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The highest chromium (6+) concentration was recorded off site at MW14S (1680 µg/L), located within the residential area, beyond the western boundary and beneath the Burren Road pathway. Lower chromium (6+) concentrations still above the adopted guidelines were recorded onsite at MW07D (38 µg/L), located near the former gasworks main pit.

## 10.7 Light-End Hydrocarbons

The additional groundwater investigations targeted the assessment of light-end hydrocarbon contamination at the Site and surrounding areas. This group of compounds comprise TPH C<sub>6</sub>-C<sub>9</sub> fractions, BTEX and VOCs, with the laboratory results summarised in **Tables E - F**. A site figure showing light-end hydrocarbon exceedances across the Site and surrounding area is provided as **Figure 21**.

The NSW DEC does not currently endorse guidelines for the assessment of TPH C<sub>6</sub>-C<sub>9</sub> in groundwater. However, TPH C<sub>6</sub>-C<sub>9</sub> concentrations in MW03D, MW04D and MW07D exceed the solubility of this range in water, which are reported in the March 1999 version of the Risk-Integrated Software for Cleanups (RISC) computer model to be 5.4mg/L for C<sub>6</sub>-C<sub>8</sub> (aliphatic) and 0.43mg/L for C<sub>8</sub>-C<sub>10</sub> (aliphatic).

High VOC concentrations above the site investigation criteria were measured in deep wells located in the area of the former tar tank and gasholder area. These wells comprised MW03D, MW04D, MW07D and MW12D. In this area the exceedances were measured in benzene and ethylbenzene, which are indicative of light-end hydrocarbons from tarry wastes produced at a gasworks site. Concentrations of these compounds in the shallow wells were much lower. This data supports the conclusion that the source of the groundwater contamination appears to be tarry wastes that were and possibly continue to be stored in former tar tanks and the gasholder annulus.

The groundwater investigations indicate that the plume of light-end hydrocarbon contamination in the deeper aquifer appears to be located entirely on railway-owned land. The plume appears to begin near the northern boundary of the Former Cleaning Shed and Gasworks areas and extends in a south-west direction for a distance of some 125m. The data indicate that the down-gradient edge of the plume is located at the Illawarra rail line. The lateral extent of the plume appears to be confined in the west to the sewer main located adjacent to the rear boundary of the residential properties, while to the plume is estimated to extend 50m to the east of the former tar tank area.









## 10.8 Middle to Heavy-End Hydrocarbons

The additional groundwater investigation targeted the assessment of middle to heavy end hydrocarbon contamination at the Site and surrounding areas. This group of compounds comprise the TPH C<sub>10</sub>-C<sub>36</sub> fraction, PAHs, SVOCs, phenols and cresols, with the laboratory results summarised in **Tables E - F**. A site figure showing middle to heavy-end hydrocarbon exceedances across the Site and surrounding area is provided as **Figure 21**.

High PAH and TPH C<sub>10</sub>-C<sub>36</sub> concentrations above the site investigation criteria were measured in both shallow and deep wells located in the area of the former tar tank and gasholder area, with the highest concentrations measured in the deep wells. The main PAH compound present was the lighter-end compound naphthalene, which is consistent with its high solubility in water. The highest concentrations of middle to heavy end hydrocarbons were measured in wells MW03D, MW04D and MW07D. This data supports the conclusion that the source of the groundwater contamination appears to be tarry wastes that were and possibly continue to be stored in former tar tanks and the gasholder annulus.

The highest off site TPH C<sub>10</sub>-C<sub>36</sub> concentrations were recorded beyond the southern boundary at MW04S, MW39D and MW40D (700, 710 and 810 µg/L respectively). These concentrations exceed the solubility range of these compounds in water, which are reported in the March 1999 version of the Risk-Integrated Software for Cleanups (RISC) computer model to be 0.034mg/L for C<sub>10</sub>-C<sub>12</sub>, 7.6x10<sup>-4</sup>mg/L for C<sub>12</sub>-C<sub>16</sub> and 1.3x10<sup>-6</sup>mg/L for C<sub>16</sub>-C<sub>35</sub>.

The groundwater investigations indicate that the plume of middle to heavy-end hydrocarbon contamination in the shallow aquifer appears to be located entirely on railway-owned land. The shallow plume appears to begin near the northern boundary of the Former Cleaning Shed and Gasworks areas and extends in a south-west direction for a distance of some 75m. The data indicate that the down-gradient edge of the plume is located at the East Hills Line at the southern edge of the site boundary. The lateral extent of the plume appears to be confined in the west to the sewer main located adjacent to the rear boundary of the residential properties, while to the plume is estimated to extend 50m to the east of the former tar tank area.

The extent of the middle to heavy-end hydrocarbon plume in the deeper aquifer appears to be larger than the shallow aquifer. While the northern, eastern and western boundaries of the plume are similar to the shallow plume, the down-gradient extent of the plume appears to cover a distance of some 160m from the former tar tank area, with its edge near the southern boundary of railway land along Railway Parade. The data indicate that the deep aquifer plume is located entirely on railway-owned land.



## **10.9 Other Parameters**

Ammonia exceeded the adopted guidelines at MW35D with a concentration of 1160 ug/kg. Well MW35D is located up-gradient from the Site and is considered to represent background concentrations of the area.

The highest ammonia exceedences were recorded on site at MW37S, MW13S and MW12S (9680, 2780 and 3190 µg/L respectively). Lower concentrations still above the nominated guidelines were recorded beyond the southern boundary at MW04S and MW39S (1340 and 1110 µg/L respectively).

Based on the shallow depth of these wells, ammonia concentrations may represent leaching process associated with the site fill layer.

## **10.10 Nature of Groundwater Contamination**

This most recent round of groundwater monitoring is considered to support the following conclusions with regard to groundwater contamination.

### **10.10.1 Light-End Hydrocarbons (TPH C<sub>6</sub>-C<sub>9</sub>, BTEX & VOCs)**

High levels of light-end petroleum hydrocarbons (TPH C<sub>6</sub>-C<sub>9</sub> and BTEX) are present in the groundwater at locations close to the former gasworks, in the vicinity of the former gasholder No.2 and the location of possible tar tanks. Contaminant concentrations significantly exceed the freshwater ecosystem criteria and exceed the solubility capacity of water causing the excess contamination to exist as free product that floats on the water table. However, there has not been any evidence of phase separated hydrocarbons at the site.

### **10.10.2 Middle to Heavy End Hydrocarbons**

Although high concentrations of low-end hydrocarbon contamination were recorded during previous investigations at the Macdonaldtown Triangle area, minimal middle to high-end contamination was detected by the additional investigation conducted by SKM. The only significant detection were detectable concentrations of bis(2-ethylhexyl) phthalate (950µg/L) recorded along the eastern boundary of the adjacent Former Gasworks area at MW03D.

### **10.10.3 Metals & Inorganics**

The data indicates that heavy metal contamination at the Site is widespread with concentrations elevated above Trigger Values for 95% Protection of Freshwater Species. The highest cadmium, copper, lead, nickel and zinc concentrations were recorded on site at locations near to the former gas production process areas and beyond the southern boundary.



Chromium (6+) concentration above the nominated guidelines was recorded off site at MW14S located off site within the residential area. Lower chromium (6+) concentrations still above the adopted guidelines were recorded onsite at MW07D, located near the former gasworks main pit.



## 11 Data and Exposure Assessment

*This section of the report provides the results of data and exposure assessments, which represent the first two steps in a site-specific risk assessment for ground contamination at the Former Gasworks site. The methodology that has been used was previously described in Section 2.4. The data assessment (Section 11.1) reviews the site data provided in the earlier sections of this report. The exposure assessment then identifies the exposure pathways and potential receptors (Section 11.2), from which estimates are developed of the exposure concentrations (Section 11.3) and exposure durations (Section 11.4) followed by the calculation of estimates for contaminant intakes (Section 11.5).*

### 11.1 Data Collection and Evaluation

The potential sources of contamination at the Macdonaldtown Triangle area were identified in **Section 5.6.1** to correspond to the former use of the area as a gasworks and railway-related activities. The potential sources and laydown mechanisms for contamination at the Macdonaldtown Triangle Area are considered to be:

- Dumping of waste materials from the former gasworks operation (eg. ash, spent oxide, coke, tar, ammoniacal liquors);
- Dumping of waste materials from former railway uses (eg. ash);
- Leakage of liquid wastes from pits, tanks and gas holders (eg. tars, phenolic wastes, ammoniacal liquors);
- Spillage of lead-based paint from former structures and train maintenance;
- Spillage of chemicals used for train cleaning (eg. solvents);
- Spillage of oils and greases from former train usage and maintenance;
- Atmospheric deposition of contaminants from the heavy industrial use of the general Erskineville/Macdonaldtown/Redfern area;
- Importation of contaminated fill; and
- Migration of contaminated groundwater from railway operations up-gradient of the site such as at the former Eveleigh railyards.

Assessments of the investigation data are provided in previous sections for soils (**Sections 5.7.1 & 9.2**), groundwater (**Sections 5.7.2 & 10**), and soil gas (**Section 9**). Assessments of the quality of the investigation data have also been provided (**Sections 5.7.3 & 7**).

**Section 5.6.2** identifies a range of potential contaminants of concern at the Site. The investigations have subsequently identified those contaminants that have been measured at concentrations in soils and groundwater that exceed the *Investigation Levels* defined in **Section 8**. The samples collected



at the Former Gasworks site exceeding the soil and groundwater *Investigation Levels* are summarised in **Table 21**.

■ **Table 21 Sample Exceedances of Soil & groundwater Investigation Levels at the Former Gasworks Site**

Location	Environmental Media	Contaminant	Concentration	Investigation Level	Type
SB02	Fill	Total PAHs	142-203 mg/kg	100 mg/kg	Health
		BaP	14 - 35 mg/kg	5 mg/kg	
SB03	Fill	TPH (C10-C36)	5,020 mg/kg	1,000 mg/kg	
		Total PAHs	295 mg/kg	100 mg/kg	
		BaP	27 mg/kg	5 mg/kg	
SB04	Fill	TPH (C10-C36)	12,100 mg/kg	1,000 mg/kg	
		Total PAHs	1697 mg/kg	100 mg/kg	
		BaP	140 mg/kg	5 mg/kg	
SB06	Fill	TPH (C10-C36)	20,000 mg/kg	1,000 mg/kg	
		Total PAHs	137-2374 mg/kg	100 mg/kg	
		BaP	30-190 mg/kg	5 mg/kg	
SB07	Fill	TPH (C10-C36)	14,400 mg/kg	1,000 mg/kg	
		Total PAHs	1145-2079mg/kg	100 mg/kg	
		BaP	26-200 mg/kg	5 mg/kg	
		Xylene	29-32 mg/kg	25 mg/kg	
SB08	Fill	BaP	7 mg/kg	5 mg/kg	
	Natural Soil	BaP	5.4 mg/kg	5 mg/kg	
SB10	Fill	Total PAHs	112 mg/kg	100 mg/kg	
		BaP	11 mg/kg	5 mg/kg	
SB12	Fill	BaP	5.8 mg/kg	5 mg/kg	
	Natural Soil	Total PAHs	224.4 mg/kg	100 mg/kg	
		BaP	8.4 mg/kg	5 mg/kg	
BH13	Fill	TPH (C10-C36)	7,100 mg/kg	1,000 mg/kg	
		Total PAHs	413 mg/kg	100 mg/kg	
		BaP	39 mg/kg	5 mg/kg	
		Benzene	1.6 mg/kg	1 mg/kg	
BH14	Fill	Benzene	4.6 mg/kg	1 mg/kg	
		Xylene	48 mg/kg	25 mg/kg	
BH15	Fill	TPH (C10-C36)	4,390 mg/kg	1,000 mg/kg	
		Total PAHs	378 mg/kg	100 mg/kg	
		BaP	16 - 58 mg/kg	5 mg/kg	