

Table 11.5: Identification of SPGWT Offsite to West

Item	Details
No. locations SPGWT identified	10
- No. in shallow fill	2
- No. in natural/ deep fill	9
No. locations DNAPL identified	0 (seen in 1 location)
- Wells DNAPL identified (MW)	NA (seen in 69)
SPGWT Locations >10mBGL	9

SPGWT was identified in offsite areas primarily within **marine sediment** or bedrock within around 20m of the downgradient (western) boundary of the declaration area. SPGWT occurred with similar frequency in locations to the west of both Block 4 and Block 5. This extent, shown on Attachment 9, Appendix A, suggests the migration of SPGWT within marine sediment downgradient from the declaration area has been reasonably limited. However, the presence of SPGWT in marine sediment at BH/MW60, located around 85m downgradient of the declaration area, suggests migration may have occurred beyond what is suggested by the analysis of SPGWT only. Alternately, the occurrence of SPGWT in marine sediment at BH/MW60 may be an isolated location, potentially derived from the filling process, but this is not consistent with the generally accepted CSM of contamination at the site.

In order to investigate the extent of offsite impact to marine sediments, AECOM reviewed other evidence of gasworks wastes such as odour and visual evidence, as well as analytical results for naphthalene and TPH C10-C14 at elevated concentrations, but not to the extent that would constitute TCM/ SPGWT. This analysis is presented on Attachments 10a and 10b, Appendix A, for fill and marine sediment, respectively. AECOM (2013b) considers that the results are *"sporadic and not indicative of continuous migration of gasworks related impacts from the Site... likely to be the result of historic landfilling of impacted fill materials..."*. Given the potential for migration of gasworks waste to have occurred through narrow pathways and the constraints of the field investigations undertaken (limited spatial coverage and limited potential for detailed visual observation), in the Auditor's opinion, there is potential for an undetected continuous pathway of gasworks impact to be present within marine sediment along the approximate alignment of the Block 4/ Block 5 and ORWN/ Central boundary towards location BH/MW60 and possibly elsewhere. AECOM notes the presence of locally shallower bedrock between BH/MW541 and BH/MW60, suggesting that there is unlikely to be a migration pathway between these two areas.

In addition to the offsite occurrences in natural materials, SPGWT was also identified in **fill** offsite, as follows:

- BH70, west of Block 5 around 20m from declaration boundary in shallow fill at 2.5mBGL (also at >16mBGL in marine sediment in this location)
- BH74, further west of Block 5, around 70m from declaration boundary in shallow fill at 1-2.5mBGL

- BH/MW541D, west of Block 5, within 20m of the declaration area boundary, in deep fill at 9.9-10mBGL.

As shown on Attachment 12, Appendix A, no offsite unsaturated soil data exceeded the SSTC. As shown on Attachment 13, Appendix A, exceedance of the groundwater SSTC occurred in three offsite locations, as follows:

- MW60 (ORWN Area) -TPH C10-14 and naphthalene;
- MW69 (Block 5, Barangaroo Central) - naphthalene; and
- MW541D (Block 5, Barangaroo Central) - benzene and naphthalene.

AECOM does not consider the groundwater concentrations exceeding the SSTCs reported at MW60 and MW69 to be representative of CIM as the groundwater impacts are present within either natural marine sediments or within the natural bedrock. Exceedances in these wells are associated with SPGWT (MW60) or sheen (MW69). BH/MW541D is screened from 7.4-10.4mBGL and the groundwater exceedance is associated with SPGWT identified in this location (9.9-10mBGL).

11.3.2 Offsite Upgradient

Properties located to the east of the site are known to contain some portions of historical gasworks infrastructure as shown on Attachment 2, Appendix A. These properties have been subject to separate investigation, remediation and development. As detailed in Section 2.3, Site Audit Statements have been prepared for the properties (30-38 Hickson Road) stating that these sites are suitable for their current land use, variously subject to conditions. AECOM (2013b) concludes that *"...it is unlikely that soil and groundwater contamination that may be present in these offsite areas warrants remediation"*. However, AECOM note that the main gasholder annulus and potentially the tar tank cross the northern site boundary into the adjoining properties and are likely to contain SPGWT. It is possible that the remediation proposed for Hickson Road may also act to address the offsite issues, however if not, management of offsite upgradient contamination, if present, is proposed as part of remediation works to prevent re-contamination of the declaration area.

11.4 Proposed Remedial Extent

11.4.1 Lateral and Vertical Extent

AECOM defined the lateral extent of remediation based on the presence of historic gasworks infrastructure and the distribution of SPGWT and CIM. The lateral extent of remediation proposed in the unsaturated and saturated zones is presented in Attachments 14 and 15, Appendix A, respectively. It includes areas of Block 4, Block 5, Hickson Road and limited offsite areas to the west. The offsite areas to the west have been defined by AECOM as circular "hotspots" around BH/MW541 and BH70. There is no basis presented for the size/shape of the proposed "hotspot" remediation area. It seems likely that for BH/MW541 at least (SPGWT in fill to 10mBGL), the impact may be laterally continuous with impact in the declaration area. The extent of impact at BH70 may be more limited since it is within shallow fill.

The vertical extent of remediation was defined as the depth to bedrock or a maximum depth of 10mBGL (approximately -7.5mAHD), plus deeper within gasworks features that are excavated into bedrock (ie, tar tank and gasholders). The proposed remediation depths for

each area (ranging from 2 to 10mBGL) are shown on Attachment 15, Appendix A. The 10mBGL bedrock contour was considered in defining the lateral remediation extent shown on this figure. If SPGWT is encountered in fill material at the base of remedial excavations, the vertical extent of remediation is proposed to be increased to the extent practicable or until marine sediment or bedrock is encountered. In this situation, AECOM has defined the extent practicable as limited to an increase in vertical extent of 1-2m, depending on whether the excavation is to be locally backfilled with permeable fill (2m) or clay fill (1m). The Auditor notes that over-excavation is likely to be required in a number of known locations, generally in the west of the declaration area where the depth of fill approaches 10mBGL and marine sediment is present over bedrock (e.g. BH/MW205).

AECOM (2013c) has further defined the extent of remediation to comprise *“Removal/remediation of contaminated fill materials such that the contaminant mass within the Remediation Extent fill material is reduced, on average, by 90%, to the extent practicable”*. This is to account for the likely 90% removal efficiency for the proposed in situ remediation methods (refer Section 13), being what can practicably be achieved. It is noted that the removal efficiency will be 100% where excavation is used as an alternative to in situ methods.

11.4.2 SPGWT and CIM Not Addressed by Proposed Remediation Extent

The lateral and vertical remediation extent defined by AECOM does not address all of the SPGWT and CIM identified in Sections 11.2 and 11.3, as follows:

- In Blocks 4 and 5, the proposed remedial extent addresses the identified SPGWT and CIM except for:
 - SPGWT at BH49 below 10mBGL (to 12.7mBGL)
 - SPGWT in marine sediment at BH405/IT03 (14-14.5mBGL)
 - Likely other marine sediment locations downgradient of the gasworks infrastructure and below 10mBGL.
- In Hickson Road, the proposed remedial extent addresses the identified SPGWT and CIM provided that the remediation of deeper tar tank/ annulus areas extends sufficiently to adjoining investigation locations (e.g. MW10).
- Downgradient of the declaration area, the proposed remedial extent addresses the identified SPGWT and CIM except for:
 - SPGWT in shallow fill at MW/BH74, located within Barangaroo Central around 70m from declaration boundary at 1-2.5mBGL. This location has been excluded from the proposed remedial extent since AECOM considers that this material is not directly related to the site. It is noted, however, that remediation may be required for the protection of human health and this should be addressed by the Barangaroo Central remediation works.
 - SPGWT in marine sediment at eight locations. AECOM notes that:
 - SPGWT and CIM at BH/MW60 is proposed to be addressed by the ORWN remediation works

- Remedial requirements with respect to sheen and groundwater exceedences at BH/MW69 (screened in fill/ bedrock 9-12mBGL) is proposed to be assessed by the Barangaroo Central RAP
- Likely other marine sediment locations downgradient of the gasworks infrastructure and below 10mBGL, primarily located within 20m of the declaration area boundary, but also potentially extending to distances of at least 85m downgradient.

In addressing the requirements for source removal and remediation of NAPL to the extent practical under DEC (2007) guidelines, AECOM (2013b) presented a detailed analysis of the residual contamination, listed above. In addition to addressing all of the primary contaminant sources, being historic gasworks infrastructure, AECOM considers that the proposed remedial extent includes the majority (97%) of locations at which NAPL has been recorded in fill, being representative of secondary contaminant sources.

AECOM (2013b) presented an argument to demonstrate that remediation of remaining “residual” areas of contamination, which primarily occur below 10mBGL, is not required. Several aspects of this argument were discussed in Section 10 and are generally supported by the Auditor. More technical aspects relating to contaminant mass flux and contaminant mass removal calculations are discussed in the following sections.

11.5 Contaminant Mass Flux

Remediation is not proposed if identified SPGWT and CIM are present onsite within marine sediments and below 10mBGL. In addition, remediation is not proposed to address identified SPGWT and CIM offsite within marine sediments, except for consideration of BH/MW60 with the ORWN remedial works. AECOM has based this approach on the finding that contaminant flux from the natural marine sediments is negligible. AECOM concludes that:

- SPGWT present in natural marine sediments is not considered to pose a significant risk to human health due to negligible flux vertically into overlying fill; and
- SPGWT present in natural marine sediments is not considered to pose a significant risk to the environment due to negligible flux laterally to Darling Harbour.

AECOM came to this conclusion based on the findings of the Groundwater Discharge Study (AECOM, 2010d) and two subsequent memos analysing mass flux and discharge at the site (AECOM, 2012b and 2013a). As outlined in Section 5.2, the Groundwater Discharge Study found that relative to the fill, groundwater discharge volumes and therefore contaminant mass flux from the marine sediments and basal sandstone was considered to be negligible. Results from sampling of multilevel groundwater monitoring wells installed as part of the Groundwater Discharge Study further support the limited vertical flux of contaminants, for example from marine sediment into overlying fill.

The first memo considered multiple lines of evidence to determine the significance of flux and discharge of contamination from the natural soil and marine sediments underlying the site into Darling Harbour. The memo considered the following:

- Calculated hydraulic conductivity and inferred groundwater flow velocities from wells screened within marine sediments.

- The tidal prism concept and particle migration as addressed in the Groundwater Discharge Study.
- The potential for sorption and biodegradation of contaminants.
- The limiting of groundwater movement by the tidal cycle.
- Calculated mass flux between two transects downgradient of the declaration area. The memo concluded that the mass discharge of benzene and naphthalene into Darling Harbour would not be detected in the receiving water.

Overall, the memo concluded that remediation of the deep natural soil and marine sediments was not warranted since there was unlikely to be significant flux and discharge of contamination into Darling Harbour. The Auditor considers the analyses performed and findings presented in the first memo to be reasonable.

The second memo documented additional flux modelling along two separate transects:

- Upgradient, within the declaration area, contamination to be removed from fill and contamination to remain within maximum 5m of sandstone; and
- Downgradient/ offsite, in fill and maximum 5m of marine clay.

The transects adopted and assumptions made regarding the thickness of the impacted marine sediment and sandstone strata (5m) are considered appropriate. The Auditor has reviewed the groundwater analytical input data and a number of issues have been noted for Transect A-A'. These relate primarily to the use of data from mixed strata, using the most recent data only (which in many cases was the lowest of multiple rounds of data) and using filtered sample results. These issues are not critical when considering of primary concern in this modelling is the marine clay from Transect B-B'. Input data for this key strata was reflective of worst case conditions, i.e. the concentration from MW60 was applied across the entire cross section. This is considered conservative and appropriate.

Mass fluxes were converted into a concentration assuming a stream flow rate of 100L/second, derived from an approximate 25ML of tide twice per day (from the Groundwater Discharge Study). The additional flux modelling concluded that the concentration of the cumulative discharge from marine sediment and fill into Darling Harbour will be below the ANZECC criteria (also the MWQC). In addition to the discharge concentration, the Auditor has considered the contaminant mass discharged, in line with the load based licensing concept. The calculated mass flux discharging into Darling Harbour, where the marine sediments contribute less than 0.5% of the total loading, is as follows (AECOM, 2013a):

- Naphthalene = 0.37kg/year
- TPH C₁₀-C₁₄ = 3.8 kg/year
- Benzene = 0.79kg/year.

It is noted that the above quantities do not take into account tidal activity and are therefore conservative.

Based on review of the information provided and following a weight of evidence approach, the Auditor supports the finding that contaminant flux from within the marine sediment is negligible and considers that the calculated concentration and mass discharges into Darling Harbour, following completion of the proposed remediation, are unlikely to present a significant risk to the environment.

The second memo calculated post-remediation flux for the upgradient transect within the declaration area to demonstrate “...the reduction in mass flux that is expected to be realised as a result of the proposed remediation works”. The Auditor agrees that the total mass flux will be reduced by the remedial works proposed, however notes that mass flux within sandstone (or marine sediment downgradient) will not be influenced by the remediation works proposed since the remediation is limited to remediation of contaminants within fill. AECOM (2013a) acknowledges this fact but notes that following remediation “the groundwater quality entering Darling Harbour will improve significantly because more than 99% of groundwater flow is through the fill and the proposed remediation is focused on reducing the contaminant mass flux from the fill”.

To account for the above, the remedial goal with respect to contaminant migration and protection of the environment is that groundwater in *fill* leaving the site approaches the MWQC. This goal is considered appropriate. Groundwater in wells on the downgradient boundary of the declaration area exceeds the MWQC for some PAH although not to a great degree (compared to, for example, exceedances in groundwater in underlying marine sediment). A specific argument proving that the MWQC will be met in fill at the site boundary following remediation has not been presented by AECOM; however, significant improvement to the quality of groundwater within fill is likely given the extent of remediation proposed. AECOM (2013b) states that “AECOM has demonstrated through consideration of multiple lines of evidence that residual contamination that will remain in situ following completion of the proposed remediation will not represent a threat to ecological health and will be protective of the identified groundwater value”.

11.6 Contaminant Mass Calculations

As outlined in Section 11.4 above, based on the proposed remediation extent, there is significant contamination proposed to be left in situ both within the site and downgradient, representing a significant contaminant mass proposed to be retained. It is appropriate to consider the mass of contaminants proposed to be removed by the remediation works compared to that to be retained in order to determine if the proposed works present a sufficient degree of contaminant source removal.

Contaminant mass calculations were presented by AECOM in the VMP Extent Report (2013b) addressing multiple depth and spatial zones. Depth zones considered were upper fill, lower fill (2m above marine sediment) and marine sediment (upper 5m only). Spatial zones considered were:

- Zone 1 - the proposed remedial extent defined to address human health risk (refer Section 11.4 and Attachments 14 and 15, Appendix A). Zone 1 was further divided into Block 4, Block 5 and Hickson Road.
- Zone 2 – areas outside the proposed remedial extent but within the declaration area
- Zone 3 – offsite (downgradient) areas within 20m of the declaration area

- Zone 4 – offsite (downgradient) areas outside 20m of the declaration area, including the area to the north of the declaration area, within Block 5.

These zones and the data points considered within them are shown on Attachment 17, Appendix A.

Calculations were based on the average concentrations of the key gasworks related contaminants at the site, being naphthalene and TPH C10-C14. These analytes were considered the key drivers in representing ongoing risk to the environment as they have the largest contaminant mass and generally exceed the MWQC by the largest order of magnitude. Since selection of soil samples for analysis was biased towards evidence of contamination, average concentrations are considered likely to be conservative (i.e. overestimate the contaminant mass).

The calculations considered the current distribution of contaminant mass and the distribution following remediation (refer Section 13) which assumed 100% contaminant removal in Block 4 (where excavation is likely) and 90% contaminant removal in Block 5 and Hickson Road (where in situ remediation is likely).

The calculations are presented in Appendix F. The Auditor has reviewed the input data and calculation method adopted. The input data is considered sufficiently accurate, noting that minor errors are unlikely to materially influence the average concentrations used given the size of the data set. The volume estimates and calculations performed are considered an appropriate means of estimating the mass of key contaminants in the subsurface for the purposes of remediation planning.

Key findings were as follows:

Current conditions:

- Between 80% and 85% (naphthalene and TPH C10-C14 concentrations, respectively) of the total gasworks related contaminant mass is currently located within Zone 1 (the human health remediation extent) and will be remediated (by between 90-100% contaminant removal) as part of the proposed remediation works.
- Less than 1% of the contaminant mass is currently located within the fill materials (both upper fill and lower fill) within Zone 2 (i.e. within the site but outside Zone 1).
- Around 5% of the contaminant mass is currently located within the fill materials (both upper and lower fill) within Zones 3 and 4 (i.e. offsite).
- Around 10% of the contaminant mass is currently located within the natural marine sediments within Zones 3 and 4 (i.e. offsite) which are generally present at depths of between approximately 13mBGL and 32mBGL.

Post remediation conditions:

- The proposed remedial extent will remove around 80% of the total gasworks related contaminant mass currently present on and offsite (downgradient) and over 90% of the gasworks related contaminant mass currently within the declaration area.
- Of the residual contamination that will remain *in situ* following the proposed remediation works, the majority (approximately half of the residual or around 10% of the total) of the

contaminant mass is present within the marine sediments of Zone 3 and 4, which as discussed above are considered to have negligible potential for contaminant flux and discharge. The majority of this is within Zone 3, within 20m of the declaration area boundary.

- The residual contamination within marine sediment in Zones 2, 3 and 4 (on and offsite) remaining after remediation equates to around 15 tonnes naphthalene and 70.5 tonnes TPH C10-C14.
- Around 20% of the residual contaminant mass will remain within the fill materials (both upper and lower fill) within Zones 3 and 4 (i.e. offsite). It is noted that these fill materials will be the subject of separate HHERAs and RAPs as part of the proposed future development works in the ORWN and Barangaroo Central areas.

11.7 Conclusion

AECOM has defined a lateral and vertical extent of remediation required for removal of the EPA declaration based on a number of considerations. The proposed remediation extent will result in around 20% of the current gasworks related contaminant mass remaining onsite and in areas downgradient, primarily within marine sediment within 20m of the declaration area boundary. In the Auditor's opinion, the extent of soil remediation is considered adequate to address the risk to human health and the environment to a degree acceptable for removal of the EPA declaration. Active remediation of groundwater is not proposed by AECOM. Groundwater contamination is proposed to be addressed by source removal/containment. The Auditor considers the remedial extent proposed to be sufficient to address "the extent practicable" for removal/ treatment of DNAPL and other requirements relating to CUTEF. The extent of remediation in offsite areas is considered adequate for removal of the declaration, although the potential for contamination to extend beyond the BH/MW541 "hotspot" is noted. Specific offsite areas are identified by AECOM that are required to be addressed by the offsite RAPs (ORWN and Central), which is considered appropriate.

AECOM (2013b) notes that the "residual" contamination within Block 4, and much of the residual impact to marine sediment downgradient of the declaration area boundary (within Block 4) will be contained within the groundwater retention wall system proposed for the Block 4 development, effectively eliminating the pathway for the migration of contamination from Block 4 to the environment. AECOM does not rely on the Block 4 development in defining the extent of remediation for VMP removal, but notes that the likely future development will "...further minimise the threat to the environment of residual contamination remaining within Block 4".

Discussion of the proposed remediation, validation and future management issues is provided in Section 13.

12 Determination of Remediation Extent for Block 4 Development

12.1 Introduction

The extent of remediation for Block 4 development was discussed by AECOM (2013c) in the RAP based on protection of human health and the environment under future land uses following development. The RAP proposes removal of SPGWT and CIM.

The Auditor has reviewed the data and analysis presented by AECOM in defining the extent of remediation required for the Block 4 development. The following Section 12.2 discusses the occurrence of SPGWT and CIM within the site. SPGWT was identified based on field and laboratory results, while CIM was identified by comparison of groundwater data with the relevant risk based remediation criteria (SSTC), discussed in Section 10. There are no unsaturated soils proposed to remain in Block 4 after development therefore there are no applicable soil criteria. In addition, a groundwater retention wall system is proposed around the entire perimeter and therefore criteria for protection of the environment are not required.

Attachment 18, Appendix A, illustrates exceedances of the SSTC for groundwater while Attachment 9, Appendix A, shows the occurrence of SPGWT. The relevant criteria are included in Appendix E. Section 12.3 describes the proposed remediation extent determined by AECOM.

The design and construction of the basement walls (including the groundwater retention walls) and base requires that tar will be removed from the immediate vicinity of outer basement walls to the extent practicable (discussed in Section 10.3.2). However, the construction methodology to be employed does not allow for inspection of excavation walls or removal of tar. AECOM has therefore adopted an in situ validation approach to confirm that tar will not be present in the immediate vicinity of outer basement walls. Consideration of in situ data to validate this aspect is discussed in Section 12.4.

12.2 SPGWT and CIM Located Onsite

The identification of SPGWT within Block 4 is summarised in Table 12.1.

Table 12.1: Identification of SPGWT at Block 4		
Item	Details	
No. locations SPGWT identified	21	
- No. in fill	15 (12 in Eastern Block 4)	
- No. in natural/ deep fill	8 (3 in Eastern Block 4)	
No. locations DNAPL identified	4 (seen in a further 4 wells) (all in Eastern Block 4)	
- Wells DNAPL identified (MW)	15, 204D, 205, 206 (seen in 200, 204S, 209, BH405/ IT03)	
SPGWT Locations >8mBGL (not included in proposed remedial extent, refer Section 12.3)	MW205 – DNAPL in sandstone	well screened 15-19.5mBGL
	BH48 – upper surface of bedrock	14.5mBGL
	BH49 – fill/ natural sandy clay	9.2-12.7mBGL

Table 12.1: Identification of SPGWT at Block 4

Item	Details	
	BH405 – silty sandy clay/ sandstone	14-14.5mBGL
	BH406 – deep fill and natural clay	14.3-16.8mBGL
	BH408 – silty sandy clay	8 – 9.4mBGL
	BH119 – fill	7.5-10mBGL

The assessment of analytical results from Block 4 against SSTC is summarised in Table 12.2. The groundwater exceedance column considered the most recent groundwater data (from 2010-2011) for each well. AECOM calculated statistics for the groundwater data set (average and median results contemplated below) which considered an additional set of results from two wells plus two duplicates from one well. The Auditor has also considered data from BH/MW40, located immediately offsite to the west. Inclusion of this well is considered appropriate since it is located immediately outside the proposed location of the groundwater retention wall, albeit screened at a depth below the basement wall (14.3-20.3mBGL).

Table 12.2: Assessment of Block 4 Results Against SSTC

Analyte	Groundwater Exceedances	Groundwater Exceedance Wells (MW)	Average Exceeds SSTC?	Median Exceeds SSTC?
2-methylnaphthalene	1/11	205	Y (2 times)	N
Acenaphthylene	0/15	-	N	N
Fluorene	1/15	205	N	N
Phenanthrene	1/15	205	N	N
Naphthalene	9/15	15, 200, 204S, 205, 206, 209, 54, IT3D, 40 (offsite)	Y (70 times)	Y (2 times)
3-&4-methylphenol	0/15	-	N	N
TPH C6-C9	0/13	-	N	N
TPH C10-C14	8/14	15, 200, 204S, 205, 206, 209, 54, IT3D	Y (60 times)	Y (1.2 times)
Benzene	2/14	15, 200	N	N
Ethylbenzene	0/14	-	N	N
Toluene	0/14	-	N	N
Total Xylenes	0/14	-	N	N
1,2,4-trimethylbenzene	0/10	-	N	N
Styrene	0/10	-	N	N

Table 12.2: Assessment of Block 4 Results Against SSTC				
Analyte	Groundwater Exceedances	Groundwater Exceedance Wells (MW)	Average Exceeds SSTC?	Median Exceeds SSTC?
Aniline	0/11	-	N	N
Ammonia	0/9	-	N	N

In summary, SPGWT is present as follows:

- In the east of Block 4, associated with gasworks infrastructure and where bedrock is shallow (SPGWT generally occurs 1-4mBGL)
- In the west of Block 4, downgradient of gasworks infrastructure and at depth (SPGWT generally occurs 7.5-15mBGL)
- Also likely to be present at other gasworks infrastructure locations that have not been investigated.

Groundwater exceedances (comprising CIM) occurred for 2-methylnaphthalene, fluorene, phenanthrene and benzene (1 to 2 wells) and most significantly in frequency and magnitude for naphthalene and TPH C10-C36. Exceedances were generally associated with the occurrence of SPGWT, or lesser evidence of impact such as sheen (eg, MW200). The only exceedance in BH/MW40, located offsite, was naphthalene marginally above the SSTC. This well is screened below 14mBGL in natural clayey sand which contained tar veins, although AECOM did not consider this to be occurring in sufficient quantity to be classified as SPGWT (>10% TCM).

12.3 Proposed Remedial Extent

12.3.1 Lateral and Vertical Extent

AECOM defined the lateral extent of remediation based on the presence of historic gasworks infrastructure and the distribution of SPGWT and CIM. The lateral extent of remediation proposed, entirely in the saturated zone, is presented in Attachment 19, Appendix A. It includes approximately half of the Block 4 area, the majority within the eastern portion, and extends to the northern, eastern and southern boundaries of Block 4.

It is noted that the remainder of Block 4 is also intended to be excavated for the basement and excavated soil will require management in accordance with the RAP. Management measures should consider the potential for odours within these materials.

Given that the Block 4 basement excavation is anticipated to extend to 8mBGL and the majority of SPGWT and CIM was identified above 8mBGL, AECOM has defined the vertical extent of remediation as 8mBGL (approximately -5.5m AHD), plus deeper within gasworks features that are excavated into bedrock (e.g., gasholder at around 9.4mBGL). The proposed depths for each area (ranging from 2 to 10mBGL) are shown on Attachment 19, Appendix A; however, it is noted that the 10mBGL target remediation depth shown on Attachment 19 is not consistent with what is proposed in the RAP (8mBGL). In order to address SPGWT below 8mBGL, if SPGWT is encountered in fill material at the base of

remedial excavations, the vertical extent of remediation is proposed to be increased by 1-2m, depending on whether the excavation is to be locally backfilled with permeable fill (2m) or clay fill (1m).

The Auditor notes that over-excavation is likely to be required in a number of known locations, generally in the west of Block 4 where the depth of fill exceeds 8mBGL and marine sediment is present over bedrock (e.g. BH/MW205, BH49, BH119 and BH408).

12.3.2 SPGWT and CIM Not Addressed by Proposed Remediation Extent

The lateral and vertical remediation extent defined by AECOM does not address all of the SPGWT and CIM identified in Section 12.2, as follows:

- Within the remediation area, below 8mBGL, SPGWT in deep fill and marine sediment at BH49 (9.2 to 12.7mBGL), BH119 (7.5-10.0mBGL), BH408 (8 – 9.4mBGL)
- Within the remediation area, below 8mBGL, DNAPL in sandstone at MW205 (well screened 15-19.5mBGL)
- Outside the remediation area, SPGWT in deep fill and marine sediment at BH48, BH406 and BH405/IT03 (>14mBGL).
- CIM (groundwater exceedance) at BH405/IT3D (screened 13.5-14.5mBGL) and BH/MW40 located just offsite (screened 14.3-20.3mBGL)
- Likely other SPGWT and CIM (groundwater exceedances) in marine sediment locations downgradient of the gasworks infrastructure (generally in the west of Block 4) and below 8mBGL.

AECOM considers that remediation to address the above is not required based on the following:

- Local over-excavation by 1-2mBGL will occur in the base of the excavation where SPGWT is present.
- Shallow and medium depth screened intervals within IT03 (screened at 2.5 and 8mBGL), contained low contaminant concentrations and are likely to be more representative of groundwater in contact with the future basement than the concentrations detected at BH405/IT03D.
- Contaminant flux from bedrock and marine sediments into overlying fill is negligible (refer Section 11.5) therefore impacts to bedrock and marine sediment remaining at depth (largely below 14mBGL) below the basement do not present a risk to human health.

Further justification was presented by AECOM relating to determining 'the extent practicable' as discussed by the Auditor with respect to the VMP removal in Section 10.2.5. Several of these elements also relate to the Block 4 development remediation works and are generally supported by the Auditor.

12.4 In Situ Validation of Groundwater Retention Wall Alignment

Data within 30m either side of the proposed groundwater retention wall system was considered by AECOM to assess the potential for tar to be present in the immediate vicinity