Infrastructure NSW

Sediment Characterisation Assessment

The new Sydney Fish Market
1A to 1C Bridge Rd, Glebe NSW

12 January 2021

60081/134799 (Rev B)

JBS&G Australia Pty Ltd

www.jbsg.com.au

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Executive Summary

JBS&G Australia Pty Ltd (JBS&G) was engaged by Infrastructure NSW (iNSW, the client) to complete a sediment characterisation assessment at a portion of the proposed new Sydney Fish Market (nSFM) located at the head of Blackwattle Bay between the Pyrmont Peninsula and the foreshore of Glebe (the site). The nSFM site is legally identified as Lots 3-5 in DP 1064339, part Lot 107 in DP 1076596 and part Lot 1 in DP835794 as shown on **Figures 1** and **2**.

It is understood that during recent demolition works for the former Hanson Wharf, sediments deposits additional to those anticipated during project planning were identified beneath the wharf footprint. As such, further site characterisation information is required to enable decision making with regard to requirements for management, potentially including relocation/removal of the sediment to enable construction of the nSFM development. In addition, consideration has also been given to the requirements for characterisation of sediment at the Site in accordance with the requirements of both the Acid Sulfate Soil Management Plan (JBS&G 2019[1]) and the Remedial Action Plan (JBS&G 2020[2]) to inform appropriate management procedures during the proposed construction works.

Based on the results of the sediment characterisation assessment and subject to the limitations in **Section 10**, the following summarises the outcomes of the assessment:

- The data obtained is considered reliable to meet the objectives of the assessment;
- Sediment sampling was conducted within the envelope of additional sediment identified beneath the former Hanson Wharf footprint in order to appropriately characterise the additional sediments for the identified COPCs and PASS characteristics at a sampling density consistent with EPA (1995) and the ASSMP (JBS&G 2019).
- The materials were observed to be largely consistent (visually) across each sampling location to the maximum depth of the investigation (2.2 m) to an average depth of 0.9 m. The materials comprised of gravelly, clayey silt (mud), with varying levels of inclusions that included coal, ash, organic material, sea shells and metal fragments.
- Representative samples of the materials were analysed for a range of identified potential contaminants of concern including heavy metals, PAHs, TRH, BTEX, VOCs, OCP/PCBs, TBT and asbestos. As consistent with the balance of the site and wider Blackwattle Bay area, elevated heavy metals, PAHs and TRH were reported in sediments across the extent of the investigation footprint. The impacts of these compounds are considered to be comparable to, and/or less than the corresponding impacts from historical investigations completed over the balance of the site. There were no reported detections of VOCs (including BTEX), OCPs or PCBs within the materials assessed herein. In addition, there no unacceptable risks identified with respect to the reported concentrations of TBT and asbestos. As such, it is considered that there were no identified impacts within the sediments assessed herein that would preclude the materials from been retained on-site.
- Based on the results of the investigation, all sediments encountered as part of this investigation comprise of PASS and require appropriate management and treatment during future works that result in their disturbance.

[1] *Acid Sulfate Soil Management Plan. The new Sydney Fish Market, 1A to 1C Bridge Road, Glebe, NSW*. JBS&G Australia Pty Ltd, 4 April 2019 (JBS&G 2019)

[2] *Remedial Action Plan. The new Sydney Fish Market, 1A to 1C Bridge Road, Glebe, NSW*. JBS&G Australia Pty Ltd, 8 July April 2020 (JBS&G 2020)

- Should the materials be disposed off-site, it is anticipated that the materials will be classified as General Solid Waste (GSW) or Restricted Solid Waste (RSW) potentially mixed with Special (asbestos) Waste owing to the trace levels of asbestos reported at SFM01 0-1, SFM04 0-0.4 and SFM07 0-1.

  The materials classified as RSW are represented by samples SFM01 1.0-1.1, SFM07 1.5-1.6 and SFM13 1.0-1.1 in which the reported total lead concentrations are above the SCC1 threshold value.

  Based on the observation of ash and coal within the sediments, it is considered that the *General Approval of the Immobilisation of Contaminants in Waste* (EPA 1999) may be applied for PAH impacts within the materials, where TCLP analysis identified that these compounds are non-leachable and immobilised within the ash/coal matrices.

  Given the reported organotin concentrations identified in sediment samples, liaison with the NSW EPA will be required to finalise waste classifications for off-site disposal of fill material.

  Further, noting that all sediments assessed herein comprise Potential Acid Sulfate Soils (PASS), the materials will require to be disposed of in accordance with the NSW *Waste Classification Guidelines, Part 4 Acid Sulfate Soils* (EPA 2014b).

  In summary, based on assessment of the current data, if it is proposed to remove the excess sediment material from the site, the following would be required to finalise a waste classification in accordance with EPA requirements:

  - Stabilisation of the material's PASS characteristics, as per the advice provided in the ASSMP (JBS&G 2019);
  - Characterisation on a batch basis of chemical contaminants identified to be associated with the material, including heavy metals, PAHs, TRH, TBT and asbestos, with consideration of the coal/ash inclusions in the material with regard to the EPA (1995) immobilisation order. Based on the current data set, it is anticipated material may fall within GSW or RSW categories with the potential to be mixed with Special (asbestos) waste;
  - Liaison with NSW EPA where TBT concentrations are detected in samples to confirm classification/disposal requirements under the CCO (1989); and
  - Preparation of a final waste classification report for submission to the proposed licensed waste facility to confirm approval to dispose of the material, prior to commencement of transportation.

- Based on the results and findings of this assessment, it is considered that the sediment materials assessed herein are suitable for on-site retention within the framework outlined in the RAP (JBS&G 2020). Notwithstanding, further assessment of sediments at depth may be required, should the excavation depth (to facilitate the construction of the new Sydney Fish Market building) within the investigation footprint extend beyond the depths reached as part of this investigation.

Abbreviations

Term	Definition
ACM	Asbestos Containing Materials
AEC	Areas of Environmental Concern
AHD	Australian Height Datum
ASRIS	Australian Soil Resource Information System
ASS	Acid Sulfate Soils
BTEXN	Benzene, Toluene, Ethylbenzene, Xylenes and Naphthalene
CLM Act	Contaminated Land Management Act
COC	Chain of Custody
COPC	Contaminants of Potential Concern
CSM	Conceptual Site Model
DBYD	Dial Before You Dig
DO	Dissolved Oxygen
DP	Development Plan
DQI	Data Quality Indicators
DQO	Data Quality Objectives
DSI	Detailed Site Investigation
EC	Electrical Conductivity
Eh	Redox Potential
EIL	Ecological Investigation Levels
EPA	NSW Environmental Protection Authority
ESA	Environmental Site Assessment
ESLs	Ecological Screening Levels
Ha	Hectare
HAR	Heritage Assessment Report
HILs	Health Investigation Levels
HSLs	Health Screening Levels
INSW	Infrastructure NSW
JBS&G	JBS&G Australia Pty Ltd
JRA	Job Risk Assessment
LEP	Local Environmental Plan
LOR	Limit of Reporting
NATA	National Accreditation Testing Authority
OCP	Organochlorine Pesticides
OPP	Organophosphate Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PID	Photoionisation Detector
POEO Act	Protection of Environment Operations Act
PSI	Preliminary Site Investigation
QA/QC	Quality Assurance/Quality Control
RPD	Relative Percentage Difference
SAQP	Sampling Analytical and Quality Plan
SCID	Stored Chemical Information Database
SWMS	Safe Work Method Statement
TRH	Total Recoverable Hydrocarbons
UCL	Upper Confidence Limit
UST	Underground storage tank
VOC	Volatile Organic Compounds

1. Introduction & Objectives

1.1 Introduction

JBS&G Australia Pty Ltd (JBS&G) was engaged by Infrastructure NSW (iNSW, the client) to complete a sediment characterisation assessment at a portion of the proposed new Sydney Fish Market (nSFM) located at the head of Blackwattle Bay between the Pyrmont Peninsula and the foreshore of Glebe (the site). The nSFM site is legally identified as Lots 3-5 in DP 1064339, part Lot 107 in DP 1076596 and part Lot 1 in DP835794 as shown on **Figures 1** and **2**.

It is understood that during recent demolition works for the former Hanson Wharf, sediments deposits additional to those anticipated during project planning were identified beneath the wharf footprint. At the direction of iNSW, this investigation has been specifically limited to the site portion beneath the Hanson Wharf, identified as part Lot 5 in DP1064339 as shown in **Figure 2**, comprising the investigation footprint.

As such, further site characterisation information is required to enable decision making with regard to requirements for management, potentially including relocation/removal of the sediment to enable construction of the nSFM development. In addition, consideration has also been given to the requirements for characterisation of sediment at the Site in accordance with the requirements of both the Acid Sulfate Soil Management Plan (JBS&G 2019[3]) and the Remedial Action Plan (JBS&G 2020[4]) to inform appropriate management procedures during the proposed construction works.

Current survey information that details the relative height and volume of the materials is currently not available, but it is anticipated the sediments will require removal/relocation to allow for the construction of the new Sydney Fish Market building.

This report has been prepared in accordance with the requirements of the NSW Environment Protection Authority (EPA) published and endorsed guidelines.

1.2 Objective

The objective of the assessment is to characterise site sediments within the investigation footprint in order to inform project decision making, including the development of appropriate management procedures associated with the proposed construction works with consideration to aspects/criteria established within the ASSMP (JBS&G 2019) and the RAP (2020).

1.3 Scope of Works

The following scope of work has been undertaken for the assessment:

- Review of previous site contamination assessment/investigation reports as made available to JBS&G;
- A systematic sediment investigation comprising the installation of 13 boreholes to adequately characterise the additional sediments within the investigation footprint for the identified contaminants of potential concern (COPCs) and potential acid sulfate soils (ASS);
- Laboratory analysis program for representative sediment samples with subsequent data evaluation against NSW EPA endorsed guideline values; and
- Preparation of this report documenting the methods and results of the investigation.

[3] *Acid Sulfate Soil Management Plan. The new Sydney Fish Market, 1A to 1C Bridge Road, Glebe, NSW*. JBS&G Australia Pty Ltd, 4 April 2019 (JBS&G 2019)

[4] *Remedial Action Plan. The new Sydney Fish Market, 1A to 1C Bridge Road, Glebe, NSW*. JBS&G Australia Pty Ltd, 8 July April 2020 (JBS&G 2020)

1.4 Previous Assessments

Previous environmental assessments and reports as available to JBS&G and relating to the site are listed following:

- *Environmental Site Investigation Blackwattle Bay Maritime Precinct Blackwattle Bay Maritime Precinct, NSW*, March 2009, Parsons Brinkerhoff (PB 2009);
- *Report to Land and Property Management Authority C/- Government Architects Office on Preliminary Environmental Site Assessment for Proposed Redevelopment – Waterfront at Markets, 56-60 Pyrmont Bridge Road, Pyrmont, NSW.* Ref: E24125Krpt, EIS, August 2010 (EIS 2010b);
- *Sydney Bays Precinct Urban Growth NSW Geotechnical Desktop Review*, 6 August 2014, Jacobs Group (Australia) Pty Limited (Jacobs 2014);
- *UrbanGrowth NSW Environmental Site Assessment The Bays Precinct Urban Transformation Area rev 1*, 18 November 2015, JBS&G Australia Pty Ltd (JBS&G 2015a);
- *UrbanGrowth NSW Site Wide Remedial Concept Plan The Bays Precinct Urban Transformation Area rev 0*, 4 December 2015, JBS&G Australia Pty Ltd (JBS&G 2015b);
- *Bays Market Precinct: Blackwattle Bay & Wentworth Park History, Built Heritage, Archaeology & Landscape Study*, July 2017, City Plan Heritage (CPH 2017);
- *Contamination Investigation The Bays Precinct – Separable Portion 1 Blackwattle Bay, Pyrmont, NSW*, 12 July 2017, Environmental Investigation Services (EIS 2017);
- *Revised Geotechnical Report to Urbangrowth NSW on Geotechnical Investigation for Proposed Bays Market District at Blackwattle bay & Wentworth Park, Pyrmont, NSW rev 2*, 14 September 2017, JK Geotechnics (JK 2017);
- *Environmental Site Assessment, The new Sydney Fish Market, 1A to 1C Bridge Road, Glebe, NSW*. 2 November 2018, JBS&G Australia Pty Ltd (JBS&G 2018);
- *Acid Sulfate Soil Management Plan. The new Sydney Fish Market, 1A to 1C Bridge Road, Glebe, NSW*. JBS&G Australia Pty Ltd, 4 April 2019 (JBS&G 2019); and
- *Remedial Action Plan. The new Sydney Fish Market, 1A to 1C Bridge Road, Glebe, NSW*. JBS&G Australia Pty Ltd, 8 July April 2020 (JBS&G 2020).

2. Site Identification & Environmental Setting

2.1 Site Identification

The site location is shown in **Figure 1**, and current site layout is shown in **Figure 2**. The site details are summarised in **Table 2.1** and described in the following sections. The assessment was limited to the extent of additional sediments as identified beneath the former Hanson Wharf during demolition works as defined by the investigation footprint shown on **Figure 2**.

Table 2.1: Summary Site Details

Site Lot / DP	Lots 3-5 in DP 1064339 Part Lot 107 in DP1076596 Part Lot 1 in DP835794
Site Address	1A to 1C Bridge Road, Glebe NSW and part 56-60 Pyrmont Bridge Road, Pyrmont NSW
Investigation Area Lot / DP	Part Lot 5 in DP1064339
Investigation Area Address	1A Bridge Road, Glebe NSW
Local Government Authority	City of Sydney Council
Approximate MGA Coordinates (MGA 56)	Easting: 332669.678 Northing: 6250259.919
Previous Use	Various industrial and commercial uses (concrete batching plant)
Proposed Use	Commercial use (fish market)
Site Area	Approximately 3.7 Ha (approximately 0.76 Ha land based)

2.2 Site Description

The investigation area footprint was inspected (where accessible) during sampling activities undertaken by experienced JBS&G personnel on 30 November 2020, with key observations documented following:

- The former wharf structure was in the process of been demolished at the time of sampling activities. Within the northern portion of the investigation area, the former deck had been completely removed, leaving only wooden piles within this portion. The concrete deck was still present in the southern portion (as represented by sampling locations SFM01-SFM06 and SFM08) which limited overhead access for sampling works;
- At high tide, all areas within the investigation footprint were flooded with surface water of Blackwattle Bay;
- At low tide, there were exposed sediments within the central-southern portion of the investigation area. The sediments were observed to comprise of dark-grey to black gravelly silt.
- Pieces of concrete were observed on the seabed adjacent to sampling locations SFM3-SFM5 and SFM8. The extent (size and distribution) as well as likely source of the concrete could not be determined during the assessment given that the pieces were partially submerged/underlying sediments.

A photographic log is provided in **Appendix F**.

2.3 Blackwattle Bay

A detailed site history and environmental setting is provided in JBS&G (2020), with a brief overview provided as follows:

- The site and Blackwattle Bay were reclaimed in the period between 1836 and 1891;
- The site was used for commercial purposes from 1900 that included timber merchants, abattoirs and garbage collectors;

- Lot 3 in DP1064339 located in the eastern portion of the site was used for unloading coal since before 1951. Coal fragments have been reported on the seafloor and within boreholes previously completed at the site;
- Blackwattle Bay receives stormwater input via drains that discharge at the south-eastern and south-western site extents;
- Water depths in Blackwattle Bay are generally less than 8 m below lowest astronomical tide (LAT), but the southern shoreline (i.e within the southern portion of the site) is considerably shallower and is exposed in certain areas at low tide;
- The current maritime usage of Blackwattle Bay includes boat storage, wharves servicing commercial (marinas and fishing) operations, recreational activities and rowing; and
- Commercial fishing has been banned throughout Blackwattle Bay (and wider Port Jackson) due to elevated contaminant concentrations in edible species. In addition, recreational fishers are advised to follow dietary advice on the consumption of seafood taken from Sydney Harbour inclusive of Blackwattle Bay.

2.4 Local Geology and Soils

Jacobs (2014) reported that review of existing geotechnical maps indicate that the area of the site is underlain by a significant depth (>3 m) of fill material as consistent with historical reclamation of the area from Blackwattle Bay. This is consistent with Wentworth Park as located further south of the site. Hawkesbury Sandstone was anticipated under site filling.

JK (2017a) reported that the 1:100,000 Geological Map of Sydney identified the site to be underlain by man-made fill and estuarine soils overlying Hawkesbury Sandstone of the Wianamatta Group. The Hawkesbury Sandstone comprises medium to coarse grained quartz sandstone with very minor shale and laminite lenses. It was further noted that at least two dykes were believed to extend through the site in a rough north-west to south-east alignment.

Geotechnical investigation boreholes in Blackwattle Bay undertaken for JK (2017a) disclosed a subsurface profile generally comprising natural clay and sandy clay of medium to high plasticity and clayey sand overlying sandstone bedrock. In the Bay, the boreholes typically encountered no fill from the seabed level, except the boreholes close to the existing shoreline where fill extending up to 4.7m depth was encountered. There generally appear to be a fill layer close to the southern shoreline. The fill was reported to comprise clayey sand and silty clay with trace amounts of fine to medium grained sand, coal and plastic fragments. Boreholes in the adjoining Wentworth Park identified fill comprising silty sand or sandy clay containing varying amounts of inclusions such as sandstone and igneous gravel, timber, tile, ceramic, glass, shell, concrete and brick fragments, slag and ash.

Natural soils were encountered either from seabed level or at about 0.5m depth in the Bay and comprised interbedded layers of silty clay, sandy clay and clayey sand soils. The predominantly clay samples were assessed as having moisture content greater than their plastic limits and based upon hand penetrometer tests completed on the samples, ranged in strength from very soft to very stiff. The clays were assessed as generally being of medium to high plasticity, although the more sandy clays were generally of low to medium plasticity. The predominantly sandy samples were assessed as wet and ranged from very loose to dense relative density. The natural soils contained varying amounts of fine to coarse grained gravel, shell fragments and other organic materials.

Sandstone bedrock was encountered underlying natural soils at depths ranging from approximately 5.5-13.4 m below ground surface (bgs, corresponding to elevations of-9.1 to -18.5 m Australian Height Datum (AHD).

2.5 Acid Sulfate Soils

Review of the Acid Sulfate Soil (ASS) Risk Map for Prospect/Parramatta indicates[5] that the subject site is located within an area of 'high probability' of acid sulfate soils within bottom sediments. In such areas, there is a severe environmental risk if bottom sediments are disturbed by activities such as dredging.

PB (2009) noted potential indicators of ASS comprising odorous marine sediments with sea shells in boreholes located in the southern portion of the site (overlying the land portion of the site) and within marine sediments in Blackwattle Bay. Similar observations were reported in JBS&G (2015) and EIS (2017), however no samples were analysed at a laboratory to confirm if the soils comprised actual ASS.

Given the proposed development scheme and the anticipated acid generation characteristics of the sediment and potentially soil at the site, an ASSMP (JBS&G 2019) was prepared in conjunction with the RAP (2020) in which all marine sediments within the development footprint (i.e. the site) are assumed to comprise PASS.

[5] *'Acid Sulfate Soil Risk Map – Prospect/Parramatta, Edition 2',* 1997 1:25 000, NSW Department of Land and Water Conservation (DLWC), Ref 9130N3 (NSW DLWC)

3. Conceptual Site Model

A conceptual site model (CSM) as specific to the areas of the site overlying surface waters within Blackwattle Bay and based on the historical results from sediment sampling in the wider site area (as presented in JBS&G 2018) is presented in **Table 3.1** following. **Figure 3** presents the historical sampling locations and sediment sample exceedances.

Table 3.1: Conceptual Site Model

CSM Aspect	Summary of Available Information
Current Extent of Known Impacts	**Sediments** Blackwattle Bay has been subjected to the discharge of industrial waste and urban run-off since the early days of colonial settlement. This has led to the sediments within the Bay to become enriched in various contaminants. Heavy metals, total polycyclic aromatic hydrocarbons (PAHs), (limited) total polychlorinated biphenyls (PCBs) and total recoverable hydrocarbon (TRH) contaminated sediments have been identified within the extent of the site. A baseline ecological assessment (UNSW 2017[6]) was conducted within the Bays Precinct and included sediment sampling within the greater area of Blackwattle Bay. The report found that the sediments of Blackwattle Bay had significant metal and nutrient contamination indicative of highly disturbed conditions. On this basis, the elevated contaminant concentrations previously reported in sediments within the subject site are likely reflective of conditions throughout the extent of Blackwattle Bay as a result of historical industrial activities along the foreshore of the Bay. All sediments within the site extent are also anticipated to be ASS. As such, management of the potential for acid generation conditions will be required during all ground/sediment disturbance activities completed at the site in accordance with the ASSMP (JBS&G 2019) unless subsequently found to not comprise of PASS.
Human and Ecological Receptors	**Human** Human receptors within the investigation footprint and wider site area (in areas overlying surface water) are likely to be limited to recreational users of Blackwattle Bay. In addition, construction workers may be exposed to sediments during excavation/construction works. **Ecological** UNSW (2017) provides a detailed review of the ecological receptors within Blackwattle Bay which were identified to include: • 14 species of native fish; • Flora and fauna on hard structures (epifauna) within the intertidal and subtidal areas that included barnacles, oysters, mussels, algae etc; and • Microorganisms that included eukaryote assemblages (such as diatoms, arthropods nematodes) and bacteria.
Potential and Complete Exposure Pathways	**Human** For general site users, exposure to site sediments is anticipated to be limited given that access is precluded by virtue that the materials are covered with surface water and/or structures. During construction, short term exposure scenarios are anticipated to be limited to oral and dermal exposure associated with direct contact, given the saturated nature of the material will likely preclude generation of dust and/or vapours. **Ecological** Organisms living within estuarine systems have the ability to bioaccumulate contaminants from sediments via direct contact and/or the ingestion of sediment particles. The concentrations of heavy metals, total PAHs, total PCBs and TRH within surficial sediment samples exceed guideline values, which indicates a potentially complete exposure pathway for ecological receptors. It is noted that the design of the development will result in a

[6] *Baseline Assessment of Ecological Structure and Environmental Conditions at the Bays Precinct*, University of New South Wales, March 2017 (UNSW 2017).

CSM Aspect	Summary of Available Information
	limited water column between the sediment bed and the basement structure, which will likely limit the extent and nature of organisms resident within the investigation area subsequent to construction of the building.
Potential for Off-site Migration	Water velocities within Blackwattle Bay are generally low (<0.1 m/s) and boat traffic is limited, therefore the redistribution of sediments to beyond the site boundary is expected to be limited. Environmental controls (such as silt curtains) will further limit the redistribution of sediments to beyond the site boundary during construction activities.
Data Gaps	The primary data gap which is the subject of this assessment is the additional sediments recently identified beneath the former Hanson Wharf that have not been characterised. Given that Blackwattle Bay has been subject to the discharge of industrial waste and urban run-off as part of its history, the additional materials have the potential to be impacted with a wide range of contaminants that includes heavy metals, TRH, benzene, toluene, ethylbenzene, xylenes (BTEX), PAHs, organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs), tributyltin (TBT) and asbestos. In addition, the extent of PASS materials which may require management during construction activities is not known.

4. Data Quality Objectives

4.1 Data Quality Objectives

Data Quality Objectives (DQOs) were established for the sediment characterisation assessment, as discussed in the following sections.

4.1.1 State the Problem

Additional sediments have been identified beneath the former Hanson Wharf that have previously not been characterised. The sediments have the potential to be impacted by virtue of the unknown origin of the materials. In addition, the materials are located within the highly disturbed Blackwattle Bay, where sediments have previously been identified to be impacted with wide range of contaminants that includes heavy metals, total PAHs, total PCBs and TRH. As such, the materials require characterisation in order to inform appropriate management procedures during the proposed construction works for the new Sydney Fish Market building.

4.1.2 Identify the Decision

The decisions required to be made for the investigation are:

- Have potential impacts within the additional sediments in the investigation footprint been appropriately characterised?
- Are the materials suitable for on-site retention/re-use?
- Has the extent of potential acid sulfate soils that require management during remediation/construction activities been appropriately defined?
- Can a preliminary waste classification be provided for materials that may require off-site disposal during future development activities?
- Is further assessment required?

4.1.3 Identify Inputs to the Decision

The following inputs are required in order to make the stated decisions:

- Previous sediment data available for the site and Blackwattle Bay;
- Sediment sampling from boreholes to assess for the presence of potential chemical COPCs, asbestos and acid sulfate soils;
- Laboratory analysis data for COPCs;
- Site assessment criteria for potentially impacted sediment for the identified COPCs; and
- Confirmation that data generated by sampling and analysis is of an acceptable quality to allow reliable comparison to assessment criteria.

4.1.4 Define the Study Boundaries

The study boundaries comprised the spatial extent of additional sediment deposits as identified beneath the former Hanson Wharf as defined by the Investigation Footprint shown on **Figure 2**. The vertical extent of the assessment was limited to the maximum depth of 2.2 m bgs (below seabed level) that could be reached as part of the investigation, given practical constraints associated with site access at the time of the investigation.

The temporal study boundaries were limited to the period of assessment works. Due to the nature of the potential contamination identified, seasonality is not considered to be significant with respect to assessing risks to future site receptors.

4.1.5 Develop a Decision Rule

The decision rules adopted to answer the decisions identified in **Section 5.1.2** are summarised in **Table 5.1**.

Table 5.1: Summary of Decision Rules

Decision Required to be Made	Decision Rule
1. Have potential impacts within sediments in the investigation footprint been appropriately characterised?	Has data been collected at the proposed sample locations in accordance with the sampling density recommended in EPA (1995[7]) and the ASSMP (2019) as well as to the maximum depth that sediments may be disturbed during future construction works? Have all potential impacts within sediments been appropriately delineated? If Yes to all, the answer to the decision is Yes. Otherwise the answer to the decision is No. In this instance, further field sampling activities and/or laboratory analysis would be required to address the question.
2. Are the materials suitable for on-site retention/re-use?	Sediment analytical data was compared against EPA endorsed criteria. Statistical analysis of the data in accordance with relevant guidance documents was undertaken where appropriate, to facilitate the decisions. The following statistical criteria were adopted with respect to sediments: Either: the reported concentrations is below the site criteria; Or: the 95% upper confidence limit (UCL) of the average concentration for each analyte is below the adopted site criterion; no single analyte concentration exceeds 250% of the adopted site criterion; and the standard deviation of the results are less than 50% of the site criterion. If the statistical criteria stated above are satisfied, the answer to the decision is Yes. If the statistical criteria above were not satisfied, a qualitative assessment was undertaken that broadly comprised a comparison of the data collected herein to the historical sediment data collected from the site and wider Blackwattle Bay areas. If the contaminant levels within sediments are comparable to historical results collected from the site and broader Blackwattle Bay area, the answer to the decision was Yes. Otherwise the answer to the decision was No.
3. Has the extent of potential acid sulfate soils that require management during remediation/construction activities been appropriately defined?	Have the additional sediments that may be disturbed during the proposed development construction works been assessed in accordance with the requirements of ASSMAC (1998[8]) and JBS&G (2019) enabling identification of ASS characteristics? If Yes, the answer to the decision was Yes. Otherwise, the answer to the decision was No.
4. Can a preliminary waste classification be provided for materials that may require off-site disposal during future development activities?	Representative sediment analytical data were compared against EPA (2014) criteria and supplementary NSW EPA advice. Statistical analysis of the data in accordance with relevant guidance documents was undertaken, where appropriate, to facilitate the provision of a preliminary waste classification of the materials. If the data comparison outcome identified that a waste classification could be provided, then the answer to the decision was Yes. Otherwise, the answer to the decision was No. In this instance, further consideration may be necessary with regard to additional data .
5. Is further assessment required?	Assessed by guidance to other decisions.

[7] *Contaminated Sites Sampling Design Guidelines*, NSW Environment Protection Authority, September 1995 (EPA 1995).
[8] *Acid Sulfate Soil Manual*, NSW Acid Sulfate Soil Management Advisory Committee, August 1998 (ASSMAC 1998).

4.1.6 Specify the Limits on Decision Error

This step is to establish the decision maker's tolerable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data. Data generated during this project must be appropriate to allow decisions to be made with confidence.

Specific limits for this project have been adopted in accordance with the appropriate guidance from the NSW EPA, NEPC 2013[9], appropriate indicators of data quality (DQIs used to assess quality assurance / quality control) and standard JBS&G procedures for field sampling and handling.

To assess the usability of the data prior to making decisions, the data will be assessed against pre-determined Data Quality Indicators (DQIs) established for the project as discussed below in relation to precision, accuracy, representativeness, comparability and completeness (PARCC parameters). The acceptable limit on decision error is 95% compliance with DQIs.

The DQIs and data assessment criteria are summarised as presented in **Table 5.2**.

- **Precision** - measures the reproducibility of measurements under a given set of conditions. The precision of the laboratory data and sampling techniques is assessed by calculating the Relative Percent Difference (RPD) of duplicate samples.
- **Accuracy** - measures the bias in a measurement system. The accuracy of the laboratory data that are generated during this study is a measure of the closeness of the analytical results obtained by a method to the 'true' value. Accuracy is assessed by reference to the analytical results of laboratory control samples, laboratory spikes and analyses against reference standards.
- **Representativeness** – expresses the degree which sample data accurately and precisely represent a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples on a representative basis across the site, and by using an adequate number of sample locations to characterise the site to the required accuracy.
- **Comparability** - expresses the confidence with which one data set can be compared with another. This is achieved through maintaining a level of consistency in techniques used to collect samples; ensuring analysing laboratories use consistent analysis techniques and reporting methods.
- **Completeness** – is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being sufficient valid data generated during the study.

Table 5.2: Summary of DQIs

Data Quality Objectives	Frequency	Data Quality Indicator
Precision		
Blind duplicates (intra laboratory)	1 / 20 samples	<50% RPD
Blind duplicates (inter laboratory)	1 / 20 samples	<50% RPD
Accuracy		
Surrogate spikes	All organic samples	70-130%
Laboratory control samples	1 per lab batch	70-130%
Matrix spikes	1 per lab batch	70-130%

[9] *National Environment Protection (Assessment of Site Contamination) Measure, 1999 Amendment No 1*, National Environment Protection Council (NEPC 2013).

Data Quality Objectives	Frequency	Data Quality Indicator
Representativeness		
Sampling appropriate for media and analytes		-
Samples extracted and analysed within holding times.	-	Sediment Organics (7-14 days), inorganics (6 months)
Trip spike (BTEX only)	1 per sampling event	70-130% recovery
Rinsate blank	1 per sampling event	<LOR
Method blank	1 per lab batch	<LOR
Comparability		
Standard operating procedures for sample collection & handling	All Samples	All samples
Standard analytical methods used for all analyses	All Samples	All samples
Consistent field conditions, sampling staff and laboratory analysis	All Samples	All samples
Limits of reporting appropriate and consistent	All Samples	All samples
Completeness		
Sample description and COCs completed and appropriate	All Samples	All samples
Appropriate documentation	All Samples	All samples
Satisfactory frequency and result for QC samples	All QA/QC samples	-
Data from critical samples is considered valid	-	Critical samples valid

4.1.7 Optimise the Design for Obtaining the Data

The purpose of this step is to identify a resource-effective field investigation sampling design that generates data that are expected to satisfy the criteria specified in the preceding steps of the DQO process. This step provides a general description of the activities necessary to generate and select data collection designs that satisfy decision performance criteria.

Based on the objectives of the assessment, a systematic sediment sampling program was undertaken across the extent of the investigation footprint. Sediment sampling was conducted to appropriately characterise potential site impacts and meet the sampling density specified in the ASSMP (JBS&G 2019) and EPA (1995). Noting that the sampling density was undertaken on the basis of a 20 m grid (as shown on **Figure 4**), the number of sample locations met the required density specified in the ASSMP (JBS&G 2019) and exceeded the density required by EPA (1995) – where it is noted that for sites of approximately 3 ha (as consistent with the development footprint area overlying surface waters over Blackwattle Bay), it is recommended to complete the sampling density on a 27 m grid.

Overall, the sediment sampling program was designed to characterise the identified COPCs (both chemical and asbestos) and potential acid sulfate soils within the investigation footprint such that a statistically robust data set sufficient to enable decision making could be obtained to enable decision making.

4.2 Assessment Methodology

4.2.1 Sediment Sampling

Sediment samples were collected via a manually-operated piston coring device (stainless steel barrels, 50.8 mm OD) to a maximum depth of 2.2 m. Penetration depth at each location was dependent on the nature of the substrate encountered and available overhead working space (due

to the remaining presence of the wharf structure at locations in the southern portion of the investigation area).

Sediment samples (for chemical constituents) were collected in the biologically active zone, i.e. 0-0.1m and then at 0.5m intervals to a maximum depth of 2.2 m or prior refusal, whichever was shallower. Sediment samples for asbestos analysis were generally collected at 1.0 intervals to the maximum depth of the investigation. During the collection of sediment samples, features such the presence of ash/coal, discolouration, staining, odours, and other indicators of contamination were noted.

Collected samples were immediately transferred to laboratory supplied sample jars (additional 500 mL plastic bags were used where asbestos analysis was required). The sample jars/bags were then transferred to a chilled ice box for sample preservation prior to and during shipment to the testing laboratory. A chain-of-custody form was completed and forwarded with the samples to the testing laboratory.

Sediment samples for field ASS and laboratory analysis of samples were placed in small zip lock plastic bags and placed directly on ice during sampling activities. Field testing of samples were completed during/following the collection of all samples in accordance with the field testing procedure presented in the ASSMAC (1998) noting that field pHf and pHfox tests were recorded.

Duplicate sediment samples were collected at a rate of one per 20 primary samples. Duplicate samples were collected for QA/QC purposes from the core by taking discrete sediment samples and placing directly into the sample jars. Samples were not mixed prior to placement into the jars to minimise the potential for loss of volatiles. Similarly, where 500 mL samples were required for duplicate asbestos analysis no mixing of material was undertaken prior to placement into plastic bags to prevent the loss of free fibres. It is noted that this methodology may result in the calculation of poor RPDs but this is considered acceptable given that the loss of volatiles/fibres that may occur if samples are mixed would result in the reporting of lower contaminant concentrations than actually present. A trip spike BTEX only) and rinsate blank (for non-dedicated equipment) were collected with the batch of samples.

All non-disposable sampling equipment, including piston coring device, were cleaned with a high pressure water/ detergent spray, rinsed with water and then air dried. The equipment was then inspected to ensure that no sediment, oil, debris or other contaminants were apparent on the equipment prior to the commencement of works. Sampling equipment was subsequently decontaminated using the above process between each location.

Not all sediment samples collected were analysed. Sediment samples were analysed in accordance with the sampling and analytical program (**Table 5.3**).

4.2.2 Analytical Methodology

JBS&G contracted Eurofins MGT (Eurofins) as the primary laboratory, with Envirolab Services (Envirolab) as the secondary laboratory. All laboratories are NATA registered for the required analyses. In addition, the laboratories were required to meet JBS&G's internal QA/QC requirements.

Table 5.3: Analytical Schedule

Sample Type	No. of Sampling Locations	Analyses (exc. QA/QC)
Sediment	13 locations	Heavy metals – 20 samples PAHs – 20 samples TRH/BTEX – 18 samples OCPs/PCBs – 16 samples VOCs – 7 samples Tributyltin – 6 samples Asbestos (500 mL) – 14 samples SPOCAS (acid sulfate soils) – 13 samples TCLP heavy metals – 19 samples TCLP PAHs – 11 samples

5. Assessment Criteria

5.1 Sediment Assessment Criteria

With respect to the assessment of potential ecological risks and corresponding suitability for on-site re-use/retention, sediment data has been screened within the framework instructed to Australian and New Zealand Guidelines for Sediment Quality (ANZAST, August 2018). Sediment guidelines are provided in ANZAST (2018) as sediment quality guideline (GV) values. These are provided as default (D-GV) and guideline-high (GV-high) values corresponding to the statistical probability of effects. For the relevant organic constituents assessed, the reported concentrations have been normalised to 1% organic carbon based on sample analysis results. A summary of the sediment assessment criteria is provided in **Table 6.1** following.

Table 6.1: Chemical Contaminants in Sediment Assessment Criteria (all units in mg/kg)

	Limit of Reporting	Laboratory Method	D-GV ANZAST 2018	GV-high ANZAST 2018
TPH				
TPH (C_6-C_{40})[1]	50	Purge Trap-GCMS (USEPA8260)	280	550
PAHs				
Total PAHs[1]	0.5	GCMS (USEPA8270)	10	50
Heavy Metals				
Arsenic	2.0	ICP-AES (USEPA 200.7)	20	70
Cadmium	0.4	ICP-AES (USEPA 200.7)	1.5	10
Total Chromium	1.0	ICP-AES (USEPA 200.7)	80	370
Copper	1.0	ICP-AES (USEPA 200.7)	65	270
Nickel	1.0	ICP-AES (USEPA 200.7)	21	52
Lead	1.0	ICP-AES (USEPA 200.7)	50	220
Zinc	1.0	ICP-AES (USEPA 200.7)	200	410
Mercury (inorganic)	0.05	Cold Vapour ASS (USEPA 7471A)	0.15	1
PCBs				
PCBs (total)[1]		GCECD (USEPA8140,8080)	0.034	0.28
OCPs				
4,4-DDE[1]	0.1	GCECD (USEPA8140,8080)	0.0014	0.007
Chlordane[1]	0.1	GCECD (USEPA8140,8080)	0.0045	0.009
DDD[1]	0.1	GCECD (USEPA8140,8080)	0.0035	0.009
DDT[1]	0.1	GCECD (USEPA8140,8080)	0.0012	0.005
Dieldrin[1]	0.1	GCECD (USEPA8140,8080)	0.0028	0.007
Endrin[1]	0.1	GCECD (USEPA8140,8080)	0.0027	0.06
Lindane[1]	0.1	GCECD (USEPA8140,8080)	0.0009	0.0014
Organometallics				
TBT[1]	0.0005	ES-MS (USEPA 8323)	9[2]	70[2]

[1] (mg/kg dry weight normalised to 1% OC within the limits of 0.2 to 10%)

[2] (units are µg/kg)

For compounds where ANZAST (2018) does not provide guideline values (such as BTEX and VOC compounds), the laboratory limit of reporting (LOR) has been adopted as an initial screening value.

Noting that it is highly unlikely that future on-site human receptors will come into direct contact with saturated sediments (and will therefore not be exposed to potential asbestos impacts within the materials), the concentration of asbestos within sediments is not considered relevant when assessing suitability for on-site retention/re-use. Notwithstanding, asbestos screening levels have been adopted as applicable to the proposed land-uses for the site and are presented in **Table 6.2** below.

Table 6.2: Asbestos in Soil Health Based Assessment Criteria (all units in % w/w)

	Health Screening Level (w/w)	
Form of Asbestos	**Recreational (C)**	**Commercial/Industrial (D)**
Bonded ACM	0.02 %	0.05 %
Fibrous asbestos or asbestos fines[3]	0.001 %	0.001 %
All forms of asbestos	No visible ACM for surface soil (0 – 0.1 m bgs).	No visible ACM for surface soil (0 – 0.1 m bgs).

5.2 Acid Sulfate Soil Criteria

The assessment of acid sulfate soil conditions was completed via use of laboratory sPOCAS analysis methods with the results compared to the site acid sulfate soil action criteria published in the *Acid Sulfate Soil Manual* (ASSMAC 1998[10]), as presented in **Table 6.3** below. Where results exceeded the site action criteria, material was considered to comprise Potential/Actual Acid Sulfate Soil.

Table 6.3: ASS Site Assessment Criteria

Soil Type		Action Criteria (1-1000 tonnes disturbed)		Action Criteria (>1000 tonnes disturbed)	
Texture	Clay Content (%)	Sulfur Trail (S_{pos}%) - S %	Acid Trail (TPA/TSA) mol H^+/tonne	Sulfur Trail (S_{pos}%) - S %	Acid Trail (TPA/TSA) mol H^+/tonne
Coarse	<5	0.03	18	0.03	18
Medium	5-40	0.06	36	0.03	18
Fine	>40	0.1	62	0.03	18

5.3 Waste Classification Assessment

To address the assessment objective for the provision of a preliminary waste classification of fill/soil materials at the site, laboratory analysis data have been compared to threshold concentrations (total and leachable concentrations) published in NSW EPA guidance documentation presented in *NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste* (EPA 2014a[11]). In addition, consideration has also been given to *NSW EPA Waste Classification Guidelines, Part 4: Acid Sulfate Soils* (EPA 2014b[12]) with respect to management during disposal of potential ASS materials.

[10] *Acid Sulfate Soil Manual*, New South Wales Acid Sulfate Management Advisory Committee, August 1998 (ASSMAC 1998)
[11] *Waste Classification Guidelines, Part 1: Classifying Waste,* NSW Environment Protection Authority, November 2014 (EPA 2014a)
[12] *Waste Classification Guidelines, Part 4: Acid Sulfate Soils*, NSW Environment Protection Authority, November 2014 (EPA 2014b)

6. Quality Assurance / Quality Control

Data quality indicators (DQIs) have been calculated as per the requirements of **Table 5.2** and are summarised in **Table 7.1** following. Laboratory reports are provided as **Appendix C**, with summarised QA/QC results presented in **Appendix D**.

Table 7.1: Summary of Quality Assurance / Quality Control Assessment

Data Quality Indicator	Frequency	Results Reported	DQI met
Precision			
Blind duplicates – sediment	2/20	0-117 % RPD	See discussion below
Split duplicates – sediment	2/20	0-114 % RPD	See discussion below
Accuracy			
Surrogate spikes	All samples for organic constituent analysis	53-148 % recovery	See discussion below
Laboratory control samples	1/20	70-130 % recovery	Yes
Matrix spikes	1/20	70-130 % recovery	Yes
Representativeness			
Sampling appropriate for media and analytes	All media	All sampling appropriate	Yes
Samples extracted and analysed within holding times.	Various	All samples extracted and analysed within holding times	See discussion below
Method blank	All analytes	<LOR	Yes
Trip blank Trip Spike	1/sampling event 1/sampling event	<LOR 70-130% recovery	Yes
Comparability			
Standard operating procedures for sample collection & handling	All samples	Standard procedures for all sampling	Yes
Standard analytical methods used for all analyses	All samples	Standard analytical methods	Yes
Consistent field conditions, sampling staff and laboratory analysis	All works	Consistent field staff and consistent field and laboratory conditions	Yes
Limits of reporting appropriate and consistent	All samples	LORs appropriate and generally consistent	Yes
Completeness			
Sample description and COCs completed and appropriate	All samples	Field documentation and COC provided and completed	Yes
Appropriate documentation	All works	Documentation provided and completed	Yes
Satisfactory frequency and result for QC samples	All samples	See discussion below	Yes
Data from critical samples is considered valid	-	Critical samples valid	Yes

6.1 Discussion of QA/QC Results

The results of QA/QC samples outside the acceptance criteria are discussed below.

6.1.1 Precision

Sediment Duplicates

Sediment blind and split duplicates were collected at a rate of greater than 1 per 20 primary samples analysed and the majority of resultant RPDs were reported to be within the JBS&G acceptable limit (0-50 %). A number of heavy metal, TRH and PAH compounds were reported to have elevated RPDs, which is considered to be a result of the difficulty in obtaining homogenous sediment samples in undisturbed sample types. As a conservative measure, the highest reported concentration of each constituent at each location will be considered when interpreting the results of the investigation.

6.1.2 Accuracy

Surrogate Spikes

Sediment surrogate spikes were conducted on all samples submitted for organic constituent analysis and generally all recoveries were reported within the JBS&G acceptable range (70-130 %). A small number of surrogates were reported outside the JBS&G acceptable range, but were within the laboratories acceptable limits (typically between 50 and 150 % recovery) under their NATA accreditation.

Elevated surrogate recoveries indicate the reported concentrations may potentially be greater than the actual concentrations, while low surrogate recoveries indicate the reported concentrations may potentially be less than the actual concentrations. Taking this into account it is considered that samples with slightly elevated or lower surrogate recoveries do not affect the reliability of the data for this investigation, with regard to the overall decision making objectives.

Matrix Spikes

The number of matrix spikes analysed exceeded the required frequency of 1 in 20 samples for sediment analysis. The reported matrix spike recoveries were within the JBS&G acceptable range (70-130 %) and therefore matrix interference is considered to not be significant with respect to the accuracy of the dataset.

Laboratory Control Samples

A sufficient number of laboratory control samples were analysed for all media types in which all recoveries were within the preferred range (70-130%) in the primary samples analysed.

6.1.3 Representativeness

Sampling appropriate for media and analytes

All sediment sampling works completed during the investigation were conducted in accordance with JBS&G standard operating procedures. Sediment sampling was conducted with the advancement of boreholes via a piston core sampler, considered appropriate to obtain undisturbed samples for the potential site chemical contaminants. It is noted that boreholes are not the preferred method of investigation for asbestos, in which the analysis as part of this investigation is for information purposes only to assist with the waste classification, if required. Given the outcomes of the investigation, the adopted assessment methodology is considered appropriate to achieve defensible decisions as required for this investigation.

Laboratory Blanks

There were no reported concentrations of contaminant compounds above the laboratory LOR in the laboratory method blanks for sediment analysis.

Holding Times

The extraction and analysis of total contaminant concentrations within primary samples were completed within the recommended holding times for all analytes. Some additional analysis (comprising TCLP and silica gel clean-up) was completed on selected samples following receipt of the initial results, in which the holding times were slightly outside of what is recommended. Noting, that all samples were refrigerated at the laboratory prior to analysis, it is considered unlikely that the slight exceedance in extraction time for these constituents would have significantly affected the reported concentrations. On this basis, these minor exceedances are not considered significant with respect to suitability of the resulting data to support the assessment decisions.

Trip Spike

A trip spike was submitted with the batch of sediment samples. All trip spike recoveries were within the acceptable limit of 70-130 %, indicating that the adopted assessment sample preservation methods were appropriate to result in a low risk of contaminant concentration loss during transport of the samples.

Trip Blank

A trip blank was submitted the batch of sediment samples submitted to the laboratory. There were no reported concentrations of BTEX above the laboratory LOR thus demonstrating the absence of significant contaminant cross contamination issues during the temporary storage and transportation of samples analysed during this investigation.

6.1.4 Comparability

Eurofins (primary laboratory) and Envirolab (secondary laboratory) were NATA accredited for comparable methods of analysis. Field works have been undertaken by a team of experienced sediment samplers in accordance with the same standard operating procedure. All field documentation was appropriately completed.

6.1.5 Completeness

Documentation

All documentation is complete and correct.

Frequency for QC Samples

The frequency of analysis for the QC samples collected has met or exceeded the required minimum frequency for each analyte and media analysed.

6.2 QA/QC Assessment

The field sampling and handling procedures produced QA/QC results which indicate that the sediment data is of an acceptable quality and suitable for use in site characterisation.

The NATA certified laboratory results sheets indicate that the project laboratory was generally achieving levels of performance within its recommended control limits during the period when the samples from this program were analysed.

On the basis of the results of the field and laboratory QA/QC program, the sediment data is of an acceptable quality in order to achieve the objectives of the assessment.

7. Sediment Assessment

The lithology encountered at the site during the field works is summarised below. Borehole logs are included in **Appendix B**. A total of 13 boreholes were installed by JBS&G as part of the current investigation.

7.1 Field Observations

Sediments at all locations comprised of gravelly, clayey silt (mud), with varying levels of inclusions that was composed of coal, ash, sea shells, organic matter and metal fragments. The gravel content was generally greatest within shallow sediments and decreased with depth. In addition, the silt and clay content generally increased with depth at each location.

The final depths of the investigation are detailed following; SFM01 (1.1 m), SFM02 (0.5 m), SFM03 (0.6 m), SFM04 (0.5 m), SFM05 (1.2 m), SFM06 (1.2 m), SFM07 (1.6 m), SFM08 (0.1 m), SFM09 (0.6 m), SFM10 (0.6 m), SFM11 (1.2 m), SFM12 (0.6 m), SFM13 (2.2 m).

Slight hydrocarbon odours were noted in sediments at locations SFM10 and SFM13. In addition, sulfidic odours were observed in sediments at all locations.

Pieces of concrete were observed on the seabed in close proximity to sampling locations SFM3-SFM5 and SFM8. The extent (size and distribution) as well as likely source of the concrete could not be determined during the assessment given that the pieces were partially submerged/underlying sediments. No visible asbestos containing material was identified during the sediment sampling activities.

Indicative images of the materials are provided in **Appendix F**.

7.2 Analytical Results

Laboratory analysis results for soil samples completed for the investigation have been summarised in tables presented in **Appendix A**, with comments discussed below for the various analyte groups. Statistical outputs from the analytical dataset are provided in **Appendix E**.

Heavy Metals

The concentrations of various heavy metals as presented in **Table A** were reported to exceed the adopted criteria as per the following:

- The concentration of arsenic was reported to exceed the D-GV (20 mg/kg) in 10 out of 20 analysed samples. The 95% upper confidence limit (UCL) of the mean concentration was reported to be 22.5 mg/kg and the standard deviation and maximum concentrations were reported to be 9.8 and 34 mg/kg respectively. The mean arsenic concentration within the materials assessed herein therefore marginally exceeds the D-GV but well below the GV-high guideline value.
- The concentration of cadmium was reported to exceed the D-GV (1.5 mg/kg) and GV-high (10 mg/kg) in 10 and 1 respective individual samples out of the 20 samples analysed. The 95% UCL of the mean concentration was reported to be 6.2 mg/kg and the standard deviation and maximum concentrations were reported to be 3.9 and 13 mg/kg respectively. The mean cadmium concentration within the materials assessed herein therefore marginally exceeds the D-GV but is below the GV-high guideline value.
- The concentration of total chromium was reported to exceed the D-GV (80 mg/kg) and GV-high (370 mg/kg) in 3 and 2 respective samples out of the 20 samples analysed. The 95% UCL of the mean concentration was reported to be 160 mg/kg and the standard deviation and maximum concentrations were reported to be 144 and 580 mg/kg respectively. The mean total chromium concentration within the materials assessed herein therefore marginally

exceeds the D-GV but is well below the GV-high guideline value. The reported concentration of chromium VI in the three samples with the highest reported total chromium concentrations (SFM07 1.5-1.6, SFM11 1.0-1.1 and SFM12 0.5-0.6) were each below <1 mg/kg.

- The concentration of copper was reported to exceed the D-GV (65 mg/kg) and GV-high (270 mg/kg) in 10 and 10 respective samples out of the 20 samples analysed. The 95% UCL of the mean concentration was reported to be 600 mg/kg and the standard deviation and maximum concentrations were reported to be 445 and 2,100 mg/kg respectively.
- The concentration of lead was reported to exceed the D-GV (50 mg/kg) and GV-high (220 mg/kg) in 3 and 17 respective samples out of the 20 samples analysed. The 95% UCL of the mean concentration was reported to be 1,102 mg/kg and the standard deviation and maximum concentrations were reported to be 723 and 3,000 mg/kg respectively.
- The concentration of mercury was reported to exceed the D-GV (0.15 mg/kg) and GV-high (1 mg/kg) in 5 and 13 respective samples out of the 20 samples analysed. The 95% UCL of the mean concentration was reported to be 4.2 mg/kg and the standard deviation and maximum concentrations were reported to be 2.3 and 6.5 mg/kg respectively.
- The concentration of nickel was reported to exceed the D-GV (21 mg/kg) and GV-high (52 mg/kg) in 11 and 3 respective samples out of the 20 samples analysed. The 95% UCL of the mean concentration was reported to be 55 mg/kg and the standard deviation and maximum concentrations were reported to be 36 and 6170 mg/kg respectively.
- The concentration of zinc was reported to exceed the D-GV (200 mg/kg) and GV-high (410- mg/kg) in 1 and 18 respective samples out of the 20 samples analysed. The 95% UCL of the mean concentration was reported to be 2,006 mg/kg and the standard deviation and maximum concentrations were reported to be 1,248 and 5,600 mg/kg respectively.

Organometallics

The reported TBT data are presented as total concentrations in **Table A** and as normalised (to total organic carbon %, TOC) values in **Table B**.

The normalised concentrations of TBT were reported to be below the adopted criterion in all samples selected for analysis with the single exception of SFM11 0.0-0.1 (9.3 µg/kg) which marginally exceeded the D-GV of 9 µg/kg. Statistical analysis of the TBT dataset identified that the 95% UCL of the mean was 8.4 µg/kg, the standard deviation (3.7 µg/kg) was less than half the criterion and the maximum concentration was less than 250% of the adopted criterion. Thus, it is considered that TBT does not present an unacceptable risk to future on-site receptors within the materials assessed herein and therefore does not require further assessment and/or management.

TRH and BTEX

The reported TRH and BTEX data are presented as total concentrations in **Table A** and as normalised (to total organic carbon %, TOC) values in **Table B**.

The reported BTEX concentrations were below the laboratory LOR in all samples selected for analysis.

The normalised total TRH concentrations were below the adopted criteria in each sample selected for analysis, with the exception of the following:

- SFM01 1.0-1.10 in which TRH >C_{10}-C_{40} was reported at 377 mg/kg following silica gel-clean-up analysis, which marginally exceeded the D-GV criterion of 280 mg/kg, but less than the GV-High criterion of 550 mg/kg. The reported TRH >C_{10}-C_{40} prior to silica-gel analysis was 112 mg/kg, indicating that there was heterogeneity in the sample.

- SFM05 0.0-0.1 in which TRH >C_{10}-C_{40} was reported at 331 mg/kg. However, following silica gel-clean-up analysis, the reported TRH >C_{10}-C_{40} was 95.5 mg/kg and below the adopted D-GV criterion, thus indicating the presence of biogenic TRH, rather than petroleum based TRH within the primary sample.
- SM07 1.5-1.6 in which TRH >C_{10}-C_{40} was reported at 1,340 mg/kg, which exceeds the GV-high criterion of 550 mg/kg. Following silica gel-clean-up analysis, the reported TRH >C_{10}-C_{40} was 529 mg/kg, which exceeds the D-GV criterion of 280 mg/kg, but indicates that a portion of the total TRH within the primary sample is from a biogenic source.

PAHs

The reported PAH data are presented as total concentrations in **Table A** and as normalised (to TOC) values in **Table B**.

The normalised total PAH concentrations were reported to exceed the D-GV (10 mg/kg) and GV-high (50 mg/kg) in 5 and 1 respective samples out of the 20 samples analysed. The 95% UCL of the mean concentration was reported to be 31.5 mg/kg and the standard deviation and maximum concentrations were reported to be 26 and 107 mg/kg respectively.

OCPs and PCBs

The reported OCP and PCB concentrations were below the laboratory LOR in all samples selected for analysis. It is noted that the laboratory LOR was slightly above the adopted criteria for these class of compounds, however based on the low concentrations reported, it is considered unlikely that the material assessed herein are impacted with OCPs and/or PCBs and are therefore considered to not require and further assessment or management.

Volatile Organic Compounds

The reported concentration of all VOC compounds were below the laboratory LOR in all samples selected for analysis.

Asbestos

Asbestos in the form of fragments of ACM were not reported to have been observed within material at any of the sampling locations. It is noted that asbestos sampling activities were completed via the advancement of boreholes, which is not the preferred method given the reduced volumes of spoil that can be inspected as part of the assessment. Trace asbestos fines were detected in samples SFM01 0-1 (0.0006 % w/w), SFM04 0-0.4 (0.0002 % w/w) and SFM07 0-1 (0.0006 % w/w) at concentrations below the adopted screening criterion (0.001 %w/w) applicable to recreational or commercial land-use.

Leachability Analysis

Comparison of the total contaminant concentrations with the NSW EPA (2014) assessment criteria identified a range of samples with total levels of heavy metals (Cr, Pb, Hg Ni), benzo(a)pyrene and PAHs (Total) exceeding the CT1, SCC1 and/or SCC2 thresholds presented in NSW EPA (2014) for waste classification without toxicity characteristic leaching procedure (TCLP) analysis. TCLP extractions were prepared for these samples and subsequently analysed for heavy metals and/or PAHs, with the results presented in **Table F**.

The reported leachable concentration of each heavy metal compound and all Benzo(a)pyrene concentrations were below the TCLP1 criteria for all samples selected for analysis.

Consistent with the observation of coal and ash inclusions within the materials assessed herein, the preliminary TCLP data suggests that the identified total PAHs are largely non-leachable and likely immobilised within the ash/coal matrix within the sediments. As such, it is anticipated that the

General Approval of the Immobilisation of Contaminants in Waste (EPA 1999/05[13]) will in the future be applied in conjunction with additional laboratory data to confirm an appropriate waste classification for off-site disposal of excess excavated material.

7.3 Acid Sulfate Soil Assessment

7.3.1 Field Observations

Field acid sulfate soil (ASS) screening was conducted within boreholes advanced as part of the investigation with the summarised results presented in **Table 8.1** following. Sulfidic odours and sea shells were observed within the majority of sediments assessed herein, as consistent with potential ASS conditions.

Table 8.1: Field ASS Screening Results

Material Type	Largest pH change	Reaction Observations	Acid Sulfate Soil Indication
Gravelly clayey silt, dark-grey to black, saturated (sediment)	8.3	Vigorous fizz/heat	**Positive**

It is noted that the average pre-oxidised pH of the materials was approximately 7.5-8.5 and following oxidation (for approximately 5 mins) – the maximum pH drop was down to 1.2 from 10.6 in sample SFM13 1.5-1.6.

7.3.2 Analytical Results

Detailed laboratory analysis reports and corresponding chain of custody documentation are provided in **Appendix C.** A summary of the results is provided below.

Thirteen representative samples were collected and assessed for the presence of ASS. The results were as follows:

- The pre-oxidised pH (ph-KCl) ranged from 7.8-8.7 and post-oxidised pH (pH-OX) ranged from 2.3-6;
- The peroxide oxidisable sulfur ranged from 0.41 to 3 % S;
- The recorded TPA and TSA ranged from <2 to 1,600 mol H^+/t;
- The recorded TAA were all <2 mol H^+/t and
- The average required liming rate was reported at 62 kg $CaCO_3$ /Tonne soil.

Based on the results presented herein, it is considered that all sediments encountered as part of this investigation comprise PASS, as consistent with sediments in the wider development footprint and reported in the ASSMP (2019).

[13] *1999/05 – General Immobilisation Approval: Ash, ash contaminated natural excavated materials or coal contaminated natural excavated materials*.

8. Site Characterisation / Discussion

Based on the decision making process for assessing urban redevelopment sites detailed in EPA (2017) and discussed in **Section 4.1.5**, the decisions required to be made in order to satisfy the objectives of the assessment are discussed below.

8.1 Have potential impacts within sediments in the investigation footprint been appropriately characterised?

Sediment sampling was conducted on the basis of a 20 m grid systematically placed across the extent of the investigation footprint, which met the minimum lateral sampling density specified in the ASSMP (JBS&G 2019) and EPA (1995). The materials were observed to be largely consistent (visually) across each sampling location to the maximum depth of the investigation. The depth of the investigation ranged from 0.1-2.2 m with an average depth of 0.9 across the investigation area. The materials comprised of gravelly, clayey silt (mud), with varying levels of inclusions composed of coal, ash, organic material, sea shells and metal fragments.

Representative samples of the materials were analysed for a range of identified potential contaminants of concern including heavy metals, PAHs, TRH, BTEX, VOCs, OCP/PCBs, TBT and asbestos. In addition, the materials were assessed for ASS characteristics. On the basis of the results of the field and laboratory QA/QC program, the sediment data was considered to be of an acceptable quality in order to adequately characterise the sediments encountered as part of the investigation and achieve the objectives of the assessment.

It is noted that current survey information that details the relative height and volume of the additional sediment materials assessed herein is currently not yet available. Notwithstanding, it is estimated that the sediment bed levels will need to be reduced by a depth of approximately 2.0-3.0 m below current levels to facilitate the construction of the new Sydney Fish Market building. The maximum depth of the investigation (where site access precluded the mechanical means of sampling with a vibrocorer) did not extend to the maximum anticipated depth of disturbance during construction activities, however it is anticipated the characterisation works covered the envelope above the formerly assumed sediment bed elevation.

It is anticipated that further assessment, consistent with the requirements of the ASSMP and RAP to be undertaken arcoss the whole of the site, will include material at depth within this site portion following confirmation of the relative sediment levels, final basement level construction design and site access been facilitated following the complete demolition works of the former wharf structure.

8.2 Are the materials suitable for on-site retention/re-use?

As consistent with the balance of the site and wider Blackwattle Bay area, elevated heavy metals were reported in sediments across the extent of the investigation footprint. Consistent with previous studies in the Parramatta River/Port Jackson, the primary heavy metals of concern comprise copper, lead and zinc, with population data sets typically exceeding the adopted GV-high sediment contaminant thresholds. Whilst comparison of the current data set does indicate that copper, lead and zinc concentrations in the sediments are somewhat greater than that previously reported in EIS (2017) and UNSW (2017), the results are within the range of concentrations previously identified within the Parramatta River/Port Jackson sediments (Birch et al 2008[14]).

With consideration to the potential for complete exposure pathways, the proposed development will result in sediments that are isolated beneath an overlying suspended concrete structure. These works will result in a situation where there are no opportunities for human contact and given the absence of light and water column disturbance beneath the overlying structure, the sediment will be

[14] *Contaminant Chemistry and toxicity of sediments in Sydney Harbour, Australia: Spatial extent and chemistry – toxicity relationships*. Marine Ecology Progress Series, Vol 363: 71-87, 2008 (Birch et al. 2008)

effectively isolated. Such an outcome will effectively nullify any ecological exposure pathways associated with the impacted sediment and therefore it is considered preferable for the material to remain within the site, rather than to be excavated and removed from the site.

The normalised total PAH concentrations were less than the adopted criteria in 14 out of 20 analysed samples. The maximum concentration was reported in sample SM07 1.5-1.6 at 107.3 mg/kg which exceeded the GV-high criterion of 50 mg/kg. The source of the PAH impacts is considered to be largely associated with ash and coal observed within the materials, where TCLP analysis identified the PAH impacts are non-leachable and likely immobilised within the matrices of these materials. Based on a review of **Figure 3b**, PAH impacts have previously been reported in sediments across the extent of the site, at concentrations up to 76.3 mg/kg (BH14 4.30-4.35). Given that the PAH impacts reported herein are comparable to sediment quality across the balance of the site, and further, likely non bioavailable (given non-leachable nature), it is considered that there were no identified PAH impacts that would preclude the materials from been retained on-site.

The normalised total TRH concentrations were less than the adopted criteria in 16 out 19 analysed samples. The maximum concentration was reported in sample SM07 1.5-1.6 at 529 mg/kg (following silica-gel clean-up) which exceeded the D-GV criterion of 280 mg/kg. Based on a review of **Figure 3c**, TRH impacts have previously been reported in sediments across the extent of the site, at concentrations up to 5,000 mg/kg (PBSS12 0.0-0.4). The TRH impacts reported herein are therefore comparable to, and/or less than the TRH impacts from the balance of the site. As such, it is considered that there were no identified TRH impacts that would preclude the materials from been retained on-site.

The normalised concentrations of TBT were reported to be below the adopted criterion in all samples selected for analysis with the single exception of SFM11 0.0-0.1 (9.3 µg/kg) which marginally exceeded the D-GV of 9 µg/kg. Statistical analysis of the TBT dataset identified that the mean concentration of TBT within the materials assessed was below the D-GV. Therefore, it is considered that there were no identified TBT impacts that would preclude the materials from been retained on-site.

There no reported detections of VOCs (including BTEX), OCPs or PCBs within the materials assessed herein. Therefore, there were no identified impacts of these compounds classes that would preclude the materials from been retained on-site.

Asbestos in the form of fragments of ACM were not reported to have been observed within material at any of the sampling locations. Furthermore, asbestos was not reported by the laboratory in any samples above the screening criteria applicable to recreational or commercial land-uses. Therefore, there were no identified asbestos impacts that would preclude the materials from been retained on-site. Notwithstanding, trace asbestos fines were detected in samples SFM01 0-1 (0.0006 % w/w), SFM04 0-0.4 (0.0002 % w/w) and SFM07 0-1 (0.0006 % w/w) where it is noted that these detections will be required to be recorded on a site asbestos management plan (AMP) to suitably address Work Health and Safety (WHS) requirements during future construction and operational activities. Given the saturated nature of the material, there is not specific requirement for management of the material as there is no prospect of airborne asbestos fibre generation. Management of construction equipment contacting the sediment as designed to manage ASS risks, including wash down following contact will ensure all equipment is appropriately decontaminated with regard to asbestos following completion of works.

8.3 Has the extent of potential acid sulfate soils that require management during remediation/construction activities been appropriately defined?

Based on the results of the investigation, all sediments encountered as part of this investigation comprise of PASS and require appropriate management and treatment during future works that result in their disturbance. As previously identified, sediments within the balance of the site are also

considered PASS. This additional data set should be considered in conjunction with the existing ASSMP (JBS&G 2019) to ensure all available data is used in the appropriate design and implementation of ASS management activities.

8.4 Can a preliminary waste classification be provided for materials that may require off-site disposal during future development activities?

All chemical contaminant data collected for this assessment has been considered with regard to the EPA (2014a and 2014b) Waste classification data to evaluate the material with regard to off-site disposal, should this be required.

As discussed in **Section 7**, there were a number of samples in which heavy metals and PAHs exceeded the CT1, SCC1 and/or SCC2 values presented in EPA (2014a) for classification using only total contaminant concentrations. Based on the results of subsequent TCLP analysis, the current material characterisation data set currently falls within either the General Solid Waste (GSW) or Restricted Solid Waste (RSW) potentially mixed with Special (asbestos) Waste classifications owing to the trace levels of asbestos reported at SFM01 0-1, SFM04 0-0.4 and SFM07 0-1.

It is noted that the materials assessed as consistent with a Restricted Waste classification correspond to samples SFM01 1.0-1.1, SFM07 1.5-1.6 and SFM13 1.0-1.1 in which the reported total lead concentrations were above the SCC1 threshold value.

Based on the observation of coal and ash inclusions within the materials assessed herein, the preliminary TCLP data suggests that PAHs are largely non-leachable and likely immobilised within the ash/coal matrix within the sediments. As such, it is anticipated that the *General Approval of the Immobilisation of Contaminants in Waste (EPA 1999/05)* as related to PAHs will in the future be applied, whereby the corresponding benzo(a)pyrene TCLP concentrations were reported as less than the TCLP1 threshold value, as consistent with GSW.

It is further noted that the presence of TBT reported in sediment samples may further trigger the classification and disposal of waste materials to be completed in accordance with the *Organotin Waste Materials Chemical Control Order 1989* (CCO 1989). As there are current no published threshold values of organotin compounds in EPA (2014), finalisation of classification and disposal requirements will require to be completed in consultation with the NSW EPA.

Assessment of the sediments within the investigation footprint has identified the materials to comprise of Potential Acid Sulfate Soils (PASS). As such, should these materials require off-site disposal, the material will require to be disposed of in accordance with the *NSW Waste Classification Guidelines, Part 4 Acid Sulfate Soils* (EPA 2014b). The material will first be required to be treated to neutralise the acid potential, following which the material will require characterisation and disposal as waste to a licensed facility.

In summary, based on assessment of the current data, if it is proposed to remove the excess sediment material from the site, the following would be required to finalise a waste classification in accordance with EPA requirements:

- Stabilisation of the material's PASS characteristics, as per the advice provided in the ASSMP (JBS&G 2019);
- Characterisation on a batch basis of chemical contaminants identified to be associated with the material, including heavy metals, PAHs, TRH, TBT and asbestos, with consideration of the coal/ash inclusions in the material with regard to the EPA (1995) immobilisation order. Based on the current data set, it is anticipated material may fall within GSW or RSW categories with the potential to be mixed with Special (asbestos) waste;
- Liaison with NSW EPA where TBT concentrations are detected in samples to confirm classification/disposal requirements under the CCO (1989); and

- Preparation of a final waste classification report for submission to the proposed licensed waste facility to confirm approval to dispose of the material, prior to commencement of transportation.

8.5 Is further assessment required?

Based on the above discussions, it is considered that the additional sediments identified under the former Hanson Wharf footprint have been broadly characterised for the identified COPCs and ASS characteristics. Notwithstanding, consistent with the requirements of the RAP (2020) and ASSMP (2019), following confirmation of the relative levels of the materials within the investigation footprint as well as depths of cut required to facilitate the construction of the building, it is anticipated additional investigation of sediment conditions to the proposed depth of disturbance will be required across the whole nSFM site, inclusive of material underlying the additional sediment.

As discussed in **Section 8.4**, should the materials be proposed to be disposed off-site, additional sampling and analysis (including TCLP) will be required upon completion of stabilisation works to confirm the final waste classification of the materials in accordance with the requirements of the RAP (2020) and EPA guidelines.

9. Conclusions and Recommendations

Based on the results of the sediment characterisation assessment and subject to the limitations in **Section 10**, the following summarises the outcomes of the assessment:

- The data obtained is considered reliable to meet the objectives of the assessment;
- Sediment sampling was conducted within the envelope of additional sediment identified beneath the former Hanson Wharf footprint in order to appropriately characterise the additional sediments for the identified COPCs and PASS characteristics at a sampling density consistent with EPA (1995) and the ASSMP (JBS&G 2019).
- The materials were observed to be largely consistent (visually) across each sampling location to the maximum depth of the investigation (2.2 m) to an average depth of 0.9 m. The materials comprised of gravelly, clayey silt (mud), with varying levels of inclusions that included coal, ash, organic material, sea shells and metal fragments.
- Representative samples of the materials were analysed for a range of identified potential contaminants of concern including heavy metals, PAHs, TRH, BTEX, VOCs, OCP/PCBs, TBT and asbestos. As consistent with the balance of the site and wider Blackwattle Bay area, elevated heavy metals, PAHs and TRH were reported in sediments across the extent of the investigation footprint. The impacts of these compounds are considered to be comparable to, and/or less than the corresponding impacts from historical investigations completed over the balance of the site. There were no reported detections of VOCs (including BTEX), OCPs or PCBs within the materials assessed herein. In addition, there no unacceptable risks identified with respect to the reported concentrations of TBT and asbestos. As such, it is considered that there were no identified impacts within the sediments assessed herein that would preclude the materials from been retained on-site.
- Based on the results of the investigation, all sediments encountered as part of this investigation comprise of PASS and require appropriate management and treatment during future works that result in their disturbance.
- Should the materials be disposed off-site, it is anticipated that the materials will be classified as General Solid Waste (GSW) or Restricted Solid Waste (RSW) potentially mixed with Special (asbestos) Waste owing to the trace levels of asbestos reported at SFM01 0-1, SFM04 0-0.4 and SFM07 0-1.

  The materials classified as RSW are represented by samples SFM01 1.0-1.1, SFM07 1.5-1.6 and SFM13 1.0-1.1 in which the reported total lead concentrations are above the SCC1 threshold value.

  Based on the observation of ash and coal within the sediments, it is considered that the *General Approval of the Immobilisation of Contaminants in Waste* (EPA 1999) may be applied for PAH impacts within the materials, where TCLP analysis identified that these compounds are non-leachable and immobilised within the ash/coal matrices.

  Given the reported organotin concentrations identified in sediment samples, liaison with the NSW EPA will be required to finalise waste classifications for off-site disposal of fill material.

  Further, noting that all sediments assessed herein comprise Potential Acid Sulfate Soils (PASS), the materials will require to be disposed of in accordance with the NSW *Waste Classification Guidelines, Part 4 Acid Sulfate Soils* (EPA 2014b).

  In summary, based on assessment of the current data, if it is proposed to remove the excess sediment material from the site, the following would be required to finalise a waste classification in accordance with EPA requirements:

- Stabilisation of the material's PASS characteristics, as per the advice provided in the ASSMP (JBS&G 2019);
- Characterisation on a batch basis of chemical contaminants identified to be associated with the material, including heavy metals, PAHs, TRH, TBT and asbestos, with consideration of the coal/ash inclusions in the material with regard to the EPA (1995) immobilisation order. Based on the current data set, it is anticipated material may fall within GSW or RSW categories with the potential to be mixed with Special (asbestos) waste;
- Liaison with NSW EPA where TBT concentrations are detected in samples to confirm classification/disposal requirements under the CCO (1989); and
- Preparation of a final waste classification report for submission to the proposed licensed waste facility to confirm approval to dispose of the material, prior to commencement of transportation.

- Based on the results and findings of this assessment, it is considered that the sediment materials assessed herein are suitable for on-site retention within the framework outlined in the RAP (JBS&G 2020). Notwithstanding, further assessment of sediments at depth may be required, should the excavation depth (to facilitate the construction of the new Sydney Fish Market building) within the investigation footprint extend beyond the depths reached as part of this investigation.

10. Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only, and has been based in part on information obtained from the client and other parties.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by JBS&G, and should not be relied upon by other parties, who should make their own enquires.

Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements.

Limited sampling and laboratory analyses were undertaken as part of the investigations undertaken, as described herein. Ground conditions between sampling locations and media may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site.

Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are based on the information obtained at the time of the investigations.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS&G reserves the right to review the report in the context of the additional information.

Figures

Figure 1 Site Location

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Figure 2 Site Layout

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Figure 3 Historical Sample Locations and Sediment Exceedances

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Figure 4 Sediment Sample Locations

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Figure 5 Sediment Sample Exceedances

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Appendix A – Summary Analytical Tables

Appendix B – Borelogs

Appendix C – Laboratory Reports and Chain of Custody Documentation

Appendix D – QA/QC Results

Appendix E – Statistical Outputs

Appendix F – Photographic Log

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