

**METROLINK**

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**A19.3cd**

**Groundwater  
Monitoring Results  
Analytical Results  
2021 – Key Text**

### Appendix A19.3

#### Summary of Key Analytical Results - Groundwater Monitoring Round 1 (January 2021) and Round 2 (March 2021)

*Note: Please read alongside tabulated summary of analytical results (provided).*

##### Introduction & Background

Groundwater sampling was undertaken at newly drilled monitoring wells installed as part of the MetroLink project. The two sampling events completed in early 2021 included baseline groundwater (and separate ground gas) monitoring at selected viable locations along the proposed MetroLink alignment to record baseline water quality and groundwater levels (as well as ground gas) in representative geological strata. A key aim of the monitoring period was the requirement to sample at identified representative [contemporary drilled and designed] boreholes ideally during a low water seasonal period and a high water seasonal period. It is noted that the wider Dublin area experienced drier than average weather and on this basis the sampling was taken as long as practicable between the first and the second sampling dates shown.

Ascertaining the 'current' existing water levels/ quality of groundwater at approximately 54 no. key indicative borehole locations along the alignment and within the four geographical split areas AZ1 – AZ4 will facilitate in assessing the potential groundwater quality and groundwater level impacts associated with the construction and operation phases of the MetroLink project and will inform the corresponding Environmental Impact Assessment Report (EIAR).

The following analytes as a minimum were included as part of the testing suite in 2021:

- Major Anions and Cations (including chloride, sulphate, sodium, calcium, potassium, magnesium, fluoride, nitrite, nitrate, ammonia, alkalinity, non-carbonate hardness);
- Metals and other compounds (including aluminium, arsenic, barium, boron, cadmium, cobalt, iron, manganese, nickel, chromium, copper, mercury, lead, selenium, phosphorous and zinc);
- Physico-chemical parameters including Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Turbidity, Redox;
- Volatile Organic Compounds (VOCs);
- Semi Volatile Organic Compounds (SVOCs);
- Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD); and
- Hydrocarbon compounds including compounds including BTEX (Benzene, Toluene, Ethyl Benzene, m/p Xylene, o Xylene), TPH CWG (Aliphatics/ Aromatics), Mineral Oil Fraction (aliphatics).

In addition, specific laboratory testing for both rounds in 2021 was included as follows:

- PFAS TOP Assay – applied to the Dublin Airport area only; and
- PCBs (WHO 12 suite) - at selected locations.

Note: Laboratory test results were compared with *S.I. No. 9 of 2010 Environmental Objectives Groundwater Regulations 2010*, *Sl. No. 366 of 2016 Environmental Objectives Groundwater Amendment Regulations 2016*, and the EPA document '*Towards Setting Guideline Values for the Protection of Groundwater in Ireland Interim Report*', 2003.

- Analysis of all groundwater tests was primarily completed at United Kingdom Accreditation Service (UKAS) laboratories which also ensured consistency with earlier stage laboratory testing for the same MetroLink project. These laboratories used were: Element Materials Technology (EMT) based at Unit 3 Deeside Point, Zone 3 Deeside Industrial Park, Deeside, CH5 2UA UK; and Chemtest Ltd. / Eurofins (Chemtest) based at Depot Road, Newmarket, CB8 0AL, UK.

All test results have been tabulated and are provided for both monitoring events in 2021. The tables should also be read alongside the Groundwater Quality Monitoring drawing (depicting well locations)

as well as the summary of key test results presented in the following subsections for each of the four geographical areas AZ1 to AZ4.

The results have been compared to relevant threshold values as follows:

- GTV - Groundwater Threshold Value (S.I. No. 9, 2010 Groundwater Regulations and S.I. No. 366, 2016 Groundwater (Amendment) Regulations)
- IGV - Interim Guideline Values (EPA, 2003)

### AZ-1 Northern Section

Representative groundwater sampling was undertaken at 4 no. (four, unless otherwise stated) wells located within the AZ1 geographical area and these included the following boreholes:

- NBH72(S) - Estuary; NBH401, NBH402, NBH406 -Swords

Overall, no significant changes in reported groundwater quality were observed between both sampling events in early 2021 (unless otherwise stated), with the key observations summarised below.

#### Metals/ Indicator parameters

In general, with regard to metals, no exceedances of the GTV were reported for samples collected at wells located within Area AZ1 for metals (including for heavy metal compounds).

Minimal exceedance of the IGV was observed for samples collected at shallow well NBH72(S) for iron (Round 1) only. Some concentrations of manganese and potassium were reported at above the available IGV of 0.05mg/l and 5.0mg/l, respectively in this area for both sampling rounds. However, for the latter compound (K) all reported values were at/ just above the available IGV.

Exceedances of the IGV for Chloride were reported in this area [NBH72(S), NBH401 & NBH402] in both rounds.

#### Hydrocarbons

During Round 1 sampling event (January 2021) a single exceedance of the GTV (0.0075mg/l) and IGV (0.01mg/l) for TPH parameters (i.e. Total aliphatic, >C5-35) was reported for purged samples collected at shallow borehole NBH72(S). The reported values were interpreted by the testing laboratory as 'possible trace degraded kerosene'. Monitoring at the location of this borehole did not indicate any obvious historical or other contamination sources present in the vicinity here. The field however is also prone to flooding and is located nearby a roadway/ access lane.

Note: The aliphatic compounds reported as part of Round 1 sampling were not detected in subsequent samples tested as part of Round 2; nor were there any detections above the method detection limit for the remaining monitoring wells sampled.

#### VOCs/ SVOCs

A minor detection of VOCs above the respective method detection limit was reported for NBH406 (single compound MTBE only) for sampling Round 1 completed in 2021, as presented in the tabulated summary of results. The reported concentration was well within the available GTV for that analyte.

The presence of SVOCs above the respective method detection limit were not reported for samples collected at monitoring wells installed within Area AZ1 for either monitoring event completed in 2021.

#### Other compounds

PFAS/ PCBs (Total 12) -There was no testing undertaken for these particular compounds on groundwater samples collected within area AZ1.

## AZ-2 Airport Section

Representative groundwater sampling was undertaken at 6 no. (six, unless otherwise stated) wells located within the AZ2 geographical area and these included the following boreholes:

- NBH60, NBH61, NBH62, NBH04 -Dublin Airport; NBH06, NBH06W -South Portal

Overall, no significant changes in reported groundwater quality were observed between both sampling events in early 2021 (unless otherwise stated), with the key observations summarised below. Boreholes NBH60 and NBH61 were recorded as dry/ damp only at the base of the monitoring well with no/ insufficient water to sample during Round 2 completed in March 2021.

### Metals/ Indicator parameters

In general, with regard to metals, there were no significant exceedances of the available GTV/ IGV reported for samples collected at monitoring wells located within Area AZ2, including for heavy metals. However, with regard to available IGV some notable exceedances of barium and manganese were reported (NBH62 & NBH04, and NBH06) over both rounds. Concentrations of iron above the respective IGV were reported for NBH04 and NBH06 for both sampling events - with the more notable values reported for NBH06 at South Portal i.e. an order of magnitude above the IGV (0.2mg/l).

The reported concentrations for sodium were elevated for samples collected and tested at monitoring wells NBH60 (80.5mg/l, Round 1 only) and NBH62 (range 113mg/l to 120mg/l including duplicate sample) when compared with the GTV of 150mg/l. These boreholes are located within the [open air] Dublin Airport T2 surface car park. Exceedances of the IGV for Chloride (30mg/l) were reported for all boreholes (with the exception of NBH06 -South Portal) located within Area AZ2 during both sampling events undertaken in 2021; the comparatively higher value was reported for NBH60 (174.2mg/l) at the same T2 car park. However, there were no exceedances of the higher GTV of 187.5 mg/l for this analyte. Minor exceedances of the IGV (1mg/l) were reported for fluoride at NBH06W (1.4mg/l to 1.6mg/l) for both sampling events.

Reported values for sulphate were generally within the lower GTV of 187.5 mg/l with a range of between 19.7mg/l (NBH60) to 112.2mg/l (NBH06) recorded over the two sampling events in 2021. Comparatively more elevated values of nitrate were reported for deep well NBH04 at the Dublin Airport T2 car park at 19.8mg/l and 24.3mg/l for Round 1 and 2, respectively, but these concentrations were below the lower IGV value of 25mg/l for this compound.

### Hydrocarbons

Exceedances of the GTV and IGV values for TPH parameters were reported for samples collected from two monitoring wells during Round 1, namely at NBH60 (aliphatics and aromatics) and NBH04 (aliphatics) - interpreted by the testing laboratory as PAHs and degraded kerosene, respectively. For Round 2, a single detection of the compounds was reported for location NBH62 (aliphatics) where the value of 0.22mg/l was interpreted by the testing laboratory as 'dissolved phase compounds'.

### VOCs/ SVOCs

Minor detections of VOCs above the respective method detection limit were reported for NBH04 for both sampling rounds completed in 2021, as presented in the tabulated summary of results. These concentrations were also within the available GTV for that analyte.

Some exceedances of SVOC compounds were reported for Round 1 at locations NBH60, NBH61 and NBH04 primarily. These include exceedances for PAH compounds mainly, along with some detections above the respective method detection limit for Phthalates and other SVOCs as presented in the tabulated results which show the initial sampling event completed in 2021.

### Other compounds

PFAS/ PCBs (Total 12) - No detections were reported for those representative samples collected and tested at monitoring wells located within area AZ2.

### AZ-3 Dardistown to Northwood Section

Representative groundwater sampling was undertaken at 4 no. (four, unless otherwise stated) wells located within the AZ3 geographical area and these included the following boreholes:

- AWN01, AWN02 -Dardistown; NBH12, NBH73 -Northwood

In general, no significant changes in reported groundwater quality were observed between both sampling events in early 2021 (unless otherwise stated), with the key observations summarised below.

### Metals/ Indicator parameters

In general, with regard to metals, there were no significant exceedances of the available GTV/ IGV reported for samples collected at monitoring wells located within Area AZ3, including for heavy metals.

Some exceedances above the IGV (0.05mg/l) of the parameter manganese were reported for locations AWN01 and NBH12 for both sampling events completed in 2021, with reported values also recorded at an order of magnitude higher than the guideline value. Potassium was reported as elevated at AWN01 (11.1mg/l for Round 1, reducing to 7.2mg/l in Round 2) for both sample rounds however the analyte was reported <IGV for AWN02, NBH12 and NBH73 for both sampling events in 2021.

Exceedances of the IGV (30mg/l) for chloride were reported for samples collected at AWN01 (36.9mg/l to 75.2mg/l) and NBH12 (34.4mg/l, Round 1 only) in 2021.

### Hydrocarbons

There were no exceedances of the available GTV/ IGV values for TPH compounds for samples collected at monitoring wells located within Area AZ3 during both monitoring events completed in 2021.

### VOCs/ SVOCs

In general, there were no exceedances of the available GTV/ IGV values for volatile/ semi-volatile compounds for samples collected at monitoring wells located within Area AZ3 during both monitoring events completed in 2021. The single exception was for NBH12 where a value of 0.5ug/l (Round 2) was reported for the compound benzene for which the GTV is 0.75ug/l.

### Other compounds

PFAS/ PCBs (Total 12) -There was no testing undertaken for these particular compounds on groundwater samples collected within area AZ3.

### AZ-4 Northwood to Charlemont Section

Representative groundwater sampling was undertaken at 37 no. (thirty seven, unless otherwise stated) wells located within the AZ4 geographical area and these included the following boreholes:

- NBH203A(S), NBH203A(D), NBH207(D) -Ballymun;
- NBH102(S), ABH30i -Albert College Park;
- NBH211, NBH223(S), NBH17 -Griffith Park;
- NBH18(S), NBH19A, NBH19W, NBH20(S) -Glasnevin
- GBH01(S), GBH01(D), GBH02(S), GBH02(D), GBH04(S), GBH04(D), GBH06, GBH09, GBH11, GBH13 -Glasnevin;
- NBH21(S), NBH215(D), NBH216A(S), NBH216A(D) - Mater;

- NBH22(S), NBH23A, NBH23W, NBH24(S), NBH63 (Dry) -O'Connell Street;
- NBH25(S), NBH26CA, NBH26CW, NBH64 -Tara Street;
- NBH219B(S), NBH219B(D) - St. Stephen's Green; and
- NBH31 -Charlemont.

### Summary of EMT results for Area AZ4 (i.e. EMT laboratory test results)

#### Metals/ Indicator parameters

Only few detections of the metal aluminium were noted within the AZ4 area and included samples collected at locations NBH203A(D) at 0.359mg/l and at NBH211 at 0.187mg/l during Round 2 only. These reported values both exceed the available GTV (0.15mg/l) for this parameter. The metal arsenic was reported for samples collected at locations NBH223(S) at 0.0083mg/l, NBH216A(D) at 0.0113mg/l, and at NBH64 at 0.0083mg/l-0.0099mg/l. All reported values exceed the lower GTV threshold value of 0.0075mg/l with the most elevated concentration recorded for deep well NBH216A(D) near Mater.

There were some exceedances of the available IGTV (0.1mg/l) for the metal barium (NBH223(S) 0.106mg/l, NBH20(S) 0.104mg/l, NBH26CA 0.243mg/l, NBH26CW 0.212mg/l) and of the lower GTV (0.75mg/l) for boron - for which the relevant range of 1.383mg/l to 1.78mg/l was reported - and which relates to samples collected at NBH25(S) at Tara Street.

Exceedances of the IGTV values for iron (0.2mg/l), manganese (0.05mg/l) and potassium (5.0mg/l) were reported on occasion throughout the AZ4 area during both rounds completed in 2021. The most elevated value for iron was reported by EMT laboratory at NBH19W at Glasnevin, with a value of 6.477mg/l. Manganese was generally reported above the available IGTV with the more notably elevated concentrations reported for samples collected at monitoring wells located within the area at Tara Street (maximum of 1.133mg/l reported) and St. Stephen's Green (maximum value of 0.305mg/l reported). The parameter magnesium was also reported as elevated (maximum value of 776.9mg/l reported at well NBH25S which significantly exceeds the available IGTV of 50mg/l) in the Tara Street area.

Potassium was generally reported below or only slightly above the available IGTV, however notable exceedances were reported for monitoring wells installed within both the O'Connell Street and Tara Street areas. A range of 2.9mg/l to 14.4mg/l was reported for O'Connell Street area and a range of 18.7mg/l to 261.7mg/l was reported for the Tara Street area.

The available IGTV for sodium is 150mg/l and this guideline value was significantly exceeded for samples collected within the Tara Street area where a [higher] range of between approximately 3,954mg/l to 6,108mg/l was reported. The parameter chloride was also reported as significantly elevated in the Tara Street area and for samples collected at the same monitoring wells with a range of approximately 7,193mg/l to 11,078mg/l reported. Note: Assessment of temporal groundwater level variations at some of the Tara Street monitoring wells has indicated some tidal effects in the area and this is likely to be the source of the elevated sodium and chloride.

With regard to the available GTV for the parameters sulphate (187.5mg/l), chloride (187.5mg/l), nitrate (37.5mg/l) and nitrite (0.375mg/l), in general there were no exceedances of the threshold values presented, however intermittent elevated values for these parameters were reported including concentrations which exceed the lower respective IGTV for each analyte. Notwithstanding this, there were some notable exceedances for sulphate at wells NBH216A(S) i.e. 194.9mg/l at Mater as well as for all wells located within the Tara Street area where a range of approximately 1,001mg/l to 1,558mg/l was reported.

Apart from elevated reported values for COD at locations NBH203A(S) at 580mg/l above the detection limit of 7mg/l, the comparatively higher concentrations were reported for monitoring wells located within the Tara Street area for which a laboratory tested range of between 201mg/l to 783mg/l was reported.

## Hydrocarbons

Exceedances of the available GTV and IGV values for TPH (aliphatics and aromatics), Mineral Oil and other hydrocarbon-based parameters were reported for samples collected at the following AZ4 areas:

- Ballymun: NBH203A(S) and NBH203A(D) reported as 'lubricating oil' with values of between 0.117mg/l at NBH203A(D) to 2.88mg/l NBH203A(S) were reported for this area. Mineral Oil (C10-C40) values of 1.99mg/l to 2.43mg/l at NBH203A(S) were also reported for this area.
- Griffith Park: A single detection of 0.003mg/l benzene was reported for NBH223(S) which exceeded the GTV of 0.00075mg/l.
- Mater: Results for deep well NBH215(D) indicated concentrations of TPH and Mineral Oil at 0.334mg/l (interpreted as degraded kerosene for the Round 2 sample) and benzene at 0.0027mg/l. Results for well locations NBH216A(S) and NBH216A(D) both indicated concentrations of TPH (aromatics) at 0.14mg/l during Round 1, exceeding the GTV of 0.0075mg/l.
- O'Connell Street: Results for monitoring well location NBH24(S) indicated concentrations of TPH (aromatics) at 0.14mg/l for Round 1 and TPH (aliphatics) at 0.011mg/l during Round 2.
- St. Stephen's Green: Results for monitoring well location NBH219B(D) indicated concentrations of TPH (aliphatics) at 0.1mg/l during Round 1, exceeding the GTV of 0.0075mg/l.

## VOCs/ SVOCs

In general, VOCs or SVOCs were not reported by the EMT testing laboratory for the AZ4 area during the sampling events completed in 2021. Notwithstanding this, some minor detections above the method detection limit were recorded at the following locations:

-Volatile Organic Compounds:

- NBH203A(S) -Vinyl chloride;
- NBH203A(D) -Vinyl chloride (value of 0.7ug/l exceeded the GTV of 0.375ug/l);
- NBH223(S) -Benzene (value of 3ug/l for both rounds exceeded the GTV of 0.75ug/l);
- NBH19W -Methyl Tertiary Butyl Ether and vinyl chloride;
- NBH22(S) -Methyl Tertiary Butyl Ether;
- NBH215(D) -Benzene (value of 2.7ug/l exceeded the GTV of 0.75ug/l);
- NBH23A -Trichloroethene (TCE);
- NBH23W -Chloroform; and
- NBH24(S) -Chloroform, Trichloroethene (TCE) and Tetrachloroethene (PCE) -for PCE, the reported value for both Round 1 (i.e. 41ug/l) and Round 2 (i.e. 30ug/l) exceeded the GTV of 7.5ug/l for this compound.

-Semi Volatile Organic Compounds:

Some exceedances of SVOC compounds were reported for Round 1 at locations NBH203A(S) at Ballymun and NBH216A(S) at Mater. These include exceedances for PAH compounds mainly along with some detections above the respective method detection limit for Phthalates and other SVOCs as presented in the tabulated results which show the initial sampling event completed in 2021.

## Other compounds

PFAS/ PCBs (Total 12) - No detections were reported for those representative samples collected and tested at monitoring wells located within area AZ4.

## Summary of Chemtest results only for AZ4 (i.e. Chemtest laboratory test results specifically)

Representative groundwater samples which were tested at the UKAS accredited laboratory Chemtest relate primarily to samples collected within the Glasnevin area of the alignment (see list above with prefix GBH). This section presents a summary of the key observations with regard to reported test results for the samples analysed at this particular laboratory during Phase 4 Site Investigation works and subsequent groundwater monitoring undertaken by AWN.

### Metals/ Indicator parameters

In general, the values for metals were reported as lying within the respective GTV/IGV where available. However, the reported values for the metal nickel exceeded the available GTV (0.015mg/l) at both GBH04(S) (i.e. 0.016mg/l) and GBH04(D) (i.e. 0.029mg/l) monitoring boreholes during Phase 4 sampling (July 2020). A single concentration of mercury above the GTV (0.00075mg/l) was reported at GBH13 in July 2020 but was not detected during sampling completed in January 2021.

Minor exceedances were reported above the respective IGV for both iron (IGV is 0.2mg/l) and manganese (IGV is 0.05mg/l) during both Round 1 and Round 2 completed in 2021. The range above the respective IGV reported for iron was 0.21mg/l to 0.65mg/l and for manganese was 0.12mg/l to 2.0mg/l. In general, the reported values for potassium were below the available IGV of 5mg/l with only slight exceedances reported above this guideline value at locations GBH01(S) at 5.2mg/l, GBH02(D) at 5.1mg/l and GBH04(D) at 6.5mg/l.

Elevated sulphate concentrations above the available lower GTV of 187.5mg/l was reported for groundwater sampled at locations GBH04(S) at 300mg/l and at GBH04(D) at 230mg/l. The remaining values for the Glasnevin area as reported by Chemtest were below the GTV. The majority of the reported results for chloride were above the lower IGV of 30mg/l but well within the GTV of 187.5mg/l. Concentrations of the parameter nitrite, where reported, were generally below the available GTV of 0.375mg/l with only some exceedances of the lower IGV (0.1mg/l) reported for samples collected at GBH04(S) at 0.28mg/l and GBH13 at 0.18mg/l.

### Hydrocarbons

Results for monitoring well location GBH01(S) indicated concentrations of TPH (aliphatics) at 0.12mg/l and TPH (aromatics) at 0.038mg/l during Round 1, exceeding the GTV of 0.0075mg/l. There were no detections of Mineral Oil reported for this sampling well. The presence of TPH compounds was not reported at the remaining monitoring wells sampled within the subject area at Glasnevin.

### VOCs/ SVOCs

The presence of VOCs and SVOCs above the respective method detection limit were not reported for samples collected at monitoring wells installed within AZ4 Glasnevin area for either monitoring event completed in 2020 (Phase 4 reporting) and 2021 (AWN groundwater monitoring) and tested at the Chemtest laboratory.

### Other compounds

PCBs (Total 12) - No detections were reported by Chemtest for those representative samples collected and tested at selected monitoring wells located within AZ4 Glasnevin area.

## Analysis of Duplicate Samples

In order to ensure quality control of laboratory results, representative Duplicate samples were taken during both sampling rounds completed in 2021, using the same purged water volume split in the field and sampled in pre-labelled sampling bottles sent to the testing laboratory under [monitored] chain of custody. An analysis of relative percent differences (RPD) between Primary and Duplicate samples was undertaken as presented below. According to relevant bibliography consulted for this analysis (i.e.



Standard Methods for the Examination of Water and Wastewater; American Public Health Association (APHA), 2012), the RPD was determined as follows:

$$RPD = \frac{|D_1 - D_2|}{\left(\frac{D_1 + D_2}{2}\right)}$$

Where:

- D<sub>1</sub>: Concentration determined for primary sample;
- D<sub>2</sub>: Concentration determined for duplicate sample.

Overall, the results showed some consistency between both Primary and Duplicate sample sets. In general, the estimated RPD for the parameters assessed for both Round 1 and Round 2 duplicates were consistently below the acceptable limit of 40% for 'reliability' of laboratory test results. Therefore, the analytical results for the 2021 groundwater quality monitoring programme were considered acceptable for use as presented.

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