

Concept Life Sciences

Certificate of Analysis

Report Number: 650404-1

Date of Report: 09-May-2017

Customer: WJ Groundwater
Unit 5 Abbots Business Park
Primrose Hill
Kings Langley
Hertfordshire
WD4 8FR

Customer Contact: Mr Tom Stockman

Customer Job Reference:

Customer Site Reference: Tottenham Hotspur

Date Job Received at Concept: 02-May-2017

Date Analysis Started: 03-May-2017

Date Analysis Completed: 08-May-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

This report should not be reproduced except in full without the written approval of the laboratory

Tests covered by this certificate were conducted in accordance with Concept SOPs



1549

Report checked
and authorised by :
Aislinn Arthey
Trainee Project Manager

Issued by :
Aislinn Arthey
Trainee Project Manager

A handwritten signature in black ink, appearing to read 'Aislinn Arthey'.

Concept Reference: 650404 Project Site: Tottenham Hotspur Customer Reference:						
Water Miscellaneous						
Analysed as Water						
Concept Reference				650404 001	650404 002	
Customer Sample Reference				East Tank	West Tank	
Date Sampled				26-APR-2017	26-APR-2017	
Determinand	Method	Test Sample	LOD	Units		
As (Dissolved)	T281	F	0.0002	mg/l	0.0010	0.0018
Fe (Dissolved)	T281	F	0.005	mg/l	<0.005	0.006
Fe (Total)	T301	AR	0.005	mg/l	0.010	0.029
Mn (Dissolved)	T281	F	0.010	mg/l	0.18	0.014
pH	T7	F			8.0	7.9
Electrical Conductivity	T7	F	1	µS/cm	840	870
Alkalinity expressed as CaCO3	T22	F	20	mg/l	190	210
Total Hardness expressed as CaCO3	T649	F	10	mg/l	300	320
Biochemical Oxygen Demand (Allyl Thiourea)	T264	F	1	mg/l	4	4
Chemical Oxygen Demand	T221	F	20	mg/l	120	<20
Total Dissolved Solids	T808	F	1	mg/l	570	580
Suspended Solids (Total)	T2	AR	10	mg/l	<10	<10
Diss Oxygen	T7	AR	1.0	mg/l	9.6	1.0
Sulphate	T686	F	0.5	mg/l	96	92
Chloride	T686	F	1	mg/l	67	74
Nitrate	T686	F	0.5	mg/l	35	21
Nitrite	T686	F	0.1	mg/l	0.3	0.2
Phosphate	T686	F	0.5	mg/l	<0.5	1.5
Ammonia expressed as NH4	T686	F	0.05	mg/l	0.15	0.21
Cyanide(Total)	T546	F	0.01	mg/l	<0.01	<0.01
Phenols(Mono)	T546	F	0.02	mg/l	<0.02	<0.02
Sodium	T6	F	0.05	mg/l	48	46
Magnesium	T6	F	0.1	mg/l	8.4	7.9
Potassium	T6	F	0.05	mg/l	15	15
TPH (C10-C40)	T219	AR	20	µg/l	<20	40
Rapidly Setttable Solids (1 hour)	T713	AR	10	mg/l	<10	<10
Setttable Solids (24 hours)	T714	AR	10	mg/l	<10	<10
Unsaponifiable Oils and Grease	T2	AR	10	mg/l	<10	<10

Index to symbols used in 650404-1

Value	Description
AR	As Received
F	Filtered
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

TPH: These samples have been analysed exceeding recommended holding times. It is possible therefore that the results provided may be compromised.

Method Index

Value	Description
T686	Discrete Analyser
T808	Calc (by EC)
T219	GC/FID (SE)
T713	Settled 1 hour/Gravimetric
T281	ICP/MS (Filtered)
T301	ICP/MS (Total)
T546	Colorimetry (CF)
T649	ICP/OES (Calc)
T2	Grav
T264	Probe (Incubation Carbonaceous) (5 Days)
T6	ICP/OES
T7	Probe

T22	Titration
T221	Colorimetry (CE)
T714	Settled 24 hours/Gravimetric

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
As (Dissolved)	T281	F	0.0002	mg/l	U	001-002
Fe (Dissolved)	T281	F	0.005	mg/l	U	001-002
Fe (Total)	T301	AR	0.005	mg/l	U	001-002
Mn (Dissolved)	T281	F	0.010	mg/l	U	001-002
pH	T7	F			U	001-002
Electrical Conductivity	T7	F	1	µS/cm	U	001-002
Alkalinity expressed as CaCO ₃	T22	F	20	mg/l	U	001-002
Total Hardness expressed as CaCO ₃	T649	F	10	mg/l	U	001-002
Biochemical Oxygen Demand (Allyl Thiourea)	T264	F	1	mg/l	N	001-002
Chemical Oxygen Demand	T221	F	20	mg/l	N	001-002
Total Dissolved Solids	T808	F	1	mg/l	N	001-002
Suspended Solids (Total)	T2	AR	10	mg/l	N	001-002
Diss Oxygen	T7	AR	1.0	mg/l	N	001-002
Sulphate	T686	F	0.5	mg/l	U	001-002
Chloride	T686	F	1	mg/l	U	001-002
Nitrate	T686	F	0.5	mg/l	U	001-002
Nitrite	T686	F	0.1	mg/l	U	001-002
Phosphate	T686	F	0.5	mg/l	U	001-002
Ammonia expressed as NH ₄	T686	F	0.05	mg/l	U	001-002
Cyanide(Total)	T546	F	0.01	mg/l	U	001-002
Phenols(Mono)	T546	F	0.02	mg/l	U	001-002
Sodium	T6	F	0.05	mg/l	U	001-002
Magnesium	T6	F	0.1	mg/l	U	001-002
Potassium	T6	F	0.05	mg/l	U	001-002
TPH (C10-C40)	T219	AR	20	µg/l	U	001-002
Rapidly Setttable Solids (1 hour)	T713	AR	10	mg/l	N	001-002
Setttable Solids (24 hours)	T714	AR	10	mg/l	N	001-002
Unsaponifiable Oils and Grease	T2	AR	10	mg/l	N	001-002



Concept Life Sciences

Certificate of Analysis

3 Crittall Drive
Springwood Industrial
Estate
Braintree
Essex
CM7 2RT
Tel : 01376 560120
Fax : 01376 552923

Report Number: 680632-1

Date of Report: 15-Sep-2017

Customer: WJ Groundwater
Unit 5 Abbots Business Park
Primrose Hill
Kings Langley
Hertfordshire
WD4 8FR

Customer Contact: Mr Tom Stockman

Customer Job Reference:

Customer Site Reference: Tottenham Hotspur FC

Date Job Received at Concept: 07-Sep-2017

Date Analysis Started: 07-Sep-2017

Date Analysis Completed: 13-Sep-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

This report should not be reproduced except in full without the written approval of the laboratory

Tests covered by this certificate were conducted in accordance with Concept Life Sciences SOPs

All results have been reviewed in accordance with Section 25 of the Concept Life Sciences, Analytical Services Quality Manual



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Report checked
and authorised by :
Claire Brown Crociquia
Customer Service Manager

Issued by :
Claire Brown Crociquia
Customer Service Manager



Concept Reference: 680632 Project Site: Tottenham Hotspur FC Customer Reference:						
Water Suite A						
Analysed as Water						
Concept Reference				680632 001	680632 002	
Customer Sample Reference				East Tank	West Tank	
Date Sampled				01-SEP-2017	01-SEP-2017	
Determinand	Method	Test Sample	LOD	Units		
As (Dissolved)	T281	F	0.0002	mg/l	0.0027	0.0009
Fe (Dissolved)	T281	F	0.005	mg/l	0.009	0.006
Fe (Total)	T301	AR	0.005	mg/l	0.022	0.075
Mn (Dissolved)	T281	F	0.010	mg/l	<0.010	<0.010
pH	T7	F			8.00	8.30
Electrical Conductivity	T7	F	1	µS/cm	1000	1000
Alkalinity expressed as CaCO ₃	T22	F	20	mg/l	47	190
Total Hardness expressed as CaCO ₃	T649	F	10	mg/l	270	360
Biochemical Oxygen Demand (Allyl Thiourea)	T264	F	1	mg/l	15	12
Chemical Oxygen Demand	T221	F	20	mg/l	270	110
Total Dissolved Solids	T808	F	1	mg/l	690	700
Suspended Solids (Total)	T2	AR	10	mg/l	13	<10
Diss Oxygen	T7	AR	1.0	mg/l	6.5	8.4
Sulphate	T686	F	0.5	mg/l	210	150
Chloride	T686	F	1	mg/l	69	77
Nitrate	T686	F	0.5	mg/l	16	58
Nitrite	T686	F	0.1	mg/l	1.6	0.1
Phosphate	T686	F	0.5	mg/l	<0.5	<0.5
Ammonia expressed as NH ₄	T686	F	0.05	mg/l	0.79	0.13
Sodium	T6	F	0.05	mg/l	63	60
Magnesium	T6	F	0.1	mg/l	8.0	12
Potassium	T6	F	0.05	mg/l	28	38
TPH (C10-C40)	T219	AR	20	µg/l	110	50
Rapidly Settleable Solids (1 hour)	T713	AR	10	mg/l	<10	<10
Settleable Solids (24 hours)	T714	AR	10	mg/l	<10	<10
Unsaponifiable Oils and Grease	T2	AR	10	mg/l	(64) <10	(64) <10
Phenols(Mono)	T546	F	0.02	mg/l	<0.02	<0.02
Cyanide(Total)	T546	F	0.01	mg/l	<0.01	<0.01

Index to symbols used in 680632-1

Value	Description
AR	As Received
F	Filtered
64	Analysis was performed by an alternative technique
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Method Index

Value	Description
T649	ICP/OES (Calc)
T546	Colorimetry (CF)
T686	Discrete Analyser
T264	Probe (Incubation Carbonaceous) (5 Days)
T219	GC/FID (SE)
T714	Settled 24 hours/Gravimetric
T808	Calc (by EC)
T221	Colorimetry (CE)
T6	ICP/OES
T713	Settled 1 hour/Gravimetric
T7	Probe
T22	Titration
T281	ICP/MS (Filtered)
T301	ICP/MS (Total)
T2	Grav

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
As (Dissolved)	T281	F	0.0002	mg/l	U	001-002
Fe (Dissolved)	T281	F	0.005	mg/l	U	001-002
Fe (Total)	T301	AR	0.005	mg/l	U	001-002
Mn (Dissolved)	T281	F	0.010	mg/l	U	001-002
pH	T7	F			U	001-002
Electrical Conductivity	T7	F	1	µS/cm	U	001-002
Alkalinity expressed as CaCO ₃	T22	F	20	mg/l	U	001-002
Total Hardness expressed as CaCO ₃	T649	F	10	mg/l	U	001-002
Biochemical Oxygen Demand (Allyl Thiourea)	T264	F	1	mg/l	N	001-002
Chemical Oxygen Demand	T221	F	20	mg/l	N	001-002
Total Dissolved Solids	T808	F	1	mg/l	N	001-002
Suspended Solids (Total)	T2	AR	10	mg/l	N	001-002
Diss Oxygen	T7	AR	1.0	mg/l	N	001-002
Sulphate	T686	F	0.5	mg/l	U	001-002
Chloride	T686	F	1	mg/l	U	001-002
Nitrate	T686	F	0.5	mg/l	U	001-002
Nitrite	T686	F	0.1	mg/l	U	001-002
Phosphate	T686	F	0.5	mg/l	U	001-002
Ammonia expressed as NH ₄	T686	F	0.05	mg/l	U	001-002
Sodium	T6	F	0.05	mg/l	U	001-002
Magnesium	T6	F	0.1	mg/l	U	001-002
Potassium	T6	F	0.05	mg/l	U	001-002
TPH (C10-C40)	T219	AR	20	µg/l	U	001-002
Rapidly Setttable Solids (1 hour)	T713	AR	10	mg/l	N	001-002
Setttable Solids (24 hours)	T714	AR	10	mg/l	N	001-002
Unsaponifiable Oils and Grease	T2	AR	10	mg/l	N	001-002
Phenols(Mono)	T546	F	0.02	mg/l	U	001-002
Cyanide(Total)	T546	F	0.01	mg/l	U	001-002



Concept Life Sciences

Certificate of Analysis

Report Number: 689576-1

Date of Report: 24-Oct-2017

Customer: WJ Groundwater
Unit 5 Abbots Business Park
Primrose Hill
Kings Langley
Hertfordshire
WD4 8FR

Customer Contact: Mr Tom Stockman

Customer Job Reference:

Customer Site Reference: THFC

Date Job Received at Concept: 16-Oct-2017

Date Analysis Started: 16-Oct-2017

Date Analysis Completed: 24-Oct-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

This report should not be reproduced except in full without the written approval of the laboratory

Tests covered by this certificate were conducted in accordance with Concept Life Sciences SOPs

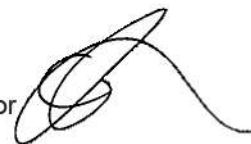
All results have been reviewed in accordance with Section 25 of the Concept Life Sciences, Analytical Services Quality Manual



1549

Report checked
and authorised by :
Christopher Payne
Customer Service Advisor

Issued by :
Christopher Payne
Customer Service Advisor



Concept Reference: 689576						
Project Site: THFC						
Customer Reference:						
Water						
Analysed as Water						
Suite A						
Concept Reference				689576 001	689576 002	
Customer Sample Reference				East Tank	West Tank	
Date Sampled				11-OCT-2017	11-OCT-2017	
Determinand	Method	Test Sample	LOD	Units		
As (Dissolved)	T281	F	0.0002	mg/l	0.0030	0.0013
Fe (Dissolved)	T281	F	0.005	mg/l	0.76	0.009
Fe (Total)	T301	F	0.005	mg/l	4.0	4.6
Mn (Dissolved)	T281	F	0.010	mg/l	0.015	<0.010
Alkalinity expressed as CaCO ₃	T22	F	20	mg/l	96	50
Ammonia expressed as NH ₄	T686	F	0.05	mg/l	0.46	0.51
Biochemical Oxygen Demand (Allyl Thiourea)	T264	F	1	mg/l	3	2
Chemical Oxygen Demand	T221	F	20	mg/l	36	32
Chloride	T686	F	1	mg/l	17	92
pH	T7	F			8.50	7.90
Sulphate	T686	F	0.5	mg/l	100	220
Nitrate	T686	F	0.5	mg/l	2.6	42
Nitrite	T686	F	0.1	mg/l	0.3	1.3
Phosphate	T686	F	0.5	mg/l	<0.5	<0.5
Sodium	T6	F	0.05	mg/l	60	81
Magnesium	T6	F	0.1	mg/l	3.5	11
Total Hardness expressed as CaCO ₃	T649	F	10	mg/l	71	250
Potassium	T6	F	0.05	mg/l	35	33
Total Dissolved Solids	T808	F	1	mg/l	580	640
Rapidly Setttable Solids (1 hour)	T713	AR	10	mg/l	140	<10
Electrical Conductivity	T7	F	1	µS/cm	870	950
Setttable Solids (24 hours)	T714	AR	10	mg/l	120	<10
Unsaponifiable Oils and Grease	T2	AR	10	mg/l	<10	<10
Suspended Solids (Total)	T2	AR	10	mg/l	160	<10
Diss Oxygen	T7	AR	1.0	mg/l	5.2	1.3
Cyanide(Total)	T546	F	0.01	mg/l	<0.01	<0.01
Phenols(Mono)	T546	F	0.02	mg/l	<0.02	<0.02
TPH (C10-C40)	T219	AR	0.020	mg/l	0.28	0.25

Index to symbols used in 689576-1

Value	Description
F	Filtered
AR	As Received
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Method Index

Value	Description
T221	Colorimetry (CE)
T649	ICP/OES (Calc)
T264	Probe (Incubation Carbonaceous) (5 Days)
T2	Grav
T714	Settled 24 hours/Gravimetric
T301	ICP/MS (Total)
T7	Probe
T713	Settled 1 hour/Gravimetric
T546	Colorimetry (CF)
T686	Discrete Analyser
T281	ICP/MS (Filtered)
T22	Titration
T219	GC/FID (SE)
T808	Calc (by EC)
T6	ICP/OES

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
As (Dissolved)	T281	F	0.0002	mg/l	U	001-002
Fe (Dissolved)	T281	F	0.005	mg/l	U	001-002
Fe (Total)	T301	F	0.005	mg/l	U	001-002
Mn (Dissolved)	T281	F	0.010	mg/l	U	001-002
Alkalinity expressed as CaCO ₃	T22	F	20	mg/l	U	001-002
Ammonia expressed as NH ₄	T686	F	0.05	mg/l	U	001-002
Biochemical Oxygen Demand (Allyl Thiourea)	T264	F	1	mg/l	N	001-002
Chemical Oxygen Demand	T221	F	20	mg/l	N	001-002
Chloride	T686	F	1	mg/l	U	001-002
pH	T7	F			U	001-002
Sulphate	T686	F	0.5	mg/l	U	001-002
Nitrate	T686	F	0.5	mg/l	U	001-002
Nitrite	T686	F	0.1	mg/l	U	001-002
Phosphate	T686	F	0.5	mg/l	U	001-002
Sodium	T6	F	0.05	mg/l	U	001-002
Magnesium	T6	F	0.1	mg/l	U	001-002
Potassium	T6	F	0.05	mg/l	U	001-002
Total Dissolved Solids	T808	F	1	mg/l	N	001-002
Total Hardness expressed as CaCO ₃	T649	F	10	mg/l	U	001-002
Rapidly Setttable Solids (1 hour)	T713	AR	10	mg/l	N	001-002
Electrical Conductivity	T7	F	1	µS/cm	U	001-002
Settlable Solids (24 hours)	T714	AR	10	mg/l	N	001-002
Unsaponifiable Oils and Grease	T2	AR	10	mg/l	N	001-002
Suspended Solids (Total)	T2	AR	10	mg/l	N	001-002
Diss Oxygen	T7	AR	1.0	mg/l	N	001-002
Cyanide(Total)	T546	F	0.01	mg/l	U	001-002
Phenols(Mono)	T546	F	0.02	mg/l	U	001-002
TPH (C10-C40)	T219	AR	0.020	mg/l	U	001-002



Concept Life Sciences

Certificate of Analysis

Report Number: 695332-1

Date of Report: 15-Nov-2017

Customer: WJ Groundwater
Unit 5 Abbots Business Park
Primrose Hill
Kings Langley
Hertfordshire
WD4 8FR

Customer Contact: Mr Tom Stockman

Customer Job Reference:

Customer Site Reference: THFC

Date Job Received at Concept: 09-Nov-2017

Date Analysis Started: 09-Nov-2017

Date Analysis Completed: 15-Nov-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

This report should not be reproduced except in full without the written approval of the laboratory

Tests covered by this certificate were conducted in accordance with Concept Life Sciences SOPs

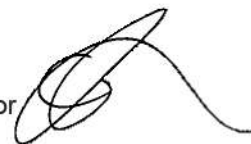
All results have been reviewed in accordance with Section 25 of the Concept Life Sciences, Analytical Services Quality Manual



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Report checked
and authorised by :
Christopher Payne
Customer Service Advisor

Issued by :
Christopher Payne
Customer Service Advisor



Concept Reference: 695332 Project Site: THFC Customer Reference:						
Water Suite A						
Analysed as Water						
Concept Reference				695332 001	695332 002	
Customer Sample Reference				East Tank	West Tank	
Date Sampled				01-NOV-2017	01-NOV-2017	
Determinand	Method	Test Sample	LOD	Units		
As (Dissolved)	T281	F	0.0002	mg/l	0.0012	0.0017
Fe (Dissolved)	T281	F	0.005	mg/l	0.043	0.042
Fe (Total)	T301	F	0.005	mg/l	0.41	0.38
Mn (Dissolved)	T281	F	0.010	mg/l	0.026	<0.010
pH	T7	F			10.0	11.3
Electrical Conductivity	T7	F	1	µS/cm	830	1200
Alkalinity expressed as CaCO ₃	T22	F	20	mg/l	71	120
Total Hardness expressed as CaCO ₃	T649	F	10	mg/l	210	350
Biochemical Oxygen Demand (Allyl Thiourea)	T264	F	1	mg/l	3	5
Chemical Oxygen Demand	T221	F	20	mg/l	36	66
Total Dissolved Solids	T808	AR	1	mg/l	560	810
Suspended Solids (Total)	T2	AR	10	mg/l	34	130
Diss Oxygen	T7	AR	1.0	mg/l	4.6	1.0
Sulphate	T686	F	0.5	mg/l	240	270
Chloride	T686	F	1	mg/l	48	98
Nitrate	T686	F	0.5	mg/l	10	2.2
Nitrite	T686	F	0.1	mg/l	0.2	7.5
Phosphate	T686	F	0.5	mg/l	<0.5	<0.5
Ammonia expressed as NH ₄	T686	F	0.05	mg/l	<0.05	0.38
Cyanide(Total)	T546	F	0.01	mg/l	<0.01	<0.01
Phenols(Mono)	T546	F	0.02	mg/l	<0.02	<0.02
Sodium	T6	F	0.05	mg/l	81	100
Magnesium	T6	F	0.1	mg/l	4.1	2.2
Potassium	T6	F	0.05	mg/l	33	42
Rapidly Settleable Solids (1 hour)	T713	AR	10	mg/l	26	100
Settleable Solids (24 hours)	T714	AR	10	mg/l	32	110
Unsaponifiable Oils and Grease	T2	AR	10	mg/l	<10	<10
TPH (C10-C40)	T219	AR	0.020	mg/l	0.19	0.76

Index to symbols used in 695332-1

Value	Description
F	Filtered
AR	As Received
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

Ammonia, Phenols and TPH. These tests have been analysed exceeding recommended holding times. It is possible therefore that the results provided may be compromised.

Method Index

Value	Description
T2	Grav
T6	ICP/OES
T221	Colorimetry (CE)
T714	Settled 24 hours/Gravimetric
T281	ICP/MS (Filtered)
T649	ICP/OES (Calc)
T686	Discrete Analyser
T264	Probe (Incubation Carbonaceous) (5 Days)
T301	ICP/MS (Total)
T546	Colorimetry (CF)
T7	Probe
T219	GC/FID (SE)

T713	Settled 1 hour/Gravimetric
T22	Titration
T808	Calc (by EC)

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
As (Dissolved)	T281	F	0.0002	mg/l	U	001-002
Fe (Dissolved)	T281	F	0.005	mg/l	U	001-002
Fe (Total)	T301	F	0.005	mg/l	U	001-002
Mn (Dissolved)	T281	F	0.010	mg/l	U	001-002
pH	T7	F			U	001-002
Electrical Conductivity	T7	F	1	µS/cm	U	001-002
Alkalinity expressed as CaCO ₃	T22	F	20	mg/l	U	001-002
Total Hardness expressed as CaCO ₃	T649	F	10	mg/l	U	001-002
Biochemical Oxygen Demand (Allyl Thiourea)	T264	F	1	mg/l	N	001-002
Chemical Oxygen Demand	T221	F	20	mg/l	N	001-002
Total Dissolved Solids	T808	AR	1	mg/l	N	001-002
Suspended Solids (Total)	T2	AR	10	mg/l	N	001-002
Diss Oxygen	T7	AR	1.0	mg/l	N	001-002
Sulphate	T686	F	0.5	mg/l	U	001-002
Chloride	T686	F	1	mg/l	U	001-002
Nitrate	T686	F	0.5	mg/l	U	001-002
Nitrite	T686	F	0.1	mg/l	U	001-002
Phosphate	T686	F	0.5	mg/l	U	001-002
Ammonia expressed as NH ₄	T686	F	0.05	mg/l	U	001-002
Cyanide(Total)	T546	F	0.01	mg/l	U	001-002
Phenols(Mono)	T546	F	0.02	mg/l	U	001-002
Sodium	T6	F	0.05	mg/l	U	001-002
Magnesium	T6	F	0.1	mg/l	U	001-002
Potassium	T6	F	0.05	mg/l	U	001-002
Rapidly Setttable Solids (1 hour)	T713	AR	10	mg/l	N	001-002
Settlable Solids (24 hours)	T714	AR	10	mg/l	N	001-002
Unsaponifiable Oils and Grease	T2	AR	10	mg/l	N	001-002
TPH (C10-C40)	T219	AR	0.020	mg/l	U	001-002



Appendix B Material Management Plan – Guy Lodge Farm

Materials Management Plan (MMP) Form

This form should be completed once the lines of evidence have been marshalled in relation to suitability for use, certainty of use and quantity required. The answers to the questions posed within this form together with the supporting information will constitute the MMP and must be provided to the Qualified Person.

A Qualified Person may comment on draft versions of this MMP, but will not complete the Declaration until all of the relevant documents, demonstrating lines of evidence have been provided for each site.

Each question must be answered. If the question is not applicable please state this and provide a brief explanation.

1. Specify the scenario to which this MMP relates, as described in the CoP (1, 2, 3 or 4):

2. Reuse on the Site of Origin

3. Direct Transfer of clean naturally occurring soil and mineral materials

4. Cluster Project

Processing will be undertaken on the source site which includes the separation of material based on a watching brief (visual and olfactory observations) before haulage off site. It is proposed to use this material on a single receiving site.

4. Combination of any of the above

In the case of a combination of reuse scenarios, please describe it below (e.g. (i) Reuse on Site of Origin and Direct Transfer of clean naturally occurring unpolluted soils, (ii) Reuse on the Site of Origin with Direct Transfer of clean naturally occurring soil to x number of development sites etc.

This MMP relates to the movement of excavated arisings (approx. 30,000m³) from the Tottenham Hotspur football stadium development, Bill Nicholson Way, 748 High Road, London, N17 0AL, approximately 6miles north to the extension and re-contouring of an noise bund adjacent to the M25 which forms part of Guy Lodge Farm, Whitewebbs Lane, Enfield, EN2 9HJ.

2. Organisation and name of person preparing this MMP (full address and contact details)

Buro Happold
71 Newman Street
London
W1t 1PD

Contact – Geoffrey Perrett, tel no. 0207 927 9700
e-mail Geoffrey.Perrett@Burohappold.com

Document Control

Date issued	06 th June 2014
Revision date	22 nd August 2014
Revision date	04 th September 2014
Revision date	19 th November 2014
Summary of revision 1	Comments following meeting with EA and changing of main contractor.
Summary of revision 2	Incorporating further information requested by the EA
Summary of revision 3	Incorporating data from Ryebidge trial pitting

Insert additional lines to the table above for any subsequent revisions.

Note - revisions to the MMP do not trigger an additional Declaration by a Qualified Person, unless an additional site is added to the project.

Revisions to the MMP must be recorded and summarised in the Document Control box above.

Site Details

5. Site / Project name(s)

Originating site - Northumberland Development Park located at Tottenham Hotspur Stadium, Bill Nicholson Way, 748 High Road, London, N17 0AL.

Material will be excavated, moved and deposited by Ryebidge Ltd, Unit 4, Barratt Industrial Park, Airport Way, Luton, Bedfordshire, LU2 9NH.

Receiving site - Land adjacent to M25 located at Guy Lodge Farm, Whitewebbs Lane, Enfield, EN2 9HJ

Landowners

4a. Name of Landowner(s) (full address and contact details) – Where excavated materials are arising from: **Tottenham Hotspur Football & Athletic Co Ltd - Registered Office address Bill Nicholson Way, 748 High Road, London N17 0AP**

4b. Name of Landowner(s) (full address and contact details) – Where materials are to be reused: ***H Mann, Guy Lodge Farm - Registered address Guy Lodge Farm, Whitewebbs Lane, Enfield, EN2 9HJ.***

Summary and objectives

5a. Provide a brief description of the planned project and how excavated materials are to be reused within it.

The former Northumberland Development Park is being redeveloped to accommodate a new stadium for Tottenham Hotspur. This will included a reduction of levels across the site prior to the start of construction which will generate arisings. Instead of taking the material off site for disposal, it is proposed to re-use this material as part of the extension and re-profiling of a noise bund adjacent to the M25 which is part of Guy Lodge Farm, Whitewebbs Lane, Enfield, EN2 9HJ. This is required in order to discharge planning conditions and enable the completion of the bund.

The material on the former Northumberland Development Park comprises Made Ground and re-worked natural materials. As the material is excavated it will be locally stockpiled before being transported to haulage. During excavation and handling of material a watching brief will be maintained and unsuitable materials segregated. Unsuitable materials are those containing anthropogenic material (brick, plastic, wood, ash) or exhibiting a hydrocarbon odour. Site investigations noted elevated metals concentrations within shallow Made Ground containing ash and brick, this material will be segregated as part of the excavation works. Any material found to have visual or olfactory evidence of contamination will be stockpiled in a separate area while laboratory testing is undertaken. All suitable material will be moved to the receiving site for constructing the noise bund.

General Plans and Schematics

6. Attach a location plan for the site(s) and a plan of the site(s) which identifies where different materials are to be excavated from, stockpile locations (if applicable), where materials are to be treated (if applicable) and where materials are to be reused.

Plan References:

Excavation Drawing – Refer to attached figures

Reuse Drawing – Refer to attached Enfield council planning approval

7. Attach a schematic of proposed materials movement. Where there is only one source area and one placement area briefly describe it below. For all other projects a schematic is required.

Schematic Reference:

The Originating/Source area is the Tottenham Stadium development site (former Northumberland Park) in Tottenham. The haulage route is showing in attached Figure 2. The placement area is on the land south of the M25 at Guy Lodge Farm, Whitewebbs Lane, Enfield as shown on the proposed bund within the Planning Approval Ref.: P13-00278PLA. A restriction of a maximum of 6 lorries per hour arriving at the receiver site has been placed on the works by the planning conditions for the receiver site.

Parties Involved and Consultation – if more than one party please provide additional details for them and identify the location that they will be working e.g. where a site is zoned

8a. Main earthworks contractor(s) (full address and contact details) – Where excavated materials are arising from.

The excavation contractor for the source site is Ryebriidge Ltd, Unit 4, Barratt Industrial Park, Airport Way, Luton, Bedfordshire, LU2 9NH. Dan Slater 07967 604081

8b. Main earthworks contractor(s) (full address and contact details) - Where materials are to be reused:

The main earthworks contractor for the receiving site is Ryebriidge Ltd, Unit 4, Barratt Industrial Park, Airport Way, Luton, Bedfordshire, LU2 9NH. Dan Slater 07967 604081

9. Treatment contractor(s) (full address and contact details) – for treatment on site of origin, or at a Hub site within a Cluster Project

The material will be excavated to form the initial construction platform (10.50m AOD). This will be undertaken under a watching brief as stated in the geoenvironmental interpretive report (REF 023971 Northumberland Development Project, Stadium. Geoenvironmental Report. October 2010.) and as required by the planning application (REF HGY/2010/1000). Unsuitable material will be segregated. If any unexpected contamination is encountered (visual or olfactory evidence) this will be stored in separate stockpiles while sampling is undertaken. On receiving the results a management plan will be submitted to the Local Authority for approval and a remediation plan will be implemented.

The following material streams and destinations are envisaged from the donor site:

Material type	Fate	Treatment process	Volume
Concrete	Not disposed of, crushed to create pile mat for development works	Crushing on the donor site	To be determined upon completion of works, significantly less than required for development works
Asphalt	Taken to Marlow House for recycling	Separated prior to excavation	175m3
Brick	To be determined, currently stockpiled on site, efforts to re-cycle the brick at a suitable licenced off site location by others are being investigated. Currently stockpiled on site.	Brick is segregated during excavation where it is in sufficient volumes / not mixed with other material	To be determined once excavation work completed
Made Ground containing anthropogenic material, brick and ash or having a hydrocarbon odour	To be disposed offsite as a waste to a suitable licenced landfill, WAC testing required, landfill to be determined, currently stockpiled on site	Segregation during excavation	To be determined once excavation work completed
Anthropogenic materials	To be disposed of offsite as a waste. Any metal recovered likely to be re-cycled at a suitable facility	Segregation during excavation	To be determined once excavation work completed
Made Ground – re worked natural material	To be taken to the Enfield receiver site to form a noise bund	Segregation during excavation	A maximum of 30,000m3 including natural material
Natural material (sandy gravel)	To be taken to the Enfield receiver site to form a noise bund	Segregation during excavation	A maximum of 30,000m3 including suitable Made Ground

10. Where wastes and materials are to be transported between sites provide details of the transport contractor(s) (full address, contact details and waste carriers registration details (if applicable)):

The transport contractor is Ryebriidge Ltd, Unit 4, Barratt Industrial Park, Airport Way, Luton, Bedfordshire, LU2 9NH. Dan Slater 07967 604081

11. For each site where materials are excavated and where materials are to be reused provide Local Authority contact details (full address and named contacts):

Tottenham Hotspur proposed Stadium at Northumberland Park Development (originating site)- Spurs Application Team, Level 6, River Park House, 225 High Road, Wood Green, N22 8HQ

Guy Lodge Farm (receiving site)- Mr A Higham, Head of Development Management, Development Management, London Borough Enfield, PO Box 53, Civic Centre, Silver Street, Enfield, Middlesex, EN1 3XE

12a. For each site where materials are to be reused and for Hub Site locations provide Environment Agency contact details (full address and named contacts):

N/A

For all Cluster Projects:

12b. Attach any relevant documentation from the EA relating to the excavation and reuse of the materials to demonstrate no objection to the proposals (see 3.37 of CoP)

EA references: **N/A**

If the EA has not been consulted please explain why (see paragraph 3.39 of the CoP).

The EA were consulted by the London Borough of Enfield during the Planning Application stage, reference no. P13-00278PLA (enclosed) and further meeting was undertaken in July 2014. It was concluded that only chemically and geotechnically suitable material would be imported to site and that validation of the completed works would be done.

Lines of Evidence

There is no one single factor that can be used to decide that a substance or object is waste, or when it is waste at what point it ceases to be waste. As complete picture as possible has to be created. The following sections require completion to ensure the correct decision is made.

If a requested item is not relevant it is important for you to clearly state why this is so (e.g. no planning permission required because permitted development status exists).

Suitable for use criteria

13. Please describe or provide copies of the required specification(s) for the materials to be reused on each site.

No specification has been provided by the receiving site, however samples have been taken from the receiving site to establish baseline conditions. When compared to the data for the suitable material to be exported it indicates that the material does not pose an unacceptable risk and that it does not introduce new hazards to the receiver site. This is considered in the risk assessment document (attached) which has shown that there is a low risk to the receiving site and environmentally sensitive receptors including the controlled waters following segregation at the donor site.

Reference:

Phase 1A works level reduction Material Management Risk Assessment. Tottenham Hotspur. Buro Happold. Ref.: 031627 Rev. 01. August 2014.

The volume of material required for the bund exceeds that from the excavation. The chemistry of the excavation material deemed to be suitable has been shown to be suitable by investigation works in 2009 and 2010 and trial pitting in 2014 and not to pose a risk to humans or the environment.

Where contamination is suspected or known to be present

14a. Please provide copies or relevant extracts from the risk assessment(s) that has been used to determine the specification for use on the site. **This must relate to the place where materials are to be used.** This must be in terms of (i) human health (ii) controlled waters and (iii) any other relevant receptors. If a risk assessment is not relevant for a particular receptor given the site setting please explain why below:

A risk assessment has been provided in support of this MMP and sampling of both the donor site material and receptor site has been undertaken.

Reference: **Tottenham Hotspur. Phase 1A works level reduction Material Management Risk Assessment. Ref.: 031627 Rev. 01 August 2014 (attached to document)**

14b. Please attach any relevant documentation from the LA relating to the excavation and reuse of the materials to demonstrate no objection (see 3.37 of the CoP)

LA references: **Planning for source site - HGY/2010/1000 Haringey Council**
Planning for receiving site - P13-00435PLA London Borough of Enfield

If the LA has not been consulted please explain why (see paragraph 3.39 of the CoP).

14c. Please attach any relevant documentation from the EA relating to the excavation and reuse of the materials to demonstrate no objection (see 3.37 and Table 2 of the CoP)

EA references: **The EA has been informed of the proposals to move the material via the planning process and THFC, BuroHappold and the EA have met to discuss the options. The risk assessment has shown that there is no risk to controlled waters receptors, human health or other environmentally sensitive receptors from the creation of a bund. Subsequent discussions on the MMP and works have also been held between the EA (Cathryn Jones and Alison Thomas) and THFC (Rebecca Noble).**

If the EA has not been consulted please explain why (see paragraph 3.39 of the CoP).

14d. Please attach any relevant documentation from any other regulators (if relevant) relating to the excavation and reuse of the materials to demonstrate no objection (see 3.37 of the CoP)

Other references: **N/A**

Where contamination is not suspected

15a. Please attach copies or relevant extracts from the Desk Top Study that demonstrates that there is no suspicion of contamination.

N/A

15b. Please attach copies or relevant extracts from the site investigation/testing reports that adequately characterise the clean materials to be used (if appropriate).

15c. Please attach copies of any other relevant information (if available) confirming that land contamination is not an issue.

Reference(s):

Certainty of use

Various lines of evidence need to be provided to demonstrate that the materials are certain to be used. This includes:

- The production of this MMP
- An appropriate planning permission (or conditions that link with the reuse of the said materials)
- An agreed Remediation Strategy(ies)
- An agreed Design Statement(s)
- Details of the contractual arrangements

Please identify in the following sections what lines of evidence relate to the site(s) **where the materials are to be used**.

16a. Planning Permission(s) relating to the site where materials are to be reused

Please provide a copy of the relevant planning permission

Reference: ***P13-00278PLA – copy of planning permission attached.***

16b. Explain how the reuse of the excavated materials fits within the planning permission(s) for each site.

The Planning Permission for the accepting site relates to the proposed construction/extension to a noise bund adjacent to the M25 at Guy Lodge Farm.

>31,000m³ of material are required at the receiving site for the construction of the earth bund.

16c. If planning permission is not required for any one site please explain why below e.g. permitted development, clean up of a chemical spill, surrender of an Environmental Permit, re-contouring within the existing permission: **N/A**

Where contamination is suspected or is known to be present

17. Please provide a copy of any Remediation Strategy(ies) that have been agreed with relevant regulators.

A Material Management Risk assessment has been undertaken. This summarises the chemical testing undertaken by a site investigation undertaken in 2010. To date the concrete slab remains in-situ therefore the records are representative of the current material underlying the site.

The results show most contaminants are below residential screening criteria and are not present in concentrations that would inhibit plant growth.

Reference: ***Phase 1A works level reduction Material Management Risk Assessment. Tottenham Hotspur. Buro Happold. Ref.: 031627 Rev.01. August 2014 (attached to document)***

Where contamination is not suspected

18. Please provide a copy of any Design Statement(s) that have been agreed (e.g. with the planning authority or in the case of permitted developments the client): **N/A**

Reference: **N/A**

Quantity of use

19. Please provide a break down of the excavated materials for each site and how much will be placed at each site or sub area of each site.

Where this is not specific to a single readily identifiable source refer to an annotated plan, schematic or attach a tabulated summary.

Reference(s): A maximum of 30,000m³ of material will be excavated from the construction of the formation level. Included in this volume is the concrete slab, which will be crushed and retained on site and material that is known to be unsuitable for incorporation in the bund. The thickness of the slab, and any associated foundations, is not known at this stage, but is expected to be in the order of 250mm. This equates to approximately 4900m³ of material (assuming 19567m² area). Currently there is no indication as to the likely volume of unsuitable material. Therefore it is likely that up to 25,100m³ of material will be used within the bund.

20a. How has consolidation/compaction being considered in the above mass balance calculations?

Due to the end use being for landscaping / ecology purposes, no compaction has been considered. There is likely to be a shortfall of material following the removal of the concrete slab and re-use on site of that material and the unsuitable material, the total volume is therefore very likely to be below 30,000m³ even allowing for bulking. It is unlikely that there will be an excess of excavated material.

20b. How has loss due to treatment being considered in the above mass balance calculations (if applicable)? **N/A**

20c. How has the addition of treatment materials being considered in the above mass balance calculations (if applicable)? **N/A**

Note - An exact figure is not required but one that is reasonable in the circumstances and can be justified if challenged.

Contingency arrangements

Explain what is to happen in the following situations and identify the appropriate clauses in the contract(s) (Such clauses must be provided to the Qualified Person, preferably as a summary document): or

21a. What is to happen to, and who is to pay for out of specification materials?

Contract reference: ***All suitable material on Tottenham Hotspur site is currently considered acceptable on the basis of the results summarised in the Materials Management Risk Assessment and the chemical analysis of the receiver site. However a watching brief will be undertaken by Ryebidge Limited under the associated planning permission. Unsuitable materials (those that contain brick or ash, anthropogenic material or display a hydrocarbon odour) are not to be incorporated and will be disposed of at suitably licenced facilities or re-cycled off site.***

If material is out of specification or considered to be so in accordance with the Methodology Specification for earthworks in Tottenham Hotspur it will be separated and assessed if unsuitable it will be sent for off-site disposal at a licenced landfill facility.

21b. What is to happen to, and who is to pay for any excess materials?

Contract reference:

Off site disposal of material to licenced landfill or re-cycling facility will be paid for by Tottenham Hotspur Football and Athletic Co Ltd.

21c. What happens if the project programme slips in relation to excavated materials or materials under going treatment?

Contract reference: The development of the source site is constrained by the site boundary, therefore it is considered unlikely that significant program slips will occur. Whilst considered unlikely, if the programme slips beyond the projected timescale, it is envisaged that the material will remain in place until such time as it is used for the remodelling.

21d. Other identified risk scenarios for the project (relating to excavated materials)?
Contract reference: **N/A**

The tracking system

22a. For all sites please describe the tracking system to be employed to monitor materials movements.

Material deposition will be tracked by a daily sheet and haulage tickets held by the banksman at the receiving site that is to be signed by the vehicle driver and notes the vehicle registration following tipping. These will be kept for verification requirements.

Where contamination is suspected or known to be present

State the procedures put in place to:

22b. Prevent contaminants not suitable for the treatment process being accepted **The acceptable material has been shown to be suitable from the samples taken and reporting in the Materials Management Risk Assessment. It is anticipated that the sorting undertaken will remove any unsuitable material. In addition a watching brief will be undertaken during the excavation and transportation of the material. This will be undertaken by the contractor on site.**

22c. Prevent cross contamination of materials not in need of treatment, wastes awaiting treatment and treated materials **Separate stockpiles of unprocessed and processed materials will be maintained.**

22d. Demonstrate that materials that do not require treatment and successfully treated materials reach their specific destination **Tracking will be undertaken by the haulage contractor.**

22e. Ensure that waste for off site disposal or treatment is properly characterised and goes to the correct facility **Such materials will be appropriately sampled (WAC tests), analysed and described before removal to a suitable disposal facility off-site.**

23. Please attach a copy of the tracking forms / control sheets that are to be used to monitor materials movements. To include transfer of loads on site into stockpiles prior to treatment (if applicable), stockpiled after treatment (if applicable), stockpiled awaiting use (as appropriate) and final placement.

Reference: ***Haulage tickets and records will be supplied by Ryebbridge.***

For Hub Sites within Cluster Projects & where materials need treatment before reuse

24. Please attach a copy of the Environmental Permit covering the treatment process. Or alternatively if the treatment is covered by a Mobile Plant Permit and associated Deployment Form, attach a copy of the EA agreement to the Deployment Form.

Following a site visit by Cathryn Jones of the EA she has confirmed that the sorting process being undertaken on site meets the requirements for removing the unsuitable material. This process does not involve a specific machine and therefore does not require a mobile plant licence.

Permit reference / EA letter reference: **N/A**

Records

25. Where, and in what form, are records to be kept?

Note – records e.g. transfer notes, delivery tickets, Desk Top Study, Site Investigation, Risk Assessment(s), Verification Report(s) need to be kept for at least 2 years after the completion of the works and production of the Verification Report

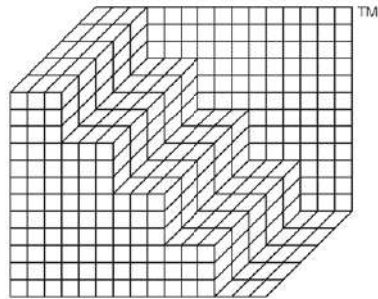
Records of the material transfer will be held by the contractor and THFC for at least 2 years.

Verification Plan

26. Provide or explain the Verification Plan which sets out how you will record the placement of materials and prove that excavated materials have been reused in the correct location and in the correct quantities within the development works.

An as built survey confirming the new finished ground level contours will be carried out by the receiving site when the works are completed and presented to the EA and the Council.

Reference: **TBC**



Buro Happold

Tottenham Hotspur

Phase 1A Material Management Risk Assessment

031627

19 November 2014

Revision 03

Revision	Description	Issued by	Date	Checked
00	Final	G Perrett	June 2014	R Frost
01	Updated following comments from EA	G Perrett	August 2014	R Frost
02	Update following further data review and EA comments	R Frost	September 2014	R Frost
03	Update with Ryebbridge trial pit data	R Frost	November 2014	R Frost

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

author **Geoffrey Perrett**

signature



date **November 2014**

approved **Rob Frost**

signature



date **November 2014**

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1 Introduction

1.1 Authorisation

Buro Happold has been commissioned by Tottenham Hotspurs Football and Athletic Co Ltd to undertake a risk assessment to inform a Materials Management Plan (MMP) for material excavated from the Phase 1A work level reduction on the Northumberland Development Park site.

The material producing site is located at the Northumberland Development Park located at Tottenham Hotspur Stadium, Bill Nicholson Way, 748 High Road, London, N17 0AL. It is proposed to use selected material from the excavation at the extension and re-contouring of a noise bund located adjacent to the M25 which forms part of the at Guy Lodge Farm, Whitewebbs Lane, Enfield, EN2 9HJ.

A plan showing the material producing site and the receiving site is presented as Figure 1.

1.2 Aims and Objectives of this report

This report will detail the activities proposed and the various waste and non waste streams arising from the excavation works at the producer site. The report will summarise the sampling that has been undertaken on the producer site and will compare those with sampling works undertaken on the receiver site. This will include a risk assessment of the proposed use of the material in the earth bund for supporting of the Materials Management Plan (MMP).

1.3 Background

The producer site is located at the Tottenham Hotspur Stadium which is being redeveloped, including a reducing in ground levels which will generate up to 30,000m³ material (i.e. total excavation volume including both suitable materials for export to the receiver site and unsuitable materials). A plan showing the excavation area is presented as Figure 2.

It is proposed to utilise suitable excavated material from the producer site as part of the construction of a noise bund adjacent to the M25 at Guy Lodge Farm, Whitewebbs Lane, Enfield, EN2 9HJ (the receiver site). The bund is to be up to 5m high, up to 30m wide, 311m long with a 1 in 3 slop on both sides. This is equivalent to 31,100m³.

1.4 Relevant planning permissions

Planning for stadium HGY/2010/1000 – Spurs Application Team, Haringey Council, Level 6, River Park House, 225 High Road, Wood Green, N22 8HQ

Planning for Guy Lodge Farm: P13-00278PLA - Mr A Higham, Head of Development Management, Development Management, London Borough Enfield, PO Box 53, Civic Centre, Silver Street, Enfield, Middlesex, EN1 3XE

The material will be excavated, transport and deposited by the Ryebriidge Ltd, Unit 4, Barratt Industrial Park, Airport Way, Luton, Bedfordshire, LU2 9NH.

2 Receiving Site Setting

2.1 Site location

The proposed noise bund is located to the south west of the adjacent M25 at Guy Lodge Farm, Whitewebbs Lane, Enfield, EN2 9HJ. The north of the site is adjacent to M25, with agricultural fields adjacent to the south, east and west of the site.

The site is presently open land formally used for agriculture, a bund has already been constructed to the east of the area where it is planned to use this material.

2.1.1 Geology and Hydrogeology

The BGS geological map for Hertford (Sheet 239, Scale 1:50,000 (1978)) and BGS boreholes logs (Appendix A), indicates that the site is underlain by the London Clay Formation which is described as a fine, sandy, silty clay/silty clay. The Dollis Hill Gravels are present in the west of the site. The London Clay Formation has been proven to 26m below ground level and is underlain by the White Chalk.

The London Clay is classified as an Unproductive Strata. The Dollis Hill Gravels is a Secondary A Aquifer, which is typically described as rocks or soils which are predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

The site is not located within a Groundwater Source Protection Zone (SPZ).

2.2 Hydrology

A tributary of the old course of the New River is located adjacent to the west of the site, the tributary flows south to the old course of the New River, which is now hydraulically separated from the New River. No chemical or ecological data is available for the watercourse.

3 Material Characterisation

3.1 Summary of Buro Happold 2010 investigation, producer site

Site Investigation

Site works took place during April 2010 and comprised the drilling of 18 dynamic (window) sample boreholes and 4 cable percussive boreholes. Up to 34 disturbed environmental samples were taken from the Made Ground and natural strata and submitted to a UKAS/MCERT accredited laboratory for testing. The exploratory hole plan is shown in Figure 2.

Sample Descriptions

The sample logs are presented in Appendix A. During the intrusive works, a moderate hydrocarbon odour was observed at the approximate water table level in the Kempton Park Gravel within BH09/12, WS21 and WS22 and in the Made Ground during drilling of BH09/06. A slight hydrocarbon odour was observed within the Kempton Park Gravel within WS10/01. In addition, a moderate hydrocarbon odour and oil sheen was observed on the surface of groundwater purged from BH09-12 and WS21 during sampling.

The source of hydrocarbon observed in soil and groundwater within the vicinity of BH09/12, WS21 and WS22 is likely to be an underground fuel tank identified on historical maps.

No other odour, visible sheen or evidence of light or dense non-aqueous phase liquids (LNAPL/DNAPL) was observed within Made Ground or natural soil within any of the other exploratory hole locations.

The chemical data has been used to identify materials that are unsuitable for incorporation into the bund. These fall into two categories, material unsuitable due to elevated hydrocarbons or materials unsuitable due to elevated metals concentrations.

Summary chemical data provided in Appendix 2, unsuitable materials as defined in section 4 of this report highlighted in red of table 1

3.2 Ryebriidge trial pitting works

Ryebriidge undertook six trial pits over the area to be excavated in July 2014. Hydrocarbon odour and visual hydrocarbon contamination were recorded in TP6 which is located close to WS21 and WS22 in the area of the suspected underground fuel storage tank. Summary chemical data is provided in Appendix 2 from this investigation. This investigation found chemical conditions similar to those recorded by the earlier investigation, though no elevated metal concentrations were recorded.

3.3 Receiver site sampling August 2014

20 trial pits completed, two lines (4m separation) with 10m between each location along proposed path of bund. Material generally comprised grass overlying slightly gravelly to gravelly CLAY. In east of site some material was a slightly clayey GRAVEL. Gravels were typically rounded medium flints with rare round coarse flint. The near surface material appeared to be re-worked natural ground.

Summary chemical data provided in Appendix 2.

4 Suitable and unsuitable materials for export to the receiver site

4.1 Materials arising from the producer site excavation

Two types of material are expected to arise from the producer site excavation works. These are materials that by their physical make up and chemical concentrations are suitable to be incorporated into the noise bund at the receiver site and those materials that are unsuitable for incorporation. Details of these materials and how they are to be distinguished are provided below.

4.2 Unsuitable materials arising from the producer site

The following materials generated as part of the excavation from the producer site are unsuitable for deposition at the receiver site and will not be incorporated in the noise bund. These materials will be segregated as part of the excavation works, their individual fate is listed in the table.

Table 4 -1 Unsuitable materials for export to Enfield receiver site

Material type	Fate	Treatment process	Distinguishable from suitable materials by
Surface concrete hard standing	Not disposed of, crushed to create pile mat for development works on site, part of permanent development platform	Crushing on the producer site to create a 6F2	Concrete surface layer is visually and physically distinguishable from other materials
Asphalt	Taken to Marlow House for recycling	Separated prior to excavation	Asphalt surface layer is visually and physically distinguishable from other materials
Brick (present as basement walls or fragments within shallow Made Ground)	To be determined, either recycled or disposed of to landfill	Brick is segregated during excavation where it is in sufficient volumes / not mixed with other material	Brick is visually and physically distinguishable from other materials
Made Ground containing anthropogenic material, brick and ash or having a hydrocarbon odour or elevated metal concentrations	To be disposed offsite as a waste to a suitable licenced landfill, WAC testing required, landfill to be determined, currently stockpiled on site	Segregation during excavation, generally no deeper than 1mbgl	Hydrocarbon contaminated material can be segregated by odour Chemical analysis from both the 2010 and 2014 investigations has shown that material that contains elevated metal and PAHs

			concentrations is associated with brick fragments and ash and is present within the top 1m. This allows the material to be segregated from underlying re-worked Made Ground. Anthropogenic material is visually and physically distinguishable.
Anthropogenic materials	To be disposed of offsite as a waste. Any metal recovered likely to be re-cycled at a suitable facility	Segregation during excavation	Visually distinguishable from other materials

4.3 Suitable materials arising from the producer site for export to the receiver site

Only suitable materials are to be exported to the receiver site to form the landscape bund.

There are two types of suitable materials:

1. Made Ground that is reworked natural material excluding any anthropogenic materials and exhibiting no hydrocarbon odour. This is generally found beneath the near surface Made Ground that contains anthropogenic materials.
2. Natural materials that are not impacted by hydrocarbons.

Suitability has been determined by reference to the chemical results compared to GAC values and other guidance values and material constituents in line with the COP for hub and cluster projects.

5 Assessment Criteria

5.1 Material Management Plan Criteria

The CL:AIRE publication, The Definition of Waste: Development Industry Code of Practice. Version 2, March 2011, defines the use of materials at receive sites as follows:

All materials must be suitable for use and must not pose unacceptable risks to the environment in order to comply with the requirements of the CoP. In implementing the precautionary principle and in aiming for a high level of environmental protection (as set out in the Waste Framework Directive and case law) the EA would expect the use of materials within a cluster project to maintain or improve the quality of land at any Donor or Receiver site. To this end the following general restrictions are applied to materials to be used under this CoP at any Receiver site:

- *The hazards to human health and the environment must not be increased beyond those which already exist at the Receiver site, by importing materials with elevated concentrations of potentially harmful substances. A project may be regarded as a 'sham recovery' if it involved the importation of soils with levels of contamination significantly above those already present i.e. to a degree that would require additional intervention should the site be redeveloped in the future.; and*
- *The importation of materials at receiver sites must not introduce any new hazards beyond those that already exist at the Receiver site, by importing materials contain new contaminants present at problematical levels. In any case this includes that importation and use of materials containing new contaminants present above hazardous waste thresholds.*

5.2 Risk Assessment Criteria

In order to assess if concentrations pose 'unacceptable risks', introduce a 'new hazard' or are present in 'problematical levels' a risk assessment is required. A risk-based approach is used for the assessment of contamination, requiring identification of a contaminant source, a receptor and a realistic pathway via which the contaminant may reach the receptor. The key receptors considered in this assessment at the receiving are site end-users, construction workers, groundwater and plant growth. In order to perform a generic quantitative risk assessment, the soil test results have been compared with available Soil Guideline Values (SGVs), Buro Happold and other industry Generic Assessment Criteria (GAC) and Environmental Quality Standards (EQS) for groundwater.

Analytical data derived from the investigation has been put into context by comparison with published guidance or derived thresholds values. Current UK guidance published thresholds comprise SGVs and C4SLs, which are available for a limited number of determinands (Ref.1 to Ref.9) and land uses. For contaminants without published SGVs, C4SLs or where soil conditions are different to those assumed for the published SGVs (6% soil organic matter content and sandy loam soil), GACs have been derived. The derivation of GACs has been carried out based on published statutory guidance documents (Ref.10 and Ref.11) and with consideration of the most sensitive receptors in the respective CLEA standard land- uses scenarios (the 0 to 6 year old child for the residential with and without plant uptake scenarios and the adult for the commercial/ industrial land-use scenario) using the software model "CLEA 1.06" and associated handbook (Ref.13 and Ref.14). Contaminant specific model input values have been selected as prescribed by the Environment Agency SGV reports. In the absence of SGV reports, contaminant specific input values have been selected as suggested by SC050021/SR7 (Ref.15) and / or the LQM report (Ref.16) and/or the EIC/AGS report (Ref.17).

Where individual concentrations of contaminants have been found exceeding assessment criteria, the data of the specific contaminant was analysed statistically in line with the 'Guidance on Comparing Soil Contaminant Data with Critical Concentrations' (Ref.23). Where the distribution of data for particular determinands showed evidence of non-normality, the 95% upper confidence limits (US95) were calculated using the Chebychev Theorem in accordance with this guidance (Ref.24).

Risks to plant life (phytotoxicity)

Soil test results indicating phytotoxicity (effects to plant growth) have been assessed using the British Standard Specification for Topsoil BS 3882: 2007 (Ref.24)

Risks to controlled waters

Groundwater samples have been assessed using Freshwater Environmental Quality Standards (EQS) (Ref.26) and UK Drinking Water Standards (DWS) (Ref.25)

Comparison between suitable producer site material and the receiver site baseline data

In order to define if a new hazard could be introduced to the receiver site a comparison between the suitable material from the producer site and the receiver site baseline has been made.

6 Analytical Results for Soils

6.1 Producer site suitable material data

Risk to human health

Following exclusion from the data set of samples that constitute unsuitable material (i.e. exhibit a hydrocarbon odour, contain brick, ash or anthropogenic material) which are to be segregated on the producer site and will not be sent to the Enfield site an assessment of the suitable material can be undertaken.

Thirty nine samples of suitable material were tested (Buro Happold and Ryebribe investigations though not all samples were analysed for all compounds) to be excavated were tested for a broad suite of inorganic and organic contaminants. With the exception of one determinand all maximum values were below the residential without plant uptake screening criteria with the exception of benzo(a)pyrene which slightly exceeded the SGV in one sample however the US95 for the dataset as a whole was well below the SGV. This data is summarised below and presented within Table 6-1

Table 6-1 Summary of inorganic exceedence for suitable producer site material (mg/kg)

Determinand	No of samples	GAC (No of samples exceeding GAC) mg/kg		Min	Max	US ₉₅ *	Outliers
		Residential without plant uptake [SGV / C4SL]	Commercial / Industrial [SGV / C4SL]				
Benzo(a)pyrene	35	1* (1) / 5.3 (0)	14 (0) / 98 (0)	<0.01	1.18	0.5	-

* SGV has been updated since the interpretive report was issued, however the exceedences remain similar

Asbestos

A total of thirty five samples were screened for asbestos, no samples were found to have asbestos within the soil matrix.

Summary

The US95 value for benzo(a)pyrene was below the SGV for residential without plant uptake scenario. The chemical analysis undertaken of the suitable material from the producer site indicates that it would not pose a risk to future site users at the receiver site.

The full chemical results and waste acceptance criteria are presented in Appendix B.

Risk to plant growth

A total of thirty five samples were analysed for phytotoxic determinands. Concentrations of nickel were below the BS 3882: 2007 for topsoil. Three samples recorded concentrations of copper and zinc above the BS 3882: 2007 for topsoil. The US95 value for both copper and zinc was below the BS 3882: 2007 for topsoil.

Table 6-2 Summary of phytotoxic exceedences for suitable producer site material (mg/kg)

Strata	Determinand	No of samples	GAC (No of samples exceeding GAC) mg/kg BS3882: 2007	Min	Max	US ₉₅ *	Outliers
Made Ground	Copper	35	200 (3)	3	363	82.6	-
Made Ground	Zinc	35	300 (3)	8	642	59	-

7 Analytical results for leachate data

The leachate from six soil samples were analysed for a number of inorganic determinands as listed in Appendix B. Most samples recorded leachable metal concentrations below both UK Drinking Water Standards (DWS) and Freshwater Environmental Quality Standards (EQS). Slightly elevated concentrations of arsenic compared to DWS were recorded in 3 samples (50%) and 4 samples (66%) exceeded the copper EQS. Based on the above results, heavy metals within the producer site materials are not considered to be highly leachable.

8 Comparison between producer site suitable material and receiver site baseline

Table 8.1 below provides a comparison between the maximum values recorded on the receiver site (receiver site baseline) and the maximum values recorded for the suitable material on the producer site. The table shows that the two materials are not significantly different chemically and that by importing the producer site material to the receiver site no new chemical hazards will be introduced.

Table 8-1 Comparison between producer site and receiver site maximum recorded values

Determinant	Units	Producer site suitable materials max concentration	Receiver site max concentration	GAC values residential without plant uptake
Moisture	% w/w	18.3	9.3	
Asbestos Screen		No fibres	No fibres	
pH		12.5	7.95	
Cyanide (total	mg/kg	<1	<1	4.5
Phenols - Total by HPLC	mg/kg	0.2	<0.06	180
Sulphide SUBCON	mg/kg	36	330	
Arsenic	mg/kg	27	23.1	32
Cadmium	mg/kg	1.9	0.553	10
Copper	mg/kg	363	22.3	2330
Chromium	mg/kg	96	39.7	630
Chromium VI	mg/kg	<1	<0.6	4.3
Lead	mg/kg	297	63.8	450
Mercury	mg/kg	1.31	<0.6	170
Nickel	mg/kg	41	35.5	130
Selenium	mg/kg	2	<1	350
Zinc	mg/kg	642	67.2	3800
Ali >C5-C6	mg/kg	0.07	0.0191	17
Ali >C6-C8	mg/kg	<0.01	0.0233	37
Ali >C8-C10	mg/kg	0.02	<0.01	9
Ali >C10-C12	mg/kg	<0.1	<0.01	43
Ali >C12-C16	mg/kg	<0.1	<0.1	340
Ali >C16-C21	mg/kg	<0.1	0.264	29000
Ali >C21-C35	mg/kg	<0.1	5.52	29000
Total Aliphatics	mg/kg	<0.1	5.52	-
Aro >C5-C7	mg/kg	<0.01	<0.01	0.05
Aro >C7-C8	mg/kg	<0.01	<0.01	1.3
Aro >C8-C9	mg/kg	<0.01	<0.01	12
Aro >C9-C10	mg/kg	<0.01	<0.01	-
Aro >C10-C12	mg/kg	<0.1	<0.01	41
Aro >C12-C16	mg/kg	<0.1	<0.1	120
Aro >C16-C21	mg/kg	<0.1	0.957	240
Aro >C21-C35	mg/kg	<0.1	12.7	890
Total Aromatics	mg/kg	<0.1	20.4	-

Determinant	Units	Producer site suitable materials max concentration	Receiver site max concentration	GAC values residential without plant uptake
TPH (Ali & Aro)	mg/kg	11	25.9	-
Benzene	mg/kg	<0.01	<0.01	0.05
Toluene	mg/kg	<0.01	<0.002	1.3
Ethyl Benzene	mg/kg	<0.01	<0.003	42
m & p Xylene	mg/kg	<0.01	<0.006	20
o Xylene	mg/kg	<0.01	<0.003	20
MTBE	mg/kg	<0.01	<0.005	-
Acenaphthene	mg/kg	1.09	0.181	200
Acenaphthylene	mg/kg	0.04	0.0224	160
Anthracene	mg/kg	0.79	0.0442	2300
Benzo(a)anthracen	mg/kg	0.82	0.247	3.1
Benzo(a)pyren	mg/kg	1.18	0.249	1.0
Benzo(b)fluoranthen	mg/kg	0.58	0.666	5.6
Benzo(ghi)perylene	mg/kg	1.61	0.526	44
Benzo(k)fluoranthen	mg/kg	0.92	0.213	8.5
Chrysene	mg/kg	3.22	0.237	6
Dibenzo(ah)anthracen	mg/kg	0.14	0.0411	0.76
Fluoranthene	mg/kg	2.91	0.506	260
Fluorene	mg/kg	0.12	<0.1	160
Indeno(123-cd)pyren	mg/kg	0.48	0.374	3.2
Naphthalene	mg/kg	0.41	0.29	0.7
Phenanthrene	mg/kg	2.15	0.195	92
Pyrene	mg/kg	3.1	0.389	560
Total PAH	mg/kg	17.9	2.84	-

9 Contaminated land generic quantitative risk assessment (GQRA)

9.1 General Approach

In the UK the assessment of risk from contamination follows the source-pathway-target approach. If one of these three elements is absent it is considered that there is no risk of harm. If, however, there is considered to be a linkage between any given source and any given target/receptor then a risk-based approach is used to assess the significance or impact of any such linkage.

Source	The contaminants that have the potential to negatively affect human health and/or the health of the environment (i.e. the hazard).
Pathway	The potential route by which a receptor may come into contact with the source.
Receptor	The specific group of human beings or aspect of the environment (e.g. controlled waters) that could be affected by the source.

Risks are defined as the probability of an event occurring combined with the severity of the consequence of that event occurring. Particularly, to assess the risk to site end users posed by any given source, the sensitivity of each receptor is considered. For example, the concentration of contamination acceptable at a site to be developed as a residential property with a garden used to grow vegetables and accessible to young children is set lower than that for a commercial site where soil is exposed in minor areas of landscaping and the only long-term users of the site are adults. Similarly, a site overlying a principal aquifer supplying potable water to a large population will be considered more stringently than a site overlying an impermeable geology with only minor seepages of groundwater.

9.2 Conceptual Site Model

The potential risks posed to human health and the environment by ground contamination at this site have been evaluated by a generic quantitative risk assessment which incorporates the 'source-pathway-receptor' identification and assessment methodology in accordance with the Model Procedures (Ref.25). The risk assessment process therefore involves the identification of each source based on this investigation and the previous investigations / assessments together with identification of each relevant exposure pathway and each potential receptor. The potential risks to the receptors are then assessed by considering the potential effect of the source on the receptor as well as the likelihood of a pathway linking the two, i.e. a contaminant linkage as discussed above.

The conceptual site model also reflects the nature of the proposed development and the development activity itself. The proposed development, although not finalised, will likely comprise the construction of residential properties with private gardens or shared communal space.

9.2.1 Identified Contamination Sources

A small number of contaminants have been identified within the suitable producer site material which exceeds human health or phytotoxic screening criteria. Marginally elevated concentrations of Benzo(a)pyrene copper and zinc have been identified from leaching tests undertaken on samples from the Made Ground with respect to Environmental Quality Standards for controlled waters (copper is below Drinking Water Standards). This contamination is likely to be associated with historic usage of the site.

Table 9-1 Principal potential sources of contamination

Potential Source	Potential contaminants of concern
Slightly elevated contaminants producer site material	Benzo(a)pyrene (reference to residential end use) Zinc and copper (topsoil criteria) Slightly elevated arsenic and copper in leachate when compared to EQS

9.2.2 Potential Receptors and Pathways

Site specific pathway receptor linkages have been identified for the site in Table 9-2 with respect to the sources outlined above and the anticipated future use of the site.

Table 9-2 Receptors and pathways

Receptor		Pathway
Controlled waters	River Terrace Deposits - (Secondary Aquifer)	Leaching and migration via permeable strata
	Surface water (New River – old course)	Leaching and migration via permeable strata into the watercourse
Human Health	Site users / construction workers	Direct contact during construction and dust inhalation. Topsoil / subsoil to cover when completed so no pathway.

9.3 Summary of Risk Assessment

The details of the Generic Quantitative Risk Assessment are presented in Table 9.3 overleaf.

Table 9-3 Summary of risk assessment

Source		Pathway [normal text] / Hazard to Receptor [bold text]	Risk Assessment (following CIRIA C552)			Description of source [bold text]. Comment on hazard realisation [normal text]	
Origin	Contaminants of concern		Zone affected	Consequence	Probability		Risk
Excavated material – producer site	B(a)P, zinc copper, arsenic	On site	Most determinands from most locations have been identified below screening concentrations for the protection of controlled waters (leachate data), human health (residential without gardens) or for phytotoxic contaminants. One marginally elevated concentrations of copper and zinc have been recorded with reference to human health screening thresholds. Marginally elevated concentrations of copper and zinc have been recorded with reference to phytotoxic screening concentrations in two samples and slightly elevated concentrations of arsenic and copper in leachate in relation to EQS values have been recorded.				
			Migration via permeable strata Degradation of groundwater quality [Dollis Hill Gravel – Secondary Aquifer]	Minor	Unlikely	Very low	Leaching data records large majority of determinands below EQS screening levels. The receiver site is only partially underlain by a Secondary Aquifer. The majority of the site is directly underlain by London Clay (unproductive strata). This provides a low permeability horizon to approximately 26m bgl providing protection to the underlying principal Chalk aquifer. The adjacent Source Protection Zone relates to the underlying Chalk which due to the presence of low permeability clay beneath the site is unlikely to be impacted by the site operations.
			Migration via permeable strata Degradation of surface water quality [New River (old course)]	Minor	Low likelihood	Very low	Leachate data records large majority of determinands below EQS screening levels. The nearest surface water course is located within 20m to the west of the area where material is to be deposited. Potential for migration via permeable strata only possible in the area where Dollis Hill Gravels are present. The watercourse is relatively low sensitivity as it is a tributary of the New River (old course).
			Human health via dust inhalation and direct contact	Medium	Unlikely	Low	One elevated concentrations of benzo(a)pyrene above residential threshold, US95 value below threshold The material will be placed within a bund that will be capped with topsoil (other source) preventing direct contact. During excavation and placement dust suppression measures including wheel washes will be used.

10 Summary

This risk assessment has identified the materials that are suitable to be excavated from the producer site and used on the receiver site to form a noise bund. Suitability has been proved by referencing chemical data to suitable assessment criteria and by comparison with the baseline data for the receiver site and by undertaking a site specific risk assessment for the receiver site.

These suitable materials are distinct from the materials deemed unsuitable for incorporation in the noise bund by their physical and visual nature and it is possible for an efficient simple segregation process to be developed on the producer site at the point of excavation.

Excavation works at the producer site are to be overseen by a resident engineer to ensure the required segregation is taking place.