

Appendix A Drawings

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Based on the current site condition, the park is not suitable for its intended use and presents a potential risk to users. Without temporary closure or remediation, the human health pollutant linkage associated with contaminated near-surface soils will remain. Although a management plan could reduce risk, it would require the permanent removal of the burrowing animals to remove the risk of further material being brought to the surface. All of the below solutions are targeted to fully break the pollutant linkage, regardless of seasonal changes in soil moisture, the long-term practicality of maintaining physical controls, and the potential for uncontrolled public access.

To fully remove the identified risks, one of the following options is recommended:

Option 1 – Full Closure

Close the park to the public and maintenance teams, installing secure fencing to prevent unauthorised access.

Option 2 – Focused Mole Solutions and Ground Management

Deploy a system to fully remove the risk of all burrowing animals from within the soils within the park boundary, cover known bare patches with a robust surface reinforcement cover and deploy regular park inspections to confirm the vegetation coverage is intact or promptly repaired where new pathways or surface wear is detected.

Option 3 – Excavation and Replacement

Remove all existing park furniture. Excavate and remove the upper 300mm of contaminated soil across the park. Install a high-visibility geotextile barrier over the remaining soils, then import and place a suitable clean cover layer to return the site to existing ground levels.

Option 4 – Capping and Level Raise

Remove all existing park furniture. Install a high-visibility geotextile barrier over the existing grass and contaminated soils, followed by the placement of a 300mm thick clean cover layer. This option would raise the overall park level by approximately 300mm.

8.0 Summary and Conclusion

Following review of the ground investigation data, soil and ACM analysis has confirmed the presence of asbestos and some localised individual PAHs within the surface and near-surface soils of the site.

Asbestos has been identified visually or through laboratory analysis in 23 out of the 30no locations. Based on the data collected and the detailed assessment, the risk posed by the asbestos in its current state, beneath managed turf, is considered to be low to very low; however, there's the potential for elevated risk associated with dry periods and areas of increased 'wear and tear'. Field evidence indicates that whilst there is generally good vegetation cover in the form of regularly maintained grass, there are areas of exposed soils where moles have pushed soil and ACM debris to the surface through the grass cover layer. Desire lines and other high traffic areas such as areas by goals posts may also retain low vegetation coverage, especially at higher use times (summer and school holidays) at certain times of the year exposing bare earth.

Whilst the site soils will generally remain relatively moist throughout the year, and there is limited bare earth exposure currently onsite, there is potential that during dry periods, dust and potentially asbestos fibres could become airborne and an inhalation pathway may exist.

Walking, running and play in the park also has the potential to 'pick up' exposed soil from the park and be tracked on shoes/boots or clothing back to a home or car and be deposited, dry and potentially generate asbestos containing dust.

The elevated speciated PAHs were identified at three investigation locations within both shallow and deeper Made Ground soils. The majority of these exceedances are viewed as minor, and unlikely to pose a risk to the intended site users, with the exception of STP10 that was relatively shallow. Additional soil sampling and speciated PAH analysis was commissioned by the client and confirmed these exceedances are isolated 'hotspots', and the exceedances could be potentially attributed to incomplete burning of fuels and coal i.e. BBQ's. As the exposure pathways to potential receptors would be via dermal contact or ingestion, the risk of prolonged exposure to a single location is deemed 'low' and can be effectively managed through grass cover and potentially signage if it was felt necessary by the client.

Table 7-1: Conceptual Site Model

Source	Pathway	Receptor	Potential Consequence	Likelihood
Asbestos fibres or debris in the Made Ground soils. Fragments of asbestos containing materials.	Inhalation of asbestos fibres	Current site users	Medium	Whilst the site has an established vegetation cover (mown grass) over the surface footprint of the park effectively 'knitting in' and 'blanketing' soils, moles are bringing asbestos impacted soils and ACM's to the surface exposing them directly to site users. The soils remain relatively damp throughout the majority of the year, however there may be periods that disturbance and dust may generate airborne asbestos fibres, that could potentially be inhaled. Areas of preferential tracking (desire paths) or areas with heavy use in wet periods (i.e. disturbance in a football goal mouth) by park users may also generate bare earth and soils developing a more likely exposure pathway.
		Future site users	Medium	
		Offsite residents	Medium	
Made Ground soils - Elevated concentrations of PAHs.	Ingestion Dermal Contact	Current site users	Low	Whilst the site has an established vegetation cover (mown grass) over the surface footprint of the park effectively 'knitting in' and 'blanketing' soils, moles are bringing potentially PAH impacted subsoils to the surface. Potentially site users could inadvertently ingest or come in to contact with the soils. In general, this scenario is low risk as it is very unlikely that there would be prolonged exposure through ingestion or dermal contact of soils to site users. Further sampling and delineation of the soils surrounding PAH exceedances confirmed these were localised 'hotspots' (3no) as no further exceedances were identified following assessment of a further 10 soil samples, obtained from near surface soils.
		Future site users	Low	
Leachable metals in made Ground soils	Migration through unsaturated soils and groundwater	River Frome, adjacent to site	Low	Samples collected from the site have identified widespread concentrations of leachable copper, lead and zinc which have the potential to represent a risk to the adjacent River Frome; however, sampling of the River has not identified an impact on the water quality of the Frome. As such, the risk to the surface water is considered low.

7.0 Conceptual Site Model

Sanctus has developed a conceptual site model (CSM) for the site to highlight environmental risks that are present on site. This includes the environmental setting of the site, using source-pathway-receptor linkage assessments to identify site-specific sources of contamination, pathways (via which the contamination can spread) and the receptors that come into contact with the potential contamination. A linkage must have all three parts to be viable. Groundwater is not considered in the CSM, as risk to the Principal Aquifer has not been identified.

7.1 Contaminant Sources

Potential sources of contamination on site are considered to be the following:

- Fragments of asbestos containing materials and asbestos fibres and clumps in soils at the surface and in shallow Made Ground soils;
- Contaminants (PAH's) identified in soils associated with the Made Ground used to establish a level parkland area; and
- Sources of leachable copper, lead and zinc in shallow Made Ground.

7.2 Contaminant Pathways

Contaminants on site could migrate along the following potential pathways:

- Plausible human health exposure pathways including inhalation, ingestion and dermal contact with the soils; and
- Leaching through infiltration of rainwater and migration through groundwater.

7.3 Contaminant Receptors

Potential receptors that could be impacted by contamination at the site include:

- Current site users;
- Future site users;
- Off-site residents; and
- Adjacent River Frome.

7.4 Conceptual Site Model

The CSM has taken into account the findings of all analysis obtained by Sanctus during the investigation, with qualitative assessment of the sources, pathways, and receptors detailed within Table 7-1, overleaf.

River Frome. Should the site be developed, a full groundwater assessment of the site would be recommended.

Determinant	GAC (µg/l)		Concentration (µg/l)			
	EQS	DWQS/ WHO	SW01	SW02	SW03	SW04
Arsenic	50	10	0.55	0.54	0.57	0.53
Boron	2,000	1,000	28	29	28	29
Cadmium	0.08	3	<0.02	<0.02	<0.02	<0.02
Chromium III	4.7	50	0.6	1.1	<0.2	0.4
Chromium VI	3.4		<5.0	<5.0	<5.0	<5.0
Copper	1	2,000	3.2	1.9	<0.5	1
Lead	1.2	10	<0.2	<0.2	<0.2	<0.2
Mercury	-	1	<0.05	<0.05	<0.05	<0.05
Nickel	4	20	<0.5	0.5	<0.5	<0.5
Selenium	-	10	<0.6	<0.6	<0.6	<0.6
Zinc	12.1	3,000	2.8	3.4	0.9	0.8
Total Cyanide	1	50	<10	<10	<10	<10
BTEX						
Benzene	10	1	<1.0	<1.0	<1.0	<1.0
Toluene	74	700	<1.0	<1.0	<1.0	<1.0
Ethylbenzene	-	300	<1.0	<1.0	<1.0	<1.0
m&p-xylene	30	500	<1.0	<1.0	<1.0	<1.0
o-xylene			<1.0	<1.0	<1.0	<1.0
Methyl tert-butyl ether	-	-	<3.0	<3.0	<3.0	<3.0
Phenols						
Total Phenol	7.7	-	<3.5	<3.5	<3.5	<3.5
Notes:						
* = WHO GAC of 15,000 µg/l considered significantly elevated. Screened against lower value of 300 µg/l, in line with other bands, based on professional judgement.						

As per the leachate analysis results, no detectable concentrations of organic contaminants have been identified in the surface waters of the River Frome.

Of the leachable concentrations which could potentially pose a risk to the river quality, copper is the only element which has been recorded above the EQS GAC, for the most upstream sample (SW01) for the river. It should be noted that samples analysed adjacent to the site and downstream, all show copper levels below the upstream sample. This shows that the landfill at the site, is not having a contributing impact on the water quality of the river [at the time the samples were taken.

Copper, lead and zinc have been identified in leachate analysis as being at potentially elevated concentrations across the site in shallow soils; however, overall, on the basis of the above analysis, the site is not considered to be significantly impacting on water quality of the

These samples were intended to determine if the known historic landfill, located to the east of the site and directly upstream was potentially impacting the background water quality, and if any Made Ground present on the site was also potentially affecting the quality. The water analysis is summarised within Table 6-2, below. A full summary table of the analysis is included in Appendix F.

Table 6-2: Assessment Summary of Surface Water Sample Chemical Analysis – Controlled Waters

Determinant	GAC (µg/l)		Concentration (µg/l)			
	EQS	DWQS/ WHO	SW01	SW02	SW03	SW04
Speciated Petroleum Hydrocarbons						
TPH-Ali >EC5-EC6	-	300*	< 1.0	< 1.0	< 1.0	< 1.0
TPH-Ali >EC6-EC8	-	300*	< 1.0	< 1.0	< 1.0	< 1.0
TPH-Ali >EC8-EC10	-	300	< 1.0	< 1.0	< 1.0	< 1.0
TPH-Ali >EC10-EC12	-	300	< 10	< 10	< 10	< 10
TPH-Ali >EC12-EC16	-	300	< 10	< 10	< 10	< 10
TPH-Ali >EC16-EC21	-	-	< 10	< 10	< 10	< 10
TPH-Ali >EC21-EC35	-	-	< 10	< 10	< 10	< 10
TPH-Aro >EC5-EC7	10	1	< 1.0	< 1.0	< 1.0	< 1.0
TPH-Aro >EC7-EC8	74	700	< 1.0	< 1.0	< 1.0	< 1.0
TPH-Aro >EC8-EC10	20	300	< 1.0	< 1.0	< 1.0	< 1.0
TPH-Aro >EC10-EC12	-	90	< 10	< 10	< 10	< 10
TPH-Aro >EC12-EC16	-	90	< 10	< 10	< 10	< 10
TPH-Aro >EC16-EC21	-	90	< 10	< 10	< 10	< 10
TPH-Aro >EC21-EC35	-	90	< 10	< 10	< 10	< 10
Speciated Polyaromatic Hydrocarbons						
Acenaphthene	-	-	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	-	-	<0.1	<0.1	<0.1	<0.1
Anthracene	0.1	-	<0.1	<0.1	<0.1	<0.1
Benzo[a]anthracene	-	-	<0.1	<0.1	<0.1	<0.1
Benzo[a]pyrene	0.00017	0.05	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	-	0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	-		<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	-		<0.1	<0.1	<0.1	<0.1
Indeno(123,cd)pyrene	-		<0.1	<0.1	<0.1	<0.1
Chrysene	-	-	<0.1	<0.1	<0.1	<0.1
Dibenz(ah)anthracene	-	-	<0.1	<0.1	<0.1	<0.1
Fluoranthene	0.0063	4	<0.1	<0.1	<0.1	<0.1
Fluorene	-	-	<0.1	<0.1	<0.1	<0.1
Naphthalene	2	-	<0.1	<0.1	<0.1	<0.1
Phenanthrene	-	-	<0.1	<0.1	<0.1	<0.1
Pyrene	-	-	<0.1	<0.1	<0.1	<0.1
Inorganics						

Determinant	GAC (µg/l)		Concentration (µg/l)				
	EQS	DWQS/ WHO	STP01 (0.05 – 0.20)	STP05 (0.30 – 0.60)	STP11 (0.20 – 0.60)	STP14 (0.05 – 0.40)	STP19 (0.05 – 0.60)
Chromium VI	3.4		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Copper	1	2,000	50	17	74	16	19
Lead	1.2	10	< 1.0	< 1.0	3.5	< 1.0	3.6
Mercury	-	1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Nickel	4	20	2.5	0.8	0.9	0.5	1.1
Selenium	-	10	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Zinc	12.1	3,000	21	19	25	9.9	15
Total Cyanide	1	50	<10	19	<10	<10	<10
BTEX							
Benzene	10	1	<1.0	<1.0	<1.0	<1.0	<1.0
Toluene	74	700	<1.0	<1.0	<1.0	<1.0	<1.0
Ethylbenzene	-	300	<1.0	<1.0	<1.0	<1.0	<1.0
m&p-xylene	30	500	<1.0	<1.0	<1.0	<1.0	<1.0
o-xylene			<1.0	<1.0	<1.0	<1.0	<1.0
Methyl tert-butyl ether	-	-	<3.0	<3.0	<3.0	<3.0	<3.0
Phenols							
Total Phenols	7.7	-	<10	<10	<10	<10	<10
Notes:							
* = WHO GAC of 15,000 µg/l considered significantly elevated. Screened against lower value of 300 µg/l, in line with other bands, based on professional judgement.							

Based on the results of the investigation, leachable concentrations of organic contaminants in soils at the site are generally below detection.

Of the inorganic results, a small number of exceedances have been identified. A single exceedance of total chromium of both the EQS and DWQS standards has been recorded for STP05. Two locations are noted to exceed the GAC for lead. There are also exceedances of the copper concentrations in all locations and zinc concentration at all but one locations when compared to the EQS standard only.

Based on the above, the risk to drinking water quality is considered to be low. An assessment of surface water quality has been undertaken in section 6.2, below.

6.2 Surface Water

4no surface water samples were obtained from the River Frome (SW01, SW02, SW03 and SW04), taken at intervals along the river from upstream to downstream, and the results have been assessed against GAC protective of the nearby surface water and drinking water quality to determine the risk posed to the identified and potential controlled waters receptors.

Table 6-1: Assessment Summary of Soil Sample Chemical Analysis – Controlled Waters

Determinant	GAC (µg/l)		Concentration (µg/l)				
	EQS	DWQS/ WHO	STP01 (0.05 – 0.20)	STP05 (0.30 – 0.60)	STP11 (0.20 – 0.60)	STP14 (0.05 – 0.40)	STP19 (0.05 – 0.60)
Speciated Petroleum Hydrocarbons							
TPH-Ali >EC5-EC6	-	300*	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-Ali >EC6-EC8	-	300*	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-Ali >EC8-EC10	-	300	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-Ali >EC10-EC12	-	300	< 10	< 10	< 10	< 10	< 10
TPH-Ali >EC12-EC16	-	300	< 10	< 10	< 10	< 10	< 10
TPH-Ali >EC16-EC21	-	-	< 10	< 10	< 10	< 10	< 10
TPH-Ali >EC21-EC35	-	-	< 10	< 10	< 10	< 10	< 10
TPH-Aro >EC5-EC7	10	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-Aro >EC7-EC8	74	700	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-Aro >EC8-EC10	20	300	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-Aro >EC10-EC12	-	90	< 10	< 10	< 10	< 10	< 10
TPH-Aro >EC12-EC16	-	90	< 10	< 10	< 10	< 10	< 10
TPH-Aro >EC16-EC21	-	90	< 10	< 10	< 10	< 10	< 10
TPH-Aro >EC21-EC35	-	90	< 10	< 10	< 10	< 10	< 10
Speciated Polyaromatic Hydrocarbons							
Acenaphthene	-	-	< 0.01	0.08	0.09	0.04	< 0.01
Acenaphthylene	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	0.1	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	0.00017	0.05	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	-	0.1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	-		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	-		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(123,cd)pyrene	-		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(ah)anthracene	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	0.0063	4	< 0.01	< 0.01	0.04	< 0.01	< 0.01
Fluorene	-	-	< 0.01	0.03	0.03	0.04	< 0.01
Naphthalene	2	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	-	-	0.05	0.13	0.15	0.07	< 0.01
Pyrene	-	-	< 0.01	< 0.01	0.02	< 0.01	< 0.01
Inorganics							
Arsenic	50	10	1.5	< 1.0	4.4	< 1.0	6.1
Boron	2,000	1,000	110	150	29	24	32
Cadmium	0.08	5	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08
Chromium III	4.7	50	1.5	240	2.3	< 0.4	0.8

6.0 Controlled Waters Risk Assessment

6.1 Groundwater

Groundwater samples have not been obtained from any of the investigation locations during the investigation works and therefore no direct assessment has been completed. Groundwater was identified at 2no locations (STP07 and STP17 at 0.60m bgl), the water was visually free of signs of contamination; however, groundwater sampling was not part of the investigation remit and no samples were taken.

To assess the risk to controlled waters from soils, 5no soil samples have been collected from a spread of locations across the site (STP01, STP05, STP11, STP14 and STP19) and analysed for leachable TPH, PAH and metals and metalloids. The results have been assessed against Environmental Quality Standards (EQS) (18) Generic Assessment Criteria (GAC), protective of surface waters, and the Drinking Water Quality Standards (DWQS) (19) or World Health Organisation (WHO) (20) GAC protective of controlled waters as a drinking water resource to determine the potential risk posed to the identified and potential controlled waters receptors.

The assessment is summarised in Table 6-1: Assessment Summary of Soil Sample Chemical Analysis – Controlled Waters below. A full summary table of the analysis is included in Appendix F.

STP10 where the previous soil sample was particularly shallow in depth. The additional sampling confirmed that the exceedances present at STP07, 09 and 10 were localised, with these locations therefore being classed as a 'hotspots' rather than representing more widespread contamination. No PAH exceedances were identified within the 10no soil samples obtained (STP201-210).

Determinant	GAC (mg/kg)	Concentration (mg/kg)			No of Exceedances/ No of Samples	Location(s) of Exceedances
		Min	Max	Average		
Phenanthrene	6,300	0.37	84	6.41	0/20	-
Anthracene	150,000	0.1	27	1.96	0/20	-
Fluoranthene	6,400	0.66	140	13.65	0/20	-
Pyrene	15,000	0.56	120	12.07	0/20	-
Benzo(a)anthracene	62	0.3	58	6.51	0/20	-
Chrysene	120	0.37	58	6.66	0/20	-
Benzo(b)fluoranthene	16	0.33	59	7.97	3/20	STP07, STP09, STP10
Benzo(k)fluoranthene	440	0.15	30	3.35	0/20	-
Benzo(a)pyrene	13	0.29	61	7.37	3/20	STP07, STP09, STP10
Dibenz(ah)anthracene	1.4	<0.05	4.0	0.67	2/20	STP09, STP10
Indeno(123-cd)pyrene	180	0.14	24	3.29	0/20	-
Benzo(ghi)perylene	1,600	0.15	26	3.63	0/20	-
Phenols						
Total Phenols	3,200	< 1.0	< 1.0	< 1.0	0/10	-
Notes:						
* = No value for Public Open Space (Parks). Residential without Consumption of Home-Grown Produce GAC substituted.						

The ground investigation has identified localised exceedances of various polycyclic aromatic hydrocarbons (PAHs) within the west and centre of the site.

Exceedances of the PAH criteria were identified in 3no locations. These locations notably are STP07, STP09 and STP10 which are located towards the west and centre of the site. The PAHs in exceedance of their respective GAC, are benzo(b)fluoranthene, benzo(a)pyrene and dibenz(ah)anthracene. The chemical analysis conducted on STP09 and STP10 demonstrated exceedances of all three of the PAHs, with STP07 only having exceedances of benzo(b)fluoranthene and benzo(a)pyrene.

All of the above PAH's are non-volatile in nature and therefore pathways exist only via dermal contact and ingestion.

Without appropriate mitigation measures, this contamination issue may pose a potential human health risk. Currently, these concentrations are in soils below a grass-covered surface soil layer.

Following discussions with the client regarding the PAH exceedances, further soil sampling was conducted in early October 2025, delineating the previous locations, notably around

Table 5-15: Assessment Summary of Soil Chemical Analysis – Human Health

Determinant	GAC (mg/kg)	Concentration (mg/kg)			No of Exceedances/ No of Samples	Location(s) of Exceedances
		Min	Max	Average		
Metals and Metalloids						
Arsenic	170	12	71	30.7	0/10	-
Beryllium	63	0.56	7.0	2.74	0/10	-
Boron	46,000	0.9	3.9	1.71	0/10	-
Cadmium	532	< 0.2	2.0	0.77	0/10	-
Chromium VI	220	< 1.8	3.0	1.95	0/10	-
Chromium III	33,000	16	50	33.75	0/10	-
Copper	44,000	50	410	151.6	0/10	-
Lead	1,300	75	1,100	370.5	0/10	-
Mercury	30	< 0.3	1.7	0.45	0/10	-
Nickel	800	13	81	37.8	0/10	-
Selenium	1,800	< 1.0	2.2	1.25	0/10	-
Vanadium	5,000	23	71	40	0/10	-
Zinc	170,000	160	680	349	0/10	-
Speciated Petroleum Hydrocarbons						
TPH-Ali >EC5-EC6	1,150	<0.01	<0.01	<0.01	0/10	-
TPH-Ali >EC6-EC8	736	<0.01	<0.01	<0.01	0/10	-
TPH-Ali >EC8-EC10	451	<0.01	0.03	<0.01	0/10	-
TPH-Ali >EC10-EC12	283	<1.0	1.2	1.02	0/10	-
TPH-Ali >EC12-EC16	142	<2.0	10	3.73	0/10	-
TPH-Ali >EC16-EC21	490,000	<8.0	130	21.49	0/10	-
TPH-Ali >EC21-EC35	490,000	<8.0	220	49.5	0/10	-
TPH-Aro >EC5-EC7	4,710	< 0.01	< 0.01	< 0.01	0/10	-
TPH-Aro >EC7-EC8	4,360	< 0.01	< 0.01	< 0.01	0/10	-
TPH-Aro >EC8-EC10	3,580	< 0.02	< 0.02	< 0.02	0/10	-
TPH-Aro >EC10-EC12	10,000	1.3	2.1	1.40	0/10	-
TPH-Aro >EC12-EC16	10,000	3.1	56	9.05	0/10	-
TPH-Aro >EC16-EC21	7,800	10	480	75.2	0/10	-
TPH-Aro >EC21-EC35	7,900	34	670	137.9	0/10	-
Volatile Organic Compounds						
Benzene	110	<0.005	<0.005	<0.005	0/10	-
Toluene	100,000	<0.005	<0.005	<0.005	0/10	-
Ethylbenzene	2,840	<0.005	<0.005	<0.005	0/10	-
m&p-Xylene	3,170	<0.008	<0.008	<0.008	0/10	-
o-Xylene	2,620	<0.005	<0.005	<0.005	0/10	-
Methyl tert-butyl ether	73*	<0.005	<0.005	<0.005	0/10	-
Polycyclic Aromatic Hydrocarbons						
Naphthalene	3,000	<0.05	0.60	0.22	0/20	-
Acenaphthylene	30,000	<0.05	0.85	0.22	0/20	-
Acenaphthene	30,000	<0.05	7.7	0.51	0/20	-
Fluorene	20,000	<0.05	7.9	0.53	0/20	-

5.4 Chemical (non-Asbestos) Soil Analysis and Assessment

To assess the risk to human health, Sanctus has screened soil analysis results against Generic Assessment Criteria (GAC) using Suitable for Use Levels for Human Health Risk Assessment (S4ULs) published by Land Quality Management (LQM)/ Chartered Institute of Environmental Health (CIEH) (15), the Soil Generic Assessment Criteria for Human Health Risk Assessment published by the Environmental Industries Commission (EIC)/ The Associated of Geotechnical and Geoenvironmental Specialists (AGS)/ Contaminated Land: Applications in Real Environments (CL:AIRE) (16) for methyl tert-butyl ether (MTBE) and the Category 4 Screening levels (C4SLs) published by DEFRA (17) for lead only.

Sanctus assessed the results against the criteria based on a 'Public Open Space - Parks' scenario as this is considered to best represent the potential exposure pathways for the site and its users.

Total Organic Carbon values were obtained during the investigation works and converted to Soil Organic Matter (SOM) by applying a factor of 1.724. This generated site specific SOM values ranging from 1.5% to 10.5%, with a mean of 5.79%, as such the a SOM value of 6% has been adopted when reviewing the laboratory analysis against the generic assessment criteria.

Where guidance values exceed the theoretical saturation levels, in regard to hydrocarbons, the theoretical saturation value has been adopted. These values have been adopted as the values above these levels mean free product maybe present which would pose an unacceptable risk to both the sites users as well as the adjacent River Frome and the underlying Principal and Secondary A Aquifers.

The soils reviewed against the generic assessment criteria are detailed within Appendix D, and summarised in Table 5-6, overleaf. A full summary table of the analysis is included in Appendix F.

- The risk assessment has utilised maximum reported concentrations of asbestos fibres (both from soil samples and from concentrations noted within the dustiness test), in accordance with best practice. This is unlikely to reflect the park's true average exposure levels per child;
- The presence of maintained vegetative cover across the site, and the repair and maintenance of exposed soil patches in well trafficked areas, is likely to reduce the potential for airborne fibre generation.

As such, the results of the combined overall excess life cancer risk for the two models, using the three fibre release scenarios are as follows:

Table 5-14 - Overall excess lifetime cancer risk (combined Mesothelioma and Lung cancer risk)

Overall excess lifetime cancer risk	(Crocidolite – Model 1)	(Chrysotile – Model 2)
1 - Soil	34-36	Insignificant
2 - Dustiness (conservative)	17,500	140-252
3 - Dustiness (refined)	4-6	Insignificant

For the models run, only the highest conservative assumptions (as discussed in section 5.1.3) have provided results considered as significant when reviewed under a chrysotile only scenario.

Crocidolite was only identified in 1No of 15No locations which reported positive results for loose asbestos. With respect to mesothelioma, crocidolite is more potent than amosite (brown asbestos), which in turn is generally regarded as being much more potent than chrysotile. Where crocidolite is present in shallow and superficial soils at the site, the maximum potential overall excess lifetime cancer risk is modelled as being 17,500 in 100,000.

5.3.1 Factors of uncertainty and discussed levels of conservatism:

Throughout the above dustiness assessment, the additional assumptions were made, which have impacted on the conservatism of the modelled conditions:

- The analysis of the fibres used to provide a fibre concentration within the dustiness test are not specific to asbestos fibres. The presence of non-asbestos fibres in the soil could result in a substantial overestimation of airborne asbestos.
- Measurement of the visually identified pACMs are limited to those detected from the surface and any disturbed soils from within the investigation hand pits. It is possible that more fibres will be released if the intensity of trafficking or surface use increases by additional public use/selected surface burns from barbeques, etc.
- The results of the quantitative risk assessment are considered to represent a conservative estimate of risk levels to the critical receptor, due to the following parameter assumptions and modelling uncertainties:
 - The total exposure frequency selected for children, especially in the No.2 conservative dustiness scenario, represents a worst case assumption;

From table 14.1 within C733, the Mesothelioma rates, for lifetime risk per 100,000 exposed, have been assumed from the following figures:

Table 5-10 - Mesothelioma lifetime age adjusted risk rates per 100,000 - Crocidolite Scenario - Model 1

Mesothelioma (Crocidolite – Model 1)	Conversion factor from nearest cumulative exposure (A)	Age factor Conversion (0-18 old park users) (B)	Conservative Asbestos Species (AxB)
1 - Soil	=0.5 x [0.005 Fibre/ml.years risk number] = 0.5 x 10	6.6	33
2 - Dustiness (conservative)	=4 x [1 Fibre/ml.years] = 4 x 650	6.6	17,160
3 - Dustiness (refined)	linear interpolation fo 0.000124 Fibre/ml.year = 0.11	6.6	0

Table 5-11 - Mesothelioma lifetime age adjusted risk rates per 100,000 - Chrysotile Scenario - Model 2

Mesothelioma (Chrysotile – Model 2)	Conversion factor from nearest cumulative exposure (A)	Age factor Conversion (0-18 old park users) (B)	Conservative Asbestos Species (AxB)
1 - Soil	Below an Insignificant value - as per table 14.1 (7)	6.6	Insignificant
2 - Dustiness (conservative)	=4 x [1 Fibre/ml.years] = 4 x 5	6.6	132
3 - Dustiness (refined)	Below an Insignificant value - as per table 14.1 (7)	6.6	Insignificant

Table 5-12 - Combined Mesothelioma lifetime risk rates per 100,000 (both Models)

Combined Mesothelioma risk rate	(Crocidolite – Model 1)	(Chrysotile – Model 2)
1 - Soil	33	Insignificant
2 - Dustiness (conservative)	17160	132
3 - Dustiness (refined)	3	Insignificant

Similarly, both models have been run for the equivalent lung cancer risk (per 100,000 people), as derived from Table 14,3 from within CIRIA C733 (7):

Table 5-13 - lung cancer – lifetime risk per 100,000 exposed (both Models)

Lung Cancer risk rate	(Crocidolite – Model 1)	(Chrysotile – Model 2)
1 - Soil	33	Insignificant
2 - Dustiness (conservative)	17,160	132
3 - Dustiness (refined)	3	Insignificant

Two models have been run, using the following asbestos types and concentrations encountered - STP12 (showing Amosite, Crocidolite and Chrysotile at a value of 1.36% w/w in the soil) and STP04 (showing just Chrysotile, but at a value of 9.801% w/w in the soil). These two models have then used the three calculated cumulative exposure levels in Fibres/ml.years concentrations:

Table 5-8 Selected Soils Data for DQRA

Parameter	Units	Model 1 - STP12	Model 2 - STP04
Soil Description	-	Brown clay and sand with gravel	Light brown sand with gravel and stones
Sample Depth	m b.g.l.	0.15 – 0.60	0.05 – 0.20
Asbestos Identified	-	Amosite, Crocidolite and Chrysotile	Chrysotile
Type of material	-	Loose Fibrous Debris	Loose Fibrous Debris, Sheeting/Board Debris
Asbestos in sample	%	1.36	9.801

It is important to note that the reporting of the asbestos quantification in the data above, does not differentiate between the different forms of asbestos. For the purposes of modelling potential risk to health, it has therefore been assumed that all of the asbestos within STP12 is crocidolite.

Using the calculated fibres/ml.years figures from the dustiness test results (as listed in section 5.2) the following time averaged fibre concentrations scenarios have been used to allow for the calculation of lifetime risk per 100,000 people, with the following assumptions:

Table 5-9 - Cumulative estimated exposure levels

Evolved Dust Scenarios	Count	Units
1 - Soil	0.0025	f/ml.yrs
2 - Dustiness (conservative)	3.978	f/ml.yrs
3 - Dustiness (refined)	0.000124	f/ml.yrs

