before such works through the submittal of a Remediation Method Statement or otherwise agreed with the PDT. The Follow-On Projects shall be responsible for the placement of a separate new marker layer, which shall be overlain by chemically acceptable materials in line with the approved Site Wide RMS Addendum (Use of Hard Cover as a Substitute to the Separation Layer and prevailing SSRS).</p> <p>In the case of the Former Retained Vegetation area covered by this report, a marker layer and 300mm thickness of human health separation layer has been placed across the entire area by Enabling Works</p>	Follow-on Project
8a-2	Inclusion of suitable vapour mitigation measures to future buildings	The potential risk to human health receptors within an indoor office environment in the areas adjacent to the EDF cable easement and Bow Back River boundary (is to be mitigated by the inclusion of suitable vapour membranes to future Legacy buildings (see Section 4.2.1). Appropriate vapour mitigation measures will also be required for any buildings present during the Olympic and Legacy land use	Follow On Project / Future land owners
8a-3	Placement of marker layer and separation layer if hardstanding is excavated and / or partially removed.	Should Follow-On Projects require removal or excavation into any part of the approved hardcover system, the Follow-On Project shall be responsible for the placement of a separate new marker layer. This shall be overlain by chemically acceptable materials in line with the approved Site Wide RMS Addendum (Use of Hard Cover as a Substitute to the Separation Layer and prevailing SSRS). In addition, the follow-on project shall seek approval from the PDT before such works through the submittal of a Remediation Method Statement or otherwise agreed with the PDT.	Follow-On Project

CONSTRUCTION ZONE 8B SPECIFIC			
No.	Title	Description	Action By
8b-1	Placement of marker layer and separation layer if hardstanding is excavated and / or partially removed	<p>A review of available data relating to the condition of the soils at the Site should be undertaken prior to any excavation and appropriate precautions must be undertaken. In particular, it must be noted that the marker layer placed across the majority of CZ8b by Enabling Works is 'redundant' and that material above the redundant marker layer has not been verified to human health separation layer criteria. The marker layer placed in the Murphy's area covered by this report is not redundant and the overlying material has been verified for human health and controlled waters in this report.</p> <p>The human health assessment presented in this report was based on long-term risks to the end-user assuming the Legacy end use stated in the SSRS and does not consider risks to construction or maintenance workers when validating the site. It is considered that following an appropriate risk assessment, any risks to construction workers will probably be safely mitigated through PPE and suitable engineering precautions.</p>	Follow on project(s) / Future land owners
8b-2	Placement of additional separation layer in CZ8b	Placement of remaining separation layer, minimum of 300 to 500mm depending on location within CZ8b (i.e. completion of the separation layer to FFL) such that the final human health separation layer is minimum 600mm in thickness.	Follow-On Project
8b-3	River wall integrity	Future development must maintain integrity of river wall to prevent potential direct pathways to the river.	Follow-On Project/ Future land owner

CONSTRUCTION ZONE 8C SPECIFIC			
No.	Title	Description	Action By
8c-1	<i>Potential removal of sub-grade with asbestos concentrations >0.1% w/w</i>	<i>Asbestos concentrations in the sub-grade have been identified at >0.1% w/w. Confirmation has now been received from the OPLC that no further works are required in this respect as the pathway to human health has been intercepted by the overlying general fill and/or separation layer.</i>	- <i>(this action has now been closed)</i>
8c-2	Placement of additional or full separation layer over remainder of CZ8c	Placement of the remainder of the separation layer over the Site (i.e. completion of the separation layer to FFL) where the initial 300mm thickness has been placed by Enabling Works or full 600mm minimum and marker layer where none has been placed, such that the final human health separation layer is minimum 600mm in thickness.	Follow on Projects
8c-3	River wall integrity	Future development must maintain integrity of river wall to prevent potential direct pathways to the river.	Follow on Projects / Future land owners

6. References

1. Planning Application Approval (Olympic, Paralympic and Legacy Transformation Planning Applications: Site Preparation Planning Application, Application No – 07/90011/FUMODA, Date of Application - 7th February 2007): Condition 35.
2. Planning Application Approval (Olympic, Paralympic and Legacy Transformation Planning Applications: Facilities and their Legacy Conditions Planning Application, Application No – 07/90010/OUMODA, Date of Application - 7th February 2007): Condition 36.
3. PDZ8 Site Specific Remediation Strategies (SSRS):
 - a) CZ8a SSRs
 - i. Atkins. REP-ATK-CM-08a-OLP-XXX-E-0001. PDZ8a Review of Approach to Remediation, March 2008 (ODA Ref.: 08/90083/AODODA)
 - ii. Atkins. REP-ATK-CM-08A-OLP-XXX-E-0002. PDZ8a Site Specific Remediation Strategy, July 2008 (ODA Ref.: 08/90083/AODODA)
 - iii. Atkins. REP-ATK-CM-08a-OLP-XXX-E-0003. Corrigendum to the PDZ8a Site Specific Remediation Strategy, September 2008 (ODA Ref.: 08/90083/AODODA)
 - b) CZ8b SSRs
 - i. Atkins. REP-ATK-CM-08b-OLP-XXX-E-0001. PDZ8b Site Specific Remediation Strategy, February 2008 (ODA Ref.: 08/90074/AODODA)
 - ii. Atkins. REP-ATK-CM-08b-OLP-XXX-E-0002. Corrigendum to the PDZ8b Site Specific Remediation Strategy, January 2009 (ODA Ref.: 09/90037/AODODA)
 - iii. Atkins. REP-ATK-CM-08b-OLP-XXX-E-0003. PDZ8b Site Specific Remediation Strategy Addendum No. 1 (Murphys Yard), June 2010. (ODA Ref.: 10/90284/AODODA)
 - c) CZ8c SSRs
 - i. Atkins. REP-ATK-CM-08c-OLP-XXX-E-0002. PDZ8c (North) Site Specific Remediation Strategy, February 2009 (ODA Ref.: 08/90326/AODODA)
 - ii. Atkins. REP-ATK-CM-08c-OLP-XXX-E-0001. PDZ8c (South) Site Specific Remediation Strategy, June 2008 (ODA Ref.: 08/90281/AODODA)
 - d) Atkins. 0241-ENW-ATK-LET-00276. Site Wide SSRS Addendum - Criteria for Asbestos in Fill Material. March 2009 (ODA Refs: 08/90083/AODODA, 08/90181/AODODA, 08/90216/AODODA, 08/90217/AODODA, 08/90218/AODODA, 08/90219/AODODA, 08/90220/AODODA, 08/90221/AODODA, 08/90222/AODODA, 08/90223/AODODA, 08/90281/AODODA and 08/90326/AODODA)
4. Capita Symonds. REP-CSP-VZ-ZZZ-OLP-XXX-E-0866. Lower Lea Valley Groundwater Model. July 2008. (this document is referenced within ODA Ref's.: 08/90083/AODODA, 08/90074/AODODA, 08/90326/AODODA and 08/90281/AODODA)

5. PDZ8 Remediation Method Statements (RMS):
 - a) CZ8a RMSs
 - i. BAM Nuttall. MST-ENL-CE-08a-OLP-SP1-E-0079. CZ8a RMS. September 2008. (ODA Ref.: 08/90156/AODODA)
 - ii. BAM Nuttall. MST-ENL-CE-08a-OLP-SP1-E-0119. CZ8a RMS Addendum No. 1, November 2008 (ODA Ref.: 08/90354/AODODA)
 - iii. WSP (for BAM Nuttall). MST-ENL-CK-08a-OLP-SP1-E-0152. CZ8a Groundwater RMS (Perched Water), October 2009 (ODA Ref.: 09/90243/AODODA)
 - iii. BAM Nuttall. MST-ENL-CK-08a-OLP-SP1-E-0178. CZ8a RMS Addendum No. 2, February 2010 (ODA Ref.: 10/90113/AODODA)
 - iv. WSP (for BAM Nuttall). MST-ENL-CK-08a-OLP-SP1-E-0181. CZ8a RTD Groundwater RMS Addendum, June 2010 (ODA Ref.: 10/90233/AODODA)
 - b) CZ8b RMSs
 - i. BAM Nuttall. MST-ENL-CE-08B-OLP-SP1-E-0071. CZ8b RMS, June 2008. (ODA Ref.: 08/90120/AODODA)
 - ii. BAM Nuttall. MST-ENL-CK-08b-OLP-SP1-E-0180. CZ8b RMS Addendum, February 2010 (ODA Ref.: 10/90112/AODODA)
 - c) CZ8c RMSs
 - i. BAM Nuttall. MST-ENL-CE-08c-OLP-SP1-E-0118. CZ8c (South) RMS, October 2008. (ODA Ref.: 08/90324/AODODA)
 - ii. BAM Nuttall. MST-ENL-CE-08c-OLP-SP1-E-0124. CZ8c (South) RMS Addendum, March 2009. (ODA Ref.: 09/90071/AODODA)
 - iii. BAM Nuttall. MST-ENL-CK-08c-OLP-SP1-E-0143. CZ8c RMS (North), March 2009 (ODA Ref.: 09/90069/AODODA)
 - iv. BAM Nuttall. MST-ENL-CE-08B-OLP-SP1-E-0071. CZ8c Soil Treatment RMS (Bioremediation), February 2011 (ODA Ref.: 08/90120/AODODA)
6. Southern Plume
 - a) Atkins. 0241-ENW-ENW-CM-REP-0007. Southern Plume Position Paper: SSRS Addendum for CZ2a, CZ2b, CZ3a (Banner Chemicals), CZ3b (Pumping Station), CZ8a, CZ8b, CZ8c North and CZ8c South. April 2011. (ODA Ref: 10/90567/AODODA)
 - b) Nuttall. MST-ENL-CE-ZZZ-OLP-SP1-E-0270. Southern Plume RMS. April 2011. (ODA Ref.: 10/90606/AODODA)
 - c) Nuttall. REP-ENL-CE-ZZZ-OLP-SP1-E-0458. CZ2a, CZ2b, CZ3a, Cz3b (Pumping Station), CZ8a, CZ8b and CZ8c Southern Groundwater Plume Validation Report. October 2011. (ODA Ref.: 11/90733/AODODA)
7. PDZ8 Validation Reports:
 - a) CZ8a Validation Reports
 - i. BAM Nuttall. REP-ENL-CK-08a-OLP-SP1-E-0208. CZ8a Unsaturated Zone Validation Report, September 2010 (ODA Ref: 10/90340/AODODA)
 - ii. BAM Nuttall. REP-ENL-CK-08a-OLP-SP1-E-0307. CZ8a Unsaturated Zone Validation Report Addendum (Incl. Groundwater Trend Analysis), September 2010 (ODA Ref: 10/90340/AODODA)
 - iii. BAM Nuttall. REP-ENL-CK-08a-OLP-SP1-E-0318. CZ8a Unsaturated Zone Validation Report Addendum No.2 (Former Retained Vegetation Area], October 2011 (ODA Ref: 11/90578/AODODA)

- iv. WSP (for BAM Nuttall). REP-ENL-CK-08a-OLP-SP1-E-0296. CZ8A Zone One (Maryland) RTD Groundwater Verification Report, December 2010 (ODA Ref: 10/90340/AODODA)
 - v. WSP (for BAM Nuttall). REP-ENL-CK-08a-OLP-SP1-E-0311. CZ8A Zone One (Maryland) RTD Groundwater Verification Report (12 months monitoring), August 2011 (ODA Ref.: 11/90578/AODODA)
- b) CZ8b Validation Reports
- i. BAM Nuttall. REP-ENL-CK-08b-OLP-SP1-E-0165. CZ8b Unsaturated Zone Validation Report , July 2010 (ODA Ref: 09/90229/AODODA)
 - ii. BAM Nuttall. REP-ENL-CK-08b-OLP-SP1-E-0167. CZ8b Unsaturated Zone Validation Report Addendum (River Wall), January 2010 (ODA Ref: 10/90067/AODODA)
 - iii. BAM Nuttall. REP-ENL-CE-08b-OLP-SP1-E-0308. CZ8b Unsaturated Validation Report (Inc. Groundwater Trend Analysis) Addendum No.2, November 2010 (ODA Ref: 10/90511/AODODA)
 - iv. BAM Nuttall. REP-ENL-CE-08b-OLP-SP1-E-0310. CZ8b Unsaturated Validation Report Addendum No. 3 (Murphy's Area), (ODA Ref: 11/90337/AODODA)
- c) CZ8c Validation Reports
- i. BAM Nuttall. REP-ENL-CK-08c-OLP-SP1-E-0223. CZ8c Unsaturated Zone Validation Report , October 2009 (ODA Ref: 09/90378/AODODA)
 - ii. BAM Nuttall. REP-ENL-CE-08c-OLP-SP1-E-0305. CZ8c Unsaturated Zone Validation Report Addendum (Incl. Groundwater Trend Analysis, October 2010 (ODA Ref: 10/90512/AODODA)
8. Atkins. REP-ATK-CM-ZZZ-OLP-XXX-E-0007. Retained Areas Risk Assessment Report. September 2011 (ODA Ref:11/90102/AODODA)
9. BAE Systems. PRO-ENL-CE-ZZZ-OLP-SP1-E-0009-01. Risk Assessment for German Air-dropped UXO. March 2007 (*this document is referenced within ODA Ref's: 10/90340/AODODA, 09/90229/AODODA and 09/90378/AODODA*)
10. Nuttall. MST-ENL-CE-ZZZ-OLP-SP1-E-0006. Decommissioning and Protection of Retained Boreholes and Window Sample Installations and Removal of Concrete Rings, April 2008. (*this document is referenced within ODA Ref's: 10/90340/AODODA, 09/90229/AODODA and 09/90378/AODODA*)
11. Temporary Holding Facility in PDZ2
- a) Nuttall. REP-ENL-CK-02Z-OLP-SP1-E-0091. CZ2a and 2b Unsaturated Zone Validation Report. November 2009 (ODA Ref.: 09/90399/AODODA)
 - b) Nuttall. REP-ENL-CK-02Z-OLP-SP1-E-0320. CZ2a and 2b Unsaturated Zone Validation Report Addendum. May 2010 (ODA Ref.: 10/90586/AODODA)

FIGURES

- Figure 1: Location of Planning Delivery Zone 8
- Figure 2: Olympic End Use for Planning Delivery Zone 8
- Figure 3: Legacy End Use Planning for Delivery Zone 8
- Figure 4: Site Investigation Locations for Planning Delivery Zone 8
- Figure 5: Sub Grade Level for Planning Delivery Zone 8
- Figure 6: Sub Formation Level for Planning Delivery Zone 8
- Figure 7: Enabling Works Formation Level for Planning Delivery Zone 8
- Figure 8: Extent of Marker Layer and Human Health Separation Layer for Planning Delivery Zone 8
- Figure 9: Non Remediated Areas within Planning Delivery Zone 8
- Figure 10: Summary of Exceedances requiring Action by Follow On Projects
- Figure 11a: Spatial Coverage of the Human Health Validation Reports within Planning Delivery Zone 8
- Figure 11b: Spatial Coverage of the Unsaturated Zone and Groundwater Validation Reports within Planning Delivery Zone 8

DRAWINGS

- SKE-ATK-XX-ZZZ-OLP-XXX-O-0003: Sub Zone Remediation Areas (including areas anticipated as no remediation)
- ENW-ATK-8a-SP1-DR-Y-3-H11-0517 Schematic Conceptual Site Model for CZ8a Human Health Assessment
- ENW-ATK-8a-SP1-DR-Y-3-H11-0518: Controlled Waters Conceptual Site Model SSRS CZ8a
- 2DD-ATK-CM-08b-OLP-XXX-E-0013: Schematic Conceptual Site Model for CZ8b Human Health Assessment
- 2DD-ATK-CM-08b-OLP-XXX-E-0014: Schematic Controlled Waters QRA Conceptual Model for CZ8b
- ENW-ATK-8c-SP1-DR-Y-3-H11-0566 8c North Human Health QRA Schematic Conceptual Site Model
- ENW-ATK-8c-SP1-DR-Y-3-H11-0567 8c North Controlled Waters QRA Schematic Conceptual Site Model
- ENW-ATK-8c-SP1-DR-Y-3-H11-0517 8c South Human Health QRA Schematic Conceptual Site Model
- ENW-ATK-8c-SP1-DR-Y-3-H11-0518 8c South Controlled Waters QRA Schematic Conceptual Site Model
- 2DD-ENL-CK-08a-OLP-SP1-E-0397: CZ8a Hotspot 20 – Exceedances of the Legacy Commercial Land Use Human Health SSAC Sheets 1 and 2.
- ENW-ATK-8a-SP1-DR-Y-3-H11-0521: SSRS CZ8a Location of Zones used in Controlled Waters DQRA
- ENW-ATK-8c-SP1-DR-Y-3-H11-0511: SSRS CZ8c South Site Plan showing Human Health QRA Zones
- ENW-ATK-8c-SP1-DR-Y-3-H11-0515: SSRS CZ8c South Controlled Waters Risk Assessment Zoning
- ENW-ATK-8c-SP1-DR-Y-3-H11-0565: SSRS CZ8c North Controlled Waters Risk Assessment Zoning
- 2DD-ENL-CK-ZZZ-OLP-SP1-E-0419: Olympic Park South: Areas that require vapour mitigation measures or further vapour assessment.

APPENDICES

Appendix A: Glossary of Terms and Definitions

Appendix B: Schedule of Key Documentation (including summary of contents)

Appendix C: Key Parties

Appendix D: Assessment of Retained Areas in PDZ8

Appendix E: Permit to Proceed Protocol (CD only)

APPENDIX A:

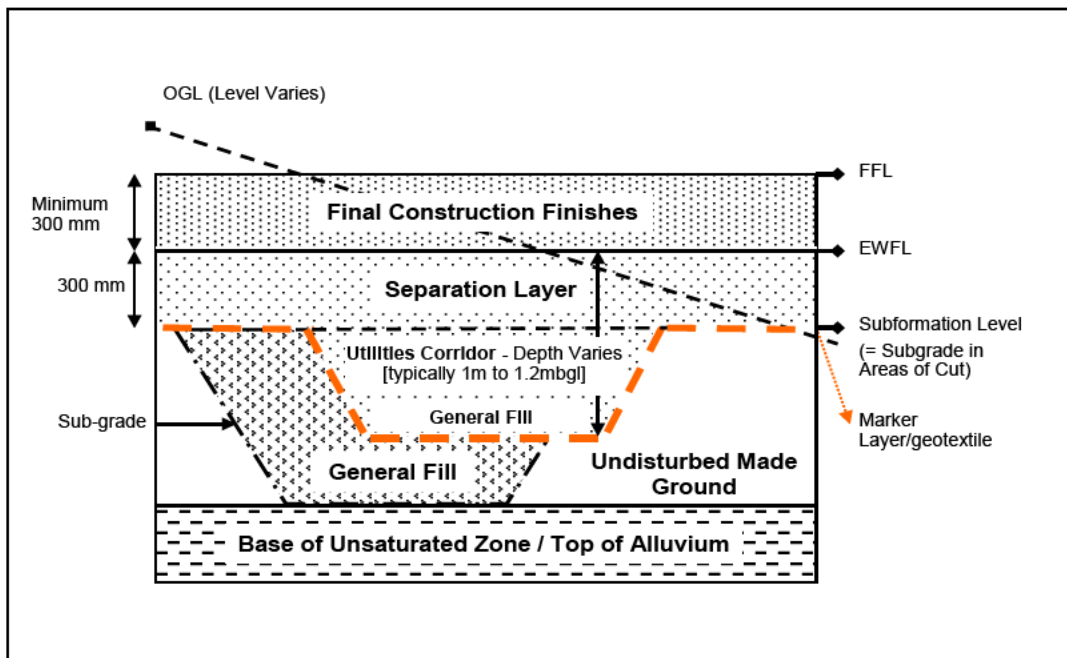
Glossary of Terms and Definitions

Glossary of Terms and Definitions

Term	Meaning / Definition
BNL	BAM Nuttall Limited (Enabling Works)
CoC	Contaminant(s) of Concern
CSM	Conceptuel Site Model
CVR	Consolidated Validation Report
CZ	Construction Zone
DPVE	Dual Phase Vapour Extraction
DQRA	Detailed Quantitative Risk Assessment
EA	Environment Agency
EQS	Environmental Quality Standard
ESGL	Environmental Scientifics Group Limited
EWFL	Enabling Works Formation Level
FFL	Final Finished Level
GRS	Global Remediation Strategy
GQRA	Generic Quantitative Risk Assessment
GWAC	Groundwater Assessment Criteria
HHSL	Human Health Separation Layer
LDA	London Development Agency (See OPLC)
LNAPL	Light Non-Aqueous Phase Liquid
ODA	Olympic Delivery Authority
ORC	Oxygen Release Compound
PAH	Polycyclic Aromatic Hydrocarbons
ODA PDT	Olympic Delivery Authority Planning Decisions Team
OPLC	Olympic Park Legacy Company (formerly known as LDA)
PDZ	Planning Delivery Zone
RMS	Remediation Method Statement
RTD	River Terrace Deposits
SSAC	Site Specific Assessment Criteria

SSRS	Site Specific Remediation Strategy
SSRSpec	Site Specific Remediation Specification
SSRT	Site Specific Remediation Target
UXO	Unexploded Ordnance
WSP	WSP Group Plc
WYGE	White Young Green Environmental

Generalised Earthworks Summary and Terminology



APPENDIX B:
Schedule of Key Documentation
(including summary of contents)

SUMMARY OF CONTENTS

This section provides a summary of the development of remedial design, implementation and validation relevant to this Planning Delivery Zone. In addition, we have summarised two site wide documents that form the basis for design and five that have resulted in changes to the SSACs for clarity. In the case of the latter five documents, whilst these are referred to the applicable Validation Reports, and in some cases the RMS's, it is felt that given the impact these reports have had, that these should be specifically discussed in this section. This section should be read in conjunction with the text of this CVR and the reference list presented in Section 6.

Site Wide Documents

Capita Symonds. MST-CSP-CM-ZZZ-OLP-XXX-E-0040. Intrusive Investigation Method Statement (IIMS). November 2006. (ODA Ref: 07/90216/AODODA)

The IIMS presents a framework and provides a generic specification for undertaking contamination intrusive investigations across the Olympic Park to gather sufficient information to support planning applications and scheme design. It has been prepared with reference to the Environment Agency Model Procedures for the Management of Land Contamination CLR 11.

The intrusive investigation works outlined in this document gathered sufficient information to inform production of Site Specific Remediation Strategies (SSRS) to support planning application requirements and detailed design.

In particular the intrusive investigation works provided sufficient information to:

- (i) assess the nature, extent and source of soil and groundwater contamination;
- (ii) assess the soil gas generation potential;
- (iii) prepare site conceptual model;
- (iv) undertake generic and detailed quantitative risk assessment; and
- (v) identify of areas requiring remediation.

Capita Symonds. REP-CSP-VZ-ZZZ-OLP-XXX-E-0076. Global Remediation Strategy, (Version 2.0, Rev B), January 2007. (ODA Ref.: 07/90011/FUMODA)

Given the scale and the strict delivery requirements of the Olympics, the GRS has been prepared to provide a common resource for remediation strategy related work, thus minimising duplication of design, regulatory requirements and programme risk.

To this end the GRS sets out site wide principles and procedures for taking forward the SSRSSs, which are, and have been, prepared for individual Construction Zones/Sub Zones. Specifically the following principles and technical resources have been established:

- (i) a 'Global Conceptual Site Model' (GCSM) for the Olympic Park identifying the major potential contamination related risks; and
- (ii) a wide range of soil and groundwater 'Generic Assessment Criteria' (GAC) for screening of chemical testing results to identify potential contamination risks.

With regard to (ii) above computer based generic quantitative risk assessment (QRA) has been undertaken to derive generic screening values for areas potentially requiring remediation.

The Environment Agency document 'Model Procedures for the Management of Land Contamination' (CLR11) has been consulted in production of this document. In this respect this document broadly represents the Generic Quantitative Risk Assessment process outlined within CLR 11.

Atkins. REP-ATK-CM-ZZZ-OLP-ZZZ-E-0004. Proposed changes to the Human Health SSAC values for Lead, General Metals, and PAHs in the Separation Layer and General Fill. August 2008. (ODA Ref.: 08/90265/AODODA)

Revised SSAC were calculated for lead using the Provisional Tolerable Weekly Intake method for the Soft Landscaping Legacy end use, for general metals using a single Soil Ingestion Rate, and for PAHs assessing the potential contribution from each of the vapour inhalation pathways based on the Henry's Law Constant.

Atkins. REP-ATK-CM-ZZZ-OLP-ZZZ-E-0004 Errata to Document entitled 'Proposed changes to the Human Health SSAC values for Lead, General Metals, and PAHs in the Separation Layer and General Fill'. September 2008. (ODA Ref.: 08/90265/AODODA)

This report recalculated the lead SSAC using the inhalation Tolerable Daily Intake and the dermal pathway. This resulted in a new SSAC for areas of soft landscaping not associated with commercial buildings.

Atkins. ENW-ATK-LET-00269. Site Wide RMS Addendum (Use of Hardcover as a Substitute to the Separation Layer). February 2009. (ODA Ref.: 08/90292/AODODA)

Under this site wide RMS addendum the remedial designers developed a framework for reducing the thickness of the HHSL under suitably robust hardstanding. The basic premise behind this design change was that hardstanding would act as a suitable barrier to certain pollution pathways (namely ingestion, dermal contact and dust inhalation) and reduce the requirement for a full-thickness HHSL.

Nuttall. MST-ENL-CE-ZZZ-OLP-SP1-E-0159 Rev 05. Site Wide RMS Addendum (Asbestos in the Sub-grade & General Fill), March 2009. (ODA Refs: 08/90083/AODODA, 08/90181/AODODA, 08/90216/AODODA, 08/90217/AODODA, 08/90218/AODODA, 08/90219/AODODA, 08/90220/AODODA, 08/90221/AODODA, 08/90222/AODODA 08/90223/AODODA, 08/90281/AODODA and 08/90326/AODODA)

The SSACs and methodology for assessing asbestos in the HHSL and below marker layer materials was further developed as the works progressed as set out in the Site Wide SSRS Addendum - Criteria for Asbestos in Fill Material (0241-ENW-ATK-LET-00276) detailed below. In addition, this RMS details the sampling strategy to be utilised when an asbestos value of >0.1% w/w is encountered within emplaced materials.

Atkins. MEM-ATK-CM-ZZZ-OLP-ZZZ-0004 Rev 2. Site Wide SSRS Addendum (Justification of Deviation from the GRS in the Derivation of SSAC). September 2009. (ODA Ref.: 09/90233/AODODA)

This document details the changes applied in the derivation of SSAC from the methodology or data sources presented in the GRS along with justification for the changes.

This memorandum has been produced to support any deviations from the GRS specifically in relation to TPH and PAH. It documents the changes Atkins has applied in the derivation of the SSAC from the methodology or data sources presented in the GRS. Where changes have been made from the GRS, these have been justified. Updated versions of the TPH and PAH criteria summary tables are appended to this document and in the case of TPH is based on differing FOC.

Site-Specific Documents

CZ8a

Atkins. REP-ATK-CM-08a-OLP-XXX-E-0001. PDZ8a Review of Approach to Remediation, March 2008 (ODA Ref.: 08/90083/AODODA)

This report was prepared in advance of a SSRS as the construction programme was accelerated for these works. As such, this report sets out the CSM, preliminary risk assessment and applies surrogate SSACs (CZ8b SSACs have been applied for CZ8a in the absence of the site investigation data and detailed quantitative risk assessment). Therefore this report aims to set out the remedial strategy based on these factors so as to avoid having to revisit them much later in the project when construction work has finished.

Atkins. REP-ATK-CM-08A-OLP-XXX-E-0002. PDZ8a Site Specific Remediation Strategy, July 2008 (ODA Ref.: 08/90083/AODODA)

The report outlines the CSM, detailed risk assessment and specifies the remedial strategy. From a controlled waters perspective there are two primary model scenarios were considered to derive SSAC for soil, leachate and perched water sources (3a) and Drawing ENW-ATK-8a-SP1-DR-Y-3-H11-0521 illustrates these scenarios:

- Scenario 1 – contamination within the Made Ground leaching directly into the perched water was originally considered to be in continuity with adjacent the Bow Back River^(3a). Following further investigations, utilising groundwater data loggers to monitor the perched water and Bow Back River levels it was subsequently demonstrated that the the perched water in the Made Ground at the south of CZ8a and the adjacent Bow Back River were not connected and so Scenario 2 applies^(5a). It was on this basis that the treatment of the perched water for the protection of human health and controlled waters was no longer considered necessary.
- Scenario 2 was further separated into contamination in the Made Ground^(2a) and Alluvium^(2b). It was considered the contamination is leaching downwards through the unsaturated zone into the River Terrace Deposits to laterally migrate to the Three Mills River.

The remedial strategy includes derivation of SSACs, remediation and the installation of a chemically and geotechnically compliant materials to the EWFL. The Designers identified four discrete outliers requiring remedial action in the unsaturated soils to be protective of Human Health and up to 11 hotspots for the protection of controlled waters. For these controlled waters

hotspots six were identified as being within the soil, while five were identified by the controlled waters DQRA as being perched water sources requiring remedial action and specified continued RTD monitoring.

BAM Nuttall. MST-ENL-CE-08a-OLP-SP1-E-0079. CZ8a RMS. September 2008 (ODA Ref.: 08/90156/AODODA)

This report sets out how the remedial strategy will be implemented and is based on the Designers 'Review of the Approach to Remediation' report and specifies the implementation of the remedial design. In addition to the placement of geotechnically and chemically compliant backfill, there is also an anticipated requirement for the removal and treatment of approximately 14 locations within the unsaturated zone as BNL had utilised a more conservative SSAC value in estimating the hotspot locations. These anticipated locations are based on the number of exceedances in any particular location, the amount by which the exceedance is over the remedial target (which is the CZ8b criteria) and a consideration of cost effectiveness. It is also considered likely that further data is required to determine whether treatment is required of the RTDs.

Atkins. REP-ATK-CM-08a-OLP-XXX-E-0003. Corrigendum to the PDZ8a Site Specific Remediation Strategy, September 2008 (ODA Ref.: 08/90083/AODODA)

This corrigendum was prepared to update Section 13 (Outline Environmental Controls) and Appendix I (SSRTs Protective of Human Health and Controlled Waters) of the CZ8a SSRS.

WSP (for BAM Nuttall). MST-ENL-CK-08a-OLP-SP1-E-0178. CZ8a Groundwater RMS (Perched Water), October 2009 (ODA Ref.: 09/90243/AODODA)

The site investigation identified localised areas of perched waters as requiring remediation for inorganics and chlorinated hydrocarbons to be protective of controlled waters and TPH to be protective of Human Health. The most recent groundwater quality data gathered show concentrations of the all the identified contaminants of concern below their respective SSACs suggesting that remediation of perched water in the Made Ground is not required. Therefore, prior to the decision to undertake any remediation works, further baseline sampling will be conducted to determine the requirement for further treatment of perched water.

BAM Nuttall. MST-ENL-CE-08a-OLP-SP1-E-0119. CZ8a RMS Addendum No. 1, November 2008 (ODA Ref.: 08/90354/AODODA)

This report is based on the SSRS and specifies the implementation of the remedial design. In addition to the placement of geotechnically and chemically compliant backfill, there is also a requirement for the removal of seven human health outliers in the unsaturated zone and up to 11 outliers to be protective of controlled waters. Further monitoring and assessment is required of the RTDs.

BAM Nuttall. MST-ENL-CK-08a-OLP-SP1-E-0178. CZ8a RMS Addendum No. 2, February 2010 (ODA Ref.: 10/90113/AODODA)

The primary aim of this RMS addendum was to demonstrate that a direct pathway does not exist between the perched water in the Made Ground at the south of CZ8a and the adjacent Bow Back River due to the replacement and upgrading of the existing River Walls. Improvements to the riverwall have been undertaken beyond those envisaged by the SSRS and are considered to

reduce the potential for perched water to enter the Bow Back River. In addition, monitoring of the perched water and adjacent Bow River levels via data loggers indicate that these two water bodies are not in direct connectivity. Indeed the monitoring which was also undertaken across the perched water level in CZ8a indicates the perched water to be discontinuous. As a result of these findings, Scenario 1 from the controlled waters DQRA presented SSRS is no longer applicable to the site. Therefore, BNL adopted the Scenario 2a criteria for perched waters within Zone 1. Scenarios 2a and 2b will be adopted for the backfill materials sub-grade within Zone 1. This CSM change and the collection of additional water data has altered the remedial strategy to: the removal of seven outliers from the unsaturated zone for the protection of controlled waters (reduced from 11) and perched water treatment no longer being considered necessary. There is no change to the number of human health unsaturated zone outliers requiring removal (four).

In addition, as the marker layer placed by Enabling Works is considered 'redundant' as the hardstanding placed by the Follow On Projects will act as a substitute for the separation layer. As such, the materials placed by Enabling Works above the marker layer have been referred to as 'upper' general fill within this report rather than human health separation layer. It must be noted that material above the redundant marker layer has not been verified to human health separation layer criteria, and as such suitable measures should be undertaken by future contractors following a review of the chemical data, when excavating at the site.

WSP (for BAM Nuttall). MST-ENL-CK-08a-OLP-SP1-E-0181. CZ8a RTD Groundwater RMS Addendum, June 2010 (ODA Ref.: 10/90233/AODODA)

This document sets out how the underlying RTD will be remediated following the identification of elevated concentrations, at discrete locations, of trichloroethene, cis-1,2-dichloroethene and vinyl chloride in the south-east portion of the CZ8a. These contaminants of concern are considered to have originated from the unsaturated zone hotspot associated with the former Maryland Plastics factory. The remedial scheme was designed to reduce these CoCs to either the RTD groundwater SSAC or up hydraulic gradient background conditions. Following the injection of the substrate, a period of groundwater monitoring will be undertaken where the collected data will be compared to the remedial objectives to demonstrate compliance.

BAM Nuttall. REP-ENL-CK-08a-OLP-SP1-E-0208. CZ8a Unsaturated Zone Validation Report, September 2010 (ODA Ref: 10/90340/AODODA)

This report details the implementation of the remedial strategy as detailed in the SSRS and RMS including the installation of compliant materials and marker layer. This report confirms the appropriate removal, validation and backfill of four human health and seven controlled water hotspots in the unsaturated zone. In the latter case this was on the basis of the RMS Addendum No.2 which demonstrated that a direct pathway does not exist between the perched water in the Made Ground at the south of CZ8a and the adjacent Bow Back River due to the upgrade of the riverwalls within this area of the site. This report also notes that one hotspot location could not be fully removed due to the presence of a temporary building.

Following the completion of the remediation, two areas within CZ8a were identified as containing residual concentrations of volatile organic compounds (VOCs) in excess of their SSRT at the further practicable extent of remediation. Further assessment identified that the exceedances were human health related and so to assess further these theoretical risks, five dual level vapour wells were installed at these locations. The vapour results identified exceedances at these locations above the vapour specific criterion based on a Legacy end use. It was therefore agreed with the landowner (OPLC) that this risk to human health in Legacy will be mitigated by the

installation of a vapour membrane into future buildings in this area (2DD-ENL-CK-08a-OLP-SP1-E-0397).

BAM Nuttall. REP-ENL-CK-08a-OLP-SP1-E-0307. CZ8a Unsaturated Zone Validation Report Addendum (Incl. Groundwater Trend Analysis), September 2010 (ODA Ref: 10/90340/AODODA)

This report reviews the available groundwater data post completion of Enabling Works and demonstrates compliance with the approved design, validation and verification sampling of perched water and shallow groundwater was undertaken throughout and post Enabling Works. Verification of the remediation of the RTD is reported separately. Further assessment of the hotspot location beneath the temporary building was undertaken by way of reviewing the CSM. This refinement concluded that the concentrations of arsenic in the soil and perched water at this location do not present an unacceptable risk to controlled waters.

BAM Nuttall. REP-ENL-CK-08a-OLP-SP1-E-0318. CZ8a Unsaturated Zone Validation Report Addendum No.2 (Former Retained Vegetation Area), October 2011 (ODA Ref: 11/90578/AODODA)

This report presents the human health and controlled waters assessments relating to additional works that have occurred since submission of the Addendum to the CZ8a Unsaturated Zone Validation Report. This report demonstrates the marker layer was installed and the backfill materials are compliant with the Designer defined SSACs.

WSP (for BAM Nuttall). REP-ENL-CK-08a-OLP-SP1-E-0296. CZ8A Zone One (Maryland) RTD Groundwater Verification Report, December 2010 (ODA Ref: 10/90340/AODODA)

The RMS identified localised areas of RTD groundwater requiring treatment of trichloroethene, cis1,2-dichloroethene and vinyl chloride. In addition, elevated concentrations of arsenic were also recorded across CZ8a and have remained relatively consistent in each monitoring well. These concentrations and observed arsenic shallow groundwater distribution is considered to be influenced by potential up-gradient sources and will therefore be considered as part of the Southern Plume work. The primary objective of this report is to confirm the physical site remediation works which comprised the injection of a proprietary substrate in a slurry form, which is specifically designed for the reduction in chlorinated ethenes; and to review the monitoring results received following three months post remediation monitoring. The post-remediation groundwater monitoring data recorded exceedances of the controlled waters SSAC for the contaminants of concern remain at two locations with respect to trichloroethene and four locations with respect to vinyl chloride. Whilst there is no SSAC for DCE (and there are five locations in excess of the laboratory MDL), the monitoring of the groundwater confirms the presence of dissolved ethene verifying that complete dechlorination is occurring. It is therefore evident that, based on these results, that the site cannot be verified against the objectives set out in the RMS at this time. However this is not unexpected given that the principal remediation pathway for the chlorinated ethenes is through enhancement of the geochemical field conditions to support reductive dechlorination and the benefit of such works is unlikely to be demonstrable after just three months groundwater monitoring. Therefore, an addendum to this verification report will be produced following the completion of one year of post-remediation monitoring data.

WSP (for BAM Nuttall). REP-ENL-CK-08a-OLP-SP1-E-0311. CZ8A Zone One (Maryland) RTD Groundwater Verification Report (12 months monitoring), August 2011 (ODA Ref.: 11/90578/AODODA)

This report is based on the full 12 months post-remediation monitoring and concludes that two locations exceed the trichloroethene controlled waters SSAC and four locations exceed the vinyl chloride controlled waters SSAC, but using the wider southern plume controlled waters assessment criteria presented in the Southern Plume RMS, it can be demonstrated that there are no unacceptable risks to controlled waters with regard to cis-1,2-dichloroethene and vinyl chloride. The use of the wider plume assessment criteria is considered appropriate as the Southern Plume includes CZ8a. It is on this basis it was considered there is no unacceptable risk to controlled waters from these contaminants. In addition, it is considered likely that the elevated concentrations are potentially associated with the recorded unsaturated zone soil source in the third party easements (High Voltage cable or at the third party boundary located up gradient of the treatment area).

Exceedances of the human health SSAC were recorded in two locations, with one location remaining above the SSAC in the final two monitoring rounds. Given that the OPLC have already confirmed that vapour protection measures are to be adopted in this area due to unsaturated zone exceedances at the practical extent of the excavation, utilising the soft landscaping GAC to demonstrate outdoor vapour exposure, there are no exceedances of the human health screening criteria. Therefore the site is also validated with respect to human health.

CZ8b

Atkins. REP-ATK-CM-08b-OLP-XXX-E-0001. PDZ8b Site Specific Remediation Strategy, February 2008 (ODA Ref.: 08/90074/AODODA)

The report outlines the CSM, detailed risk assessment and specifies the remedial strategy. The remedial strategy includes derivation of SSACs, remediation and the installation of a chemically and geotechnically compliant materials to the EWFL. The Designers identified two discrete outliers requiring remedial action to be protective of Human Health (one in the unsaturated soils and one from perched water) and seven hotspots for the protection of controlled waters (this includes one hotspot requiring treatment for both human health and controlled waters. In addition, elevated concentrations of inorganic and organic contaminants were found in the RTD groundwater at the northern (up-gradient) boundary, which may be sourced off site and may represent a contaminant plume moving onto the site.

BAM Nuttall. MST-ENL-CE-08B-OLP-SP1-E-0071. CZ8b RMS, June 2008 (ODA Ref.: 08/90120/AODODA)

This report sets out how the remedial strategy will be implemented based on the SSRS and specifies the implementation of the remedial design. In addition to the placement of geotechnically and chemically compliant backfill, there is also an anticipated requirement for the removal and treatment of two human health hotspots and seven controlled water hotspots within the unsaturated zone. In addition, the main aim is to remove any free product encountered within the perched water in the Made Ground. The need for RTD groundwater treatment is currently under review.

Atkins. REP-ATK-CM-08b-OLP-XXX-E-0002. Corrigendum to the PDZ8b Site Specific Remediation Strategy, January 2009 (ODA Ref.: 09/90037/AODODA)

This document is a corrigendum to the CZ8b SSRS providing an update to the site specific remedial target (SSRT) tables. These tables have been revised following an update to the controlled waters risk assessment, to bring the CSM into line with the CSMs for adjacent construction zones. This report does not alter the remedial strategy specified in the main SSRS.

BAM Nuttall. REP-ENL-CK-08b-OLP-SP1-E-0165. CZ8b Unsaturated Zone Validation Report, July 2009 (ODA Ref: 09/90229/AODODA)

This report applies to CZ8b South Plaza area only and details the implementation of the remedial strategy as detailed in the SSRS and RMS including the installation of compliant materials and marker layer. This report confirms the appropriate removal, validation and backfill of five human health and controlled water hotspots in the unsaturated zone. The hotspots identified in the SSRS and RMS were found to extend and merge during the earthworks and validation process.

In addition, as the marker layer is 'redundant', the materials placed by Enabling Works above the marker layer have been referred to as 'upper' general fill within this report rather than human health separation layer. It must be noted that material above the redundant marker layer has not been verified to human health separation layer criteria, and as such suitable measures should be undertaken by future contractors following a review of the chemical data, when excavating at the site.

BAM Nuttall. MST-ENL-CK-08b-OLP-SP1-E-0180. CZ8b RMS Addendum, February 2010 (ODA Ref.: 10/90112/AODODA)

The primary aim of this RMS addendum is to provide clarification regarding the future development of the site and as a consequence, the assessment criteria to be used for materials placed above the Enabling Works marker layer. This is to maintain consistency with the design approach presented in the SSRS regarding applicable human health pathways between source and receptor in such materials. In addition and for completeness, changes to the design that have occurred since the issue of the main RMS are also presented. This reports sets out that the marker layer and separation layer installed by BNL Enabling Works will be superseded ('redundant') by the FOPs intention to install hardstanding across the entire site, which will then provide the primary human health protection and will be classed as the 'separation layer'. As a result, any materials placed above the 'redundant' Enabling Works marker layer shall be compared to the applicable general fill criteria.

BAM Nuttall. REP-ENL-CK-08b-OLP-SP1-E-0167. CZ8b Unsaturated Zone Validation Report Addendum No. 1 (River Wall), February 2010 (ODA Ref: 10/90067/AODODA)

This addendum covers the area adjacent to the eastern boundary of CZ8b associated with works to the river wall that was not verified as part of the main works in CZ8b. The area was defined by a 5m offset from the river wall with a batter that was left during the CZ8b main works due to operational reasons. Verification samples obtained from the batter indicated that contamination was likely to continue towards the river wall.

Excavation of the area was limited by the presence of timber piles and cross ties that support the river wall structure. Material that was visually impacted was removed to the furthest practical extent and replaced with 'clean' fill. On the batter against the river wall potentially contaminated material remains in four separate areas where no further excavation could be undertaken due to the proximity of the river wall. Validation sampling identified elevated concentrations of arsenic and naphthalene within this material that exceed the controlled waters SSAC. Therefore, further groundwater monitoring will be undertaken to confirm whether these soils results do pose a risk to groundwater.

Atkins. REP-ATK-CM-08b-OLP-XXX-E-0003. PDZ8b Site Specific Remediation Strategy Addendum No. 1 (Murphys Yard), June 2010 (ODA Ref.: 10/90284/AODODA)

This addendum has been prepared as a result of access to a part of the CZ, referred to as Murphy's Yard, which was not available at the time of writing the main SSRS in February 2008. Murphy's Yard is situated in the south west of CZ8b. As a result of access to this area of the CZ becoming available, a recent ground investigation was undertaken and therefore additional information has become available. This data was assessed and found not to present an unacceptable risk to human health and controlled waters.

BAM Nuttall. REP-ENL-CE-08b-OLP-SP1-E-0308. CZ8b Unsaturated Validation Report (Inc. Groundwater Trend Analysis) Addendum No.2, November 2010 (ODA Ref: 10/90511/AODODA)

This report aims to verify the underlying groundwater in relation to the SSRS. These were achieved by sampling of the shallow groundwater throughout and post Enabling Works. A review of this groundwater data identified generally compliant conditions across CZ8b, but noted that further monthly monitoring should be undertaken in the vicinity of the eastern river wall, particularly at NBHCZ8B-610 to confirm whether elevated PAH concentrations observed in the most recent sample are indicative of longer-term conditions or an isolated occurrence.

In addition, further assessment of shallow groundwater arsenic and chlorinated ethene (e.g. vinyl chloride) contamination associated with the Southern Plume originating from the CZ3a site is required, to assess the potential risk to controlled waters.

BAM Nuttall. REP-ENL-CE-08b-OLP-SP1-E-0310. CZ8b Unsaturated Validation Report Addendum No. 3 (Murphy's Area), May 2011 (ODA Ref: 11/90337/AODODA)

This report applies to CZ8b Murphys Yard only and details the implementation of the remedial strategy as detailed in the SSRS and RMS including the installation of compliant materials and marker layer. There were no identified hotspots requiring remediation.

Further monitoring at borehole NBHCZ8b-610 identified residual contamination exceeding the controlled waters SSAC in the RTD groundwater. However, the unsaturated zone source has been removed to the furthest practical extent and only minimal finite contaminated material remains immediately adjacent to the borehole.

Elevated organic concentrations were identified along the southern boundary, which was considered to be associated with the adjacent (off-site) former glue factory. The historical maps indicate the presence of former tanks located off-site immediately adjacent to the southeast site boundary to CZ8b and NBHCZ8b-610. It was due to this that Enabling Works installed a cohesive barrier founded in the alluvium. The purpose of the barrier was to separate clean fill placed within the site and unremediated land associated with the third party boundary and to mitigate potential contamination migration onto the site.

CZ8c

Atkins. REP-ATK-CM-08c-OLP-XXX-E-0001. PDZ8c (South) Site Specific Remediation Strategy, June 2008 (ODA Ref.: 08/90326/AODODA)

The report outlines the CSM, detailed risk assessment and specifies the remedial strategy. From a controlled waters perspective a significant proportion of the site is adjacent to the most-sensitive controlled water receptor (Waterworks River). The SSRS has divided the site into two zones; Zone 1, which includes all land within 25m of the river and Zone 2, the remainder of the site. The purpose of this was to reflect the different pathway distances for contaminants to the Waterworks River and to recognise that perched water identified in the vicinity of the river wall may come into direct contact with surface water in the river. As such, the following controlled water pathways to the Waterworks River were identified in the CSM and the two zones are illustrated in Drawings ENW-ATK-8c-SP1-DR-Y-3-H11-0565 and 0515 for CZ8c North and South respectively:

- Scenario 1a – unsaturated soils, leachate and perched water in Made Ground in Zone 1, assuming direct contact with the Waterworks River and no vertical migration through the Alluvium to the River Terrace Deposits.
- Scenario 1b – unsaturated soils, leachate and perched water in Made Ground in Zone 2, assuming vertical migration through the Alluvium to the River Terrace Deposits and subsequent dilution and transport to the Waterworks River.
- Scenario 1c – unsaturated soils, leachate and perched water in Made Ground in Zone 1, assuming vertical migration through the Alluvium, followed by dilution in the River Terrace Deposits in direct contact with the Waterworks River.
- Scenario 2a – soils and leachate originating from the Alluvium in Zone 1, with dilution in the River Terrace Deposits in direct contact with the Waterworks River.
- Scenario 2b – soils and leachate originating from the Alluvium in Zone 2, with subsequent dilution in the River Terrace Deposits and transport to the Waterworks River.

With regard to human health the more conservative GAC of the Olympic and Legacy end uses were selected on a contaminant specific basis and are considered to be protective of the critical human health receptor. Therefore the site has been split into the following four zones as illustrated in Drawing ENW-ATK-8c-SP1-DR-Y-3-H11-0511:

- Zone 8cS.1: Olympic end use comprises Accreditation Checking and the 'Ramps' to the boardwalks along the Greenway which comprise a mixture of Soft and Hard Landscaping; Legacy end use comprises a mixture of Soft and Hard Landscaping.
- Zone 8cS.2: Olympic end use comprises spectator Services, Accreditation Checking and Hard Landscaping (concourse); Legacy end use comprises predominantly Residential Mixed Use.
- Zone 8cS.3: Olympic end use comprises Hard Landscaping (including concourse areas) and 'Ramps' to the proposed boardwalks along the Waterworks River which comprises a mixture of Soft and Hard landscaping; Legacy end use comprises Soft and Hard landscaping.
- Zone 8cS.4: located in the northeast; Olympic end use comprises Accreditation Checking; Legacy end use comprises Soft and Hard landscaping.

The remedial strategy includes derivation of SSACs, remediation and the installation of a chemically and geotechnically compliant materials to the EWFL. The Designers identified that remediation of all soils within the unsaturated Made Ground zone across Zone 1 (which shall in

turn address five identified controlled waters outliers and one identified human health and controlled waters perched water location); and three locations in Zone 2 to be protective of controlled waters. This gives an overall total of one human health hotspot and nine controlled waters hotspot, although one perched water location represents a risk to both human health and controlled waters.

**BAM Nuttall. MST-ENL-CE-08c-OLP-SP1-E-0118 CZ8c (South) RMS, October 2008
(ODA Ref.: 08/90324/AODODA)**

This report sets out how the remedial strategy will be implemented based on the SSRS and specifies the implementation of the remedial design. In addition to the placement of geotechnically and chemically compliant backfill, there is also the requirement for the removal and treatment of one identified controlled waters hotspot, one identified human health and controlled waters perched water location in Zone 1 and two controlled water locations in Zone 2. Overall there is therefore one human health hotspots and three controlled waters hotspots, although one hotspot extended across the majority of Zone 1.

**Atkins. REP-ATK-CM-08c-OLP-XXX-E-0002. PDZ8c (North) Site Specific
Remediation Strategy, February 2009 (ODA Ref.: 08/90281/AODODA)**

The report outlines the CSM, detailed risk assessment and specifies the remedial strategy. The remedial strategy includes derivation of SSACs, remediation and the installation of a chemically and geotechnically compliant materials to the EWFL. The Designers identified remediation of all soils within the unsaturated Made Ground zone across Zone 1 (which shall in turn address one identified controlled waters outlier and two identified controlled waters perched water locations); remedial action to address soil outliers in the unsaturated Made Ground at three locations in Zone 2 to be protective of controlled waters and two locations in the perched water that represented a risk to controlled waters. Therefore in total there were no human health hotspots and six controlled waters hotspots.

**BAM Nuttall. MST-ENL-CK-08c-OLP-SP1-E-0143 CZ8c RMS (North), March 2009
(ODA Ref.: 09/90069/AODODA)**

This report sets out how the remedial strategy will be implemented based on the SSRS and specifies the implementation of the remedial design. In addition to the placement of geotechnically and chemically compliant backfill, BNL confirmed that Scenario 1a was not active as the riverwall was sufficiently competent thereby removing the direct contact of unsaturated soils, leachate and perched water in the Made Ground layer in Zone 1 with the Waterworks River. This was determined by pump tests, visual inspections and comparisons of records of water levels in the River, the excavation and local boreholes. This change to the CSM resulted in there being no requirement for specific remedial action to be protective of Human Health or Controlled Waters.

**BAM Nuttall. MST-ENL-CE-08c-OLP-SP1-E-0124. CZ8c (South) RMS Addendum,
March 2009 (ODA Ref.: 09/90071/AODODA)**

This report has been produced to take into account design changes since issuance of the main RMS. These primarily relate to both site wide changes which have resulted in changes to the Human Health and Controlled Water SSACs and confirmation that Scenario 1a is not applicable. The latter is confirmed following collection and assessment of additional data such as pump tests, visual inspections and comparisons of records of water levels in the River, which conclude that

the river wall was sufficiently competent to allow the direct pathway (Scenario 1a) to the river to be disregarded. This therefore removes the direct contact of unsaturated soils, leachate and perched water in the Made Ground layer in Zone 1 with the Waterworks River and Scenario 1c applies. These design changes and reassessment have resulted in a reduction in the remedial works to two locations requiring treatment for the protection of Controlled Waters. There is no requirement for the treatment to be protective of Human Health.

BAM Nuttall. REP-ENL-CK-08c-OLP-SP1-E-0223. CZ8c Unsaturated Zone Validation Report, October 2009 (ODA Ref: 09/90378/AODODA)

This reports validates the conclusions of the SSRS's and RMS's and confirms the placement of chemically and geotechnically compliant materials to the EWFL. The approved designs identified a number of Relevant Pollutant Linkages (RPL) pertaining to the unsaturated zone within CZ8c, which required remedial action at two controlled waters locations only. In addition a further three hotspots were removed to give a total of five controlled water hotspots which were excavated in CZ8c. One of these hotspots had been previously been defined as requiring removal as part of the earlier SSRS/RMS process and this had commenced prior to a change in the remedial design that required that it be no longer removed. A further two hotspots were found as part of the sub-grade validation works and these were removed. All these hotspots were appropriately excavated, validated and replaced with acceptable materials.

BAM Nuttall. REP-ENL-CE-08c-OLP-SP1-E-0305. CZ8c Unsaturated Zone Validation Report Addendum (including Groundwater Trend Analysis, October 2010 (ODA Ref: 10/90512/AODODA)

This report updates the previous validation report following the completion of additional earthworks and placement of human health and separation layer. However, the primary aim of this report is to verify the underlying groundwater in relation to the SSRS. These were achieved by sampling of the shallow groundwater throughout and post Enabling Works. A review of this groundwater data identified compliant conditions across CZ8c. It was therefore concluded that the Enabling Works undertaken within CZ8c have not had a significantly adverse impact on the underlying water quality or caused an obvious deterioration in conditions over time.

BAM Nuttall. MST-ENL-CE-08B-OLP-SP1-E-0071. CZ8c Soil Treatment RMS (Bioremediation), February 2011 (ODA Ref.: 08/90120/AODODA)

This RMS addendum has been prepared to provide additional detail applicable to the proposed bioremediation works in CZ8c. This report sets out the proposed layout and method statement as well as pertinent permitting/licensing documentation.

Atkins. 0241-ENW-ATK-LET-00276. Site Wide SSRS Addendum - Criteria for Asbestos in Fill Material. March 2009 (ODA Refs: 08/90083/AODODA, 08/90181/AODODA, 08/90216/AODODA, 08/90217/AODODA, 08/90218/AODODA, 08/90219/AODODA, 08/90220/AODODA, 08/90221/AODODA, 08/90222/AODODA 08/90223/AODODA, 08/90281/AODODA and 08/90326/AODODA)

The SSACs and methodology for assessing asbestos in the HSL and below marker layer materials was further developed as the works progressed. This resulted in the following changes:

Separation Layer:

- The material for the upper section of the separation layer has a maximum concentration of potentially asbestos fibres of 0.001% w/w [dry weight].
- The lower section will have an arithmetical average (mean) concentration of asbestos fibres of 0.005% w/w [dry weight].

Below Marker Layer:

The asbestos acceptance criteria for materials below the marker layer are not based on potential risk to Legacy end user human health as the presence of a minimum 600mm thick separation layer eliminates the inhalation and other pathways between source and receptor for the exposure of end users of the site. The below marker layer SSAC for placed material (general fill) is based on the EA Hazardous Waste guidance, which is set at 0.1%w/w [wet weight]. This criterion is based on pre-classification of material rather than in-situ testing.

The sub-grade criterion is solely based on potential landowner liabilities. Therefore, as this material is not considered a 'waste', it is not bound by the Hazardous Waste Regulations. However, the landowner is conscious of the classification of these materials in the future, should they be excavated for disposal, and so uses the waste criterion as a screening measure to inform them on the need for further action.

The risks to construction and future maintenance workers are not addressed by remediation, as they are expected to be dealt with by risk assessment and subsequent mitigating actions.

SOUTHERN PLUME

Atkins. 0241-ENW-ENW-CM-REP-0007. Southern Plume Position Paper: SSRS Addendum for CZ2a, CZ2b, CZ3a (Banner Chemicals), CZ3b (Pumping Station), CZ8a, CZ8b, CZ8c North and CZ8c South. April 2011. (ODA Ref: 10/90567/AODODA)

This report presents a detailed technical review of the distribution of contaminants in River Terrace Deposits groundwater in the area referred to as the Southern Plume (CZ2a, CZ2b, CZ3a, CZ3b, CZ8a, CZ8b and CZ8c). The following contaminants of concern (COC) are considered relevant to the Southern Plume - tetrachloroethene (PCE); trichloroethene (TCE); cis1,2-dichloroethene (cDCE); vinyl chloride (VC); and arsenic. This report also sets out the requirements for remediation and monitoring of the COC concentrations (as appropriate) in the Southern Plume and as such, constitutes an SSRS addendum for the construction zones listed above. Quarterly monitoring for chlorinated ethenes, ethene and arsenic will be carried out and the monitoring results will be evaluated to demonstrate the validation criteria is being met. These assessments will be presented at meetings with the Regulators. In addition, quarterly monitoring reports will be produced and submitted to the PDT as informatives prior to the final validation report. If the validation requirements are met and subject to approval by the PDT, monitoring will cease after a period of one year.

Nuttall. MST-ENL-CE-ZZZ-OLP-SP1-E-0270. Southern Plume RMS. April 2011. (ODA Ref.: 10/90606/AODODA)

This reports outlines how the remediation and monitoring strategy defined in the SSRS addendum will be implemented and sets out the validation objectives and the proposed content of the validation report.

Nuttall. REP-ENL-CE-ZZZ-OLP-SP1-E-0458. CZ2a, CZ2b, CZ3a, Cz3b (Pumping Station), CZ8a, CZ8b and CZ8c Southern Groundwater Plume Validation Report. October 2011 (ODA Ref.: 11/90733/AODODA)

This report assesses and provides a commentary upon the contaminant data collected from the specified monitoring network. This report concludes that complete dechlorination is occurring resulting in concentrations of PCE, TCE, cDCE and VC being less than the SSAC and recorded arsenic concentrations being compliant with the wider plume objectives primarily as a result of source removal. In summary, this report confirms via monitoring, that the Southern Plume COCs do not represent an unacceptable to risk to Human Health and Controlled Waters. Following review of this report, the PDT has requested that monitoring be extended both in its geographical extent (as monitoring wells in CZ3a Banner are now included) and duration (monitoring to be undertaken for a further 12 months based on monthly monitoring for the first quarter and then quarterly thereafter), although the overall number of monitoring wells has significantly reduced.

In addition to the discrete fluctuation of cDCE and Vinyl Chloride in NBHCZ3a-1043 and NBHCZ3a-889 in the final two rounds of the initial groundwater monitoring regime, the PDT requested continuation of groundwater monitoring to further understand the stability of the arsenic plume following in-situ remedial works. It is considered that this additional monitoring will enable the longer term assessment of these contaminant trends.

APPENDIX C:

Key Parties

Key Parties for PDZ8

Responsibility	Organisation
Client:	Olympic Delivery Authority (ODA)
Land owner:	Olympic Park Legacy Company (OPLC) (this was transferred from London Development Agency)
Local Planning Authority:	ODA Planning Decisions Team - PDT
Key Stakeholders:	Environment Agency London Borough of Newham
Client's Project Manager:	Atkins
Designer:	Atkins
CDM Coordinator:	Arup
Enabling Works Tier 1 Contractor:	BAM Nuttall Limited (Nuttall)
Enabling Works Tier 1 Contractor Technical Adviser – Remediation:	Halcrow
Main soil treatment contractors (Tier 2 Contractor):	DEME Environmental Contractors (DEC)
Groundwater Monitoring – Enabling Works:	Nuttall
Groundwater Monitoring – Post Enabling Works:	WSP Environmental
Chemical Testing Laboratory:	TES Bretby (ESGL)
Geotechnical Testing Laboratory:	Environmental Services Group Limited (ESGL)
Groundwater remediation in CZ1a (Tier 2 Contractor)	Erith/WSP Remediation
UXO Study:	BAE Systems
UXO Site Specialists:	NUVIA (formerly known as NUKEM)

APPENDIX D:

Areas to be retained within PDZ8

APPENDIX E:

Permit to Proceed Protocol (CD only)