APPENDIX D SCREENING RISK ASSESSMENT (GHD 'INTERIM AUDIT REPORT')

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
Flowchart 1	GASWORKS SITE, Land Segment: On-site beneficial uses								
1ABCGLMN	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Volatile emission -> Soil gas -> Diffusion into buildings & structures	Human health: Park users - Adult	phenol, ethyl benzene, toluene, xylene	2	D	Medium	Controls as per ICMPs - Potential vapour exposure within the buildings to be minimised through the continual use of air conditioning systems and adequate ventilation. Time spent in poorly ventilated locations should be minimised pending further measurements and recommendations.	Vapour and Edible Vegetation Risk Assessment (July 2004) - The 2004 Golder indoor air vapour risk assessment involved sampling the air in buildings at four locations on the site. Golder tested for VOCs, SVOCs and CN. Four chemicals of interest (COIs) were identified. These were: phenol, ethylbenzene, toluene and xylenes. The risk assessment of the COIs detected in indoor air used the highest concentrations of each chemical measured at any of the indoor monitoring locations. Based on the data collected for the indoor air vapour risk assessment, Golder concluded that the gasworks waste on the site did not appear to be posing vapour risks to workers and residents on the site.	Uncertainty about the representativeness of the study (the vapour risk assessment used measurement data collected from soil gas bores (sampled on one occasion) and indoor air (also sampled on one occasion). Although the sampling design tried to collect data that would result in conservative estimates of risk (i.e. targeting areas closest to potential sources) without time-series data it cannot be determined whether the sampling programme actually captured vapour concentrations at the high end of the range for the site (Golder discusses this in their report). Nor can it be determined what future vapour risks may be for the site. Therefore, the vapour risk assessment can only be considered a point-in-time assessment only. Uncertainty regarding the robustness of the ventilation systems ie. could they shut off?
		Human health: Park users - Child	As above.	2	D	Medium	As above.	As above.	As above.
		Human health: Workers - Surface	phenol, ethyl benzene, toluene, xylene	2	D	Medium	Controls as per ICMPs - Potential vapour exposure within the buildings to be minimised through the continual use of air conditioning systems and adequate ventilation. Time spent in poorly ventilated locations should be minimised pending further measurements and recommendations.	Vapour and Edible Vegetation Risk Assessment (July 2004)- In addition to the above information, it is noted that the 2004 Golder sampling was undertaken on a Monday morning to be conservative as it was considered that any vapours inside the buildings may be at higher concentrations after the buildings were closed/less frequently used over the weekend. Two park based buildings were selected based on the site history to be as close as practical to the worst potential areas for vapours, i.e. one location was in the bookshop in the administration area of the site (west of the former coal gasification plant); and the other in the dressing room of the theatre (in the administration building area of the site, and east of the former underground purifiers).	Uncertainty of vapour ingress at other buildings on the site (there are actually 11 buildings on the site and the 2004 study only sampled within two buildings - albeit targeted as close to potential sources).
		Aesthetics	VOCs and SVOCs	2	D	Medium	Not explicitly addressed in the ICMPs, but odours can be expected to be managed by use of the ventilation systems.	Reports of objectionable odours within buildings have not been seen by the auditor, however the contaminants of concern at the site are known to be odorous. Odours have been observed during the soil and groundwater investigations and noted on logs.	As above.
1ABCGLMO	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Volatile emission -> Soil gas -> Diffusion into residential homes/Southport	Human health: Residents	phenol, ethyl benzene, toluene, xylene	2	D	Medium	Southport ICMP states that potential vapour exposure within the buildings should be minimised through the continual use of air conditioning systems and adequate ventilation. Time spent in poorly ventilated locations should be minimised pending further measurements and recommendations.	Vapour and Edible Vegetation Risk Assessment (July 2004) - Four non-carcinogenic COIs were detected within some of the four buildings sampled at the site (2004). Two of the sampling locations were within the Southport Site. A quantitative RA based on the highest concentrations was conducted and concluded that based on the data collected there did not appear to be a risk to workers or residents.	Uncertainty about the representativeness of the Golder Vapour and Edible Vegetation Risk Assessment (July 2004) study (i.e. vapour samples were collected on one occasion and may not be representative of the high-end of the vapour that may be emitted, or what may be emitted in the future. The 2004 study represents a point in time and is not substantial enough to understand current risk or future risks. At the time of preparing the ICMP, Golder was about to commence indoor vapour testing to provide further information for guidance on this issue. The ICMP was to be updated should the testing indicate additional actions are required. ICMPs were not updated. Uncertainty regarding the robustness of the ventilation systems ie. could they shut off?
		Aesthetics	VOCs and SVOCs	2	D	Medium	Not explicitly addressed in the ICMPs, but odours can be expected to be managed by use of the ventilation systems.	Reports of objectionable odours within buildings have not been seen by the auditor, however the contaminants of concern at the site are known to be odorous. Odours have been observed during the soil and groundwater investigations and noted on logs.	As above.
1ABCGLMP	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Volatile emission -> Soil gas -> Diffusion into excavations	Human health: Workers - Subsurface	VOCs and SVOCs	3	D	Medium	ICMP - All intrusive maintenance works (>30cm bgl) must prepare a task specific contamination management plan in consultation with a CoPP Health and Safety Coordinator. Considerations to be included: dust management, what to do is coloured or odorous soils are encountered, hygiene practices such as washing hands after working at the site.	Risks from vapours to subsurface works was not included in the Golder 2004 study.	The Golder 2004 soil gas study did not explicitly address risks to subsurface worke4rs, however soil gas bores detected a number of VOCs and SVOCs, and it can be assumed that these would be present in deeper excavations that might be undertaken.
1ABCGLMQ	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Volatile emission -> Soil gas -> Diffusion into ambient air	Human health: Park users - Adult	VOCs and SVOCs	1	C	Low	ICMPs - do not address this exposure pathway, likely because the risks were considered to be low.	Vapour and Edible Vegetation Risk Assessment (July 2004) - The outdoor air vapour risk assessment involved sampling four soil gas bores installed at various locations around the Park. Twenty COIs were identified. Not all COIs were detected at all of the soil gas bore locations, and soil gas concentrations varied significantly between locations. A quantitative risk assessment of the highest measured concentrations of the COIs did not find unacceptable risks to child and adult recreational users of the Park or outdoor maintenance workers on the Park. Therefore, based on the data collected for the outdoor air vapour risk assessment, Golder concluded that gasworks waste on the site did not appear to be posing vapour risks to recreational users of, or workers on, the Park. The assessment of risks to both child and adult recreational park users found that risks from all noncarcinogenic COIs to be less than a value of 0.2, and carcinogenic risks from benzene to child and adult recreational park users were found to be less than 1 x 10-5 and therefore also acceptable.	Uncertainty about representativeness of study (ie. study was limited in scope and conclusions based on a single sampling event at 4 soil gas bore locations).
		Human health: Park users - Child	VOCs and SVOCs	1	C	Low	As above.	As above.	As above.
		Human health: Workers - Surface	VOCs and SVOCs	1	C	Low	Park ICMP includes measures to minimise risk w.r.t. standard maintenance activates related to direct contact with soils/waste.	As above. for park users.	
		Human health: Residents	VOCs and SVOCs	1	C	Low	ICMPs - do not address this exposure pathway, likely because the risks were considered to be low.	As above for park users.	
		Aesthetics	VOCs and SVOCs	1	C	Low	ICMPs - do not address this exposure pathway, likely because the risks were considered to be low.	Reports of objectionable odours have not been seen by the auditor, although hydrocarbon odours and staining was noted in soil bore locations BH6, BH7, BH8, BH10 and BH11 and groundwater monitoring wells GW2 to GW4.	

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1ABCGLMR	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Volatile emission -> Soil gas -> Diffusion into plant root zones	Ecosystems: Natural/Modified/Highly Modified		1	D	Low	No controls, although plants grow throughout the site, in many areas the plants are established on some form of capping rather than directly on waste/contaminated soil.	Some gases may kill or harm plants but are generally not bioaccumulative . The other bioaccumulative chemicals tend to solid liquid such as PAHs, PCBs, pesticides.	
		Food production		1	D	Low	Edible vegetables are not being proactively grown at the site, ie. bush tucker trail and fruit trees. Golder identified that some part of plants that grow at the site could be eaten (see Report 5) but that it is unlikely this would occur.	Some gases may kill or harm plants but are generally not bioaccumulative. The other bioaccumulative chemicals tend to solid liquid such as PAHs, PCBs, pesticides.	
1ABDMN	Historical activities -> Contaminated soil -> Volatile emission -> Soil gas -> Diffusion into buildings & structures	Human health: Park users - Adult	phenol, ethyl benzene, toluene, xylene	2	D	Medium	Controls as per ICMPs - Potential vapour exposure within the buildings to be minimised through the continual use of air conditioning systems and adequate ventilation. Time spent in poorly ventilated locations should be minimised pending further measurements and recommendations.	The 2004 Golder indoor air vapour risk assessment involved sampling the air in buildings at four locations on the site. Golder tested for VOCs, SVOCs and CN. Four chemicals of interest (COIs) were identified. These were: phenol, ethylbenzene, toluene and xylenes. The risk assessment of the COIs detected in indoor air used the highest concentrations of each chemical measured at any of the indoor monitoring locations. Based on the data collected for the indoor air vapour risk assessment, Golder concluded that the gasworks waste on the site did not appear to be posing vapour risks to workers and residents on the site.	The vapour risk assessment used measurement data collected from soil gas bores (sampled on one occasion) and indoor air (also sampled on one occasion). Although the sampling design tried to collect data that would result in conservative estimates of risk (i.e. targeting areas closest to potential sources) without time-series data it cannot be determined whether the sampling programme actually captured vapour concentrations at the high end of the range for the site (Golder discusses this in their report). Nor can it be determined what future vapour risks may be for the site. Therefore, the vapour risk assessment can only be considered a point-in-time assessment only.
		Human health: Park users - Child	As above.	2	D	Medium	As above for adult users.	As above.	As above.
		Human health: Workers - Surface	phenol, ethyl benzene, toluene, xylene	2	D	Medium	Workers/resident artists at the site.	Vapour and Edible Vegetation Risk Assessment (July 2004) - In addition to the above information, it is noted that the 2004 Golder sampling was undertaken on a Monday morning to be conservative as it was considered that any vapours inside the buildings may be at higher concentrations after the buildings were closed/less frequently used over the weekend. Two park based buildings were selected based on the site history to be as close as practical to the worst potential areas for vapours, i.e. one location was in the bookshop in the administration area of the site (west of the former coal gasification plant); and the other in the dressing room of the theatre (in the administration building area of the site, and east of the former underground purifiers).	There are actually 11 buildings on the site and the 2004 study sampled within two buildings - albeit targeted as close to potential sources.
1ABDMO	Historical activities -> Contaminated soil -> Volatile emission -> Soil gas -> Diffusion into residential homes/Southport	Human health: Residents	phenol, ethyl benzene, toluene, xylene	2	D	Medium	Southport ICMP - Potential vapour exposure within the buildings to be minimised through the continual use of air conditioning systems and adequate ventilation. Time spent in poorly ventilated locations should be minimised pending further measurements and recommendations.	Vapour and Edible Vegetation Risk Assessment (July 2004) - Four non-carcinogenic COIs were detected within some of the four buildings sampled at the site (2004). Two locations were within the Southport site. A quantitative RA based on the highest concentrations was conducted and concluded that based on the data collected there did not appear to be a risk to workers or residents.	Vapour samples were collected on one occasion and may not be representative of the high-end of the vapour that may be emitted, or what may be emitted in the future. Report 5 represents a point in time and is not substantial enough to understand current risk or future risks. At the time of preparing the ICMP indoor vapour testing was about to be commenced to provide further information for guidance on this issue. The ICMP was to be updated should the testing indicate additional actions are required.
		Aesthetics	VOCs and SVOCs	2	D	Medium		Reports of objectionable odours have not been seen by the auditor, though it is possible that the contamination could give rise to odours within buildings.	
1ABDMP	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Volatile emission -> Soil gas -> Diffusion into excavations	Human health: Workers - Subsurface	VOCs and SVOCs	3	D	Medium	Park ICMP - task specific management for any works > 30cm bgl.	Risks from vapours to subsurface works was not included in the Golder 2004 study.	Uncertain whether the results from the soil gas sampling by Golder in 2004 can be applied to assess risk to subsurface workers.
1ABDMQ	Historical activities -> Contaminated soil -> Volatile emission -> Soil gas -> Diffusion into ambient air	Human health: Park users - Adult	VOCs and SVOCs	1	C	Low	No controls on this exposure pathway.	Vapour and Edible Vegetation Risk Assessment (July 2004) - The outdoor air vapour risk assessment involved sampling four soil gas bores installed at various locations around the Park. Twenty COIs were identified, and not all COIs were detected at all of the soil gas bore locations. Soil gas concentrations varied significantly between locations. A quantitative risk assessment of the highest measured concentrations of the COIs did not find unacceptable risks to child and adult recreational users of the Park or outdoor maintenance workers on the Park. Therefore, based on the data collected for the outdoor air vapour risk assessment, Golder concluded that gasworks waste on the site did not appear to be posing vapour risks to recreational users of, or workers on, the Park. The assessment of risks to both child and adult recreational park users found that risks from all noncarcinogenic COIs to be less than a value of 0.2 and carcinogenic risks from benzene to child and adult recreational park users to be less than 1 x 10-5, and therefore acceptable.	Again, the 2004 vapour study was limited in scope and conclusions based on a single sampling event at four soil gas bore locations.
		Human health: Park users - Child	VOCs and SVOCs	1	C	Low	As above.	As above.	
		Human health: Workers - Surface	VOCs and SVOCs	1	C	Low	As above.	As above for park users.	
		Human health: Residents	VOCs and SVOCs	1	C	Low	As above.	As above for park users.	
		Aesthetics	VOCs and SVOCs	1	C	Low	As above.	Objectionable odours in the parkland do not appear to be a significant issue, however hydrocarbon odours and staining have been noted in several soil and groundwater borehole locations.	
1ABDMR	Historical activities -> Contaminated soil -> Volatile emission -> Soil gas -> Diffusion into plant root zones	Ecosystems: Natural/Modified/Highly Modified		1	D	Low	No controls - plants grow through the site, in many areas established on capping rather than directly on waste/contaminated soil.	Some gases may kill or harm plants but are generally not bioaccumulative . The other bioaccumulative chemicals tend to solid liquid such as PAHs, PCBs, pesticides.	

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		Food production		1	D	Low	Edible vegetables are not being proactively grown at the site, ie. bush tucker trail and fruit trees. Golder identified that some part of plants that grow at the site could be eaten but that it is unlikely this would occur.	Some gases may kill or harm plants but are generally not bioaccumulative . The other bioaccumulative chemicals tend to solid liquid such as PAHs, PCBs, pesticides.	
1ABE	Historical activities -> Contaminated soil -> Direct contact	Buildings and structures	pH, sulphates	3	A	Low	No explicit controls, however new buildings would need to be approved by CoPP, and CoPP is likely to consider the requirements for building design (eg low pH and sulphate impact on buildings and structures).	Review of Contamination Status, Southport Nursing Home (July 2006) have indicated a potential for site soils to impact upon buildings and structures built on the site, ie. soil data collected during the various assessments reported pH range between 2.7-8.5 pH units, in both the fill and natural soils. Golder recommended remediation or management of the issue, and that the site can be considered suitable for the proposed uses (being medium/high density residential and/or open space uses). The Australian Standard for Piling Design and Installation (AS 2159-1995) indicates that for concrete piles the site soil pH would be considered very severe to non-aggressive. Golder advised that soil condition on the site can be variable and caution should be taken when designing new buildings and structures. Sulphate was of less significance, and Golder found that two samples out of 38 analysed were above the adopted criterion and therefore the risk of impacts to buildings and structures represented by the sulphate in soils was considered to be low. It is noted that Golder used the NEPM EIL for sulphate of 2000 mg/kg to assess impact to this beneficial use; this is conservativ	The available information relates mostly to the Southport Site and, while it is probably indicative of the situation elsewhere, there is some uncertainty in this.
1ABEH	Historical activities -> Contaminated soil -> Direct contact -> Dermal contact	Human health: Park users - Adult	PAHs, TPHs, Benzene, cyanide	2	B	Low	ICMP requires that the separation layer be maintained over the non-building areas of the site.	Soils on Gasworks Park and Southport are contaminated with gasworks waste. A number of contaminant concentrations were found to exceed the criteria adopted for the protection of human health and the environment the current site usage. Elevated concentrations were found for lead and some organic compounds such as total recoverable hydrocarbons and polycyclic aromatic hydrocarbons, including benzo(a)pyrene, consistent with material originating from gasworks sites. Golder Associates collected surface samples from across the Park in 2004. Results were compared to NEPM E HIL criteria to assess the severity. The low severity ranking is based on the measurement of PAHs at the surface at up to 120 ppm (see Further Recommendations for Action Letter, February 2004), which is only slightly greater than the NEPM D threshold value (80 mg/kg) for commercial land use.	There is uncertainty regarding the extent of the capping at the site and the concentrations of contaminants that might occur at the surface of the site.
		Human health: Park users - Child	PAHs, TPHs, Benzene, cyanide	2	B	Low	As above.	As above.	As above.
		Human health: Workers - Surface	PAHs, TPHs, Benzene, cyanide	2	B	Low	ICMP - Golder recommended that workers or people who spend more than two days a week at the site be briefed by the Health and Safety Coordinator regarding site issues, the need to minimise exposure to soil at the site and the need to adopt standard hygiene practices following contact with the surrounding soils.	This exposure pathway considers commercial building workers and resident artists etc within this category. Elevated concentrations were found for lead and some organic compounds consistent with material originating from gasworks sites, such as total recoverable hydrocarbons and polycyclic aromatic hydrocarbons, including benzo(a)pyrene. Golder Associates collected surface samples from across the Park in 2004. Results were compared to NEPM E HIL criteria to assess the severity. The low severity ranking is based on concentrations of PAHs at the surface at up to 120 ppm (refer to comment above for significance).	
		Human health: Workers - Subsurface	PAHs, TPHs, Benzene, cyanide	4	B	Medium	ICMP - All intrusive maintenance works (>30cm bgl) must prepare a task specific contamination management plan in consultation with a CoPP Health and Safety Coordinator. Considerations to be included: dust management, what to do is coloured or odorous soils are encountered, hygiene practices such as washing hands after working at the site.	Elevated concentrations were found for lead and some organic compounds consistent with material originating from gasworks sites, such as total recoverable hydrocarbons and polycyclic aromatic hydrocarbons, including benzo(a)pyrene. Severity is based on the measured results for soils from surface to maximum investigation depth. Results were compared to NEPM F HIL criteria to assess the severity. Severity is based on the maximum measured benzene concentration, at a depth of 2.3 - 2.4 m. However, there are reports of tar and tarry odour (eg Report 7), and this suggests that the investigations to date have not identified the highest concentrations.	There is uncertainty regarding the extent of the capping at the site and the concentrations of contaminants that might occur at shallow depths on the site.
		Human health: Residents	PAHs	3	B	Low	Southport ICMP has specified control w.r.t. access to fill/natural soils underlying the separation layers, and that capping be maintained over non-building areas of the site.	Soils on Gasworks Park and Southport are contaminated to various degrees with gasworks waste. A number of contaminant concentrations were found to exceed the criteria generally adopted for the protection of human health and the environment for a site used for the current purposes. The elevated concentrations were generally found for lead and some organic compounds consistent with material originating from gasworks sites, such as total recoverable hydrocarbons and polycyclic aromatic hydrocarbons, including benzo(a)pyrene. Severity is based on the measured concentrations of PAHs and B(a)P in surface soils.	There is uncertainty regarding the extent of the capping at the site and the concentrations of contaminants that might occur at the surface of the site.
1ABEI	Historical activities -> Contaminated soil -> Direct contact -> Ingestion	Human health: Park users - Adult	PAHs, TPHs, Benzene, cyanide	4	B	Medium	ICMP requires that the separation layer be maintained over the non-building areas of the site.	Soils on Gasworks Park and Southport are contaminated to various degrees with gasworks waste. A number of contaminant concentrations were found to exceed the criteria generally adopted for the protection of human health and the environment for a site used for the current purposes. The elevated concentrations were generally found for lead and some organic compounds consistent with material originating from gasworks sites, such as total recoverable hydrocarbons and polycyclic aromatic hydrocarbons, including benzo(a)pyrene. Analytical data provided by Golder commences at a depth of 0.5 m below surface. Results were compared to NEPM F HIL criteria to assess the severity. Severity is based on the measured benzene concentration at a depth of 2.3 -2.4 m.	There is uncertainty regarding the extent of the capping at the site and the concentrations of contaminants that might occur at the surface of the site.
		Human health: Park users - Child	PAHs, TPHs, Benzene, cyanide	4	B	Medium	As above.	As above.	As above.
		Human health: Workers - Surface	PAHs, TPHs, Benzene, cyanide	4	B	Medium	ICMP - Golder recommended that workers or people who spend more than two days a week at the site be briefed by the Health and Safety Coordinator regarding site issues, the need to minimise exposure to soil at the site and the need to adopt standard hygiene practices following contact with the surrounding soils.	This exposure pathway considers commercial building workers and resident artists etc within this category. Analytical data provided by Golder commences at a depth of 0.5 m below surface. Results were compared to NEPM F HIL criteria to assess the severity. Severity is based on a benzene concentration at a depth of 2.3 -2.4 m.	As above.

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		Human health: Workers - Subsurface	PAHs, TPHs, Benzene, cyanide	4	B	Medium	ICMP - All intrusive maintenance works (>30cm bgl) must prepare a task specific contamination management plan in consultation with a CoPP Health and Safety Coordinator. Considerations to be included: dust management, what to do is coloured or odorous soils are encountered, hygiene practices such as washing hands after working at the site.	Severity is based on soils from surface to maximum investigations depth. Results were compared to NEPM F HIL criteria to assess the severity. Severity is based on the measured benzene concentration at a depth of 2.3 - 2.4 m. However, there are reports of tar and tarry odour (eg Report 7), and this suggests that the investigations to date have not identified the highest concentrations.	There is uncertainty regarding the extent of the capping at the site and the concentrations of contaminants that might occur at shallow depths on the site.
		Human health: Residents	PAHs	1	B	Negligible	Southport ICMP puts controls over access to fill/natural soils underlying the separation layers.	Soils on Gasworks Park and Southport are contaminated to various degrees with gasworks waste. A number of contaminant concentrations were found to exceed the criteria generally adopted for the protection of human health and the environment for a site used for the current purposes. The elevated concentrations were generally found for lead and some organic compounds consistent with material originating from gasworks sites, such as total recoverable hydrocarbons and polycyclic aromatic hydrocarbons, including benzo(a)pyrene. Severity is based on the measured concentrations of BaP in soils less than 0.4m below surface level. One of four samples between surface and 0.4 m recorded a B(a)P concentration exceeding NEPM D HIL criteria. However, it should be noted that the highest severity recorded on the site is 4, based on the B(a)P concentration at a depth of 0.5 - 0.6 m. However, there is uncertainty as to whether the highest concentrations have been identified.	There is uncertainty regarding the extent of the capping at the site and the concentrations of contaminants that might occur at the surface of the site.
1ABEJ	Historical activities -> Contaminated soil -> Direct contact -> Surface contamination/ waste	Aesthetics	Surface waste	2	D	Medium	Aesthetic issues partially addressed by site management actions. The site ICMPs specify that most areas of the site outside of the buildings are covered by a separation layer that consists of paved areas including gravel paths, grassed areas with a dense healthy cover and landscaped gardens with woodchip cover.	Report 7 – At the site fill material varies from 0.5 m and 3.2 m in thickness. Near the surface, fill material has been reported as generally comprised of black sands with fragments of coke, bricks and glass. In addition, the fill has also been reported to include tar and large sections of steel and other metallic waste. A strong tarry odour has been associated with the fill material at the locations reporting tar. Hydrocarbon odours and staining have been identified within the fill and natural material on the site.	A basis for the controls in the ICMPs was generally that activities undertaken at the site by site occupiers and the general public are not considered to pose a significant human health risk in the short term due to the infrequent exposure to the soil. However, there is some uncertainty regarding the extent of the capping at the site.
1ABFK	Historical activities -> Contaminated soil -> Root zones -> Plants/Produce	Ecosystems: Natural/modified/highly modified	PAHs, metals	2	B	Low	No controls - plants grow through the site, in many areas established on capping rather than directly on waste/contaminated soil.	The major contaminants in soil have been found to be PAHs, including benzo(a)pyrene) and TPHs (>C9). The PAHs are considered to have potential to be in two forms in soils on the site – a liquid form (e.g., tars, liquors in and near tanks and pits) and in solid form (e.g., ash, coke, coal in and near hoppers and bunkers). The potential for the VOCs and SVOCs to impact on the terrestrial ecosystems (eg plants has not been well characterised in the assessment reports. Metals have been found above NEPM EILs, and other contaminants such as low pH and sulphate may impact the beneficial use of maintenance of ecosystems. In practice, park management practices have been able to select plants that will grow in the soils at the site, and contaminant concentrations in surface soils do not appear to be a limiting consideration.	The effect of the contamination on plants has not been well characterised.
		Human health: Park users - Adult	PAHs, metals	1	B	Negligible	The bush tucker trail is understood to have been removed from the site. Not sure about the fruit trees.	To derive an overall risk ranking for contaminant uptake and potential consumption, Golder identified site plants, and assessed the expected root depth, the edible portion of the plant, the likelihood of consumption, and the expected form of the PAHs contamination. The risks associated with consumption of other edible vegetation on Gasworks Park were expected ranked as negligible to nil - as uptake was expected to be low and consumption of vegetation expected to be infrequent.	The contamination in soil and fill has not been well characterised, and the potential for uptake by plants is not well characterised; prediction of uptake is highly uncertain. Analysis of plant material would provide a more direct measure of plant uptake.
		Human health: Park users - Child	PAHs, metals	1	B	Negligible	The bush tucker trail is understood to have been removed from the site. Not sure about the fruit trees.	As above for adult park users.	
		Human health: Workers - Surface	PAHs, metals	1	B	Negligible	The bush tucker trail is understood to have been removed from the site. Not sure about the fruit trees.	As above for park users, but considering that frequency at the park is expected to be less than park users.	
		Human health: Workers - Subsurface	PAHs, metals	1	B	Negligible	Edible vegetables are not being proactively grown at the site, ie. bush tucker trail and fruit trees. Golder identified that some part of plants that grow at the site could be eaten (see Report 5) but that it is unlikely this would occur.	As above for park users, but considering that frequency at the park is expected to be less than park users.	
		Human health: Residents	PAHs, metals	1	B	Negligible	The bush tucker trail is understood to have been removed from the site. Not sure about the fruit trees.	As above for adult park users.	
		Food production	PAHs, metals	2	B	Low		The major contaminants in soil have been found to be PAHs, including benzo(a)pyrene) and TPHs (>C9). The PAHs have potential to be in two forms in soils on the site – a liquid form (e.g., tars, liquors in and near tanks and pits) and in solid form (e.g., ash, coke, coal in and near hoppers and bunkers). PAHs in solid form are expected to have a lower potential for uptake by plant roots. PAHs in liquid form are expected to have a higher potential for uptake by plant roots, and effect on plant growth. Metals have been found above NEPM EILs, and also could give rise to plant uptake and effects on plant growth. Because of the controls on the use of plants for food, the relevance of this beneficial use is reduced.	The significance of the contamination with respect to plant uptake and effects on plants and plant growth is uncertain and not well characterised.

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
Flowchart 2	GASWORKS SITE, Groundwater Segment: On-site beneficial uses								
2ABCEG	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Extraction	Potable water - Desirable/acceptable	TDS, arsenic, manganese, ammonia and cyanide nickel exceed the drinking water criteria.	4	A	Low	Extractive uses of groundwater are not addressed in the ICMPs, but unlikely to occur given CoPP management/control over activities at the site.	Groundwater contaminant concentrations on site exceed the potable water guideline concentrations for As, Ni, Mn, NH3 (health and aesthetics), SO4 (health and aesthetics) . NH3 especially is orders of magnitude above the potable use aesthetic guideline concentrations. In addition, the salinity has been elevated in the aquifer above Segment A background levels in 5 bores within the site boundaries. Potable use on site is unlikely to be realised because of the CoPP controls, the reticulated water supply to the area and expected on-going use of the park as public space.	
		Agriculture, parks & gardens	TDS, boron, arsenic, manganese	4	B	Medium	CoPP controls on use. Use of groundwater for irrigation onsite is unlikely.	Concentrations of arsenic and boron exceed the adopted irrigation criterion in GW2 and GW4. The source of arsenic may be associated with the naturally occurring arsenic in the Brighton Group soils mobilised by low pH conditions on the site. It is possible that the boron concentration is associated with background concentrations. The salinity of the groundwater on parts of the site has been elevated by contamination and this will have altered the potential for use of the groundwater for irrigation. Even in parts of the site in which the groundwater has salinity less than 1500mg/L, contaminants (eg boron and CN) are present that could affect the use of the groundwater for irrigation. A medium level risk has been assigned based on the low likelihood of extractive use of groundwater at the site (that is, irrigation is unlikely ('B'), but not improbable ('A')	
		Stock animals		4	A	Low	CoPP controls on use. Use of groundwater for stock watering onsite is improbable.	Molybdenum in monitoring well GW4 (0.012 mg/L) and As in MW3 marginally exceeds the adopted stock watering guideline (0.01 mg/L for Mo).	
		Industrial use	SO4, pH	2	A	Low	CoPP controls on use. Use of groundwater for industrial purposes onsite is improbable.	Groundwater unlikely to be suitable for industrial uses without some treatment prior to use.	
		Primary contact recreation	NH3, As, B, Mn,	4	A	Low	CoPP controls on use. As above for potable water use.	Groundwater contaminant concentrations on parts of the site exceed the guideline concentrations for primary contact recreation for NH3 by several orders of magnitude as well as being slightly above guideline concentrations for As, CN, boron and manganese.	
2ABCEH	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Direct contact	Buildings & structures	low pH, sulphates	2	B	Low	Groundwater is currently below the likely depth of most structures at the site.	Review of Contamination Status, Southport Nursing Home report (July 2006) - Sulphate concentrations in groundwater at the site were recorded between 220 mg/L and 2,400 mg/L; pH between 6.2 and 8.1 pH units. The soil assessment indicated that pH conditions (and to a lesser extent sulphate conditions) may impact upon the beneficial use of the land for buildings and structures. The groundwater concentrations indicated impact from sulphate but less of an impact from the low pH soils. The Australian Standard for Piling Design and Installation (AS2159-1995) considers buried concrete, and groundwater at the site can be classified as being between mild and non-aggressive; current information indicating that the groundwater condition at the site is not likely to present an unacceptable risk to the beneficial use of buildings and structures.	There is uncertainty as to whether the sewers might be repaired in the future, and in which case the groundwater might rise and affect high rise apartments with potentially deep foundations and basements.
2ABCEI	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Discharge	Maintenance of ecosystems	NH3, As	5	No surface water body onsite	Negligible	No surface water body onsite.	On the site, the concentration of NH3 and CN exceed the ecosystem criteria by several orders of magnitude. As and Mn are also elevated above what could be background concentrations. There is no surface water body on site to which groundwater would discharge.	
2ABDFJ	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Deep groundwater -> Extraction	Potable water	TDS, arsenic, manganese, NH3 and cyanide nickel exceed the drinking water criteria.	4	A	Low	Extractive uses of groundwater are not addressed in the ICMPs, but unlikely to occur given CoPP management/control over activities at the site.	It is not expected that dissolved phase groundwater contamination at the site will migrate vertically downward to deeper aquifers (unless via DNAPL - covered later in Flowchart 7).	There are no data on the groundwater conditions beneath the Brighton Group aquifer
		Agriculture, parks & gardens	TDS, boron, arsenic, manganese	4	B	Medium	As above.	As above. A medium level risk has been assigned on the basis of the possibility of extractive use of groundwater at the site (that is, irrigation is unlikely ("B"), but not improbable ('A'))	
		Stock animals		4	A	Low	As above.	As above. A low level risk has been assigned on the basis of the possibility of the extractive use of groundwater at the site (that is, this use is improbable ('A'))	
		Industrial use	SO4, pH	2	A	Low	As above.	As above. Use is improbable.	
		Primary contact recreation	NH3, As, B, Mn,	4	A	Low	As above.	As above. Use is improbable.	
2ABDFK	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Deep groundwater -> Direct contact	Buildings & structures	Sulphates	2	B	Low	Groundwater is currently below the likely depth of most structures at the site.	As above.	
2ABDFL	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Deep groundwater -> Discharge	Maintenance of ecosystems	NH3, As	5	No surface water body onsite	Negligible	No surface water body onsite.	As above.	

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
Flowchart 3	GASWORKS SITE, Groundwater Segment: Offsite beneficial uses (near the site)								
3ABCEGKP	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Transfer -> Offsite shallow groundwater -> Extraction	Potable water supply: Desirable/Acceptable	TDS, NH3	4	B	Medium	Deep sewers intercept groundwater and restrict flow under most residential areas surrounding the site, although not in all areas. The likely low yield of the Brighton Group aquifer could be a restriction on the abstraction of groundwater for extractive uses. Groundwater abstraction for potable water use is unlikely to be realised due to availability of reticulated water.	Groundwater contaminant concentrations offsite exceed the potable water guideline concentrations for NH3 (aesthetics), As, Ni, Mn, SO4 (health and aesthetics) . NH3 especially is orders of magnitude above the potable use aesthetic guideline concentrations, particularly in the wells immediately adjacent to the eastern and northeastern boundary of the site. A plume extending beneath the residential area beyond Richardson Street contains groundwater with elevated salinity above Segment A background levels (to Segment C), accompanied by increases in SO4, BTEX, CN and NH3. There are no known groundwater extraction wells in the vicinity of the site, and the area would not appear to be within any declared Groundwater Quality Restricted Use Zone. It would be possible for use to be controlled by the bore licensing Authority (Southern Rural Water) if advised by EPA.	The extent of elevated concentrations in offsite areas is an area of uncertainty. Further, it is uncertain whether groundwater is being used by residents in the vicinity of the site.
		Agriculture, parks & gardens	TDS	4	C	Medium	As above, noting that groundwater use for irrigation is considered possible.	The elevated salinity in the area bounded by Richardson, Greig and Bridport Streets of up to 3600mg/L in GW27 is above desirable concentrations for watering of gardens, and is the limiting contaminant. Boron and manganese are elevated and can exceed guideline levels for irrigation use. There is potential for the groundwater in the residential area adjacent to the site to be used for irrigation.	As above.
		Stock watering	NH3, CN,	4	A	Low	Groundwater use for stock watering is considered improbable	Contaminant concentrations in immediate offsite wells appear to be within or only slightly above the guideline concentrations for stock watering, except for ammonia. Stock watering is unlikely to be a realised beneficial use in the urban area, and the contamination is therefore considered to represent a low risk with respect to this beneficial use.	As above.
		Industrial water use	TDS, NH3	2	B	Negligible	Groundwater use for industrial water use is considered unlikely.	The elevated NH3 and TDS could limit the use of the groundwater for industrial use. It is not expected that shallow groundwater on the site is likely to be used for industrial purposes because of the ready availability of reliable mains supply.	As above.
		Primary contact recreation (e.g. bathing, swimming)	NH3	4	C	Medium	Groundwater use for filling swimming pools is considered possible.	Groundwater contaminant concentrations exceed the guideline concentrations for primary contact recreation for NH3 by several orders of magnitude in the NE corner around Richardson St as well as elevated As, CN, boron and manganese. It is possible that groundwater could be used by residents for make up for swimming pools.	As above.
3ABCEGKQ	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Transfer -> Offsite shallow groundwater -> Direct contact	Buildings & structures	SO4, pH	1	B	Negligible	Groundwater is currently below the likely depth of most structures at the site.	The elevated salinity and the SO4 is not considered to be high enough to be of concern for deep foundations and basements and the range of pH suggests that the waters are non aggressive .	There is uncertainty as to whether the sewers might be repaired in the future, and in which case the groundwater might rise and affect high rise apartments with potentially deep foundations and basements.
3ABCEGKR	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Transfer ->	Maintenance of ecosystems	NH3	4	A	Low	There are no nearby surface waters into which the groundwater will discharge. The Bay is approximately 1 km distant from the site.	It is highly unlikely that contamination would discharge at concentrations greater than ecosystem protection criteria at such a distance from the site.	
3ABDFHLP	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Deep groundwater -> Transfer -> Offsite deep groundwater -> Extraction	Potable water supply: Desirable/ Acceptable	TDS, NH3	4	B	Medium	Deep sewers intercept groundwater and restrict flow under most residential areas surrounding the site, although not in all areas. The likely low yield of the Brighton Group aquifer could be a restriction on the abstraction of groundwater for extractive uses. Groundwater abstraction for potable water use is unlikely to be realised due to availability of reticulated water.	It is not expected that dissolved phase groundwater contamination at the site will migrate vertically downward to deeper aquifers, unless via DNAPL migration (covered in later Flowchart 8). Migration downwards would include similar contaminants to those identified in the shallow aquifer, and in the absence of deeper groundwater data the same severity as shallow groundwater has been assumed.	There are no direct data about the deeper aquifer water quality in the vicinity the site. Uncertain use of deep groundwater by residents in the area.
		Agriculture, parks & gardens	TDS	4	C	Medium	As above, noting that groundwater use for irrigation is considered possible.	As above.	As above.
		Stock watering	NH3, CN,	4	A	Negligible	Groundwater use for stock watering is considered improbable	As above.	As above.
		Industrial water use	TDS, NH3	2	B	Negligible	Groundwater use for industrial water use is considered unlikely.	As above.	As above.
		Primary contact recreation (e.g. bathing, swimming)	NH3	4	C	Medium	Groundwater use for filling swimming pools is considered possible.	As above.	As above.
3ABDFHLQ	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Deep groundwater -> Transfer ->	Buildings & structures	SO4, pH	1	B	Negligible	Groundwater is currently below the likely depth of most structures at the site.	Deep groundwater will not come into contact with buildings and structures, other than the deep sewers. It is not expected that groundwater contamination will migrate and affect the deeper aquifers. The low pH if it were to migrate to depth could affect concrete structures.	There is uncertainty as to whether the sewers might be repaired in the future, and in which case the groundwater might rise and affect high rise apartments with potentially deep foundations and basements. There is uncertainty about the long term effect of the contamination on the structure of the sewers.
3ABDFHLR	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Deep groundwater -> Transfer -> Offsite deep groundwater -> Discharge -> Offsite water bodies	Maintenance of ecosystems	NH3	4	A	Low	There are no nearby surface waters into which the groundwater will discharge. The Bay is approximately 1 km distant from the site.	There are no nearby surface waters into which the groundwater will discharge. The Bay is approximately 1 km distant from the site and it is highly unlikely that contamination would discharge at concentrations greater than ecosystem protection criteria at such a distance from the site.	

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
Flowchart 4	**GASWORKS SITE, Groundwater and Surface Water Segment: Off-site beneficial uses (far from the site)**								
4ABCEHKN	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Transfer -> Offsite shallow groundwater -> Extraction/direct contact	Potable water supply: Desirable/ Acceptable	NH3, TDS	3	A	Low	No controls on groundwater use regionally.	Contamination will attenuate with distance and it is highly unlikely that contaminants could migrate at concentrations of concern far from the site.	The actual use of groundwater regionally is uncertain. The offsite extent of groundwater contamination is not fully delineated.
		Agriculture, parks & gardens	TDS, boron	2	C	Low	As above.	As above.	As above.
		Stock watering		0	A	Negligible	As above.	As above.	As above.
		Industrial water use	TDS	1	B	Negligible	As above.	As above.	As above.
		Primary contact recreation (e.g. bathing, swimming)	NH3	3	B	Low	As above.	As above.	As above.
		Buildings and structures	pH, sulphates	1	B	Negligible	Groundwater that is impacted from the site is expected to be below the likely depth of most structures.	Groundwater unlikely to make contact with building footings.	As above.
4ABCEHKOS	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Transfer -> Offsite shallow groundwater -> offsite discharge -> Offsite water body i.e. **Port Phillip Bay**	WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Substantially natural ecosystems with some modifications	NH3	3	B	Low	Deep sewers intercept groundwater, although not in all areas.	The groundwater plume from the site in the direction of Port Phillip Bay mostly appears to be contained by the sewers along Bridport, Graham and Pickles Streets. The concentration of NH3 exceeds the ecosystem criteria by several orders of magnitude, and CN, As, Mn and possibly Se are also elevated above what could be background concentrations by at least ten times. The closest surface water receptor for groundwater from the site is Port Phillip Bay approx 1km south of the site. In the event that sewers are repaired in future, preventing groundwater level control by the sewers surrounding the site, a conservative estimate of the velocity of flow towards the Bay could be around 0.4 - 4 m/yr (based on groundwater level of 1m AHD at the site and for the range of hydraulic conductivity for the Brighton Group of 0.1 -1 m/day), although the extent of migration will relate to localised soil conditions (and hydraulic conductivity). It can be expected that at this flow velocity the extent of attenuation will be very high and contaminants will not reach the Bay at concentrations of concern.	There is no information regarding the rate of attenuation of the contaminants by degradation, retardation or dispersion of the plume. It is uncertain as to the extent to which soil contamination, such as gasworks wastes, is present that could give rise to groundwater contamination. The groundwater flow rate suggested by Golder is very low (0.01 - 0.002m/yr) and appears to be based on very low hydraulic conductivity of the material around the sewer (4 x 10-9 m/sec, ie 3.5 x 10-4 m/day). The Brighton Group could have higher hydraulic conductivity than this, in which case the estimated offsite migration rates may be higher (0.4 -4 m/yr). In the Richardson St area, there is already offsite contaminant migration of 70m or more - which implies at least 0.5m/yr. This anomaly should be clarified.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Highly modified ecosystems with some habitat values	NH3	3	B	Low	Deep sewers intercept groundwater, although not in all areas.		
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Primary contact	NH3	1	B	Negligible	Deep sewers intercept groundwater, although not in all areas.		
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Secondary contact	NH3	1	B	Negligible	Deep sewers intercept groundwater, although not in all areas.		
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aesthetics enjoyment	PAHs	1	B	Negligible	Deep sewers intercept groundwater, although not in all areas.		
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Normal populations	PAHs	1	B	Negligible	Deep sewers intercept groundwater, although not in all areas.		
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aquaculture	PAHs	1	B	Negligible	Deep sewers intercept groundwater, although not in all areas.		
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Commercial and recreation use of edible fish and crustacea	PAHs	1	B	Negligible	Deep sewers intercept groundwater, although not in all areas.		
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Navigation & shipping		1	B	Negligible	Deep sewers intercept groundwater, although not in all areas.		
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Industrial water use	TDS	1	B	Negligible	Deep sewers intercept groundwater, although not in all areas.		
4ABCEHKLPT	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Transfer -> Offsite shallow groundwater -> sewer -> discharge -> Offsite water body ie. **Western Treatment Plant**	Effluent discharge from the treatment plant is to Port Phillip Bay under EPA waste discharge licence.	NH3, TDS, Mn,	1	E	Low	Deep sewers intercept groundwater, although not in all areas.	The contaminant load into the sewers has been estimated by Golder to be very low, and the inflow to the sewers from the site is estimated to be around 0.001% of the typical daily flow rate in the sewer in this area. The overall contaminant load contributed to the sewer from the Gasworks site which could affect the treatment system is expected to be low to negligible.	The basis for the modelling and load to the sewer is uncertain and further clarification being sought from Golder.
4ABCFIMQ	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation ->Deep groundwater -> Transfer -> Deep groundwater -> Extraction/direct contact	Potable water supply: Desirable/ Acceptable	TDS, NH3	3	A	Low	No controls on groundwater use regionally.	It is not expected that groundwater contamination at the site will migrate vertically downward to deeper aquifers nor likely to be extracted. Migration downwards would include similar contaminants to those identified in the shallow aquifer. It is unlikely that groundwater will be used for potable purposes because of the availability of reticulated supplies.	There are no data concerning groundwater in deeper (basalt) aquifers in the vicinity the site
		Agriculture, parks & gardens	TDS	2	C	Low	No controls on groundwater use regionally.	As above.	As above.
		Stock watering	NH3, CN	0	A	Negligible	No controls on groundwater use regionally.	As above.	As above.
		Industrial water use	TDS, NH3	1	B	Negligible	No controls on groundwater use regionally.	As above.	As above.
		Primary contact recreation (e.g. bathing, swimming)	NH3, CN	3	B	Low	No controls on groundwater use regionally.	As above.	As above.
		Buildings and structures	SO4, pH	1	B	Negligible	Groundwater that is impacted from the site is expected to be below the likely depth of most structures.	As above.	As above.

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4ABCFIMRU	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Deep groundwater -> Transfer -> Offsite deep groundwater -> offsite discharge -> Offsite water body i.e. **Port Phillip Bay**	WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Substantially natural ecosystems with some modifications	NH3	3	B	Low	Deep sewers intercept groundwater, although not in all areas.	Migration downwards would include similar contaminants to those identified in the shallow aquifer. Contamination will attenuate with distance and it is highly unlikely that contaminants could migrate at concentrations of concern to Port Phillip Bay.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Highly modified ecosystems with some habitat values	NH3	3	B	Low	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Primary contact	NH3	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Secondary contact	NH3	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aesthetics enjoyment	PAHs	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Normal populations	PAHs	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aquaculture	PAHs	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Commercial and recreation use of edible fish and crustacea	PAHs	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Navigation & shipping		1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Industrial water use	TDS	1	B	Negligible	As above.	As above.	
4ABDGJU	Historical activities -> Contaminated soil -> Runoff -> Stormwater Drainage -> Discharge -> Offsite water body i.e. **Port Phillip Bay**	WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Substantially natural ecosystems with some modifications	Sediment/turbidity	1	B	Negligible	The site is capped, although the integrity of the capping is uncertain.	It is possible for some contamination to be present in the surface soils above sediment criteria applicable to the Bay. It may erode under storm conditions into the stormwater drainage system and reach the Bay. Dilution will occur with other run off into the stormwater system, and the potential for the contamination to give rise to significant areas of contaminated sediments (from the site) is low.	Uncertainties include the extent of surface soil contamination exceeding sediment criteria, the potential for surface soils to enter stormwater system, and the level of dilution that will occur prior to final discharge into the Bay.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Highly modified ecosystems with some habitat values	Sediment/turbidity	1	B	Negligible	As above.		As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Primary contact	Sediment/turbidity	1	B	Negligible	As above.	As above.	As above.

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		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Secondary contact	Sediment/turbidity	1	B	Negligible	As above.	As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aesthetics enjoyment	Sediment/turbidity	1	B	Negligible	As above.	As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Normal populations	Sediment/turbidity	1	B	Negligible	As above.	As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aquaculture	Sediment/turbidity	1	B	Negligible	As above.	As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Commercial and recreation use of edible fish and crustacea	Sediment/turbidity	1	B	Negligible	As above.	As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Navigation & shipping		1	B	Negligible	As above.	As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Industrial water use	Sediment/turbidity	1	B	Negligible	As above.	As above.	As above.

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
Flowchart 5	GASWORKS SITE, Land Segment: Off-site beneficial uses (near to the site)								
5ABCFEDGIK	Historical activities -> Contaminated soil -> Leaching/Infiltration/ Percolation -> Shallow groundwater -> Transfer -> Offsite shallow groundwater -> Volatile emission -> Soil gas -> Diffusion into Buildings and structures	Human health: General Public - Adult	NH3	2	C	Low	Deep sewers intercept groundwater, minimising offsite transfer of contaminated groundwater, although the sewers do no intercept flow in all areas.	Field logs from the offsite bores MW26-28 and MW30 drilled in the Richardson St area where the highest impacts of groundwater have been detected do not report significant odours at the water table level. A nearby bore MW29 reported slight hydrocarbon odours at about 8m, but no hydrocarbons were detected in groundwater samples from this bore. In MW15 offsite in Bridport St on the SW corner a slight to moderate odour was detected at a depth of 7.5 - 7.7m, just above the water table (around 8.8m). PID readings were 0 ppm for the soil sample collected from this location. Groundwater is typically below the likely depth of most buildings in the vicinity the site. However there is presently potential for volatile emissions to migrate into deep foundations and basements. In the event of the sewers being repaired and water levels being re-established to natural levels, there is potential for shorter pathways to vapour receptors. The ammonia plume that has been identified offsite (NE & W) would present an odour issue rather than a health issue.	No soil gas or air monitoring data for off site scenarios available.
		Human health: General Public - Child	NH3	2	C	Low	As above.	As above..	As above.
		Human health: Workers - Surface	NH3	2	C	Low	As above..	As above.	As above.
		Human health: Workers - Subsurface	NH3	3	C	Medium	Typical OHS procedures for entry into deep sewers should be protective of sewer/maintenance workers.	As above - though noting that the pathway is shorter, and the concentrations of gases can be higher, but time duration of exposure can be less for works being carried out in trenches compared with exposure occurring in buildings. Understood that Melbourne Water was informed of the contamination that may be entering the sewer from the Site. Golder Associates recommended that a similar agreement to that proposed with Melbourne Water be sought with South East Water to inform workers of the potential contamination status of the sewer due to the ingress of contaminated groundwater (see Further Groundwater Investigation, Pickle Street Sewer, West of the Former South Melbourne Gasworks, Gasworks Precinct, October 2007). Low rate of seepage, minimal exposure to seepage because of the low rate of discharge, OHS and confined space procedures in place for deep sewer entry should be protective of personnel.	The effectiveness of the Water Authority notifications/agreements is not known.
		Aesthetics	NH3	2	C	Low	As above.	Unlikely that volatiles (eg ammonia) would be at levels that would give rise to odours within buildings.	No soil gas or air monitoring data for off site scenarios available.
5ABCFEDGIL	Historical activities -> Contaminated soil -> Leaching/Infiltration/ Percolation -> Shallow groundwater -> Transfer -> Offsite shallow groundwater -> Volatile emission -> Soil gas -> Diffusion into Residential homes	Human health: Residents	NH3	2	C	Low	As above.	Field logs from the offsite bores MW26-28 and MW30 drilled in the Richardson St area where the highest impacts of groundwater have been detected do not report significant odours at the water table level. A nearby bore MW29 reported slight hydrocarbon odours at about 8m, but no hydrocarbons were detected in groundwater samples from this bore. In MW15 offsite in Bridport St on the SW corner a slight to moderate odour was detected at a depth of 7.5 - 7.7m, just above the water table (around 8.8m). PID readings were 0 ppm for the soil sample collected from this location. Groundwater is typically below the likely depth of most buildings in the vicinity the site. However there is presently potential for volatile emissions to migrate into deep foundations and basements. In the event of the sewers being repaired and water levels being re-established to natural levels, there is potential for shorter pathways to vapour receptors. The ammonia plume has been identified offsite (NE & W) and can be expectged to present an odour issue rather than a health issue.	No soil gas or air monitoring data for off site scenarios available.
		Aesthetics	NH3	2	C	Low	As above.	Ammonia from soil gas unlikely to be detectable (as odour) inside buildings.	As above.
5ABCFEDGIM	Historical activities -> Contaminated soil -> Leaching/Infiltration/ Percolation -> Shallow groundwater -> Transfer -> Offsite shallow groundwater -> Volatile emission -> Soil gas -> Diffusion into ambient air	Human health: General Public - Adult	NH3	1	B	Negligible	Deep sewers intercept groundwater, minimising offsite transfer of contaminated groundwater, although the sewers do no intercept flow in all areas.	Field logs from the offsite bores MW26-28 and MW30 drilled in the Richardson St area where the highest impacts of groundwater have been detected do not report significant odours at the water table level. A nearby bore MW29 reported slight hydrocarbon odours at about 8m, but no hydrocarbons were detected in groundwater samples from this bore. In MW15 offsite in Bridport St on the SW corner a slight to moderate odour was detected at a depth of 7.5 - 7.7m, just above the water table (around 8.8m). PID readings were 0 ppm for the soil sample collected from this location. Groundwater is typically below the likely depth of most buildings in the vicinity the site. However there is presently potential for volatile emissions to migrate into deep foundations and basements. In the event of the sewers being repaired and water levels being re-established to natural levels, there is potential for shorter pathways to vapour receptors. The ammonia plume has been identified offsite (NE & W) would present an odour issue rather than a health issue.	No soil gas or air monitoring data for off site scenarios available.
		Human health: General Public - Child	NH3	1	B	Negligible	As above.	As above.	As above.
		Aesthetics		2	C	Low	As above.	As above.	As above.
5ABCFEDGIN	Historical activities -> Contaminated soil -> Leaching/Infiltration/ Percolation -> Shallow groundwater -> Transfer -> Offsite shallow groundwater -> Volatile emission -> Soil gas -> Root zones/ Plants/ Produce	Ecosystems: Natural/Modified/ Highly Modified	Ammonia	1	B	Negligible	Deep sewers intercept groundwater, minimising offsite transfer of contaminated groundwater, although the sewers do no intercept flow in all areas.	It is highly unlikely that soil gas associated with ammonia and other contaminants will cause adverse impact to ecosystems and plants compared to direct contact with contamination.	No data that relates to soil gas impacts on offsite ecosystems/plants, but this is not considered to be a significant area of uncertainty as risk is expected to be very low.
		Food production	Ammonia	1	B	Negligible	As above.	As above.	As above.

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
5ABCFHJO	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Discharge -> Sewer -> Dermal contact/direct contact	Human health: Workers - Subsurface	NH3	3	C	Medium	Typical OHS procedures for entry into deep sewers should be protective of sewer/maintenance workers.	Understood that Melbourne Water was informed of the contamination that may be entering the sewer from the Site. Golder Associates recommended that a similar agreement to that proposed with Melbourne Water be sought with South East Water to inform workers of the potential contamination status of the sewer due to the ingress of contaminated groundwater (see Further Groundwater Investigation, Pickle Street Sewer, West of the Former South Melbourne Gasworks, Gasworks Precinct, October 2007). Low rate of seepage, minimal exposure to seepage because of the low rate of discharge, OHS and confined space procedures in place for deep sewer entry should be protective of personnel.	The frequency that works need to access sewer is unknown. Sewers thought to be too narrow to allow entry. The effectiveness of the Water Authority notifications/agreements is not known.
		Buildings & structures	SO4, pH	1	B	Negligible		The concentration of the groundwater and the pH is generally between 7 and 7.9. One location GW5 has pH 6 and 6.2 which also coincides with sulphate concentrations of 2400 and 2000 mg/L. The groundwater discharge into the sewer is not considered to be highly corrosive. Likewise the salinity at less than 5000mg/L is unlikely to be corrosive to the sewer infrastructure.	Uncertain whether the sewerage system has been constructed with materials that can accommodate aggressive groundwater conditions - they are known to be leaky, in that groundwater is leaking into them.
5ABCFHJP	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Discharge -> Sewer -> Volatile emission	Human health: Workers - Subsurface	NH3	3	C	Medium	Typical OHS procedures for entry into deep sewers should be protective of sewer/maintenance workers.	Understood that Melbourne Water was informed of the contamination that may be entering the sewer from the Site. Golder Associates recommended that a similar agreement to that proposed with Melbourne Water be sought with South East Water to inform workers of the potential contamination status of the sewer due to the ingress of contaminated groundwater (see Further Groundwater Investigation, Pickle Street Sewer, West of the Former South Melbourne Gasworks, Gasworks Precinct, October 2007). Low rate of seepage, minimal exposure to seepage because of the low rate of discharge, OHS and confined space procedures in place for deep sewer entry should be protective of personnel.	The effectiveness of the Water Authority notifications/agreements is not known.

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
Flowchart 6	GASWORKS SITE, NAPL, Land Segment: On-site beneficial uses								
6ABCFK	Historical activities -> NAPL on-site -> Volatile emission -> Soil gas -> Diffusion into buildings & structures	Human health: Park users - Adult	coal tars & tar oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	2	D	Medium	Controls as per ICMP ie Potential vapour exposure within the buildings to be minimised through the continual use of air conditioning systems and adequate ventilation. Time spent in poorly ventilated locations should be minimised pending further measurements and recommendations.	Vapour and Edible Vegetation Risk Assessment (July 2004) - Golder tested for VOCs, SVOCs and CN within four onsite buildings. Four chemicals of interest (COIs) were identified: phenol, ethylbenzene, toluene and xylenes. The risk assessment of the COIs detected in indoor air used the highest concentrations of each chemical measured at any of the indoor monitoring locations. The 2004 Golder sampling was undertaken on a Monday morning to be conservative as it was considered that any vapours inside the buildings may be at higher concentrations after the buildings were closed/less frequently used over the weekend. Two park based buildings were selected based on the site history to be as close as practical to the worst potential areas for vapours, i.e. one location was in the bookshop in the administration area of the site (west of the former coal gasification plant); and the other in the dressing room of the theatre (in the administration building area of the site, and east of the former underground purifiers). Golder concluded that the gasworks waste on the site did not appear to be posing vapour risks to worker	NAPL is expected to be at the Site but there is uncertainty about where, such as whether NAPL is present in the southeast part of the site as well as in the vicinity of the Southport Nursing Home in the northeast. Uncertain about the extent to which volatiles may migrate into buildings, as a function of location and different atmospheric conditions. Uncertainty regarding the robustness of the ventilation systems ie. could they shut off?
		Human health: Park users - Child	As above.	2	D	Medium	As above.	As above.	As above.
		Human health: Workers - Surface	As above.	2	D	Medium	As above.	As above.	As above.
		Aesthetics	As above.	2	D	Medium	Not explicitly addressed in the ICMP, but odours expected to be managed by use of the ventilation systems.	Reports of objectionable odours within buildings have not been seen by the auditor, however the contaminants of concern at the site are known to be odorous. Odours have been observed during the soil and groundwater investigation, and noted on bore logs.	As above.
6ABCFL	Historical activities -> NAPL on-site -> Volatile emission -> Soil gas -> Diffusion into residential homes/Southport	Human health: Residents	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	2	D	Medium	Controls as per ICMP ie Potential vapour exposure within the buildings to be minimised through the continual use of air conditioning systems and adequate ventilation. Time spent in poorly ventilated locations should be minimised pending further measurements and recommendations.	As for pathway 6ABCFK. Four non-carcinogenic COIs were detected within some of the four buildings sampled at the site (2004). Two locations were within the Southport site. A quantitative RA based on the highest concentrations was conducted and concluded that based on the data collected there did not appear to be a risk to workers or residents.	Vapour samples were collected on one occasion and may not be representative of the high-end of the vapour that may be emitted, or what may be emitted in the future. The 2005 vapour study represents a point in time and is not substantial enough to understand current risk or future risks. At the time of preparing the ICMP indoor vapour testing was about to be commenced to provide further information for guidance on this issue. The ICMP was to be updated should the testing indicate additional actions are required - ICMPs were not updated, probably because Golder concluded that risk was low.
		Aesthetics	As above.	2	D	Medium	Not explicitly addressed in the ICMP, but odours expected to be managed by use of the ventilation systems.	Reports of objectionable odours within buildings have not been seen by the auditor, however the contaminants of concern at the site are known to be odorous. Odours have been observed from the soil and groundwater investigation bores.	As above.
6ABCFM	Historical activities -> NAPL on-site -> Volatile emission -> Soil gas -> Diffusion into excavations	Human health: Workers - Subsurface	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	3	D	Medium	Park ICMP - task specific management for any works > 30cm bgl.	Contamination by volatile substances is present in the subsurface. Risks from vapours to subsurface workers was not included into the Golder 2004 study.	Uncertain whether the results from the gas sampling can be applied to assess risk to subsurface workers. Uncertain whether the Park ICMP is being adequately implemented to protect workers.
6ABCFN	Historical activities -> NAPL on-site -> Volatile emission -> Soil gas -> Diffusion into ambient air	Human health: Park users - Adult	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	1	C	Low	No controls on this exposure pathway.	The outdoor air vapour risk assessment (Golder 2004) involved sampling four soil gas bores installed at various locations around the Park. Twenty COIs were identified, and not all COIs were detected at all of the soil gas bore locations. Soil gas concentrations varied significantly between locations. A quantitative risk assessment of the highest measured concentrations of the COIs did not find unacceptable risks to child and adult recreational users of the Park or outdoor maintenance workers on the Park. Therefore, based on the data collected for the outdoor air vapour risk assessment, Golder concluded that gasworks waste on the site did not appear to be posing vapour risks to recreational users of, or workers on, the Park. The assessment of risks to both child and adult recreational park users found that risks from all noncarcinogenic COIs to be less than a value of 0.2, and carcinogenic risks from benzene to child and adult recreational park users were found to be less than 1 x 10-5 and therefore also acceptable. In general, dilution in unconfined ambient air can be expected to be very high and the risk low.	Uncertainty as to the adequacy of results of investigations in characterising the concentrations of volatile gases (study was limited in scope and conclusions based on a single sampling event at 4 soil gas bore locations).
		Human health: Park users - Child	As above.	1	C	Low	As above.	As above.	As above.
		Human health: Workers - Surface	As above.	1	C	Low	As above.	As above.	As above.
		Human health: Residents	As above.	1	C	Low	As above.	As above.	As above.
		Aesthetics	As above.	1	C	Low	As above.	Objectionable odours in the parkland does not appear to be a significant issue, however hydrocarbon odours and staining have been noted in several soil and groundwater borehole locations.	As above.
6ABCFO	Historical activities -> NAPL on-site -> Volatile emission -> Soil gas -> Diffusion into plant root zones	Ecosystems: Natural/modified/highly modified	coal tars, tar oils, PAHs	1	D	Low	No controls - plants grow through the site, in many areas established on capping rather than directly on waste/contaminated soil.	Some gases may kill or harm plants but are generally not bioaccumulative . The other bioaccumulative chemicals tend to solid liquid such as PAHs, PCBs, pesticides.	As above.
		Food production	coal tars, tar oils, PAHs	1	D	Low	Edible vegetables are not being proactively grown at the site, ie. bush tucker trail and fruit trees. Golder identified that some part of plants that grow at the site could be eaten (see Report 5) but that it is unlikely this would occur.	Some gases may kill or harm plants but are generally not bioaccumulative . The other bioaccumulative chemicals tend to solid liquid such as PAHs, PCBs, pesticides.	As above.
6ABDG	Historical activities -> NAPL on-site -> Direct contact -> Dermal contact/direct contact	Human health: Park users - Adult	As above.	2	C	Low	Maintenance of the separation layer over the site required as part of the ICMP.	Soils on Gasworks Park and Southport are contaminated to various degrees with gasworks waste and free product/tars/NAPL and while expected to remain at the site free product not observed on site surface.	NAPL is expected to be at the Site but there is uncertainty about where, such as whether NAPL is present in the southeast part of the site as well as in the vicinity of the Southport Nursing Home in the northeast.
		Human health: Park users - Child	As above.	2	C	Low	As above.	As above.	As above.
		Human health: Workers - Surface	As above.	2	C	Low	As above.	As above.	As above.
		Human health: Workers - Subsurface	As above.	2	D	Medium	Park ICMP - task specific management for any works > 30cm bgl.	Soils on Gasworks Park and Southport are contaminated to various degrees with gasworks waste and free product/tars/NAPL are expected to be encountered at depth.	As above.
		Human health: Residents	As above.	2	C	Low	Maintenance of the separation layer over the site required as part of the ICMP.	As above.	As above.

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
		Buildings & structures	coal tars and tar oils	1	B	Low	No specific controls on existing building w.r.t. resistance to NAPL/tars. Golder advice CoPP (as per reports) is limited to the need to assess new building designs for compatibility with low pH and high sulphates.	NAPL/tar has been identified in wells in the southern portion of the site and would be expected to be in contact with subsurface structures at depth. Potential for attack on existing and new structures has not been characterised, although extent of attack is likely to be limited.	There is potential for tar and soil contamination present to attack concrete structures, the extent of free product occurrence has not been determined.
6ABDH	Historical activities -> NAPL on-site -> Direct contact -> Ingestion	Human health: Park users - Adult	coal tars & tar oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	2	C	Low	ICMP requires that the separation layer be maintained over the non-building areas of the site to minimise access to subsurface contamination.	Soils on Gasworks Park and Southport are contaminated to various degrees with gasworks waste and NAPL/tars are expected to remain at the site. In terms of assessing the contamination, Golder has applied NEPM D and E criteria - these appear appropriate.	NAPL is expected to be at the Site but there is uncertainty about where, such as whether NAPL is present in the southeast part of the site as well as in the vicinity of the Southport Nursing Home in the northeast.
		Human health: Park users - Child	As above.	2	C	Low	As above.	As above.	As above.
		Human health: Workers - Surface	As above.	2	C	Low	ICMP - Golder recommended that workers or people who spend more than two days a week at the site be briefed by the Health and Safety Coordinator regarding site issues, the need to minimise exposure to soil at the site and the need to adopt standard hygiene practices following contact with the surrounding soils.	Free product not observed on site surface and unlikely to encountered by workers (ie within buildings, gardeners etc) at the site.	As above.
		Human health: Workers - Subsurface	As above.	2	C	Low	ICMP - All intrusive maintenance works (>30cm bgl) must prepare a task specific contamination management plan in consultation with a CoPP Health and Safety Coordinator. Considerations to be included: dust management, what to do is coloured or odorous soils are encountered, hygiene practices such as washing hands after working at the site.	Tar observed in at least two bore holes in the southern portion of the site. Expected to be contacted should subsurface works be undertaken in the area.	As above.
		Human health: Residents	As above.	2	C	Low	Southport ICMP puts controls over access to fill/natural soils underlying the separation layers.	Soils on Gasworks Park and Southport are contaminated to various degrees with gasworks waste, but free product is not being observed on the site surface and is unlikely to be contacted/ingested by users of the park.	As above.
6ABDI	Historical activities -> NAPL on-site -> Direct contact -> Surface contamination/ waste	Aesthetics	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	2	B	Low	ICMP - Golder recommended that workers or people who spend more than two days a week at the site be briefed by the Health and Safety Coordinator regarding site issues, the need to minimise exposure to soil at the site and the need to adopt standard hygiene practices following contact with the surrounding soils.	Free product not observed on site surface.	As above.
6ABEJ	Historical activities -> NAPL on-site -> Root zone/ Plants/ Produce	Ecosystems: Natural/modified/highly modified	coal tars, tar oils, PAHs	3	B	Low	Plants grow through the site, in many areas established on capping rather than directly on waste/contaminated soil. Planting situation and plant varieties are generally suitable for the conditions. Produce of the plants is not thought to be used for human consumption (refer next item).	The major contaminants in soil have been found to be PAHs, including benzo(a)pyrene) and TPHs (>C9). The PAHs are considered to have potential to be in two forms in soils on the site – a liquid form (e.g., tars, liquors in and near tanks and pits) and in solid form (e.g., ash, coke, coal in and near hoppers and bunkers). PAHs in solid form are expected to have a lower potential for uptake by plant roots and effect on plant growth. PAHs in liquid form are expected to have a higher potential for uptake by plant roots, and effect on plant growth, but it is not likely that NAPL will be in the plant root zone. Metals have been found above NEPM EILs, and other contaminants such as low pH and sulphate may impact the beneficial use of maintenance of ecosystems - but these are not expected to be NAPL-related issues.	NAPL is expected to be at the Site but there is uncertainty about where, and at what depth it may occur.
		Human health: Park users - Adult	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	1	B	Negligible	The bush tucker trail is understood to have been removed from the site. Golder identified that some part of plants that grow at the site could be eaten (see Report 5) but that it is unlikely this would occur. Not sure about the status of fruit trees on the site.	As above. To derive an overall risk ranking for contaminant uptake and potential consumption, Golder identified site plants, and assessed the expected root depth, the edible portion of the plant, the likelihood of consumption, and the expected form of the PAHs contamination. Golder ranked the hazard as "nil" when the exposure pathway for a particular plant did not exist (i.e., the plant was not consumed). A hazard was ranked "negligible" when the plant had an expected shallow root depth. A hazard was ranked "low" when a plant had an expected deep root depth near areas that had potential for the presence of liquid PAHs (NAPL) and the plant had an edible portion that had potential to be consumed by Gasworks Park users. No hazards were ranked higher than low due to the low potential for PAH uptake by plants - as uptake was expected to be low and consumption of vegetation expected to be infrequent.	Extent of uptake by fruit trees is uncertain. Extent of consumption of produce is uncertain. Golder suggested that should quantitative confirmation of the qualitative findings be required, that may be possible by analysing the fruit from the fruit trees on the site.
		Human health: Park users - Child	As above.	1	B	Negligible	As above.	As above for adult park users.	As above,
		Human health: Workers - Surface	As above.	1	B	Negligible	As above.	As above for park users, but considering that frequency at the park is expected to be less than park users.	As above.
		Human health: Workers - Subsurface	As above.	1	B	Negligible	As above.	As above for park users, but sub-surface workers are not likely to consume produce.	As above.
		Human health: Residents	As above.	1	B	Negligible	As above.	As above for adult park users, although residents are not likely to consume produce.	As above.
		Food production	coal tars, tar oils, PAHs	3	B	Low	As above.	As above, plants are not expected to be used for systematic food production. Most VOCs and SVOC results have not been compared to EILs or similar.	Toxicity of contaminants to plants has not been evaluated. Effect of contaminants on food production has not been evaluated.

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
Flowchart 7	GASWORKS SITE, NAPL, Groundwater Segment: On-site beneficial uses								
7ABCEH	Historical activities -> NAPL on-site -> Dissolution into groundwater on-site -> Shallow groundwater -> Extraction	Potable water	PAHs, metals	4	A	Low	Extractive uses of groundwater are not addressed in the ICMPs, but unlikely to occur given CoPP management/control over activities at the site.	Considering the history of the site, NAPL might be expected; however, there does not appear to be a positive identification of NAPL within the saturated zone at the site, although some very high dissolved phase concentrations of PAH and some odours in well MW24 suggest that NAPL may be present nearby. If NAPL is extracted by pumping either by a well penetrating NAPL or by being pumped from the surrounding aquifer into a well, the concentrations will exceed extractive use levels. In addition, NAPL will comprise an on-going source of contaminants to be dissolved in migrating groundwater.	In the absence of positive identification of NAPL, there is uncertainty about the application in this situation of the SEPP GoV clause 18 that requires that NAPL be removed from an aquifer unless the Authority is satisfied that there is no acceptable risk posed to any beneficial use by the NAPL.
		Agriculture, parks & gardens	PAHs, metals	4	B	Medium	As above.	As above. The risk has been assessed as medium on the basis that the extractive use of groundwater at the site for irrigation is unlikely ('B')	As above for potable water use.
		Stock animals	PAHs, metals	4	A	Low	As above.	As above. Use is improbable.	As above for potable water use.
		Industrial Use		2	A	Low	As above.	Groundwater unlikely to be suitable for industrial uses without some treatment prior to use. Use is improbable.	As above for potable water use.
		Primary contact: recreation	PAHs, metals	4	A	Low	As above.	As above. Use is improbable.	As above for potable water use.
7ABCEI	Historical activities -> NAPL on-site -> Dissolution into groundwater on-site -> Shallow groundwater -> Discharge	Maintenance of Ecosystems	PAHs, metals	5	No surface water body onsite.	Negligible	No surface water/groundwater dependant ecosystem at the site.		
7ABF	Historical activities -> NAPL on-site -> Direct contact	Buildings & structures	PAHs, metals	2	B	Low	No explicit controls however groundwater is currently below the likely depth of most structures at the site.	Structures on site are well above the groundwater level and as the park is expected to remain as public space, this is considered to be an unlikely impact.	Uncertainty as to whether the sewers will be repaired at some time in the future, giving rise to groundwater rise.
7ABDGJ	Historical activities -> NAPL on-site -> Dissolution into groundwater on-site -> Deep groundwater -> Extraction	Potable water	PAHs, metals	4	A	Low	Extractive uses of groundwater are not addressed in the ICMPs, but unlikely to occur given CoPP management/control over activities at the site.	DNAPL such as tar can migrate vertically downwards through an aquifer. There is no data on the deeper aquifer water quality at the site. It is suspected that NAPL may be present in the SE and NE corners, but it have not been encountered by the investigations to date. For the purposes of ranking the risk, it is assumed that some DNAPL may be present and may have migrated vertically.	In the absence of positive identification of NAPL, there is uncertainty about the application in this situation of the SEPP GoV clause 18 that requires that NAPL be removed from an aquifer unless the Authority is satisfied that there is no acceptable risk posed to any beneficial use by the NAPL.
		Agriculture, parks & gardens	PAHs, metals	4	B	Medium	Use of groundwater for irrigation onsite is unlikely.	As above. The risk has been assessed as medium on the basis that the extractive use of groundwater at the site for irrigation is unlikely ('B')	As above for potable water use.
		Stock animals	PAHs, metals	4	A	Low	Use of groundwater for stock watering onsite is improbable.	As above.	As above for potable water use.
		Industrial use	PAHs, metals	2	A	Low	Use of groundwater for industrial purposes onsite is improbable.	As above.	As above for potable water use.
		Primary contact: recreation	PAHs, metals	4	A	Low	Use of groundwater for filling swimming pools or other recreational use onsite is improbable.	As above.	As above for potable water use.
7ABDGK	Historical activities -> NAPL on-site -> Dissolution into groundwater on-site -> Deep groundwater -> Discharge	Maintenance of Ecosystems	PAHs, metals	5	No surface water body onsite.	Negligible	No surface water/groundwater dependant ecosystem at the site.		

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
Flowchart 8	**GASWORKS SITE, NAPL, Land Segment: Off-site beneficial uses (near to the site)**								
8ABCDFIJ	Historical activities -> NAPL on-site -> Vertical/lateral migration through aquifer -> Off-site groundwater -> Volatile emission -> Soil gas -> Diffusion into buildings & structures	Human health: Residents - Adult	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	2	A	Low	Deep sewers intercept groundwater and potentially NAPL, although not in all areas.	As for 7ABCEH. Some very high dissolved phase concentrations and some odours in wells near the SE corner suggest that NAPL may be present. NAPL migration laterally through the aquifer can occur, although the high viscosity and density suggest that migration rates of NAPL are not likely to be rapid even under the hydraulic gradient in the vicinity of the sewers, and therefore it is unlikely that NAPL will migrate off site.	Uncertainty about the presence of NAPL and its location and rate of migration if present
		Human health: Residents - Child	As above.	2	A	Low	As above.	As above.	As above.
		Human health: Workers - Surface	As above.	2	A	Low	As above.	As above.	As above.
		Aesthetics	As above.	2	A	Low	As above.	As above.	As above.
8ABCDFIK	Historical activities -> NAPL on-site -> Vertical/lateral migration through aquifer -> Off-site groundwater -> Volatile emission -> Soil gas -> Diffusion into residential homes	Human health: Residents	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	2	A	Low	As above.	As for 7ABCEH. Some very high dissolved phase concentrations and some odours in wells near the SE corner suggest that NAPL may be present. NAPL migration laterally through the aquifer can occur, although the high viscosity and density suggest that migration rates of NAPL are not likely to be rapid even under the hydraulic gradient in the vicinity of the sewers, and therefore it is unlikely that NAPL will migrate off site.	As above.
		Aesthetics	As above.	2	A	Low	As above.	As above.	As above.
8ABCDFIL	Historical activities -> NAPL on-site -> Vertical/lateral migration through aquifer -> On-site groundwater -> Transfer -> Off-site groundwater -> Volatile emission -> Soil gas -> Diffusion into excavations	Human health: Workers - Subsurface	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	2	C	Low	Deep sewers intercept groundwater and potentially NAPL, although not in all areas.	As above.	As above
8ABCDFIM	Historical activities -> NAPL on-site -> Vertical/lateral migration through aquifer -> On-site groundwater -> Transfer -> Off-site groundwater -> Volatile emission -> Soil gas -> Diffusion into ambient air	Human health: General Public - Adult	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	1	B	Negligible	As above.	As above.	As above.
		Human health: General Public - Child	As above.	1	B	Negligible	As above.	As above.	As above.
		Human health: Workers - Surface	As above.	1	B	Negligible	As above.	As above.	As above.
		Aesthetics	As above.	1	C	Low	As above.	As above.	As above.
8ABCDFIN	Historical activities -> NAPL on-site -> Vertical/lateral migration through aquifer -> On-site groundwater -> Transfer -> Off-site groundwater -> Volatile emission -> Soil gas -> Dissolution into plant root zones	Ecosystems: Natural/Modified/ Highly Modified	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	0	A	Negligible	As above.	As above.	As above.
		Food production	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	0	A	Negligible	As above.	As above.	As above.
8ABCFGIL	Historical activities -> NAPL on-site -> Vertical/lateral migration through aquifer -> On-site groundwater -> Discharge -> Sewer -> Dermal contact	Human health: Workers - Subsurface	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	3	C	Medium	As above.	As above. In addition inspections of the sewers have shown stalactites hanging from the sewer roof, although it has not been confirmed whether or not this is NAPL or some other material (such as algae). NAPL within the sewer would be an indication of NAPL in the soils surrounding the sewer walls. The volatile emissions would however be only a small part of the emissions present in the sewers so the severity is considered to be low	As above
8ABCFGIJ	Historical activities -> NAPL on-site -> Vertical/lateral migration through aquifer -> On-site groundwater -> Discharge -> Sewer -> Volatile emission	Human health: Workers - Subsurface	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	3	C	Medium	As above.	As above.	As above.
Flowchart 9	**GASWORKS SITE, NAPL, Groundwater Segment: Off-site beneficial uses (near to the site)**								
9ABCFJ	Historical activities -> NAPL on-site -> Lateral NAPL migration through aquifer -> Shallow aquifer -> Extraction	Potable water supply	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	4	B	Low	Deep sewers intercept groundwater and potential NAPL, although not in all areas.	As 7ABCEH. NAPL has not been encountered by Golder work to date, however some very high dissolved phase concentrations and odours in wells near the SE corner suggest that NAPL may be present. The dissolved concentrations around Richardson St where there appears to have been offsite contaminant migration do not appear to indicate the present of offsite NAPL. Similarly, the elevated concentrations of constituents in the NE corner (near Alinta) do not appear to indicate NAPL. If NAPL is extracted by pumping either by a well penetrating NAPL or by being pumped from the surrounding aquifer into a well, the concentrations will exceed extractive use levels. The SE area between the site and the sewer is Council owned land and it is improbable that someone would drill and extract in this area as a potable water supply.	The presence and possible extent of NAPL on site is uncertain. The quality of deeper groundwater that may be migrating from the site (especially in areas where groundwater is not being intercepted by the sewer network) is uncertain
		Agriculture, parks & gardens	As above.	4	C	Medium	As above.	As above, noting that groundwater use for irrigation is considered possible.	As above.
		Stock watering	As above.	4	A	Low	As above.	As above, though noting that groundwater use for stock watering is considered improbable	As above.
		Industrial Use	As above.	2	B	Negligible	As above.	As above though noting that groundwater use for industrial water use is considered unlikely.	As above.

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
		Primary contact: recreation (e.g. bathing)	As above.	4	C	Medium	As above.	As above, though noting that groundwater use for filling swimming pools is considered possible.	As above.
9ABCFK	Historical activities -> NAPL on-site -> Lateral NAPL migration through aquifer -> Shallow aquifer -> Direct contact	Buildings & structures	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	1	B	Negligible	Groundwater is currently below the likely depth of most structures at the site.	NAPL has not been identified on site, though expected. Would seem improbable that it would migrate laterally off the site beyond the sewer system and impact of buildings and structures. NAPL might have an impact on the sewer infrastructure itself.	As above.
9ABCFL	Historical activities -> NAPL on-site -> Lateral NAPL migration through aquifer -> Shallow aquifer -> Discharge	Maintenance of Ecosystems	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	4	A	Negligible	There are no nearby surface waters into which the groundwater will discharge. The Bay is approximately 1 km distant from the site.	NAPL has not been identified on site, though expected.	As above.
9ABDGJ	Historical activities -> NAPL on-site -> Dissolution into groundwater -> Shallow groundwater -> Extraction	Potable water supply	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	4	B	Low	Deep sewers intercept groundwater and potential NAPL, although not in all areas such as in the SE region of the site.	NAPL has not been encountered by Golder work to date, however some very high dissolved phase concentrations and odours in wells near the SE corner suggest that NAPL may be present, and in this area there is potential for dissolved phase contamination to move off site. However, the dissolved concentrations around Richardson St where there appears to have been offsite contaminant migration do not appear to indicate the presence of offsite NAPL. Similarly, the elevated concentrations of constituents in the NE corner (near Alinta) do not appear to indicate NAPL. If groundwater contaminated by NAPL constituents is extracted by pumping, the concentrations are likely to exceed extractive use levels. Use of groundwater for potable use is considered to be unlikely.	As above.
		Agriculture, parks & gardens	As above.	4	C	Medium	As above.	As above, noting that groundwater use for irrigation is considered possible.	As above.
		Stock watering	As above.	4	A	Negligible	As above.	As above, though noting that groundwater use for stock watering is considered improbable	As above.
		Industrial water use	As above.	2	B	Negligible	As above.	As above though noting that groundwater use for industrial water use is considered unlikely.	As above.
		Primary contact: recreation (e.g. bathing)	As above.	4	C	Medium	As above.	As above, though noting that groundwater use for filling swimming pools is considered possible.	As above.
9ABDGK	Historical activities -> NAPL on-site -> Dissolution into groundwater -> Shallow groundwater -> Direct contact	Buildings & structures	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	1	B	Negligible	Groundwater is currently below the likely depth of most structures at the site.	Due to the depth to groundwater, it would appear that the only subsurface structure that might contact groundwater would be the sewers. The SO4 and pH of the groundwater is not considered to be aggressive; also neither is directly related to NAPL.	As above.
9ABDGL	Historical activities -> NAPL on-site -> Dissolution into groundwater -> Shallow groundwater -> Discharge	Maintenance of Ecosystems	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	4	A	Low	No surface water body near the site.	NAPL has not been identified on site, though expected.	As above.
9ABDHM	Historical activities -> NAPL on-site -> Dissolution into groundwater -> Deep groundwater -> Extraction	Potable water supply	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	4	B	Low	Deep sewers intercept groundwater and potential NAPL, although not in all areas. It is possible that there is NAPL in the SE region of the site, and that in this area the control applied by the sewer is not effective.	There has not been a direct investigation of deep groundwater undertaken (on or offsite). The density of gasworks NAPL could cause it to migrate vertically to deeper aquifers, and it has been assumed that the deeper groundwater is affected to the same degree as for the shallow groundwater. It is unlikely that groundwater will be used for potable purposes.	It is uncertain as to whether the deep groundwater has been contaminated.
		Agriculture, parks & gardens	As above.	4	C	Medium	As above.	As above, noting that groundwater use for irrigation is considered possible	As above.
		Stock watering	As above.	4	A	Low	As above.	As above, though noting that groundwater use for stock watering is considered improbable	As above.
		Industrial water use	As above.	2	B	Negligible	As above.	As above though noting that groundwater use for industrial water use is considered unlikely.	As above.
		Primary contact: recreation (e.g. bathing)	As above.	4	C	Medium	As above.	As above, though noting that groundwater use for filling swimming pools is considered possible.	As above.
9ABDHN	Historical activities -> NAPL on-site -> Dissolution intro groundwater -> Deep groundwater -> Direct contact	Buildings & structures	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	1	B	Negligible	Groundwater is currently below the likely depth of most structures at the site.	Unlikely for structures to intersect deep aquifers.	As above.
9ABDHO	Historical activities -> NAPL on-site -> Dissolution intro groundwater -> Deep groundwater -> Discharge	Maintenance of Ecosystems	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	4	A	Low	No surface water body near the site.	The impact on of groundwater discharge on a surface water ecosystem could be considered significant; however this is a scenario that exists far from the site, such as for Port Phillip Bay, and not locally.	As above.
9ABEIM	Historical activities -> NAPL on-site -> Vertical NAPL migration through aquifer -> Deep aquifer -> Extraction	Potable water supply	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	4	B	Low	Deep sewers intercept groundwater and potential NAPL, although not in all areas. It is possible that there is NAPL in the SE region of the site, and that in this area the control applied by the sewer is not effective.	There has not been a direct investigation of deep groundwater undertaken (on or offsite). The density of gasworks NAPL could cause it to migrate vertically to deeper aquifers, and it has been assumed that the deeper groundwater is affected to the same degree as for the shallow groundwater. It is unlikely that groundwater will be used for potable purposes.	As above.
		Agriculture, parks & gardens	As above.	4	C	Medium	As above.	As above, noting that groundwater use for irrigation is considered possible.	As above.
		Stock watering	As above.	4	A	Low	As above.	As above, though noting that groundwater use for stock watering is considered improbable.	As above.
		Industrial water use	As above.	2	B	Negligible	As above.	As above though noting that groundwater use for industrial water use is considered unlikely.	As above.

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
		Primary contact: recreation (e.g. bathing)	As above.	4	C	Medium	As above.	As above, though noting that groundwater use for filling swimming pools is considered possible.	As above.
9ABEIN	Historical activities -> NAPL on-site -> Vertical NAPL migration through aquifer -> Deep aquifer -> Direct contact	Buildings & structures	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	1	B	Negligible	Groundwater is currently below the likely depth of most structures at the site.	Unlikely for structures to intersect deep aquifers.	As above.
9ABEIO	Historical activities -> NAPL on-site -> Vertical NAPL migration through aquifer -> Deep aquifer -> Discharge	Maintenance of Ecosystems	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	4	A	Low	No surface water body near the site.	The impact on of groundwater discharge on a surface water ecosystem could be considered significant; however such discharge is far from the site, such as for Port Phillip Bay, and not locally.	As above.

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
Flowchart 10	GASWORKS SITE, NAPL, Groundwater Segment: Off-site beneficial uses (far from the site)								
10ABCEHKN	Historical activities -> NAPL -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Transfer -> Offsite shallow groundwater -> Extraction/direct contact	Potable water supply: Desirable/ Acceptable	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	0	A	Negligible	Deep sewers intercept groundwater, and although do not offer complete groundwater containment, NAPL (if present) is not expected to migrate far from the site.	The high viscosity and density of NAPL make it unlikely to migrate within aquifers towards other users or ecosystems far from the site. Considerable attenuation can be expected to occur on migration of groundwater contamination some distance from the site.	
		Agriculture, parks & gardens	As above.	0	A	Negligible	As above.	As above.	
		Stock watering	As above.	0	A	Negligible	As above.	As above.	
		Industrial water use	As above.	0	A	Negligible	As above.	As above.	
		Primary contact recreation (e.g. bathing, swimming)	As above.	0	A	Negligible	As above.	As above.	
		Buildings and structures	As above.	0	A	Negligible	As above.	As above.	
10ABCEHKOS	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Transfer -> Offsite shallow groundwater -> offsite discharge -> Offsite water body I.e. **Port Phillip Bay**	WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Substantially natural ecosystems with some modifications	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	1	B	Negligible	Deep sewers intercept groundwater, and although do not offer complete groundwater containment, NAPL (if present) is not expected to migrate far from the site.	The high viscosity and density of NAPL make it unlikely to migrate within aquifers towards other users or ecosystems far from the site. Considerable attenuation can be expected to occur on migration of groundwater contamination some distance from the site.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Highly modified ecosystems with some habitat values	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Primary contact	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Secondary contact	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aesthetics enjoyment	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Normal populations	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aquaculture	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Commercial and recreation use of edible fish and crustacea	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Navigation & shipping	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Industrial water use	As above.	1	B	Negligible	As above.	As above.	

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
10ABCEHKLPT	Historical activities -> NAPL -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Transfer -> Offsite shallow groundwater -> sewer -> discharge -> Offsite water body ie. **Western Treatment Plant**	Effluent discharge from the treatment plant is to Port Phillip Bay under EPA waste discharge licence.	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	1	B	Negligible	Dilution in sewer; waste water treatment at the plant; discharge limits set my EPA as per licence.	Because of the very high level of dilution in the sewer, ingress into the sewer is not expected to give rise to problems at the discharge of effluent from the sewage treatment plant.	The basis for the modelling and load to the sewer is uncertain and is being clarified.
10ABCFIMQ	Historical activities -> NAPL -> Leaching/ Infiltration/ Percolation ->Deep groundwater -> Transfer -> Deep groundwater -> Extraction/direct contact	Potable water supply: Desirable/ Acceptable	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	0	A	Negligible	Deep sewers intercept groundwater, although not in all areas.	Dissolved phase groundwater contamination has been identified in localised areas off site and close to the site. It is not clear that contamination of the deep aquifer has occurred, and this is less likely than the shallow aquifer. Considerable attenuation of contamination can be expected to occur on migration of groundwater some distance from the site.	Extent of contamination in deep aquifer is uncertain. Uncertain as to extent to which the deep groundwater will be intercepted by the sewer.
		Agriculture, parks & gardens	As above.	0	A	Negligible	As above.	As above.	As above.
		Stock watering	As above.	0	A	Negligible	As above.	As above.	As above.
		Industrial water use	As above.	0	A	Negligible	As above.	As above.	As above.
		Primary contact recreation (e.g. bathing, swimming)	As above.	0	A	Negligible	As above.	As above.	As above.
		Buildings and structures	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	0	A	Negligible	Groundwater is currently below the likely depth of most structures at the site.	Unlikely for structures to intersect deep aquifers.	Uncertainty as to whether the sewers will be repaired at some time in the future, giving rise to groundwater rise.
10ABCFIMRU	Historical activities -> NAPL -> Leaching/ Infiltration/ Percolation -> Deep groundwater -> Transfer -> Offsite deep groundwater -> offsite discharge -> Offsite water body i.e. **Port Phillip Bay**	WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Substantially natural ecosystems with some modifications	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	0	A	Negligible	Deep sewers intercept groundwater, and although do not offer complete groundwater containment, NAPL (if present) is not expected to migrate far from the site.	The high viscosity and density of NAPL make it unlikely to migrate within aquifers towards other users or ecosystems far from the site. Considerable attenuation can be expected to occur on migration of groundwater contamination some distance from the site.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Highly modified ecosystems with some habitat values	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Primary contact	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Secondary contact	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aesthetics enjoyment	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Normal populations	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aquaculture	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Commercial and recreation use of edible fish and crustacea	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Navigation & shipping	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Industrial water use	As above.	0	A	Negligible	As above.	As above.	
10ABDGJU	Historical activities -> NAPL -> Runoff -> Stormwater Drainage -> Discharge -> Offsite water body i.e. **Port Phillip Bay**	WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Substantially natural ecosystems with some modifications	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	0	A	Negligible	The site is capped, although the extent and integrity of the capping is uncertain.	It is possible for some contamination to be present in the surface soils above sediment criteria applicable to the Bay. It may erode under storm conditions into the stormwater drainage system and reach the Bay. Dilution will occur with other run off into the stormwater system, and the potential for the contamination to give rise to significant areas of contaminated sediments (from the site) is low.	Uncertainties include the extent of surface soil contamination exceeding sediment criteria, the potential for surface soils to enter stormwater system, and the level of dilution that will occur prior to final discharge into the Bay.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Highly modified ecosystems with some habitat values	As above.	0	A	Negligible		As above.	As above.

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		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Primary contact	As above.	0	A	Negligible		As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Secondary contact	As above.	0	A	Negligible		As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aesthetics enjoyment	As above.	0	A	Negligible		As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Normal populations	As above.	0	A	Negligible		As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aquaculture	As above.	0	A	Negligible		As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Commercial and recreation use of edible fish and crustacea	As above.	0	A	Negligible		As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Navigation & shipping	As above.	0	A	Negligible		As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Industrial water use	As above.	0	A	Negligible		As above.	As above.

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
Flowchart 10	GASWORKS SITE, NAPL, Groundwater Segment: Off-site beneficial uses (far from the site)								
10ABCEHKN	Historical activities -> NAPL -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Transfer -> Offsite shallow groundwater ->Extraction/direct contact	Potable water supply: Desirable/ Acceptable	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	0	A	Negligible	Deep sewers intercept groundwater, and although do not offer complete groundwater containment, NAPL (if present) is not expected to migrate far from the site.	The high viscosity and density of NAPL make it unlikely to migrate within aquifers towards other users or ecosystems far from the site. Considerable attenuation can be expected to occur on migration of groundwater contamination some distance from the site.	
		Agriculture, parks & gardens	As above.	0	A	Negligible	As above.	As above.	
		Stock watering	As above.	0	A	Negligible	As above.	As above.	
		Industrial water use	As above.	0	A	Negligible	As above.	As above.	
		Primary contact recreation (e.g. bathing, swimming)	As above.	0	A	Negligible	As above.	As above.	
		Buildings and structures	As above.	0	A	Negligible	As above.	As above.	
10ABCEHKOS	Historical activities -> Contaminated soil -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Transfer -> Offsite shallow groundwater -> offsite discharge -> Offsite water body I.e. **Port Phillip Bay**	WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Substantially natural ecosystems with some modifications	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	1	B	Negligible	Deep sewers intercept groundwater, and although do not offer complete groundwater containment, NAPL (if present) is not expected to migrate far from the site.	The high viscosity and density of NAPL make it unlikely to migrate within aquifers towards other users or ecosystems far from the site. Considerable attenuation can be expected to occur on migration of groundwater contamination some distance from the site.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Highly modified ecosystems with some habitat values	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Primary contact	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Secondary contact	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aesthetics enjoyment	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Normal populations	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aquaculture	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Commercial and recreation use of edible fish and crustacea	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Navigation & shipping	As above.	1	B	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Industrial water use	As above.	1	B	Negligible	As above.	As above.	

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
10ABCEHKLPT	Historical activities -> NAPL -> Leaching/ Infiltration/ Percolation -> Shallow groundwater -> Transfer -> Offsite shallow groundwater -> sewer -> discharge -> Offsite water body ie. **Western Treatment Plant**	Effluent discharge from the treatment plant is to Port Phillip Bay under EPA waste discharge licence.	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	1	B	Negligible	Dilution in sewer; waste water treatment at the plant; discharge limits set my EPA as per licence.	Because of the very high level of dilution in the sewer, ingress into the sewer is not expected to give rise to problems at the discharge of effluent from the sewage treatment plant.	The basis for the modelling and load to the sewer is uncertain and is being clarified.
10ABCFIMQ	Historical activities -> NAPL -> Leaching/ Infiltration/ Percolation ->Deep groundwater -> Transfer -> Deep groundwater -> Extraction/direct contact	Potable water supply: Desirable/ Acceptable	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	0	A	Negligible	Deep sewers intercept groundwater, although not in all areas.	Dissolved phase groundwater contamination has been identified in localised areas off site and close to the site. It is not clear that contamination of the deep aquifer has occurred, and this is less likely than the shallow aquifer. Considerable attenuation of contamination can be expected to occur on migration of groundwater some distance from the site.	Extent of contamination in deep aquifer is uncertain. Uncertain as to extent to which the deep groundwater will be intercepted by the sewer.
		Agriculture, parks & gardens	As above.	0	A	Negligible	As above.	As above.	As above.
		Stock watering	As above.	0	A	Negligible	As above.	As above.	As above.
		Industrial water use	As above.	0	A	Negligible	As above.	As above.	As above.
		Primary contact recreation (e.g. bathing, swimming)	As above.	0	A	Negligible	As above.	As above.	As above.
		Buildings and structures	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	0	A	Negligible	Groundwater is currently below the likely depth of most structures at the site.	Unlikely for structures to intersect deep aquifers.	Uncertainty as to whether the sewers will be repaired at some time in the future, giving rise to groundwater rise.
10ABCFIMRU	Historical activities -> NAPL -> Leaching/ Infiltration/ Percolation -> Deep groundwater -> Transfer -> Offsite deep groundwater -> offsite discharge -> Offsite water body i.e. **Port Phillip Bay**	WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Substantially natural ecosystems with some modifications	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	0	A	Negligible	Deep sewers intercept groundwater, and although do not offer complete groundwater containment, NAPL (if present) is not expected to migrate far from the site.	The high viscosity and density of NAPL make it unlikely to migrate within aquifers towards other users or ecosystems far from the site. Considerable attenuation can be expected to occur on migration of groundwater contamination some distance from the site.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Highly modified ecosystems with some habitat values	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Primary contact	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Secondary contact	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aesthetics enjoyment	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Normal populations	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aquaculture	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Commercial and recreation use of edible fish and crustacea	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Navigation & shipping	As above.	0	A	Negligible	As above.	As above.	
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Industrial water use	As above.	0	A	Negligible	As above.	As above.	
10ABDGJU	Historical activities -> NAPL -> Runoff -> Stormwater Drainage -> Discharge -> Offsite water body i.e. **Port Phillip Bay**	WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Substantially natural ecosystems with some modifications	coal tars & are oils; likely chemicals - VOCs and SVOCs, ie PAHs, BTEX, phenols	0	A	Negligible	The site is capped, although the extent and integrity of the capping is uncertain.	It is possible for some contamination to be present in the surface soils above sediment criteria applicable to the Bay. It may erode under storm conditions into the stormwater drainage system and reach the Bay. Dilution will occur with other run off into the stormwater system, and the potential for the contamination to give rise to significant areas of contaminated sediments (from the site) is low.	Uncertainties include the extent of surface soil contamination exceeding sediment criteria, the potential for surface soils to enter stormwater system, and the level of dilution that will occur prior to final discharge into the Bay.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Maintenance of aquatic ecosystems with some modification - Highly modified ecosystems with some habitat values	As above.	0	A	Negligible		As above.	As above.

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Exposure path no.	Exposure path description	Beneficial use	Limiting contaminant	Severity	Likelihood	Risk	Controls	Comment	UNCERTAINTY
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Primary contact	As above.	0	A	Negligible		As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Water based recreation - Secondary contact	As above.	0	A	Negligible		As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aesthetics enjoyment	As above.	0	A	Negligible		As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Normal populations	As above.	0	A	Negligible		As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Production of molluscs for human consumption - Aquaculture	As above.	0	A	Negligible		As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Commercial and recreation use of edible fish and crustacea	As above.	0	A	Negligible		As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Navigation & shipping	As above.	0	A	Negligible		As above.	As above.
		WoV Schedule F6 "General" Segment of Port Phillip Bay: Industrial water use	As above.	0	A	Negligible		As above.	As above.