

SYDNEY METRO MARTIN PLACE – INTEGRATED STATION DEVELOPMENT GROUNDWATER MONITORING REPORT JANUARY-JUNE 2021



REVISION STATUS

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1.0 INTRODUCTION

1.1 Sydney Metro project background

The New South Wales (NSW) Government through Transport for NSW (TfNSW) is implementing Sydney's Rail Future, a plan to transform and modernise Sydney's rail network so that it can grow with the city's population and meet the needs of commuters and customers in the future.

Sydney Metro is a new standalone rail network identified in Sydney's Rail Future. The Sydney Metro network consists of Sydney Metro Northwest (previously known as the North West Rail Link), Sydney Metro City & Southwest and Sydney Metro West.

This monitoring report has been developed for construction of the Martin Place Metro Station.

1.2 Martin Place - Integrated Station Development (ISD)

The Martin Place Integrated Station Development (ISD) comprises of the new Martin Place Metro Station, and Over Station Development (OSD) consisting of a south tower and a north tower, and is outlined below.

The Martin Place Metro Station works are being completed as part of the Critical State Significant Infrastructure (CSSI) project (reference SSI 7400), and as approved by SSI 7400 MOD 3. The south tower and north tower OSD works will be completed under separate State Significant Development (SSD) approvals.

MPISD occupied the south site, north site and Bligh Street compound throughout the reporting period.

1.3 Project location

The Project is located between Hunter Street to the north, 50 Martin Place to the south, Elizabeth Street to the east and Castlereagh Street to the west, also termed the Martin Place north site.

The location of this Project is shown in Figures 1 and 2 below.

1.4 Construction Groundwater Management Plan

A Construction Groundwater Management Plan (CGMP) has been prepared for the construction of the Martin Place Metro Station project.

The CGMP includes a groundwater monitoring program, which specifies monitoring required throughout construction. This monitoring report has been prepared to address the requirements of the groundwater monitoring program.

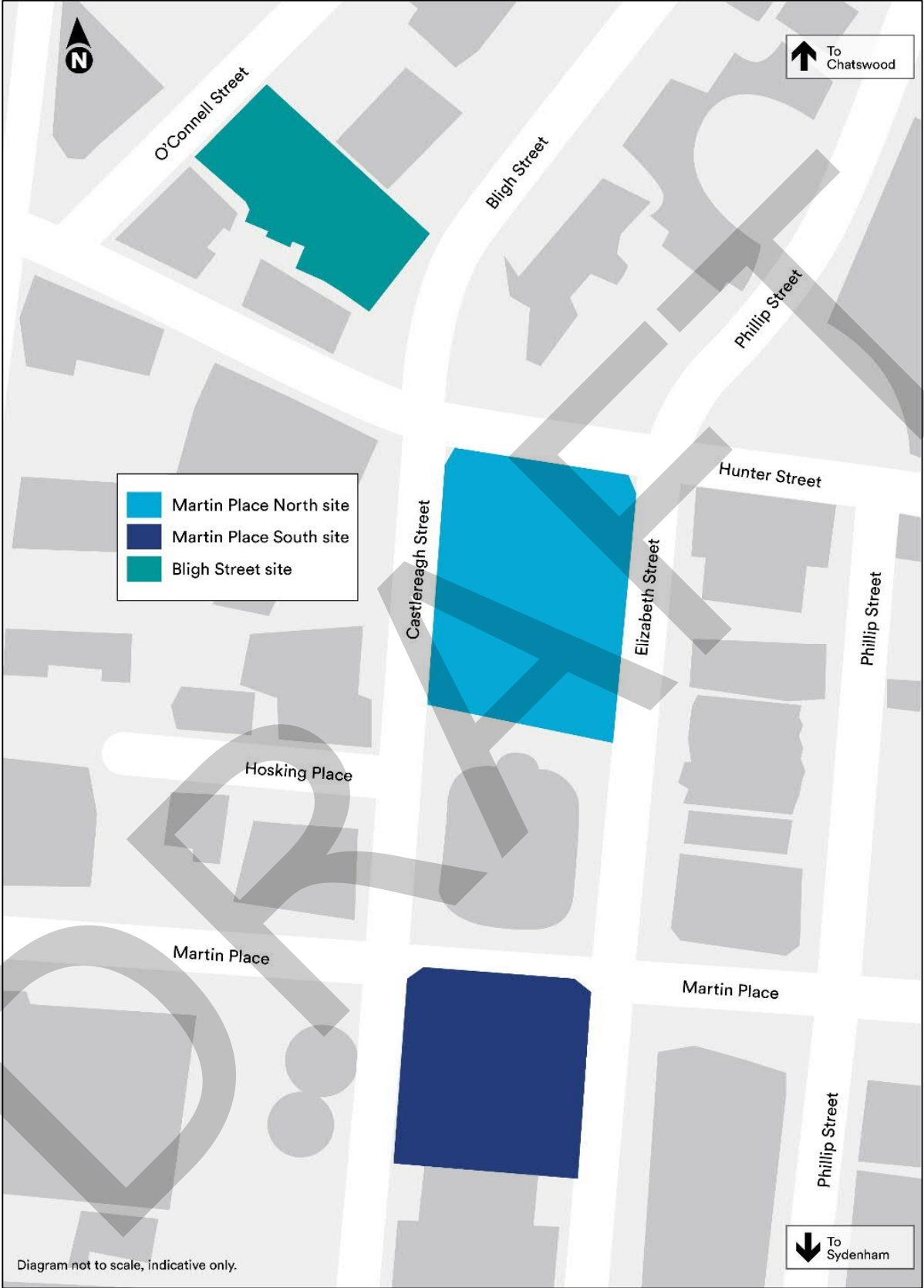


Figure 1 – Project Site Location

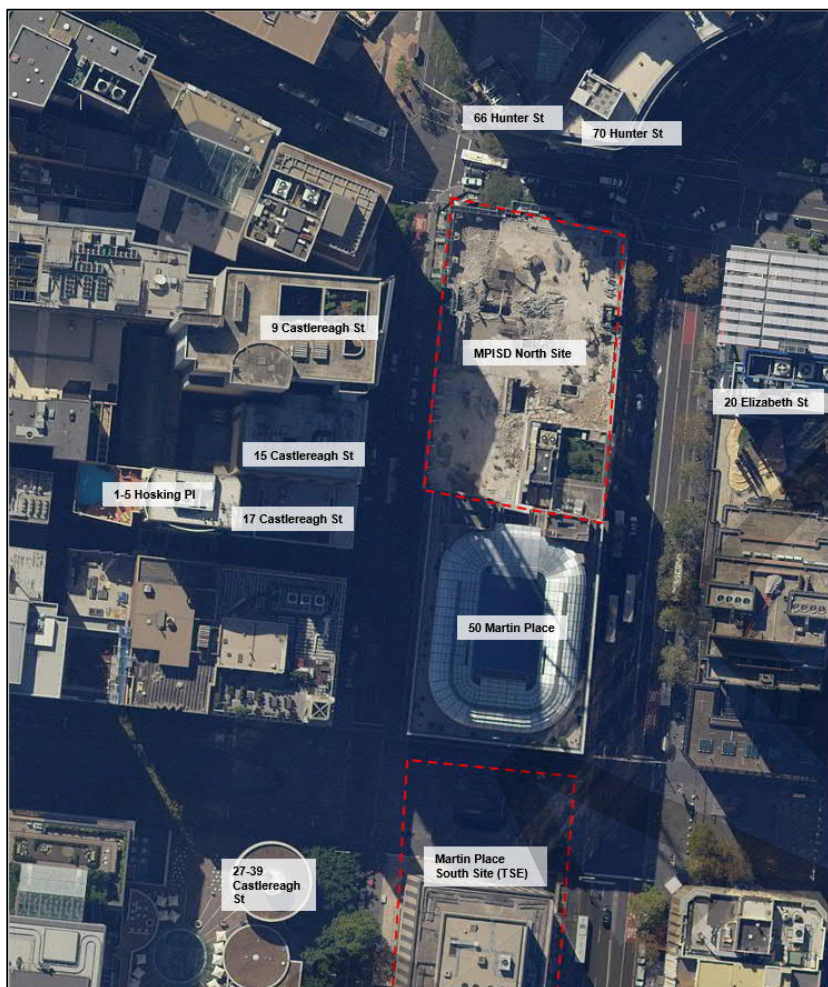


Figure 2 – North & South Project Sites
(Source: maps.six.nsw.gov.au)

2.0 WORK ACTIVITIES

Works have comprised of the following activities:

- Deliveries
- Pedestrian tunnel excavation.
- Loading and haulage of excavated material.
- Underpinning works at 50 Martin Place
- Detailed excavation of footings and foundations using hydraulic hammers and saws.
- Construction of station footings and foundations including steel & concrete placement.
- Waterproofing.
- Structural station elements including steel and concrete placement.
- Operation of the Bligh Street compound and water treatment plant.

3.0 MONITORING REQUIREMENTS

Table 1 below summarises groundwater-related monitoring that is required by the Construction Groundwater Management Plan, along with the current status of monitoring.

Table 1 – CGMP monitoring summary

Monitoring Location	Parameters	Frequency	Standards	Status at start of reporting period
Groundwater Bore – MMP-BH005	Groundwater elevation	Continuous, until completion of excavation	-	Complete
Groundwater Bore – MMP-BH007	Groundwater elevation	Continuous, until completion of excavation	-	Complete
Groundwater Bore – JCG-BH113	Groundwater elevation	Continuous, until completion of excavation	-	Complete
Groundwater discharge	pH, Turbidity, Suspended Solids, Oil and Grease, Iron, Manganese, Copper, Lead, Mercury, Nickel, Zinc, Hydrocarbons.	Prior to offsite discharge from WTP which incorporates captured station excavation groundwater, then quarterly.	Alert & trigger criteria	Ongoing

As per the previous groundwater monitoring report, groundwater levels at the completion of bulk excavation were stable and hence groundwater level monitoring at the groundwater bores adjacent to the site was completed in December 2020.

Evidence from the site suggested that groundwater seepage rates were far less than predicted. As of December 2020, MPISD had not encountered any groundwater in the north shaft or south shaft, with all excavation completed. Site information and anecdotal evidence has shown no significant groundwater seepage present at the Bligh Street decline.

The remaining aspect of groundwater monitoring required by the Construction Groundwater Management Plan is water treatment plant (WTP) influent and discharge, as per Table 1. Note that this tunnel influent water is a mix of groundwater seepage into the Sydney Metro tunnels (being constructed separately) between Central and Barangaroo, and construction site runoff. Due to this, the water quality does not represent actual groundwater conditions at the Martin Place site as it is mixed with stormwater runoff and construction runoff.

4.0 MONITORING LOCATIONS

The monitoring location is at the inlet and discharge at the Bligh St WTP, the location of which is shown in Figure 3 below.

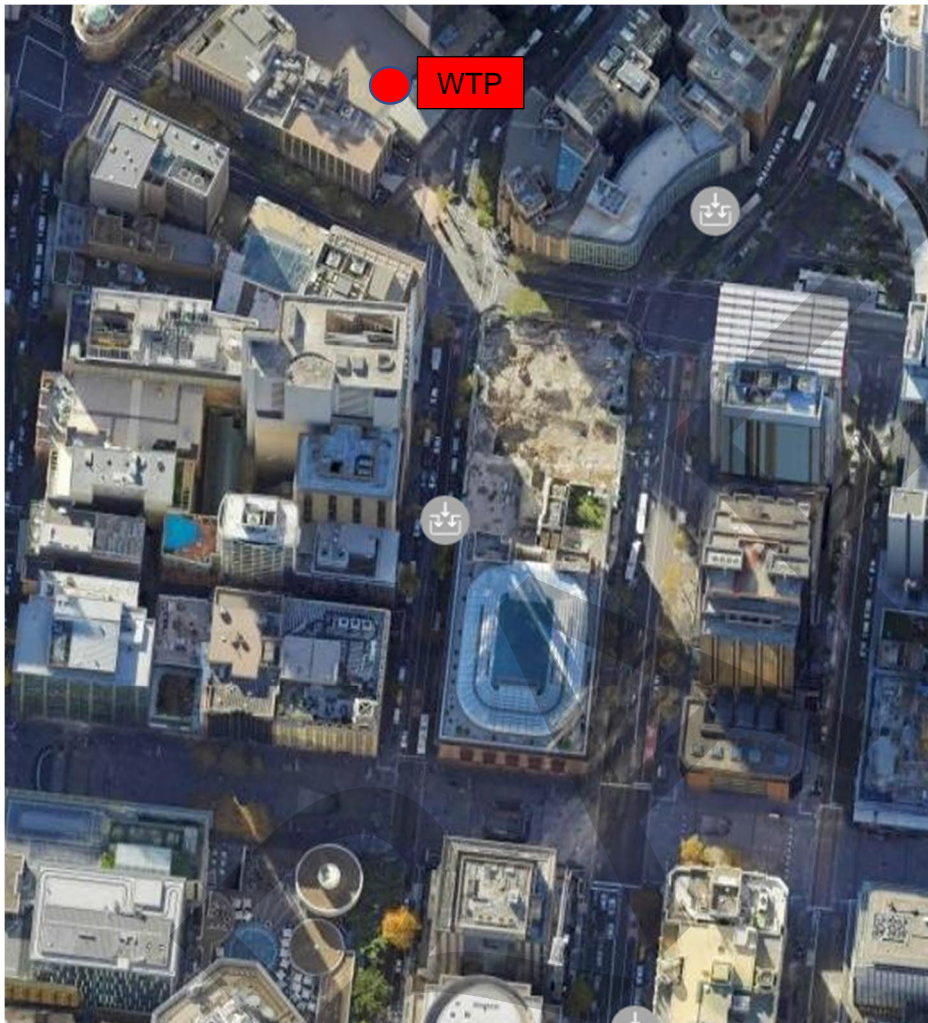


Figure 3 – WTP monitoring location

5.0 MONITORING RESULTS

5.1 WTP Influent Monitoring

Table 2 compares the maximum WTP influent from tunnels for the period January to June 2021, to selected pre-construction levels as was referenced within the Construction Groundwater Management Plan.

Table 2 – WTP influent comparison to pre-project levels (all mg/L)

Analyte	Maximum Recorded Martin Place Precinct (pre-construction)	Maximum WTP Influent (Jan-Jun 2021)
Sulfate	2,500	375
Iron	3.6	0.6
Manganese	0.68	0.022
Cadmium	0.0021	0.0003
Copper	0.520	0.160
Lead	0.064	0.006
Mercury	0.00054	0.0002
Nickel	0.290	0.014
Zinc	3.7	0.204

These results show that for the selected groundwater-related analytes, the maximum WTP influent for the period January to June 2021 was generally less than that recorded in groundwater prior to construction.

A summary of all WTP influent monitoring results is provided in Table 3 below.

Relevant criteria shaded blue are the derived water quality criteria in the MPISD Water Discharge Procedure Rev 2, dated 28 January 2021. These criteria are based on:

- NSW WQO (2006) for Sydney Harbour, Lower Estuary.
- ANZG 95% (2018) protection of marine ecosystems / project specific guidelines for discharge at Sydney Harbour at Man O'War (MOW) Steps.

Comparison of the results to the project criteria demonstrates that exceedances would be expected if there were no treatment, and influent water was permitted to discharge into Sydney Harbour.

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Table 3 – WTP influent monitoring summary

	Parameter	Unit	EQL	Project Criteria	Minimum Concentration	Average Concentration	Maximum Concentration
Field							
	Temp (Field)	°C			15.6	20	22.5
	DO % Saturation (Field)	%Sat			10.8	76	235
	EC (field)	uS/cm			343.6	1,171	3,015
	pH	-		6.5-8.5	8.02	10	12.12
	Redox Potential (Field)	mV			-214	-17	79.7
	Turbidity (Field)	NTU		20	17.8	130	382
	TDS (Field)	mg/L			223	4,047	69,550
	DO (Field)	mg/L			0.93	7.2	21.04
Analytical results – general							
	TSS	mg/L	5	50	<5	235	1,200
	TDS	mg/L	5		250	862	3,100
	Electrical Conductivity (Lab)	µS/cm	10		460		460
	pH (Lab)	-	0.1		9.4		9.4
Analytical results – alkalinity							
	Alkalinity (Bicarbonate as CaCO ₃)	mg/L	1		<1	79	480
	Alkalinity (Carbonate as CaCO ₃)	mg/L	1		<1	336	2,200
	Alkalinity (Hydroxide) as CaCO ₃	mg/L	1		<1	56	420
	Alkalinity (total) as CaCO ₃	mg/L	1		37	465	2,300
Analytical results – nutrients							
	Ammonia as N	mg/L	0.01	1.9	0.12	0.55	1.3
	Nitrite + Nitrate as N	mg/L	0.01		<0.05	0.55	1.38
	Kjeldahl Nitrogen Total	mg/L	0.1		<0.2	1.6	5
	Nitrite (as N)	mg/L	0.01		<0.02	0.17	1.23
	Nitrate (as N)	mg/L	0.01		<0.02	0.38	1.2
	Nitrogen (Total)	mg/L	0.1		0.51	2.1	5.27
	Reactive Phosphorus as P	mg/L	0.01		0.01	0.06	0.86
	Phosphorus	mg/L	0.01		0.04	0.19	1.4
Inorganics							
	Calcium	mg/L	0.5		<5	38	140
	Calcium (filtered)	mg/L	0.5		2	10	29
	Chloride	mg/L	1		21	160	1,200
	Fluoride	mg/L	0.1		0.2	0.34	0.8
	Phosphate	µg/L	10		230	583	860
	Silicon as SiO ₂	mg/L	0.1		38.6		38.6
	Silicon as SiO ₂ (filtered)	mg/L	0.1		26.3	32	37.6
	Sodium Absorption Ratio (filtered)	-	0.01		4.82	38	96.6
	Free Carbon Dioxide as CO ₂	mg/L	1		<1	0.5	<1
	Sulphate	mg/L	2	2900	19	207	1,200
	Sodium	mg/L	0.5		49	244	1,200
	Sodium (filtered)	mg/L	0.5		67	326	847

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	Parameter	Unit	EQL	Project Criteria	Minimum Concentration	Average Concentration	Maximum Concentration
	Magnesium	mg/L	0.5		0.6	3.2	<25
	Magnesium (filtered)	mg/L	0.5		1	0.62	1
	Potassium	mg/L	0.5		20	52	180
	Potassium (filtered)	mg/L	0.5		29	71	137
	Anions Total	meq/L	0.01		4.86	18	44.6
	Ionic Balance	%	0.01		1.89	4.6	6.11
	Cations Total	meq/L	0.01		4.39	17	40.6
	Sulfate as SO ₄ - (filtered)	mg/L	1		34	130	375
Metals							
	Aluminium	mg/L	0.05		1.4	3.8	11
	Aluminium (filtered)	mg/L	0.05		0.12	0.46	1.1
	Arsenic	mg/L	0.001		0.001	0.0038	0.011
	Arsenic (filtered)	mg/L	0.001		0.001	0.003	0.012
	Barium	mg/L	0.001		0.01	0.047	0.15
	Barium (filtered)	mg/L	0.001		0.007	0.016	0.08
	Boron	mg/L	0.05		0.05	0.088	0.44
	Boron (filtered)	mg/L	0.05		0.05	0.069	0.17
	Cadmium	mg/L	0.0001		0.0001	0.0001	0.0002
	Cadmium (filtered)	mg/L	0.0001	1.0	<0.0001	0.00013	0.0003
	Chromium (III+VI)	mg/L	0.001		0.001	0.018	0.11
	Chromium (III+VI) (filtered)	mg/L	0.001		<0.001	0.0091	0.042
	Copper	mg/L	0.001		<0.001	0.011	0.045
	Copper (filtered)	mg/L	0.001	1.1	0.001	0.036	0.16
	Strontium	mg/L	0.001		0.07	0.17	0.57
	Strontium (filtered)	mg/L	0.001		0.025	0.1	0.42
	Iron	mg/L	0.05		<0.05	2	6.9
	Iron (filtered)	mg/L	0.05	3.5	0.05	0.15	0.6
	Lead	mg/L	0.001		0.001	0.0048	0.024
	Lead (filtered)	mg/L	0.001	1.0	<0.001	0.0019	0.006
	Manganese	mg/L	0.001		0.005	0.075	0.19
	Manganese (filtered)	mg/L	0.001	2.9	0.001	0.0065	0.022
	Mercury	mg/L	0.0001		0.0001	0.000065	0.0002
	Mercury (filtered)	mg/L	0.0001	0.001	0.0001	0.000059	0.0002
	Nickel	mg/L	0.001		<0.001	0.0064	0.016
	Nickel (filtered)	mg/L	0.001	1.1	0.001	0.0054	0.014
	Zinc	mg/L	0.005		0.011	0.14	0.706
	Zinc (filtered)	mg/L	0.005	1.0	<0.005	0.056	0.204
BTEX							
	Benzene	µg/L	1		<1	0.5	<1
	Ethylbenzene	µg/L	1		<1	0.65	<2
	Toluene	µg/L	1		<1	0.91	4
	Total BTEX	µg/L	1		<1	0.5	<1
	Xylene (m & p)	µg/L	2		<2	1	<2

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	Parameter	Unit	EQL	Project Criteria	Minimum Concentration	Average Concentration	Maximum Concentration
	Xylene (o)	µg/L	1		<1	0.65	<2
	Xylene Total	µg/L	2		<2	1.4	<3
TRH							
	C10-C16	µg/L	50		<50	333	2,000
	C10-C16 (F2 minus Naphthalene)	µg/L	50		<50	333	2,000
	C10-C40 (Sum of total)	µg/L	100	100	<100	1,605	6,630
	C16-C34	µg/L	100		<100	1,143	5,100
	C34-C40	µg/L	100		<100	197	1,330
	C6-C10	µg/L	20		<20	30	320
	C6-C10 (F1 minus BTEX)	µg/L	20		<20	30	320
PAH							
	Naphthalene	µg/L	1		1	0.68	<10
	Acenaphthene	µg/L	1		<1	0.5	<1
	Acenaphthylene	µg/L	1		<1	0.5	<1
	Anthracene	µg/L	1		<1	0.5	<1
	Benz(a)anthracene	µg/L	1		<1	0.54	<2
	Benzo(a) pyrene	µg/L	0.5		<0.5	0.46	<2
	Benzo(a)pyrene TEQ calc (Zero)	mg/L	0.0005		<0.0005	0.00025	<0.0005
	Benzo(b+j)fluoranthene	mg/L	0.001		<0.001	0.00054	<0.002
	Benzo(g,h,i)perylene	µg/L	1		<1	0.54	<2
	Benzo(k)fluoranthene	µg/L	1		<1	0.54	<2
	Chrysene	µg/L	1		<1	0.54	<2
	Dibenz(a,h)anthracene	µg/L	1		<1	0.54	<2
	Fluoranthene	µg/L	1		<1	0.52	<2
	Fluorene	µg/L	1		<1	0.5	<1
	PAHs (Sum of total)	µg/L	0.5		<0.5	0.48	<2
	Indeno(1,2,3-c,d)pyrene	µg/L	1		<1	0.54	<2
	Phenanthrene	µg/L	1		<1	0.5	<1
	Pyrene	µg/L	1		<1	0.52	<2
TPH							
	Oil and Grease	mg/L	5	None visible	<5	6.4	24
	+C10-C36 (Sum of total)	µg/L	50		<50	1,522	6,070
	C15-C28	µg/L	100	100	<100	1,051	3,800
	C10-C14	µg/L	50		<50	204	1,200
	C29-C36	µg/L	50		<50	325	2,770
	C6-C9	µg/L	20		<20	29	330

5.2 WTP Discharge Monitoring

A summary of WTP discharge monitoring results for the reporting period is provided in Table 4 below.

Relevant criteria shaded blue are the derived water quality criteria in the MPISD Water Discharge Procedure Rev 2, dated 28 January 2021. These criteria are based on:

- NSW WQO (2006) for Sydney Harbour, Lower Estuary.
- ANZG 95% (2018) protection of marine ecosystems / project specific guidelines for discharge at Sydney Harbour at Man O'War (MOW) Steps.

Comparison of the results to the project criteria demonstrates that WTP discharges during the reporting period have not exceeded criteria, and hence have not impacted on ambient water quality within Sydney Harbour.

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Table 4 – WTP discharge monitoring summary

Parameter	Unit	EQL	Project Criteria	Minimum Concentration	Average Concentration	Maximum Concentration
Field						
Temp (Field)	°C			15.7	20	22.5
DO % Saturation (Field)	%Sat			2.4	57	100.6
EC (field)	uS/cm			123.3	1,082	2,282
pH	-		6.5-8.5	6.68	7.3	8.1
Redox Potential (Field)	mV			-220.2	64	255.9
Turbidity (Field)	NTU		20	0.14	4.9	17.50
TDS (Field)	mg/L			304.85	860	2,931.50
DO (Field)	mg/L			0.2	5.4	12.3
Analytical results – general						
TSS	mg/L	5	50	<5	9.4	45
TDS	mg/L	5		133	879	2,300
Turbidity	NTU	1		<1		<1
Electrical Conductivity (Lab)	µS/cm	10		910	1,982	3,300
pH (Lab)	-	0.1		7.2	7.5	8
Analytical results – alkalinity						
Alkalinity (Bicarbonate as CaCO ₃)	mg/L	1		<20	146	380
Alkalinity (Carbonate as CaCO ₃)	mg/L	1		<1	47	1,400
Alkalinity (Hydroxide) as CaCO ₃	mg/L	1		<1	15	290
Alkalinity (total) as CaCO ₃	mg/L	1		28	197	1,700
Analytical results – nutrients						
Ammonia as N	mg/L	0.01	1.90	0.13	0.7	1.9
Nitrite + Nitrate as N	mg/L	0.01		<0.01	0.44	1.4
Kjeldahl Nitrogen Total	mg/L	0.1		<0.2	1.1	3.6
Nitrite (as N)	mg/L	0.01		<0.01	0.061	0.33
Nitrate (as N)	mg/L	0.01		<0.01	0.38	1.3
Nitrogen (Total)	mg/L	0.1		0.43	1.5	3.9
Reactive Phosphorus as P	mg/L	0.01		0.01	0.022	0.12
Phosphorus	mg/L	0.01		<0.01	0.064	0.45
Inorganics						
Calcium	mg/L	0.5		13	36	79
Calcium (filtered)	mg/L	0.5		9	21	33
Chloride	mg/L	1		23	177	400
Fluoride	mg/L	0.1		0.1	0.33	1
Phosphate	µg/L	10		<10	82	360
Silicon as SiO ₂	mg/L	0.1		8.9		8.9
Silicon as SiO ₂ (filtered)	mg/L	0.1		3.3	8.4	18.3
Sodium Absorption Ratio (filtered)	-	0.01		1.08	13	27.2
Free Carbon Dioxide as CO ₂	mg/L	1		<1	2.8	6
Sulphate	mg/L	2	2900	98	345	810

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Parameter	Unit	EQL	Project Criteria	Minimum Concentration	Average Concentration	Maximum Concentration
Sodium	mg/L	0.5		61	272	730
Sodium (filtered)	mg/L	0.5		17	203	341
Magnesium	mg/L	0.5		<0.5	1.7	<25
Magnesium (filtered)	mg/L	0.5		1	1.4	4
Potassium	mg/L	0.5		22	55	110
Potassium (filtered)	mg/L	0.5		4	41	65
Anions Total	meq/L	0.01		2.01	12	19.9
Ionic Balance	%	0.01		2.08	5.2	9.89
Cations Total	meq/L	0.01		1.79	11	17.5
Sulfate as SO ₄ - Turbidimetric (filtered)	mg/L	1		8	251	377
Metals						
Aluminium	mg/L	0.05		0.18	0.24	0.41
Aluminium (filtered)	mg/L	0.05		0.07	0.1	0.12
Arsenic	mg/L	0.001		0.001	0.0017	0.008
Arsenic (filtered)	mg/L	0.001		0.001	0.0017	0.008
Barium	mg/L	0.001		0.008	0.022	0.07
Barium (filtered)	mg/L	0.001		0.011	0.021	0.07
Boron	mg/L	0.05		0.05	0.1	0.37
Boron (filtered)	mg/L	0.05		0.05	0.089	0.33
Cadmium	mg/L	0.0001		<0.0001	0.000087	<0.0002
Cadmium (filtered)	mg/L	0.0001	1.0	0.0001	0.00016	0.0009
Chromium (III+VI)	mg/L	0.001		0.001	0.0058	0.026
Chromium (III+VI) (filtered)	mg/L	0.001		0.001	0.0052	0.025
Copper	mg/L	0.001		0.001	0.0024	0.019
Copper (filtered)	mg/L	0.001	1.1	0.001	0.024	0.113
Strontium	mg/L	0.001		0.034	0.13	0.58
Strontium (filtered)	mg/L	0.001		0.031	0.12	0.53
Iron	mg/L	0.05		<0.05	0.096	0.74
Iron (filtered)	mg/L	0.05	3.5	0.05	0.049	0.44
Lead	mg/L	0.001		0.001	0.0006	0.002
Lead (filtered)	mg/L	0.001	1.0	0.001	0.0014	0.009
Manganese	mg/L	0.001		0.002	0.019	0.078
Manganese (filtered)	mg/L	0.001	2.9	0.005	0.019	0.077
Mercury	mg/L	0.0001		0.0001	0.000056	0.0002
Mercury (filtered)	mg/L	0.0001	0.001	0.0001	0.000056	0.0002
Nickel	mg/L	0.001		0.001	0.0039	0.024
Nickel (filtered)	mg/L	0.001	1.1	0.001	0.0074	0.028
Zinc	mg/L	0.005		0.005	0.034	0.16
Zinc (filtered)	mg/L	0.005	1.0	<0.005	0.062	0.451
BTEX						
Benzene	µg/L	1		<1	0.5	<1

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Parameter	Unit	EQL	Project Criteria	Minimum Concentration	Average Concentration	Maximum Concentration
Ethylbenzene	µg/L	1		<1	0.64	<2
Toluene	µg/L	1		<1	0.64	<2
Total BTEX	µg/L	1		<1	0.5	<1
Xylene (m & p)	µg/L	2		<2	1	<2
Xylene (o)	µg/L	1		<1	0.64	<2
Xylene Total	µg/L	2		<2	1.4	<3
TRH						
C10-C16	µg/L	50		<50	47	230
C10-C16 (F2 minus Naphthalene)	µg/L	50		<50	47	230
C10-C40 (Sum of total)	µg/L	100		100	91	630
C16-C34	µg/L	100		100	75	400
C34-C40	µg/L	100		100	51	100
C6-C10	µg/L	20		<20	18	230
C6-C10 (F1 minus BTEX)	µg/L	20		<20	18	230
PAH						
Naphthalene	µg/L	1		<1	0.5	<1
Acenaphthene	µg/L	1		<1	0.5	<1
Acenaphthylene	µg/L	1		<1	0.5	<1
Anthracene	µg/L	1		<1	0.5	<1
Benz(a)anthracene	µg/L	1		<1	0.53	<2
Benzo(a) pyrene	µg/L	0.5		<0.5	0.46	<2
Benzo(a)pyrene TEQ calc (Zero)	mg/L	0.0005		<0.0005	0.00025	<0.0005
Benzo(b+)fluoranthene	mg/L	0.001		<0.001	0.00053	<0.002
Benzo(g,h,i)perylene	µg/L	1		<1	0.53	<2
Benzo(k)fluoranthene	µg/L	1		<1	0.53	<2
Chrysene	µg/L	1		<1	0.53	<2
Dibenz(a,h)anthracene	µg/L	1		<1	0.53	<2
Fluoranthene	µg/L	1		<1	0.51	<2
Fluorene	µg/L	1		<1	0.5	<1
PAHs (Sum of total)	µg/L	0.5		<0.5	0.46	<2
Indeno(1,2,3-c,d)pyrene	µg/L	1		<1	0.53	<2
Phenanthrene	µg/L	1		<1	0.5	<1
Pyrene	µg/L	1		<1	0.51	<2
TPH						
Oil and Grease	mg/L	5	None visible	<5	5.2	18
+C10-C36 (Sum of total)	µg/L	50		<50	92	600
C15-C28	µg/L	100	100	<100	79	100
C10-C14	µg/L	50		<50	41	230
C29-C36	µg/L	50		<50	45	100
C6-C9	µg/L	20		<20	18	240



6.0 CONCLUSION

As groundwater levels at the end of 2020 were stable, groundwater level monitoring at the piezometers was completed in December 2020.

Evidence from the site suggested that groundwater seepage rates were far less than predicted. As of December 2020, MPISD had not encountered any groundwater in the north shaft or south shaft, with all excavation completed. Site information and anecdotal evidence has shown no significant groundwater seepage present at the Blich Street decline.

Remaining groundwater-related monitoring at the MPISD site comprised of WTP influent from Linewide works within the tunnels, and WTP discharge monitoring.

Comparison of the influent results to the project criteria demonstrates that exceedances would be expected if there were no treatment, and influent water was permitted to discharge into Sydney Harbour.

Comparison of the discharge results to the project criteria demonstrates that WTP discharges during the reporting period have not exceeded criteria, and hence have not impacted on ambient water quality within Sydney Harbour.

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