



Net Zero
Teesside

Preliminary Environmental Information Report

Volume III - Appendices

Appendix 10B: Contaminated Land - Conceptual Site
Model

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended)



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10B. Contaminated Land - Conceptual Site Model

10.1 Outline

- 10.1.1 In order to make an assessment of the construction, environmental and human health risks attributed to the Site, a conceptual model needs to be developed. This requires an examination of the 'Source-Pathway-Receptor' linkages associated with existing and future conditions. The first step of the model development is to identify the contaminants of concern, their possible sources and potential receptors on and around the Site.
- 10.1.2 The risk assessment is based on guidance provided in CIRIA C552 - Contamination Land Risk Assessment, A Guide to Good Practice. At this stage, the risk assessment is of a preliminary nature as site specific GI and laboratory test results are not available. The risk assessment is based on information obtained in this geotechnical and geo-environmental study and should be updated as further information becomes available.
- 10.1.3 The risk assessment is performed in accordance with the precautionary principle, in which a pathway is assumed to exist unless there is reasonable contrary evidence. The risk associated with each source-receptor linkage is a product of the probability that a significant pathway exists and the severity of the potential impact. For the purposes of the PRA, the adopted method for risk evaluation is a qualitative method and involves classification of:
- The magnitude of the potential consequence (severity) of risk (Table 6.3 - CIRIA 552), classified as: Severe, Medium, Mild, Minor; and
 - The magnitude of the probability (likelihood) of risk occurring (Table 6.4 - CIRIA 552), classified as High Likelihood, Likely, Low Likelihood, Unlikely.
- 10.1.4 Assuming that a pathway is present, the consequence of exposure depends on the concentrations of the contaminants as well as the exposure route and the sensitivity of the receptor. This principle drives the Department for Environment, Food & Rural Affairs (Defra) Contaminated Land Exposure Assessment model (CLEA). It is therefore necessary to make the following considerations:
- The potential hazard a chemical may pose;
 - The normal range of chemical concentrations likely to be characteristic of the land use;
 - The efficiency of the delivery of the contaminant by the anticipated pathway (e.g. direct contact, ingestion, dust or vapour inhalation); and
 - The sensitivity of the receptor, be that adult or child.

- 10.1.5 A comparison of consequence against probability is undertaken to indicate the risk presented by each pollutant linkage. The probability indicates the likelihood that an exposure route may exist. This depends on whether the impacted soils are likely to be present, or indeed exposed, and also the probability that the potential receptor will come in contact with enough of the contamination to be impacted. The principal factors governing probability of exposure are the likely distribution of contaminants and the possible activities that may lead to exposure.
- 10.1.6 Overall risk is calculated in accordance with Table 6.5 – CIRIA 552, reproduced in Table 10B-1.

Table 10B-1: Overall Risk Classification Model

		CONSEQUENCE			
		Severe	Medium	Mild	Minor
PROBABILITY	High Likelihood	Very high risk	High risk	Moderate risk	Moderate / low risk
	Likely	High risk	Moderate risk	Moderate / low risk	Low risk
	Low Likelihood	Moderate risk	Moderate / low risk	Low risk	Very low risk
	Unlikely	Moderate / low risk	Low risk	Very low risk	Very low risk

10.2 Potential Sources of Contamination

- 10.2.1 Table 10B-2 presents the potential sources of contamination associated with historical industrial land use across the Site (these are discussed in further detail in Appendix 10A (Preliminary Environmental Information (PEI) Report, Volume III).

Table 10B-2: Potential Sources of Contamination

Potential Source	Description
Brine Works	The main contaminants from this industry are assumed to be Sodium Chloride and other common evaporites such as sulphates, other halides and borates from escaped brine, as well as coal combustion products from pump engines and heating plant, e.g. ash and clinker containing metals and PAHs. As well as using Durham coal some salt pans are reported to be heated by gas, which is a product of the iron industry.
Synthetic Ammonia Works (Billingham)	The contaminants of concern associated with the Ammonia Works are wastes from coal reforming and combustion (principally PAHs), ammonia liquors and ammonium salts, , metals, acids, alkalis, naphtha, fuel oils, PCBs, asbestos.
Coking Works (associated with the early chemical industry and iron & steel works)	The contaminants of concern from this industry are coal tar, ammonium sulphate, pure benzene and toluene, naphthalene, nickel, zinc, thiocyanate, phenols and other acids and organic compounds. Ammoniacal liquor and coal tars wastes / products are commonly stored in underground tanks or “wells”. Liquors contain free cyanides (easily liberated) and fixed or complex cyanides, thiocyanate, ferrocyanate, as well as other salts of ammonium, chloride, sulphate and thiosulphate. Spent iron oxide generated from gas purification containing complex cyanide “Prussian Blue” may have been exported to a sulphuric acid manufacturer assuming economical quantities of sulphur, or it was commonly disposed of on site. Slaked Lime may also have been used for gas purification resulting in “Foul Lime” with a potential for generation of Hydrogen Sulphide gas. Other potential contaminants according to Department of Environment (DoE) Industry Profiles include acids, alkalis, metals, asbestos, sulphur compounds, Polycyclic Aromatic Hydrocarbons (PAHs) (especially in coal tar), benzene, toluene, ethylbenzene and xylene (BTEX) including the manufactured fuel Benzol, phenols, cresols, xylenols, and numerous other organic chemicals including heterocyclic compounds.
Railways	The Department of Environment (DoE) Industry Profile for Railway Land indicates imported fill was often utilised during construction of the railways where there was a shortfall of natural excavated material. Imported fill often included waste material containing clinker and ash. Given the context of the Site, it is probable that wastes from the iron & steel works will have been utilised in railway construction. Boiler ash generated by steam locomotives was also often used to form ballast along many railway lines. Other potential sources of contaminants that

Potential Source

Description

	<p>may be encountered on railway land include herbicides, polychlorinated biphenyls (PCBs) utilised in electrical transformers, and general spills of materials used or transported which may include fuels, oils, paraffin, solvents, antifreeze liquids such as ethylene glycol, creosotes and paints. Metal fines, ash and asbestos are also frequently present on railway land. There is limited potential for point sources of contamination to exist associated with leaks or spills from railway traffic, however the impact of these is likely to be localised. Concentrations of contaminants (if present) are likely to be relatively low and acute or chronic health risks are not anticipated for future site users. It is impossible to anticipate the likely distribution of contaminants from accidental release therefore precautionary control measures are likely to be necessary for ground workers. The main contaminants associated with railway land are metals (As, Cd, Cr, Cu, Pb, Ni, Zn), sulphate, asbestos, Polycyclic Aromatic Hydrocarbons (PAHs), chlorinated aromatic hydrocarbons and PCBs.</p>
<p>Tar Macadam Slag Works</p>	<p>Coal Tars contains a wide variety of compounds however the main risk drivers are considered to be Polycyclic Aromatic Hydrocarbons (PAHs) including benzo(a)pyrene, which is used as a surrogate marker for coal tar carcinogenicity. Other contaminants of particular concern to water resources include BTEX and other petrol and diesel range petroleum hydrocarbons present in fuels. Phenols, cresols, xylenols and heterocyclic compounds and other contaminants found in coal tars are also likely to be present.</p>
<p>Iron & Steel Works</p>	<p>The wastes from iron making comprise mainly blast furnace slag, dry dust from gas cleaning, wet solids from gas cleaning and refractory waste from ladles and runners. Effluent water from slurry requires treatment prior to recycling or discharge as it may contain high concentrations of lead, zinc and alkalis.</p> <p>Steel making wastes include acid or basic slag, scrap, dust and slurries and refractory material. . Due to the high phosphorus content of some ores, (basic) steel slag may contain more than 15% phosphorous pentoxide.</p> <p>Fines from dust or slurry produced as a result of flume cleaning at steel works contain around 50% iron, lead, zinc and other metals.</p> <p>Fine mill scale from rolling mills that is generally discharged into lagoons and eventually disposed of, may become contaminated with hydrocarbons. Oily waste is often treated using solvent extraction e.g. using halogenated solvents, refined by a specialist contractor or incinerated. Other refractory wastes arising from soaking pits, reheating furnaces and similar</p>

Potential Source

Description

	<p>equipment in the rolling mill are generally disposed of according to DoE to on-site landfills or tips.</p> <p>Spent sulphuric acid, hydrochloric acid and sodium hydroxide from pickling are generally regenerated at large plants, however at smaller sites they may be neutralised prior to disposal. The wastes from galvanising and tinning processes are produced only in small quantities compared to the other wastes as a whole.</p> <p>Other wastes commonly found in on-site tips that are not directly attributed to the iron & steel processes include; building and demolition rubble, slurries from water treatment plants, insulation material such as asbestos (including roofing and cladding for pipes) and empty chemical containers. Transformers and other electrical equipment may contain PCBs.</p> <p>Metals, metal compounds, the products of coke making and metal finishing are the most significant contaminants at iron and steel works. The distribution of these contaminants will be dependent on the type of process and material storage taking place on the Site. Leakage may have occurred from tanks and pipework carrying products or waste. It is highlighted that in old-established sites, contaminants may be present in on-site landfills, lagoons or soakaways. Storage of oily scrap could have led to ground contamination.</p>
<p>Cement Manufacture</p>	<p>Contaminants related to the manufacture of cement include calcium (usually carbonate), silicon, aluminium and iron. The principal contaminants related to this industry are those that are associated with fuel (coal, hydrocarbons) and combustion products (TPH,PAH), alkali (e.g. clinker), sulphate, asbestos and metals.</p>
<p>Anhydrite Process - Sulphuric Acid Manufacture</p>	<p>The principal contaminants are associated with fuel (coal, hydrocarbons) and combustion products (TPH,PAH), alkali (e.g. clinker), acid (e.g. sulphuric acid), sulphate, asbestos and metals.</p>
<p>Anhydrite Mining</p>	<p>Mining is commonly associated with contamination from plant from spilt fuel and combustion products (that may be contaminated with harmful TPH / PAHs), PCBs used as dielectrics in electrical transformers and construction and demolition rubble. It is possible that asbestos may be present in the construction and demolition waste. The 7m thick seam of anhydrite is unlikely to have generated much spoil, however anhydrite (calcium sulphate) is likely to be present within made ground.</p>

Potential Source

Description

Wilton Chemical Works

The Wilton International site was purchased by I.C.I. in 1945 for development of a chemical industry estate supporting plant operated by several divisions of the company. North (1975) indicates that the first to come on stream were the plants producing Perspex, phenol and formaldehyde moulding paper in 1949. But the most important process by far was the cracking of petroleum and production of nylon and Terylene commencing in 1951. The petroleum crackers or Olefins Plant split naphtha into several simpler compounds, the most important being ethene and propene. These acted as raw materials for the production of a wide range of other chemicals. Ethylene oxide, which like ethene is a gas at room temperature and pressure, and ethylene glycol imported from Severnside were used for the manufacture of liquid detergents such as “Lissapol” and “Stergene”, for anti-freeze and shock absorber fluids, lubricants, weed killers, humectants, heat transfer media such as “Thermocal” and de-icing fluids.

A large part of the ethene and also propene was used by the Plastics Division at Wilton to produce “Alkathene” and “Propathene” (a brand name of polypropylene), respectively. Butadiene a product of processing chemicals from the Olefins plants was one of the chemicals used by the Plastics Division at Wilton to make “Butakon” synthetic rubber.

One of the many intermediate chemicals made by I.C.I. was vinyl acetate monomer produced by direct oxidation of ethene. This was an important ingredient in the manufacture of emulsion paints, adhesives, textile sizes and paper coatings by the Paints Division.

Methane and “tail gas” (methane mixed with hydrogen) were used by the Mond Division to make hydrogen cyanide, which was a precursor to the manufacture of “Perspex” by the Plastics Division.

Petrol, a co-product of the Olefins plant, was another important product produced at Wilton, although distribution was mainly confined to the North of England and south and central Scotland.

Public information available for Wilton International (15 January 2020) is available at <https://chemicalparks.eu/parks/wilton-international> states that the main compounds processed at the Site are;

Products:

- a) LDPE (Polyethylene)

Potential Source

Description

-
- b) Nitrobenzene
 - c) Petrochemicals
 - d) Ethylene
 - e) Propylene
 - f) Butadiene
 - g) Intermediate Chemicals
- Feedstocks:
- h) Natural Gas
 - i) Naphtha
 - j) Ethane
 - k) LPG
 - l) Nitrobenzene
 - m) Hydrogen
 - n) Crude Oil
 - o) Bioethanol

10.3 Potential Receptors

Table 10B-3 provides a summary of the potential receptors at the Site(s) of the Proposed Development.

Table 10B-3: Potential Receptors

Potential Receptor	Description
Future Site Users	Future site users may be affected by the presence of elevated concentrations of certain determinants in soil, soil leachate and groundwater. Future site users may also be affected by the presence of ground gas.
Construction Workers	Construction workers may be affected by the presence of elevated concentrations of certain determinands in soil, soil leachate and groundwater, particularly during earthworks. Construction workers may also be at risk from ground gas where temporary structures are in place on site during the construction phase.
Maintenance Workers (buried connections)	Maintenance workers may be affected by the presence of elevated concentrations of certain determinands in soil, soil leachate and groundwater. Maintenance workers may also be at risk from ground gas if their work requires them to enter confined spaces or work below ground level.
Maintenance Workers (above ground facilities)	No abnormal risk from exposure to contaminants in soil or groundwater has been assumed for workers maintaining above-ground facilities.
Flora and Fauna	Risk from contamination is minimal for the completed works since the main facilities are to be constructed on industrial land and there are limited pathways for contact with contaminated soil. Protection and reinstatement of existing natural resources is considered under ecology.
Development Infrastructure	Mitigation may be required to protect infrastructure such as concrete, steel, plastic water pipes, barrier membranes and buildings from contamination in soil and groundwater including acids, alkalis, hydrocarbons, sulphates, chlorides, nitrates, hazardous ground gas.
Controlled Waters	<p>The main surface water receptors are the River Tees, Tees Bay and surface water features within the proposed development boundary.</p> <p>Significant groundwater receptors within the superficial geology at the Site include the following:</p> <ul style="list-style-type: none"> p) Blown Sand: Secondary Aquifer A q) Tidal Flat Deposits (sand and silt): Secondary Aquifer A r) Till (Diamicton): Secondary Aquifer - Undifferentiated

Potential Receptor	Description
	<ul style="list-style-type: none"> s) Glaciofluvial Deposits (sand and gravel): Secondary Aquifer A t) Glaciolacustrine Deposits (sand): Secondary Aquifer A <p>Significant groundwater receptors within the bedrock geology at the Site include the following:</p> <ul style="list-style-type: none"> u) Redcar Mudstone Formation - Mudstone: Secondary Aquifer - Undifferentiated v) Mercia Mudstone Group - Mudstone: Secondary Aquifer B w) Penarth Group - Mudstone: Secondary Aquifer B x) Sherwood Sandstone Group – Sandstone – Principal Aquifer <p>Due to the distance of travel by ground or by watercourse there is likely to be significant attenuation for most contaminants before drainage reaches the receiving waters, as well as upon entering the Tees estuary or North Sea. Nevertheless, it is considered unsatisfactory for the development to release trapped contamination or to speed up the delivery of latent contamination to controlled waters.</p>
Off-Site Receptors	<p>Off-site receptors may be affected by the presence of elevated concentrations of certain determinants in soil, soil leachate and groundwater. Off-site receptors may also be affected by the presence of migrated ground gas. This includes residents and occupiers of surrounding properties and the ecology of the surrounding area. However, since no exposure to soils or groundwater is envisaged if works are carried out in accordance with environmental regulations, there should be no contaminant linkage.</p>

10.4 Potential Contaminant Linkages

10.4.1 The potential contaminant linkages and associated risks identified for the Site in its proposed use are presented in Table 10B-4.

Table 10B-1: Potential Contaminant Linkages

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
A. ICI Synthetic Ammonia Works / Anhydrite Process Plant / Anhydrite Mine					
Metals, metalloids	1. Ingestion/ skin contact	Ground Workers (1,2,10)	Mild	Likely	Moderate/Low
		Site Users (1,2)	Mild	Low	Low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
pH, acids, alkalis, sulphate, chloride, ammonia, cyanides	2. Dust Inhalation	General Public (off-site) (1,2)	Mild	n/a	n/a
	3. Vapour Inhalation	Fauna & Flora (5)	Minor	Low	Very low
	4. Explosion / Asphyxiation	Surface Water (6)	Mild	Low	Low
	5. Plant Uptake / Phytotoxicity	Groundwater (7)	Mild	Low	Low
	6. Leaching to surface water	Ground Workers (1,10)	Severe	Low	Moderate
	7. Leaching to groundwater	Site Users (1,9)	Medium	Low	Moderate/Low
	8. Corrosion/chemical attack	General Public (off-site) (1)	Medium	n/a	n/a
	9. Permeation of pipes	Fauna & Flora (5)	Mild	Low	Low
	10. Exposure to contaminated water	Surface Water (6)	Medium	Low	Moderate/Low
	Oils, lubricants, greases (TPH - LRO)		Groundwater (7)	Medium	Low
		Infrastructure (8,9)	Medium	Likely	Moderate
		Ground Workers (1)	None	n/a	n/a
		Site Users (1)	None	n/a	n/a
		General Public (off-site) (1)	None	n/a	n/a
Petroleum Fuel - (TPH - PRO, DRO)		Fauna & Flora (5)	None	n/a	n/a
		Infrastructure (8)	None	n/a	n/a
		Ground Workers (1,2,3,4,10)	Minor	Likely	Low
		Site Users (1,2,3,4,9)	Minor	Low	Very low
		General Public (off-site) (1,2,3)	Minor	n/a	n/a
		Infrastructure (4,8,9)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Coal Tars (PAH,TPH), phenols, cresols, xylenols, heterocyclics		Ground Workers (1,2,3,10)	Medium	Likely	Moderate
		Site Users (1,2,3,9)	Medium	Low	Moderate/Low
		General Public (off-site) (1,2,3)	Medium	n/a	n/a
		Fauna & Flora (5)	Minor	Low	Very low
		Surface Water (6)	Mild	Low	Low
		Groundwater (7)	Mild	Low	Low
		Infrastructure (8,9)	Minor	Likely	Low
POPs: PCBs, dioxins, furans		Ground Workers (1,2)	None	n/a	n/a
		Site Users (1,2)	None	n/a	n/a
		General Public (off-site) (1,2)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
Asbestos		Ground Workers (2)	Medium	Likely	Moderate
		Site Users (2)	Medium	Unlikely	Low
		General Public (off-site) (2)	Medium	Unlikely	Low
Coal Dust		Ground Workers (4)	None	n/a	n/a
		Site Users (4)	None	n/a	n/a
		Infrastructure (4)	None	n/a	n/a
Hazardous Gas		Ground Workers (4)	Mild	Low	Low
		Site Users (4)	Mild	Low	Low
		Infrastructure (4)	Mild	Low	Low

B. Brine Works

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
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Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk	
Metals, metalloids	1. Ingestion/skin contact	Ground Workers (1,2,10)	Mild	Likely	Moderate/Low	
	2. Dust Inhalation	Site Users (1,2)	Mild	Low	Low	
	3. Vapour Inhalation	General Public (off-site) (1,2)	Mild	n/a	n/a	
	4. Explosion / Asphyxiation	Fauna & Flora (5)	Minor	Low	Very low	
	5. Plant Uptake / Phytotoxicity	Surface Water (6)	Mild	Low	Low	
		Groundwater (7)	Mild	Low	Low	
	pH, acids, alkalis, sulphate, chloride, ammonia, cyanides	6. Leaching to surface water	Ground Workers (1,10)	Mild	Likely	Moderate/Low
		7. Leaching to groundwater	Site Users (1,9)	Mild	Low	Low
			General Public (off-site) (1)	Mild	n/a	n/a
		8. Corrosion/chemical attack	Fauna & Flora (5)	Minor	Low	Very low
9. Permeation of pipes		Surface Water (6)	Mild	Low	Low	
		Groundwater (7)	Mild	Low	Low	
10. Exposure to contaminated water		Infrastructure (8,9)	Mild	Likely	Moderate/Low	

C. Petroleum Refineries / Tank Farms / Fuel Storage

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Oils, lubricants, greases (TPH - LRO)	1. Ingestion/skin contact	Ground Workers (1)	Minor	Likely	Low
	2. Dust Inhalation	Site Users (1)	Minor	Low	Very low
	3. Vapour Inhalation	General Public (off-site) (1)	Minor	n/a	n/a
	4. Explosion / Asphyxiation	Fauna & Flora (5)	Minor	Low	Very low
		Infrastructure (8)	Minor	Likely	Low
Petroleum Fuel - (TPH - PRO, DRO)	5. Plant Uptake / Phytotoxicity	Ground Workers (1,2,3,4,10)	Medium	Likely	Moderate
		Site Users (1,2,3,4,9)	Medium	Unlikely	Low
		General Public (off-site) (1,2,3)	Medium	n/a	n/a

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk	
General Organics (VOC/SVOC including Olefins)	6. Leaching to surface water	Infrastructure (4,8,9)	Mild	Likely	Moderate/Low	
	7. Leaching to groundwater	Fauna & Flora (5)	Mild	Low	Low	
		Surface Water (6)	Medium	Low	Moderate/Low	
	8. Corrosion/chemical attack	Groundwater (7)	Medium	Low	Moderate/Low	
	9. Permeation of pipes	Ground Workers (1,2,3,10)	Minor	Likely	Low	
		10. Exposure to contaminated water	Site Users (1,2,3,9)	Minor	Low	Very low
			General Public (off-site) (1,2,3)	Minor	n/a	n/a
			Surface Water (6)	None	n/a	n/a
		Groundwater (7)	None	n/a	n/a	
		Infrastructure (9)	Minor	Low	Very low	
Asbestos		Ground Workers (2)	Medium	Low	Moderate/Low	
	Site Users (2)	Medium	Unlikely	Low		
	General Public (off-site) (2)	Medium	Unlikely	Low		

D. Tar Macadam Slag Works

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Metals, metalloids	1. Ingestion/skin contact	Ground Workers (1,2,10)	Minor	Likely	Low
	2. Dust Inhalation	Site Users (1,2)	Minor	Low	Very low
		General Public (off-site) (1,2)	Minor	n/a	n/a
	3. Vapour Inhalation	Fauna & Flora (5)	None	n/a	n/a
	4. Explosion / Asphyxiation	Surface Water (6)	Minor	Low	Very low
Coal Tars (PAH,TPH), phenols, cresols, xylenols, heterocyclics	5. Plant Uptake / Phytotoxicity	Groundwater (7)	Minor	Low	Very low
		Ground Workers (1,2,3,10)	Severe	Likely	High
	Site Users (1,2,3,9)	Severe	Low	Moderate	

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
General Organics (VOC/SVOC including Olefins)	6. Leaching to surface water	General Public (off-site) (1,2,3)	Severe	n/a	n/a
	7. Leaching to groundwater	Fauna & Flora (5)	Mild	Low	Low
		Surface Water (6)	Medium	Low	Moderate/Low
	8. Corrosion/chemical attack	Groundwater (7)	Medium	Low	Moderate/Low
	9. Permeation of pipes	Infrastructure (8,9)	Mild	Likely	Moderate/Low
	10. Exposure to contaminated water	Ground Workers (1,2,3,10)	Mild	Likely	Moderate/Low
		Site Users (1,2,3,9)	Mild	Low	Low
		General Public (off-site) (1,2,3)	Mild	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
Infrastructure (9)		Mild	Low	Low	
POPs: PCBs, dioxins, furans		Ground Workers (1,2)	None	n/a	n/a
	Site Users (1,2)	None	n/a	n/a	
	General Public (off-site) (1,2)	None	n/a	n/a	
	Fauna & Flora (5)	None	n/a	n/a	
	Surface Water (6)	Minor	Low	Very low	
	Groundwater (7)	Minor	Low	Very low	
	Asbestos	Ground Workers (2)	Medium	Likely	Moderate
		Site Users (2)	Medium	Unlikely	Low
General Public (off-site) (2)		Medium	Unlikely	Low	
Hazardous Gas	Ground Workers (4)	Minor	Likely	Low	
	Site Users (4)	Minor	Low	Very low	
	Infrastructure (4)	Minor	Low	Very low	

E. Iron / Steel / Coking Works

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk	
Metals, metalloids	1. Ingestion/skin contact	Ground Workers (1,2,10)	Minor	Likely	Low	
	2. Dust Inhalation	Site Users (1,2)	Minor	Low	Very low	
	3. Vapour Inhalation	General Public (off-site) (1,2)	Minor	n/a	n/a	
	4. Explosion / Asphyxiation	Fauna & Flora (5)	None	n/a	n/a	
	5. Plant Uptake / Phytotoxicity	Surface Water (6)	Minor	Low	Very low	
		Groundwater (7)	Minor	Low	Very low	
	pH, acids, alkalis, sulphate, chloride, ammonia, cyanides		Ground Workers (1,10)	Minor	Likely	Low
		6. Leaching to surface water	Ground Workers (2)	Medium	High	High
		7. Leaching to groundwater	Site Users (1,9)	Minor	Low	Very low
			Site Users (2)	Mild	Likely	Moderate / Low
8. Corrosion/chemical attack		General Public (off-site) (1)	Minor	n/a	n/a	
9. Permeation of pipes		Fauna & Flora (5)	None	n/a	n/a	
10. Exposure to contaminated water		Surface Water (6)	Minor	Low	Very low	
		Groundwater (7)	Minor	Low	Very low	
		Infrastructure (8,9)	Mild	Likely	Moderate/Low	
Oils, lubricants, greases (TPH - LRO)			Ground Workers (1)	None	n/a	n/a
		Site Users (1)	None	n/a	n/a	
		General Public (off-site) (1)	None	n/a	n/a	
		Fauna & Flora (5)	None	n/a	n/a	
		Infrastructure (8)	None	n/a	n/a	
Petroleum Fuel - (TPH - PRO, DRO)		Ground Workers (1,2,3,4,10)	Mild	Likely	Moderate/Low	
		Site Users (1,2,3,4,9)	Mild	Low	Low	

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk	
Coal Tars (PAH,TPH), phenols, cresols, xylenols, heterocyclics		General Public (off-site) (1,2,3)	Mild	n/a	n/a	
		Infrastructure (4,8,9)	Minor	Likely	Low	
		Fauna & Flora (5)	Minor	Low	Very low	
		Surface Water (6)	Mild	Low	Low	
		Groundwater (7)	Mild	Low	Low	
		Ground Workers (1,2,3,10)	Severe	Likely	High	
		Site Users (1,2,3,9)	Severe	Low	Moderate	
		General Public (off-site) (1,2,3)	Severe	n/a	n/a	
		Fauna & Flora (5)	Mild	Low	Low	
		Surface Water (6)	Medium	Low	Moderate/Low	
General Organics (VOC/SVOC including Olefins)		Groundwater (7)	Medium	Low	Moderate/Low	
		Infrastructure (8,9)	Mild	Likely	Moderate/Low	
		Ground Workers (1,2,3,10)	Minor	Likely	Low	
		Site Users (1,2,3,9)	Minor	Low	Very low	
		General Public (off-site) (1,2,3)	Minor	n/a	n/a	
		Surface Water (6)	None	n/a	n/a	
		Groundwater (7)	None	n/a	n/a	
		Infrastructure (9)	Minor	Low	Very low	
	POPs: PCBs, dioxins, furans		Ground Workers (1,2)	None	n/a	n/a
			Site Users (1,2)	None	n/a	n/a
		General Public (off-site) (1,2)	None	n/a	n/a	
		Fauna & Flora (5)	None	n/a	n/a	
		Surface Water (6)	Minor	Low	Very low	

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Asbestos		Groundwater (7)	Minor	Low	Very low
		Ground Workers (2)	Severe	Likely	High
		Site Users (2)	Medium	Likely	Moderate
		General Public (off-site) (2)	Medium	Unlikely	Low
Coal Dust		Ground Workers (4)	Minor	Likely	Low
		Site Users (4)	Minor	Low	Very low
		Infrastructure (4)	Minor	Low	Very low
Hazardous Gas		Ground Workers (4)	Mild	Likely	Moderate/Low
		Site Users (4)	Mild	Low	Low
		Infrastructure (4)	Mild	Low	Low

F. Olefins (cracking) - Chemical works

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Oils, lubricants, greases (TPH - LRO)	1. Ingestion/skin contact	Ground Workers (1)	None	n/a	n/a
	2. Dust Inhalation	Site Users (1)	None	n/a	n/a
	3. Vapour Inhalation	General Public (off-site) (1)	None	n/a	n/a
	4. Explosion / Asphyxiation	Fauna & Flora (5) Infrastructure (8)	None	n/a	n/a
Petroleum Fuel - (TPH - PRO, DRO)	5. Plant Uptake / Phytotoxicity	Ground Workers (1,2,3,4,10) Site Users (1,2,3,4,9)	Minor Minor	Likely Low	Low Very low
	6. Leaching to surface water	General Public (off-site) (1,2,3)	Minor	n/a	n/a
	7. Leaching to groundwater	Infrastructure (4,8,9) Fauna & Flora (5)	None	n/a	n/a
	8. Corrosion/chemical attack	Surface Water (6)	Minor	Low	Very low
	9. Permeation of pipes	Groundwater (7)	Minor	Low	Very low
	10. Exposure to	Ground Workers (1,2,3,10)	Medium	Likely	Moderate
Coal Tars (PAH,TPH), phenols, cresols, xylenols, heterocyclics					

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
	contaminated water	Site Users (1)	Medium	Low	Moderate/Low
		Site Users (2)	Mild	Unlikely	Very low
		Site Users (3)	Minor	Unlikely	Very low
		Site Users (9)	Mild	Low	Low
		General Public (off-site) (1,2,3)	Medium	n/a	n/a
		Fauna & Flora (5)	Minor	Low	Very low
		Surface Water (6)	Mild	Low	Low
		Groundwater (7)	Mild	Low	Low
		Infrastructure (8,9)	Minor	Likely	Low
		General Organics (VOC/SVOC including Olefins)		Ground Workers (1,2,3,10)	Mild
Site Users (1,2,3,9)	Mild			Low	Low
General Public (off-site) (1,2,3)	Mild			n/a	n/a
Surface Water (6)	Minor			Low	Very low
Groundwater (7)	Minor			Low	Very low
Infrastructure (9)	Mild			Low	Low
POPs: PCBs, dioxins, furans				Ground Workers (1,2)	None
		Site Users (1,2)	None	n/a	n/a
		General Public (off-site) (1,2)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
		Asbestos		Ground Workers (2)	Severe
Site Users (2)	Severe			Unlikely	Moderate/Low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Hazardous Gas		General Public (off-site) (2)	Medium	Unlikely	Low
		Ground Workers (4)	Mild	Likely	Moderate/Low
		Site Users (4)	Mild	Likely	Moderate/Low
		Infrastructure (4)	Minor	Low	Very low

G. Power Generation & Distribution

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk	
Oils, lubricants, greases (TPH - LRO)	1. Ingestion/skin contact	Ground Workers (1)	None	n/a	n/a	
	2. Dust	Site Users (1)	None	n/a	n/a	
	3. Inhalation	General Public (off-site) (1)	None	n/a	n/a	
	4. Vapour					
	4. Explosion / Asphyxiation	Fauna & Flora (5)	None	n/a	n/a	
		Infrastructure (8)	None	n/a	n/a	
	POPs: PCBs, dioxins, furans	5. Plant Uptake / Phytotoxicity	Ground Workers (1,2)	None	n/a	n/a
			Site Users (1,2)	None	n/a	n/a
6. Leaching to surface water		General Public (off-site) (1,2)	None	n/a	n/a	
		Fauna & Flora (5)	None	n/a	n/a	
7. Leaching to groundwater		Surface Water (6)	Minor	Low	Very low	
8. Corrosion/chemical attack		Groundwater (7)	Minor	Low	Very low	
9. Permeation of pipes						
10. Exposure to contaminated water						

H. Infilled Land

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Metals, metalloids	1. Ingestion/skin contact	Ground Workers (1,2,10)	Minor	Likely	Low
		Site Users (1,2)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk	
pH, acids, alkalis, sulphate, chloride, ammonia, cyanides	2. Dust Inhalation	General Public (off-site) (1,2)	Minor	n/a	n/a	
	3. Vapour Inhalation	Fauna & Flora (5)	None	n/a	n/a	
	4. Explosion / Asphyxiation	Surface Water (6)	Minor	Low	Very low	
		Groundwater (7)	Minor	Low	Very low	
	5. Plant Uptake / Phytotoxicity	Ground Workers (1,10)	Minor	Likely	Low	
		Site Users (1,9)	Minor	Low	Very low	
	6. Leaching to surface water	General Public (off-site) (1)	Minor	n/a	n/a	
	7. Leaching to groundwater	Fauna & Flora (5)	None	n/a	n/a	
		Surface Water (6)	Minor	Low	Very low	
		Groundwater (7)	Minor	Low	Very low	
Oils, lubricants, greases (TPH - LRO)	9. Permeation of pipes	Infrastructure (8,9)	Minor	Likely	Low	
	10. Exposure to contaminated water	Ground Workers (1)	None	n/a	n/a	
		Site Users (1)	None	n/a	n/a	
		General Public (off-site) (1)	None	n/a	n/a	
		Fauna & Flora (5)	None	n/a	n/a	
		Infrastructure (8)	None	n/a	n/a	
	Coal Tars (PAH,TPH), phenols, cresols, xylenols, heterocyclics		Ground Workers (1,2,3,10)	Mild	Likely	Moderate/Low
			Site Users (1,2,3,9)	Mild	Low	Low
			General Public (off-site) (1,2,3)	Mild	n/a	n/a
			Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low	
		Groundwater (7)	Minor	Low	Very low	
		Infrastructure (8,9)	None	n/a	n/a	

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
General Organics (VOC/SVOC including Olefins)		Ground Workers (1,2,3,10)	Minor	Likely	Low
		Site Users (1,2,3,9)	Minor	Low	Very low
		General Public (off-site) (1,2,3)	Minor	n/a	n/a
		Surface Water (6)	None	n/a	n/a
		Groundwater (7)	None	n/a	n/a
		Infrastructure (9)	Minor	Low	Very low
Asbestos		Ground Workers (2)	Mild	Likely	Moderate/Low
		Site Users (2)	Mild	Unlikely	Very low
		General Public (off-site) (2)	Mild	Unlikely	Very low
Organic Matter		Ground Workers (4)	Minor	Likely	Low
		Site Users (4)	Minor	Low	Very low
		Infrastructure (4)	Minor	Low	Very low
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	None	n/a	n/a
Hazardous Gas		Ground Workers (4)	Minor	Likely	Low
		Site Users (4)	Minor	Low	Very low
		Infrastructure (4)	Minor	Low	Very low

I. Railways

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Metals, metalloids	1. Ingestion/skin contact	Ground Workers (1,2,10)	Minor	Likely	Low
	2. Dust	Site Users (1,2)	Minor	Low	Very low
	3. Inhalation	General Public (off-site) (1,2)	Minor	n/a	n/a
	4. Vapour Inhalation	Fauna & Flora (5)	None	n/a	n/a
	4. Explosion / Asphyxiation	Surface Water (6)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk	
pH, acids, alkalis, sulphate, chloride, ammonia, cyanides	5. Plant Uptake / Phytotoxicity	Groundwater (7)	Minor	Low	Very low	
		Ground Workers (1,10)	Minor	Likely	Low	
	6. Leaching to surface water	Site Users (1,9)	Minor	Low	Very low	
		General Public (off-site) (1)	Minor	n/a	n/a	
	7. Leaching to groundwater	Fauna & Flora (5)	None	n/a	n/a	
	8. Corrosion/chemical attack	Surface Water (6)	Minor	Low	Very low	
		Groundwater (7)	Minor	Low	Very low	
	9. Permeation of pipes	Infrastructure (8,9)	Minor	Likely	Low	
	Oils, lubricants, greases (TPH - LRO)	10. Exposure to contaminated water	Ground Workers (1)	None	n/a	n/a
			Site Users (1)	None	n/a	n/a
		General Public (off-site) (1)	None	n/a	n/a	
		Fauna & Flora (5)	None	n/a	n/a	
		Infrastructure (8)	None	n/a	n/a	
Petroleum Fuel - (TPH - PRO, DRO)		Ground Workers (1,2,3,4,10)	Minor	Likely	Low	
		Site Users (1,2,3,4,9)	Minor	Low	Very low	
		General Public (off-site) (1,2,3)	Minor	n/a	n/a	
		Infrastructure (4,8,9)	None	n/a	n/a	
		Fauna & Flora (5)	None	n/a	n/a	
		Surface Water (6)	Minor	Low	Very low	
		Groundwater (7)	Minor	Low	Very low	
	Coal Tars (PAH,TPH), phenols, cresols, xylenols, heterocyclics		Ground Workers (1,2,3,10)	Mild	Likely	Moderate/Low
			Site Users (1,2,3,9)	Mild	Low	Low
			General Public (off-site) (1,2,3)	Mild	n/a	n/a

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
POPs: PCBs, dioxins, furans		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
		Infrastructure (8,9)	None	n/a	n/a
		Ground Workers (1,2)	None	n/a	n/a
		Site Users (1,2)	None	n/a	n/a
		General Public (off-site) (1,2)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
Asbestos		Groundwater (7)	Minor	Low	Very low
		Ground Workers (2)	Mild	Likely	Moderate/Low
		Site Users (2)	Mild	Unlikely	Very low
		General Public (off-site) (2)	Mild	Unlikely	Very low

Magnitude of the potential **Consequence** (severity) of risk, Table 6.3, CIRIA C552.

Magnitude of the **Probability** (likelihood) of risk occurring, Table 6.4 - CIRIA C552.

Risk presented by each pollutant linkage, Table 6.5 – CIRIA C552.

10.4.2 Actions corresponding with the risk classification are calculated based on the requirements of Table 6.6 – CIRIA 552. The table indicates that any risk classified as moderate or higher will require further investigation or mitigation measures.

