Annexure F - Groundwater Modelling Report

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REPORT

Groundwater Modelling Report

F6 Extension Stage 1

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Contents

Tables

(contained within report text)

Figures

(contained within report text)

Appendices

1 Introduction

The F6 Extension is a proposed new motorway for Sydney, which encompasses the proposed projects previously referred to as M1 Gateway to the South and the WestConnex Southern Extension.

The F6 Extension proposal will ultimately provide a motorway standard link between the New M5 at Arncliffe and the existing M1 Princes Motorway at Waterfall. It will connect St George, Sutherland Shire and Illawarra regions to the Sydney motorway network.

Roads and Maritime Services (RMS) are currently seeking approval for Stage 1 of the project, including the construction of 3.8 km of primarily 3-lane twin tunnels, to connect into tunnel stubs at Arncliffe currently under construction as part of the WestConnex New M5 works. The tunnels will extend south beneath Rockdale, with on and off ramps to an interchange at President Avenue in Brighton Le Sands (Figure 1). The project will include a ventilation outlet located within the existing New M5 construction compound at Arncliffe.

The construction and operation of the Project will potentially impact on groundwater levels and groundwater quality due to tunnelling activities and associated works. A groundwater assessment is being undertaken by AECOM to outline the predicted impacts of the project, as well as the cumulative impacts with the WestConnex tunnelling works. RPS has been requested to develop a three-dimensional numerical groundwater model to quantify groundwater impacts due to construction and throughout the operations phase. This groundwater assessment will form a component of the Stage 3 Environmental Impact Statement (EIS) to be lodged in accordance with the requirements of the *Environmental Planning and Assessment Act 1979*.

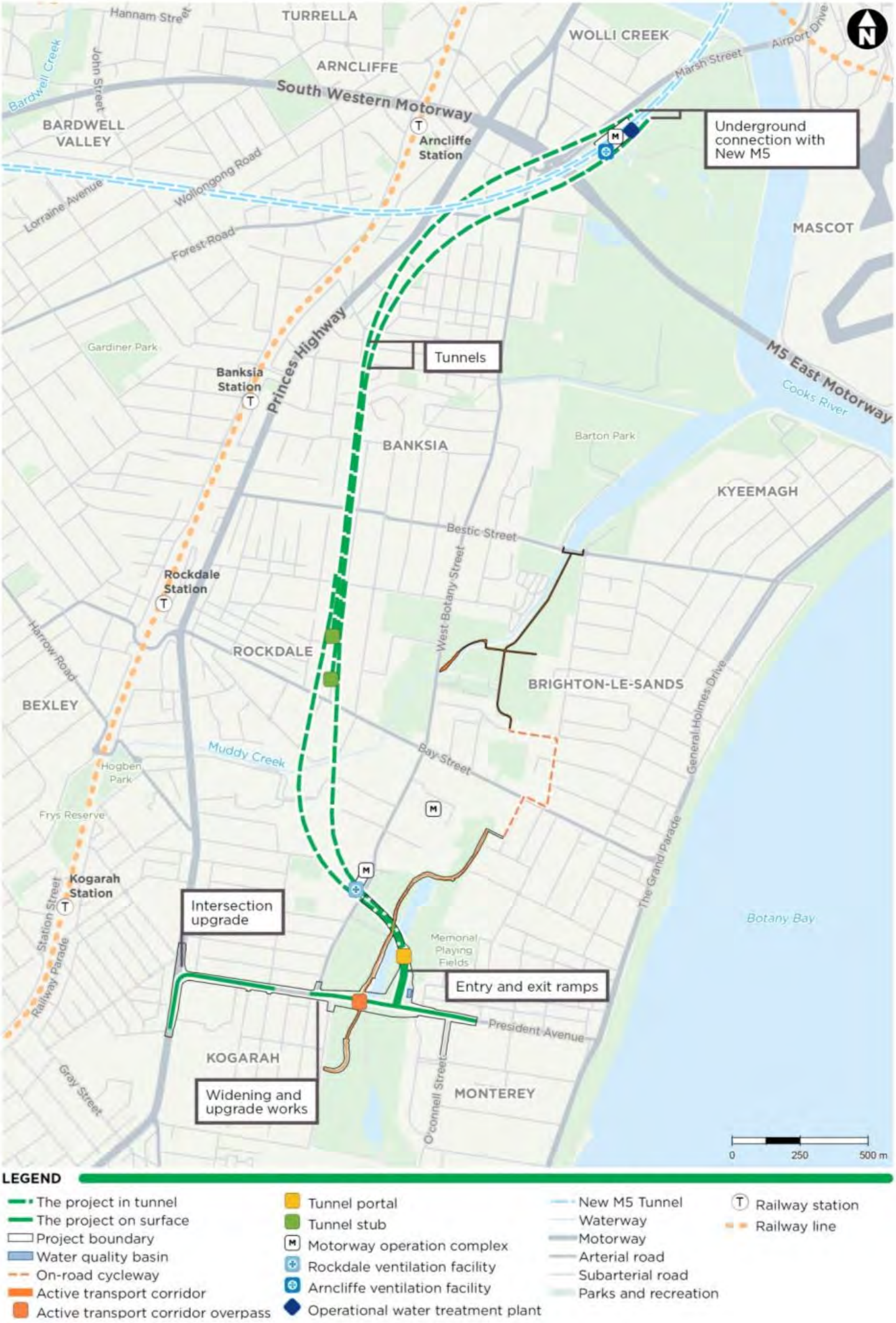


Figure 1 Project Overview

1.1 Scope of Work

The key tasks for this groundwater modelling assessment are:

1. Review of literature and data, as well as of tunnel design.
2. Analysis of data, namely geology, groundwater levels, groundwater recharge, permeability and porosity parameters, and any groundwater inflow data from existing tunnel projects in combination with AECOM.
3. Construction of a groundwater model (e.g. geology/layers, recharge, permeability, tunnels, boundary conditions).
4. Calibration of this model under steady state and transient conditions to historical groundwater levels and potentially considering any available groundwater inflow data from nearby tunnels.
5. Run a 'null' run to determine baseline conditions (as per Barnett *et al*., 2012) and predictive scenarios (2) to predict groundwater inflow into the tunnel during construction and long-term operations for both the Project and the cumulative impacts with the interfacing WestConnex program of works.
6. Predict the groundwater drawdown around the tunnel due to groundwater inflow to the tunnel due to construction and long-term operations.
7. Predict the impacts (groundwater drawdown and water quality) to nearby registered groundwater users and groundwater dependant ecosystems, in accordance with the Aquifer Interference Policy and other requirements.
8. Predict impacts to groundwater quality due to salt water intrusion.
9. Preparation of a groundwater modelling report outlining the model development, assumptions, calibration and predictions in accordance with the *Australian Groundwater Modelling Guidelines* (Barnett *et al*., 2012).

Groundwater modelling has been conducted in accordance with the *Australian Groundwater Modelling Guidelines* (Barnett *et al*., 2012) as well as the *MDBC Groundwater Flow Modelling Guideline* (MDBC, 2001). Analysis and assessment has been carried out with consideration of the following groundwater-related technical and policy guidelines:

- NSW Aquifer Interference Policy (Department of Primary Industries Office of Water), September 2012
- NSW Guidelines for Controlled Activities on Waterfront Land (NOW, 2012)
- National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (Agriculture and Resource Management Council of Australia and Australian and New Zealand Environment and Conservation Council [ARMCANZ & ANZECC, 2000])
- NSW State Groundwater Policy Framework Document (NSW Department of Land and Water Conservation [DLWC, 1998])
- NSW Wetlands Policy (DECCW, 2010)
- NSW State Groundwater Quality Protection Policy (DLWC, 1998)
- NSW State Groundwater Quantity Management Policy (DLWC, undated) Draft;
- NSW Groundwater Dependent Ecosystem Policy (DLWC, 2002)
- Groundwater Modelling Guidelines, namely
  - Murray-Darling Basin Groundwater Quality. Sampling Guidelines. Technical Report No 3 (Murray-Darling Basin Commission [MDBC, 1997])

- Australian National Groundwater Modelling Guidelines, published by the National Water Commission (Barnett et al, 2012)

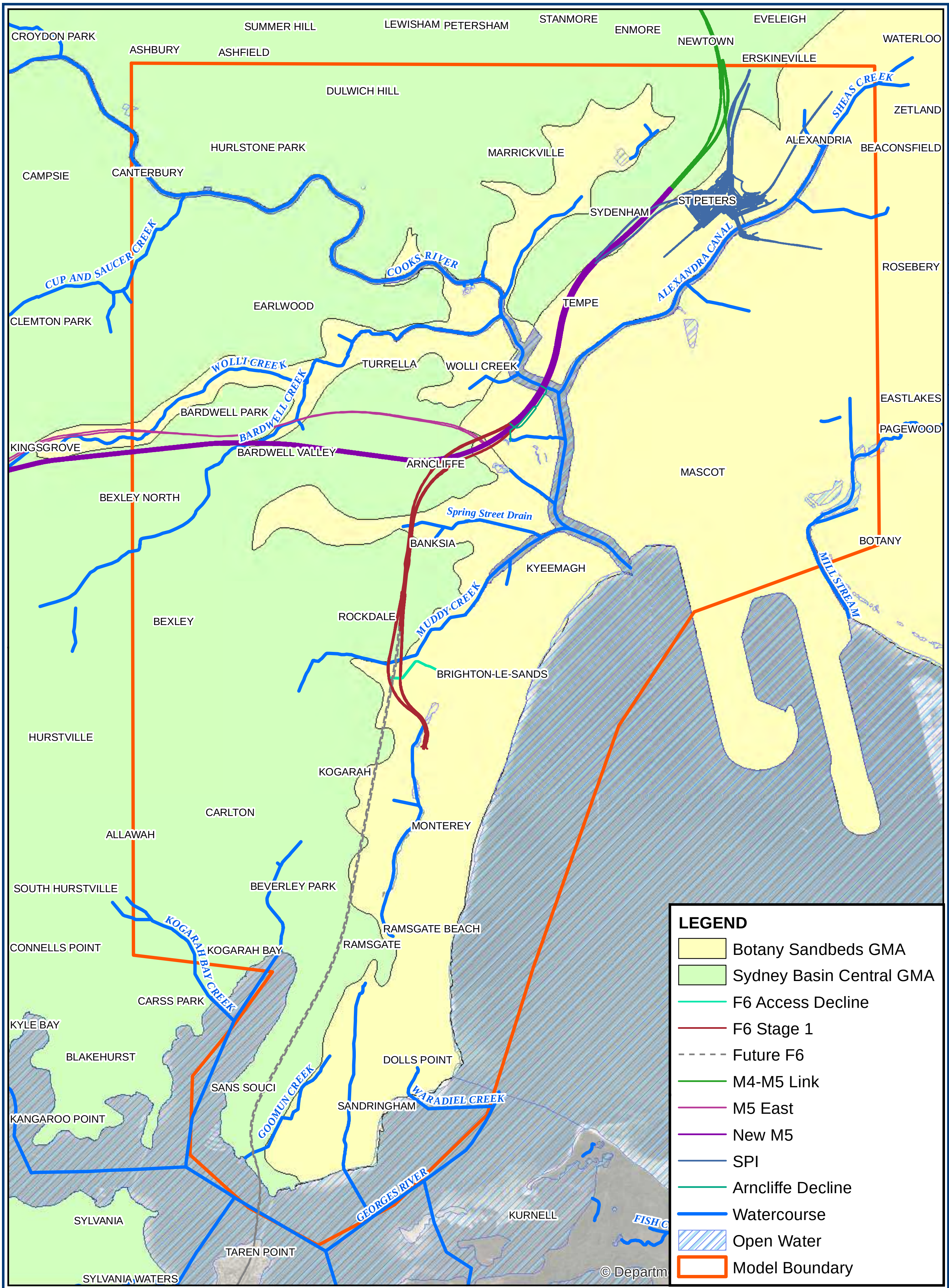
- Draft Guidelines for the Assessment & Management of Groundwater Contamination (NSW Department of Environment and Climate Change [DECC, 2007]).

1.2 Groundwater Management Area

The F6 Extension project is located within the Water Sharing Plan (WSP) for the *Greater Metropolitan Region Groundwater Sources*. The relevant Groundwater Management Areas (GMAs), as defined by the DI (Crown Lands & Water), are:

- The Sydney Basin - Central GMA area covers the majority of the project. This is a porous hard rock aquifer.
- Zone 2 of The Botany Sands Groundwater Source Management Zone – an alluvial and coastal sand bed aquifer occurs in localised portions of the project area near St Peters, Banksia and Rockdale/Brighton-Le-Sands.

The locations of these GMAs are shown in Figure 2 relative to the F6 Extension program of works.



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GDA 1994 MGA Zone 56

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Figure 2

Groundwater Management Areas

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1.2.1 Groundwater Productivity

The *NSW Aquifer Interference Policy* (the AI Policy) (NSW Government, 2012) establishes minimal impact considerations for ‘Highly Productive’ and ‘Less Productive’ groundwater.

The Botany Sands aquifer and the land overlying it has been subject to contamination from historical unregulated industrial activity, and therefore parts of the aquifer are under embargo for certain uses. Within Zone 2 domestic bore use is banned to protect the health of users and minimise the risk of contamination spread through pumping. Industrial bores are permitted, providing annual testing and reporting requirements are followed. However, there are no industrial bores registered within the project area in the Botany Sands Aquifer. DI (Crown Lands & Water) still classify this aquifer as “highly productive”.

The porous hard rock units of the Sydney Basin are considered “less productive”. In this area, this is because groundwater in the Ashfield Shale is generally saline and corrosive, and while groundwater in the underlying Hawkesbury Sandstone is typically of better quality and often potable, typical bore yields from the Hawkesbury Sandstone are not high enough to be considered “highly productive”.

1.3 Requirements for the EIS

Requirements for the EIS are outlined in AECOM (2018) *Groundwater Technical Assessment Report*, to which this report is an Appendix.

2 Background to F6 Extension Project

The following subsections describe the background to the F6 program of works with specific regard to the Stage 1 portion. Two terms are used frequently in the following sections and are defined as:

- **The Project** – Specific to the Stage 1 portion of the F6 Extension project inclusive of the tunnelling extending from Arncliffe to President Avenue.
- **Study area** – a 7.5 km x 12 km area, as shown by the model boundary on Figure 3 and defined as such to encompass the geological and hydrological features that might be important to the Project and to the numerical model built for the purpose of impact assessment for this portion of the overall F6 Extension program of works.

2.1 F6 Extension Stage 1

This Project would be generally located within the Bayside local government area. The Project commences about 8 kilometres south west of the Sydney central business district (CBD). The proposed President Avenue interchange would be located about 11 kilometres south east of the Sydney CBD.
Key components of the project would include:

- Twin mainline tunnels. Each mainline tunnel would be around three kilometres in length, sized for three lanes of traffic, and line marked for two lanes as part of the project.
- A tunnel-to-tunnel connection to the New M5 southern extension stub tunnels. The stub tunnels at Arncliffe will be built in a south-westerly direction and at a depth of about 75 metres underground. This will provide a direct connection for the project to Sydney's motorway network.
- An interchange at President Avenue, including:
  - Entry and exit ramps, including sections of tunnel to provide connections to the mainline tunnel
  - A tunnel portal at Brighton-Le-Sands within Rockdale Bicentennial Park East, to provide connections to President Avenue
- A widened President Avenue at the location of the interchange, including slip lanes to provide a connection to the project
- Upgrade of the President Avenue / Princes Highway intersection to improve intersection capacity.
- Mainline tunnel stubs to allow for connections to future stages of the F6 Extension
- An active transport corridor connecting Bestic Street, Brighton-Le-Sands to Civic Avenue, Kogarah.
- Reinstatement of Bicentennial Park and recreational facilities.
- Temporary construction ancillary facilities and temporary works to facilitate the construction of the project, including a decline tunnel at Arncliffe constructed as part of the WestConnex New M5 project.
- Three motorway operation complexes
  - Arncliffe, involving fitout (mechanical and electrical) of a ventilation facility and connection to the water treatment facility, both currently being constructed as part of the New M5 project.
  - Rockdale (north), including deluge tanks, a workshop and an office.
  - Rockdale (south), including a ventilation facility, substation and power supply.
- In-tunnel ventilation systems including jet fans and ventilation ducts connecting to the ventilation facilities.

- Drainage infrastructure to collect surface water and groundwater inflows for treatment.
- Ancillary infrastructure for electronic tolling, traffic control and signage (both static and electronic signage).
- Emergency access and evacuation facilities (including pedestrian and vehicular cross and long passages); fire and life safety systems.
- New service utilities, modifications and connections to existing service utilities.

Key Stage 1 project features are shown on Figure 1, and Figure 3 shows the overall proposed F6 Extension project extending to Waterfall.

The indicative construction program for the F6 Stage 1 mainline and ventilation tunnels is shown in Table 1**.**

Table 1 Construction Program for F6 Stage 1

Construction Program	Activities
Year 1 (2021)	Mobilise design team Site establishment commences
Year 2 (2022)	Approval of construction Environmental Management Plan Commence cut-and-cover structures Finalise mainline detailed design Commence mainline tunnelling from Arncliffe Commence surface works Commence mainline tunnelling from Rockdale
Year 3 (2023)	Commence active transport corridor Commence tunnel fitout Surface works complete
Year 4 (2024)	Tunnelling complete Tunnel fitout complete Testing and commissioning complete Project opening

2.2 Adjoining WestConnex New M5 Project

As part of this assessment it is a requirement to determine the cumulative impacts of existing infrastructure. The New M5 motorway tunnel is currently under construction and is located just south of the existing M5 East motorway tunnel. The New M5 consists of 9 km of unlined twin tube tunnels. The tunnels are of variable width being constructed to accommodate up to three lanes between the western portals and Arncliffe, and up to five lanes between Arncliffe and St Peters in both directions. Construction of the New M5 commenced in June 2017 and is planned for completion in 2019.

The methodology for assessing these cumulative impacts is discussed in the Predictive Modelling section (Section 5).

Figure 3 Greater F6 Extension Program of Works

3 Hydrogeological Conceptual Model

3.1 Topography and drainage

Topography within the study area has been defined based on 1 m contour interval LIDAR information. Topography of the study area ranges from Sea Level (0 mAHD) to localised highs of approximately 60 mAHD (Figure 4). Regional drainage is ultimately to Botany Bay at the south east. At the centre of the study area, drainage is towards Cooks River and its lesser tributaries Wolli Creek and Bardwell Creek, and Georges River at the south. Both Cooks River and Georges River drain to Botany Bay. The topography in the location of the project is generally relatively low lying (less than 20 m AHD) with a gentle gradient towards Botany Bay.

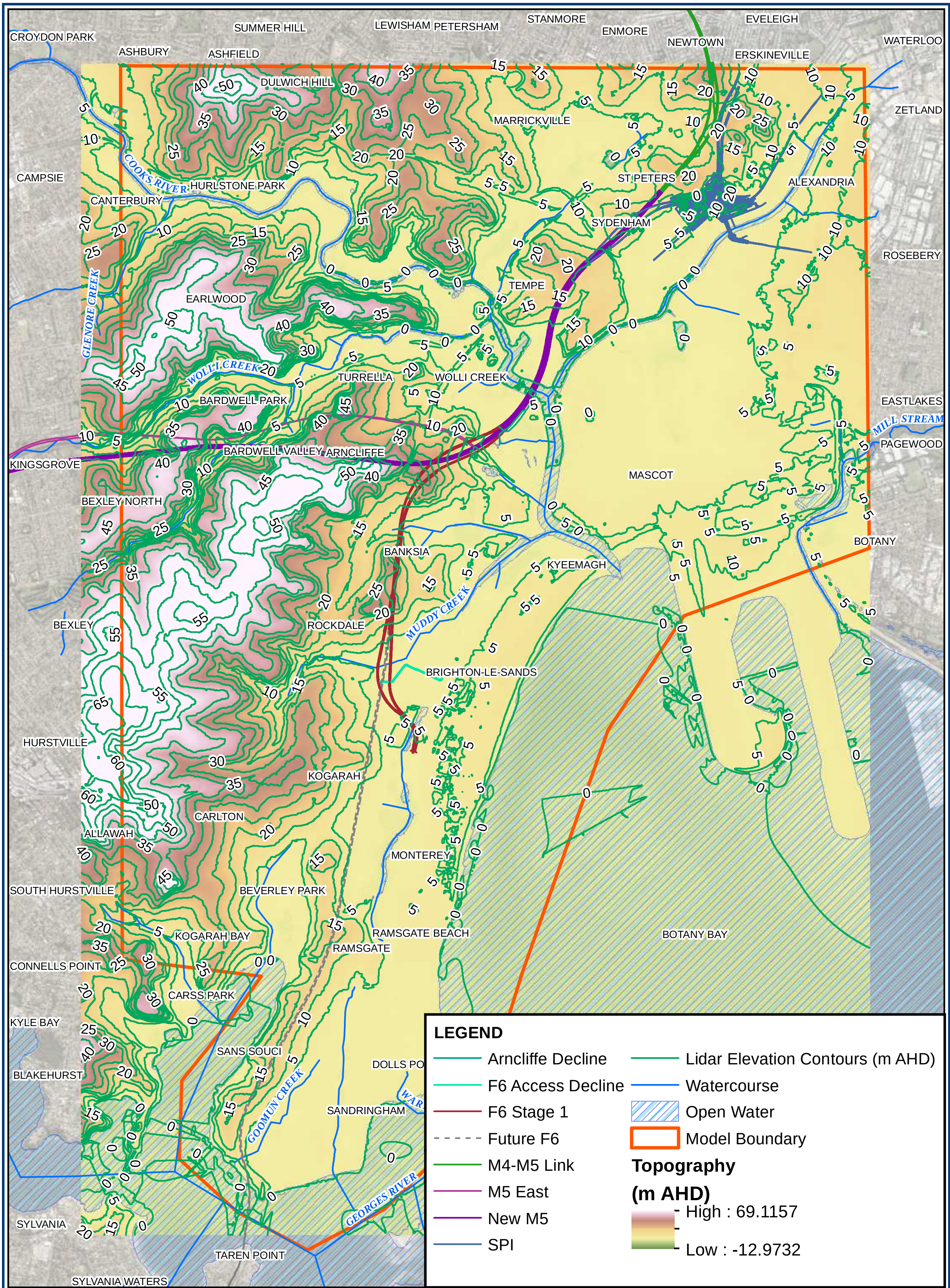

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Figure 4

Topography

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3.2 Geology

The Project is situated within the Permo-Triassic Sydney Basin. The Sydney Basin is a regional foreland basin comprising sub-horizontal layered clastic sedimentary successions of mostly sandstone and shale, with some interbedded coal seams and localised igneous volcanic rocks and dykes (Och *et al.*, 2009). To the east of the main tunnel alignment is the Botany Basin, which comprises sediment eroded from the Triassic basement and is centred at Botany Bay (Hatley, 2004).

The stratigraphy of the project area is summarised in Table 2. The outcrop geology is shown in Figure 5.

Table 2 Stratigraphy

Age	Stratigraphic Unit	Description
Quaternary	Fill	Waste material and engineered fill
	Botany Sands	Aeolian sand and clay
	Estuarine and alluvial sediments	Interbedded sands and clay
	Marine Sediments	Clayey sediments with sand lenses
Jurassic	Volcanics	Dykes
Triassic	Wianamatta Group – Bringely Shale, Ashfield Shale	Shale sometimes weathered to clay
	Mittagong Formation	Interlaminated siltstone and sandstone
	Hawkesbury Sandstone	Fine to coarse quartz sandstone with minor shale lenses

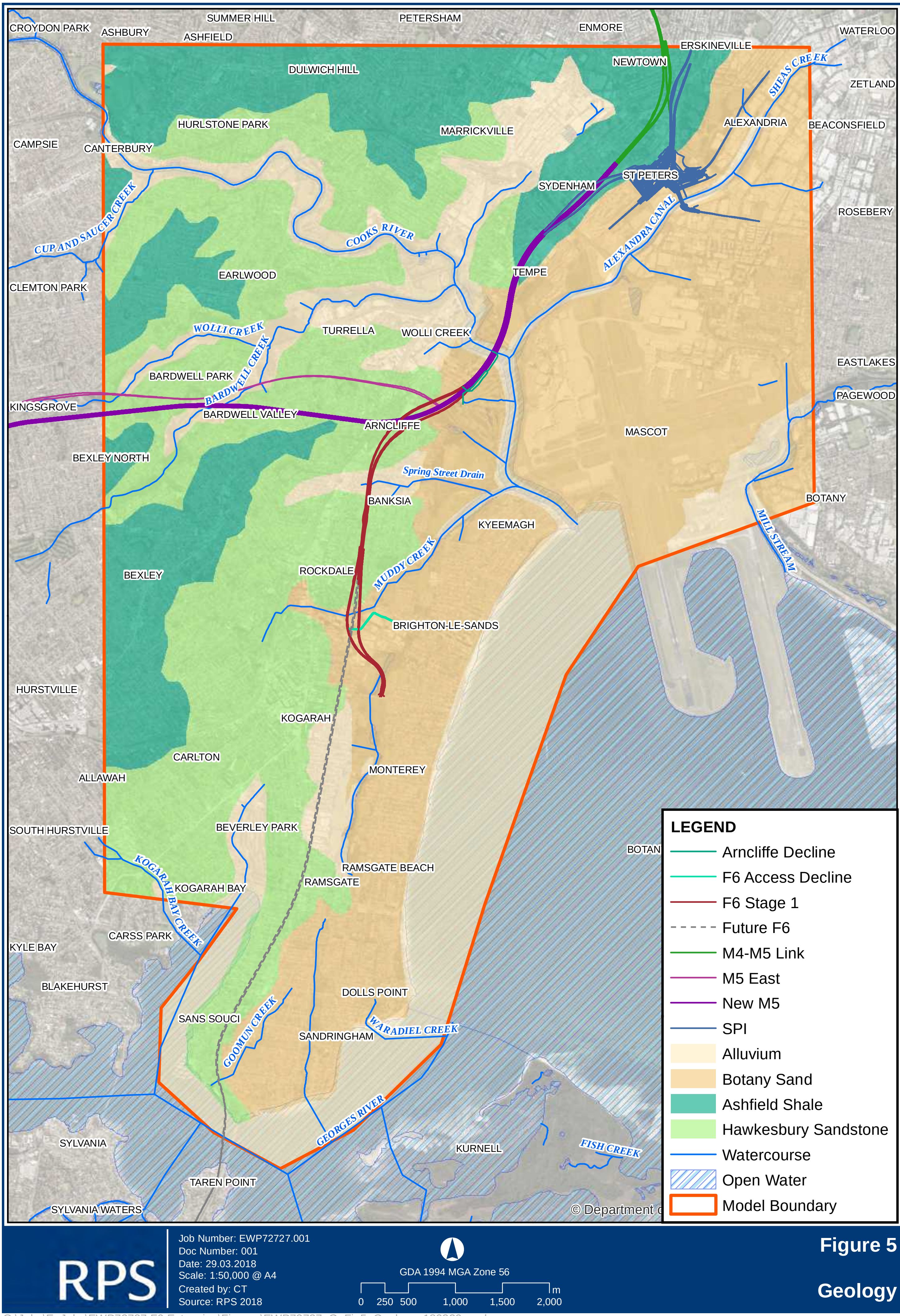

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Figure 5

Geology

Level 2, 27-31 Troode Street, West Perth

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3.2.1 Fill Materials

Fill material is extensive across the project area due to the urban environment in which it is situated. The fill is highly variable ranging from well compacted engineered fill to unconsolidated waste. Substantial filling has occurred along low-lying areas such as reclamation works associated with Alexandra Canal, and Tempe and St Peters Brick Pit. Fill materials typically consist of local dredged material and imported rubble and waste. The most substantial fill deposits occur at the Alexandria Landfill which has been infilled with uncompacted fill to depths of 35 to 40 m.

3.2.2 Alluvium

Alluvial sediments consisting of sand, silt, clay and gravel are found along the major creeks and gullies within the study area. Paleochannels up to 37 m thick associated with the alluvium are beneath Spring Street Drain, Cooks River, Wolli Creek and Bardwell Creek.

3.2.3 Botany Sands

The Botany Sands overlie the Ashfield Shale and Hawkesbury Sandstone at the south east of the study area and underlie part of the St Peters Interchange. The Botany Sands consist of unconsolidated clayey sand, silty sand and muds with occasional gravel (Hatley, 2004). In the vicinity of the project, the Botany Sand has a maximum thickness of 32 m (in the location of the access decline).

3.2.4 Wianamatta Group

The Wianamatta Group of sedimentary strata consists of the Bringelly Shale, Minchinbury Sandstone and Ashfield Shale, of which the Ashfield Shale is the only member within the Study Area. The Ashfield Shale is not intercepted by the Project; however, it is intercepted by the New M5 and M4-M5 Link at St Peters and Alexandria. The Ashfield Shale is a laminated fine-grained sequence of clay, silt and sand that was deposited in a marine environment and has undergone minor deformation. Where the Ashfield Shale outcrops at the surface it has a typical weathering profile of 3 m to 10 m consisting of stiff to hard clay of medium to high plasticity (AECOM, 2018).

3.2.5 Mittagong Formation

The Mittagong Formation is a transitional unit between the Ashfield Shale and Hawkesbury Sandstone, containing an interbedded sequence of silty sandstone and shales. The Mittagong Shale rarely outcrops within the study area and for the purposes of this project has been included within the Ashfield Shale.

3.2.6 Hawkesbury Sandstone

The Hawkesbury Sandstone extends across the entire Sydney Basin and is therefore present across the whole study area. The Hawkesbury Sandstone is a fluvial sequence up to 290 m thick and contains massive fine to medium grained sandstones, cross-bedded sandstone and sandstone interlaminated with siltstone. Jointing and fracturing are common in the Hawkesbury Sandstone, predominantly where it is at or close to the surface.

3.3 Climate

3.3.1 Rainfall

The nearest long-term Bureau of Meteorology (BoM) climate stations to the Project are Sydney Airport AMO (station 066037), with records going back to 1929, and Sans Souci Public School (station 066058) with records going back to 1899.

Rainfall records show a long-term average annual rainfall of 1084 mm at Sydney Airport AMO and 1081 mm at Sans Souci Public School (Table 3). Average monthly rain records show that the highest rainfall typically occurs in June and the lowest in September, with the first six months of the year (January to June) typically having higher rainfall than the latter six months (July to December). Rainfall at both climate stations was lower than average in 2017, with Sydney Airport recording a total of 874 mm (80% of average annual rainfall) and Sans Souci recording 577 mm (53% of average annual rainfall) (Table 4).

Table 3 Average Monthly Rainfall [mm]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Sydney Airport AMO	94.6	111.6	117.1	108.8	96.9	124.2	69.6	76.8	59.7	69.7	80.4	73.6	1083.4
Sans Souci	93.3	99.9	116.1	110.5	102.5	111.5	86.5	71.9	60.9	70.1	76.4	75.1	1080.9

Table 4 2017 Monthly Rainfall [mm]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Sydney Airport AMO	48.4	158.0	232.2	94.4	32.4	113.6	18.0	27.2	0.2	59.6	38.4	52.0	874.4
Sans Souci	8.0	58.0	223.0	43.0	22.0	66.0	9.0	16.0	0	41.0	37.0	54.0	577.0

Information on long-term rainfall trends is provided by the Residual Mass Curve (RMC). This curve is generated by aggregating the residuals between actual monthly rainfall and long-term average rainfall for each month. The procedure is essentially a low-pass filter operation which suppresses the natural spikes in rainfall and enhances the long-term trends.

Given the usually slow response of groundwater levels to rainfall inputs, the RMC can be expected to correlate well with groundwater hydrographs over the long term. The groundwater levels recorded during periods of rising RMC are expected to rise while those recorded during periods of declining RMC are expected to decline.

The RMC plot using rainfall data from the Sydney Airport AMO and Sans Souci Public School stations from January 1930 to December 2017 (Figure 6) shows that the long-term trend in rainfall comprises a long period of lower than average rainfall between 1936-1950. This was followed by a sustained period of mostly above average rainfall until the early 1990s, with short-lived droughts interspersed, including 1980-83. The 'Millennium Drought' (1997-2011), which affected much of South-eastern Australia, shows a strong signature in the record. Rainfall levels approach average conditions from 2012, with Sydney Airport maintaining average conditions to present day while Sans Souci records a below average trend from 2016.

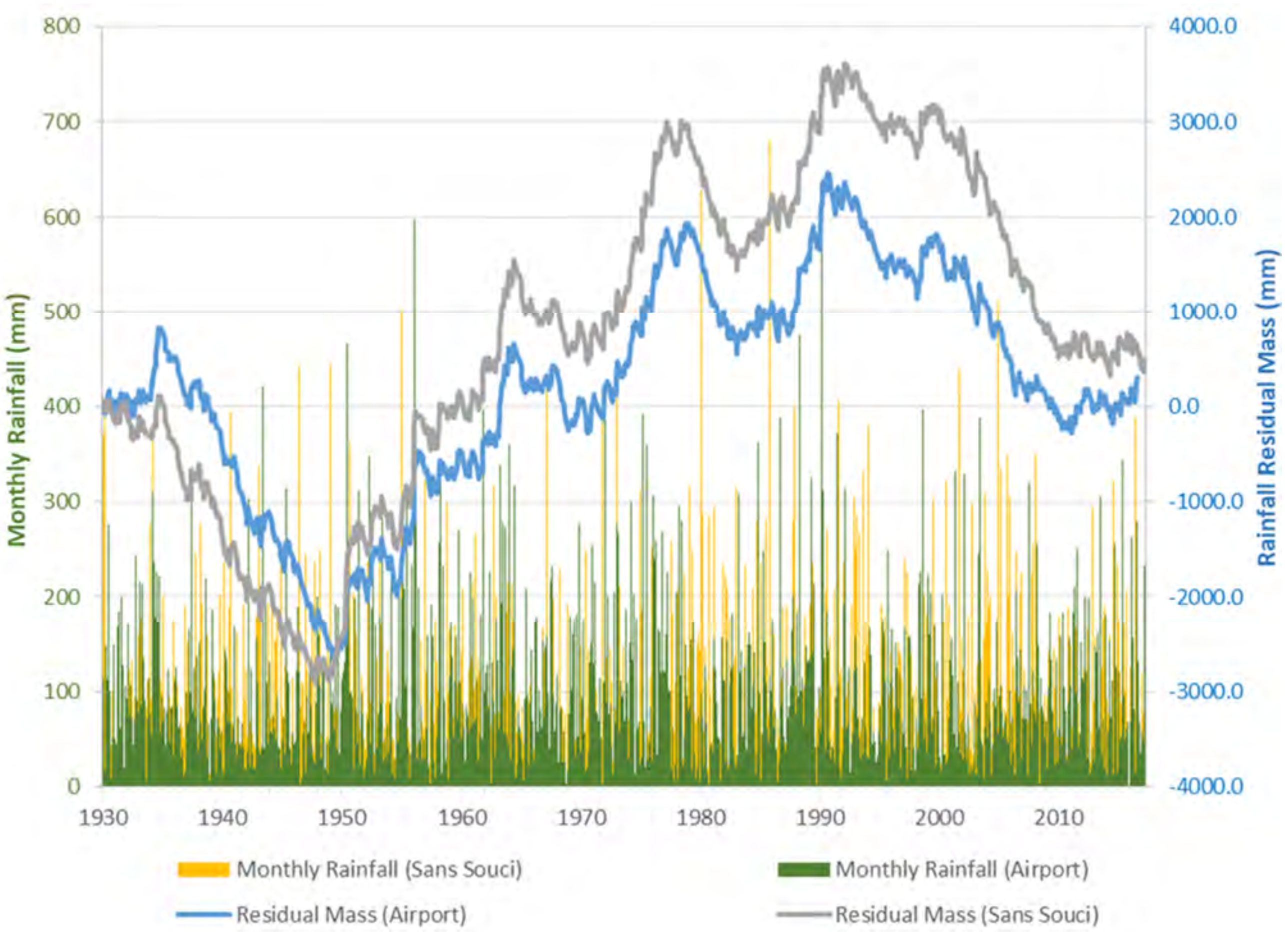

Figure 6 Monthly Rainfall and Rainfall Residual Mass

3.3.2 Evaporation

Potential evaporation (PE) for the region is approximately 1220 mm/a, while actual evapotranspiration (AE) for the region is up to approximately 620 mm/a (BoM, 2018)[1] (Table 5).

Table 5 Summary of Evaporation Data [mm]

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Potential ET	181	134	122	78	51	38	40	55	80	127	153	162	1221
Actual ET	109	78	66	32	20	22	21	17	23	62	85	88	623

The derived average pattern of PE is compared against rainfall in Figure 7. This shows that there is a rainfall deficit (i.e. PE is higher than rainfall) from September to March, and a rainfall surplus April to August. AE only exceeds rainfall November through January.

[1] These regional PE and Actual Evapotranspiration (AE) values have been obtained from the BoM map viewer. AE is the evapotranspiration that takes place under current water supply or rainfall conditions, calculated or averaged over a large area so as to remove local variation. See http://www.bom.gov.au/jsp/ncc/climate_averages/evaporation/index.jsp.

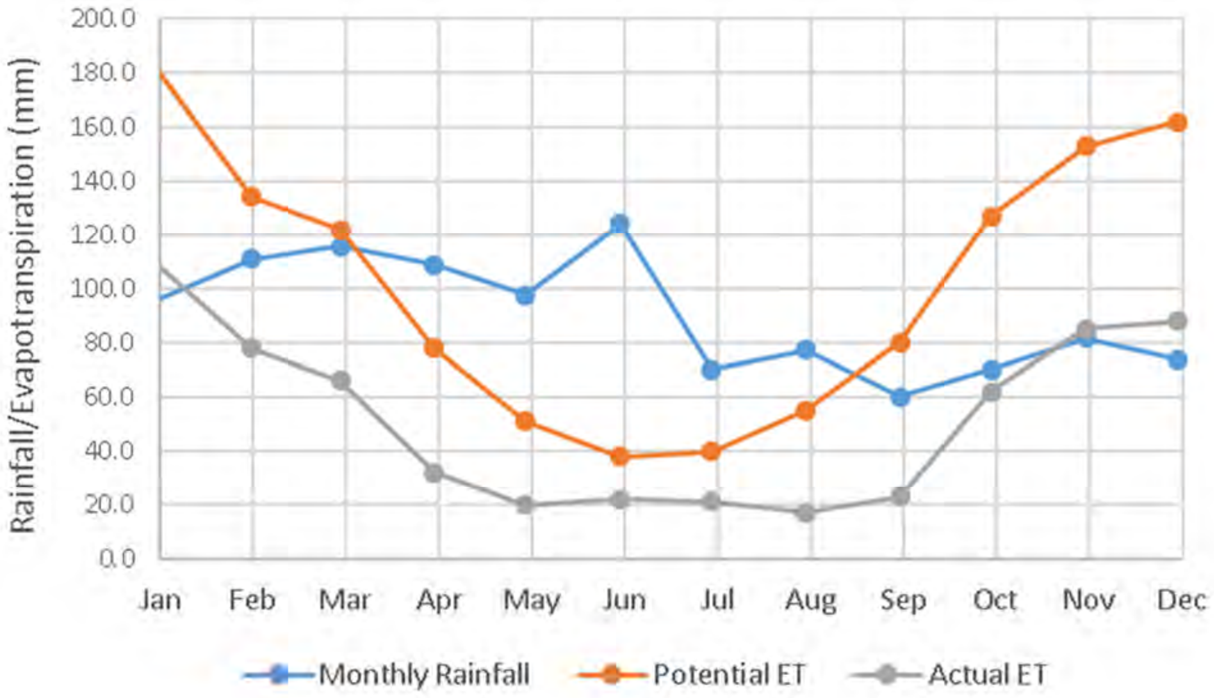

Figure 7 Average Monthly Rainfall Vs Potential and Actual Evapotranspiration

3.4 Surface Water

The Project is located in a highly developed setting with intensive land use. Consequently, the majority of water courses are highly modified and degraded channels, usually lined by concrete or rock revetments. The Project is located within the Cooks River catchment, with the Cooks River in turn draining to Botany Bay. Major tributaries Wolli Creek, Muddy Creek and Alexandra Canal drain into Cooks River. Of these, all are modified lined channels except for the upper reaches of Wolli Creek and its tributary, Bardwell Creek (Figure 8).

Muddy Creek is the only major tributary of Cooks River that is in the direct area of the Project and consists of a series of concrete and brick lined channels and box culverts draining a highly urbanised catchment. Spring Street Drain, a concrete lined channel, is its main tributary.

The Study Area (model boundary) also includes part of the Georges River catchment to the south of the Project, where future components of the F6 Extension are proposed. Bado-Berong Creek, Goomun Creek and Kogarah Bay Creek drain into Georges River. The majority of these watercourses have also been modified to improve drainage during urbanisation.

The lower reaches of the watercourses are tidally influenced, causing the groundwater in the alluvium to mix with saline tidal water.

A series of wetlands exist in a corridor directly to the east of the Project, these being (from north to south) Eve Street Wetland, Spring Street Wetland, Landing Lights Wetland, Kings Wetland, Rockdale Wetland and Scarborough Ponds. Rockdale Wetlands are located to the North of the proposed ramps to the President Road interchange, and Scarborough Ponds to the south. These tidal and freshwater wetlands are a remnant of a once more extensive complex of wetlands along the western shore of Botany Bay. In more recent times the wetlands have been drained and filled to create artificial lakes and are largely modified to form stormwater detention basins. Of these wetlands, only the Rockdale Wetlands are considered to be sustained by groundwater (BoM, 2018b) while the other locations are not considered to be groundwater dependent, rather they are intermittent wetlands expected to provide seasonal recharge to groundwater (BoM, 2018b; Rockdale City Council, 2018).

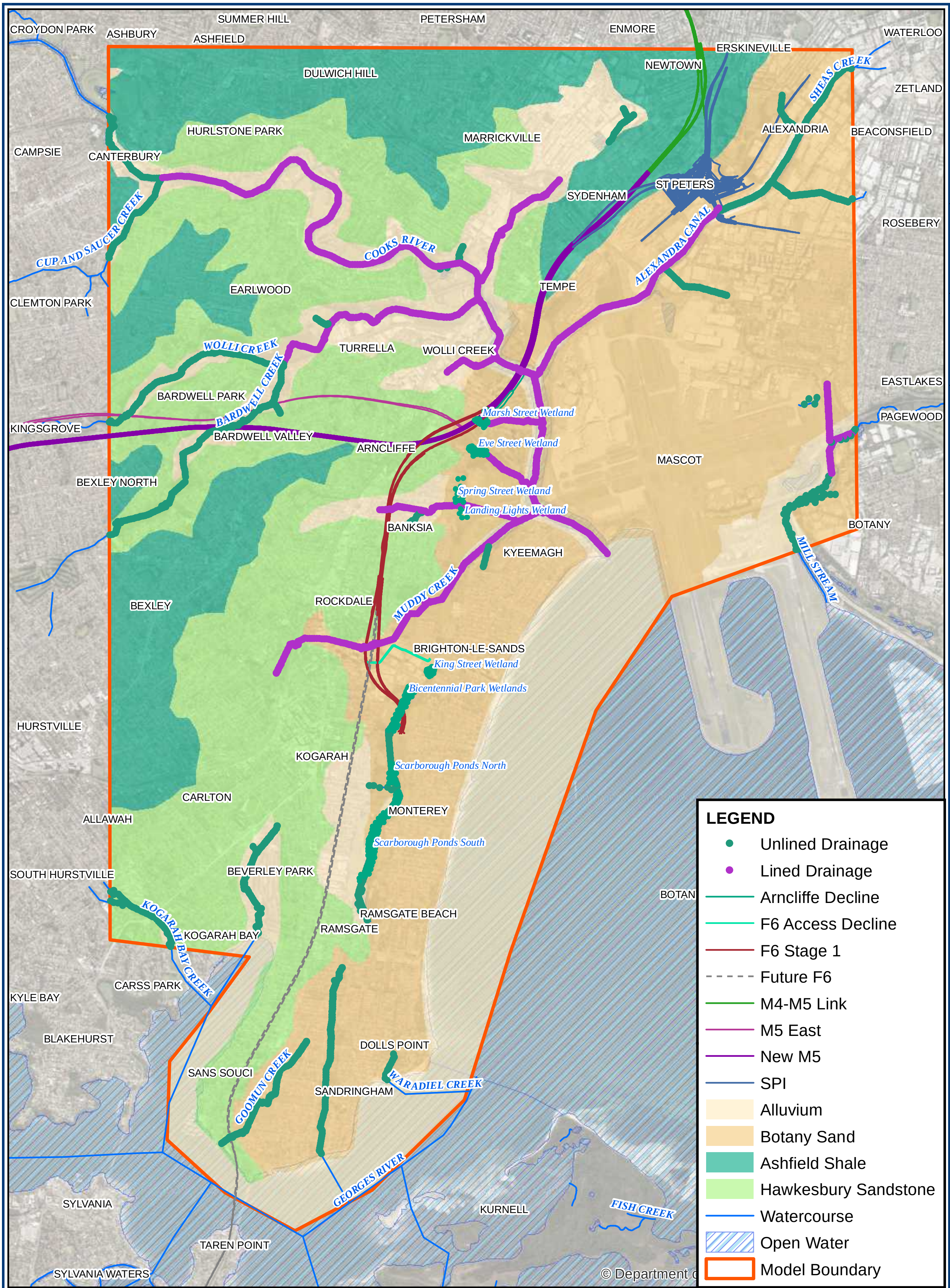

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Figure 8

Rivers/Drainage Channels

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3.5 Land Use

The project area is situated to the south-west of Sydney CBD and consists largely of highly urbanised developments such as low to medium density housing, commercial and industrial precincts, and scattered parklands and recreational areas. AECOM (2018) provides a detailed description of the major uses of the land adjacent to the Project.

3.6 Groundwater Dependent Ecosystems

The NSW State Groundwater Dependent Ecosystems (GDE) Policy (DLWC, 2002) describes the following types of groundwater systems in the Study Area:

- **Sedimentary Rock Groundwater Systems** – sedimentary rock aquifers including sandstone, shale and coal (e.g. Great Artesian Basin, Sydney Basin and Clarence Moreton Basin).
- **Coastal Sand Bed Groundwater Systems** – significant sand beds along the coast of NSW (e.g. Botany and Tomago sand beds).

There are no high priority GDEs listed within the Greater Metropolitan WSP within the project area. The closest high priority GDE is Towra Point Estuarine Wetlands, located within the Botany Sands approximately 3.5 km east of the Project. Lachlan Swamp is another high priority GDE in the Botany Sands, located approximately 8 km north-east of the Project. Both of these GDEs are situated outside of the Study Area. Due to the significant distance, it is most unlikely that these GDEs would be affected by construction of the F6 Stage 1 tunnels or any cumulative impacts with WestConnex.

A review of the BoM GDE Atlas[2], relevant legislation and other literature has been conducted. Inspection of the BoM GDE Atlas indicated that there are 32 potential GDEs within the study area which access groundwater in the subsurface (i.e. 'terrestrial GDEs'). Of these, 10 are identified as having high potential for groundwater interaction, 10 have moderate potential and 12 have low potential (Table 6). Most of the potential GDEs are located near to the New M5 alignment along Wolli Creek and Bardwell Creek (Figure 9). The wetlands located in the coastal flats of the Botany Sands to the east and south of the project are also considered GDEs, with the closest being the Bicentennial Park wetlands, located directly over the President Avenue ramps.

Table 6 Potential GDEs Listed in BoM GDE Atlas

BoM Identifier	Easting	Northing	Potential for GW Interaction	Location
1974035	328775	6244399	Moderate	Wolli Creek Turrella
1974071	328750	6244408	Moderate	Wolli Creek Turrella
1974062	328733	6244428	Low	Wolli Creek Turrella
1974150	328408	6244329	High	Wolli Creek Turrella
1974138	328161	6244308	Low	Wolli Creek Turrella
1974223	328060	6244267	High	Wolli Creek Turrella
1974416	327802	6243997	High	Wolli Creek Turrella

[2] http://www.bom.gov.au/water/groundwater/gde/map.shtml

BoM Identifier	Easting	Northing	Potential for GW Interaction	Location
1974540	327676	6243933	High	Wolli Creek Turrella
1974116	328030	6244369	Low	Wolli Creek Turrella
1974462	327575	6244046	Low	Wolli Creek Turrella
1974496	327536	6244028	Low	Wolli Creek Turrella
1975211	327216	6243370	Moderate	Bardwell Valley Golf Club
1975149	327071	6243393	Low	Bardwell Valley Golf Club
1975262	326892	6243328	Moderate	Bardwell Valley Golf Club
1975237	326680	6243362	Moderate	Bardwell Valley Golf Club
1975206	326646	6243374	Low	Bardwell Valley Golf Club
1975273	326612	6243342	Low	Bardwell Valley Golf Club
1975433	326286	6243194	Moderate	Bardwell Valley Stotts Reserve
1975481	326111	6243151	Moderate	Bardwell Valley Stotts Reserve
1976236	326445	6242376	High	Bardwell Valley Parklands
1976242	326078	6242314	Moderate	Bardwell Valley Parklands
1978363	328750	6240374	High	Rockdale Bicentennial Park
1978514	328657	6240246	High	Rockdale Bicentennial Park
1978549	328626	6240218	High	Rockdale Bicentennial Park
1978643	328738	6240147	Low	Rockdale Bicentennial Park
1979115	3284017	6239754	Moderate	Scarborough Park
1979157	328662	6239719	Moderate	Scarborough Park
1979308	328459	6239553	Low	Scarborough Park
1979335	328500	6239532	Low	Scarborough Park
1980128	327432	6238920	High	Beverly Park Golf Club
1981054	327410	6238895	High	Beverly Park Golf Club

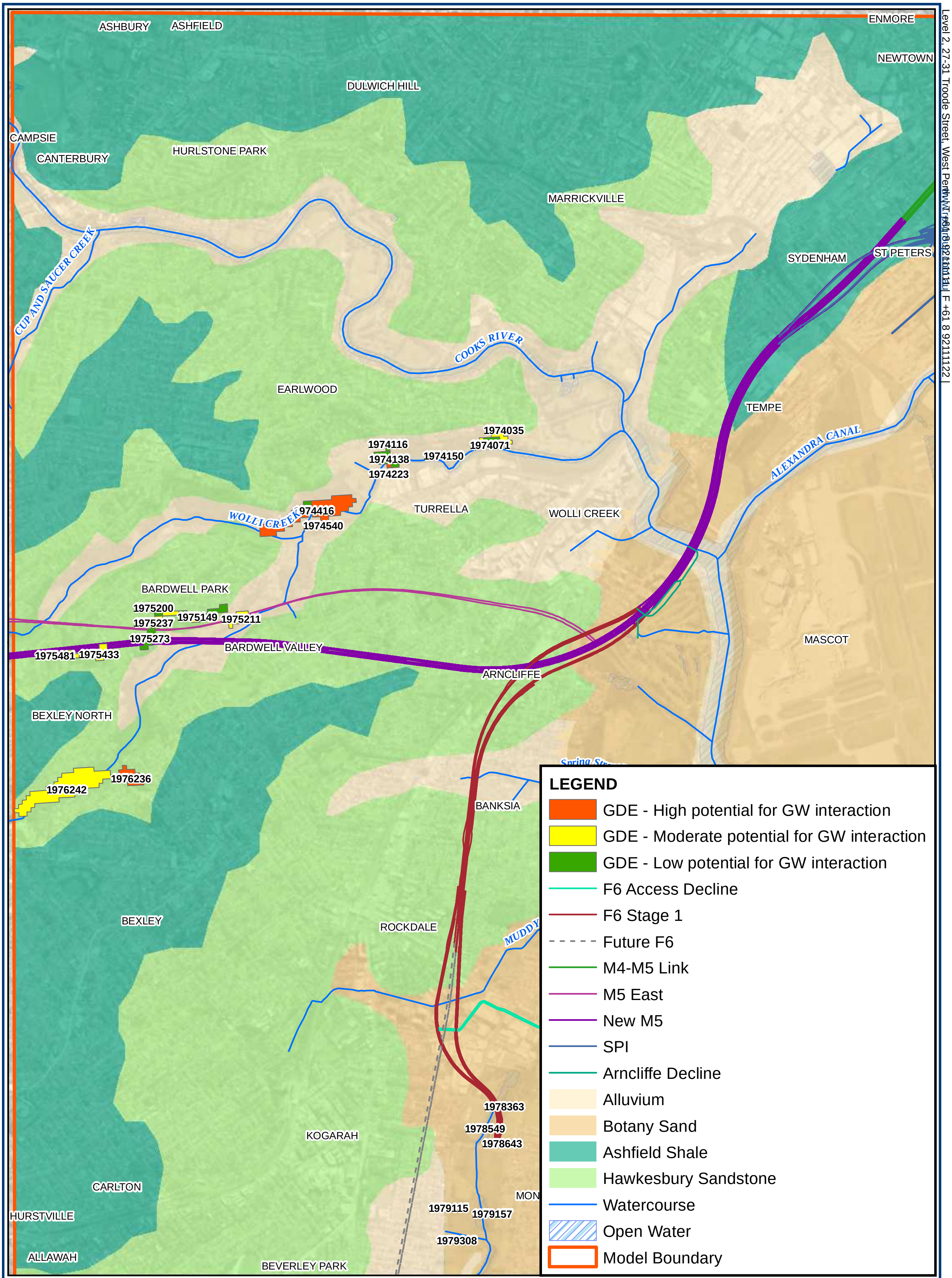

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Figure 9

Groundwater Dependent Ecosystems

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3.7 Hydrogeology

3.7.1 Anthropogenic Groundwater Use

Based on data received from BoM's National Groundwater Information System (NGIS) and the DI (Crown Lands & Water) Pinneena groundwater database in January 2018, there are 1,188 registered groundwater works within the study area (7.5 x 12 km), mostly shallow bores located within Botany Sands or alluvial aquifers. The numbers of bores and their registered uses are summarised in Table 7. The majority of bores are shallow domestic bores screened in the Botany Sands, however as noted in Section 1.2.1, abstraction of groundwater from much of the Botany Sands for domestic use is no longer allowed due to the risk of spreading contamination, therefore many of these bores will no longer be operational. There are also a number of monitoring bores assumed to be constructed for the purposes of investigation/monitoring of contamination.

Table 7 Registered Groundwater Bores in Pinneena and the NGIS

Purpose	Number	Min Depth (m)	Max Depth (m)
Domestic	832	0	108
Water Supply	117	0	13.2
Industrial	14	0	148
Irrigation	17	4.2	15.2
Recreation	14	0	90.5
Unknown	31	0	90
Monitoring	161	0	204
Exploration	1	18.2	18.2
Drinking	1	3.5	3.5

3.7.2 Groundwater Levels

A review has been conducted of groundwater levels from both WestConnex monitoring bores and other data sources, including bores registered on the NGIS database. The majority of historical data from the NGIS registered bores is limited to notes on levels and salinity records taken at the time of drilling or installation. Two bores that are located near to the Project have long-term water level records. GW075059 in screened in the alluvium and GW075063 is screened in the Botany Sand as shown in Figure 10. Hydrographs for these locations are shown in Figure 11. Water levels in both boreholes appear to respond rapidly to rainfall events of over 10mm, with the general water level trend does mimicking the rainfall residual mass.

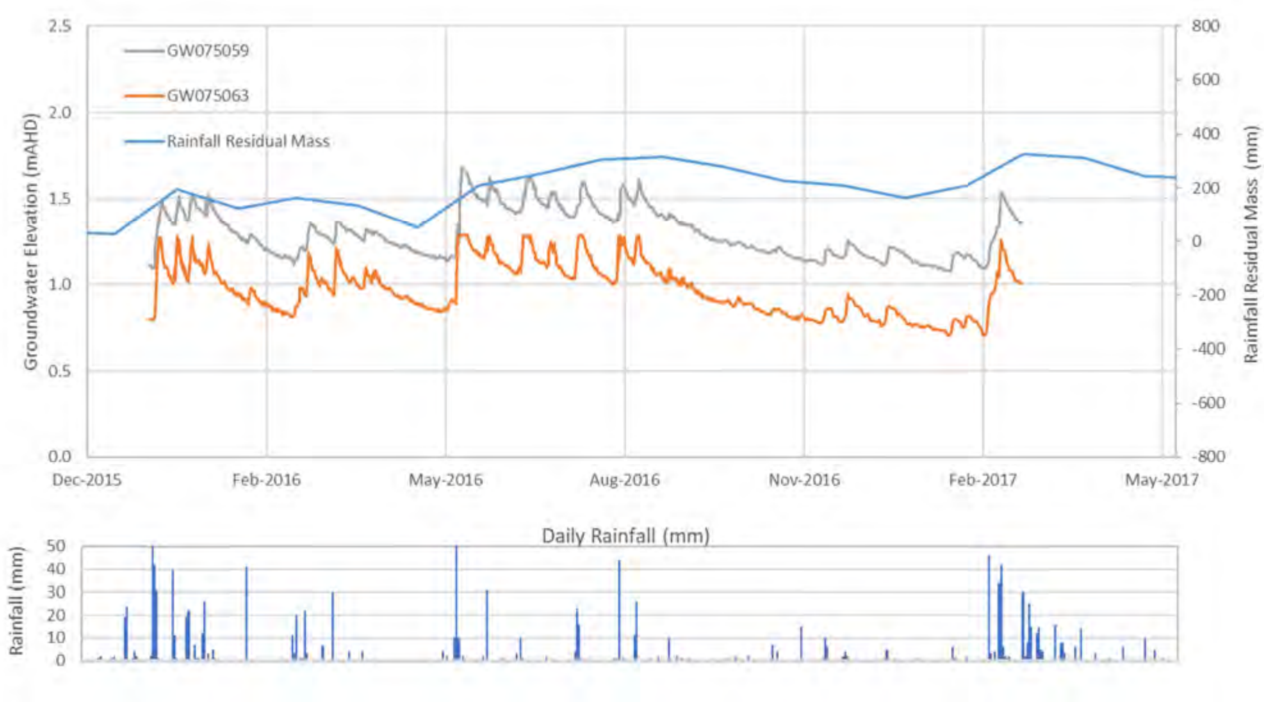


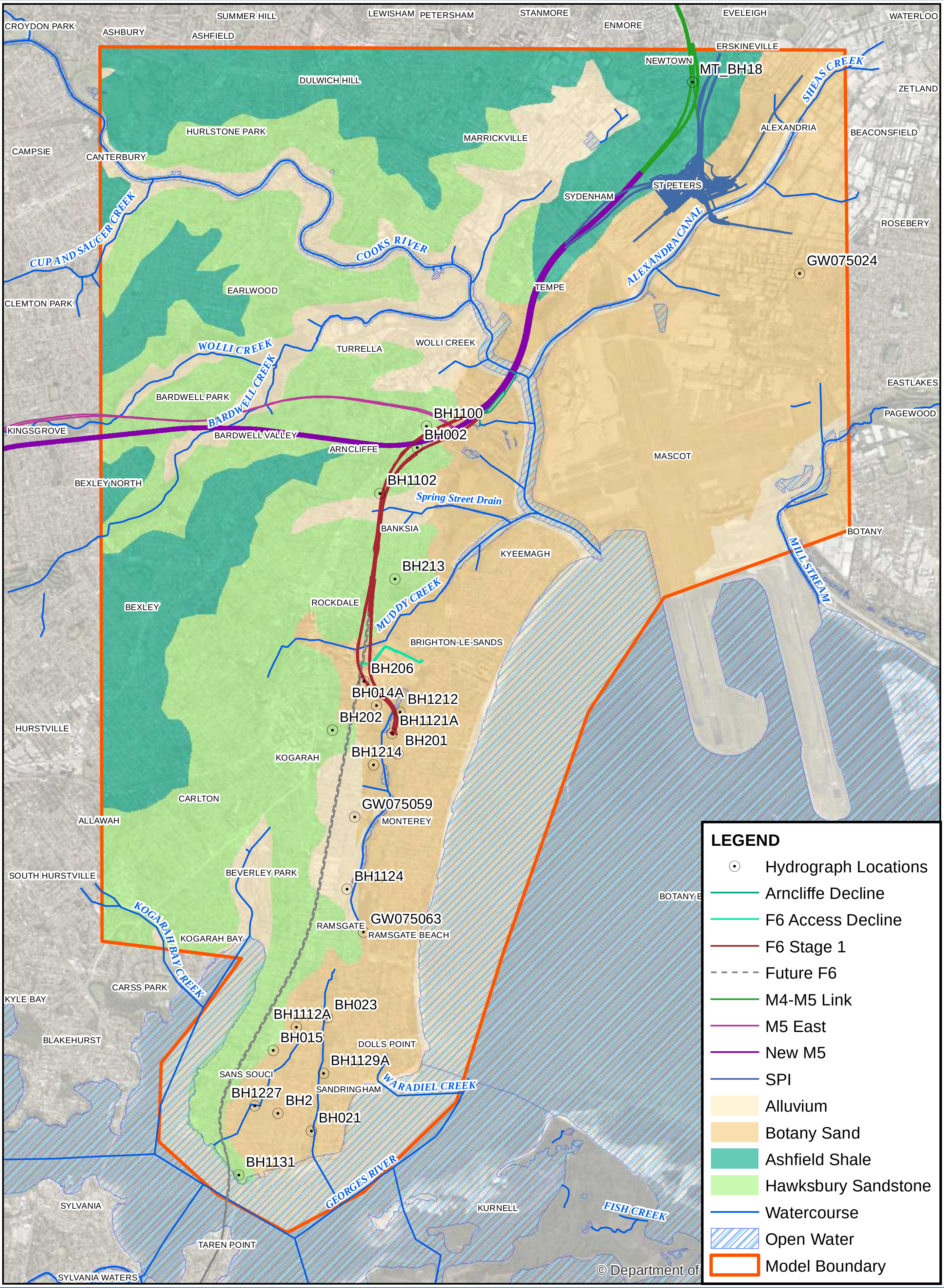
Figure 10 Registered Bore Hydrographs

Groundwater level monitoring for the New M5 component of WestConnex began in early 2015 and available data has been included in the model dataset. Some sporadic water level data is available from these and other tunnel infrastructure projects.

Groundwater monitoring along the F6 Extension project alignment also commenced in March 2015, with boreholes being added to the monitoring network as drilling investigation continues. The monitoring network consists of 32 monitoring bores constructed to depths between 5 and 78 m**.** The majority of monitoring bores were constructed in the Hawkesbury Sandstone, with some also screened in the Botany Sands and alluvium. Monitoring bores are equipped with automatic data loggers, and most are manually dipped on a monthly basis.

3.7.3 Groundwater Hydrographs

The SMEC (2017) interpretive report provides a detailed description of all water levels monitored as part of the Project. A selection of key hydrographs for each formation is discussed here. Figure 11 shows the locations of the selected bore hydrographs.



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GDA 1994 MGA Zone 56

0 250 500 1,000 1,500 2,000 m

Figure 11

Hydrograph Locations

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3.7.3.1 Alluvium

Figure 12 (BH1131) and Figure 13 (BH1124) show alluvial hydrographs with daily rainfall and Cumulative Daily Rainfall Residual (RMC) also plotted. BH1131 is located south of the current Project near to Georges River, and clearly shows a water level strongly influenced by tidal oscillations with an average of 0.3 mAHD to 0.4 mAHD. BH1124 is screened in the alluvium adjacent to Scarborough Ponds and shows a groundwater level that follows the rainfall residual mass curve, with a rapid response of 0.4 m and 0.2 m after significant (40mm and 30mm) rainfall events in February and June 2017.

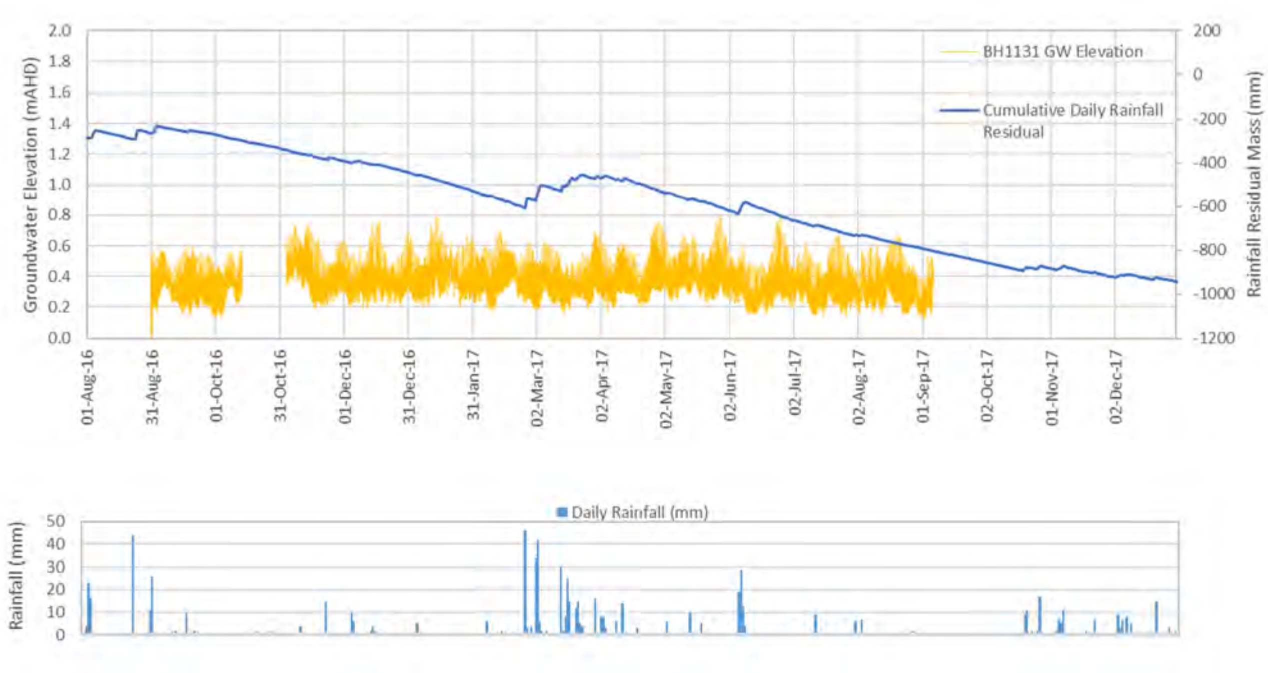

Figure 12 Hydrograph BH1131 Screened in Alluvium

Figure 13 Hydrograph BH1124 Screened in Alluvium

3.7.3.2 Botany Sands

Water levels within the Botany Sands are presented in Figure 14 to Figure 20. Water levels in all bores show a clear response to rainfall (except for BH1227 and BH1212, where trends could not be ascertained due to short monitoring duration). As an example, the large rainfall event in February 2017 is followed by a rise in water level in all boreholes, with most notable rises of ~0.5m in BH021 (Figure 16), ~0.7m in BH1129A (Figure 17) and ~0.7m in BH1112a (Figure 18). The boreholes screened in the Botany Sand closely follow the declining rainfall residual mass trend observed due to the reduced rainfall in 2017.

Figure 14 Hydrograph BH1227 Screened in Botany Sands

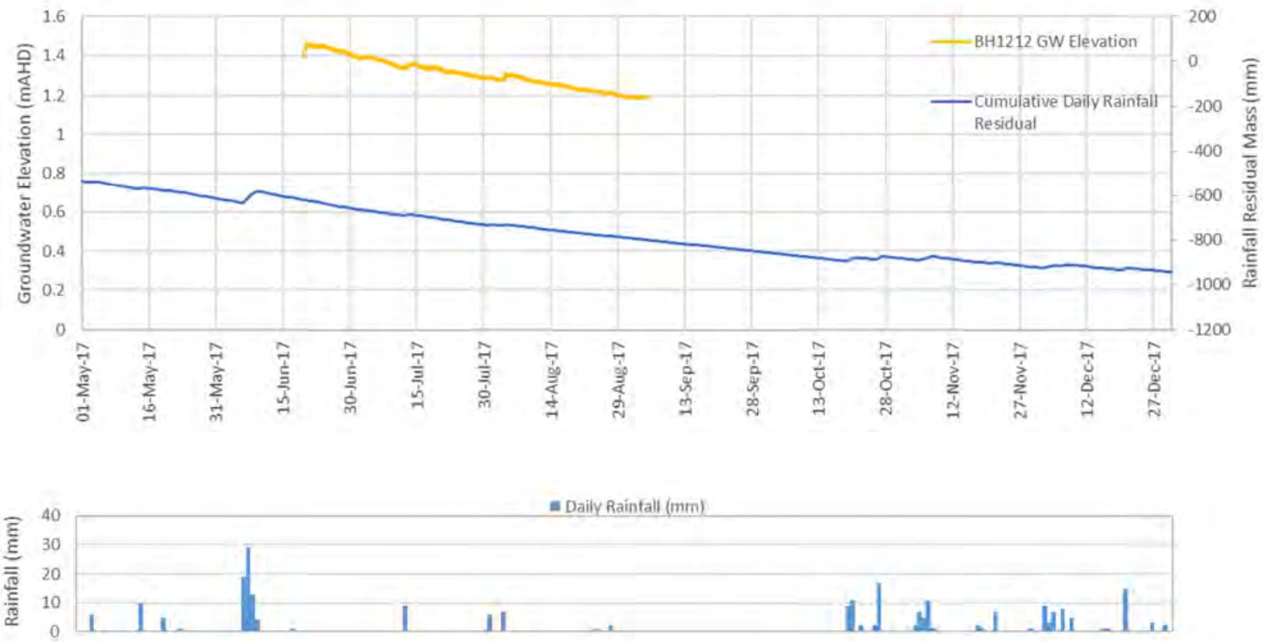

Figure 15 Hydrograph BH1212 Screened in Botany Sands

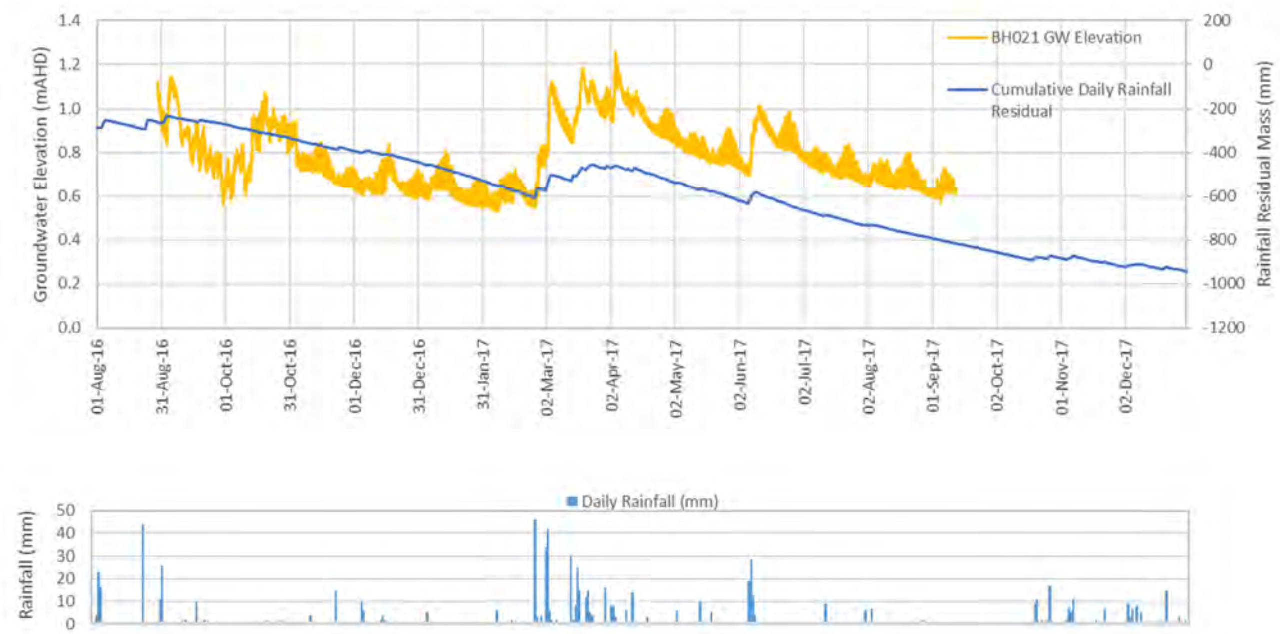

Figure 16 Hydrograph BH021 Screened in Botany Sands

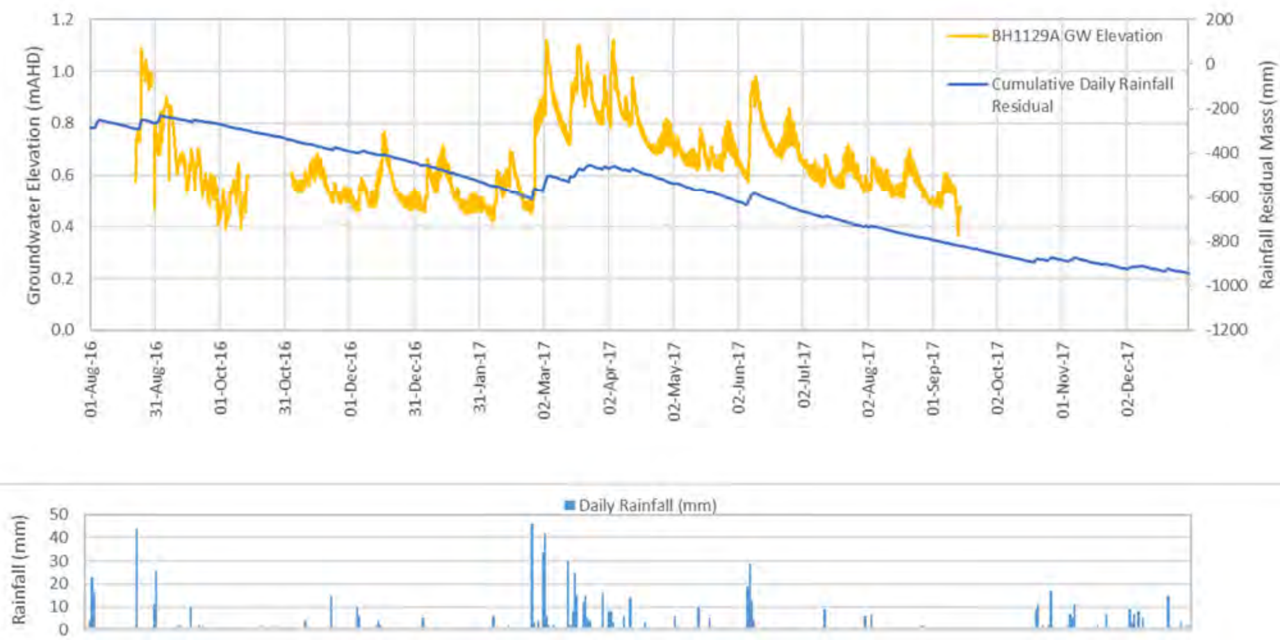

Figure 17 Hydrograph BH1129A Screened in Botany Sands

Figure 18 Hydrograph BH1112a Screened in Botany Sands

Figure 19 Hydrograph BH1121A Screened in Botany Sands

Figure 20 Hydrograph BH014a Screened in Botany Sands

3.7.3.3 Ashfield Shale

Water levels within the Ashfield Shale are not monitored as part of the Project, as the Ashfield Shale is not present within the vicinity of the proposed tunnelling. A hydrograph is presented for completeness of monitoring bore MT_BH18 which was established during the M4-M5 Link investigations (Figure 21). After initial slow water level recovery after drilling and piezometer installation (approximately 2 weeks) water levels are fairly stable at around 12 mAHD, with occasional short term declines presumably related to sampling events. The water levels in the Ashfield Shale do not appear to respond to the rainfall residual mass. The slow water level recovery is representative of very low permeability aquifer material.

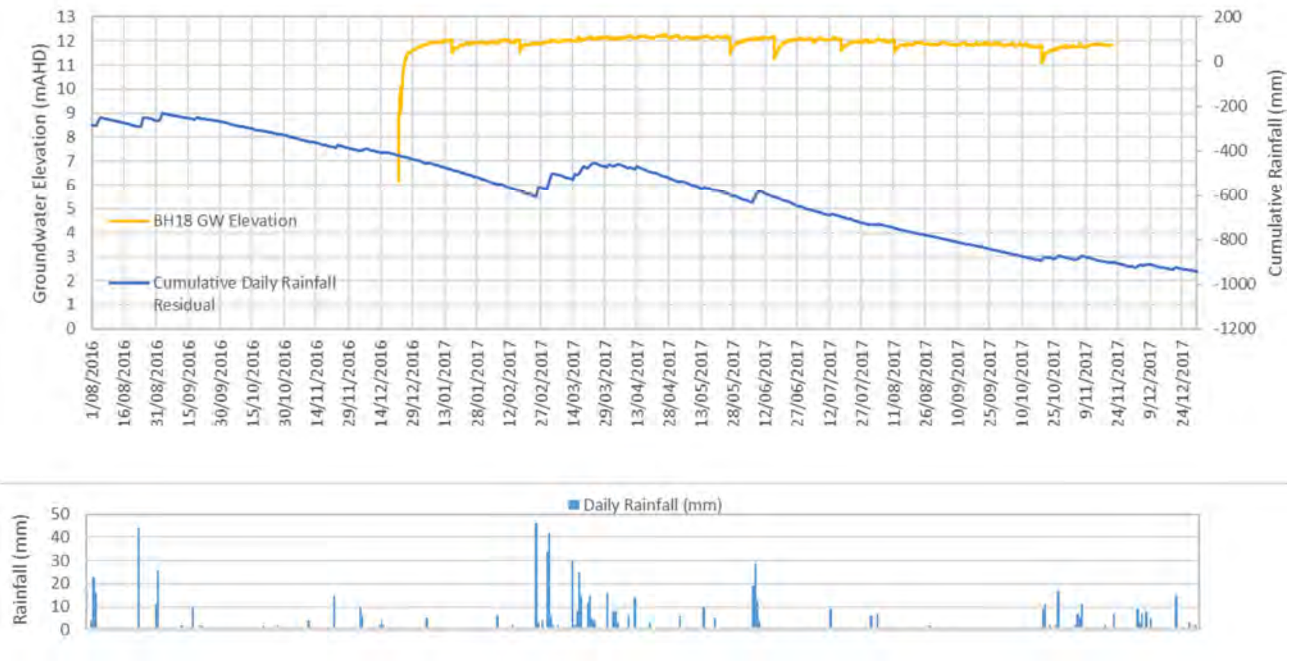

Figure 21 Hydrograph MT_BH18 Screened in Ashfield Shale

3.7.3.4 Hawkesbury Sandstone

Water levels within the Hawkesbury Sandstone are presented in Figure 22 to Figure 31. Water levels within the Hawkesbury Sandstone broadly follow the RMC trend in most bores. The change in water level is less pronounced in the Hawkesbury Sandstone in comparison to the Botany Sands. The largest response to rainfall is seen in BH1214, BH023 and BH2 (Figure 25, Figure 27 and Figure 29). Water levels rose between 0.3m (BH2) and 0.5m (BH023) in response to February 2017 rainfall. BH015 (Figure 30) shows a more delayed response to the rainfall event in February 2017 than some other bores (e.g. BH1214, BH023 and BH2). BH002 (Figure 26) and BH1100 (Figure 31) appear to be affected by drawdown due to New M5 tunnelling, with first drawdowns recorded by data loggers in late May 2017. However, scheduling data provided by the contractor indicates that tunnelling commenced at Arncliffe in July 2017. This suggests that either the schedule provided is not completely accurate, or that dewatering commenced prior to tunnel excavation. Logger data for BH1100 indicates 3 m of drawdown (most likely due to access decline tunnelling) in May 2017, and approximately 9m of drawdown is recorded at BH002 between May and September 2017.

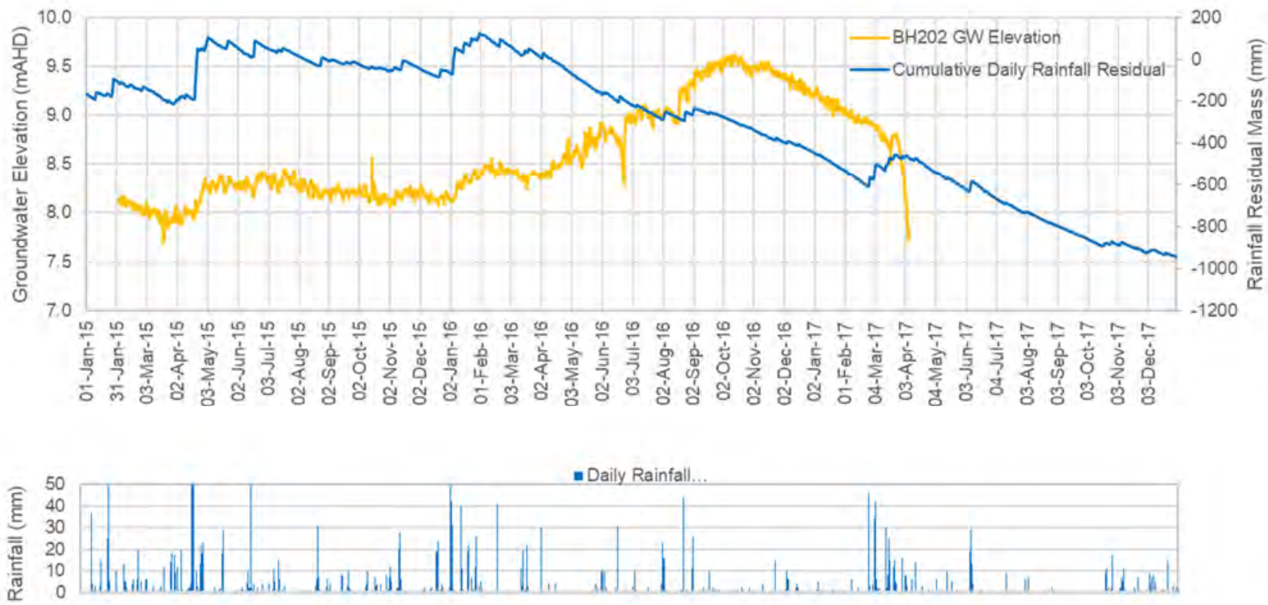

Figure 22 Hydrograph BH202 Screened in Hawkesbury Sandstone

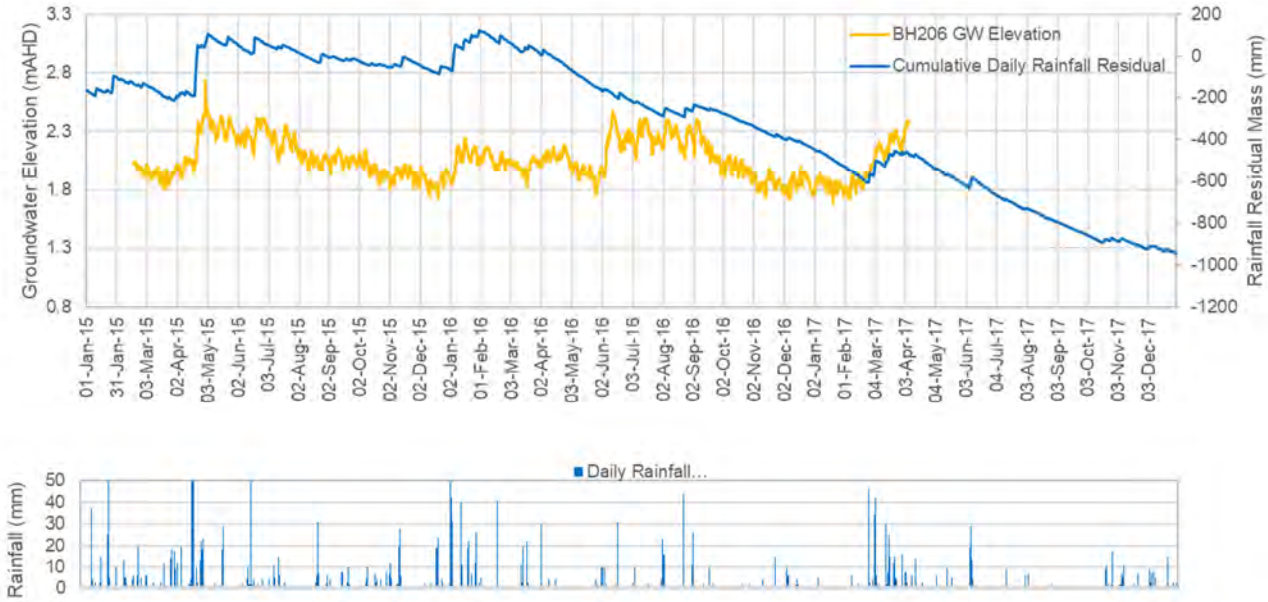

Figure 23 Hydrograph BH206 Screened in Hawkesbury Sandstone

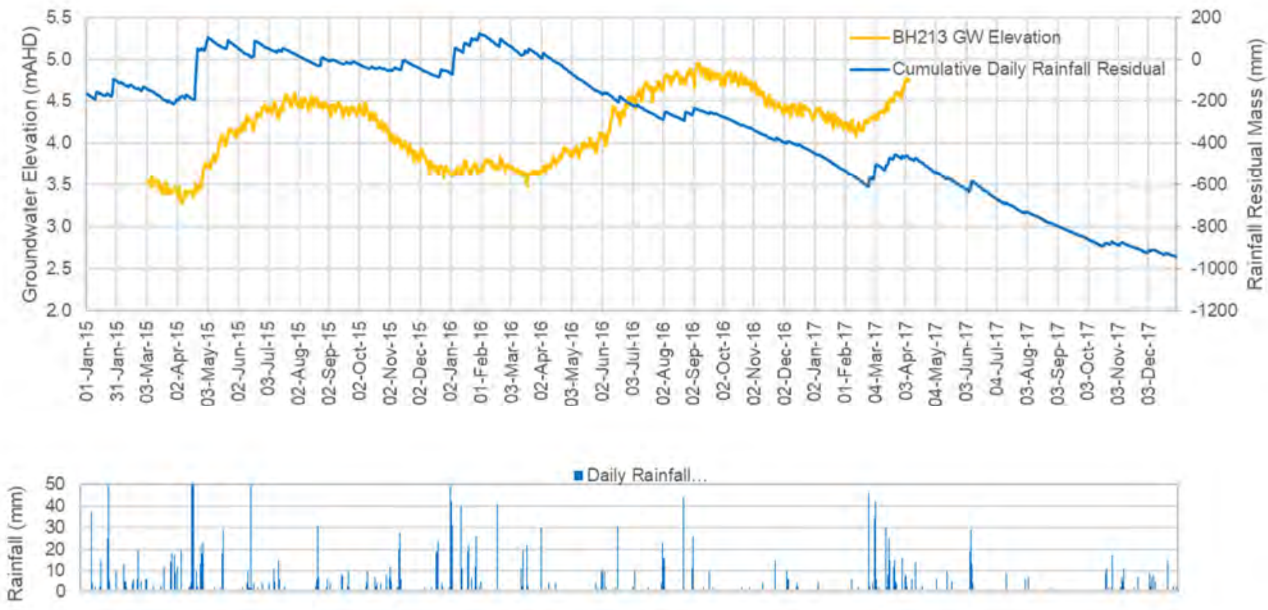

Figure 24 Hydrograph BH213 Screened in Hawkesbury Sandstone

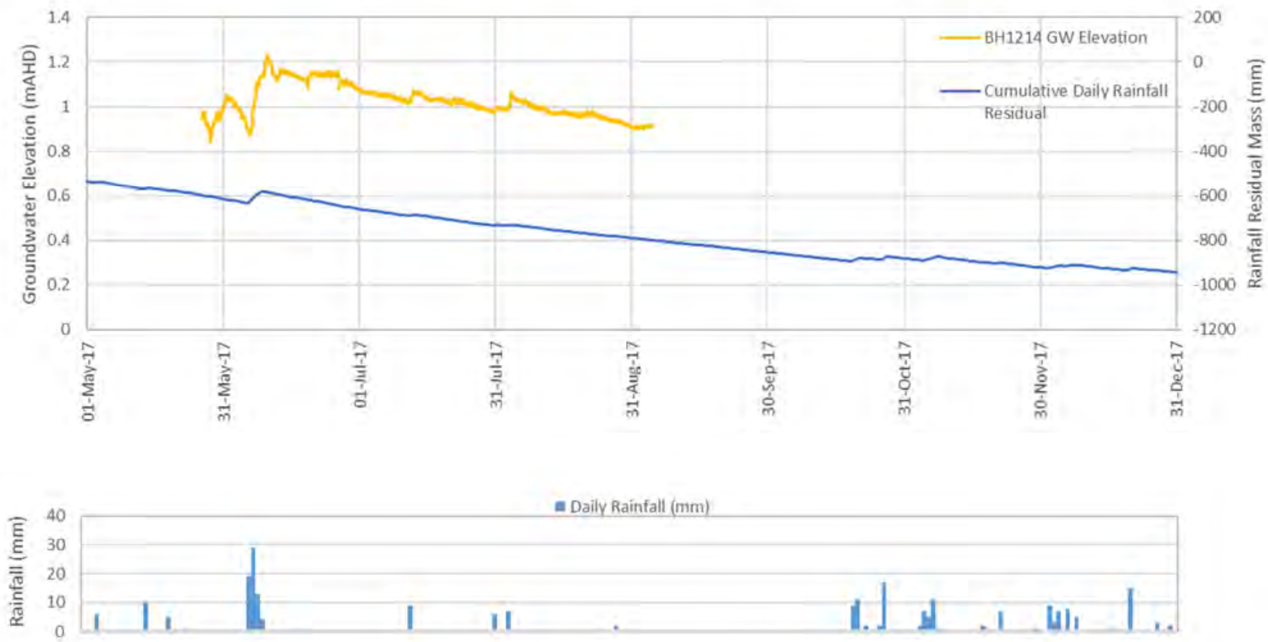

Figure 25 Hydrograph BH1214 Screened in Hawkesbury Sandstone

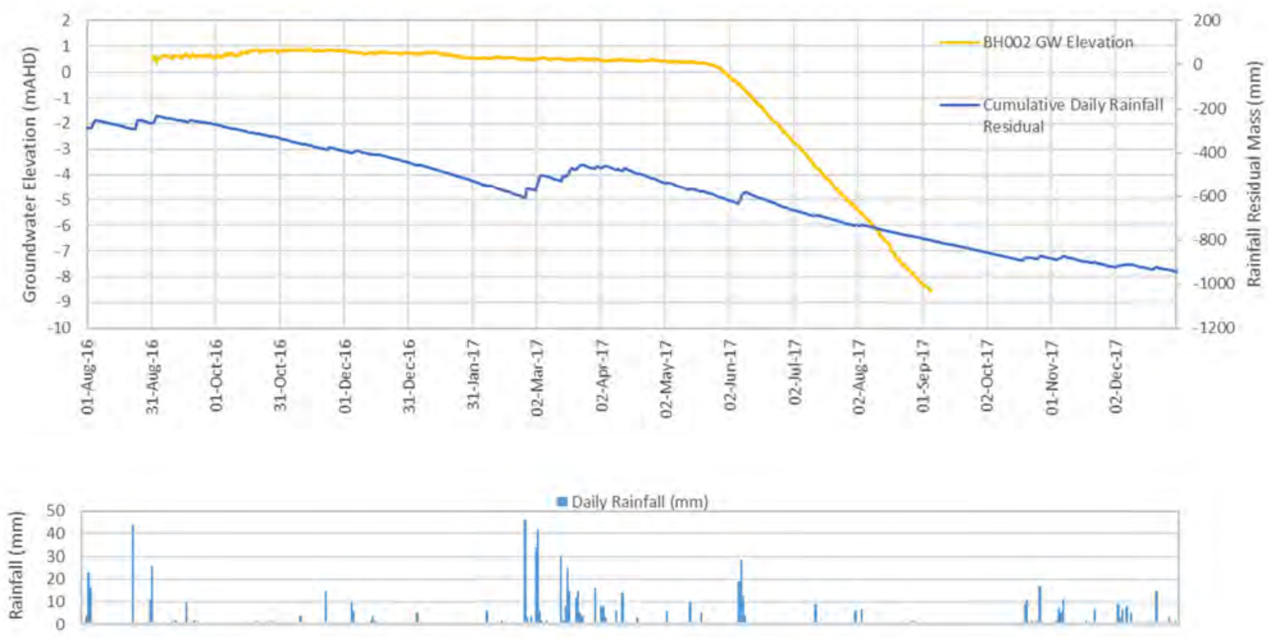

Figure 26 Hydrograph BH002 Screened in Hawkesbury Sandstone

Figure 27 Hydrograph BH023 Screened in Hawkesbury Sandstone

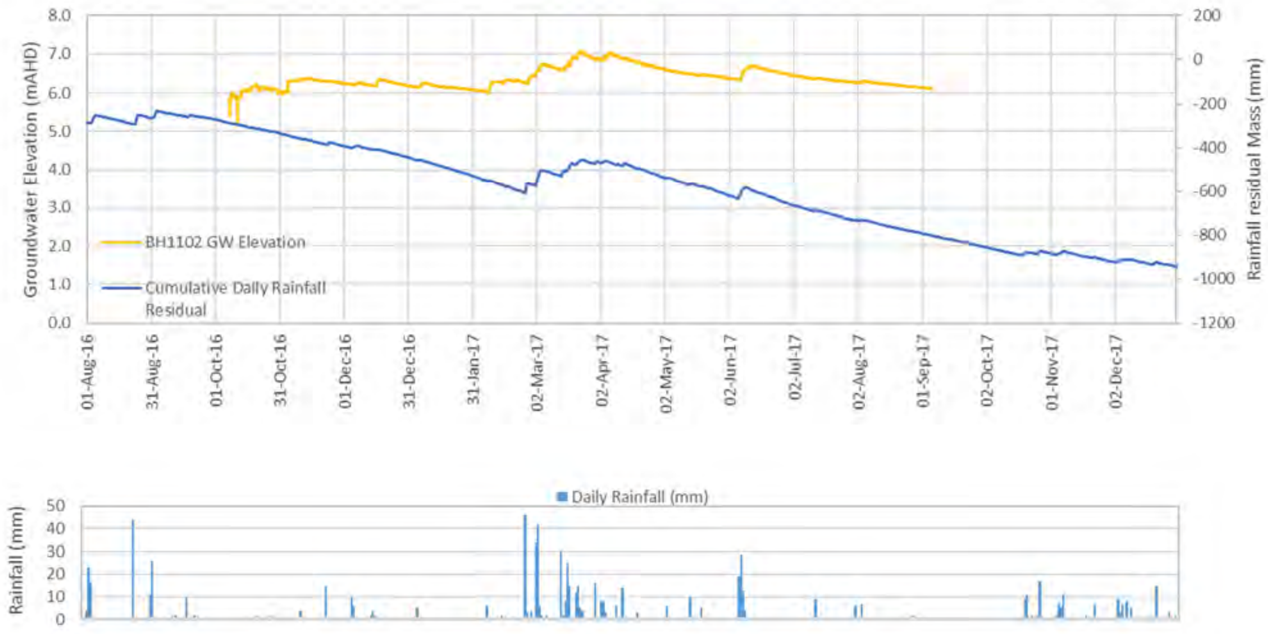

Figure 28 Hydrograph BH1102 Screened in Hawkesbury Sandstone

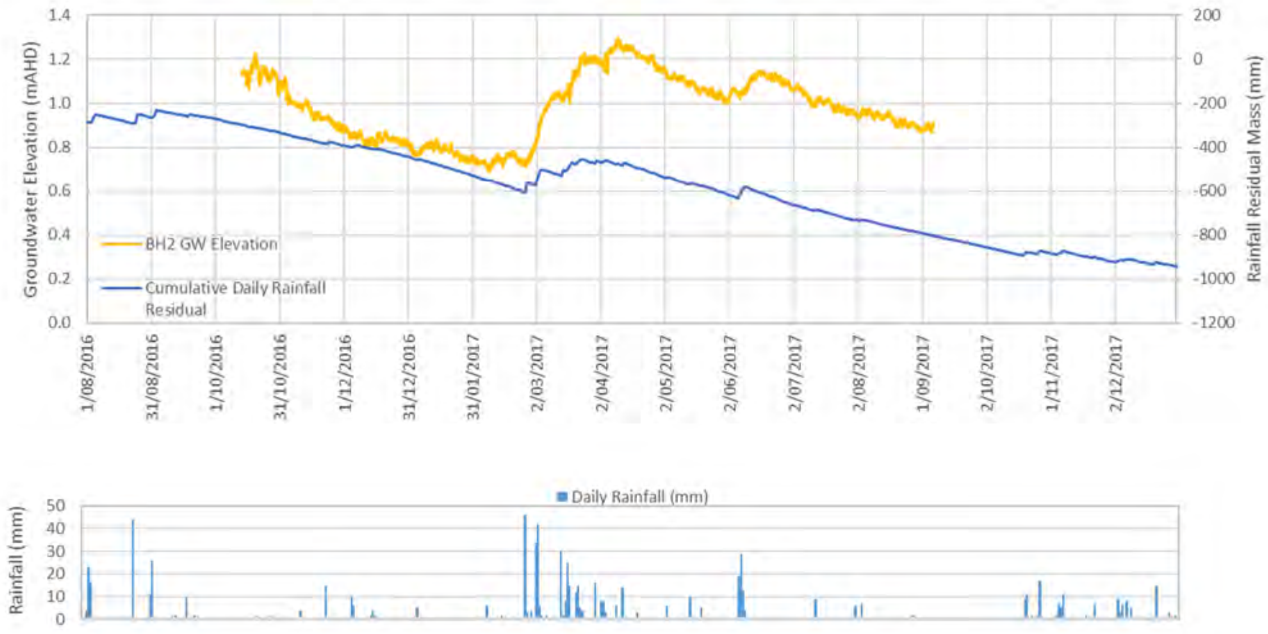

Figure 29 Hydrograph BH2 Screened in Hawkesbury Sandstone

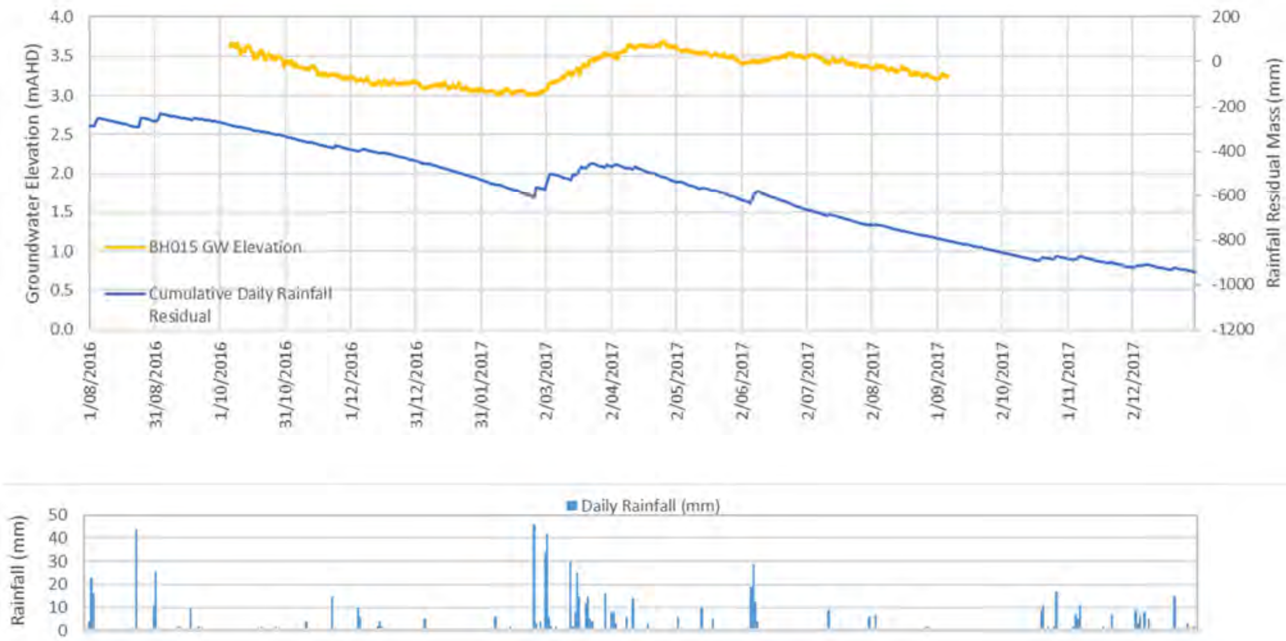

Figure 30 Hydrograph BH015 Screened in Hawkesbury Sandstone

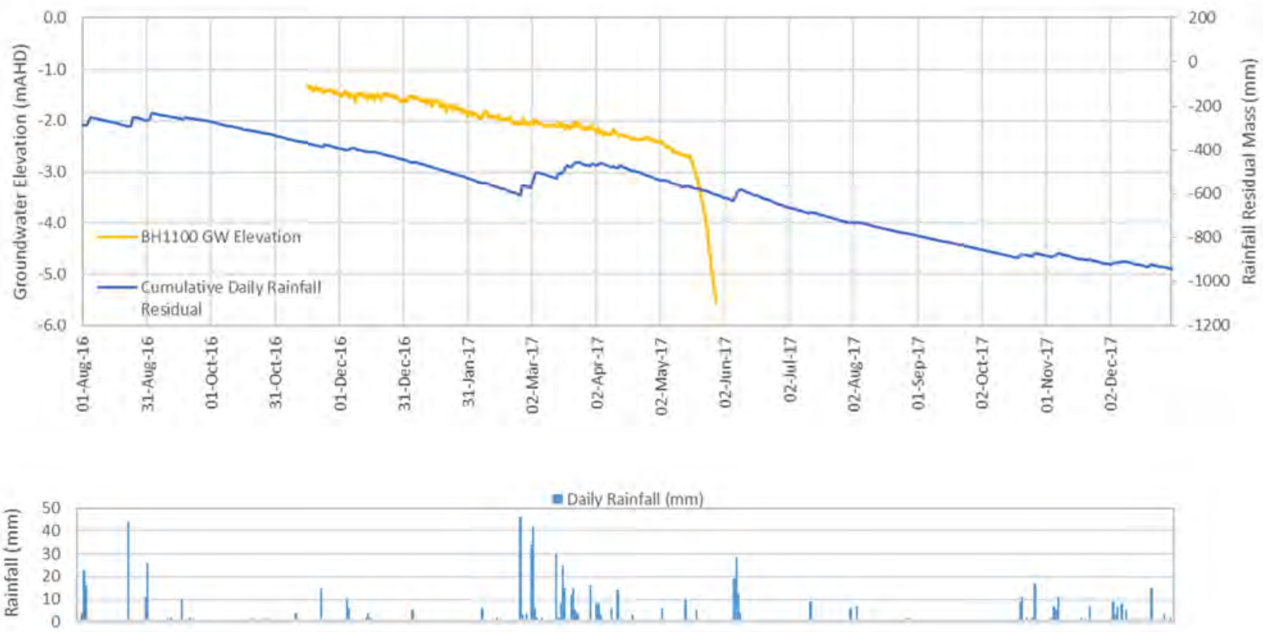

Figure 31 Hydrograph BH1100 Screened in Hawkesbury Sandstone

3.7.4 Hydraulic Properties

Four major hydrogeologic units exist within the study area, the unconsolidated sediments of the alluvium, the Botany Sands aquifer, and the layered sedimentary sequences of the Ashfield Shale and Hawkesbury Sandstone. For the purposes of this project the Mittagong Formation is considered to be comparable in properties to the Ashfield Shale and therefore these units are grouped together. Table 8 presents a summary of the hydraulic properties reported for the study area.

Table 8 Summary of Hydraulic Properties from Nearby Studies

	Age	Type	Kh [m/d]	Kv [m/d]	Sy	Ss [m^{-1}]	Source
Alluvium	Quaternary	Aquifer	4.32E-1	8.64E-3			1
			5.00E-1	5.00E-2			2
			1.00E+0				3
			1.00E+0				4
			1.00E-2 to 1.00E+0	Ratio Kv:Kh 1:10 to 100	2.00E-1		6
Botany Sands	Quaternary	Aquifer	8.64E-1	1.73E-2			1
			1.00E-2 to 1.00E+1	Ratio Kv:Kh 1:10 to 100	2.00E-1		6
Ashfield Shale	Triassic	Leaky aquitard	8.00E-4	8.00E-4			1
			1.00E-3	1.00E-4			2
			1.08E-2				3
			1.91E-4 to 6.62E-3				4
			1.00E-4 to 1.00E-2				5
			1.00E-4 to 1.00E-2		1.00E-2	1.00E-5	6
Mittagong Formation	Triassic	Leaky aquitard	5.00E-3	Ratio Kv:Kh 1:10 to 1000			4
Hawkesbury Sandstone	Triassic	Aquifer	1.00E-2	1.00E-2			1
			1.00E-2	5.00E-4			2
			1.00E-3 to 5.16E-3				3
			1.00E-3 to 5.00E-2				4
			1.00E-3 to 1.00E-1				5
			1.00E-3 to 1.00E-0	Ratio Kv:Kh 1:10 to 100	2.50E-2	5.00E-6 to 5.00E-5	6

Sources: 1. Golder, 2016 M4 East model calibration (SS). 2. CDM Smith, 2016 New M5 Model calibration (SS). 3. GHD, 2015 M4 East Model Calibration (steady-state). 4. GHD, 2015 M4 East Model Calibration (transient). 5. Hewitt (2005). 6. Golder, 2016 Regional Literature Review

3.7.4.1 Quaternary Alluvium

Alluvium is found along the edges of the watercourses within the study area and forms localised unconfined aquifers. As the water level is typically connected to adjacent water courses, the water levels are typically shallow and strongly controlled by topography. Lower in the catchments, groundwater within the alluvial aquifers is typically influenced by tidal fluctuations. Reported hydraulic conductivity values within the study area range from 0.1 m/day to 1 m/day, with vertical hydraulic conductivity being an order of magnitude or more less than horizontal due to the layered depositional sequence.

3.7.4.2 Ashfield Shale

The Ashfield Shale is considered a regional leaky aquitard due to its low ability to transmit water through its fine-grained sequence and tight bedding planes. Groundwater flow is mostly restricted to flow through fractures and joints (secondary porosity), although the bulk hydraulic conductivity is typically low, in the order of 0.01 to 0.00001m/day.

Packer testing conducted by AECOM (2018a) indicates that the horizontal hydraulic conductivity of the shale in the areas of Camperdown and St Peters typically averages close to 0.01 m/day, although a zone of higher hydraulic conductivity (up to 0.8 m/day) seems to occur at depths between 10 and 20 m below ground surface (Figure 32). This is likely due to the surficial shales being weathered to plastic clays, while the fresher material beneath the weathered zone is likely to contain a higher fracture/joint density thereby increasing the hydraulic conductivity. Testing of shale below 40 m depth has not been undertaken but it is expected that the hydraulic conductivity will continue to decrease with depth as a function of decreasing density of fracturing and tighter bedding partitions.

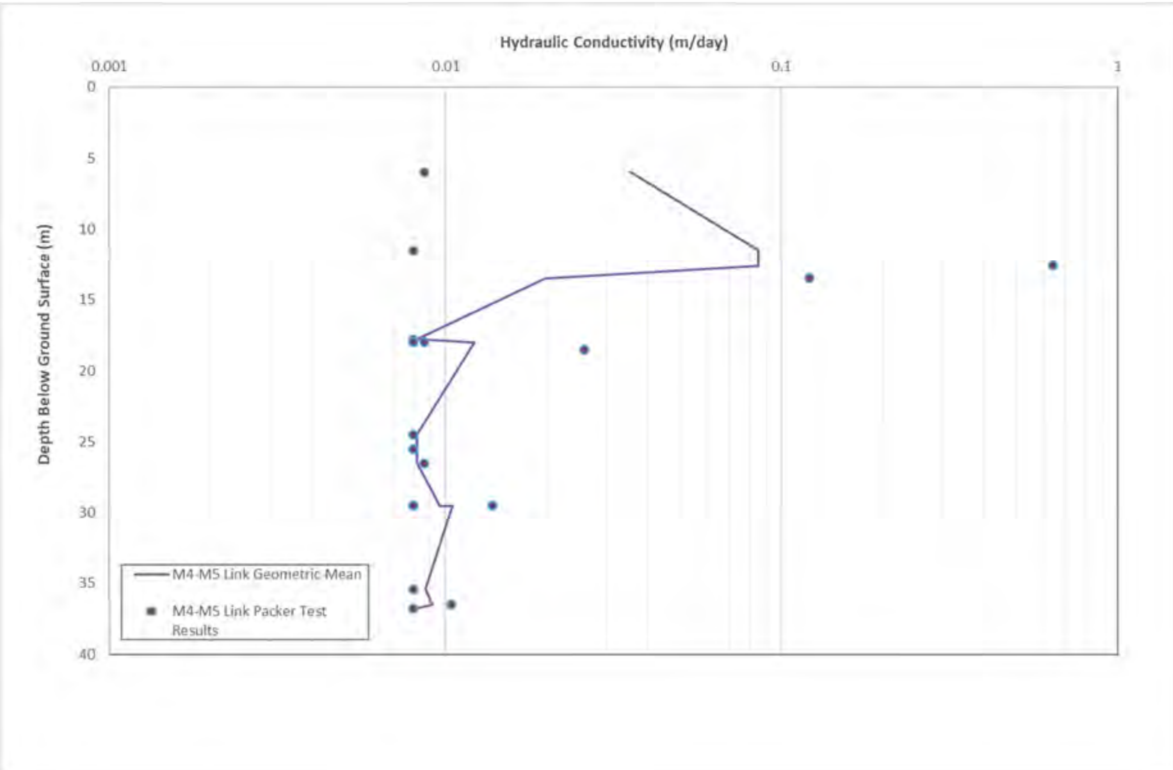

Figure 32 Hydraulic Conductivity from Packer Testing Along M4-M5 Alignment

3.7.4.3 Hawkesbury Sandstone

The Hawkesbury Sandstone is a dual porosity aquifer with groundwater dominantly transmitted via interconnected fracturing. The bulk hydraulic conductivity of the Hawkesbury Sandstone is typically in the order of 0.001 to 0.1 m/day (Table 8). Vertical anisotropy (K_V:K_H) is in the range of 1:10 to as low as 1:100. Extensive packer testing has been undertaken in the Hawkesbury Sandstone across the Sydney Basin. Tammetta and Hawkes (2009) have compiled the results of many of these tests (Figure 33), with the horizontal conductivities reported ranging from over 1m/day in the upper 50m to as low at 0.00003 m/day at 400 m depth. There is a clear trend in the regional data of decreasing hydraulic conductivity with depth from ground surface, which is again most likely to be due to less frequent fracture spacing with depth.

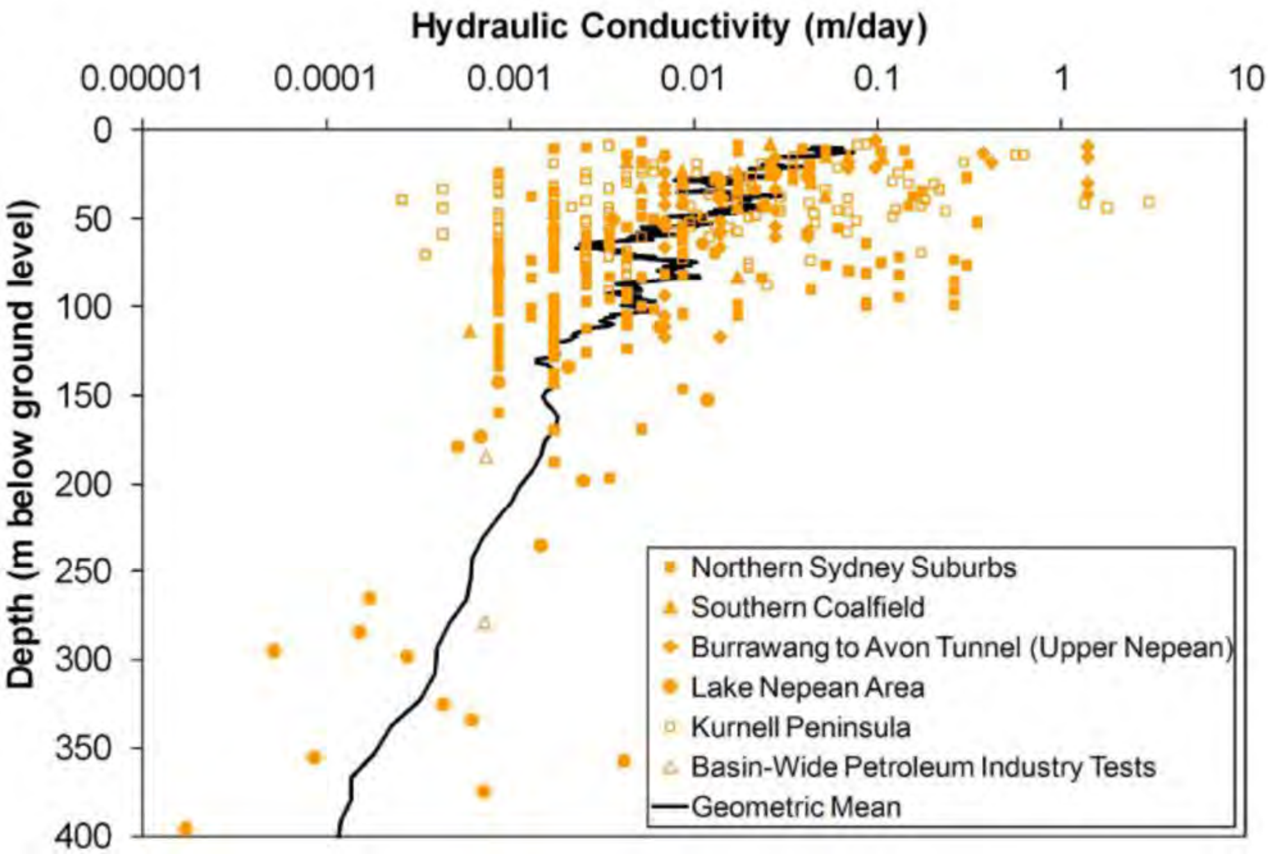

Figure 33 Hydraulic Conductivity from Packer Testing of Mesozoic Sandstones in Sydney Basin (Tammetta & Hawkes, 2009)

Packer testing has been undertaken for the Hawkesbury Sandstone as part of the current Project (Figure 34), and for the neighbouring New M5 and M4-M5 Link components of WestConnex. Average hydraulic conductivities in the Hawkesbury Sandstone recorded during packer testing for the New M5 alignment were typically in the range of 0.0005 to 0.01 m/day, while the test results for the M4-M5 Link are an order of magnitude higher (most likely due to the limit of testing for the M4-M5 Link being too high for the unit being tested). Packer testing that was undertaken for the New M5 alignment shows the greatest range in values, with minimum recorded values of 0.000005 m/day and a maximum of 4 m/day. As per the regional data, a general trend of decreasing hydraulic conductivity with depth can be seen in packer test results associated with the F6 and WCX projects.

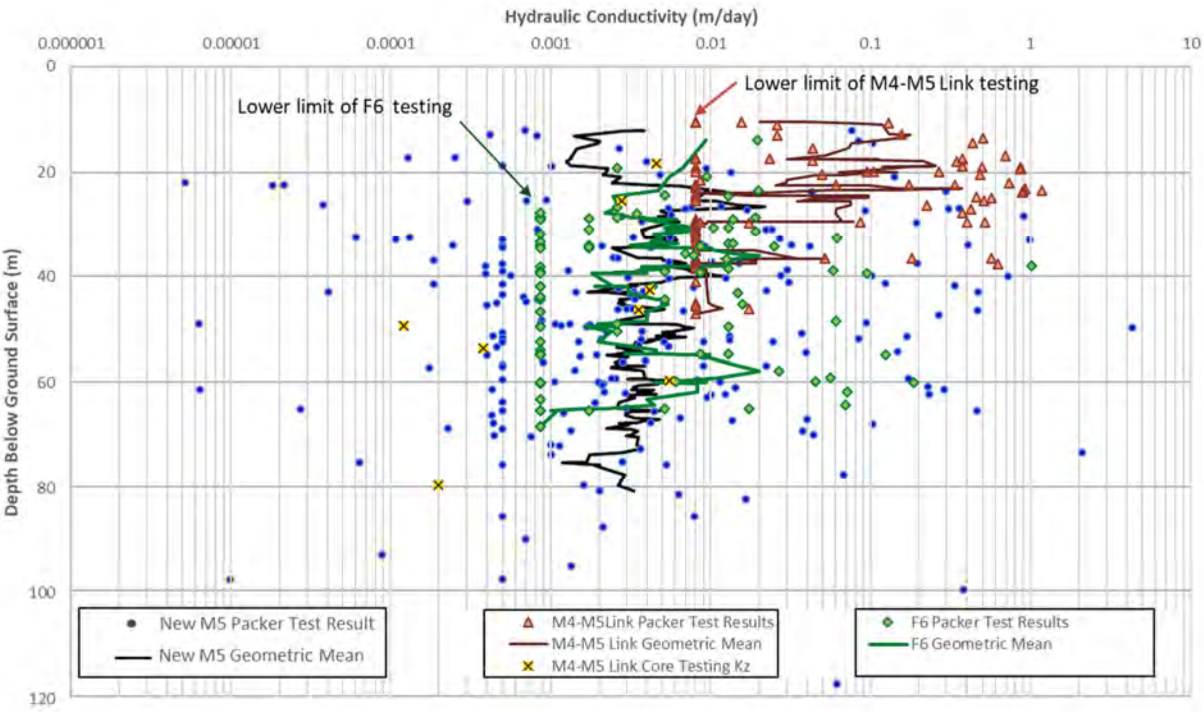

Figure 34 Hydraulic Conductivity from Packer Testing Along the New M5 Alignment (RMS, 2015)

Studies conducted in the Sydney metropolitan area and elsewhere indicate a specific yield of between 0.01 and 0.02 (i.e. 1-2%) is reasonable for typical Hawkesbury Sandstone (Tammetta and Hewitt, 2004). A pumping test was conducted at Arncliffe and a local groundwater model calibrated to the observed water levels during the pumping test. Calibrated specific yield values in the Hawkesbury Sandstone were 0.01 and specific storage values 0.000002 m^{-1} (Golder, 2017).

Core porosity (total) and permeability testing was undertaken for a few boreholes within the M4-M5 alignment, with results shown in Table 9. Total porosity ranges from 11 to 19% in the Hawkesbury Sandstone. Measured vertical hydraulic conductivity ranges between 0.0001 m/day to 0.005 m/day in the Hawkesbury Sandstone, generally decreasing with depth.

Table 9 M4-M5 Link Core Porosity and Permeability Testing

Monitoring	Sample Interval (m)	Lithology	Vertical Hydraulic Conductivity	Total Porosity
Well			m/day	%
EP_BH04	25.3 - 25.46	Hawkesbury Sandstone	2.76E-03	13.6
HB_BH24	18.27 - 18.45	Hawkesbury Sandstone	4.58E-03	14.1
MT_BH01	59.43 - 59.61	Hawkesbury Sandstone	5.53E-03	13.1
MT_BH07	42.38 - 42.58	Hawkesbury Sandstone	4.15E-03	11.3
MT_BH11	53.38 - 53.56	Hawkesbury Sandstone	3.80E-04	13.6
MT_BH12	46.11 - 46.25	Hawkesbury Sandstone	3.54E-03	18.7
MT_BH16	79.45 - 79.58	Hawkesbury Sandstone	1.99E-04	14.6
RZ_BH60	49.15 - 49.30	Hawkesbury Sandstone	1.21E-04	14.3

3.7.5 Groundwater Inflow to Tunnels

The tunnels associated with the Project and the adjoining WCX program of works are primarily designed to be free draining, under the restriction of a maximum inflow rate of 1L/sec/km during tunnel operation, with the exception of the F6 access decline which has a long-term allowed inflow rate of 2L/sec/km (where it is designed as drained tunnel). Local grouting will be undertaken as necessary where high inflow features (such as conductive faults and large fractures) are intercepted during tunnel excavation. It is proposed that the shallow sections of the access decline and President Avenue ramps will be tanked or will be of cut and cover or slotted type and lined with a diaphragm cut-off wall extending from surface to competent rock (Figure 35). These tanked and lined structures are assumed to be impermeable and therefore groundwater inflow will be zero, additionally the presence of cut-off walls is expected to locally inhibit groundwater flow through the unconsolidated sediments.

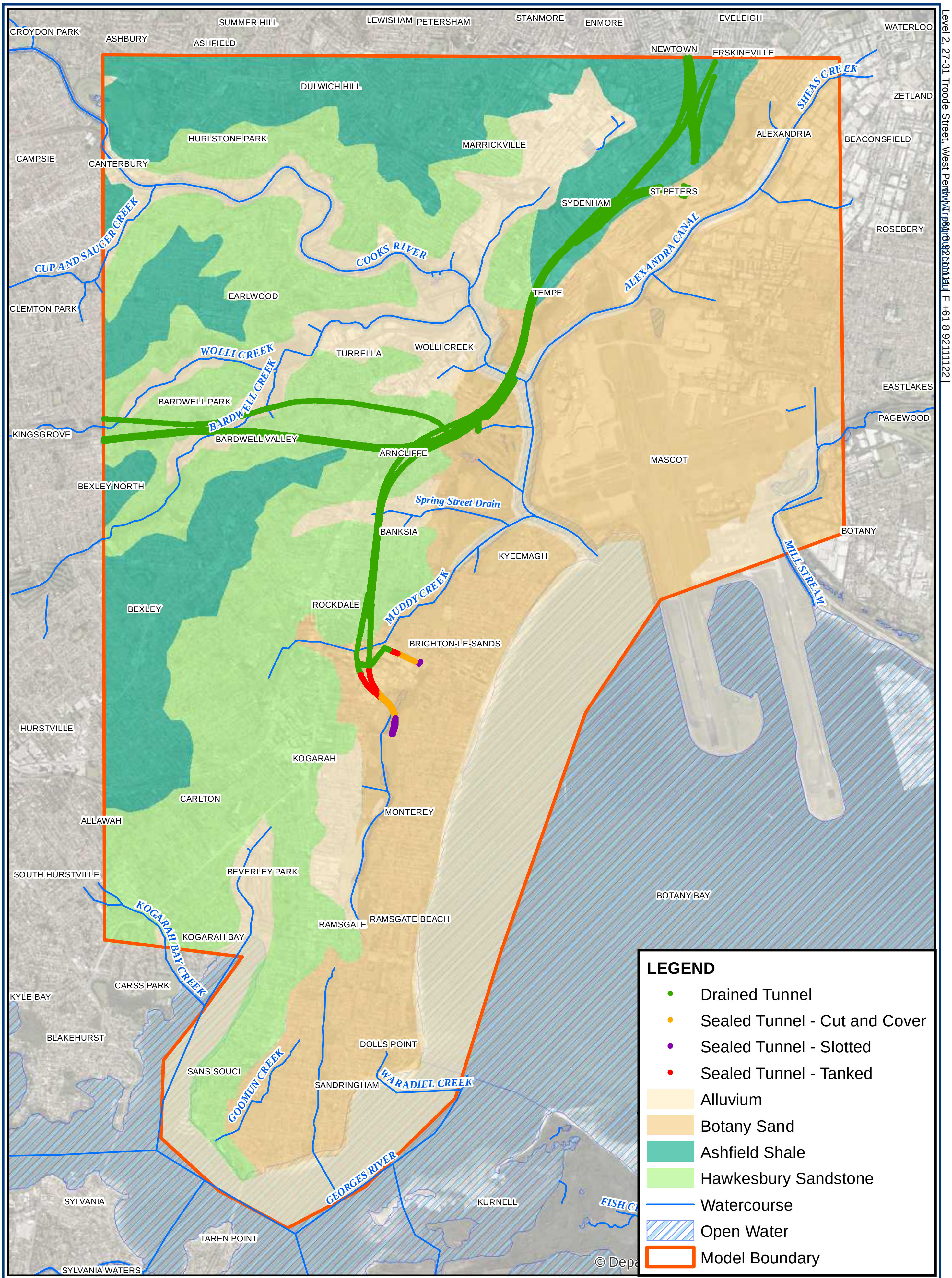

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Figure 35

Tunnel StructureType

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Hewitt (2005) has compiled a list of the long term inflow to existing tunnels in the Sydney metropolitan area (Table 10). Reported drainage inflow rates range from 0.1L/sec/km to <3L/sec/km. The M5 East motorway is the only existing drained tunnel within the project area, having a long term inflow rate of 0.8 to 0.9 L/sec/km. Short term localised high inflows in the order of 3 to 20 L/s were reported associated with localised features such as faults, shear zones, dykes and enhanced jointing below paleo-valleys (stress relief joints). These higher inflows were reported to reduce significantly over time.

Table 10 Long Term Inflow to Existing Tunnels (Hewitt, 2005)

Tunnel	Type	Length (km)	Width (m)	Long Term Inflow (L/sec/km)
Northside Storage	Water	20	6	0.9 (10 without extensive grouting)
Epping to Chatswood	Rail	13	7.2 (twin)	0.9
M5 East	Road	3.9	8 (twin)	0.8-0.9
Eastern Distributor	Road	1.7	12 (double deck)	1
Hazelbrook	Water	9.5	2	0.1
Cross City	Road	2.1	8 (twin)	<3
Lane Cove	Road	3.6	9 (twin)	<3

Modelling for M4 East and the New M5 of WCX has been undertaken prior to this project. Modelling results from those projects predict inflow values of between 0.16 L/sec/km to 3.76 L/sec/km (recharge dependent) for M4 East (GHD, 2015) and less than 1L/sec/km for the New M5, with localised inflows during construction of up to 6.7 L/sec/km around Arncliffe/Cooks River crossing (Golder, 2017). The groundwater inflow design criteria for M4 East, the New M5 and NorthConnex was also set at 1L/sec/km, with grouting required to reduce the hydraulic conductivity at high-inflow areas.

3.7.6 Rainfall Recharge

The Coastal Porous Rock Rainfall Recharge Study by EMM (2015) completed a literature review of the reported recharge values for areas east of the NSW Great Dividing Range, with 5% mean annual rainfall being the average for the Hawkesbury Sandstone. There is limited data for the Ashfield Shale, but it is suggested that recharge to the shale will be equal to or less than the sandstone.

Crosbie (2015) conducted a study to estimate recharge based on the chloride mass balance method in the Sydney Basin, and provided recharge estimates as follows

- Botany Sands – 40 to 100% rainfall
- Hawkesbury Sandstone – 2 to 10% rainfall
- Ashfield Shale – 1 to 2 % rainfall

Hatley (2004) conducted a literature review of rainfall recharge to the Botany Basin, with values between 6% to 37% of rainfall reported, based primarily on transient model calibration by Merrick (1994).

Due to the study area being within an urban setting, the recharge received in natural environments with unmodified surface cover is likely to be significantly reduced with increased surface runoff to stormwater drains and surface channels. However localised recharge from leaky pipes and stormwater drains may partially counteract this reduction, as well as the reduced evapotranspiration associated with lower density vegetation and an impervious ground cover.

3.7.7 Groundwater Quality

Groundwater quality within the unconsolidated sediments and Hawkesbury Sandstone is generally of good quality, although there are some areas that may be impacted due to historic and current land-use practices. Measured values of electrical conductivity within the alluvium are variable ranging from 254 microsiemens per centimetre (µS/cm) (BH1314) to 17,100 µS/cm (WCX_BH201). Elevated electrical conductivity values in excess of 10,000 µS/cm in wells BH1303 (12,780 µS/cm), WCX_BH201 and (17,100 µS/cm) is attributed to tidal mixing with groundwater. Measured electrical conductivity values measured within the Hawkesbury Sandstone are similar to those measured within the alluvium ranging from 516 µS/cm (WCX_BH063) to 10,400 µS/cm (WCX_BH202) with the range of results is attributed to the degree of tidal mixing.

Previous and current land-uses along the alignment that could impact groundwater quality include:

- Market gardens and associated pesticides and herbicides
- Service stations and associated fuel storage
- Fire station and associated fire-fighting foam residues
- Smash repairs and mechanics and the use of oils and solvents
- Waste management and storage
- Light industrial including the use of solvents and manufacturing.

Contaminated groundwater could be intersected by the tunnels from the above sources but would be captured and treated prior to discharge. Similarly parts of the project that could be impacted by acid sulfate soils and if excavated appropriate measures would be put in place to manage acidic groundwater. Saltwater intrusion is expected to commence as soon as the drawdown cone of depression reaches the edge of nearby tidal surface waterbodies and starts to impact groundwater close to the shoreline. Long term groundwater monitoring will be instigated to monitor the effects of saltwater intrusion.

4 Groundwater Modelling

4.1 Model Software and Complexity

Numerical modelling has been undertaken using Geographic Information Systems (GIS) in conjunction with MODFLOW-USG, which is distributed by the United States Geological Survey (USGS). MODFLOW-USG is a relatively new version of the popular MODFLOW code (McDonald and Harbaugh, 1988) developed by the United States Geological Survey (USGS). MODFLOW is the most widely used code for groundwater modelling and has long been considered an industry standard.

MODFLOW-USG represents a major revision of the MODFLOW code, in that it uses a different underlying numerical scheme: control volume finite difference (CVFD), rather than traditional MODFLOW's finite difference (FD) scheme. 'USG' is an acronym for Un-Structured Grid, meaning that MODFLOW-USG supports a variety of structured and unstructured model grids, including those based on cell shapes including prismatic triangles, rectangles, hexagons, and other cell shapes (Panday *et al.*, 2013). The CVFD method also means that a model cell can be connected to an arbitrary number of adjacent cells, which is not the case with a standard FD scheme.

In contrast with structured rectangular finite-difference grids, flexible meshes have a number of advantages. Firstly, they allow finer grid resolution to be focused solely in areas of a model that require it (e.g. along the tunnel alignments), as opposed to refinement over the entire grid, significantly decreasing cell count and consequently model runtimes. Secondly, spatial areas not required in the model may be omitted rather than deactivating cells or retaining "dummy" layers (e.g. for layer pinch-outs). Thirdly, flexible meshes allow cell boundaries to follow important geographical or geological features, such as watercourses or outcrop traces, more accurately modelling the physical system. Finally, the orientation of the flow interfaces between cells may vary, allowing preferential flow directions to be modelled with higher accuracy.

Additionally, MODFLOW-USG is able to simulate variably saturated flow and can handle desaturation and re-saturation of multiple hydrogeological layers without the "dry cell" problems of traditional MODFLOW. This is pertinent to models which simulate layers, such as surficial regolith, which frequently alternate between unsaturated and saturated, as well as the depressurisation and desaturation that occurs due to tunnel excavation. Traditional versions of MODFLOW can handle depressurisation and desaturation to some extent, but model cells that are dewatered (reduced below atmospheric pressure) are replaced by "dry" cells, which can interfere with the simulation of various processes and also cause model instability.

4.2 Model Geometry

4.2.1 Model Extent

The maximum extent of the groundwater model is roughly 7.5 x 12 km, with the south and south-east boundary being represented by the central channel of Georges River/Botany Bay, and is shown on many figures in this report. This extent is based on the need for inclusion of adjoining WestConnex works and other major tunnel infrastructure (M5 East) as part of the cumulative impact assessment, and practical considerations for modelling (most notably model run time, file size and processing of results). The model also includes the proposed F6 Extension Stage 2 tunnel extent, however this is not included as part of this assessment.

The active domain is centred on the Project, and partially includes neighbouring New M5 and M4-M5 Link components of WestConnex. The Airport Rail Link tunnel is fully lined and was excluded from the model on the basis that it would not impact the regional flow regime, as there is no drawdown associated with its operation and local groundwater is able to flow around the tunnels.

4.2.2 Model Layering

The topography of the model relies on LiDAR data provided by AECOM. The model domain is discretised into nine (9) layers, as shown in Table 11**.** All layers are fully extensive, however where a particular hydrogeological unit is not present (e.g., because of erosion), the model layer representing that unit has been assigned a layer thickness of 0.5 m and the layer has been given the same hydraulic properties as the layer below. The relative orientation of the model layers is shown in the model cross-section in Figure 36 (the location of the section line is shown in Figure 37). The Bald Hill Claystone is considered a regional aquitard and forms the model basement.

Table 11 Model Layering and Hydrostratigrahpy

Layer	Unit	Average Thickness# (m)	Min Thickness (m)	Max Thickness (m)
1	Fill, Regolith, Alluvium, Botany Sands	13.7	3	49.3
2	Upper Ashfield Shale	6.4	0.5	10
3	Lower Ashfield Shale/ Mittagong Formation	6.8	0.7	23.1
4	Hawkesbury Sandstone	22.9	0.5	66.7
5	Hawkesbury Sandstone	13.7	0.5	20
6	Hawkesbury Sandstone	16.3	0.5	20
7	Hawkesbury Sandstone	17.6	0.5	20
8	Hawkesbury Sandstone	20	0.5	20
9	Hawkesbury Sandstone	20	0.5	20

Average thickness does not include 0.5m thickness assigned where the geological unit is not present

The lateral boundaries of the geological model are based on the Sydney 1:100,000 Geological Map. Vertical boundaries were developed using:

- The intersection of LIDAR data with the Sydney 1:100,000 geology outcrop extents.
- Geological logs from drilling investigations specific to the F6 project.
- Compiled GINT database information provided by AECOM for nearby road infrastructure projects
- CSIRO depth of unconsolidated soils
- GSNSW 3D modelling surfaces for the base of the Hawkesbury Sandstone

The two main geological units, the Ashfield Shale and the Hawkesbury Sandstone have been subdivided into multiple model layers. This is particularly important in the Hawkesbury Sandstone, and has been done for the following reasons:

- The Hawkesbury Sandstone cannot be considered to be a single aquifer. Due to the layered sedimentary nature of the sandstone with variable grain size and cementation, multiple aquifers often exist through the Hawkesbury Sandstone sequence. There is usually perching along with the 'regional' groundwater head.

- Multiple layers are required to adequately represent the steep vertical gradient induced by drainage of groundwater local to the tunnels.

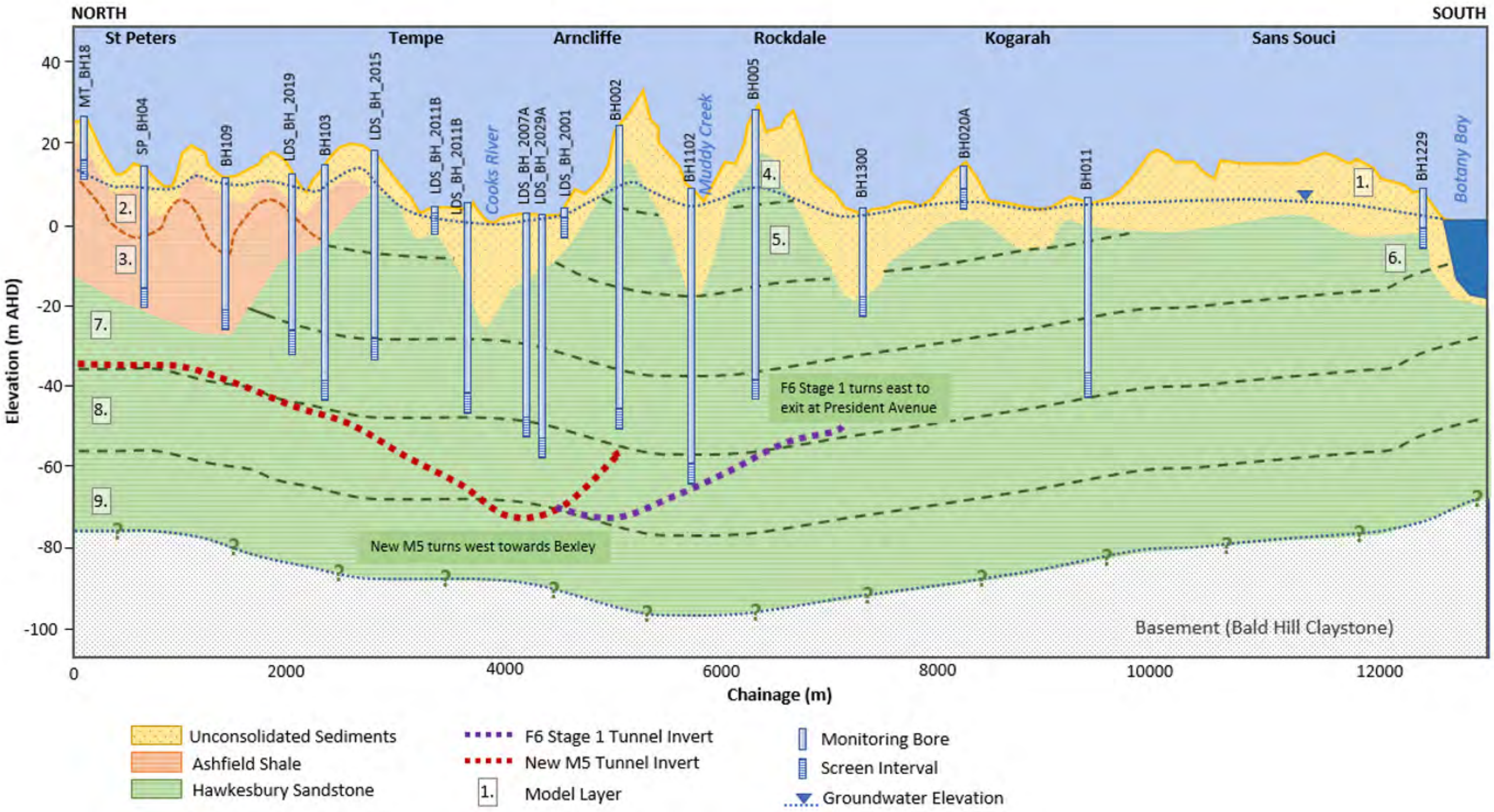
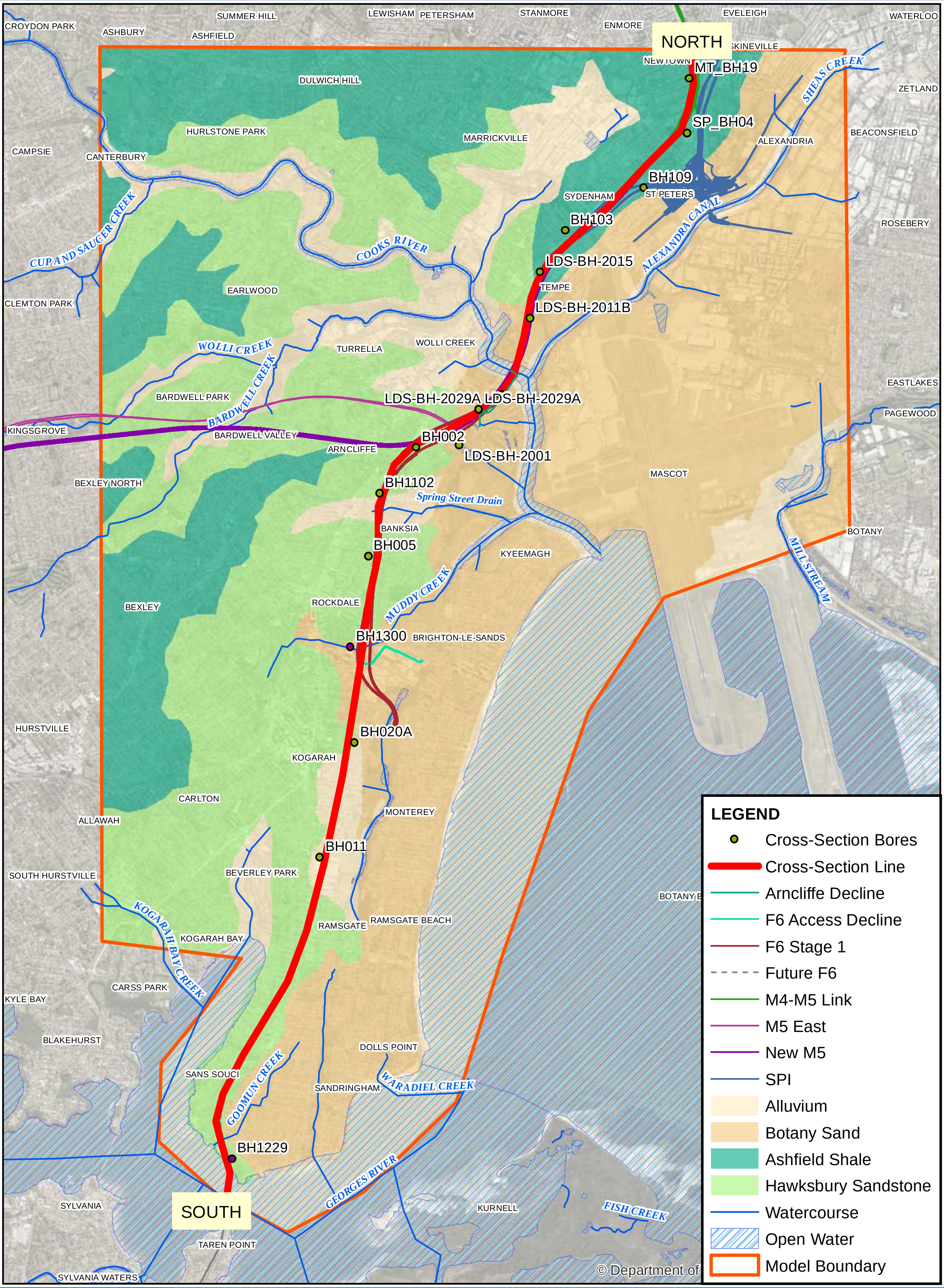


Figure 36 Model Cross-Section



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GDA 1994 MGA Zone 56

0 250 500 1,000 1,500 2,000 m

Figure 37

Cross-Section Location

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4.2.3 Model Zones

As discussed in the Hydraulic Properties data analysis (Section 3.7.4) the hydraulic conductivity of the geological units typically decreases with depth. Accordingly, zonation within the Ashfield Shale and Hawkesbury Sandstone was applied as per Table 12, using the top of Layer 1 minus the layer mid-point elevation to determine the relevant zone within each layer. Thus, each layer is spatially divided into several depth-dependant hydraulic zones for calibration.

Table 12 Model Hydraulic Zonation

Depth (m bgl)	Ashfield Shale Model Zone Number	Hawkesbury Sandstone Model Zone Number
0 to 10	21	41
10 to 20	22	42
20 to 40	23	43
40 to 60	24	44
60 to 80	25	45
80 to 100	NA	46
>100	NA	47

As the Alluvium, Botany Sands and Fill/regolith occur only in Layer 1, a single zone was applied for each and no variation in hydraulic conductivity with depth was modelled.

4.2.4 Model Grid

MODFLOW-USG (Section 4.1) allows the use of an unstructured or irregular mesh. For this project, a Voronoi-based mesh has been adopted (Amenta and Bern, 1998), which has the advantage of being not only irregular but maintaining the property that a line connecting adjacent cell-centres is perpendicular to the shared cell boundary. Use of the unstructured mesh allows refinement by using small cell sizes along road tunnels and watercourses while letting the cell size increase in areas that are not near features of interest.

The model domain is discretised into 46,262 cells for each layer, with a total cell count of 416,358 cells. Where a model layer extends across an area where the geological unit represented by that layer is not present (e.g. where the Ashfield Shale has been eroded away in Layer 2 and 3), the layer is given a thickness of 0.5m and assigned the hydraulic properties of the next present geological unit below it (in this example the Hawkesbury Sandstone in Layer 4), creating a continuous vertical profile.

The Voronoi mesh was generated using the proprietary HydroAlgorithmics software ‘AlgoMesh’ (Merrick and Merrick, 2015), which provides significant control over the mesh generation process, and can export MODFLOW-USG files, in addition to other formats.

The following general approach was taken when using AlgoMesh:

- Polylines mapped along the proposed tunnel alignments were used to create a mesh of Voronoi cells to define the tunnel with a maximum single tube width of 20m.
- Polylines along mapped rivers and creeks were used to ensure the mesh conformed to mapped drainage networks, and to enforce variable spatial detail along streams (e.g. greater detail along streams closest to the Project).

- Calibration target boreholes were included in the mesh generation process to ensure sufficient spatial detail in areas with observations (bores) located close to one another.
- Maximum grid cell resolution in key areas of interest is as follows:
  - 12.5 m in 2-lane road tunnels;
  - 14.5 m in 3-lane road tunnels;
  - 18 m in 4-lane road tunnels;
  - 20 m in 5-lane road tunnels;
  - 25 m along waterways;
  - 50 m in alluvium areas.

Figure 38 shows the number of lanes for each part of the tunnel modelled.

Maximum cell width is approximately 500 m, with cells gradually grading to this size in areas away from tunnels and watercourses.

Additionally, a buffer of 15m wide cells has been applied within a 2 km radius around the F6 alignment. This allows the model to be readily adapted for minor changes to the design without the requirement of re-meshing.

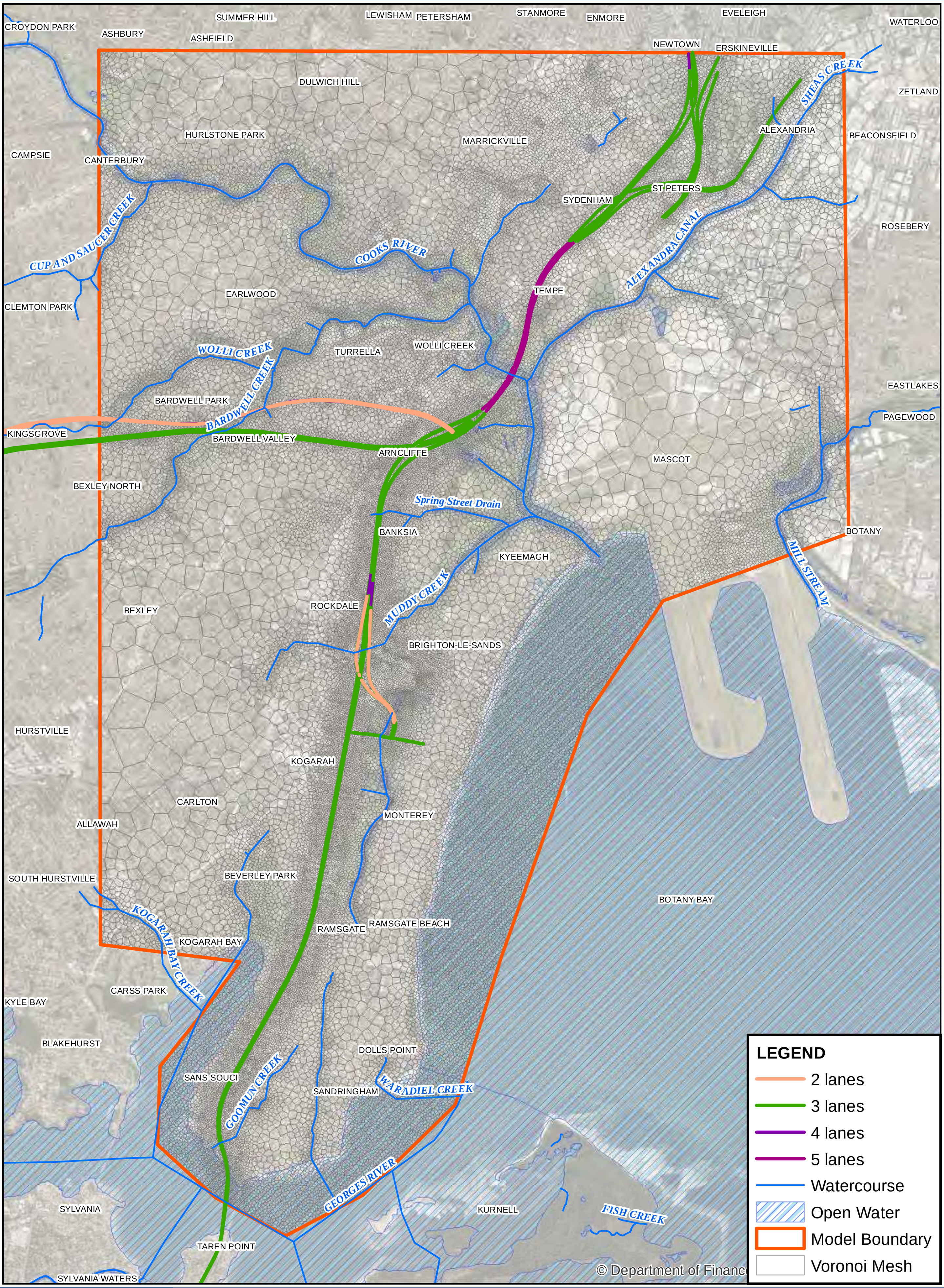

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Figure 38

Lane Configuration

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4.3 Model Variants

Both steady-state and transient models have been developed:

- Steady-state model of inferred existing conditions, including any drawdown associated with existing tunnels including the M5 East Motorway. The purpose of the steady-state model is to generate plausible initial conditions for the start of the transient simulation.
- Transient model of the transition from recent and existing conditions, commencing in 2015 and extending to year 2100 (total simulation time of 85 years) with construction simulated for the current project, and the WestConnex New M5 and M4-M5 link projects). The purpose of the transient model is to simulate the changing groundwater regime over time with tunnel construction and long-term operation.

An additional transient model was run without the F6 Stage 1 tunnelling in order to determine the project's individual contribution to the modified groundwater regime by comparing the model predictions with the run that includes the F6 tunnels.

The steady-state and transient periods are incorporated into a single run (i.e. the steady-state period automatically provides initial conditions for the subsequent transient period). The transient model is broken into phases of calibration, construction and prediction. For the purpose of the modelling the "calibration" period reflects the period for which monitoring data exists (i.e. 2015 to late 2017), and is inclusive of the initial tunnelling activities for the New M5. The "construction" phase represents the period from the end of calibration to project opening (Q3 2024) and "operation" reflects the ongoing operational inflows into the tunnel thereafter. The timing of the model is described in Figure 39.

	SP	From	To	No Days	Num months	Total days	Total years	SP
Initial Condition	1	STEADY STATE						1
Transient Calibration	2	1/01/2015	31/01/2015	31	1	31	0.08	2
	3	1/02/2015	28/02/2015	28	1	59	0.16	3
	4	1/03/2015	31/03/2015	31	1	90	0.25	4
	5	1/04/2015	30/04/2015	30	1	120	0.33	5
	6	1/05/2015	31/05/2015	31	1	151	0.41	6
	7	1/06/2015	30/06/2015	30	1	181	0.5	7
	8	1/07/2015	31/07/2015	31	1	212	0.58	8
	9	1/08/2015	31/08/2015	31	1	243	0.67	9
	10	1/09/2015	30/09/2015	30	1	273	0.75	10
	11	1/10/2015	31/10/2015	31	1	304	0.83	11
	12	1/11/2015	30/11/2015	30	1	334	0.91	12
	13	1/12/2015	31/12/2015	31	1	365	1	13
	14	1/01/2016	31/01/2016	31	1	396	1.08	14
	15	1/02/2016	29/02/2016	29	1	425	1.16	15
	16	1/03/2016	31/03/2016	31	1	456	1.25	16
	17	1/04/2016	30/04/2016	30	1	486	1.33	17
	18	1/05/2016	31/05/2016	31	1	517	1.42	18
	19	1/06/2016	30/06/2016	30	1	547	1.5	19
	20	1/07/2016	31/07/2016	31	1	578	1.58	20
	21	1/08/2016	31/08/2016	31	1	609	1.67	21
	22	1/09/2016	30/09/2016	30	1	639	1.75	22
	23	1/10/2016	31/10/2016	31	1	670	1.83	23
	24	1/11/2016	30/11/2016	30	1	700	1.92	24
	25	1/12/2016	31/12/2016	31	1	731	2	25
	26	1/01/2017	31/01/2017	31	1	762	2.09	26
	27	1/02/2017	28/02/2017	28	1	790	2.16	27
	28	1/03/2017	31/03/2017	31	1	821	2.25	28
	29	1/04/2017	30/04/2017	30	1	851	2.33	29
	30	1/05/2017	31/05/2017	31	1	882	2.41	30
	31	1/06/2017	30/06/2017	30	1	912	2.5	31
	32	1/07/2017	31/07/2017	31	1	943	2.58	32
	33	1/08/2017	31/08/2017	31	1	974	2.67	33
	34	1/09/2017	30/09/2017	30	1	1004	2.75	34
	35	1/10/2017	31/10/2017	31	1	1035	2.83	35
	36	1/11/2017	30/11/2017	30	1	1065	2.92	36
	37	1/12/2017	31/12/2017	31	1	1096	3	37

	SP	From	To	No Days	Num months	Total days	Total years	SP
Prediction - Construction	38	1/01/2018	31/03/2018	90	3	1186	3.25	38
	39	1/04/2018	30/06/2018	91	3	1277	3.5	39
	40	1/07/2018	30/09/2018	92	3	1369	3.75	40
	41	1/10/2018	31/12/2018	92	3	1461	4	41
	42	1/01/2019	31/03/2019	90	3	1551	4.25	42
	43	1/04/2019	30/06/2019	91	3	1642	4.5	43
	44	1/07/2019	30/09/2019	92	3	1734	4.75	44
	45	1/10/2019	31/12/2019	92	3	1826	5	45
	46	1/01/2020	31/03/2020	91	3	1917	5.25	46
	47	1/04/2020	30/06/2020	91	3	2008	5.5	47
	48	1/07/2020	30/09/2020	92	3	2100	5.75	48
	49	1/10/2020	31/12/2020	92	3	2192	6	49
	50	1/01/2021	31/03/2021	90	3	2282	6.25	50
	51	1/04/2021	30/06/2021	91	3	2373	6.5	51
	52	1/07/2021	30/09/2021	92	3	2465	6.75	52
	53	1/10/2021	31/12/2021	92	3	2557	7	53
	54	1/01/2022	31/03/2022	90	3	2647	7.25	54
	55	1/04/2022	30/06/2022	91	3	2738	7.5	55
	56	1/07/2022	30/09/2022	92	3	2830	7.75	56
	57	1/10/2022	31/12/2022	92	3	2922	8	57
	58	1/01/2023	31/03/2023	90	3	3012	8.25	58
	59	1/04/2023	30/06/2023	91	3	3103	8.5	59
	60	1/07/2023	30/09/2023	92	3	3195	8.75	60
	61	1/10/2023	31/12/2023	92	3	3287	9	61
	62	1/01/2024	31/03/2024	91	3	3378	9.25	62
	63	1/04/2024	30/06/2024	91	3	3469	9.5	63
	64	1/07/2024	30/09/2024	92	3	3561	9.75	64
Prediction - Long Term	65	1/10/2024	31/12/2024	92	3	3653	10	65
	66	1/01/2025	31/03/2025	90	3	3743	10.25	66
	67	1/04/2025	30/06/2025	91	3	3834	10.5	67
	68	1/07/2025	30/09/2025	92	3	3926	10.75	68
	69	1/10/2025	31/12/2025	92	3	4018	11	69
	70	1/01/2026	31/03/2026	90	3	4108	11.25	70
	71	1/04/2026	30/06/2026	91	3	4199	11.5	71
	72	1/07/2026	30/09/2026	92	3	4291	11.75	72
	73	1/10/2026	31/12/2026	92	3	4383	12	73
	74	1/01/2027	31/12/2027	365	12	4748	13	74
	75	1/01/2028	31/12/2028	366	12	5114	14	75
	76	1/01/2029	31/12/2029	365	12	5479	15	76
	77	1/01/2030	31/12/2030	365	12	5844	16	77
	78	1/01/2031	31/12/2035	1826	60	7670	21	78
	79	1/01/2036	31/12/2040	1827	60	9497	26	79
	80	1/01/2041	31/12/2045	1826	60	11323	31	80
	81	1/01/2046	31/12/2050	1826	60	13149	36	81
	82	1/01/2051	31/12/2099	17897	600	31046	85	82

Figure 39 Model Stress Period Setup

Page 54

4.4 Model Stresses and Boundary Conditions

The model domain and boundaries shown in Figure 40 have been selected to incorporate the significant hydrological processes identified in the conceptual model (Section 3), including features such as watercourses that could be affected by tunnelling. Following is a detailed description of each of the modelled boundary conditions.

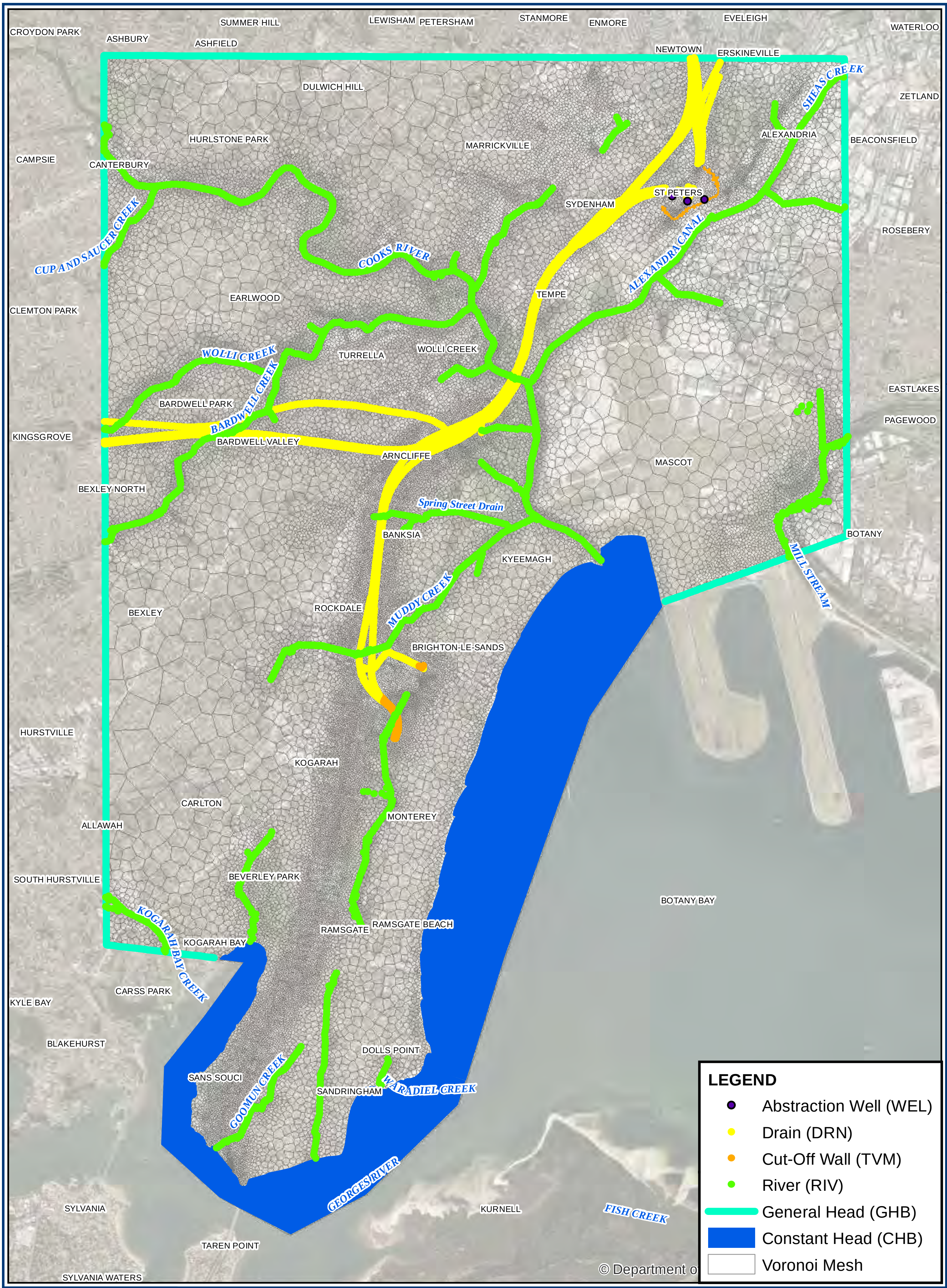

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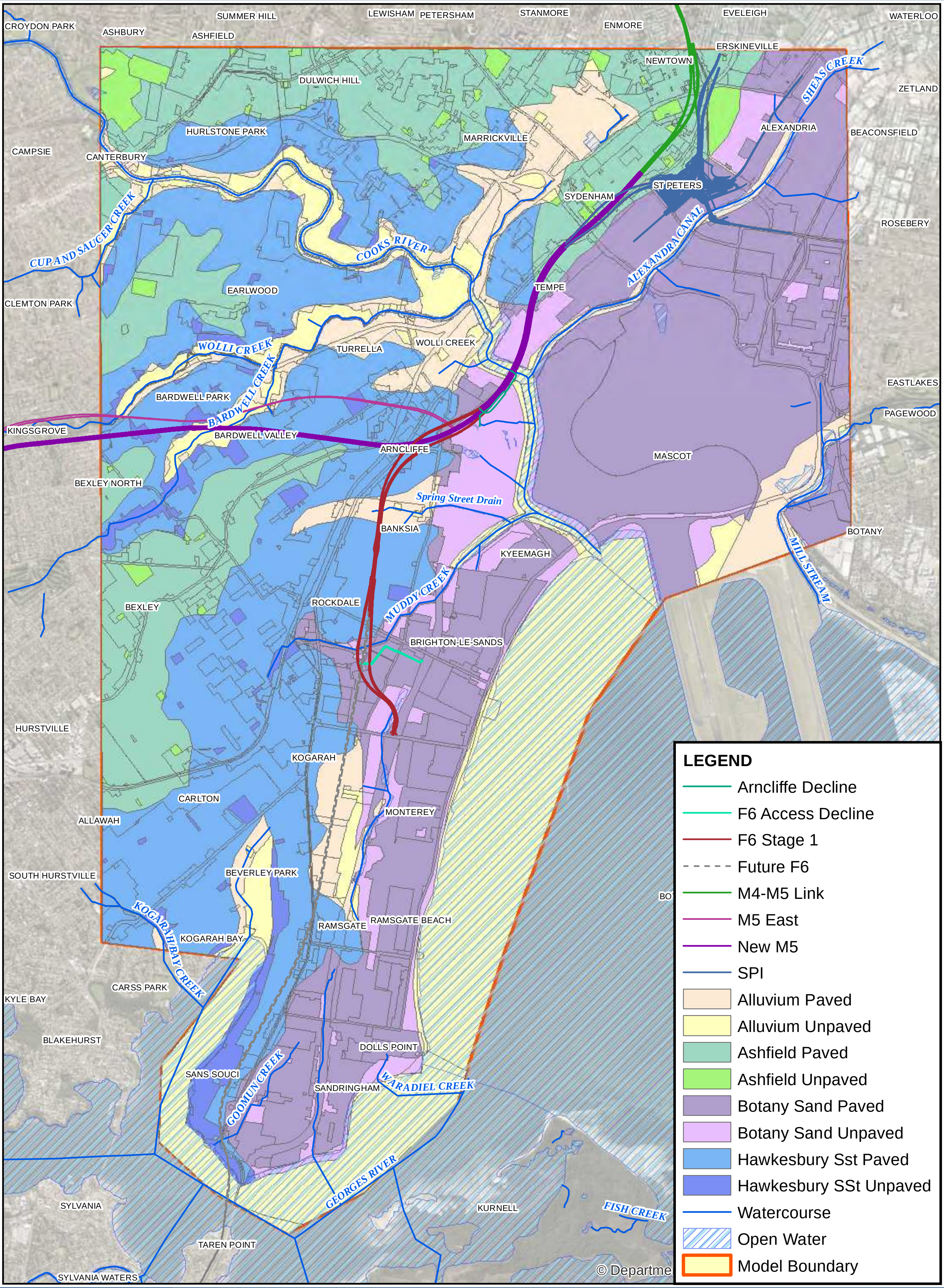
Figure 40

Model Boundary Conditions

4.4.1 Recharge

The MODFLOW Recharge (RCH) package is used to simulate diffuse rainfall recharge. Rainfall recharge has been imposed as a percentage of actual rainfall (for transient calibration) or long-term average rainfall (for steady-state calibration and prediction). Refer to the rainfall recharge analysis and discussion in Section 3.7.6.

Spatially and temporally variable groundwater recharge rates were applied to the groundwater model. Spatial variations are based on the outcropping hydrogeological units (Botany Sands, Alluvium, Ashfield Shale and Hawkesbury Sandstone). These are then divided into further zones based on paved vs unpaved areas identified from open-source land use data (DP&E, 2016), giving a total of eight recharge zones, as shown in Figure 41. No differentiation of paved areas into density of urbanisation/use has been attempted, nor specific recharge due to stormwater drainage pipes/culverts/channels, as this is difficult to quantify both volumetrically and spatially. Any leakage from the urban infrastructure is assumed to balance out with overall recharge estimation.



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GDA 1994 MGA Zone 56

0 250 500 1,000 1,500 2,000 m

Figure 41

Model Recharge Zones

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Temporal variation to recharge for the transient simulation has been calculated using the ratio between actual observed monthly rainfall data and the long term monthly/annual averages, with resulting multipliers applied to the steady-state recharge as per Figure 42.

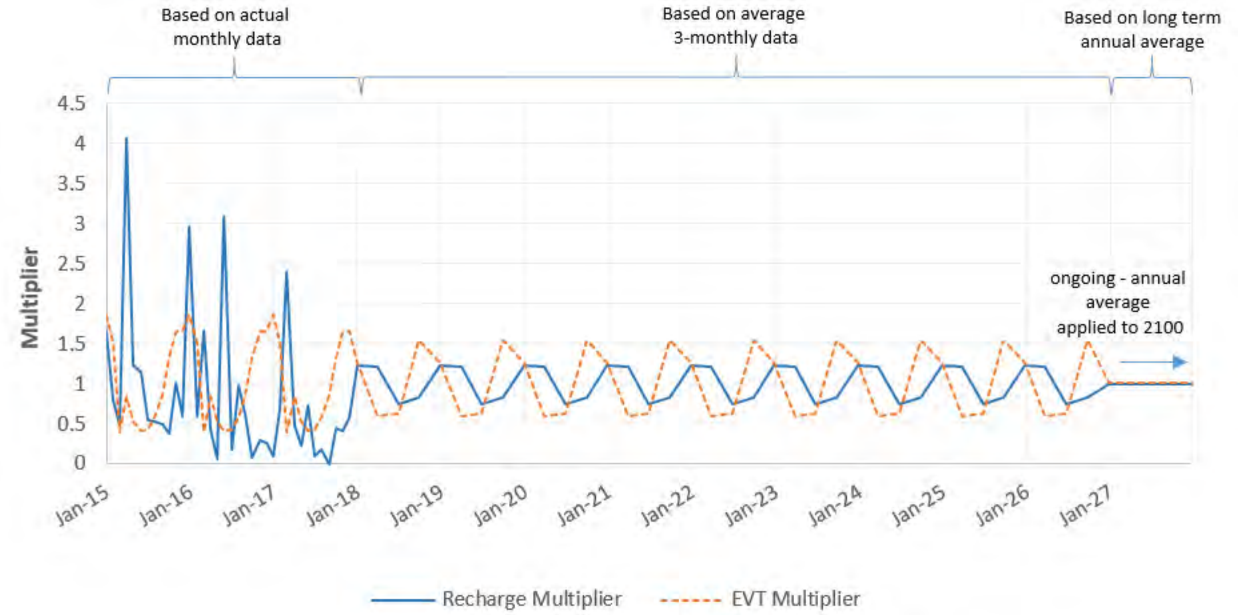

Figure 42 Recharge and Evapotranspiration Transient Multipliers

4.4.2 Evapotranspiration from Groundwater

The MODFLOW Evapotranspiration (EVT) package was used to simulate evapotranspiration from the groundwater system. Extinction depths were set to 0.5 m below ground across most of the model domain to reflect the reduced evapotranspiration in paved areas, and extinction depths of 1 m for open grassland areas and 5 m for forested areas (based upon average rooting depths reported in Canadell (1996)). Maximum potential rates were set using potential evapotranspiration values and transient multipliers in the same manner as described above for recharge.

4.4.3 Watercourses

The watercourses in the area are mostly lined channels designed to rapidly transmit surface water runoff and shallow groundwater drainage out of the urbanised areas. Major lined channels include Cooks River, Alexandra Canal, Muddy Creek and the lower reaches of Wolli Creek. These lined channels are established as “River” cells in model Layer 1 (denoted by green cells in Figure 40) using the MODFLOW RIV package, with the river stage equal to the river bed elevation (set at the topographic surface). This allows water to flow unrestricted into the channel from the aquifer if/when the groundwater level reaches the ground surface, but not allowing unrestricted leakage out of the channels, effectively acting as “drains”.

It is assumed some leakage will occur from these lined channels due to the deterioration of the lining (disintegration, cracking, root damage etc). A second set of RIV boundary cells has been applied beneath the aforementioned freely draining cells to enable the model to simulate minor recharge from the lined channels. Leakage from the channels has been restricted by using a channel conductance equivalent to a hydraulic conductivity of 0.001m/day, approximately 3 orders of magnitude lower than the hydraulic conductivity of the alluvium. Unlined rivers (upper Wolli Creek, Bardwell Creek, Kogarah Bay Creek, Bado-

Berong Creek and Goomun Creek) have bed conductance values equivalent to a hydraulic conductivity of 0.1 m/day (roughly one order of magnitude lower than the hydraulic conductivity of alluvium) as they have unmodified (natural) banks. Due to the lack of surface water gauge levels, river stage elevations have been estimated across the model, with an average stage of 2 m applied in channels known to be influenced by the tide, 0.5 m in non-tidal major channels, and 0.1 m in minor channels. Seasonal fluctuations in stage have been applied using the same multipliers applied for recharge, with stage fluctuations scaled to rise/fall by up to 0.5m. The river bed (base of channel) elevation is set as 2 m below topography for all drainage channels.

Major water bodies including Georges River and Botany Bay were represented using constant head (CHD) boundary conditions of 0.3 m AHD to represent mean annual tide (shown in blue in Figure 40).

4.4.4 Regional Groundwater Flow

The model perimeter is set as a ‘no-flow’ boundary by default, except where regional groundwater flow is likely to enter or leave the active model area in which case a general head boundary (GHB) is specified. The GHB boundary condition is used to represent the regional flow into and out of the model area and has been assigned using GHBs in Hawkesbury Sandstone model layers 4, 6 and 8 using the relationship of observed water level to topography for bores screened in the relevant layer (as per equations in Figure 43). Groundwater will enter the model where the head set in the GHB is higher than the modelled head in the adjacent cell and leave the model when the water level is lower in the GHB. Conductance is calculated using the modelled hydraulic conductivity of the Hawkesbury Sandstone multiplied by the cell area and is therefore variable in this model due to variable cell-size.

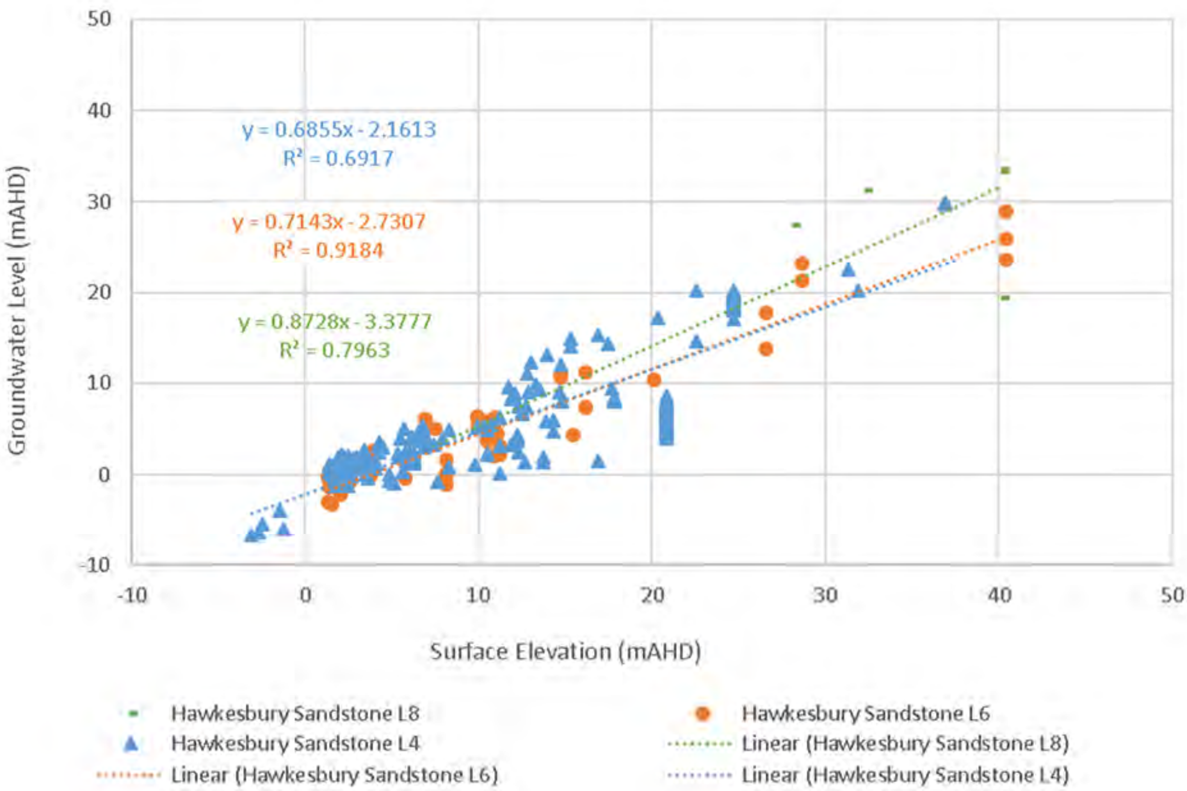

Figure 43 Relationship Between Topography and Water Level in the Hawkesbury Sandstone

4.4.5 Groundwater Use

Groundwater abstraction has been historically carried out at Alexandria Landfill near to the WestConnex St Peters Interchange location. At this site, pumping is known to have occurred since 2001 to mid-2017, at a rate of about 0.18 ML/day. Water level monitoring carried out for this project shows the drawdown effect of this pumping (AECOM, 2017). In order to calibrate the groundwater model to this data, it was therefore necessary to include the two extraction wells situated in the Botany Sands to the east of the landfill, and the pumping from the landfill sump which collects leachate from the waste as well as drainage from the Ashfield Shale and Botany Sands (Figure 44). The rates applied to each of these extraction points is given in Table 13.

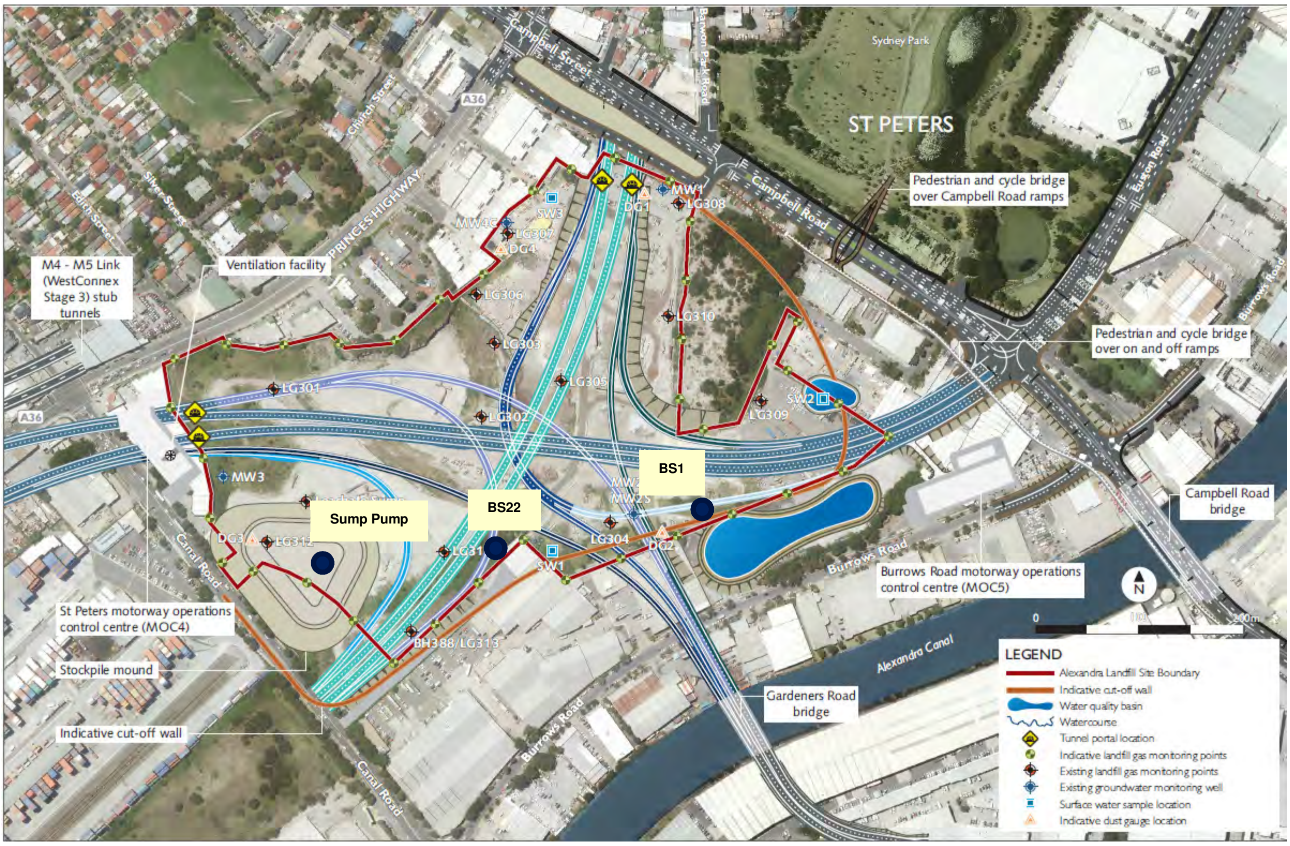

Figure 44 Alexandria Landfill Layout and Proposed Cut-Off Wall Alignment

Table 13 Modelled Extraction Rates from Alexandria Landfill

Bore	Pre-July 2017 Abstraction Rate (ML/day)	Post-July 2017 Abstraction Rate (ML/day)
BS1	0.018	0
BS2	0.025	0
Sump Pump	0.14	0.1
Total	0.183	0.10

As part of the preparation for development of the St Peters Interchange, a cut-off wall has been established on the eastern side of the landfill to minimise ingress of water from the Botany Sands. Pumping is now discontinued from the Botany Sands bores and leachate pumping will be reduced to approximately 0.1 ML/day. Inclusion of the cut-off wall has been incorporated into the modelling by the use of a reduced hydraulic conductivity zone implemented with the Time-Variant Materials (TVM) package developed by HydroAlgorithmics that is available with the MODFLOW-USG-Beta code. The Hydraulic Flow Barrier (HFB) package in MODFLOW could not be used to represent the cut-off wall due to the inability to turn this feature on part way through the model simulation. The cut-off wall has a design hydraulic conductivity of 1.0E-08 m/sec (8.6E-04 m/day) which was applied in the model zone used to represent the wall. Pumping from the Botany Sands bores was turned off simultaneously with the addition of the cut-off wall, at an assumed date of July 2017.

Groundwater abstraction from other bores (from mainly within the Botany Sands) has not been included in the modelling due to lack of abstraction data. Groundwater abstraction across the model area is expected to be very low due to the current embargo on pumping from the Botany Sands, and it is likely that any operational bores have very localised drawdowns that will not significantly impact model results.

4.4.6 Tunnel Workings

“Drain” (DRN) cells are used to represent the tunnel alignment. Invert levels were determined from CAD design files provided by AECOM, with the invert level of the DRN cell calculated to be the minimum elevation of all features on the design files that are positioned within each model cell. For F6 Stage 1, the minimum elevation of modelled tunnel is -75 mAHD, with the deepest areas located where the tunnels join into and pass under the New M5 tunnels. The deepest point for the New M5 is also -75 mAHD at Arncliffe. The timing for activating the drain cells in the model was based on the time-chainage progression of F6 (Figure 45).

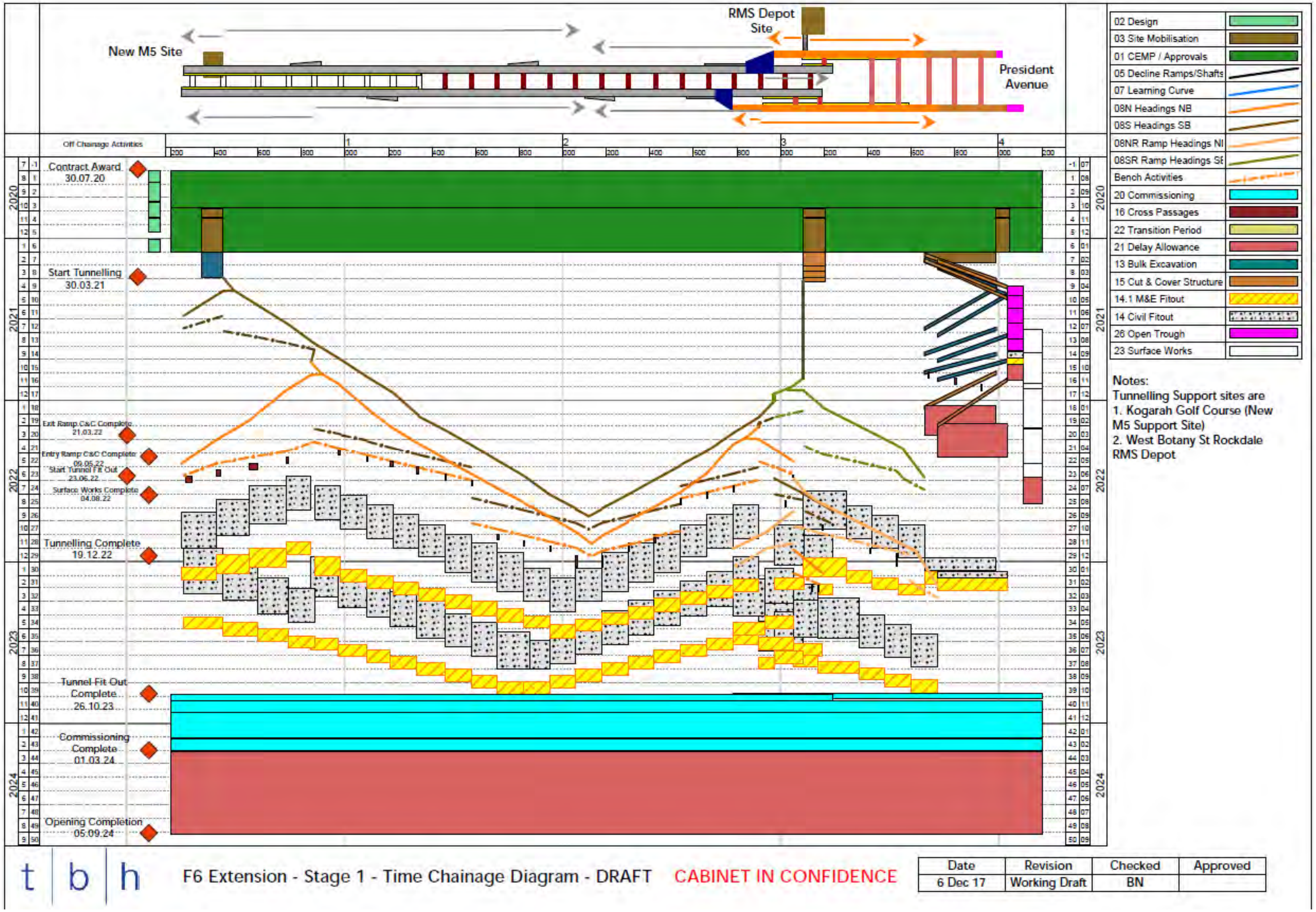

Figure 45 F6 Time-Chainage Progression

The existing M5 East tunnel opened in 2001, therefore it is considered likely that the drawdown associated with the long-term inflows to the tunnel will have begun to approximate steady-state levels. Thus, the M5 East tunnel drains were included in the steady-state model simulation, and throughout the entire transient simulation.

Actual construction progression for the New M5 to January 2018 was included as provided by the construction contractor, and future progression of tunnelling for the New M5 and M4-M5 Link projects interpreted from the relevant published Environmental Impact Statements (EIS). The Arncliffe decline constructed as part of the construction phase for the New M5 is proposed to be further utilised for the construction of F6 Stage 1. The New M5 specific portion of the decline (extending in the direction of St Peters under Cooks River) will be decommissioned (backfilled) post the completion of the New M5 (circa end 2019). The remaining portion of the decline that connects to the F6 tunnel stubs will be decommissioned at the end of Project construction.

The conductance of the DRN cells associated with tunnels was set to constrain inflows to 1 L/sec/km for drained mainline tunnels and ramps as per the conditions of approval set for the WestConnex and NorthConnex works. A 1L/sec/km inflow rate has also been assumed for the Arncliffe decline for its period of operation (2017 – 2024). The drained portion of the F6 access decline from the RMS depot has an allowed inflow design of up to 2 L/sec/km, and will continue to be free-draining for the duration of tunnel operation.

It is assumed that areas of high inflow will be shotcreted during construction (AECOM, 2017). The minimum drain conductance applied to constrain the inflows was 0.01 m^2/day. In general, drain conductance only required constraining in areas where the tunnels pass beneath unconsolidated sediments (e.g. alluvial channels and Botany Sands). Sections of the tunnels proposed to be tanked or sealed via a diaphragm wall (cut and cover and slotted design, as per Figure 35) were assumed to have zero inflows. Diaphragm walls installed alongside the slotted and cut and cover tunnel sections will be installed from surface to rock (i.e. through the full vertical profile of unconsolidated sediments), and will therefore form a hydraulic flow barrier in the unconsolidated sediments. These have been simulated in the model in the same fashion as the cut-off wall at Alexandria Landfill, using the TVM package to reduce the horizontal conductivity of the relevant model cells in model Layer 1 to 8.6E-04 m/day. This has not been applied for tanked tunnel sections as it is assumed groundwater will be able to flow around (above and below) the tunnel.

4.5 Model Calibration

4.5.1 Steady State Calibration

Steady-state calibration was undertaken using the automated calibration utility PEST (Doherty, 2010) with 221 groundwater targets. Manual parameter tweaking was then undertaken to ensure the calibrated parameters were consistent with the conceptual understanding of the hydrogeological system, most specifically with the trend of declining hydraulic conductivity with depth. Calibration focused on both horizontal and vertical hydraulic conductivity, with parameter bounds informed as per Table 14. Vertical hydraulic conductivity was calibrated as a factor of horizontal conductivity (K_V/K_H) with a maximum ratio of 0.5 to represent the reduced vertical hydraulic conductivity typically observed due to sedimentary layering in the Hawkesbury Sandstone and Ashfield Shale.

Table 14 Parameter Calibration Limits Used During PEST Calibration

Layer	Zone	Units	Depth Below Ground (m)	Initial K_H (m/day)	Min K_H (m/day)	Max K_H (m/day)	Initial K_V (m/day)	Allowed K_V/K_H Ratio
1	10	Alluvium	Any	1.0E+00	1.0E-02	1.0E+01	5.0E-02	*0.1 to 0.001*
1	11	Botany Sands	Any	2.0E+01	1.0E-02	3.0E+01	2.0E+01	*0.1 to 0.001*
1	12	Regolith	Any	1.0E-01	1.0E-03	1.0E+00	1.0E-02	*0.1 to 0.001*
2-3	21	Ashfield Shale	<10	2.0E-02	1.0E-04	1.0E-01	2.0E-03	*0.1 to 0.001*
2-3	22	Ashfield Shale	10 - 20	5.0E-03	1.0E-04	1.0E-01	5.0E-04	*0.1 to 0.001*
2-3	23	Ashfield Shale	20 - 40	4.0E-03	2.0E-04	2.0E-01	4.0E-04	*0.1 to 0.001*
2-3	24	Ashfield Shale	40 - 60	2.0E-03	2.0E-05	2.0E-01	2.0E-04	*0.1 to 0.001*
2-3	25	Ashfield Shale	>60	1.0E-03	5.0E-05	5.0E-01	1.0E-04	*0.1 to 0.001*
4-8	41	Hawkesbury Sandstone	<10	4.0E-02	5.0E-04	5.0E-01	4.0E-03	*0.5 to 0.001*
4-8	42	Hawkesbury Sandstone	10 - 20	8.0E-03	5.0E-04	5.0E-01	8.0E-04	*0.5 to 0.001*
4-8	43	Hawkesbury Sandstone	20 - 40	6.0E-03	5.0E-04	5.0E-01	6.0E-04	*0.5 to 0.001*
4-8	44	Hawkesbury Sandstone	40 - 60	3.0E-03	5.0E-04	5.0E-01	3.0E-04	*0.5 to 0.001*
4-8	45	Hawkesbury Sandstone	60 - 80	2.0E-03	5.0E-04	5.0E-01	2.0E-04	*0.5 to 0.001*
4-8	46	Hawkesbury Sandstone	80 - 100	1.0E-03	5.0E-04	5.0E-01	1.0E-04	*0.5 to 0.001*
4-8	47	Hawkesbury Sandstone	>100	8.0E-04	5.0E-04	5.0E-01	8.0E-05	*0.5 to 0.001*

Storage parameters are not required during steady-state calibration. Recharge was calibrated as per Table 15.

Table 15 Recharge Table Values Used in Steady-State

Recharge Zone	mm/yr	m/day	% rain
Alluvium (unpaved)	150	4.11E-04	13.6
Alluvium (paved)	100	2.74E-04	9.1
Sandstone (Unpaved)	70	1.92E-04	6.4
Sandstone (paved)	40	1.10E-04	3.6
Shale (unpaved)	40	1.10E-04	3.6
Shale (paved)	20	5.48E-05	1.8
Botany Sands (unpaved)	280	7.67E-04	25.5
Botany Sands (paved)	180	4.93E-04	16.4

The conductance of the M5 East Motorway drain cells was varied during calibration to obtain a flow of approximately 0.8 to 0.9 L/sec/km (as per Hewitt, 2005 (see Section 3.7.5)).

Calibrated parameters are shown in Table 16. Relative sensitivity of model calibration to each of the parameter zones is shown in Figure 46 (as calculated by PEST using Jacobian sensitivity matrices), indicating that the horizontal and vertical hydraulic conductivity of the Hawkesbury Sandstone particularly at the depth interval of 40 m – 80 m below ground level tends to dominate the calibration results. The horizontal conductivity of the unconsolidated sediments (alluvium and Botany Sands) also has a strong influence on calibration. This sensitivity is biased due to the large number of calibration targets in these model zones relative to others.

Table 16 Steady-State Calibrated Parameters

Layer	Zone	Units	Depth Below Ground (m)	Calibrated K_H	Calibrated K_V
1	10	Alluvium	Any	6.85E-01	3.43E-01
1	11	Botany Sands	Any	1.85E+01	1.80E+01
1	12	Regolith	Any	1.00E+00	1.00E-01
2-3	21	Ashfield Shale	<10	5.00E-02	5.00E-03
2-3	22	Ashfield Shale	10 - 20	5.00E-03	5.00E-04
2-3	23	Ashfield Shale	20 - 40	4.00E-03	4.00E-04
2-3	24	Ashfield Shale	40 - 60	2.00E-03	2.00E-04
2-3	25	Ashfield Shale	>60	1.00E-03	1.00E-04
4-8	41	Hawkesbury Sandstone	<10	2.00E-01	2.53E-02
4-8	42	Hawkesbury Sandstone	10 - 20	2.00E-02	6.00E-03
4-8	43	Hawkesbury Sandstone	20 - 40	8.00E-03	3.00E-03
4-8	44	Hawkesbury Sandstone	40 - 60	5.00E-03	1.00E-03
4-8	45	Hawkesbury Sandstone	60 - 80	3.00E-03	5.00E-04
4-8	46	Hawkesbury Sandstone	80 - 100	2.00E-03	2.00E-04
4-8	47	Hawkesbury Sandstone	>100	9.00E-04	1.50E-04

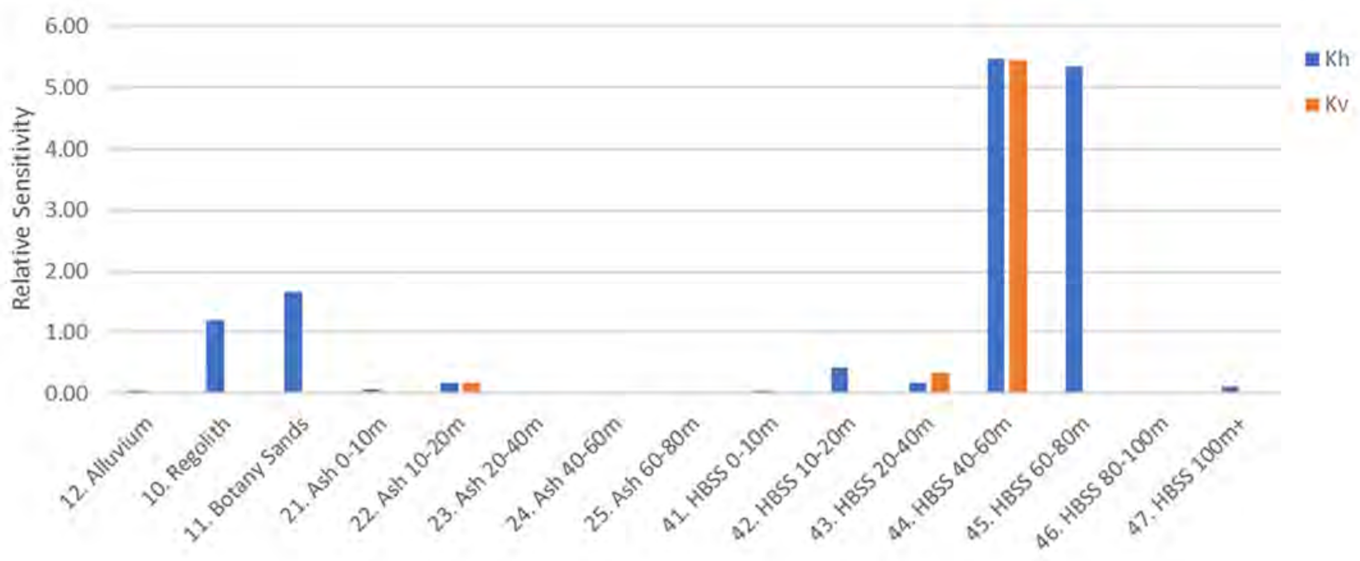

Figure 46 Relative Parameter Sensitivity as Determined by PEST

Figure 47 shows the calibrated hydraulic conductivity values relative to field and laboratory testing data. Hydraulic conductivity values simulated for the Hawkesbury Sandstone approximate the mean of packer test results obtained along the F6 Extension and New M5 project alignments. Hydraulic conductivity of the Ashfield Shale is approximately half an order of magnitude lower than that from packer testing along the M4-M5 Link.

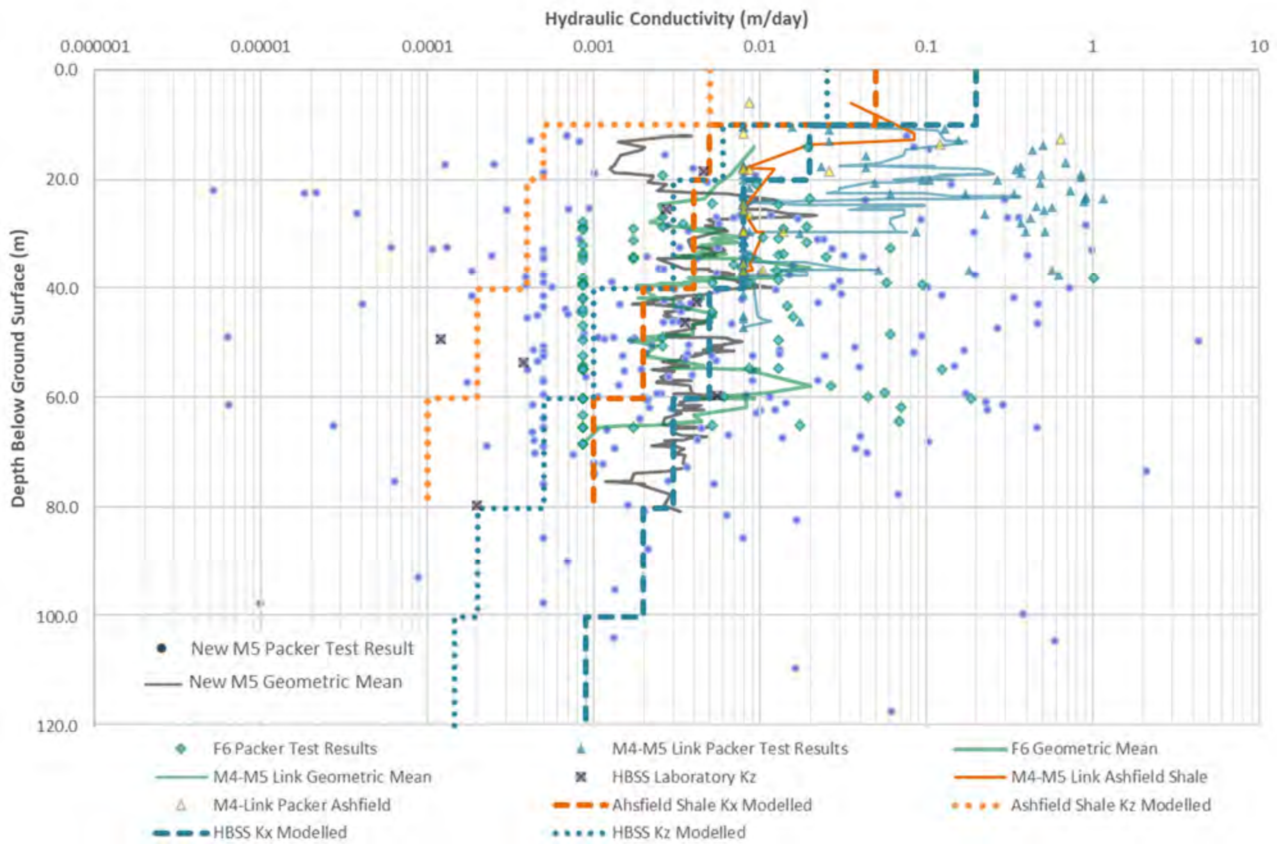

Figure 47 Modelled Versus Measured Hydraulic Conductivity

4.5.2 Calibration Statistics

Steady-state calibration was assessed against groundwater levels provided by AECOM for the Project, as well as those collated from WestConnex tunnelling projects. Water levels recorded in the NGIS database / Pinneena were also used. Some quality analysis of calibration targets was undertaken and dubious targets were removed. Key reasons for selected target removal include:

- locations where the only water level record was taken on the date of borehole drilling in the Ashfield Shale and Hawkesbury Sandstone (as slow recovery to standing water level is expected in these sediments)
- where there were two or more levels within the same borehole at similar times with significantly different readings (likely to be due to water quality sampling and/or aquifer testing)
- where there is uncertainty regarding which model layer the bore is monitoring due to lack of details regarding borehole depth/screen interval
- Water levels recorded prior to 2001 (M5 East tunnel operation) were removed

After quality checking the targets, 229 water levels were used in the steady-state calibration. Resulting calibration statistics for the steady-state simulation are shown in Table 17 and average residuals for each model layer are shown in Table 18.

The scaled RMS error is 4.5% and is satisfactory according to the suggested statistical target below 5% to 10% indicated in groundwater modelling guidelines (MDBC, 2001 and Barnett *et al.*, 2012) to indicate "goodness of fit". The lower the scaled RMS error the closer match between modelled and observed water levels. Most of the RMS error comes from the Hawkesbury Sandstone, which is primarily due to the majority of targets being within the Hawkesbury Sandstone. No layers consistently over or under predict groundwater elevation, and it is probable that the monitored heads in the Hawkesbury Sandstone show local variations (due to it being a multi-layered aquifer system) that have not been represented in the regional scale of the model.

Table 17 Steady-State Calibration Statistics (from model run F6_TR38_SP1)

Statistic	Value
Residual Mean (m)	0.01
RMS Error (m)	1.37
Minimum Residual (m)	-3.9
Maximum Residual (m)	4.84
Scaled RMS Error	4.5%
% Targets within ±1m	63%
% Targets within ±2m	83%
% Targets within ±5m	100%

Table 18 Average Residual by Model Layer

Model Layer	Formation	Average Residual (m)	Number of Locations
1	Fill, Regolith, Alluvium, Botany Sands	-0.05	51
2	Ashfield Shale	0.87	8
3	Ashfield Shale	-0.34	16
4	Hawkesbury Sandstone	0.10	88
5	Hawkesbury Sandstone	0.19	23
6	Hawkesbury Sandstone	0.40	12
7	Hawkesbury Sandstone	-0.64	19
8	Hawkesbury Sandstone	-0.17	19
9	Hawkesbury Sandstone	NA	NA

Negative residuals indicate modelled heads higher than measured, positive indicate modelled heads lower than measured.

A graphical plot of observed vs modelled water levels is shown in Figure 49. Calibration residuals have a slight skew towards negative residuals (Figure 49), indicating a small tendency in the model for predicting water levels higher than observed, however predicted water levels at higher elevations are typically simulated slightly lower than observed. Predictions within ±2 m of target levels are distributed evenly across the model domain (Figure 50).

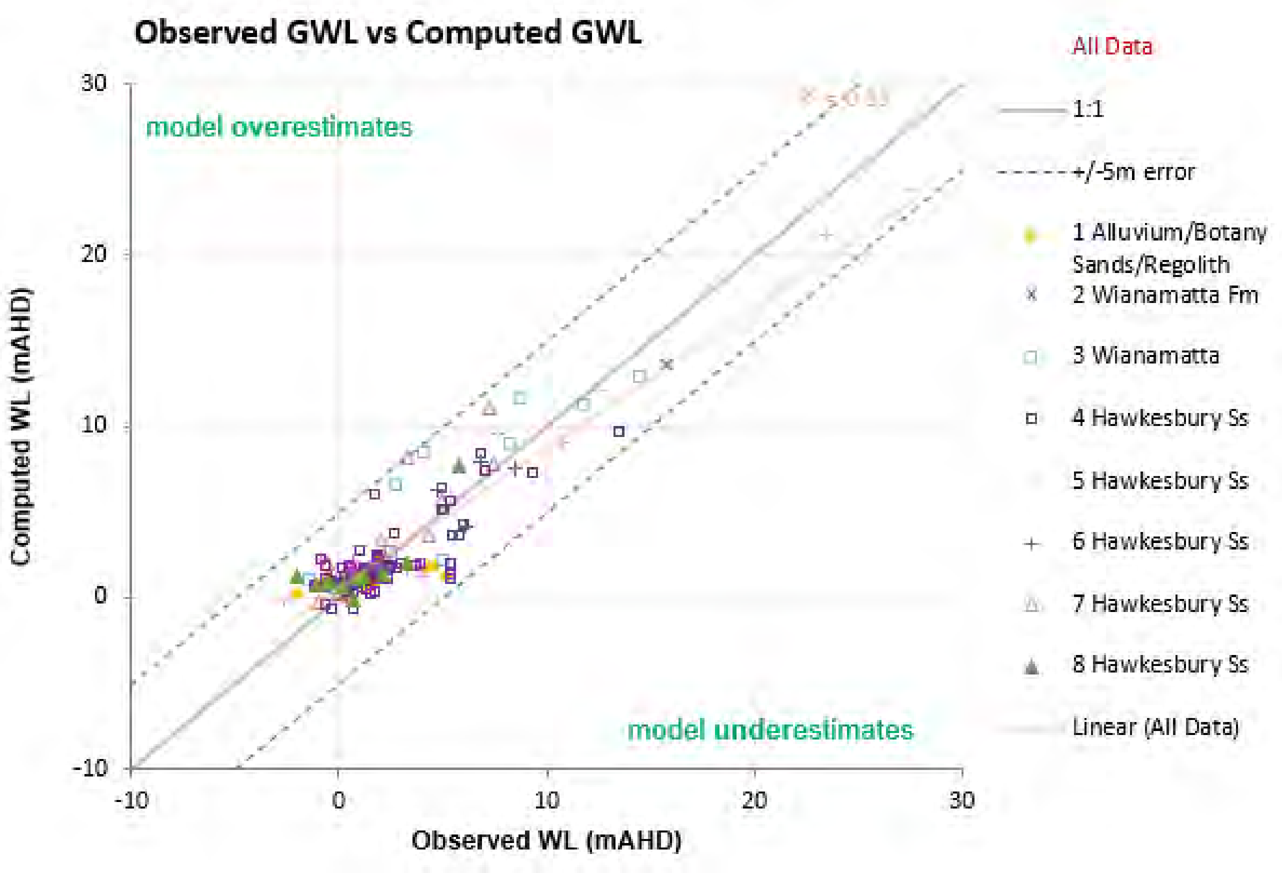

Figure 48 Plot of Observed Vs Computed Water Levels for Steady-State Model

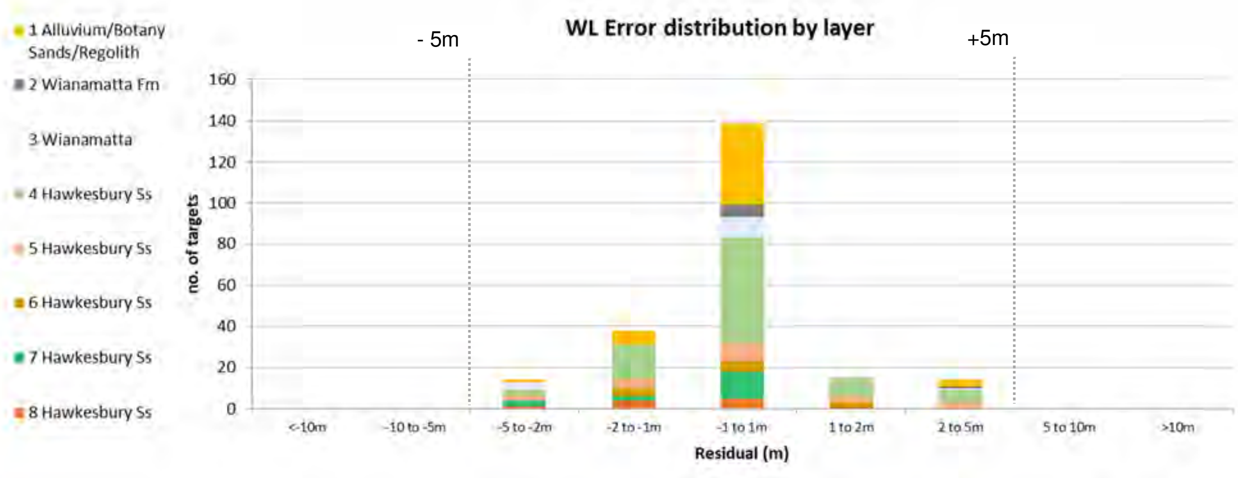

Figure 49 Residual Error Distribution for Steady-State Model

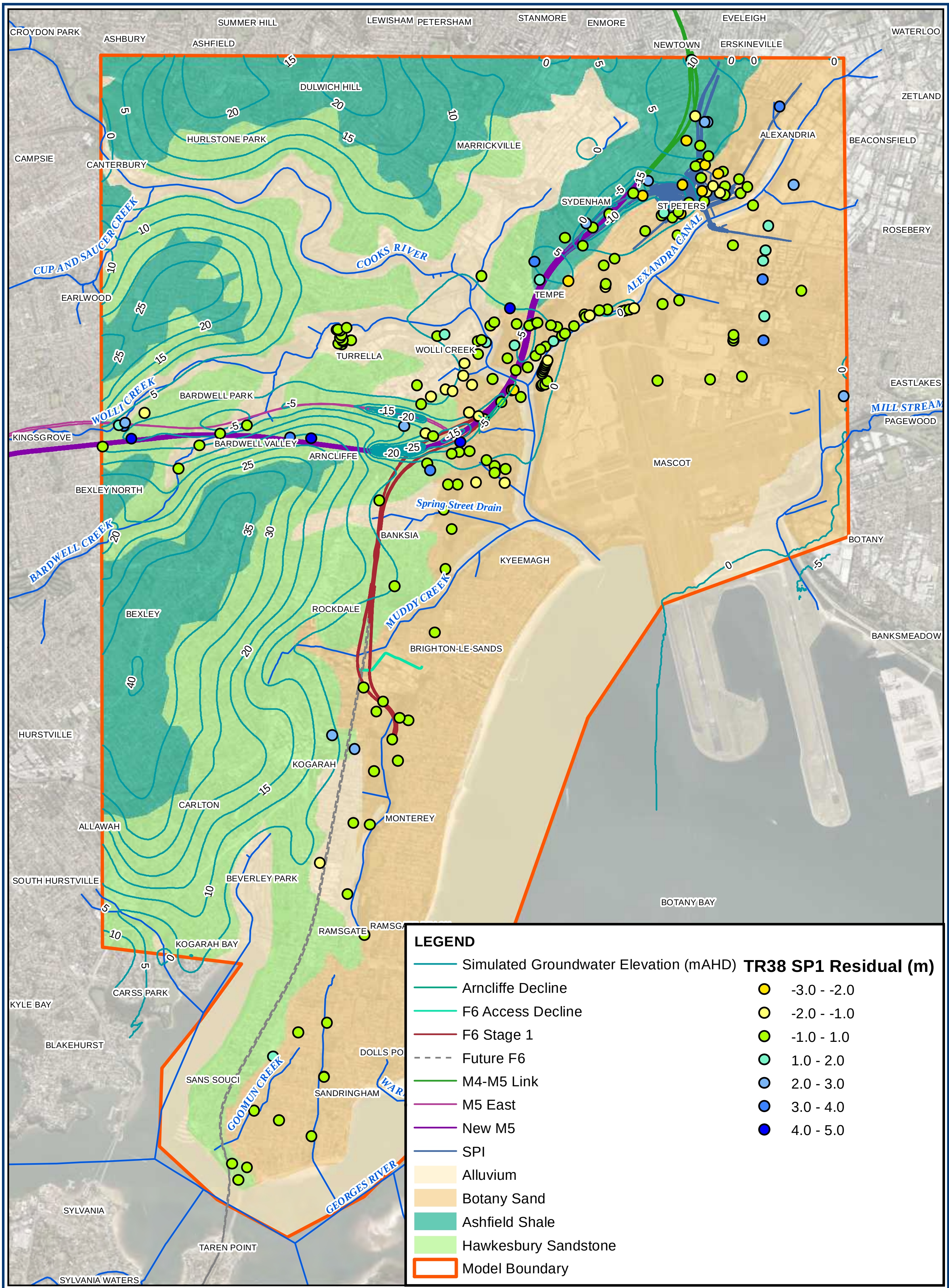

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Figure 50

Steady State Residuals

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4.5.3 Steady-State Water Balance

The water balance for the steady-state simulation is presented in Table 19. It can be observed that the majority of recharge to the groundwater system is direct rainfall recharge (85%), with an 11% contribution from river leakage and the remainder from regional boundary flow. Evapotranspiration removes approximately half (56%) of the water from the system, with outflow to rivers/drainage channels equal to 19% of total outflow. Regional outflow and flow to tidal areas are 12% and 5% respectively.

Outflow to drains (in this case solely representing M5 East) is 0.32ML/day, which equals 3.7 L/sec. The modelled length of the M5 East is approximately 4 km, thus this volume of flow represents 0.92 L/sec/km of tunnel, which is consistent with the long term inflows of 0.8 to 0.9 L/sec/km reported by Hewitt (2005).

The model water balance indicates that the man-made impacts to the groundwater system (i.e. drainage to the M5 East tunnel and pumping at Alexandria Landfill) are very small compared to the natural recharge and discharge processes.

Table 19 Steady-State Model Water Balance

Water Balance Parameter	Inflow (ML/day)	Outflow (ML/day)
Recharge (RCH)	5.15	0
ET (from GW) (EVT)	0.00	3.4
GW Extraction Alexandria Landfill (WEL)	0.00	0.04
SW-Aquifer Interaction Rivers/Channels (RIV)	0.65	1.14
Regional GW Flow (GHB)	0.12	0.39
Tidal Areas (CHD)	0.11	0.74
Tunnels (DRN)	0.00	0.32
Storage	NA	NA
Total	6.03	6.03
% Error	0.00	0.00

CHD = Constant Head Boundary GHB = General Head Boundary

4.5.4 Transient Calibration

Transient calibration was performed for the period January 2015 to December 2017 using monthly stress periods. The use of these periods allows the groundwater model to replicate the transitional behaviour of key groundwater hydrographs with seasonal fluctuations. In all, 567 target heads were established for 50 sites.

Due to limited data for transient calibration, hydraulic conductivity parameters calibrated in the steady-state model were held constant for transient calibration, while calibration was attempted using only changes to specific storage (Ss) and specific yield (Sy) (Table 20). Recharge was set to vary with time using the multiplication factors calculated from monthly rainfall (Section 4.4.1).

Table 20 Calibrated Storage Parameters (F6_TR38)

Layer	Zone	Units	Depth Below Ground (m)	Calibrated Ss (m^{-1})	Calibrated Sy
1	10	Alluvium	Any	2.0E-04	1.0E-01
1	11	Botany Sands	Any	1.0E-04	2.0E-01
1	12	Regolith	Any	1.0E-05	1.0E-01
2-3	21	Ashfield Shale	<10	1.0E-05	1.0E-02
2-3	22	Ashfield Shale	10 - 20	1.0E-05	1.0E-02
2-3	23	Ashfield Shale	20 - 40	1.0E-05	1.0E-02
2-3	24	Ashfield Shale	40 - 60	1.0E-05	1.0E-02
2-3	25	Ashfield Shale	>60	1.0E-05	1.0E-02
4-9	41	Hawkesbury Sandstone	<10	2.0E-06	1.0E-02
4-9	42	Hawkesbury Sandstone	10 - 20	2.0E-06	1.0E-02
4-9	43	Hawkesbury Sandstone	20 - 40	2.0E-06	1.0E-02
4-9	44	Hawkesbury Sandstone	40 - 60	2.0E-06	1.0E-02
4-9	45	Hawkesbury Sandstone	60 - 80	2.0E-06	1.0E-02
4-9	46	Hawkesbury Sandstone	80 - 100	2.0E-06	1.0E-02
4-9	47	Hawkesbury Sandstone	>100	2.0E-06	1.0E-02

Resulting calibration statistics for the transient simulation are shown in Table 21 and average residuals are shown in Table 22. The model scaled RMS is 6.2%, again considered a good fit using statistical targets suggested by the MDBC (2001) and Barnett et al. (2012). The calibration scatter plot is shown in Figure 51 and the distribution of error by layer in Figure 52. The spatial distribution of residuals is shown in Figure 53. Transient calibration hydrographs are presented in Appendix A.

Table 21 Transient Calibration Statistics (from Model Run F6_TR38)

Statistic	Value
Residual Mean (m)	0.20
RMS Error (m)	1.25
Minimum Residual (m)	-3.52
Maximum Residual (m)	4.75
Scaled RMS Error	6.2%
% Targets within ±1m	66%
% Targets within ±2m	83%
% Targets within ±5m	100%

Table 22 Average Residual by Model Layer (from Model Run F6_TR38)

Model Layer	Formation	Average Residual (m)	Number of Observations
1	Fill, Regolith, Alluvium, Botany Sands	0.28	208
2	Ashfield Shale	NA	NA
3	Ashfield Shale	0.01	49
4	Hawkesbury Sandstone	0.42	27
5	Hawkesbury Sandstone	-0.40	7
6	Hawkesbury Sandstone	0.77	85
7	Hawkesbury Sandstone	-0.62	106
8	Hawkesbury Sandstone	0.57	85
9	Hawkesbury Sandstone	NA	NA

Negative residuals indicate modelled heads higher than measured, positive indicate modelled heads lower than measured.

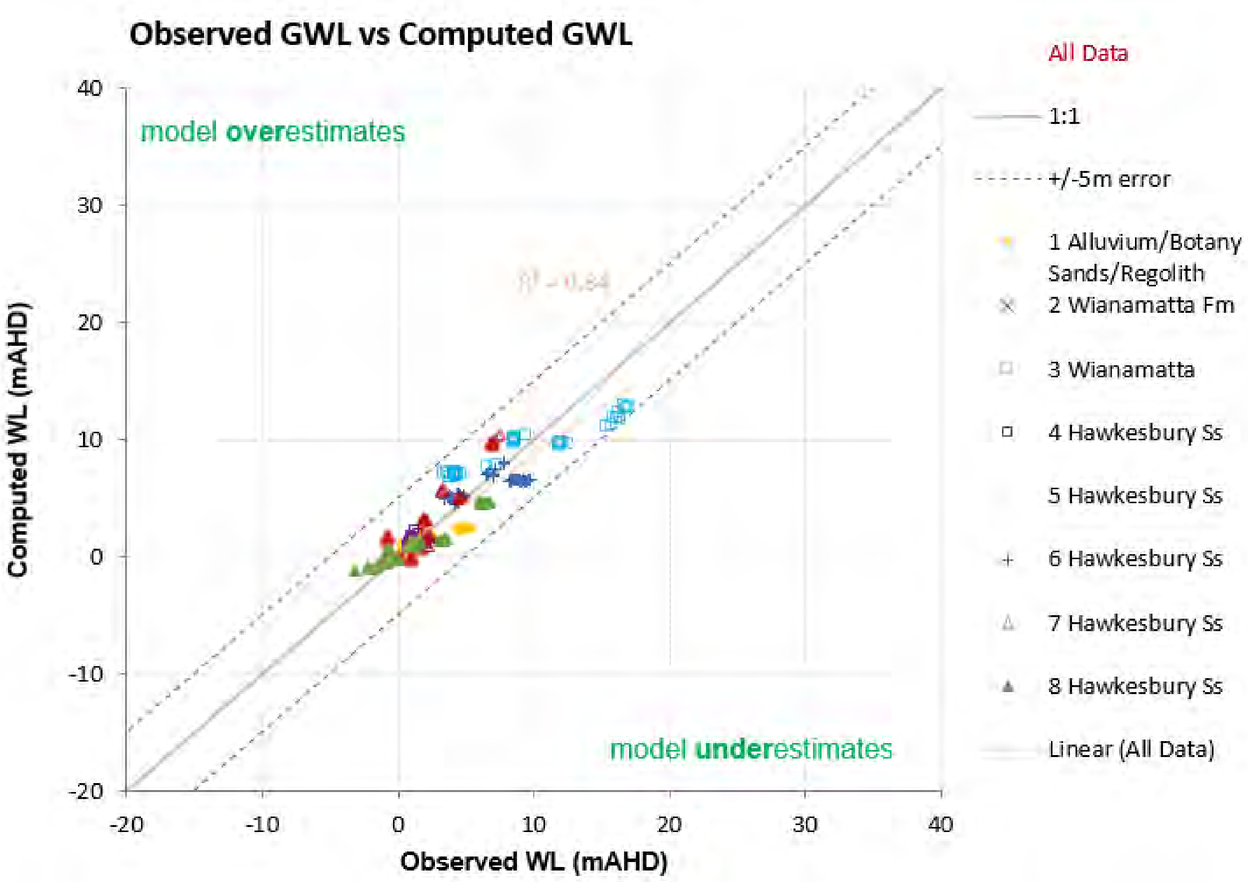

Figure 51 Plot of Observed Vs Computed Water Levels for Transient Model

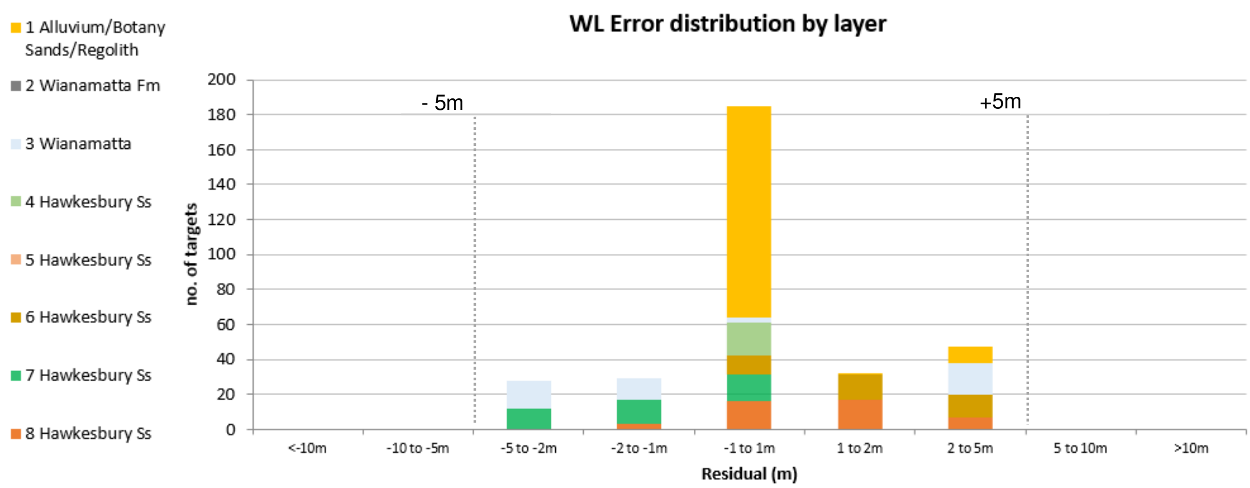

Figure 52 Residual Error Distribution for Transient Model

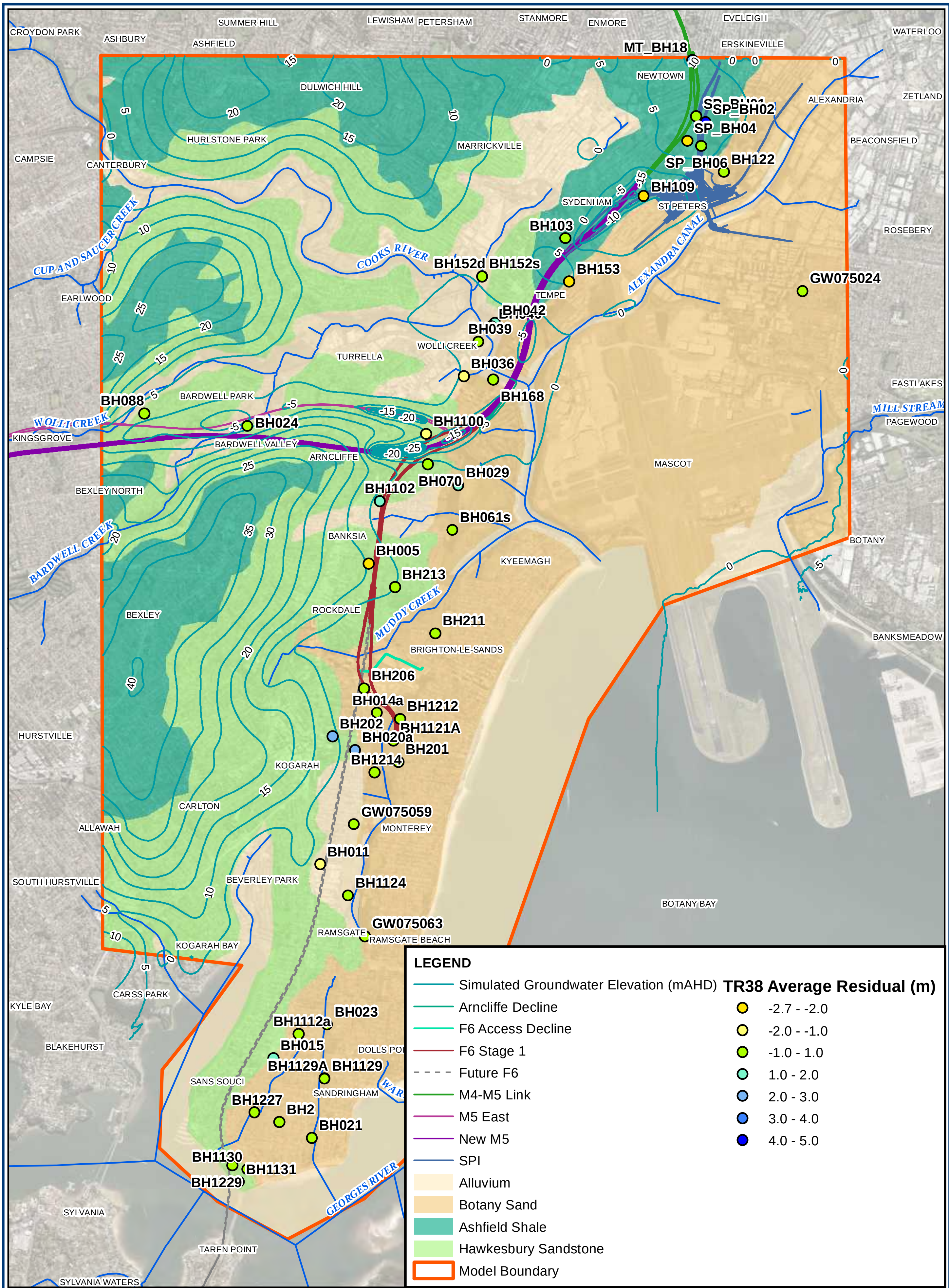

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Figure 53

Transient Residuals

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The transient calibration hydrographs (Appendix A) are plotted for the period January 2015 to December 2017 and display observed groundwater levels, modelled groundwater levels and the rainfall residual mass curve (from Sydney Airport). Sixteen hydrographs are simulated within the Botany Sands and alluvium in Layer 1. Water levels generally follow the seasonal fluctuations observed in boreholes, with simulated water levels showing an average of 0.2m to 0.5m decline over the calibration period as a result of lower than average rainfall. Three hydrographs represent groundwater trends within the Ashfield Shale (Layer 3). Modelled groundwater levels are between 1 and 3 m of the observed groundwater levels, with modelled over-predictions and under-predictions of similar magnitude in the boreholes, all located in the region of the St Peters Interchange. Although the absolute water levels are not particularly accurately modelled in the Ashfield Shale, the trend in water levels is well represented. The remainder of the hydrographs (28) simulate groundwater levels within the Hawkesbury Sandstone with 3 hydrographs representing Layer 4, 1 representing Layer 5, 4 representing Layer 6, 13 representing Layer 7, and 7 hydrographs in Layer 8. Overall the modelled hydraulic heads within the Hawkesbury Sandstone are well represented, with modelled heads within 1 m of observed heads at most locations. Some locations that appear to be affected by tunnel dewatering operations are not accurately represented in the model timing due to a mis-alignment between measured water level logger data and construction details provided by the contractor (refer to Section 3.7.3.4). Although not accurately represented in modelled water levels on a time scale, the magnitude of drawdown is similar to that which is observed, indicating the model is accurately predicting the impacts of tunnelling (based on the limited available data).

4.5.5 Transient Water Balance

The water balance for the transient simulation is presented in Table 23. Over the calibration period rainfall is typically below average, resulting in recharge lower than simulated under average (steady-state) conditions. During the calibration period 58% of the inflow to groundwater comes from rainfall recharge, while 36% of inflow comes from leakage from creeks/channels and minor regional inflow (4%). Evapotranspiration represents the major losses of water from the system (48%), with 20% baseflow to rivers, 16% discharge to tidal areas and 12% discharge to regional flow boundaries.

Average tunnel inflow (i.e. model outflow via drains) is 0.38 ML/day, including M5 East as well as minor contributions from the New M5 construction at Arncliffe and Blexley commencing towards the end of the calibration period. There is a net loss in storage which is attributable mostly to below average rainfall during the calibration period rather than loss of water to man-made stresses.

Table 23 Transient Model Water Balance (Averaged over Calibration Period Jan 2015 to Dec 2017)

Water Balance Parameter	Inflow (ML/day)	Outflow (ML/day)
Recharge (RCH)	4.35	0.00
ET (from GW) (EVT)	0.00	4.90
GW Extraction Alexandria Landfill (WEL)	0.00	0.05
SW-Aquifer Interaction Rivers/Channels (RIV)	2.68	1.98
Regional GW Flow (GHB)	0.31	1.17
Tidal Areas (CHD)	0.10	1.67
Tunnels (DRN)	0.00	0.38
Storage	5.72	3.01
Total without Storage	7.44	10.15
Storage	5.72	3.01
Total with Storage	13.16	13.16
Net change in Storage	-2.71	
% Error	0.00	0.00

CHD = Constant Head Boundary GHB = General Head Boundary

4.6 Assessment of Model Performance and Limitations

4.6.1 Model Confidence Level

Under the earlier MDBC (2001) modelling guideline, the model is best categorised as an Impact Assessment Model of medium complexity. That earlier guide (MDBC, 2001) describes this model type as follows:

> *"Impact Assessment model - a moderate complexity model, requiring more data and a better understanding of the groundwater system dynamics, and suitable for predicting the impacts of proposed developments or management policies."*

Barnett *et al.*, 2012, developed a system within the more recent modelling guidelines to classify the confidence level for groundwater models. Models are classified as Class 1, Class 2 or Class 3 in order of increasing confidence based on key indicators such as available data, calibration procedures, consistency between calibration and predictive analysis, and level of stresses. Under these guidelines, this model would be classified as a Confidence Level 2 (Class 2) groundwater model, with the following key indicators (based on Table 2-1 of Barnett *et al.*, 2012):

- Daily rainfall and evaporation data are available (Level 3 – higher than Level 2).
- Groundwater head observations and bore logs are available and with a reasonable coverage around the F6 Extension and WestConnex works, but without spatial coverage throughout the full model domain (Level 2).
- Seasonal fluctuations not accurately replicated in all parts of the model domain (Level 2).
- Scaled RMS error and other calibration statistics are acceptable (Level 3).

- Suggested use is for prediction of impacts of proposed developments in medium value aquifers (Level 2).

4.6.2 Model Limitations

Model calibration data includes up to 34 months' worth of monitoring data associated with the project and the New M5 component of WestConnex allowing a reasonable representation of baseline conditions to be established. However, limited monitoring data collected for the New M5 monitoring post the commencement of tunneling has been made available by the contractor in time for this modelling, therefore the calibration to drawdown associated with the New M5 tunneling is not well captured in the model. Additionally, the timing of tunneling activities completed to date provided by the contractor does not appear consistent with observed water levels at Arncliffe (observed drawdown begins ~2 months prior to the recorded commencement of tunneling). This may reflect an additional groundwater stress related to construction that is not represented by the model.

Tidal variations of up to 1.5 m (which occur on a bi-daily basis) are not able to be represented in a model that simulates only monthly variations in groundwater stress conditions. Therefore, it is assumed that the data used for calibration represents a median water level in areas that are tidally affected.

The use of a MODFLOW-USG unstructured grid allows optimal grid mesh design to represent tunnel workings and other key areas of interest. The groundwater model mesh is based on the design plans issued on 24 January 2018. If the final reference design contains significant changes to the tunnel depth and/or alignment, major reworking to the model would be required due to the requirement to recreate a mesh specific to the new design.

All tunnels are assumed to be constructed as unlined except where information is available to indicate areas of lining as part of the design (e.g. at shallow sections of the President Avenue on/off ramps and access decline, see Section 3.7.5 and Section 4.4.6). Any changes to this design may affect the predicted impacts from the Project.

Excavation of the tunnels is assumed to have minimal impact on the surrounding geology. No increase in hydraulic properties (conductivity or storage) are simulated in this model to zones above and/or adjacent to the tunnel. In reality the removal of rock during tunneling is likely to induce local fracturing and/or open existing fractures, however this is expected to be minimal as tunneling is proposed in competent rock, or is engineered such that the tunnel is protected from groundwater inflows where it passes through low strength rock and unconsolidated zones. Additionally, high inflow zones are to be sealed during construction to create a maximum inflow rate of 1L/sec/km, therefore for the purposes of this model any alteration to existing hydraulic properties as a result of tunneling is not important in terms of inflow volumes. Other predicted impacts (drawdowns, baseflow impacts and take from the Botany Sands) are expected to be negligibly affected by the localized increase in hydraulic conductivity.

Only major tunneling works are included in the model to induce drawdown to the water table or reduce potentiometric heads. No other interferences to the water table from pumping, dewatering activities or stormwater drainage channels is included, other than the leachate pumping at Alexandria Landfill. Similarly, recharge from leaking pipeworks, or any artificial recharge (e.g. irrigation) is not included in the model.

The scheduling of tunnel excavation within the model is a best estimate interpretation of the available data within the existing EIS documentation and preliminary draft scheduling for this Project. Information regarding New M5 tunnel progression to January 2018 has been provided and applied in the model, however future progression has been interpreted by RPS based on the current rate of tunneling as no forward scheduling was able to be obtained. No construction inflow data for the New M5 tunneling has been made available. In any case, the model is a regional model designed to simulate long-term regional impacts. It is not considered that the model accurately represents the localised inflows that are likely to be obtained during construction, therefore should not be used for the purposes of planning water management and/or grouting requirements during the construction phase. Rather, the model simulates an approximate construction scenario with enough detail to represent indicative impacts from the construction phase. Should a particular local area require more detailed assessment of groundwater drawdown and inflow, further analysis should be undertaken as part of the detailed design process.

The project design and timing may change from what has been modelled once the contractor undertakes detailed design.

5 Predictive Modelling

5.1 Modelling Approach

Three main predictive model scenarios were run:

1. Scenario 1: A 'No-Project' or 'Null' run (as per Barnett *et al.*, 2012), without the F6 Extension (or any of the stages of WCX works) but including the existing tunnel M5 East. Hereafter referred to as the 'Null' run or condition.
2. Scenario 2: "Null" run plus the current approved WCX tunnelling (M4 East, New M5 and M4-M5 Link).
3. Scenario 3: A run the same as Scenario 2 but including the current project (F6 Extension Stage 1).

Comparison of these three runs then allows project-specific and cumulative impact assessment to be carried out. Construction of the New M5 has already commenced, however it is not considered appropriate to include this as part of the 'Null' run as construction is ongoing and it is not expected that groundwater levels have reached equilibrium.

The Aquifer Interference Policy requests impact assessments to be carried out inclusive of all stresses to the groundwater condition that are known to exist at the time of assessment, therefore in the following sections the cumulative model inclusive of the existing and future WestConnex tunnelling is considered representative of the expected changed groundwater regime. Where appropriate the impacts specific to the Project are quantified for its relative contribution.

All models use the calibrated transient historical period, as described in Section 4.5.4, as a run-in precursor to the predictive simulation period. Climate conditions are simulated consistent with average historical conditions, as per Section 4.4.1.

5.2 Water Balance

The simulated water balance for all three scenarios averaged to the time of project opening (September 2024) is presented in Table 24 and the long-term water balance for all three scenarios is presented in Table 25.

The water balance indicates that for all scenarios the major inputs into the model are from rainfall recharge and river leakage. The key outflows from the model are via evapotranspiration, river baseflow and regional flow, with the volume of water exiting the model by these outlets reducing with each scenario as a response to additional water being removed with extra length of tunnels. There is a net loss to storage which increases for each scenario, indicating that the successive lengths of tunnel are increasingly draining water from the system. The relative impacts of the Project, and cumulative impacts with the interfacing WestConnex works, on the water balance are discussed in the following sections.

Table 24 Simulated Groundwater Balance to Project Opening (Q3 2024) for each Scenario

Component (ML/day)	Inflow (Recharge)			Outflow (Discharge)		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Recharge (RCH)	4.92	4.92	4.92	0.00	0.00	0.00
ET (from GW) (EVT)	0.00	0.00	0.00	4.41	4.22	4.19
GW Extraction Alexandria Landfill (WEL)	0.00	0.00	0.00	0.03	0.03	0.03
SW-Aquifer Interaction Rivers/Channels (RIV)	3.18	3.23	3.24	1.61	1.58	1.56
Regional GW Flow (GHB)	0.30	0.34	0.34	1.16	1.15	1.15
Tidal Areas (CHD)	0.12	0.15	0.15	1.68	1.66	1.65
Tunnels (DRN)	0.00	0.00	0.00	0.31	0.99	1.14
Storage	2.98	3.23	3.28	2.30	2.24	2.22
Total	11.50	11.86	11.93	11.50	11.86	11.93

Scenario 1= Null run (M5 East tunnel only), Scenario 2 = Scenario 1 + New M5 + M4-M5 Link, Scenario 3 = Scenario 2 + F6 Stage 1

Table 25 Simulated Long-Term Groundwater Balance (Average to 2100) for each Scenario

Component (ML/day)	Inflow (Recharge)			Outflow (Discharge)		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Recharge (RCH)	5.12	5.12	5.12	0.00	0.00	0.00
ET (from GW) (EVT)	0.00	0.00	0.00	3.64	3.45	3.37
GW Extraction Alexandria Landfill (WEL)	0.00	0.00	0.00	0.01	0.01	0.01
SW-Aquifer Interaction Rivers/Channels (RIV)	1.08	1.10	1.10	1.35	1.27	1.25
Regional GW Flow (GHB)	0.12	0.17	0.17	0.40	0.38	0.38
Tidal Areas (CHD)	0.11	0.12	0.12	0.93	0.91	0.87
Tunnels (DRN)	0.00	0.00	0.00	0.19	0.61	0.76
Storage	0.39	0.41	0.42	0.29	0.29	0.29
Total	6.82	6.92	6.93	6.82	6.92	6.93

Scenario 1= Null run (M5 East tunnel only), Scenario 2 = Scenario 1 + New M5 + M4-M5 Link, Scenario 3 = Scenario 2 + F6 Stage 1

5.3 Predicted Water Levels

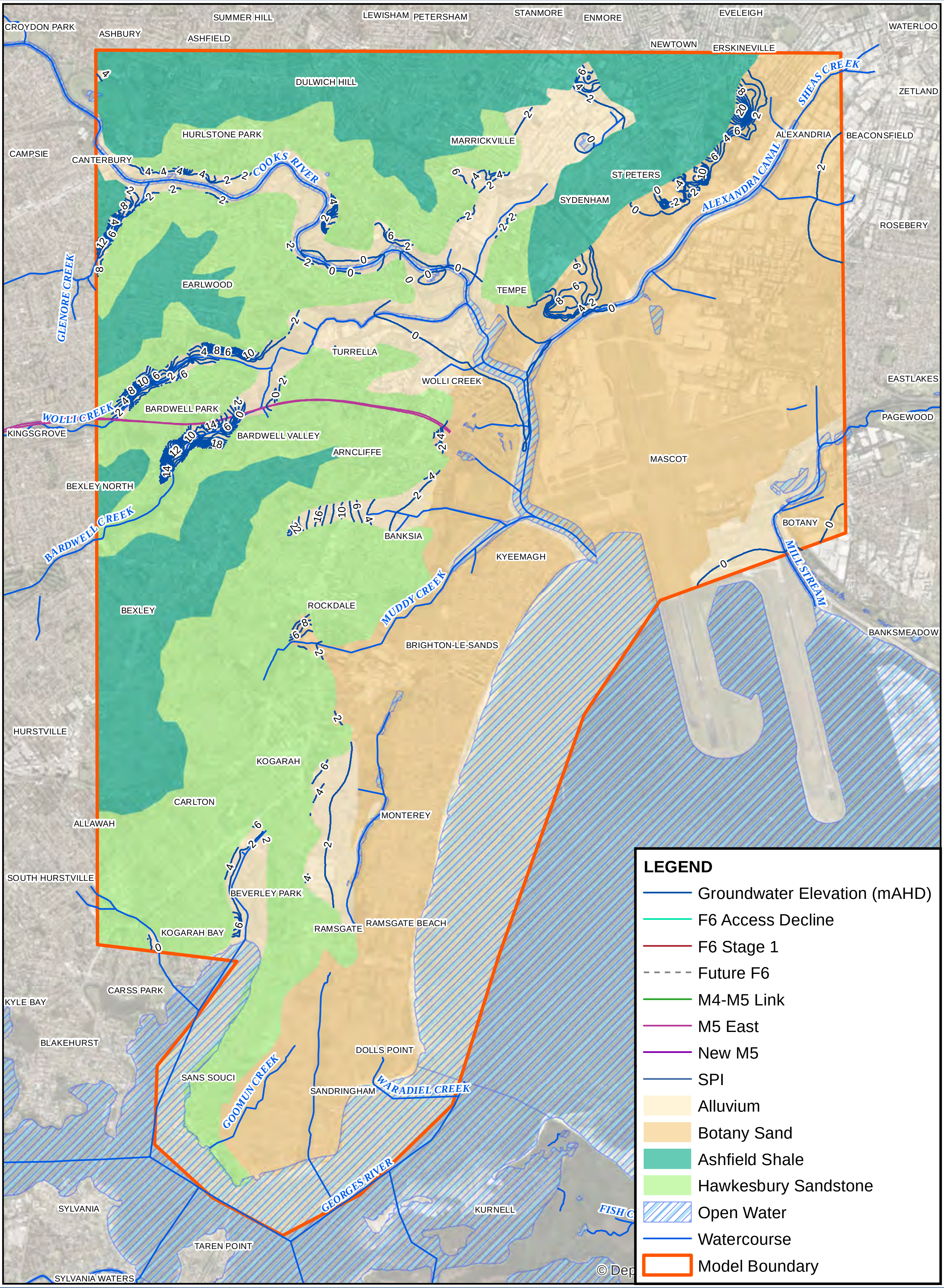
Predicted groundwater levels at the time of project opening (September 2024) are shown in Figure 54 to Figure 59. These figures show groundwater levels for the unconsolidated sediments and Hawkesbury Sandstone in representative model layers 1 and 7 (respectively).

5.3.1 Scenario 1 - Null Run with Only the Existing M5 East Tunnel Operational

Figure 54 and Figure 55 show predicted groundwater levels in each unit for Scenario 1 (only M5 East tunnel operational).

Water levels in the unconsolidated sediments (Figure 54) are strongly influenced by topography with steeper gradients at the upper reaches of water courses flattening with topography down to groundwater water levels at sea level in tidal areas. Simulated groundwater levels in the Bardwell Creek alluvium show a localised low of 0m AHD directly above the M5 East alignment.

Water levels in Scenario 1 show the groundwater levels in the Hawkesbury Sandstone (Figure 55) are controlled by topography with regional drainage towards Botany Bay (and to a lesser extent Georges River) in the southern portion of the model. Groundwater flow in the northern portion of the model is largely controlled by drainage towards Cooks River and its tributaries in the north-west portion of the model, and Alexandra Canal in the north-east. Depressed water levels exist along the M5 East alignment with a localised flow gradient towards the tunnel.



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Doc Number: 001
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Scale: 1:50,000 @ A4
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Source: RPS 2018

Figure 54
Groundwater Level at Project Opening Unconsolidated - M5 East Only

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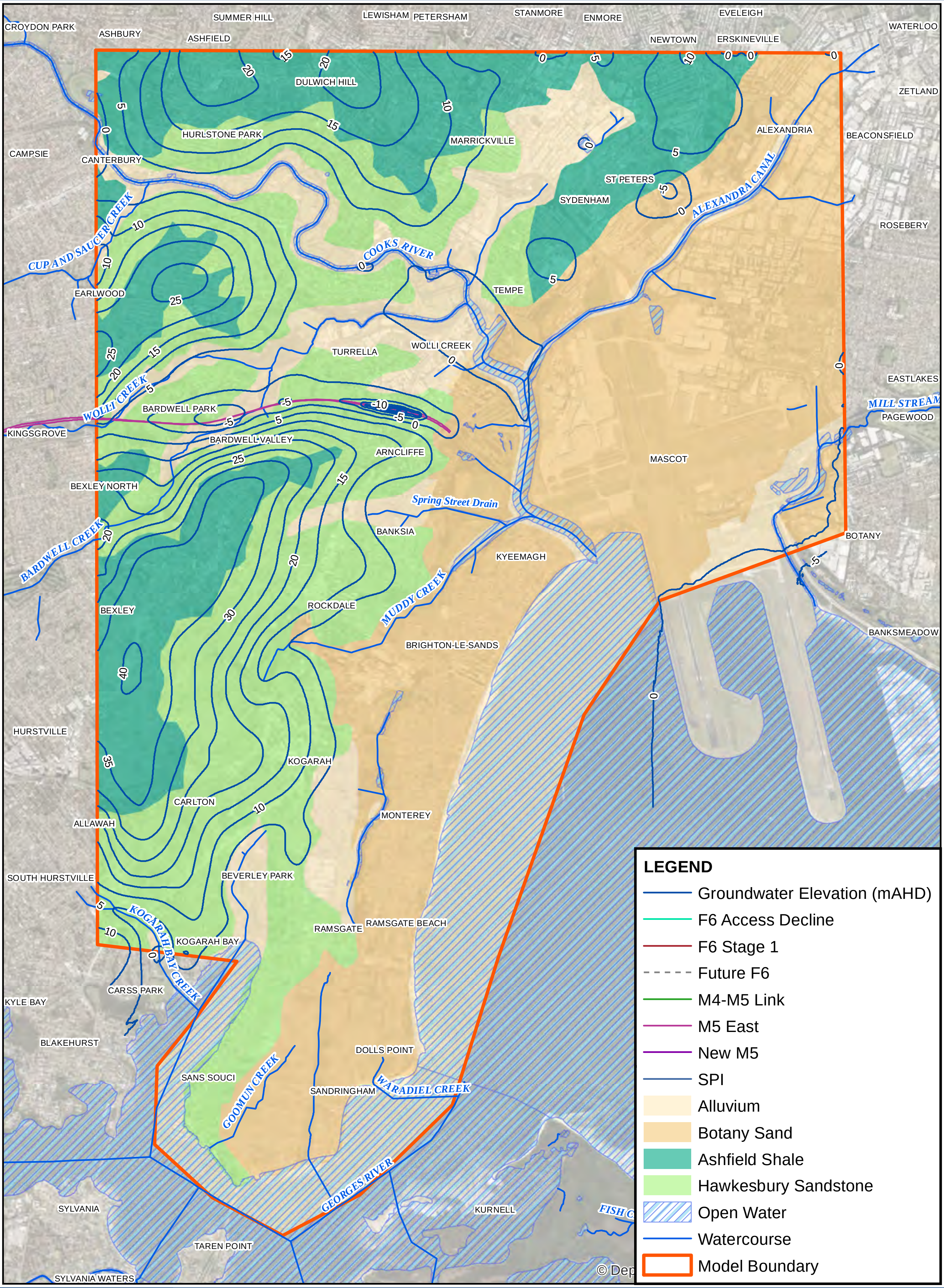

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Created by: CT
Source: RPS 2018

GDA 1994 MGA Zone 56

0 250 500 1,000 1,500 2,000 m

Figure 55
Groundwater Level at Project Opening
Hawkesbury Sandstone - M5 East Only

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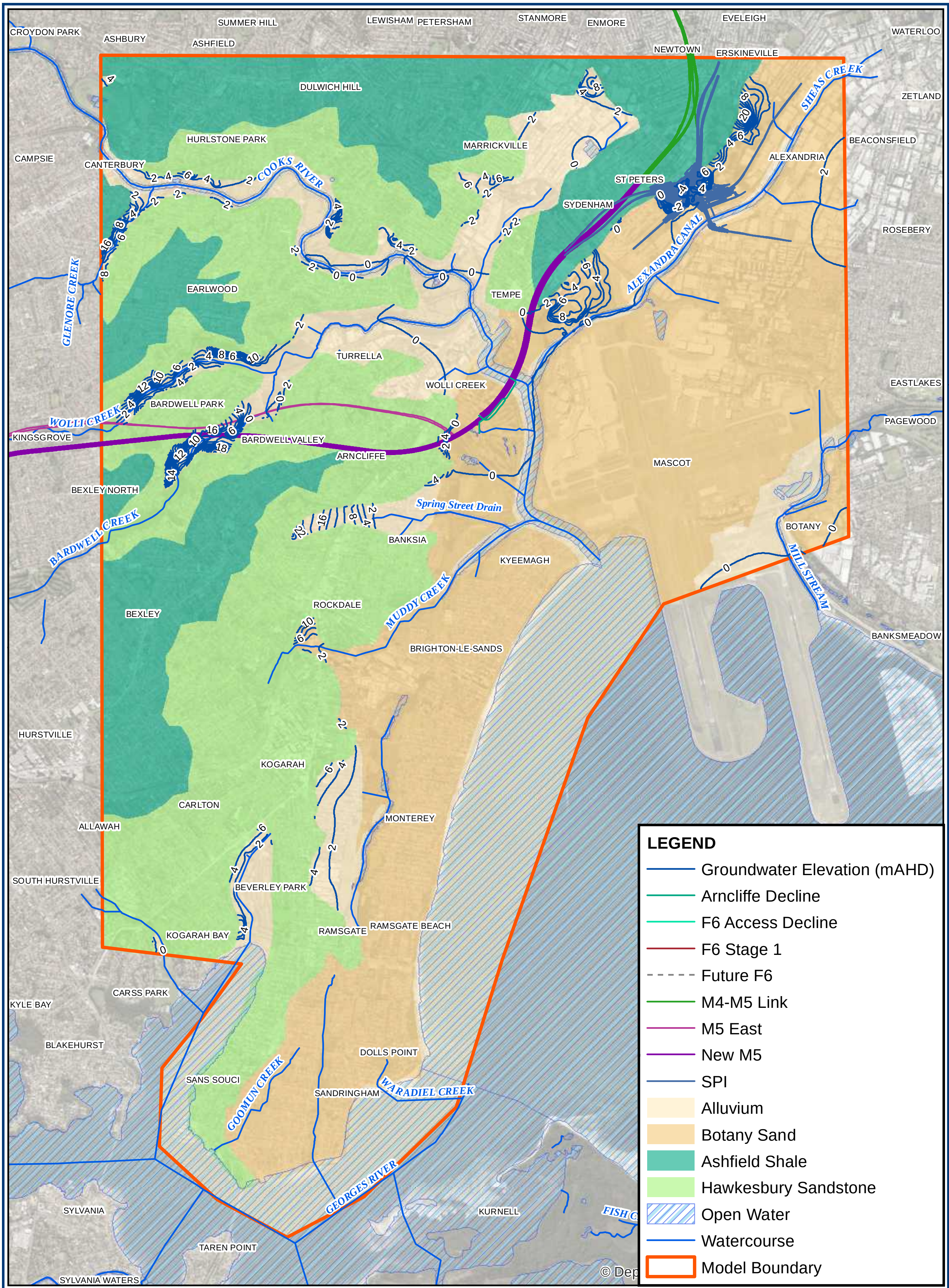
5.3.2 Scenario 2 - Null Run plus WestConnex New M5 and M4-M5 Link

Figure 56 and Figure 57 show predicted groundwater levels in each unit for Scenario 2 (M5 East, New M5 and M4-M5 Link).

Water levels in the unconsolidated sediments (Figure 56) are very similar to those simulated in Scenario 1, with some minor additional depressed areas in the vicinity of the WestConnex tunnel alignments. Scenario 2 shows the groundwater level in the Hawkesbury Sandstone (Figure 57) is additionally depressed along the WestConnex alignment resulting in a localised groundwater sink causing a reversal of groundwater flow towards the tunnels. This remains a relatively localised change, however the tunnel acts as a sink along almost its entire length effectively blocking the transmission of groundwater to its original discharge points. It is expected that due to the thickness of the Hawkesbury Sandstone (up to 290 m regionally), groundwater at some depth below the tunnel would cease being drawn upwards towards the tunnels and regional groundwater flow would continue uninterrupted towards natural zones of discharge; however this process would occur beyond the base of the sandstone modelled (the maximum thickness of Hawkesbury Sandstone modelled is 150 m, with 100 m being the average thickness).The groundwater flow pattern away from the tunnels does not appear to be significantly affected by the construction of the tunnels, with localised upwards drainage of deep groundwater to channel alluvium remaining the dominant discharge mechanism across the model domain.



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Scale: 1:50,000 @ A4
Created by: CT
Source: RPS 2018

GDA 1994 MGA Zone 56

0 250 500 1,000 1,500 2,000 m

Figure 56
Groundwater Level at Project Opening
Unconsolidated - No F6

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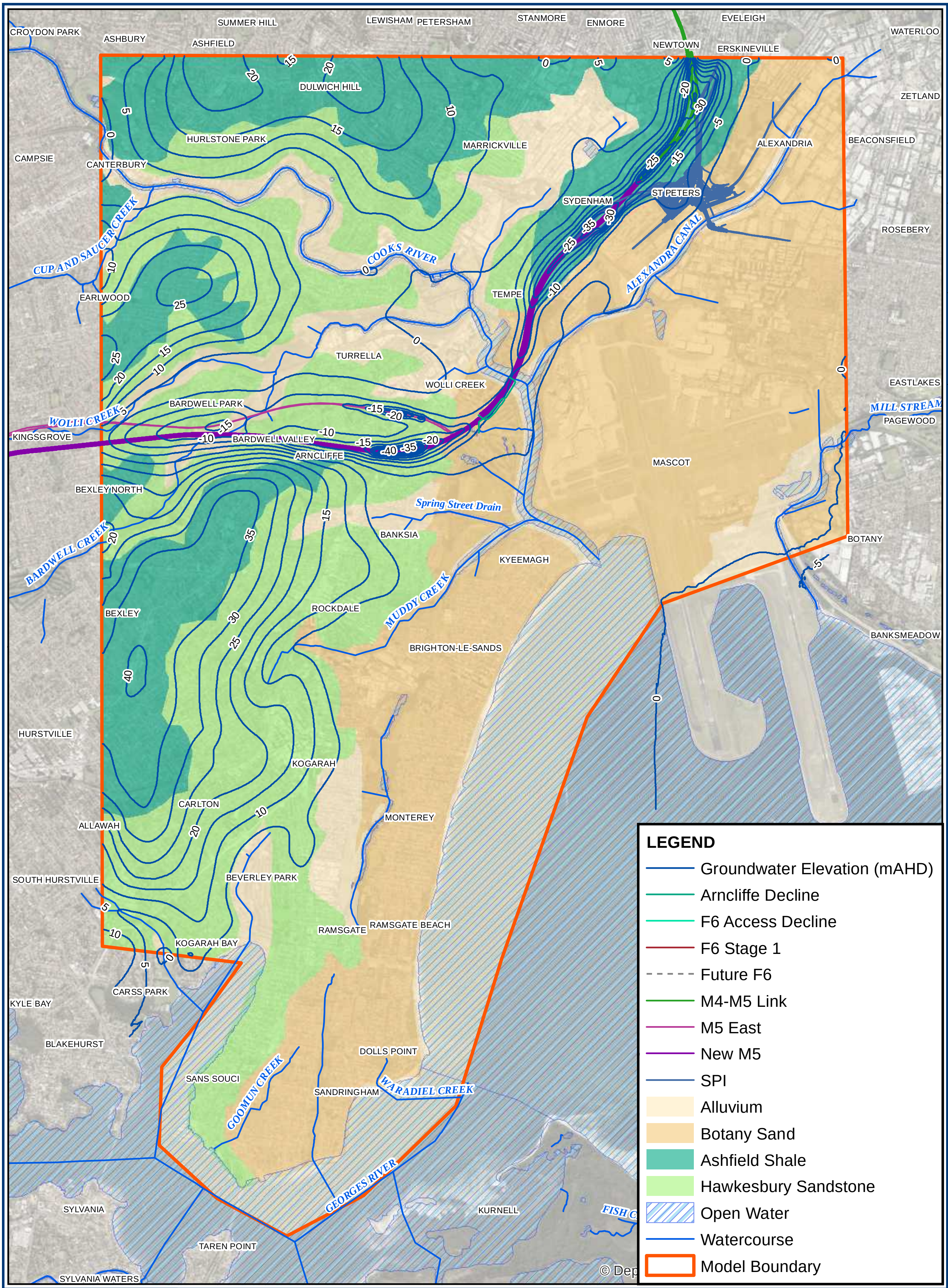

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Source: RPS 2018

GDA 1994 MGA Zone 56

0 250 500 1,000 1,500 2,000 m

Figure 57
Groundwater Level at Project Opening
Hawkesbury Sandstone - No F6

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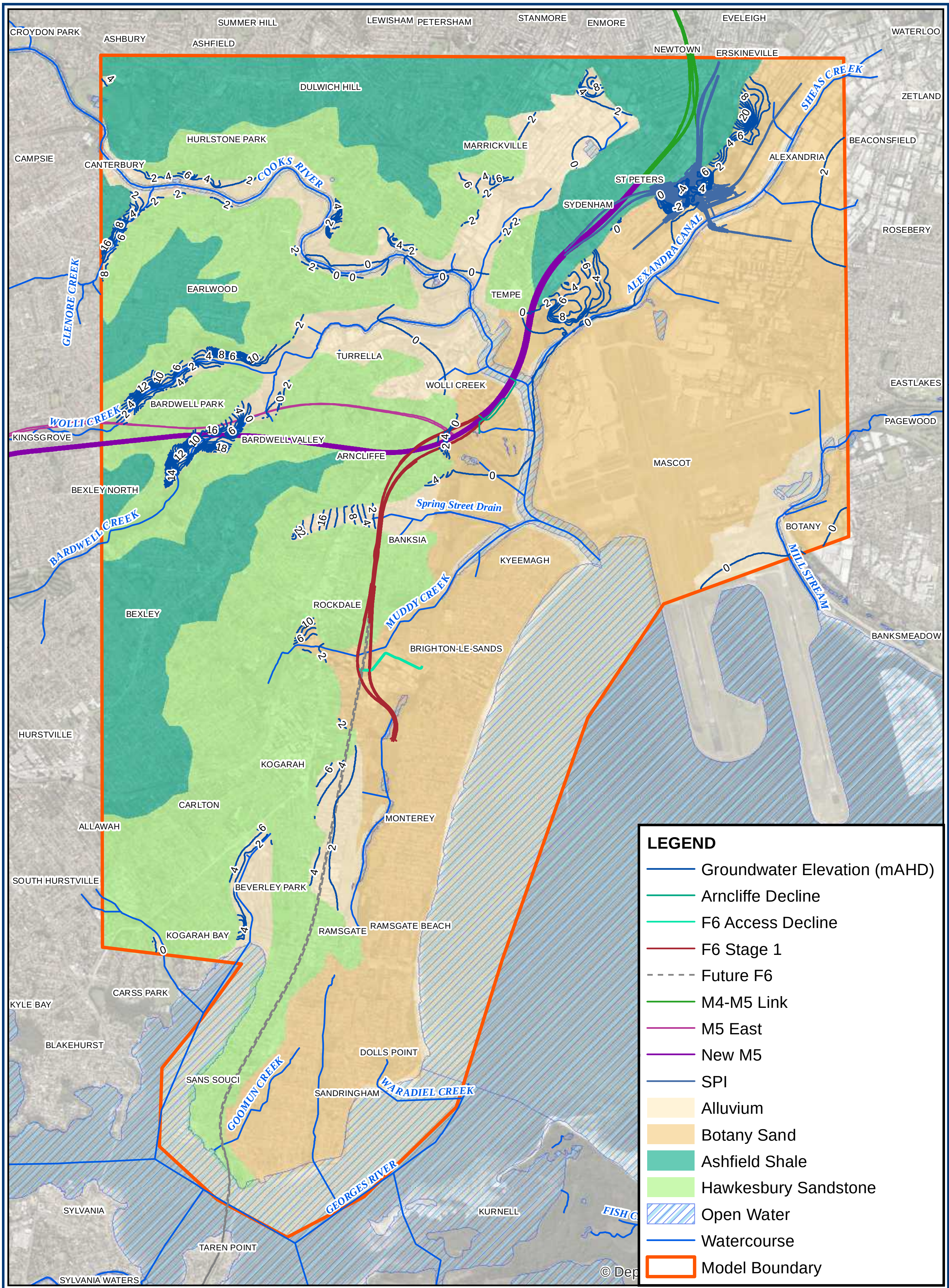
5.3.3 Scenario 3 - Scenario 2 plus the Project (F6 Stage 1)

Groundwater contours for Scenario 3 with the inclusion of F6 Extension Stage 1 are shown in Figure 58 and Figure 59. The addition of the F6 Extension has a negligible regional effect on groundwater levels in the unconsolidated sediments, with the only notable variation being the localised lowering of water levels in the Spring Street Drain channel sediments and Botany Sands at Arncliffe. As with the other tunnel alignments, the F6 Extension tunnel creates a localised depression in the Hawkesbury Sandstone, with the steepest depressurisation occurring at the first locations of drained tunnel beyond the proposed limit of tanked tunnels (both President Ave ramps and Access Decline) at Rockdale.



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Source: RPS 2018

GDA 1994 MGA Zone 56

0 250 500 1,000 1,500 2,000 m

Figure 58
Groundwater Level at Project Opening
Unconsolidated - Cumulative

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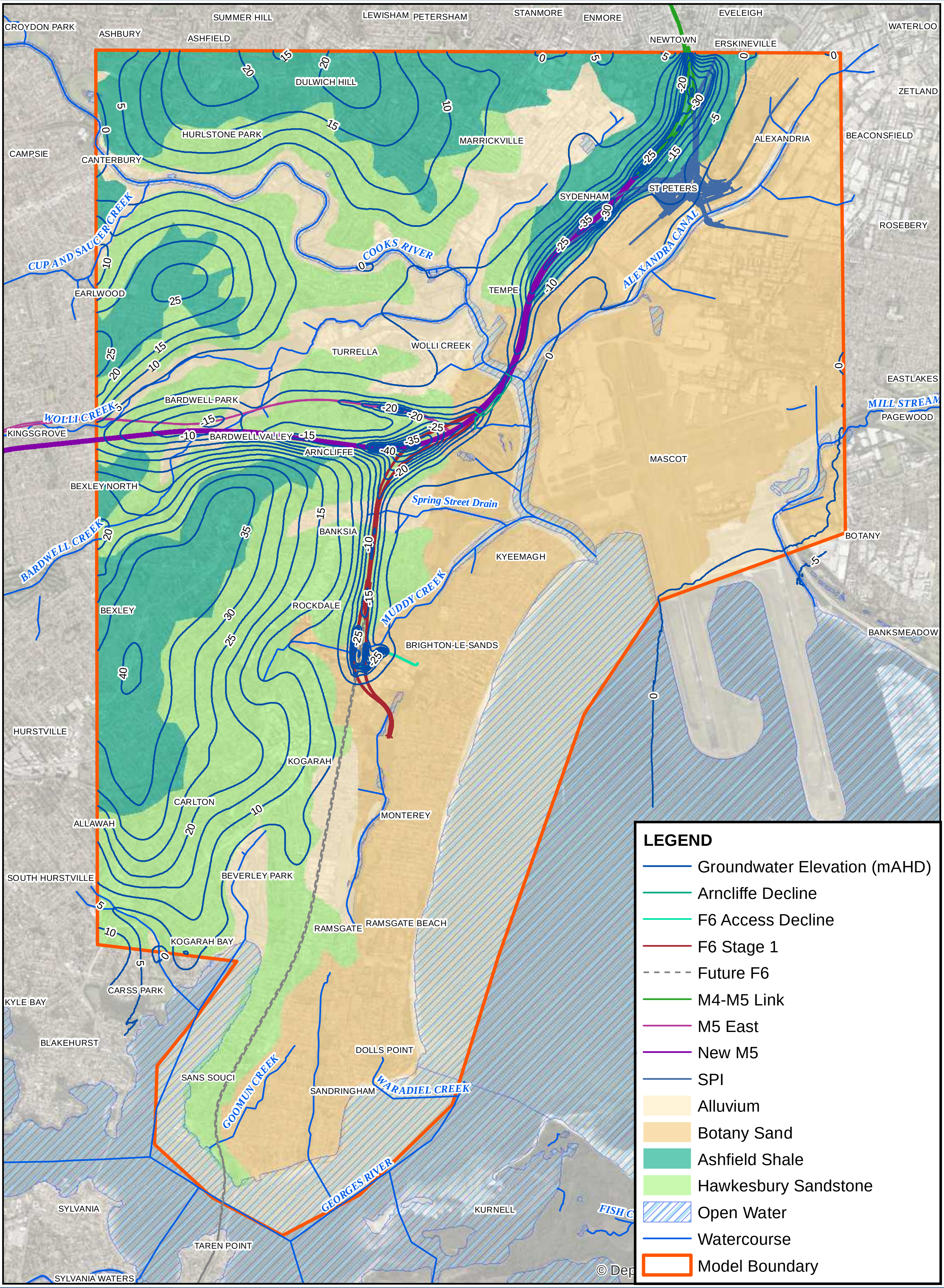

RPS

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Doc Number: 001
Date: 03.04.2018
Scale: 1:50,000 @ A4
Created by: CT
Source: RPS 2018

Figure 59
Groundwater Level at Project Opening Hawkesbury Sandstone - Cumulative

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5.4 Predicted Tunnel Inflow

5.4.1 Base case (M5 East Only)

Table 26 presents the inflow as simulated to the existing M5 East tunnel over the model duration. It is predicted that the long term inflow rate to the existing M5 East tunnel gradually declines over time, as is expected with the spread of drawdown from the nearby New M5.

Table 26 Predicted Tunnel Inflows M5 East (Scenario 1)

YEAR	Inflow ML/day	Inflow L/sec/km	Total Tunnel Length (km)
2016	0.32	0.92	4.00
2017	0.31	0.89	4.00
2018	0.30	0.86	4.00
2019	0.28	0.81	4.00
2020	0.26	0.74	4.00
2021	0.24	0.70	4.00
2022	0.23	0.68	4.00
2023	0.23	0.66	4.00
2024	0.23	0.65	4.00
2025	0.22	0.65	4.00
2030	0.20	0.59	4.00
2040	0.20	0.57	4.00
2050	0.19	0.55	4.00
2100	0.19	0.55	4.00

5.4.2 Project Specific Inflows

With the exception of lined tunnel sections identified in Section 3.7.5, the F6 Extension tunnels are being constructed as drained tunnels (unlined) with design criterion of a maximum of 1L/sec/km for the mainline tunnels and 2L/sec/km for the decline tunnel of on-going “drainage water” permitted during operation. Table 27 summarises the predicted annual inflow rates simulated by the model for the drained tunnel components of F6 Extension Stage 1 trafficable tunnels (inclusive of the mainline tunnel and ramps to president avenue) and the access decline tunnel. Inflow rates peaks at 0.55 ML/day for the trafficable tunnel in 2023 (corresponding with the end of trafficable tunnel excavation in December 2022), when the greatest length of tunnel is excavated (approximately 6.5 km inclusive of both directions along the mainline and ramps). Inflow to the decline tunnel represents a much lesser volume, peaking at 0.07 ML/day in 2022. Arncliffe decline inflows decrease from 0.07 ML/day in 2020 (prior to commencement of F6 tunnelling) reducing to 0.5 ML/day at the end of F6 construction when it is backfilled in 2024.

Table 27 Predicted Tunnel Inflows F6 Extension (Scenario 3 minus Scenario 2)

	Trafficable Tunnels			Rockdale Access Decline			Arncliffe Access Decline^		
YEAR	Inflow ML/day	Inflow L/sec/km	Total Tunnel Length (km) #	Inflow ML/day	Inflow L/sec/km	Total Tunnel Length (km)	Inflow ML/day	Inflow L/sec/km	Total Tunnel Length (km)
2016	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA
2017	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA
2018	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA
2019	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA
2020	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.76	1.0
2021	0.14	0.97	1.70	0.07	1.94	0.40	0.06	0.73	1.0
2022	0.48	0.87	6.50	0.07	1.89	0.40	0.06	0.71	1.0
2023	0.55	0.98	6.50	0.07	1.89	0.40	0.06	0.71	1.0
2024	0.54	0.97	6.50	0.07	1.88	0.40	0.05	0.55	1.0
2025	0.54	0.96	6.50	0.07	1.88	0.40	0.00	0.00	0.00
2030	0.53	0.95	6.50	0.06	1.87	0.40	0.00	0.00	0.00
2040	0.53	0.94	6.50	0.06	1.87	0.40	0.00	0.00	0.00
2050	0.52	0.93	6.50	0.06	1.87	0.40	0.00	0.00	0.00
2100	0.52	0.93	6.50	0.06	1.87	0.40	0.00	0.00	0.00

represents tunnelling in both directions
^Inflows to the Arncliffe Decline are attributed to New M5 during the period 2017 to 2019.

5.4.3 WestConnex Tunnelling Inflows

Predicted inflows for the New M5 and M4 East components of the WestConnex program of works are shown in Table 28. It should be noted that the volumes tabulated only reflect the extent of the tunnels that have been included in the current model for the purposes of cumulative drawdown impact assessment, and therefore the values of inflow may differ when averaged over the full length of the tunnels including those which are not modelled. Peak inflows for the New M5 and M4-M5 Link tunnels are predicted to be 0.89 ML/day and 0.26 ML/day respectively. The Arncliffe decline has a predicted peak inflow rate of 0.9ML/day during construction of the New M5. The decline is partially backfilled at the end of New M5 construction (2019) and inflows to the remaining portion after this time are attributed to the F6. The maximum rate in L/sec/km for each tunnel is predicted to be 0.73 L/sec/km for the New M5, similar to that predicted by CDM Smith (2015) of 0.67 L/sec/km. The maximum rate of 0.93 L/sec/km for the M4-M5 Link Tunnelling is also similar the maximum of 0.87 L/sec/km reported by HydroSimulations (2017).

Table 28 Predicted Tunnel Inflows for New M5 and M4-M5 Link (Scenario 2 minus Scenario 1)

	New M5 Tunnels*			M4-M5 Link Tunnels*			Arncliffe Access Decline^		
YEAR	Inflow ML/day	Inflow L/sec/km	Total Tunnel Length (km) #	Inflow ML/day	Inflow L/sec/km	Total Tunnel Length (km)#	Inflow ML/day	Inflow L/sec/km	Total Tunnel Length (km)
2016	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2017	0.21	0.56	4.30	0.00	0.00	0.00	0.09	0.74	1.4
2018	0.63	0.73	10.00	0.01	0.71	0.10	0.09	0.71	1.4
2019	0.76	0.54	16.20	0.24	0.93	3.00	0.08	0.70	1.4
2020	0.89	0.64	16.20	0.26	0.65	4.60	NA	NA	NA
2021	0.88	0.63	16.20	0.17	0.44	4.60	NA	NA	NA
2022	0.81	0.58	16.20	0.14	0.35	4.60	NA	NA	NA
2023	0.78	0.56	16.20	0.12	0.31	4.60	NA	NA	NA
2024	0.75	0.54	16.20	0.12	0.30	4.60	NA	NA	NA
2025	0.74	0.53	16.20	0.11	0.29	4.60	NA	NA	NA
2030	0.70	0.50	16.20	0.10	0.26	4.60	NA	NA	NA
2040	0.69	0.49	16.20	0.10	0.25	4.60	NA	NA	NA
2050	0.69	0.49	16.20	0.10	0.25	4.60	NA	NA	NA
2100	0.69	0.49	16.20	0.10	0.25	4.60	NA	NA	NA

*represents the portion of tunnelling included in current model only
represents tunnelling in both directions
^ Arncliffe Decline inflows attributable to F6 Extension from 2020

5.4.4 Cumulative Inflows

Table 29 presents the cumulative tunnel inflows for the F6 Stage 1 and WestConnex program of works (to the extent simulated). Total inflow volumes are predicted to peak at 1.56 ML/day in 2023, corresponding with final tunnel excavation for the F6 Extension Stage 1 at December 2022. The declining inflow rate with time indicates that the modelled recharge does not supply enough water to the system to maintain the initial inflow rates. It is possible long term inflows may be slightly higher if rainfall recharge is higher than simulated, or if additional recharge is induced to the system due to the lowered hydraulic head along the tunnel alignment.

Table 29 Cumulative Tunnel Inflows for F6 Stage 1 and WestConnex* (Scenario 3)

YEAR	Inflow ML/day	Inflow L/sec/km	Total Tunnel Length (km) #
2016	0.00	0.00	0.00
2017	0.30	0.61	5.70
2018	0.71	0.71	11.50
2019	1.07	0.60	20.60
2020	1.20	0.64	21.80
2021	1.32	0.64	23.90
2022	1.55	0.63	28.70
2023	1.56	0.63	28.70
2024	1.51	0.61	28.70
2025	1.45	0.61	27.70
2030	1.40	0.58	27.70
2040	1.38	0.58	27.70
2050	1.37	0.57	27.70
2100	1.37	0.57	27.70

*represents the portion of New M5 and M4-M5 Link tunnelling included in current model only
represents tunnelling in both directions and at interchanges

5.5 Predicted Capture Area

MODPATH3DU (Muffels *et al.,* 2014) was used to simulate particle tracking in order to determine the capture area of the tunnels during operation, with the main aim of this analysis being to identify the potential for saline intrusion due to water being drawn from tidal regions towards the tunnels. The calibrated steady-state model (as opposed to the transient model) was used for this investigation. The steady-state model represents equilibrium conditions with constant stresses applied to the model, whereas transient models represent variable groundwater stresses and groundwater conditions dependant on the length of each stress-period in the model. The use of the transient model was not suitable for this analysis due to many of the particle traces generated indicating total travel times much greater than the 85 year duration simulated in the transient model. The steady-state model includes averaged groundwater stresses (e.g. recharge and evapotranspiration) based on long term climatic conditions, and includes all the operational tunnels, thereby demonstrating the greatest possible capture area (as constrained by hydraulic parameters used in the calibrated model).

Backwards tracking of particles set at the tunnel inverts shows the “path” each “particle” of water would take from its origin (at the water table or a model boundary condition e.g. river) based on advective flow (the average linear groundwater velocity). Thus the time displayed at the point along the path-line indicates the travel time from that point to its entry (via seepage) into the tunnel.

The travel time (but not overall capture area) is sensitive to the effective porosity values applied in the model. Total porosity values obtained from core testing are shown in Table 30 (greater detail can be found in Section 3.2.6), averaging between 10 to 20% for the Hawkesbury Sandstone and around 6% for the Ashfield Shale. The effective porosity is less than the total porosity, as it includes only interconnected porosity through which water is able to be transmitted (i.e. excludes isolated voids and “dead-end” pore space). The effective porosity values applied in this analysis are also summarised in Table 30. It is assumed that the effective porosity is close to the total porosity typical of unconsolidated sands in model Layer 1.

Table 30 Total Porosity Values from Laboratory Testing and Simulated Effective Porosity

Layer	Unit	Total Porosity (%)	Effective Porosity (%)
1	Alluvium/Botany Sands/Regolith	20 – 30	20
2	Weathered Ashfield Shale		18
3	Ashfield Shale	6	3
4	Hawkesbury Sandstone	10 - 20	20
5	Hawkesbury Sandstone	10 - 20	15
6	Hawkesbury Sandstone	10 - 20	10
7	Hawkesbury Sandstone	10 - 20	8
8	Hawkesbury Sandstone	10 - 20	5
9	Hawkesbury Sandstone	10 - 20	5

A total of 2336 particles were simulated from the base of the tunnels. Figure 60 shows the travel time for the particles, and Figure 61 shows the layers that the particles pass through along their path. Comparing these figures shows that the particles that travel from regions of groundwater mounding (corresponding with topographic highs) have the longest travel times (greater than 1000 years) and pass through the deepest model layers before emerging at the tunnel. Water originating at the water table closer to the tunnel alignment does not pass through the deep layers and therefore takes significantly less time to reach the tunnel (less than 100 years).

The implications for potential saline intrusion are discussed in Section 6.8.

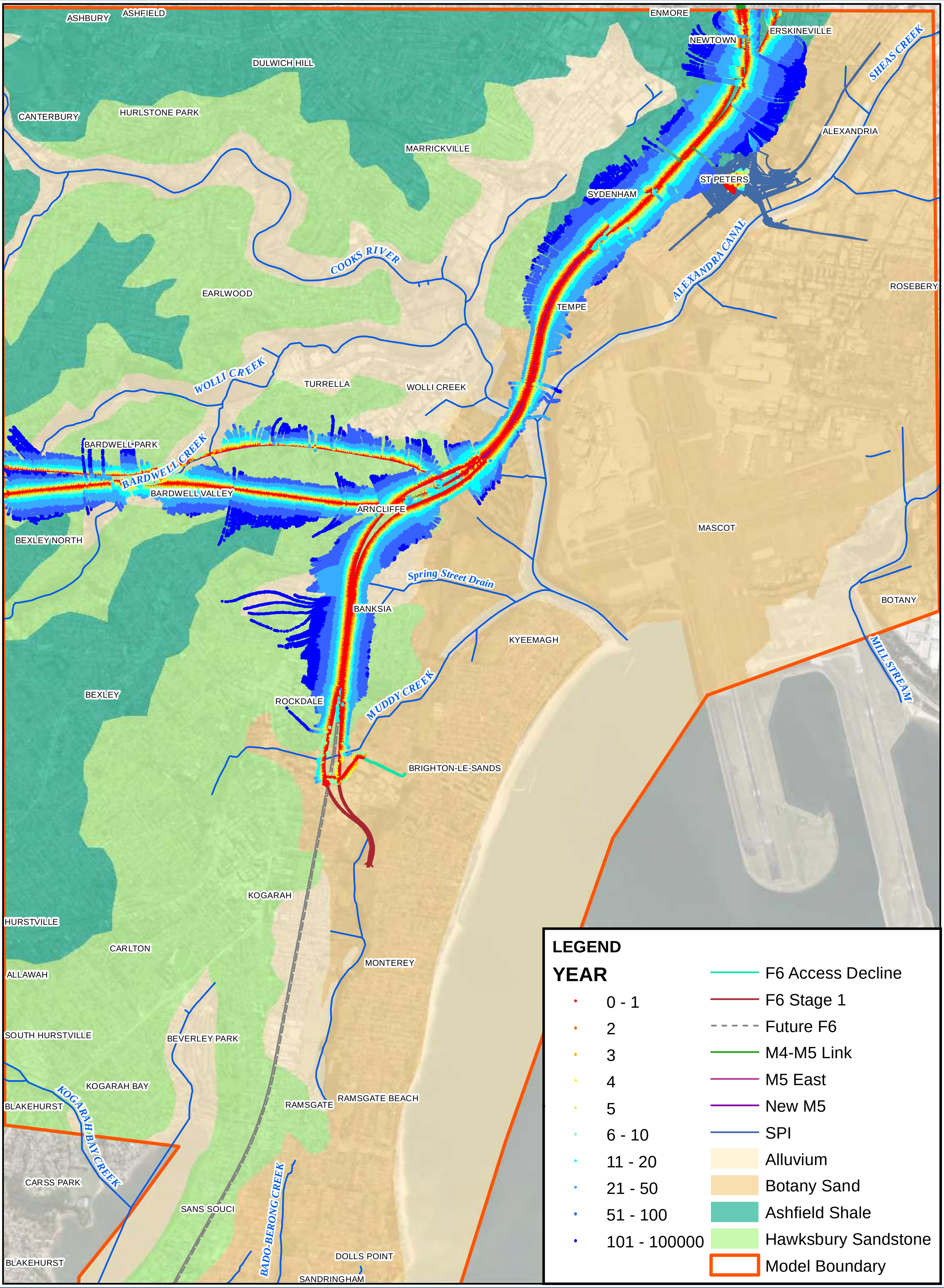

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Figure 60
Cumulative Capture Zone Travel Times

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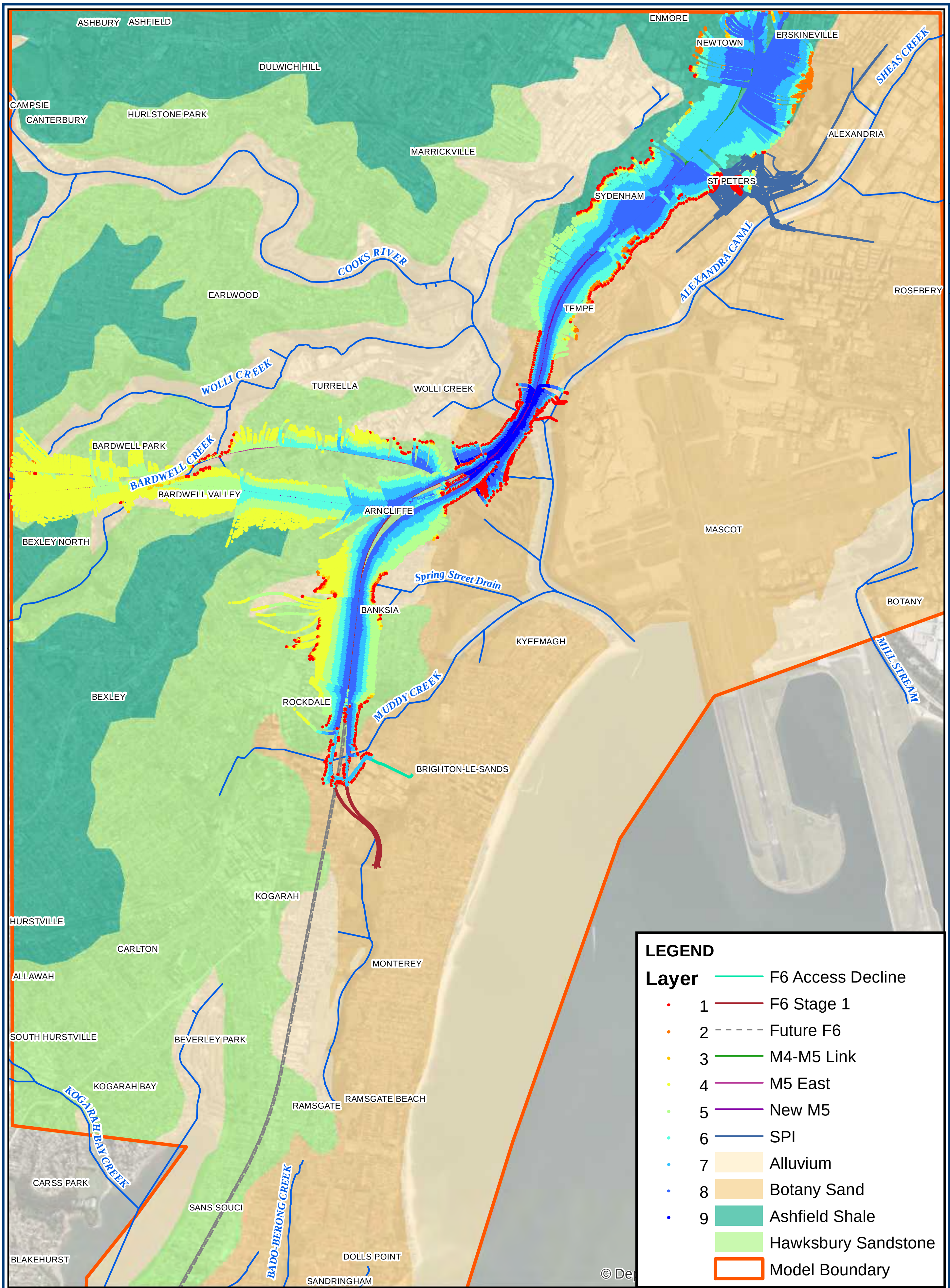

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Source: RPS 2018

GDA 1994 MGA Zone 56

0 200 400 800 1,200 1,600 m

Figure 61
Cumulative Capture Zone
Model Layer

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6 Potential Impacts of the Project

The main impact of tunnel construction on the groundwater regime are groundwater inflow and subsequent removal of groundwater that enters the tunnel void. The operational inflows along the tunnel alignment occur at variable rates depending of the localised geology intercepted, however where high inflows are intercepted during construction, surface treatment will take place to ensure the long-term inflow rate does not exceed 1L/sec/km (or 2L/sec/km for the access decline). This long-term drainage of groundwater from the system has a number of possible effects that may arise during both the construction phase and on-going operation of the tunnels. These can be summarised as follows:

- inflow of groundwater to the tunnels and water management;
- drawdown of groundwater levels and depressurisation of groundwater, both within the Hawkesbury Sandstone and alluvium/Botany Sands;
- saline intrusion where the tunnel inflow is hydraulically connected to surface water bodies either directly or via the alluvium/Botany Sands; and
- effects on baseflow to nearby non-tidal rivers including the upper reaches of Cooks River, Wolli Creek, Bardwell Creek, Muddy Creek and the Spring Street Drain.

6.1 Predicted Inflow to Tunnels

6.1.1 Early Inflows During Construction of Sealed Structures

During the early phases of construction, diaphragm cut-off walls will be installed through the Botany Sands as part of construction of the sealed tunnel structures identified in Figure 35. Although the horizontal flows into the working excavation will be restricted by the cut-off walls, an initial upwards vertical flow will occur into the base of the excavation before the tunnel construction is complete. An estimate of the short-term construction inflows for sizing of dewatering detention ponds is provided in Table 31. Maximum inflows associated with the construction of the mainline cut and cover sections is predicted to be 1.6 ML/day, and 1.3 ML/day from the decline excavation, totaling approximately 3ML/day of short-term dewatering to be managed while the sealed structures are completed.

Table 31 Construction Dewatering Volumes Between Cut-Off Walls

Construction Time	President Avenue Ramps (ML/day)	F6 Access Decline (ML/day)
Q1 2021	1.6	1.3
Q2 2021	0.5	NA
Q3 2021	0.4	NA
Q4 2021	0.4	NA
Q1 2022	0.4	NA

The above values were determined by applying a line of low conductivity cells along the outer edge of the simulated tunnels, in the same fashion as the simulated cut-off wall at Alexandria Landfill (Section 4.4.5). In the absence of detailed construction information, it is assumed that the cut-off walls will be installed ahead of tunnel construction and therefore all walls will be installed early in the first quarter of 2021. The TVM package was used to activate these low conductivity cells, with additional low conductivity cells progressively activated in-between the cut-off walls to represent the sealed tunnel completion as per the construction program (Figure 45). Other key assumptions include that the cut-off wall will fully penetrate the unconsolidated sediments (i.e. extends to the full depth of model Layer 1) and that dewatering will only be required to the design invert level of the tunnels.

6.1.2 Project Specific Inflow

The predicted annual inflow and cumulative inflow with time for the F6 Stage 1 tunnelling are presented in Table 32. Peak inflow for the Project is predicted to be 246 ML/year coinciding with the end of construction. At the time of Project Opening (2024) The F6 Stage 1 tunnelling is predicted to have an inflow rate of 238 ML/year, with 831 ML of water predicted to have been drained by the Project (not inclusive of any high inflows prior to tunnel lining or grouting of high inflow zones). The long term annual inflow is predicted to be 215 ML/year, with a total volume of 16 GL drained by year 2100.

Table 32 Predicted Annual and Cumulative Tunnel Inflows for F6 Stage 1

	Annual Inflow				Cumulative Total Inflow			
YEAR	F6 Stage 1 Trafficable Tunnels Inflow (ML/yr)	F6 Stage 1 Access Decline Inflow (ML/yr)	Arncliffe Decline (ML/yr)#	F6 Stage 1 Combined Inflow (ML/yr)	F6 Stage 1 Trafficable Tunnels Cumulative Inflow (ML)	F6 Stage 1 Access Decline Cumulative Inflow (ML)	Arncliffe Decline Cumulative Inflow (ML)	F6 Stage 1 Cumulative Combined Inflow (ML)
2016	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0
2020	0	0	24	24	0	0	24	24
2021	52	23	23	99	52	24	47	123
2022	177	24	22	223	229	48	69	347
2023	200	24	22	246	429	72	92	593
2024	197	24	17	238	626	96	109	831
2025	196	24	0	220	822	120	109	1,051
2030	193	24	0	217	1,788	238	109	2,134
2040	192	24	0	216	2,748	356	109	3,213
2050	191	24	0	215	4,662	592	109	5,363
2100	191	24	0	215	14,228	1,773	109	16,111

Arncliffe decline flows attributed to F6 from 2020.

6.1.3 Cumulative Inflow

The maximum annual inflow for F6 Stage 1 and WestConnex (for the components included in the model) peaks at 571 ML/year in 2023 (Table 33). The cumulative inflow to tunnels at the end of all trafficable tunnel excavation (end 2022) is 2.2 GL, and 3.4 GL of groundwater is predicted to have drained to the greater WCX tunnels by the time of F6 Stage 1 opening in 2024. Annual inflow volumes decrease with time after the peak inflows are reached, as water in aquifer storage is drained, and spreading drawdown reduces the hydraulic gradient towards the tunnels (indicating recharge does not replace the volumes lost).

Table 33 Predicted Annual and Cumulative Tunnel Inflows for the Greater WCX Program of Works

	Annual Inflow			Cumulative Total Inflow		
YEAR	New M5 and M4-M5 Link (ML/yr)	Total F6 Stage 1 (ML/yr)	Combined Cumulative Inflow (ML/yr)	New M5 and M4-M5 Link (ML)	Total F6 Stage 1 (ML)	Combined Cumulative Inflow (ML)
2016	0	0	0	0	0	0
2017	108	0	115	109	0	109
2018	258	0	289	367	0	367
2019	390	0	421	757	0	757
2020	415	24	439	1,171	24	1,195
2021	381	99	480	1,552	123	1,675
2022	343	223	566	1,895	347	2,241
2023	325	246	571	2,220	593	2,812
2024	314	238	552	2,534	831	3,364
2025	309	220	529	2,842	1,051	3,893
2030	292	217	509	4,302	2,134	6,437
2040	287	216	502	5,736	3,213	8,949
2050	285	215	500	8,587	5,363	13,950
2100	285	215	500	22,815	16,111	38,925

6.2 Predicted Drawdown due to F6 Stage 1

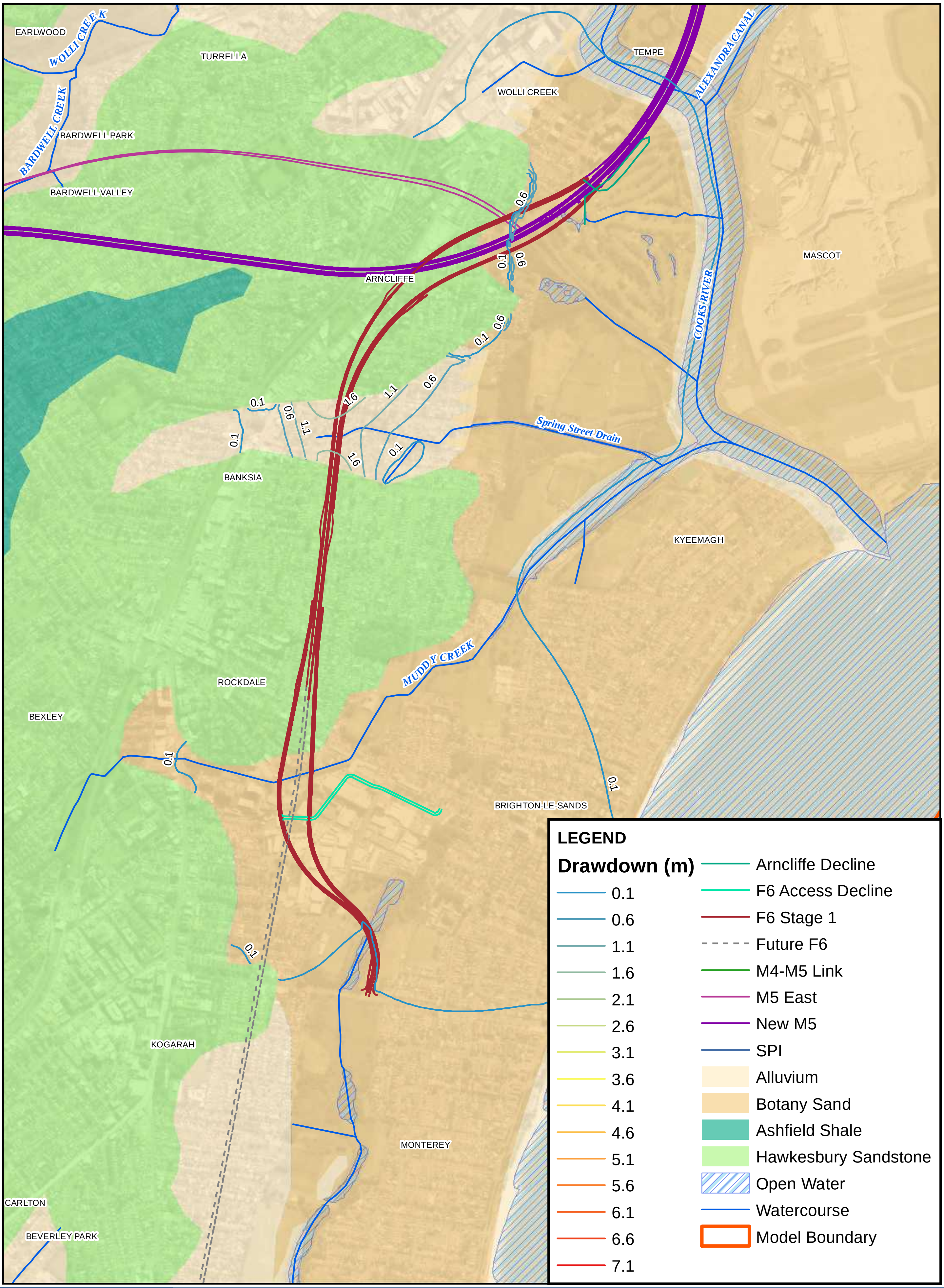
Project specific drawdown related to the construction of F6 Stage 1 are shown in Figure 62 to Figure 65. This drawdown was calculated by subtracting the results of model Scenario 3 (inclusive of the M5 East, New M5, M4-M5 Link and F6 Stage 1 projects) from model Scenario 2 (inclusive of the M5 East, New M5 and M4-M5 Link only). Model Scenario 2 forms an appropriate “baseline” for calculating drawdown due to the F6 Stage 1 project as the construction of the components of WestConnex included in the model has commenced.

Drawdown is presented for the unconsolidated sediments (model Layer 1) and is restricted to the lateral and vertical extent of the alluvium and Botany Sands to aid in the calculation of potential settlement in these units. Maximum drawdown for the Hawkesbury Sandstone is also shown using the water levels computed in model Layer 7. The drawdown in the other Hawkesbury Sandstone model layers may vary slightly from those depicted, however not significantly.

6.2.1 Drawdown at Project Opening

At the proposed time of project opening (September 2024) drawdown that is limited to the base of the alluvium/Botany Sands (Figure 62) is estimated at 2 m in the alluvium at the Spring Street Drain paleochannel. This indicates that there is a hydraulic connection between the Hawkesbury Sandstone and the alluvium, with the significant drawdown in the Hawkesbury Sandstone creating a local sink drawing groundwater downwards from the alluvium. Minor drawdown of up to 0.1m also occurs in the Botany Sands. Drawdown is less in the Botany Sands than in the alluvium for two main reasons, firstly the drawdown in the underlying Hawkesbury Sandstone is greatest under the Spring Street Drain paleochannel due to the depth of the tunnel at this location, and secondly the Botany Sands are of higher hydraulic conductivity (and therefore higher lateral recharge) enabling the replenishment of groundwater where it is removed via tunnel drainage at a faster rate than is possible in the channel alluvium. Areas where the tunnel are directly intercepting the Botany Sands (e.g. at the shallow limits of the access decline and President Ave ramps) are designed as lined tunnels to prevent high inflows and resulting extensive drawdown in the Botany Sands.

In the Hawkesbury Sandstone (Figure 63) drawdowns of up to 24 m occur at Arncliffe, where the tunnel alignment is deepest after passing under the New M5 tunnels. Drawdown of 33 m also occurs at the southern end of the alignment centered over the decline and where the access ramp joins into the mainline tunnel. Drawdown is likely to be most significant here due to the higher inflow (2 L/sec/km) into the drained portion of access decline. The maximum extent of drawdown due to the project at September 2024 is approximately 250 m either side of the alignment at Arncliffe.



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GDA 1994 MGA Zone 56

0 100 200 400 600 800 m

Figure 62
Project Drawdown at Project Opening
Unconsolidated Sediments

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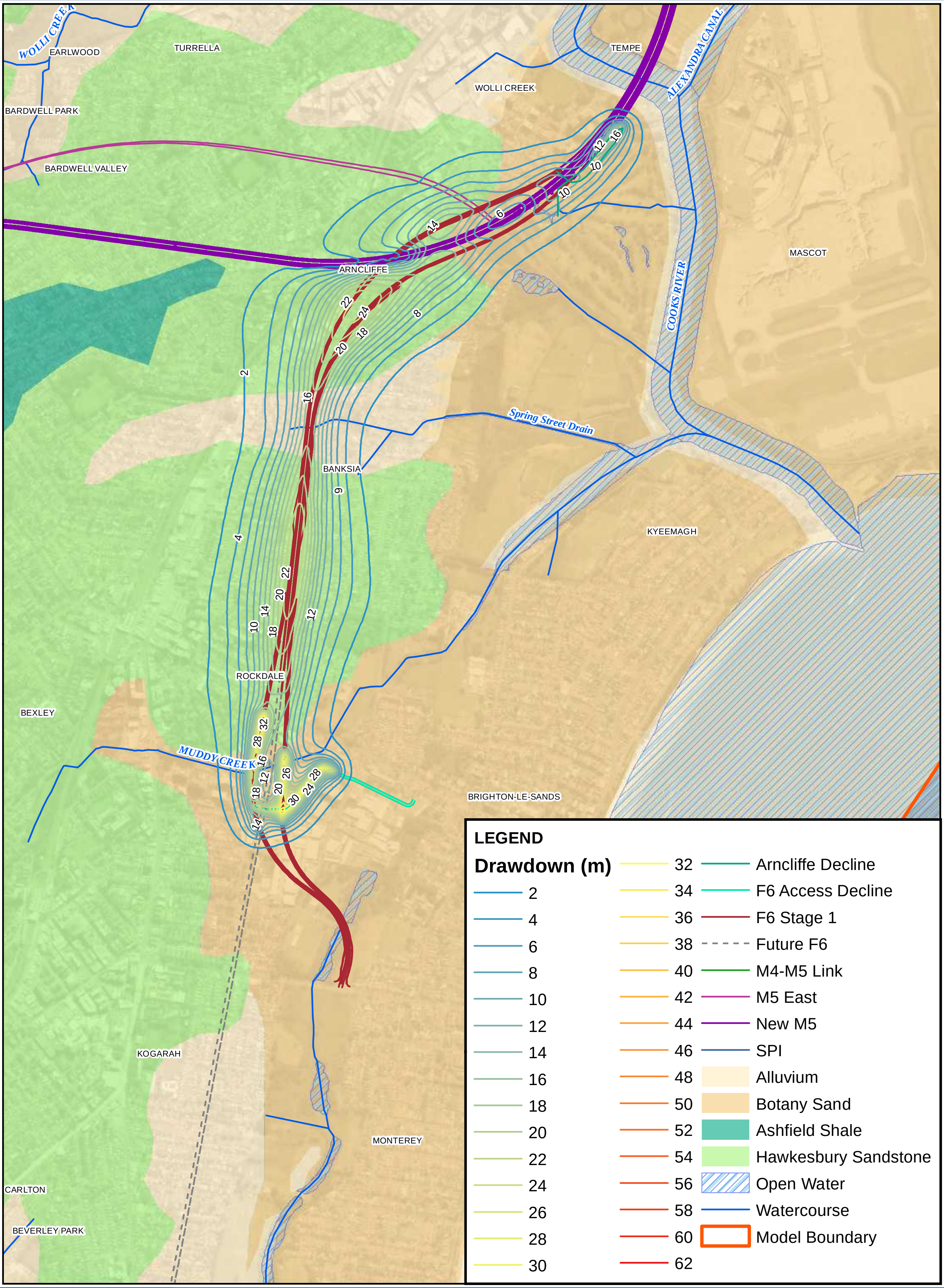

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Figure 63
Project Drawdown at Project Opening
Hawkesbury Sandstone

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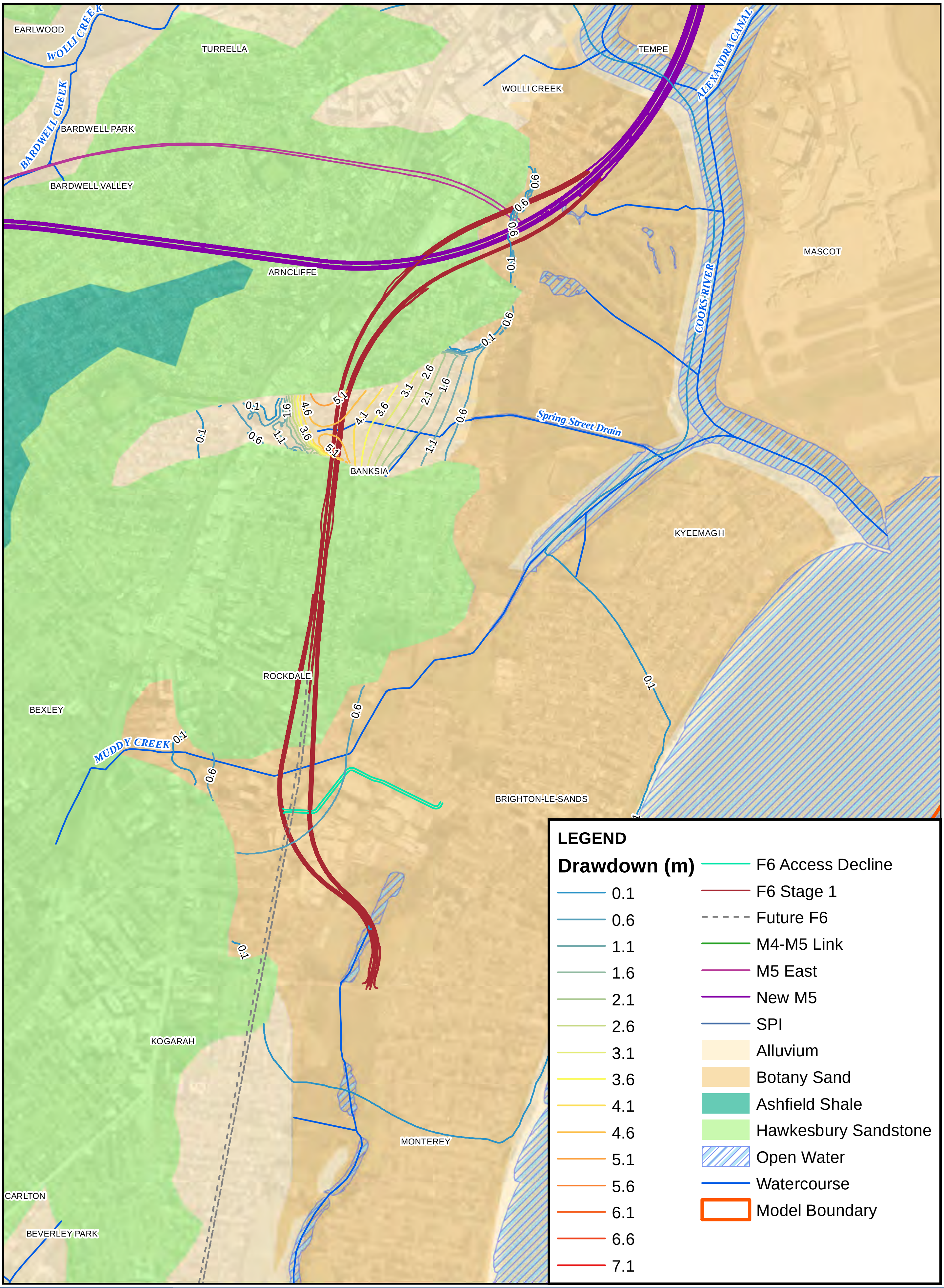
6.2.2 Long Term Drawdown

Long term drawdowns of up to 5.3 m occur in the alluvial sediments associated with the Spring Street Drain alluvium in the model simulation ending year 2100 (Figure 64). Drawdown in the Botany Sands reaches 0.6 m and is centred over the access decline, with shallow drawdown in the Botany Sands extending east towards the edge of Botany Bay.

Drawdown in the Hawkesbury Sandstone at the end of the long term simulation (Figure 65) shows that the drawdown remains at 33 m over the decline and increases to 30 m at Arncliffe. It is expected that these water levels represent a steady-state condition due to the inflows to tunnels stabilising (see Section 5.4).



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0 100 200 400 600 800 m

Figure 64
Project Drawdown at 2100
Unconsolidated Sediments

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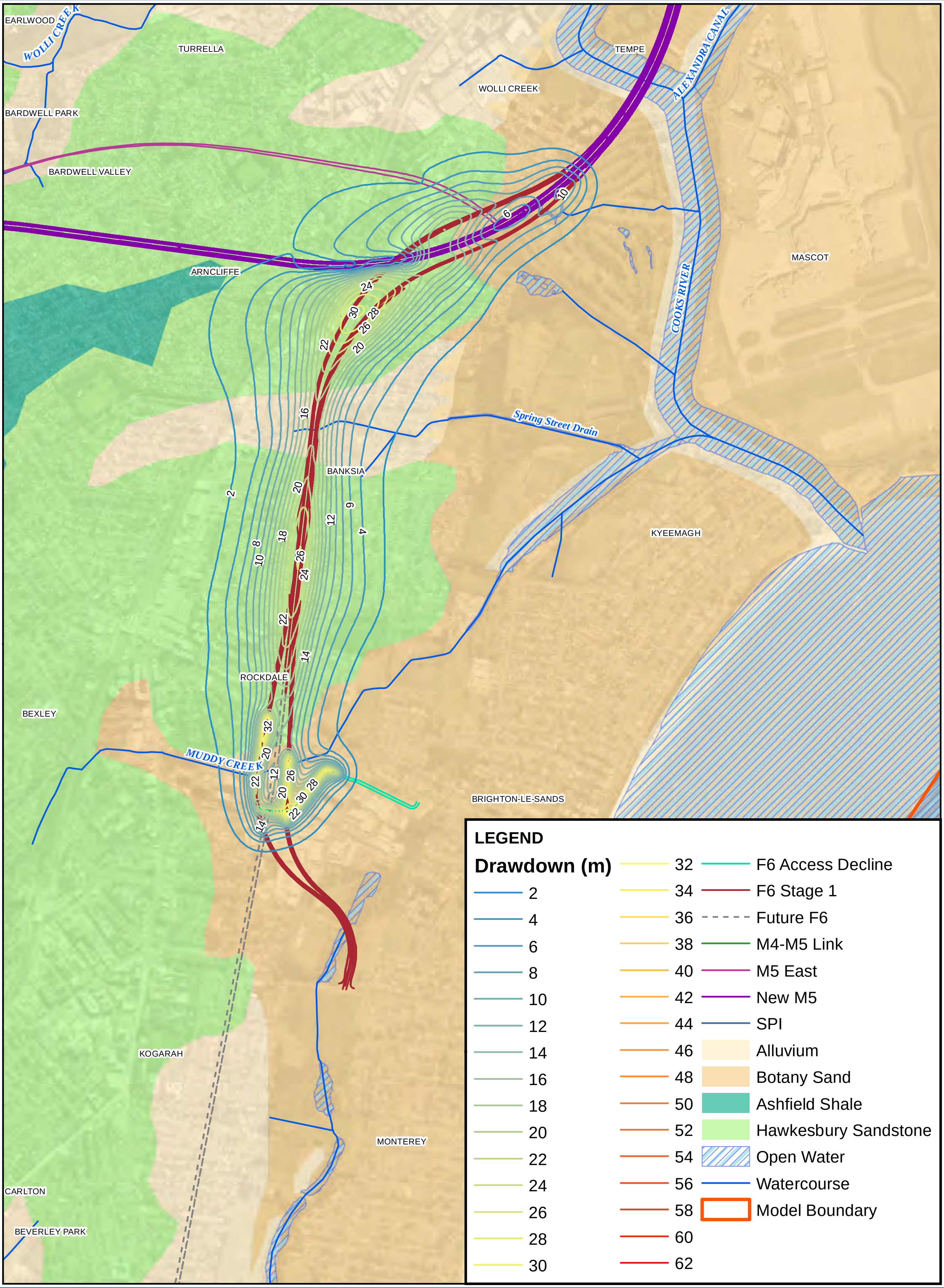

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Figure 65
Project Drawdown at 2100
Hawkesbury Sandstone

6.3 Predicted Cumulative Drawdown

6.3.1 Drawdown at Project Opening

Drawdown that is limited to the base of the unconsolidated sediments (Figure 66) shows that there is a small increase in the drawdown in paleochannel sediments at Spring Street Drain of 0.5 m (total drawdown 4.1 m) due to the cumulative tunneling with WestConnex at September 2024, but negligible change to any unconsolidated sediments adjacent to the Project further south. Drawdown of up to 0.7m is predicted within channel sediments associated with Cooks River, most of which (>0.5m) can be attributed to the New M5 tunneling. Localised drawdowns of up to 2.6 m are predicted to occur with the unconsolidated sediments to the north of Cooks River between the New M5 tunnel alignment and Alexandra Canal, however these are entirely related to the WestConnex program of works and are not associated with the Project. Up to 1.1 m of drawdown in the Bardwell Creek sediments is expected to occur due to New M5 tunneling.

Cumulative drawdown in the Hawkesbury Sandstone increases to 61 m at the connection with the New M5 tunnels at Arncliffe at Project Opening (Figure 67). Although the New M5 tunnels are not any deeper than the F6 Extension tunnels at this location, the combination of the New M5 mainline tunnel and F6 Stage 1 connection tunnels increases the combined volume of water removed at this location, thus resulting in a greater depth of drawdown than from the F6 project alone. Drawdown of up to 2m extends a maximum of 560 m either side of the tunnels, with the greatest drawdown extent in the Arncliffe area due to the combined New M5, F6 Stage 1 and M5 East tunneling. The drawdown extent narrows where the tunnels pass under watercourses due to the additional recharge associated with the alluvial sediments and stream leakage.

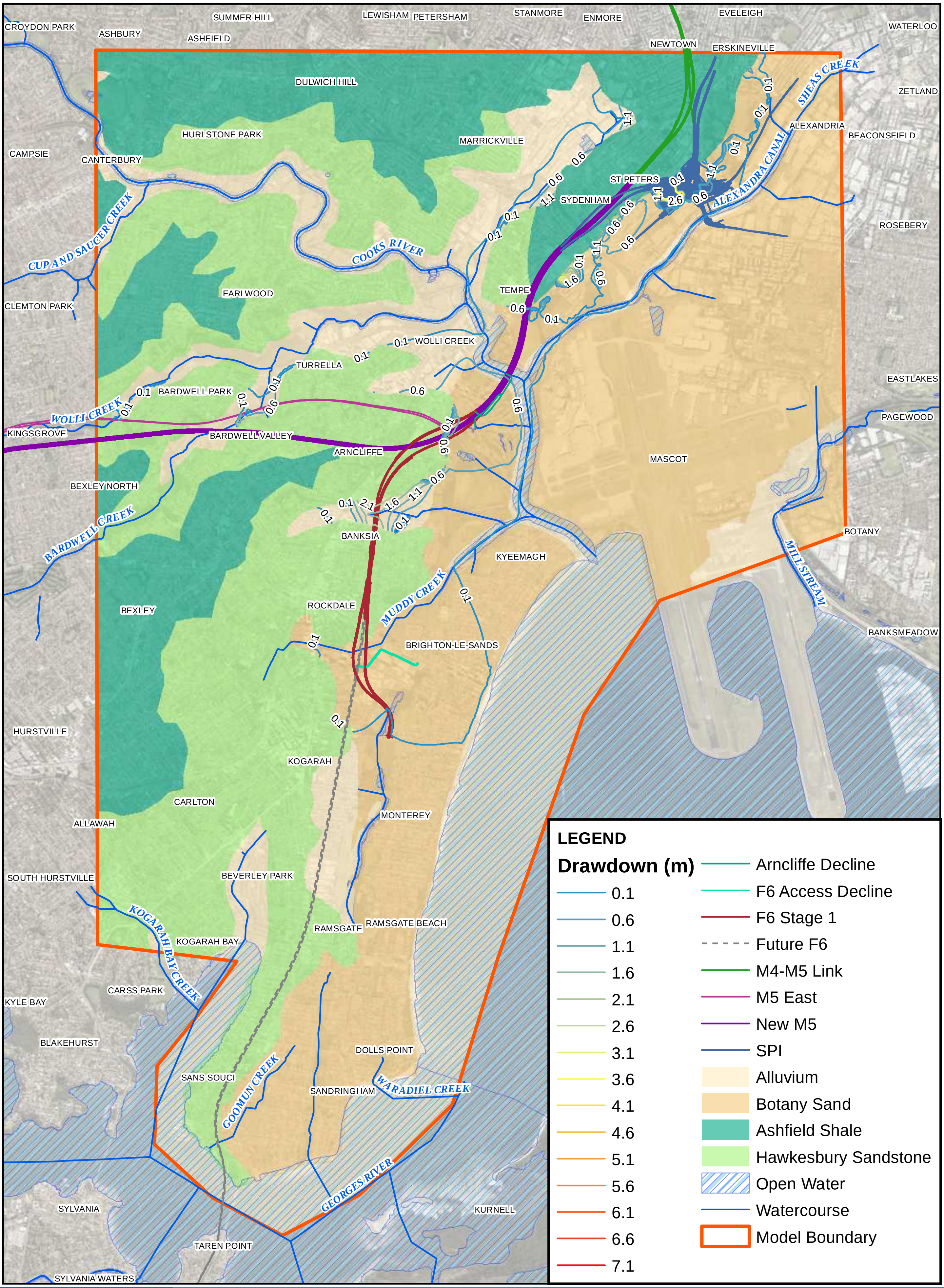

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Figure 66
Cumulative Drawdown at Project Opening
Unconsolidated Sediments

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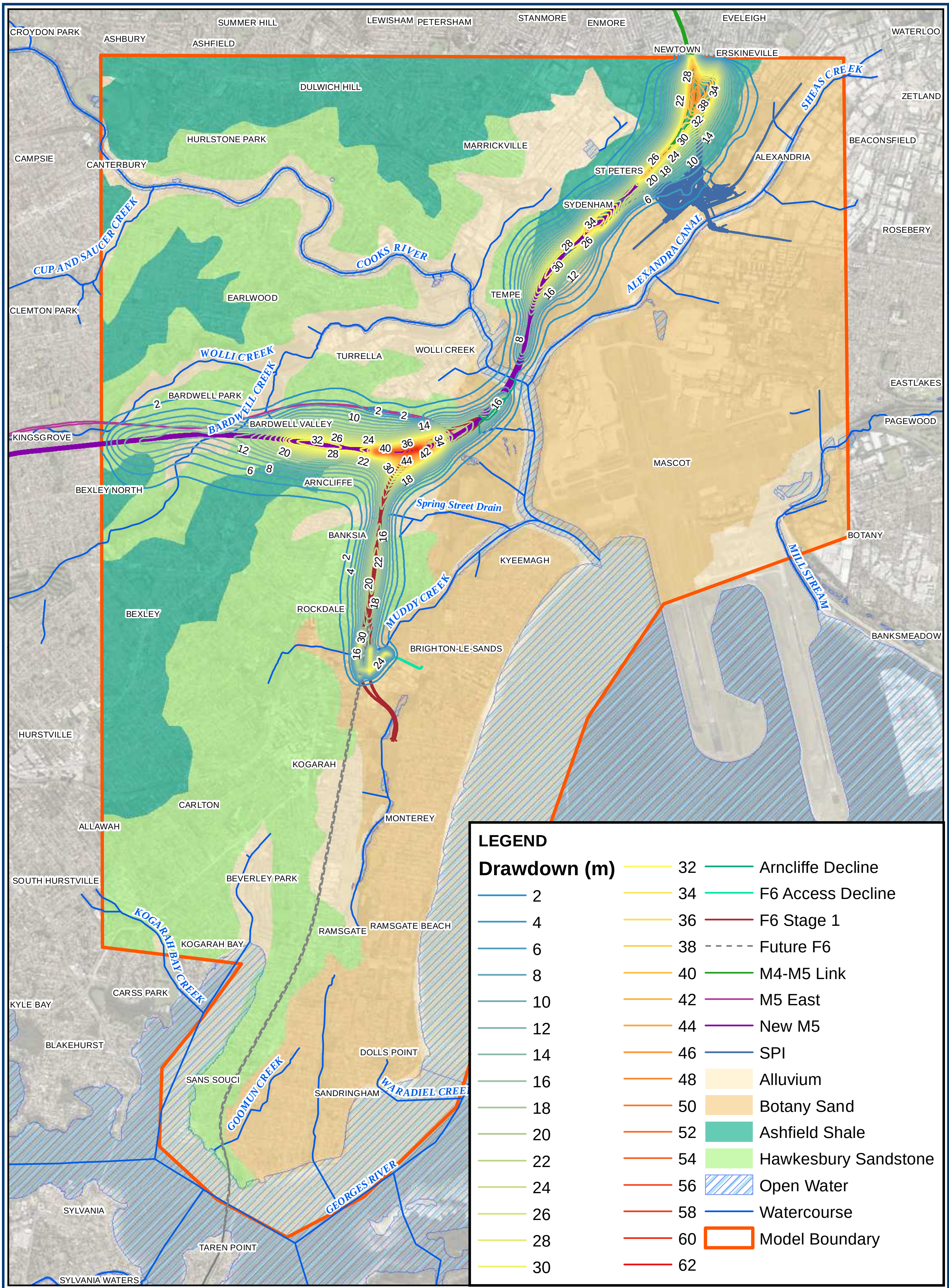

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Figure 67
Cumulative Drawdown at Project Opening Hawkesbury Sandstone

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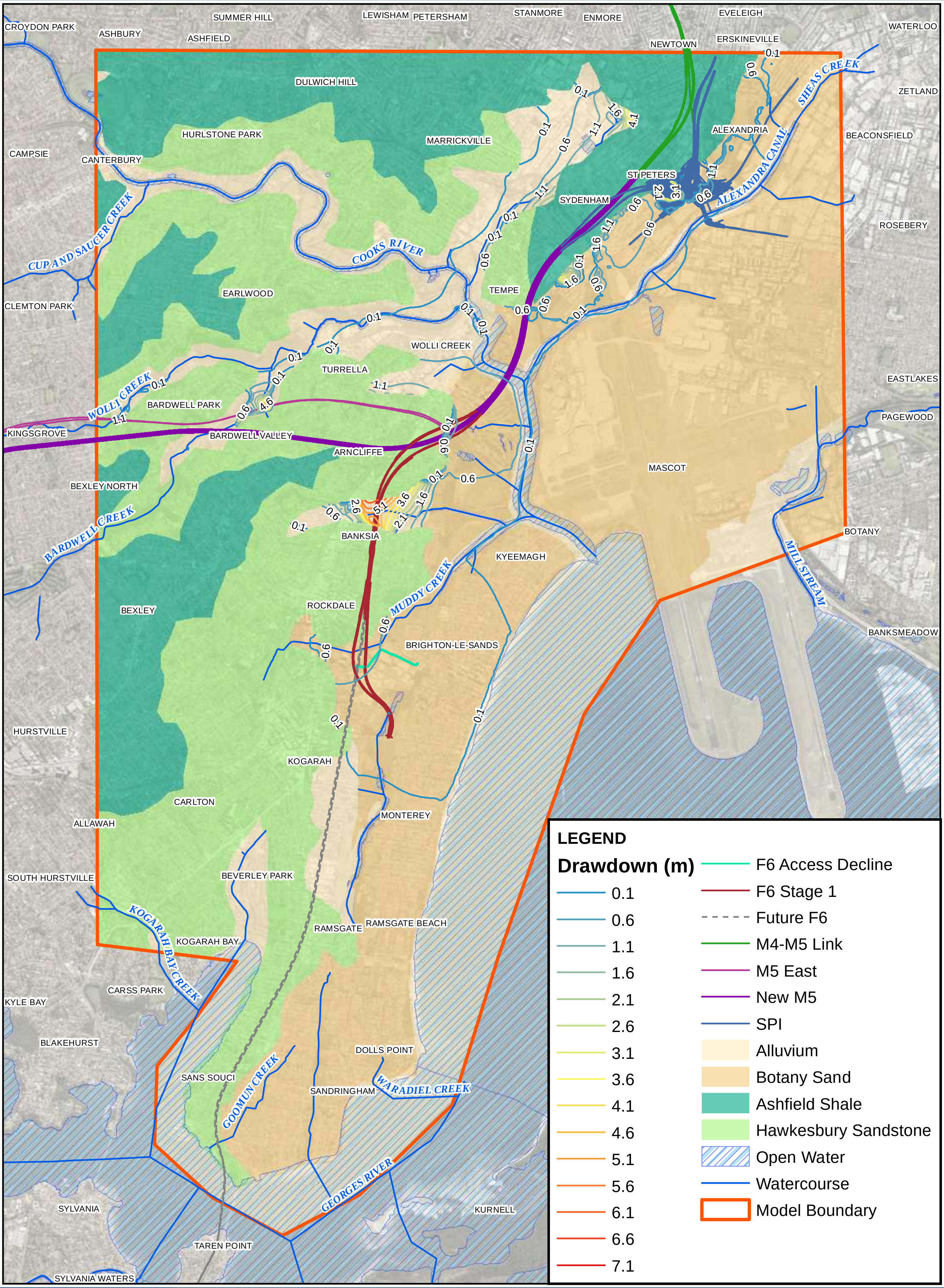
6.3.2 Long Term Drawdown

Cumulative long term drawdown in the unconsolidated sediments (Figure 68) reaches a maximum of 7.5 m in the Spring Street Drain alluvium. The drawdown in the unconsolidated sediments to the south of the Spring Street Drain are not affected by cumulative drawdown, and remain at a maximum drawdown of 0.6 m above the decline. Additional drawdown of up to 0.8m occurs in the Botany Sands between the New M5 Alignment and Cooks River/Alexandra Canal. A localised maximum predicted drawdowns of 4m occurs at Tempe, but this drawdown is a result of the WestConnex tunneling only.

In the Hawkesbury Sandstone (Figure 69), maximum long term drawdown of 62 m is predicted at Arncliffe as a result of the joining of the Project to the New M5 tunnel stubbs. The drawdown extent reaches up to 650m either side of the tunnels, with the widest drawdown extent south of the New M5 in the Arncliffe/Bardwell Valley area.



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GDA 1994 MGA Zone 56

0 250 500 1,000 1,500 2,000 m

Figure 68
Cumulative Drawdown at 2100 Unconsolidated Sediments

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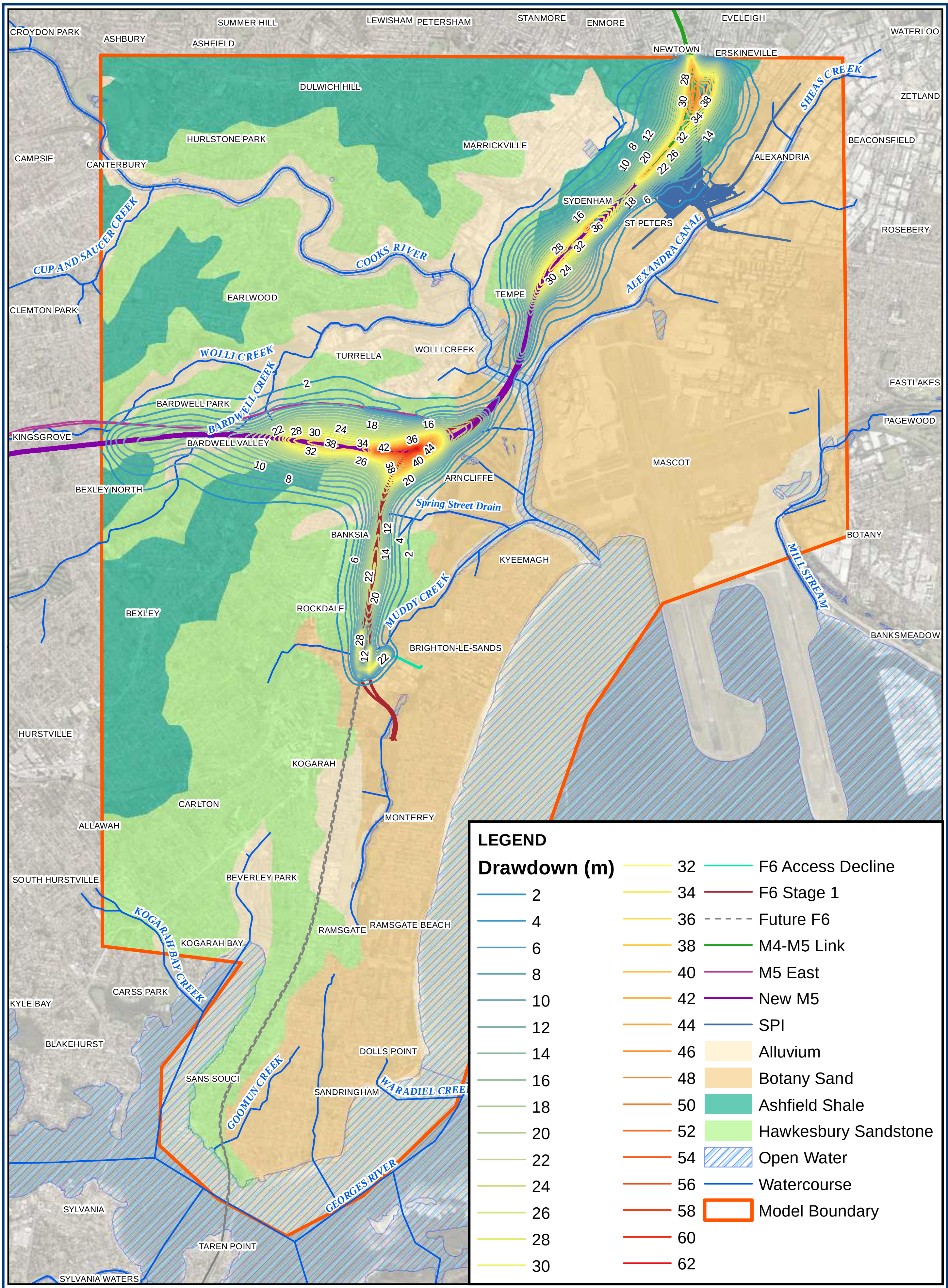

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Created by: CT
Source: RPS 2018

Figure 69
Cumulative Drawdown at 2100
Hawkesbury Sandstone

6.4 Predicted Impacts on Stream Flow

6.4.1 Baseflow

Baseflow is defined here as the groundwater that discharges to a creek or a river and occurs when the groundwater elevation is higher than the stage of the river. Modelled changes in baseflow for the major rivers simulated in the model are summarized in Table 34 for the impact on baseflow at project opening in 2024 and Table 35 for the long-term impact on baseflow (at 2100). The actual proportion of total stream flow attributed to groundwater baseflow was unable to be determined for any streams as part of this study due to lack of gauging data and therefore any absolute volume of baseflow predicted by the model is highly uncertain. However, as the channels are identically represented in each model scenario, the assessment of relative changes of impacts due to the project are likely to be representative, as per Barnett et al., 2012.

The two channels that are forecasted to have the highest baseflow reduction due to the Project include Muddy Creek and Spring Street Drain, however both are concrete lined and tidally influenced over much of their reach. Therefore, the baseflow contribution to total stream flow is expected to be a negligible proportion, with the majority of streamflow coming from surface run-off and tidal waters at low elevation. Of this small proportion, there is a predicted 11.5% and 28.4% reduction in baseflow at the end of construction for the two channels respectively, increasing to 11.6% and 36.4% with the cumulative impacts from WestConnex. Wolli Creek and Bardwell Creek (unlined, natural channels in the vicinity of the tunneling) are not predicted to be impacted by the project. Baseflow reductions of 8.6% and 15% are predicted for Wolli and Bardwell Creeks respectively, with this being entirely attributable to the New M5 tunneling.

With long-term operation, the project is predicted to have an ongoing effect of reducing existing baseflow volumes by 20.4% and 40.5% in Muddy Creek and Spring Street Drain, with an increase to 20.8% and 56.0% under cumulative operations with WestConnex. Wolli Creek is predicted to have a 15.9% long-term reduction in baseflow, and Bardwell Creek 13.2% due to the operation of the New M5 Tunnels.

Table 34 Predicted Changes in Baseflow at the End of Construction

		Muddy Creek	Spring Street Drain	Cooks River	Wolli Creek	Bardwell Creek
Base Case	Baseflow m3/day	29.9	198.8	10.6	106.6	126.1
Project	Baseflow m3/day	26.5	142.4	10.6	106.6	126.1
	Reduction in baseflow m3/day	3.4	56.4	0.0	0.0	0.0
	% reduction	11.5	28.4	0.0	0.0	0.0
Cumulative	Baseflow m3/day	26.5	126.4	10.6	97.4	107.2
	Reduction in baseflow m3/day	3.5	72.4	0.0	9.2	18.9
	% reduction	11.6	36.4	0.0	8.6	15.0

Table 35 Predicted Long-Term Changes in Baseflow

		Muddy Creek	Spring Street Drain	Cooks River	Wolli Creek	Bardwell Creek
Base Case	Baseflow m3/day	36.6	139.8	14.1	55.6	103.7
Project	Baseflow m3/day	29.2	83.2	14.1	55.6	103.7
	Reduction in baseflow m3/day	7.4	56.6	0.0	0.0	0.0
	% reduction	20.4	40.5	0.0	0.0	0.0
Cumulative	Baseflow m3/day	29.0	61.5	14.1	46.7	90.1
	Reduction in baseflow m3/day	7.6	78.3	0.0	8.8	13.7
	% reduction	20.8	56.0	0.0	15.9	13.2

6.4.2 Leakage

Leakage is the process of water exiting the surface water flow channel and recharging the groundwater. In this model it is restricted by a low stream bed conductivity of 0.001 m/day, a value arbitrarily applied to represent the degraded lining of the majority of water-courses in the study area. Upper Wolli Creek and Bardwell Creek have natural stream beds and a bed sediment conductivity of 0.1 m/day was applied for these. An increase in leakage from the creeks occurs when the drawdown due to tunneling lowers the groundwater elevation to below the creek stage. All simulated creeks (except Bardwell Creek) have a tidal influence in the areas where tunneling will occur, therefore the leakage from these water courses induced as a result of tunneling is likely to have an electrical conductivity approaching that of sea-water which will mix with the groundwater in alluvium. Modelled changes in leakage for the major rivers simulated in the model are summarized in Table 36 at project opening in 2024 and Table 37 for the long-term change in leakage (at 2100).

At the end of construction there is predicted to be no change in the leakage from Muddy Creek and Spring Street Drain, suggesting that the localized drawdown does not reduce the groundwater level below the channel level. Long term drawdown in the Spring Street Drain alluvium results in a long term leakage increase of 309%. Lesser drawdowns at Muddy Creek result in a 2.8% increase in leakage, with a minor increase due to the WestConnex tunnels. Bardwell Creek, which is a natural creek under which the New M5 tunnels pass, has an increased leakage of 91.8% at the end of construction and 76.6% long term.

Table 36 Predicted Changes in Leakage at the End of Construction

		Muddy Creek	Spring Street Drain	Cooks River	Wolli Creek	Bardwell Creek
Base Case	Leakage m3/day	2.6	1.0	0.8	1.4	39.1
Project	Leakage m3/day	2.6	1.0	0.8	1.4	39.1
	Increase in Leakage m3/day	0.0	0.0	0.0	0.0	0.0
	% increase	0.0	0.0	0.0	0.0	0.0
Cumulative	Leakage m3/day	2.6	1.0	0.8	1.4	75.0
	Increase in Leakage m3/day	0.0	0.0	0.0	0.0	35.9
	% increase	0.0	0.0	0.0	0.0	91.8

Table 37 Predicted Long-Term Changes in Leakage

		Muddy Creek	Spring Street Drain	Cooks River	Wolli Creek	Bardwell Creek
Base Case	Leakage m3/day	3.4	1.1	12.1	3.4	74.8
Project	Leakage m3/day	3.5	4.4	12.1	3.4	74.8
	Increase in Leakage m3/day	0.1	3.3	0.0	0.0	0.0
	% increase	2.8	308.9	0.0	0.1	0.0
Cumulative	Leakage m3/day	3.5	4.4	12.1	6.4	132.0
	Increase in Leakage m3/day	0.1	3.3	0.0	3.0	57.3
	% increase	2.9	309.2	0.0	88.0	76.6

6.5 Predicted Take from Botany Sands

Groundwater within the Botany Sands is known to have areas of contamination resulting from past and present industrial activities, therefore any groundwater drainage induced from the Botany Sands due to tunneling has the potential to cause localised spreading of contamination. The project intercepts the Botany Sands at Brighton-le-Sands and underlies the Botany Sands at Arncliffe and the project and cumulative tunneling with the WestConnex New M5 works will result in drawdown of water levels in the Botany Sand.

Predicted take from the Botany Sands is shown in Table 38. At project opening, there is a 0.22 ML/day take due to the project, and 0.46 ML/day inclusive of WestConnex. Long-term take stabilizes at 0.14 ML/day for the project and 0.36 ML/day for the cumulative works. This volume is calculated using ZoneBudget (Harbaugh, 1990) as the difference between flow volumes from the Botany Sands to the Hawkesbury Sandstone for the model scenarios. These volumes are representative of water moving out of the Botany

Sands due to the tunneling into the intermediate zone (Hawkesbury Sandstone) between the sands and the tunnels, but do not represent the exact volume of water inflowing to the tunnels at a given time. As a worst-case scenario for consideration of management of inflow water quality, if all the water drained from the Botany Sands were to reach the tunnels, it would equate to roughly 50% of the tunnel inflow at project opening and 25% of the total tunnel inflows long term.

Table 38 Predicted Take from Botany Sands

	F6 Extension		Cumulative Works	
YEAR	ML/day	Total ML	ML/day	Total ML
2016	0.00	0	0.00	0
2017	0.00	0	0.09	32
2018	0.00	0	0.19	100
2019	0.00	0	0.21	177
2020	0.03	13	0.23	260
2021	0.10	50	0.33	379
2022	0.22	131	0.46	546
2023	0.21	207	0.45	709
2024	0.20	280	0.44	869
2025	0.17	343	0.42	1021
2030	0.14	611	0.36	1715
2040	0.14	1087	0.36	3026
2050	0.14	1574	0.36	4347
2100	0.14	3992	0.36	10849

6.6 Predicted Impacts on GDEs

There are no high priority GDEs identified within the study area, however there are several wetlands identified as potential GDEs in the BoM GDE Atlas (Section 3.6). The majority of potential GDEs are associated with man-made ponds and topographical lows collecting surface runoff, and it is considered that the GDEs are more likely to sustain perched water tables in a natural condition. Few of the impacted GDEs are considered as having a high potential for groundwater interaction (as per the BoM GDE Atlas), with the exception of the wetlands at Rockdale Bicentennial Park. The existing wetlands are highly modified, and further modification will be required due to the need to temporarily divert the wetlands during construction of the diaphragm walls at the President Avenue ramp tunnels. The wetlands will be reinstated and remediated after construction, as per AECOM (2018).

The potential for drawdown at these locations has been investigated and the results are shown in Table 39. The NSW Aquifer Interference Policy states that predicted drawdowns of greater than 10% of natural variation will require adaptive management for high priority GDEs (e.g. monitoring and mitigation/remediation during operation), should the project be approved. Natural seasonal variation in monitoring data is in the order of 1 m, therefore the drawdown threshold for predicted impact reporting has been taken as 0.1 m. It should be noted that none of the GDEs described below are of high priority, however drawdown is reported for completeness.

Twenty of the 32 potential GDEs located within the model boundary (Section 3.6) would experience drawdowns of greater than 0.1 m if they are in direct hydraulic connection with the regional water table. The Rockdale Bicentennial Park GDEs are predicted to have drawdowns of up to 0.32 m due to the project (not inclusive of any impacts associated with the temporary diversions due to construction) and up to 0.12 m at Scarborough Park south of President Avenue. There is no additional drawdown at these GDE locations due to cumulative works with WestConnex. The New M5 tunneling is predicted to cause drawdown at a number of GDEs in Bardwell Valley, which has been assessed as part of the previous EIS for this project. There are no additional drawdown impacts due to the Project at the locations predicted to be impacted by the New M5.

Table 39 Drawdown >0.1m at Potential GDE Locations

BoM Identifier	Potential for GW Interaction	Location	Project Drawdown		Cumulative Drawdown	
			Opening	2100	Opening	2100
1974035	Moderate	Wolli Creek Turrella	0.00	0.00	0.01	0.10
1974416	High	Wolli Creek Turrella	0.00	0.00	0.04	0.13
1974071	Moderate	Wolli Creek Turrella	0.00	0.00	0.01	0.10
1974540	High	Wolli Creek Turrella	0.00	0.00	0.02	0.10
1975149	Low	Bardwell Valley Golf Club	0.00	0.00	4.03	4.19
1975200	Moderate	Bardwell Valley Golf Club	0.00	0.00	4.62	4.93
1975206	Low	Bardwell Valley Golf Club	0.00	0.00	5.05	5.33
1975211	Moderate	Bardwell Valley Golf Club	0.00	0.00	7.71	10.53
1975237	Moderate	Bardwell Valley Golf Club	0.00	0.00	6.88	6.97
1975262	Moderate	Bardwell Valley Golf Club	0.00	0.00	4.25	4.51
1975273	Low	Bardwell Valley Golf Club	0.00	0.00	17.22	17.45
1975433	Moderate	Bardwell Valley Stotts Reserve	0.00	0.00	23.56	23.61
1975481	Moderate	Bardwell Valley Stotts Reserve	0.00	0.00	24.64	24.69
1976242	Moderate	Bardwell Valley Parklands	0.00	0.00	0.41	0.51

BoM Identifier	Potential for GW Interaction	Location	Project Drawdown		Cumulative Drawdown	
			Opening	2100	Opening	2100
1978363	High	Rockdale Bicentennial Park	0.19	0.32	0.19	0.32
1978514	High	Rockdale Bicentennial Park	0.02	0.28	0.02	0.28
1978549	High	Rockdale Bicentennial Park	0.02	0.27	0.02	0.27
1978643	Low	Rockdale Bicentennial Park	0.10	0.23	0.10	0.23
1979115	Moderate	Scarborough Park	0.01	0.11	0.01	0.11
1979157	Moderate	Scarborough Park	0.02	0.12	0.02	0.12

6.7 Predicted Impacts at Key Wetlands

Wetlands that do not have any listed potential groundwater dependency (as per the BoM GDE Atlas) have also been assessed to determine potential drawdown (Table 40). Key wetlands in the Project corridor from north to south include the Marsh Street, Eve Street, Spring Street, Landing Lights and King Street wetlands (Rockdale and Scarborough wetlands are assessed in Section 6.6.). Drawdown of greater than 0.1 m (~10% of seasonal groundwater level fluctuation) is predicted to occur as a result of the Project at all these wetlands at the time of project opening (September 2024), ranging from 0.11 m at Landing Lights wetland to 0.33 m at the Marsh Street wetlands, increasing to 0.28 m at Landing Lights and 0.47 m at Marsh Street in the long-term.

As would be expected, the greatest cumulative impacts with the WestConnex tunnels are to wetlands in Arncliffe, with cumulative drawdown decreasing southwards away from the interface between the two projects. The largest cumulative drawdowns of 0.83 m at 2024 and 1.03 m long-term are predicted at the Marsh Street wetlands. Eve Street wetlands are predicted to have a cumulative drawdown of 0.69 m at 2024 and 0.89 m by 2100. Spring Street wetlands are predicted to have a cumulative drawdown of 0.36 m at 2024 and 0.56 m by 2100. Landing Lights wetlands are predicted to have a cumulative drawdown of 0.24 m at 2024 and 0.43 m by 2100. The King Street wetland is not expected to be affected by cumulative impacts due to WestConnex, with drawdowns of 0.23 m at 2024 and 0.36 m at 2100 being entirely attributable to the F6 Stage 1 works.

Table 40 Drawdown at Wetlands

Wetland	Project Drawdown		Cumulative Drawdown	
	Opening	2100	Opening	2100
Marsh St	0.33	0.47	0.83	1.03
Eve St	0.28	0.42	0.69	0.89
Spring Street	0.15	0.33	0.36	0.56
Landing Lights	0.11	0.28	0.24	0.43
King Street	0.23	0.36	0.23	0.36

6.8 Predicted Impacts on Existing Groundwater Users

Drawdown due to the construction and operation of the overall WCX works would affect 7 registered groundwater abstraction bores, screened within the Alluvium and Hawkesbury Sandstone (Table 41). Under the NSW Aquifer Interference Policy, make good provisions are required where drawdown greater than 2m occurs at to a water supply bore. Five bores are predicted to have greater than 2m drawdown due to the F6 Stage 1 tunneling, and 7 bores are predicted to have greater than 2m drawdown with cumulative drawdown from WestConnex.

One bore (GW072161) has a significant drawdown of 65.12 m at the end of construction resulting from the cumulative drawdown caused by the New M5 and F6 projects, including the continued use of the New M5 decline at Arncliffe during the construction of F6 Stage 1. However, this bore is situated within the line of the New M5 mainline tunnels, thus it is expected this bore will be destroyed (if not already) during new M5 tunneling at Arncliffe.

Three bores (GW024062, GW023194 and GW110735) are expected to have water levels drawn down below the base of the bore, which will mean they will no longer be able to operate without being deepened. The remaining impacted bores (GW108295, GW108439 and GW110735) are also likely to have compromised ability to abstract water over time as they are shallow bores (8m deep) screened in the alluvium.

Figure 70 and Figure 71 show the impacted bores and drawdown in the Alluvium and Hawkesbury Sandstone respectively.

Drawdown predicted at all registered bore locations is presented in Appendix B.

Table 41 Drawdown >2m at Registered Abstraction Bore Locations

Reg. Bore ID	Depth (m)	Use	Screened Geology	Easting	Northing	Project Drawdown		Cumulative Drawdown	
						Opening	2100	Opening	2100
GW024062	3.6	Water Supply	Alluvium	328680	6242384	0.99	3.78	1.21	4.14
GW108295	8.0	Domestic	Alluvium	328907	6242466	0.45	2.07	0.68	2.42
GW108439	8.0	Domestic	Alluvium	328893	6242478	0.57	2.32	0.89	2.79
GW110735	8.0	Domestic	Alluvium	328935	6242529	0.56	2.16	0.91	2.67
GW023194	4.8	Water Supply	Sandstone	329156	6242811	1.86	2.51	3.58	4.47
GW072161	90.5	Recreation	Sandstone	329636	6243437	3.18	1.57	65.12	63.49
GW107993	13.6	Recreation	Sandstone	328242	6243424	0.03	0.36	8.98	14.29

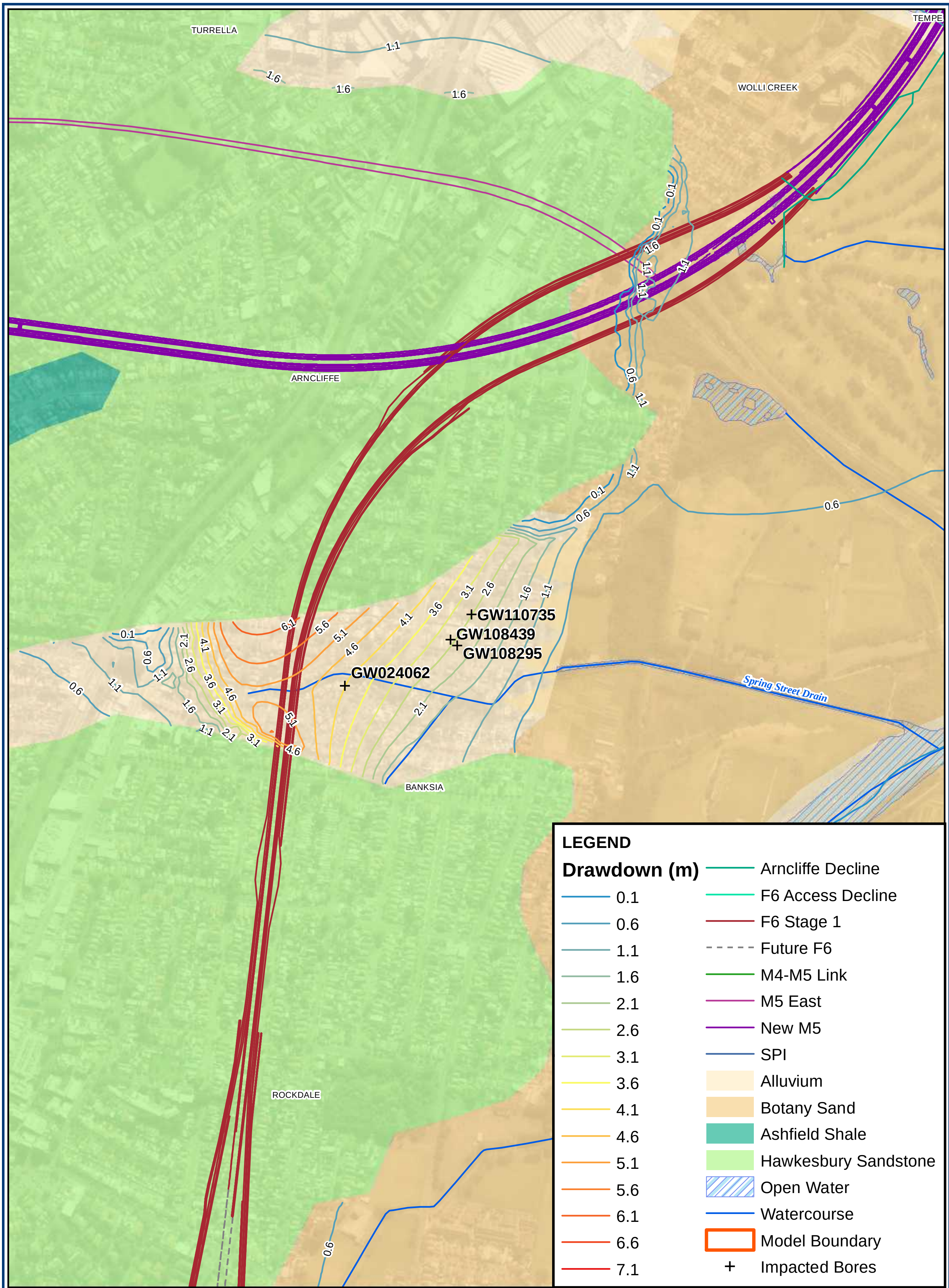

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Figure 70
Registered Bores >2m Drawdown
Unconsolidated Sediments

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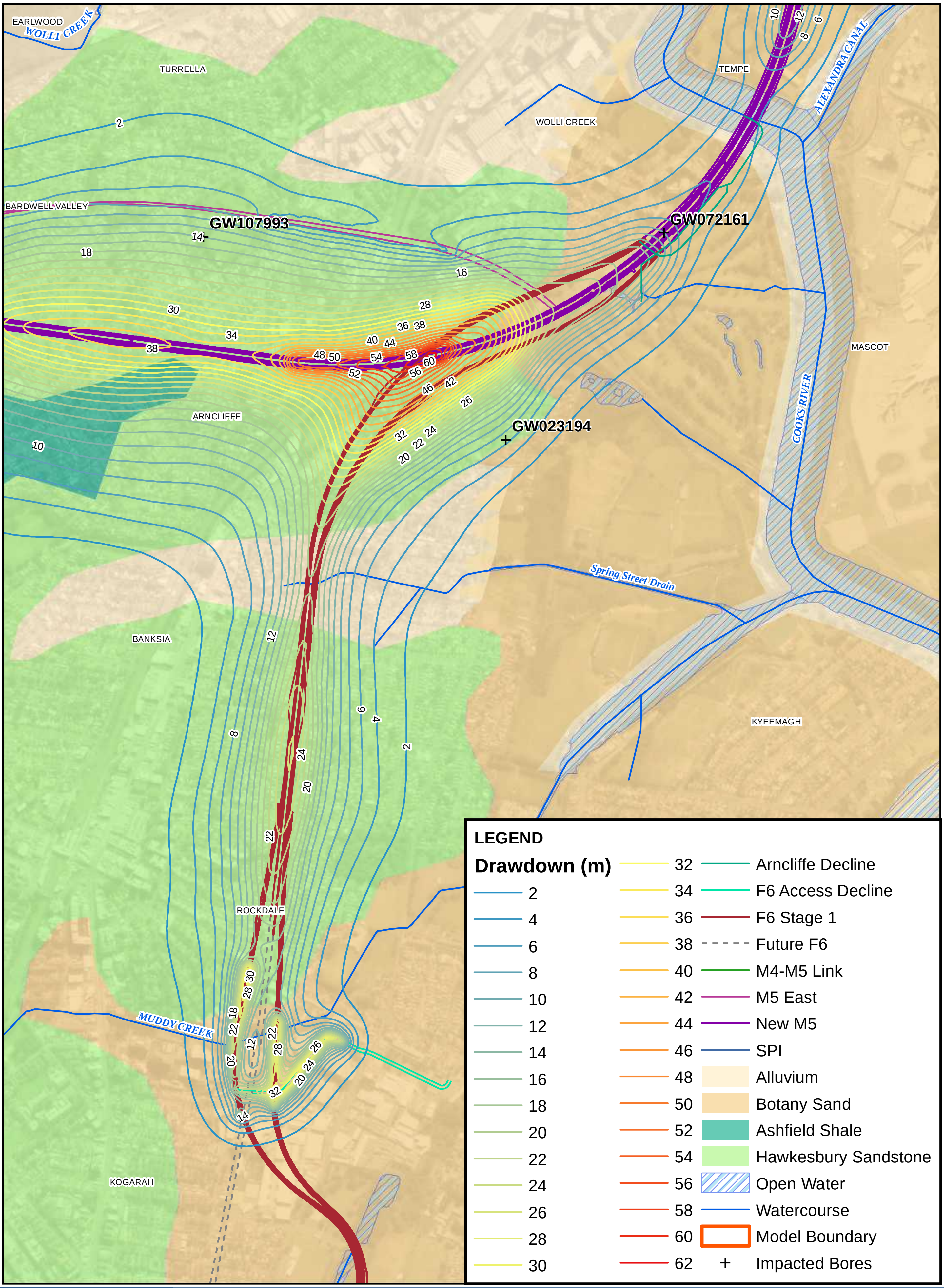

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GDA 1994 MGA Zone 56

0 75 150 300 450 600 m

Figure 71
Registered Bores >2m Drawdown
Hawkesbury Sandstone

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6.9 Predicted Impacts on Groundwater Quality

It is not possible to quantify volumes or concentrations of saline[3]/contaminated water entering the tunnels at any given time using the groundwater flow model created for the Project; therefore the following discussion of potential for saltwater intrusion is qualitative only.

The backwards particle tracking analysis undertaken in Section 5.5 indicates that water from tidal alluvial areas (likely to have similar salinity to seawater) and the western-most area of the Botany Sands will enter the tunnel. This will happen rapidly at Rockdale and Banksia where the tunnel passes directly through and beneath the Botany Sands and alluvium, but will take in the order of 10 to 100 years for the New M5 project which lies approximately 200m west of the Botany Sands extent. The capture zone differs from the drawdown area shown in **Section 6.2.** The reported drawdown reflects the area where the hydraulic gradient has been changed due to tunnelling, while the capture area shows where the water that ultimately enters the tunnel originates from, and is controlled by both regional flow and localised drawdown. All water within the capture zone will at some stage enter the drawdown cone of depression and increase in velocity due to the increased hydraulic gradient towards the tunnel associated with the drawdown. Areas where drawdown brings the groundwater level to below sea level (approximately 0-1 mAHD) will have ingress of water from tidal areas over time due to a reversal of hydraulic gradient away from the natural groundwater discharge areas.

Table 42 summarises the travel times computed from each major alluvial area and Botany Sands to the tunnels. These times are based on the end-point time for all path-lines and do not include intermediate times. Saline water from areas of alluvium is predicted to flow into the tunnels in time frames varying from days to thousands of years. Early saline/poor quality inflows are expected from water in the Botany Sands in areas where the tunnel is directly beneath the Botany Sands (F6 Access Decline and President Avenue ramps). The volume of saline water is expected to increase with time as water is drawn from more distant areas of the alluvium.

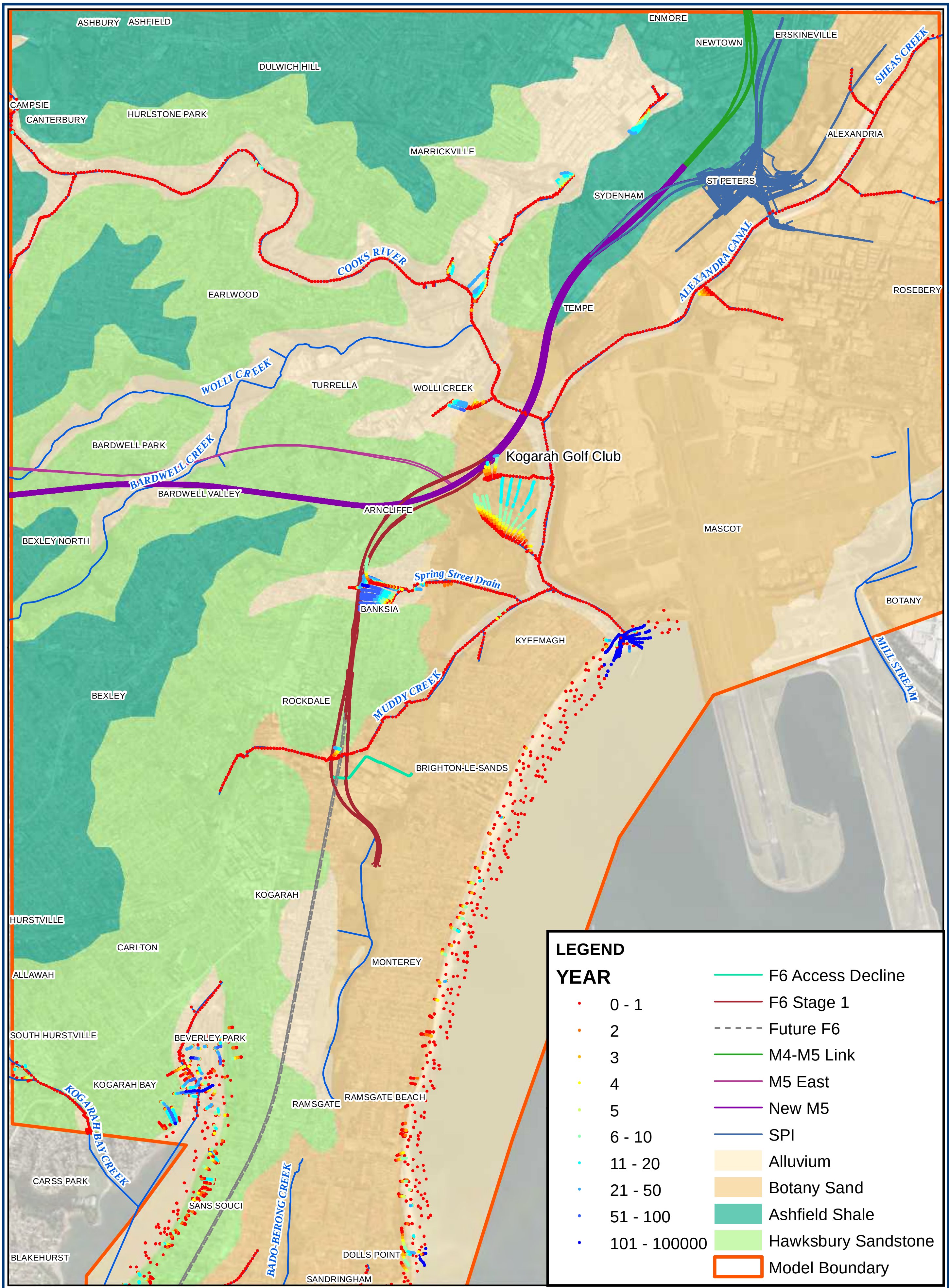
Table 42 Travel Times from Major Alluvium Areas (Backward Tracking)

Alluvium Area	Tunnel Entering	Minimum Time	Maximum Time	Average Time
Spring Street Drain	F6 Mainline	31 Years	171 Years	46 Years
Lower Cooks River / Alexandra Canal	New M5/St Peters Interchange	14 Years	155 Years	80 Years
Wolli Creek	New M5	117 Years	195 Years	150 years
Bardwell Creek	New M5	9 Years	57 Years	34 Years
Botany Sands	F6 Mainline and decline, New M5	0 Days	>1,000 Years	127 Years

Forward tracking from tidal watercourses has been used to identify where there is potential for water to be drawn towards the tunnels from these saline water bodies, and therefore potential for saline intrusion to occur into the aquifer between the saline water body and the tunnels. Figure 72 and Figure 73 show the

3 Note the term “saline” as used in this discussion refers to water of greater quantities of dissolved salts than the average regional water quality due to mixing with tidal waters, and is not representative of a specific range in concentrations

travel pathways of water originating in the tidal watercourses. They show that there is potential for saline intrusion of tidal waters to impact the water quality of natural groundwater at the location of the Spring Street Drain and in the aquifer at Arncliffe, particularly in the vicinity of Kogarah Golf Club, which may affect the ability of groundwater to be used for irrigation. Saline waters of Botany Bay are not predicted to be drawn towards the tunnels (i.e. no saline intrusion from Botany Bay will occur), with the gradient near to Botany Bay remaining towards the coast.



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Source: RPS 2018

GDA 1994 MGA Zone 56

0 200 400 800 1,200 1,600 m

Figure 72
Forward Tracking From Tidal Areas Travel Times

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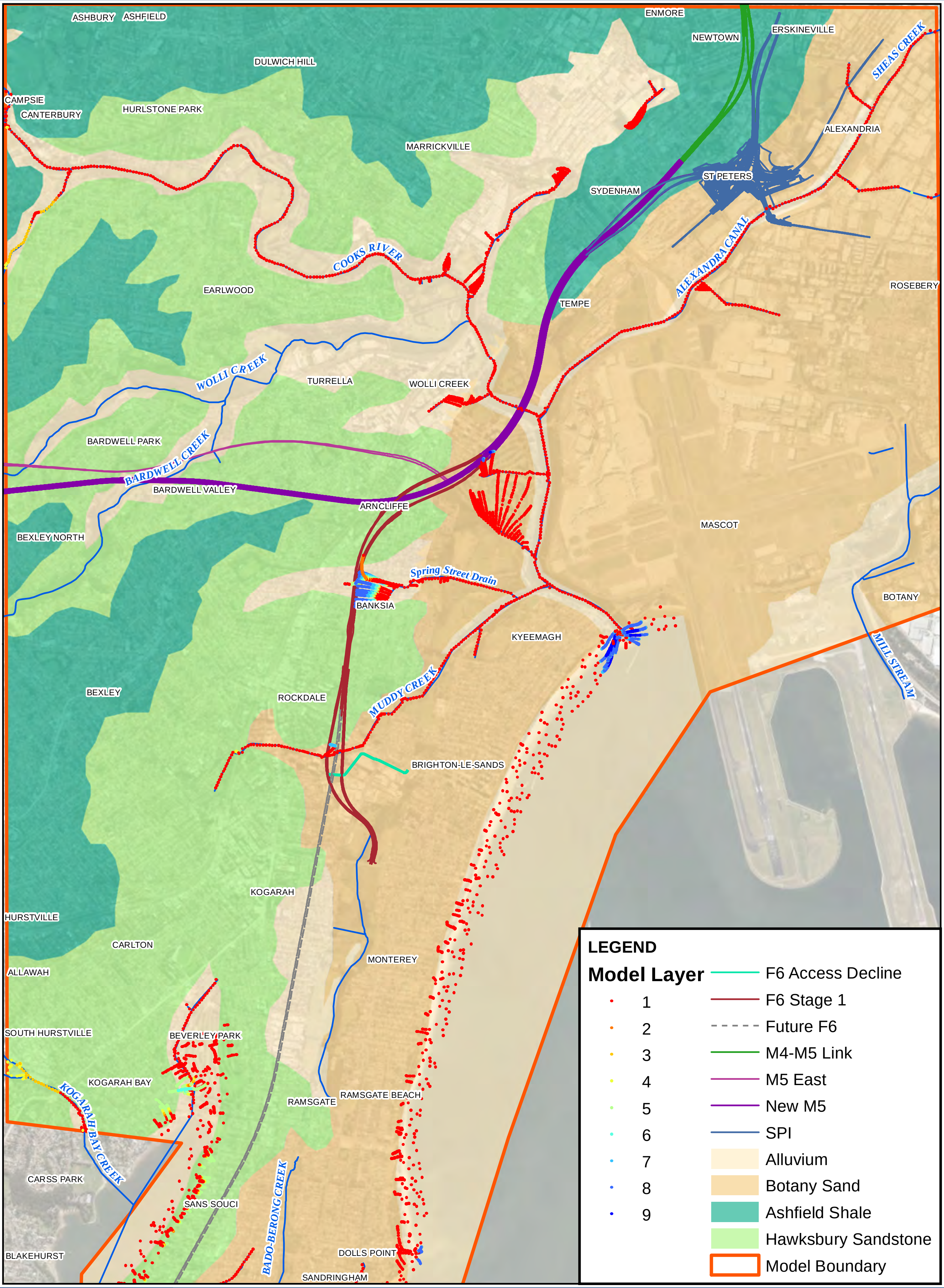

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Figure 73
Forward Tracking From Tidal Areas Model Layer

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7 Sensitivity and Uncertainty Analysis

7.1 Sensitivity Analysis Approach

Broadly, sensitivity is defined as the change in an output quantity as a result of the change in an input quantity. In groundwater modelling, sensitivity testing is done intrinsically during the calibration process by varying one model parameter to establish a closeness of fit to the calibration dataset. The model was calibrated with the objective of minimising the sum of squared residuals error, where the residuals are the difference between head observations and equivalent modelled outputs; therefore the sensitivity of the objective function to the change in model parameters governs the calibration success. Due to model non-uniqueness, whereby multiple combinations of parameters may be equally good at fitting historical measurements, there is inherent uncertainty in the parameterisation of the groundwater model. This parameter uncertainty leads to an uncertainty in model predictions.

The focus of the following sensitivity and uncertainty analyses is to investigate any increase or decrease in potential impacts for the purposes of decision making and groundwater management for F6 Stage 1 tunnels.

To assess the model sensitivity to parameter changes and to give an indication of the uncertainty range of impact predictions, a series of model variations have been simulated as per Table 43 below.

Table 43 Sensitivity Model Run Details

Run	Explanation	Rationale
Kv -1 order	Decrease the vertical hydraulic conductivity of the Ashfield Shale and Hawkesbury Sandstone (all layers) by 1 order of magnitude	Reduce vertical propagation of drawdown
Kv +1 order	Increase the vertical hydraulic conductivity of the Ashfield Shale and Hawkesbury Sandstone (all layers) by 1 order of magnitude	Increase vertical propagation of drawdown
Ss -1 order	Decrease the specific storage of the Ashfield Shale and Hawkesbury Sandstone (all layers) by 1 order of magnitude	Decrease inflows, increase speed of drawdown propagation
Ss +1 order	Increase the specific storage of the Ashfield Shale and Hawkesbury Sandstone (all layers) by 1 order of magnitude	Increase inflows, decrease speed of drawdown propagation
Faults	Include faults and dykes simulated in Golder (2017)	Assess sensitivity of model calibration and inflows to presence of faults
Sy -20%	Decrease the specific yield of all layers by 20%	Decrease inflows
Sy +20%	Increase the specific yield of all layers by 20%	Increase inflows
Kh -1 order	Decrease the horizontal hydraulic conductivity of the Ashfield Shale and Hawkesbury Sandstone (all layers) by 1 order of magnitude	Reduce horizontal propagation of drawdown
Kh +1 order	Increase the horizontal hydraulic conductivity of the Ashfield Shale and Hawkesbury Sandstone (all layers) by 1 order of magnitude	Increase horizontal propagation of drawdown

The sensitivity analysis was undertaken using an earlier design that did not include the Arncliffe access decline. However, inclusion of the Arncliffe decline had minimal impact on the results reported in previous chapters and upon discussion with the AECOM project team it was considered that the sensitivity study does not need to be re-visited for the updated design.

7.2 Calibration Sensitivity

The model calibration sensitivity to the changes in parameters is discussed in the following sections for steady-state and transient calibration. The calibration "success" can be determined by assessing the key statistics in the following tables, with the lower number (closest to zero) representing a closer fit to data (except in the case of number of targets within a given accuracy range, in which case 100% is best). It is important to note that the sensitivity analysis changes apply to the calibrated model parameter values only, which in themselves may be non-unique.

7.2.1 Steady-State Calibration Sensitivity Statistics

Calibration statistics for the steady-state sensitivity simulations (Table 44) indicate that although the base-case model has the best overall calibration, the statistics for variations in vertical/horizontal hydraulic conductivity and the inclusion of faults also yield reasonable calibration results (i.e. SRMS <10% indicated in MDBC, 2001 and Barnett *et al.*, 2012), suggesting that all runs are plausible. The model is most sensitive to horizontal conductivity in steady-state. The sensitivity runs that involved changing storage parameters have no reported statistics as storage is not applicable to steady-state simulations.

Table 44 Steady-State Calibration Statistics for Sensitivity Runs

Statistic	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy -20%	Sy +20%	Kh -1 order	Kh +1 order
Residual Mean (m)	0.01	0.13	0.15	NA	NA	0.3	NA	NA	-0.48	0.74
RMS Error (m)	1.37	1.8	1.6	NA	NA	1.77	NA	NA	2.07	2.71
Minimum Residual (m)	-3.9	-4.02	-4.31	NA	NA	-3.34	NA	NA	-12.47	-4.24
Maximum Residual (m)	4.84	9.91	6.23	NA	NA	11.84	NA	NA	7.4	23.07
Scaled RMS Error %	4.5	5.9	5.2	NA	NA	5.8	NA	NA	6.7	8.8
% Targets within ±1m	63%	62%	61%	NA	NA	62%	NA	NA	58%	60%
% Targets within ±2m	83%	83%	81%	NA	NA	83%	NA	NA	83%	78%
% Targets within ±5m	100%	98%	98%	NA	NA	98%	NA	NA	96%	94%

7.2.2 Transient Calibration Sensitivity Statistics

Generally, the transient sensitivity results indicate that the model is least sensitive to storage changes (both specific storage and specific yield) and most sensitive to changes in hydraulic conductivity, with horizontal conductivity again having a higher sensitivity than vertical (Table 45). The transient calibration statistics for the variation in horizontal Kh (both increase and decrease by one order of magnitude) result in a scaled SRMS >10%, suggesting the results from this simulation are less likely to be representative. Again, it is worth noting that the horizontal conductivity values could be likely be successfully calibrated if other model parameters, particularly recharge, were changed at the same time (i.e. non-uniqueness). The addition of faults reduces the calibration success slightly but remains within a plausible calibration range.

Table 45 Transient Calibration Statistics for Sensitivity Runs

Statistic	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy -20%	Sy +20%	Kh -1 order	Kh +1 order
Residual Mean (m)	0.2	0.57	0.21	0.2	0.13	0.47	0.23	0.18	-0.66	1.34
RMS Error (m)	1.25	1.65	1.46	1.25	1.24	1.3	1.26	1.25	3.54	2.43
Minimum Residual (m)	-3.52	-3.75	-4.43	-3.52	-3.53	-3.2	-3.5	-3.56	-23.47	-3.94
Maximum Residual (m)	4.75	10.81	6.47	4.77	4.59	5.89	5.06	4.53	3.33	12.81
Scaled RMS Error %	6.2	8.2	7.2	6.2	6.1	6.4	6.2	6.2	12.2	12
% Targets within ±1m	66%	74%	63%	65%	66%	66%	66%	66%	58%	63%
% Targets within ±2m	83%	83%	80%	83%	84%	85%	83%	83%	75%	73%
% Targets within ±5m	100%	98%	98%	100%	100%	98%	100%	100%	94%	92%

7.3 Predictive Sensitivity and Uncertainty

The following sections outline the changes to predicted potential impacts of the Project and cumulative impacts using the parameters associated with each sensitivity run. The sensitivity of predictions to the model parameters used for each sensitivity run were assessed using the Relative Percent Difference (RPD) between the base case (calibrated) and subsequent simulations, classified as per Table 46. Maximum and minimum results for sensitivity runs indicate the likely range of “worst-case” and “best-case” impacts respectively, providing an indication of model predictive uncertainty.

Table 46 Relative Per Cent Difference Sensitivity Classifications

Relative Per Cent Difference	Interpretation
RPD < 5%	Not sensitive
5% < RPD < 20%	Low sensitivity
20% < RPD < 50%	Moderate sensitivity
50% < RPD < 100%	High sensitivity
RPD > 100%	Very high sensitivity

7.3.1 Tunnel Inflows

Inflows predicted by each sensitivity run are not fully representative due to the original model having an inflow constrained to a maximum of 1L/sec/km for operational inflows with assumed grouting undertaken as required during construction. In the sensitivity model runs, the drain file (.DRN) was not modified, therefore the inflows are able to increase and decrease relatively with the change in parameters (e.g. aquifer hydraulic conductivity outside of tunnel/ .DRN cells) but are not unrestricted, i.e. the inflows for sensitivity runs do not represent the free-draining (pre-grouting) inflows for each parameter change.

A graphical representation of the change in tunnel inflow predictions relative to the base case modelling reported in Section 5.4 is shown in Figure 74. In summary this shows that increasing horizontal or vertical hydraulic conductivity parameters by one order of magnitude causes the inflows to approximately double, while decreasing the same parameters by one order of magnitude causes inflows to halve. The addition of faults and dykes into the model causes a 40% increase of inflows, while changes to storage properties have a minor effect on predicted results at the time of project opening, and no effect long term, implying inflows for the long-term prediction have reached a steady-state. Actual predicted values for each sensitivity run are tabulated in the following sections.

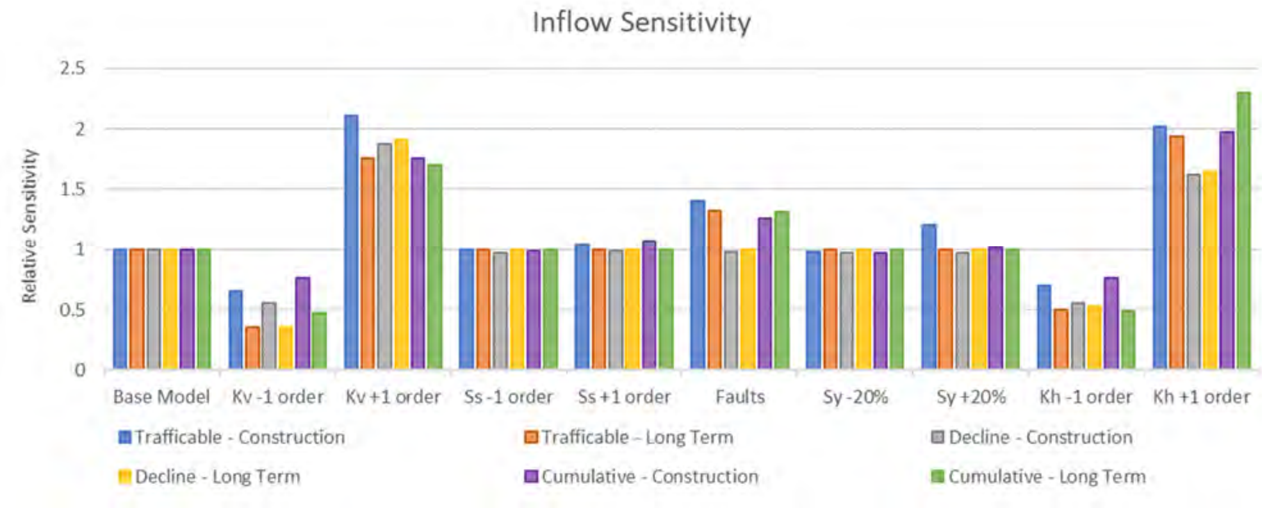


Figure 74 Relative Change of Tunnel Inflow Predictions from Base-Case

Table 47 lists the predicted inflow volumes for each sensitivity run. The maximum inflows to tunnels during Project construction are 2.07 L/sec/km for trafficable tunnels, and 3.64 L/sec/km for the decline. The minimum is 0.64 L/sec/km and 1.07 L/sec/km for the trafficable tunnels and decline respectively. The maximum and minimum inflows are a result of increasing and decreasing the vertical hydraulic conductivity respectively.

The maximum long term inflows to trafficable tunnels are 1.8L/sec/km, and 3.57 L/sec/km for the decline. Minimum inflows are 0.33L/sec/km and 0.67L/sec/km for trafficable and decline tunnels respectively.

Modelled inflows to the cumulative tunnels (Project and WestConnex) vary for each of the sensitivity runs in a similar fashion to that for the Project, with changes to horizontal and vertical hydraulic conductivity most strongly affecting the inflow result.

The maximum cumulative inflows to tunnels during construction are 1.44 L/sec/km for trafficable tunnels, and the minimum is 0.56 L/sec/km. This is lower than the Project inflow rate due to inflows associated with WestConnex being lower than that of the F6 Extension, reducing the total average inflow rate.

The maximum long term cumulative inflow to tunnels is 1.31 L/sec/km and 0.27 L/sec/km is the minimum. Maximum inflows are given by increasing the horizontal hydraulic conductivity by 1 order of magnitude, while minimum values are given by reducing the vertical conductivity.

Table 47 Sensitivity of Tunnel Inflow Predictions

Tunnel Inflows	Trafficable Tunnels Project – Opening (L/sec/km)	Trafficable Tunnels Project - Long Term (L/sec/km)	Decline Tunnel Project - Opening (L/sec/km)	Decline Tunnel Project – Long Term (L/sec/km)	Cumulative - Opening (L/sec/km)	Cumulative - Long Term (L/sec/km)	RPD Trafficable Tunnels Project – Opening (%)	RPD Trafficable Tunnels Project - Long Term (%)	RPD Decline Tunnel Project - Opening (%)	RPD Decline Tunnel Project – Long Term (%)	RPD Cumulative – Opening (%)	RPD Cumulative - Long Term (%)
Base Model	0.98	0.93	1.94	1.87	0.73	0.57	0	0	0	0	0	0
Kv -1 order	0.64	0.33	1.07	0.67	0.56	0.27	-35	-65	-45	-64	-23	-53
Kv +1 order	2.07	1.63	3.64	3.57	1.28	0.97	111	75	88	91	75	70
Ss -1 order	0.98	0.93	1.89	1.87	0.72	0.57	0	0	-3	0	-1	0
Ss +1 order	1.02	0.93	1.91	1.87	0.78	0.57	4	0	-2	0	7	0
Faults	1.38	1.23	1.9	1.87	0.92	0.75	41	32	-2	0	26	32
Sy -20%	0.96	0.93	1.89	1.87	0.71	0.57	-2	0	-3	0	-3	0
Sy +20%	1.18	0.93	1.89	1.87	0.74	0.57	20	0	-3	0	1	0
Kh -1 order	0.69	0.47	1.07	0.99	0.56	0.28	-30	-49	-45	-47	-23	-51
Kh +1 order	1.98	1.8	3.15	3.08	1.44	1.31	102	94	62	65	97	130
Max	2.07	1.8	3.64	3.57	1.44	1.31						
Min	0.64	0.33	1.07	0.67	0.56	0.27						

7.3.2 Drawdown

7.3.2.1 Extent

Sensitivity of maximum drawdown extent predictions in the Hawkesbury Sandstone are summarised in Figure 75 and shown spatially in Figure 76 to Figure 79. A one order reduction in vertical hydraulic conductivity in the Hawkesbury Sandstone (and Ashfield Shale) has the effect of increasing the drawdown (depressurisation) extent by approximately 2 times in the Hawkesbury Sandstone, while increasing the vertical hydraulic conductivity has little impact on the lateral spread of drawdown in the Hawkesbury Sandstone. Reducing the horizontal hydraulic conductivity of the sandstone by one order of magnitude approximately halves the drawdown extent, while increasing the hydraulic conductivity causes a 250% larger drawdown extent in the sandstone resulting from the project, and 350% for the cumulative drawdown. As with tunnel inflows, changes to storage properties have a negligible effect on the drawdown extent, and the addition of faults has a localised effect of increasing drawdown to the south of the New M5 in the Arncliffe area.

The maximum and minimum drawdown extent is governed by the horizontal hydraulic conductivity, with a maximum cumulative extent of 2.3 km to the western side of the tunnels due to a one order increase in horizontal hydraulic conductivity, and a minimum extent of 0.35 km with a one order decrease in horizontal hydraulic conductivity.

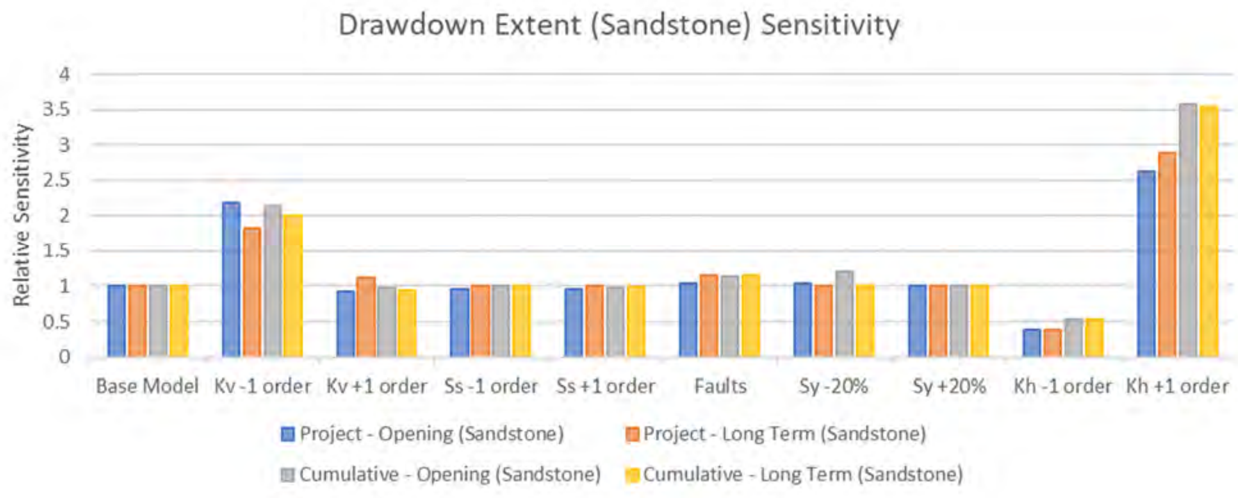
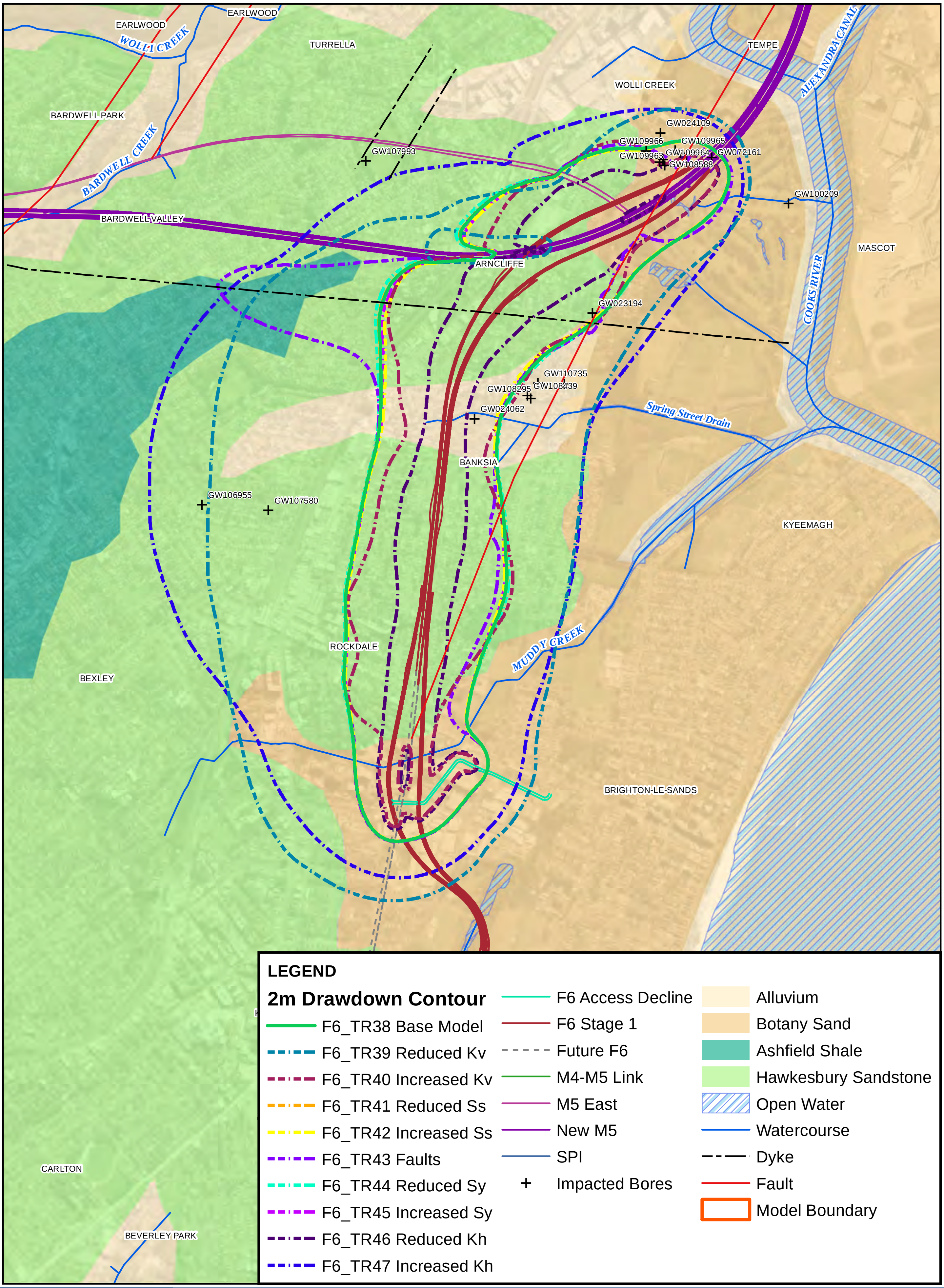


Figure 75 Relative Change of Maximum Hawkesbury Sandstone Drawdown Extent Predictions from Base-Case



RPS

Job Number: EWP72727.001
Doc Number: 001
Date: 15.02.2018
Scale: 1:20,000 @ A4
Created by: CT
Source: RPS 2018

GDA 1994 MGA Zone 56

0 100 200 400 600 800 m

Figure 76
Project Drawdown at Project Opening Sensitivity - Hawkesbury Sandstone

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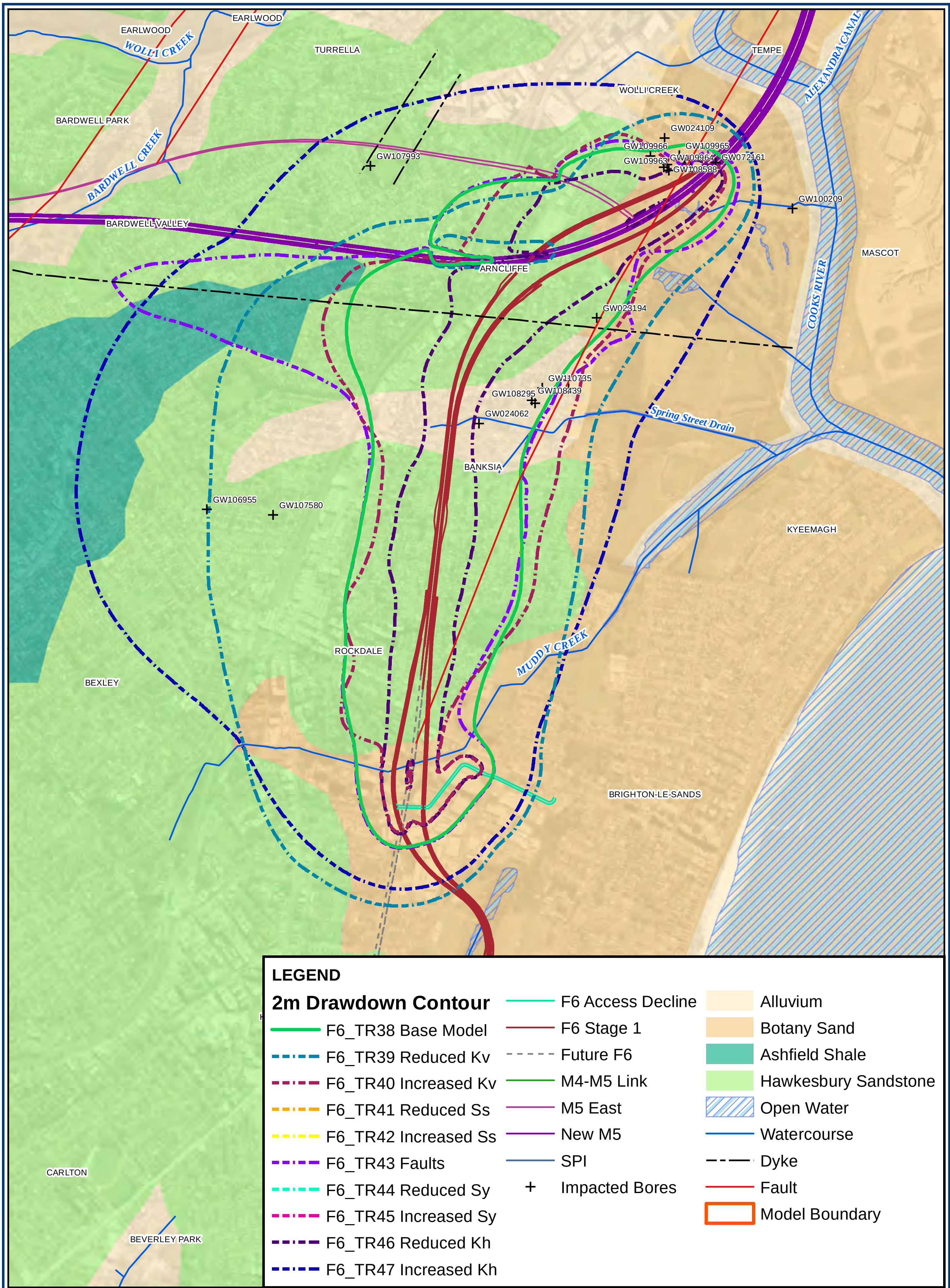

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Doc Number: 001
Date: 15.02.2018
Scale: 1:20,000 @ A4
Created by: CT
Source: RPS 2018

GDA 1994 MGA Zone 56

0 100 200 400 600 800 m

Figure 77
Project Drawdown at 2100
Sensitivity - Hawkesbury Sandstone

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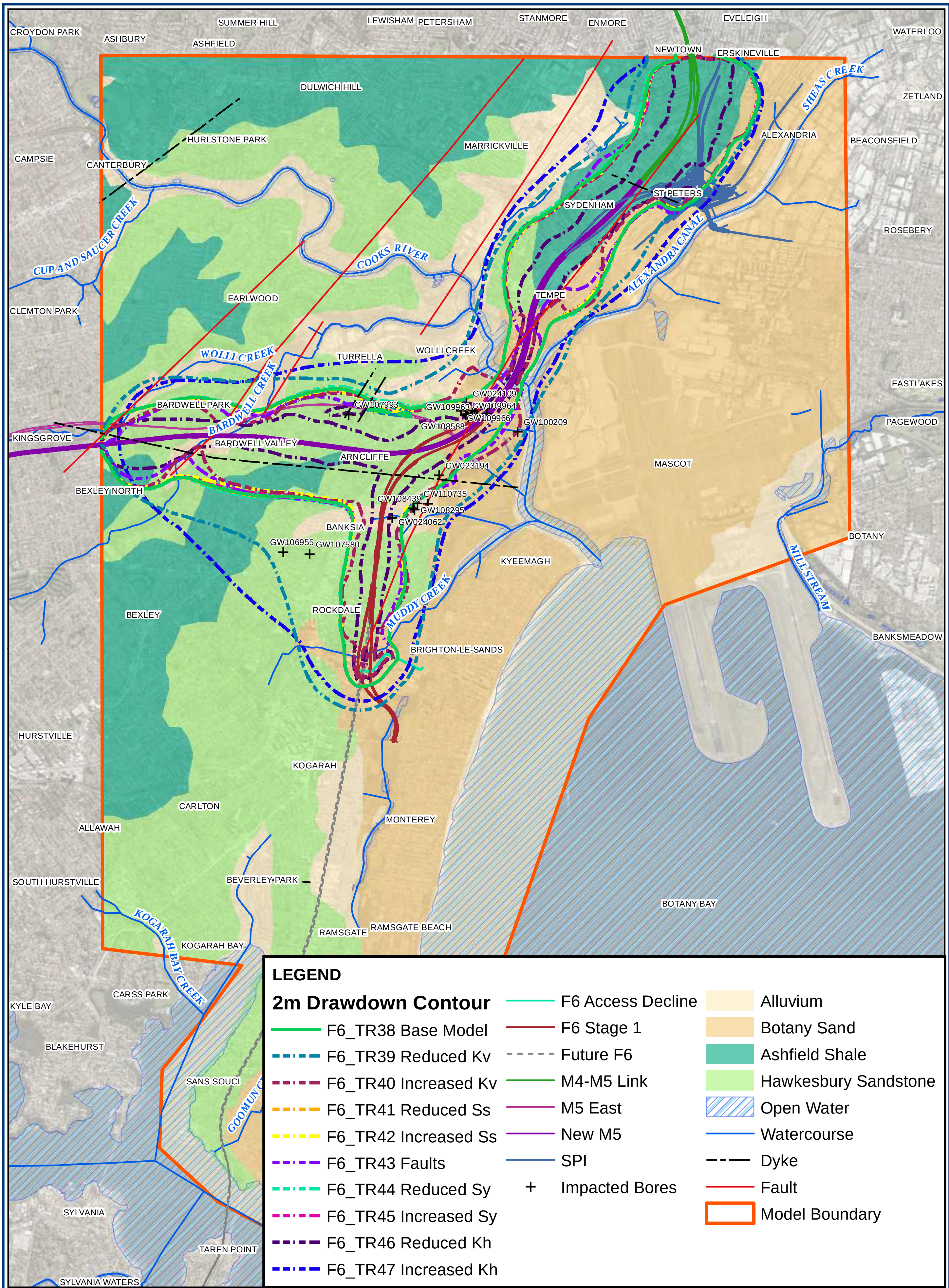

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Source: RPS 2018

Figure 78
Cumulative Drawdown at Project Opening Sensitivity - Hawkesbury Sandstone

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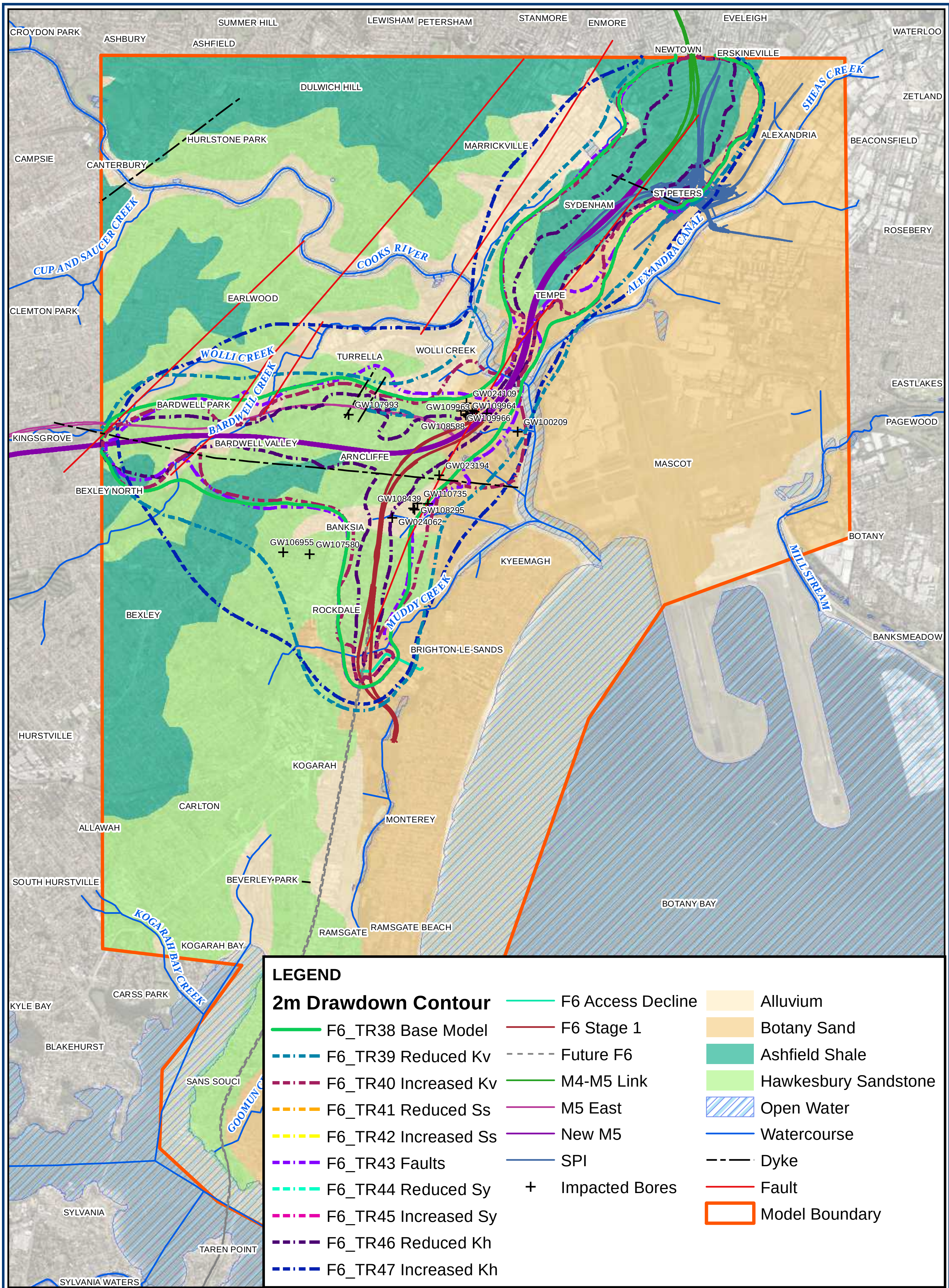

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Doc Number: 001
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Created by: CT
Source: RPS 2018

GDA 1994 MGA Zone 56

0 250 500 1,000 1,500 2,000 m

Figure 79
Cumulative Drawdown at 2100
Sensitivity - Hawkesbury Sandstone

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7.3.2.2 Depth

The relative sensitivity of predicted maximum drawdown depth to model parameters is shown in Figure 80 for unconsolidated sediments and Figure 81 for Hawkesbury Sandstone. The maximum depth of drawdown is most sensitive to vertical hydraulic conductivity, with an increase in vertical hydraulic conductivity resulting in 3.3 times deeper drawdown for the unconsolidated sediments and 2 times deeper drawdown in the Hawkesbury Sandstone. A reduction in vertical hydraulic conductivity has a slight effect of reducing the maximum drawdown depth in the Hawkesbury Sandstone, but significantly reduces the maximum depth of drawdown in unconsolidated sediments associated with the project (up to 90% reduction) and slightly reduces the cumulative unconsolidated drawdown.

Maximum drawdown in the unconsolidated sediments and Hawkesbury Sandstone also shows a relatively large degree of sensitivity to horizontal hydraulic conductivity. Reducing the horizontal conductivity of the sandstone increases the maximum drawdown depth in the sandstone (results in a steeper more localised cone of drawdown around the tunnels) but reduces the drawdown in the overlying unconsolidated sediments. Conversely, increasing the horizontal conductivity reduces the depth (but increases the extent) of drawdown in the Hawkesbury Sandstone, and increases the depth of drawdown in the overlying sediments.

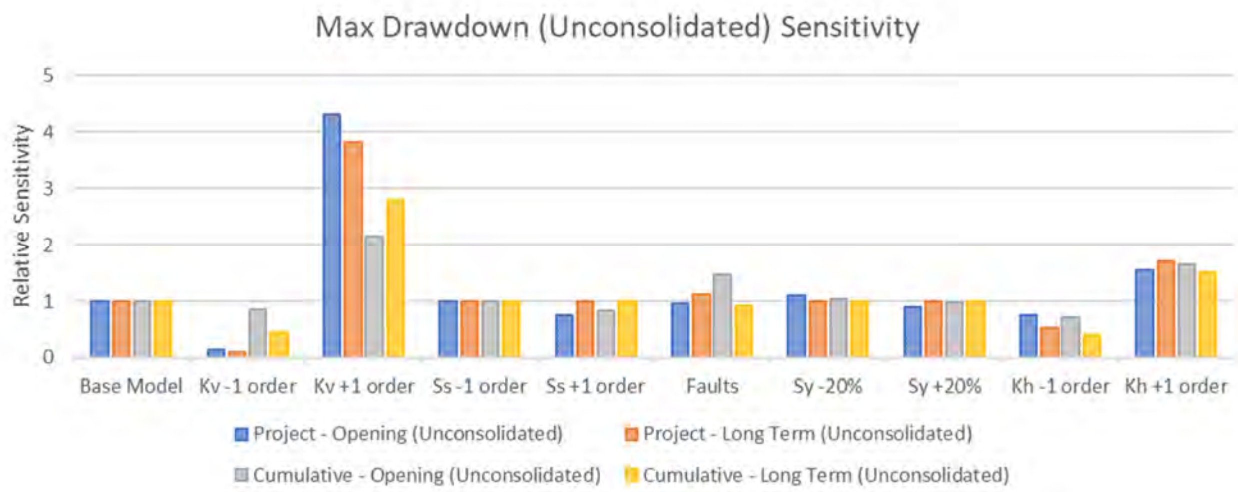

Figure 80 Relative Change of Maximum Unconsolidated Sediment Drawdown Predictions from Base-Case

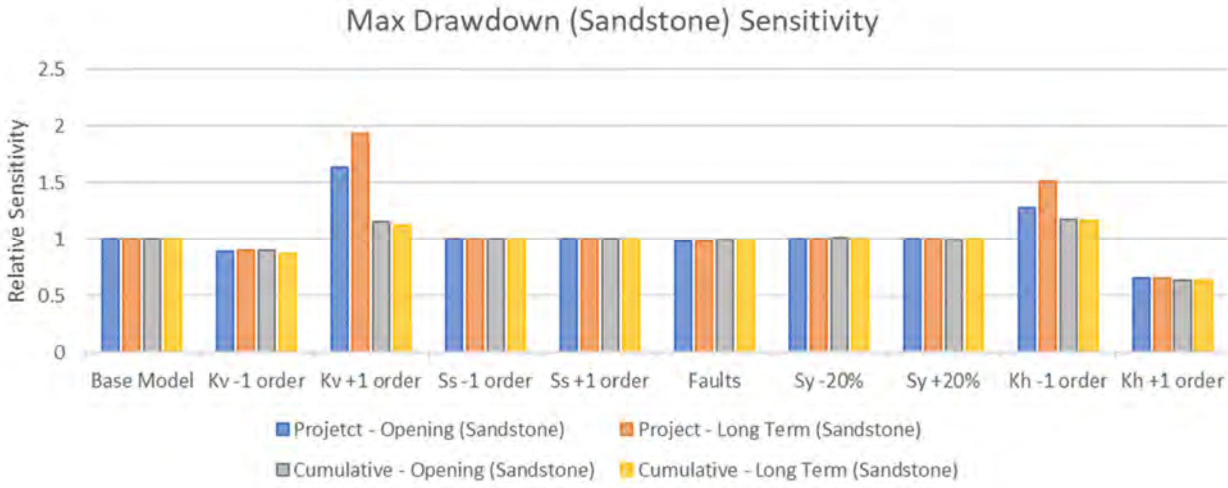

Figure 81 Relative Change of Maximum Hawkesbury Sandstone Drawdown Predictions from Base-Case

As shown in Table 48, maximum depth of drawdown in the unconsolidated sediments ranges from 0.28 m to 8.6 m at project opening (located within the Spring Street Drain alluvium), related to a reduction and increase in vertical hydraulic conductivity respectively. Inclusive of cumulative drawdown due to WestConnex, this range increases to a minimum of 3.3 m to a maximum of 21 m at year 2100.

Table 48 Sensitivity of Unconsolidated Drawdown Depth Predictions

Maximum Depth Of Drawdown	Project – Opening (m)	Project - Long Term (m)	Cumulative – Opening (m)	Cumulative - Long Term (m)	RPD Project – Opening (%)	RPD Project - Long Term (%)	RPD Cumulative – Opening (%)	RPD Cumulative - Long Term (%)
Base Model	2	0.93	5.3	7.5	0	0	0	0
Kv -1 order	0.28	0.33	0.58	3.3	-86	-89	-20	-56
Kv +1 order	8.6	1.63	20.2	21	330	281	115	180
Ss -1 order	2	0.93	5.3	7.5	0	0	0	0
Ss +1 order	1.5	0.93	5.3	7.5	-25	0	-17	0
Faults	1.9	1.23	5.9	6.9	-5	11	46	-8
Sy -20%	2.2	0.93	5.3	7.5	10	0	5	0
Sy +20%	1.8	0.93	5.3	7.5	-10	0	-2	0
Kh -1 order	1.5	0.47	2.8	3.3	-25	-47	-29	-56
Kh +1 order	3.1	1.8	9.1	11.4	55	72	66	52

Maximum Depth Of Drawdown	Project – Opening (m)	Project - Long Term (m)	Cumulative – Opening (m)	Cumulative - Long Term (m)	RPD Project – Opening (%)	RPD Project - Long Term (%)	RPD Cumulative – Opening (%)	RPD Cumulative - Long Term (%)
Max	8.6	1.8	20.2	21				
Min	0.28	0.33	0.58	3.3				

With a one order increase in vertical hydraulic conductivity, the maximum predicted cumulative depth of drawdown in the Hawkesbury Sandstone is 76.4 m at the connection with the New M5 project at Arncliffe, of which 64.5 m is attributed to the Project (Table 49).

Table 49 Sensitivity of Sandstone Drawdown Depth Predictions

Maximum Depth of Drawdown	Project – Opening (m)	Project - Long Term (m)	Cumulative – Opening (m)	Cumulative - Long Term (m)	RPD Project – Opening (%)	RPD Project - Long Term (%)	RPD Cumulative – Opening (%)	RPD Cumulative - Long Term (%)
Base Model	33.2	33.4	60.6	62.3	0	0	0	0
Kv -1 order	46.3	46.3	54.5	54.5	39	39	-10	-13
Kv +1 order	54.2	64.5	70.2	76.4	63	93	16	23
Ss -1 order	33.2	33.4	60.6	62.3	0	0	0	0
Ss +1 order	33.2	33.4	60.6	62.3	0	0	0	0
Faults	32.7	32.7	60	61.6	-2	-2	-1	-1
Sy -20%	33.3	33.4	61.3	62.3	0	0	1	0
Sy +20%	33.2	33.4	60.3	62.3	0	0	0	0
Kh -1 order	42.3	50.7	71.6	72.7	27	52	18	17
Kh +1 order	21.7	21.8	38.7	39.7	-35	-35	-36	-36
Max	54.2	64.5	71.6	76.4				
Min	21.7	21.8	38.7	39.7				

7.3.3 Predicted Impacts to GDEs

Figure 82 summarises the relative sensitivity of a number of potential GDE locations with greater than 0.1m drawdown for each sensitivity run, relative to base-model predictions. An increase in horizontal hydraulic conductivity results in a greater extent of drawdown (Section 7.3.2), which particularly in the case of drawdown directly attributable to the Project, results in a significant increase in the number of potentially affected GDEs. This is because the drawdown extent increases towards Bardwell Valley, however when cumulative impacts are considered the relative impact of the Project drawdown extent is reduced, as the additional GDEs are mostly impacted already by the New M5 project. Reducing either the horizontal or vertical hydraulic conductivity reduces the vertical propagation of drawdown to the unconsolidated sediments, and therefore reduces the number of potentially affected GDEs.

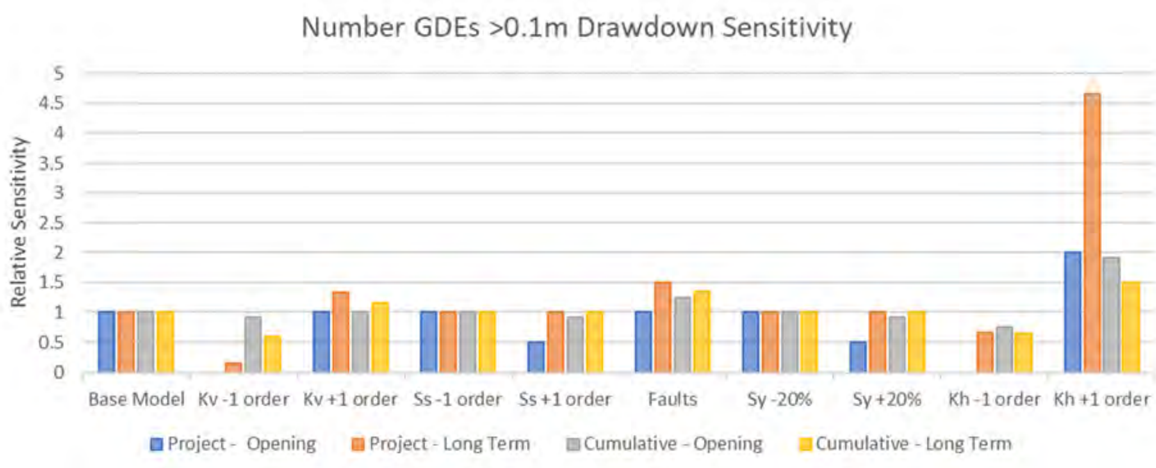

Figure 82 Relative Change of Number of Impacted GDE's from Base-Case

The maximum number of potential GDEs predicted to have >0.1 m drawdown over the long term are increased from 20 locations with the base-model parameterisation to 30 impacted locations (inclusive of WestConnex drawdown) with the increase of horizontal hydraulic conductivity by one order of magnitude (Table 50). The reduction of horizontal vertical hydraulic conductivity by one order reduced the number of impacted GDEs to 13 and 12 respectively, while changes in storage parameters do not affect the ultimate number of impacted GDEs. The increase in horizontal and vertical hydraulic conductivity also has the most significant impact on the magnitude of drawdown, with a one order increase in these parameters leading to a drawdown approximately double the base case predictions at most locations. The relative drawdowns at potential GDEs is given in Appendix C.

Table 50 Sensitivity of Number of Impacted GDEs Predictions

Number of GDEs >0.1m Drawdown	Project - Opening	Project - Long Term	Cumulative - Opening	Cumulative - Long Term	RPD Project – Opening (%)	RPD Project - Long Term (%)	RPD Cumulative – Opening (%)	RPD Cumulative - Long Term (%)
Base Model	2	6	12	20	0	0	0	0
Kv -1 order	0	1	11	12	-100	-83	-8	-40
Kv +1 order	2	8	12	23	0	33	0	15
Ss -1 order	2	6	12	20	0	0	0	0
Ss +1 order	1	6	11	20	-50	0	-8	0
Faults	2	9	15	27	0	50	25	35
Sy -20%	2	6	12	20	0	0	0	0
Sy +20%	1	6	11	20	-50	0	-8	0
Kh -1 order	0	4	9	13	-100	-33	-25	-35
Kh +1 order	4	28	23	30	100	367	92	50
Max	4	28	23	30				
Min	0	1	9	12				

7.3.4 Predicted Impacts to Existing Groundwater Users

Figure 83 summarises the relative sensitivity of a number of registered bore locations with greater than 2 m drawdown for each sensitivity run, relative to base-model predictions. Table 51 provides the absolute number of impacted bores, and Appendix D gives the predicted drawdowns at each bore location for the sensitivity runs. The location of registered bores that are reported to have greater than 2m drawdown in the following sections are shown on drawdown extent maps (Figure 76 to Figure 79). An increase in horizontal or vertical hydraulic conductivity increases the number of (cumulatively) affected bores by up to 3.7 times that predicted in the base model, which has more to do with the relative location of the bores to the projects rather than the effect of the model parameterisation. Reducing either the horizontal or vertical hydraulic conductivity reduces the propagation of drawdown to the unconsolidated sediments, and therefore reduces the number of potentially affected bores.

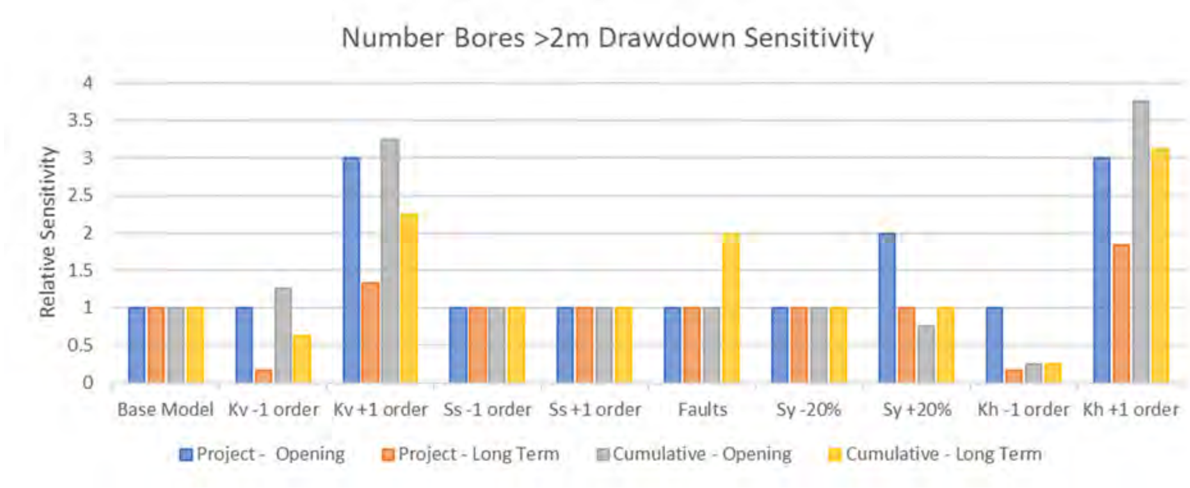

Figure 83 Relative Change of Number of Impacted Registered Bores from Base-Case

Under the base-model parameterisation there are no registered bores in the vicinity of the Project expected to be impacted at project opening and a result of the F6 Stage 1 tunnelling. Increasing the horizontal or vertical hydraulic conductivity results in 2 bores having >2m drawdown at opening (different locations) and increasing the specific yield results in one bore having >2m drawdown.

In the long term the Project is predicted to impact 5 registered bore locations in the base model predictions. This remains the case for sensitivity scenarios which alter storage properties and include faulting, but is expected to increase to 10 and 7 impacted bores with increased horizontal hydraulic conductivity and vertical hydraulic conductivity respectively. No bores are predicted to be impacted by the project if horizontal or vertical hydraulic conductivity are reduced by one order of magnitude.

The maximum number of bores expected to be impacted under the cumulative scenario at project opening is 3 for the base model, but increases to 12 bores with an increase in vertical hydraulic conductivity and 14 bores with an increase in horizontal hydraulic conductivity. In the long-term, this number increases to 17 and 24 bores for the increase in vertical hydraulic conductivity and horizontal hydraulic conductivity respectively. The addition of faults into the model also increases the number of bores with greater than 2 m drawdown to 15 over the long-term.

Table 51 Sensitivity of Number of Impacted Bore Predictions

Number of Bores >2m Drawdown	Project - Opening	Project - Long Term	Cumulative - Opening	Cumulative - Long Term	RPD Project – Opening (%)	RPD Project - Long Term (%)	RPD Cumulative – Opening (%)	RPD Cumulative - Long Term (%)
Base Model	0	5	3	7	0	0	0	0
Kv -1 order	0	0	4	4	0	-100	33	-43
Kv +1 order	2	7	12	17	200	40	300	143
Ss -1 order	0	5	3	7	0	0	0	0
Ss +1 order	0	5	3	7	0	0	0	0
Faults	0	5	3	15	0	0	0	114
Sy -20%	0	5	3	7	0	0	0	0
Sy +20%	1	5	2	7	100	0	-33	0
Kh -1 order	0	0	0	1	0	-100	-100	-86
Kh +1 order	2	10	14	24	200	100	367	243
Max	2	10	14	24				
Min	0	0	0	1				

8 Conclusions

A regional scale groundwater model has been prepared by RPS to provide input to the predicted effects of the F6 Stage 1 project required as part of the Technical Groundwater Assessment (AECOM, 2018). The model was also required to consider the cumulative impacts of the adjoining WestConnex projects (New M5 and M4-M4 Link) that will be constructed prior to commencement of tunneling for this Project.

The model has been built consistent with methods outlined in the *Australian Groundwater Modelling Guidelines* (Barnett *et al.*, 2012) as well as the *MDBC Groundwater Flow Modelling Guideline* (MDBC 2001), and provides a Class 2 confidence level, which is suitable for its intended use of predicting the impacts of the proposed developments.

The key findings of this assessment are:

- The peak inflow to the F6 Extension Stage 1 project (inclusive of access tunnels) peaks in 2023, where a peak volume of 246 ML/year is obtained (coinciding with the end of tunnel excavation at the end of 2022).
- An additional 3 ML/day will be required to be dewatered during the initial construction phases of the sealed structures.
- The cumulative inflow to the Project as well as the New M5 and M4-M5 Link (to the extent modelled, including the temporary Arncliffe access decline) at the end of all phases of tunnel construction (end of 2022) is 2.2 GL, and 3.4 GL at project opening (September 2024). This does not include any short-term high inflows that may occur prior to grouting during construction.
- Long term tunnel inflow rates are 0.94 L/sec/km for the drained portions of F6 Extension mainline (6.5km) and 1.89 L/sec/km for the F6 access decline (0.4km) tunnels, below the allowed limit of 1L/sec/km for the mainline and 2L/sec/km for the F6 access decline respectively. The model has been constructed such that these long term inflows are below design criteria and some grouting will be required during construction to achieve these inflows.
- Drawdown (to the 2m contour) caused by the Project is expected to remain localised to the tunnel alignments, with a maximum modelled drawdown extent of less than 400 m either side of the alignment for all layers at project opening (2024), extending to 500 m at the end of the long-term model prediction (2100).
- The Project reduces baseflow to Muddy Creek by 11.5% at project opening, and 20.4% long term, with a minor increase in leakage of 2.8% long term. It also reduces baseflow to the Spring Street Drain by 28.4 % at project opening, and 40.5% long term, with an increase in leakage of 309% long term. The cumulative drawdown from WestConnex has negligible effect on the flows from Muddy Creek, but increases the baseflow loss at Spring Street Drain to 36% and 56% at opening and long term respectively. However it is important to note that the baseflow contribution to stream flow is expected to be very small in these channels due to the channels being concrete lined, with the majority of flow coming from tidal supplied water and surface runoff. Therefore the loss in baseflow is not expected to have a significant impact on overall flow. The New M5 component of WestConnex is predicted to cause up to 15% loss in baseflow to Wolli Creek and Bardwell Creek (natural creeks), with no additional loss resulting from the F6 project.
- There are no high priority GDEs in the study area. Six locations identified by BoM as being potential GDEs would experience predicted drawdowns of greater than 0.1 m over the long-term due to the project at Rockdale Bicentennial Park and Scarborough Park. Another 14 locations are predicted to have greater than 0.1m drawdown in Turrella and Bardwell Valley related to the construction and operation of the New M5.

- Drawdowns of greater than 0.1 m are also predicted to occur at Marsh Street Wetland, Eve Street Wetland, Landing Lights Wetland and Spring Street Wetland due to the F6 Stage 1 works, and increase due to cumulative impacts with WestConnex. Drawdowns greater than 0.1m are predicted to occur at King Street Wetland as a result of the F6 Extension works only.
- Long term operation of the Project is expected to result in drawdown greater than 2 m at 6 registered groundwater abstraction bores (GW024062, GW108295, GW108439, GW110735, GW023194 and GW072161) screened within the alluvium or Hawkesbury Sandstone. One additional bore (GW107993) is expected to be impacted due to cumulative operation with WestConnex.
- Capture zone analysis qualitatively suggests groundwater from the Botany Sands (assumed to be of poor quality due to contamination from industry) and tidal alluvial areas (assumed to have a high salinity due to direct connection with water bodies with concentrations at or approaching sea water) is likely to enter the tunnels. The water from the Botany Sands would enter a tunnel within days where the tunnel is to be driven directed through and beneath the Botany Sands, i.e. at the location of the access decline and President Avenue Ramps. Connection with tidally affected alluvium located at Spring Street Drain and Cooks River is expected to occur within the order of a few decades, as drawdown in these locations slowly induces drainage from the upper sediments into the tunnel. The relative contribution of saline water would increase in volume (and therefore overall concentration) with time as water is increasingly drawn towards the tunnel from further afield. The drainage of groundwater from saline water bodies is expected to increasingly reduce the groundwater quality in aquifers locally between the sources and the tunnels, however the actual concentration of water over time is not able to be quantified with this groundwater flow model. Reversal of the overall flow direction towards Botany Bay is not predicted, and therefore saline intrusion from the Bay is not predicted.
- Parameter modification as part of the sensitivity analysis results in a statistically calibrated model (SRMS <10%) in all instances bar a one order of magnitude change in horizontal hydraulic conductivity, which results in an SRMS ~12 %. Sensitivity and uncertainty analysis suggests that the model predictions are most sensitive to variations in hydraulic conductivity (both horizontal and vertical). Impact predictions are moderately sensitive to the inclusion of faults into the model, and generally not sensitive to changes in storage properties.

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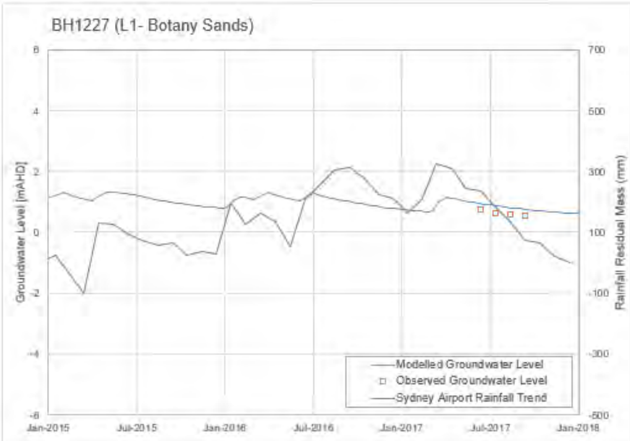
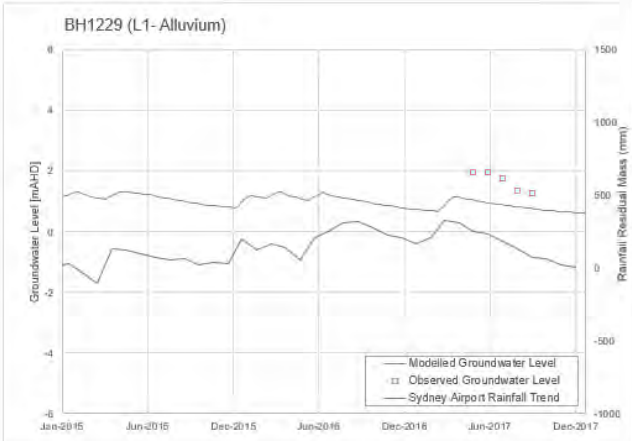
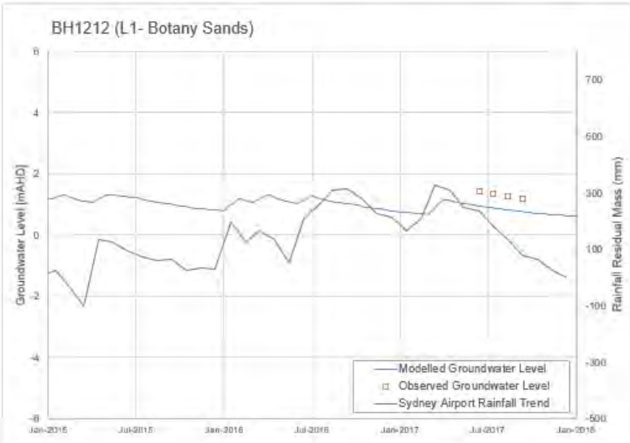
Appendix A

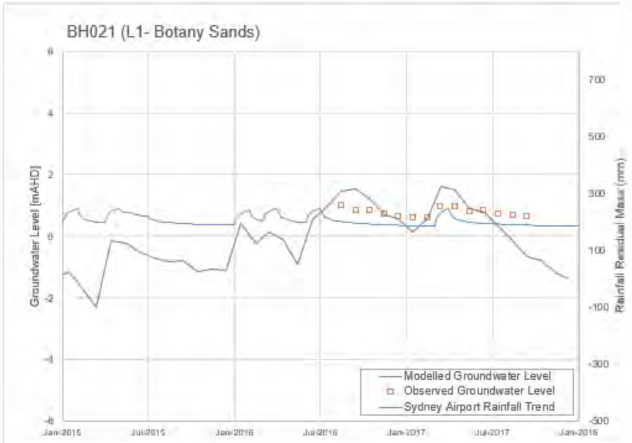
Transient Calibration Hydrographs

Appendix A Transient Calibration Hydrographs

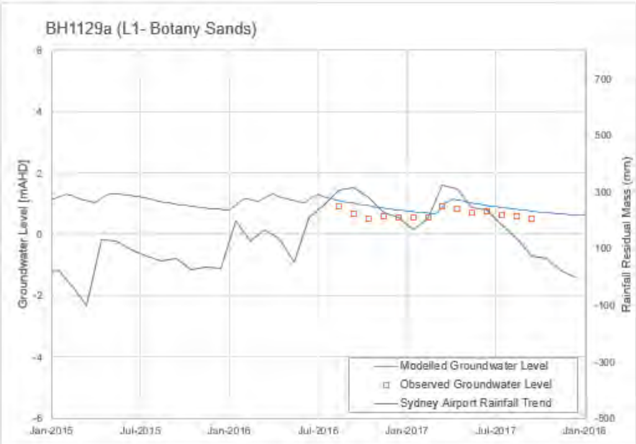


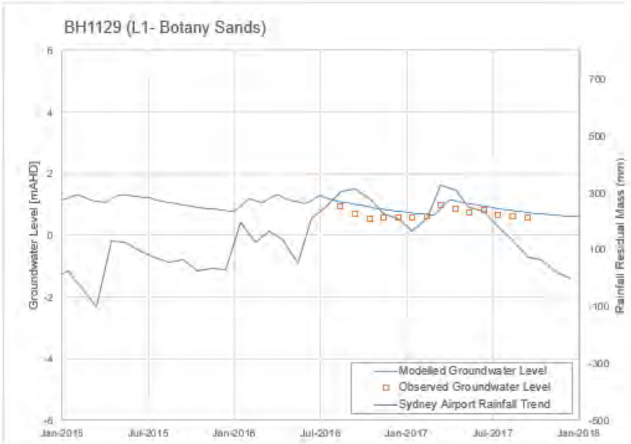


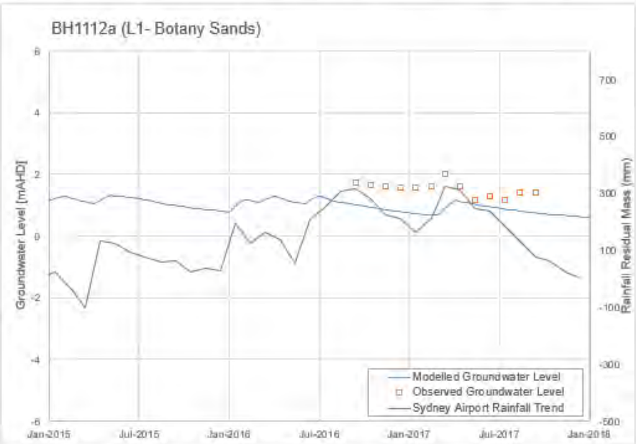




RPS


BH1129a (L1- Botany Sands)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
Jan-2015
Jul-2015
Jan-2016
Jul-2016
Jan-2017
Jul-2017
Jan-2018


BH1129 (L1- Botany Sands)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
Jan-2015
Jul-2015
Jan-2016
Jul-2016
Jan-2017
Jul-2017
Jan-2018


BH1112a (L1- Botany Sands)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
Jan-2015
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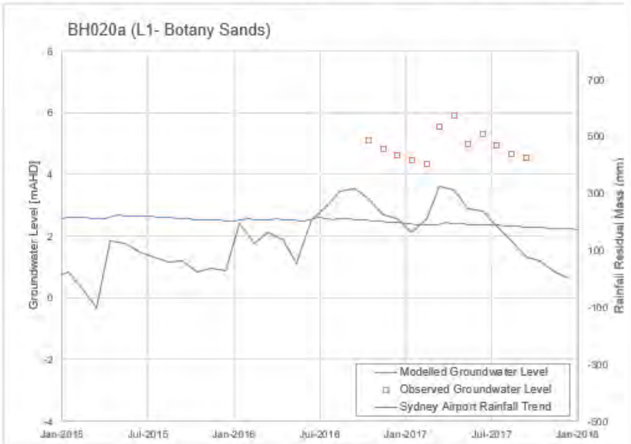
Jan-2017
Jul-2017
Jan-2018


BH020a (L1- Botany Sands)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
Jan-2015
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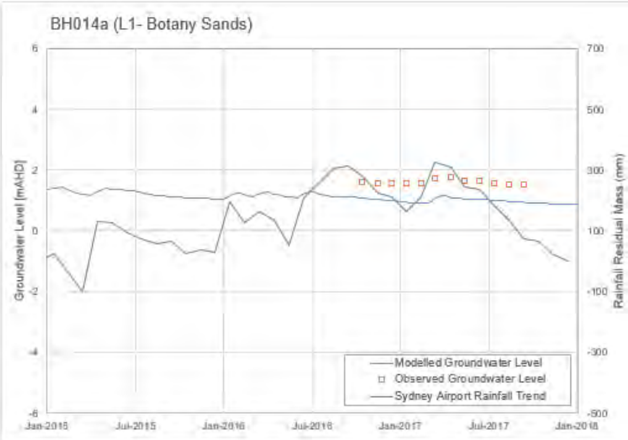
Jan-2017
Jul-2017
Jan-2018


BH014a (L1- Botany Sands)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
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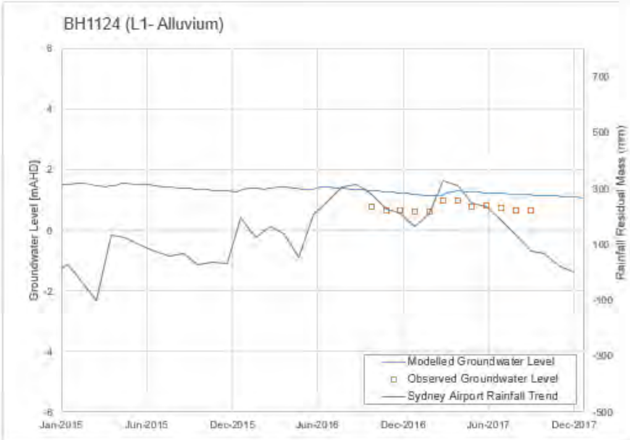
Jan-2017
Jul-2017
Jan-2018


BH1124 (L1- Alluvium)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
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Dec-2015
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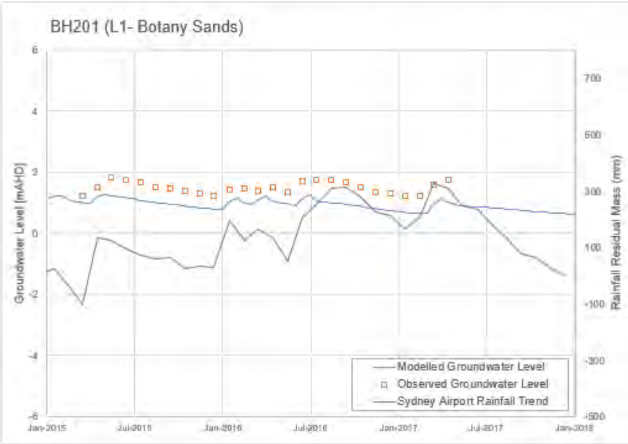
Dec-2016
Jun-2017
Dec-2017


BH201 (L1- Botany Sands)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
Jan-2015
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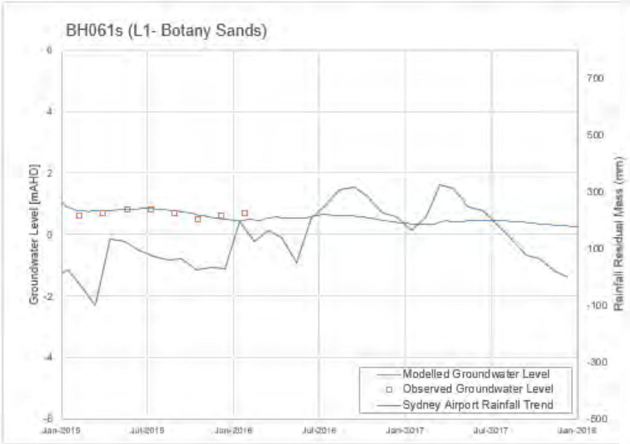
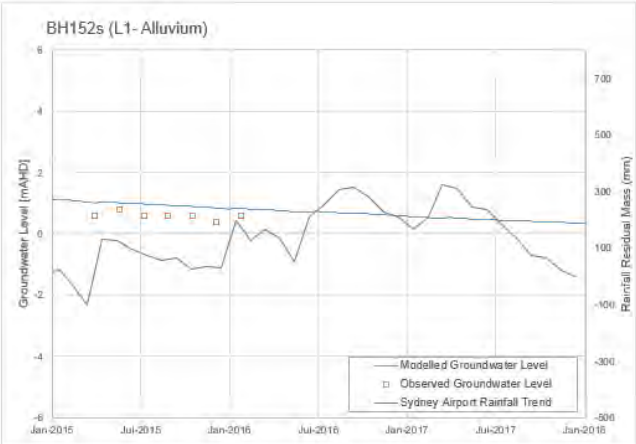
Jan-2016
Jul-2016
Jan-2017
Jul-2017
Jan-2018


BH061s (L1- Botany Sands)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
Jan-2015
Jul-2015
Jan-2016
Jul-2016
Jan-2017
Jul-2017
Jan-2018


BH152s (L1- Alluvium)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
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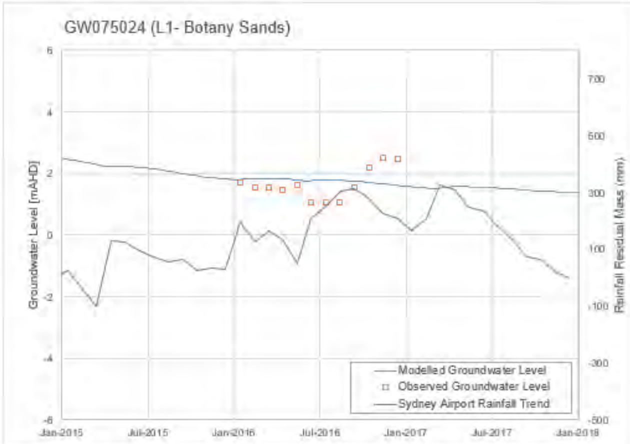
Jan-2017
Jul-2017
Jan-2018


GW075024 (L1- Botany Sands)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
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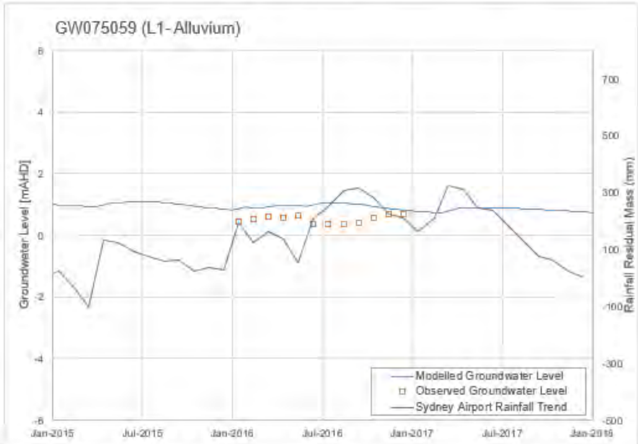
Jan-2017
Jul-2017
Jan-2018


GW075059 (L1- Alluvium)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
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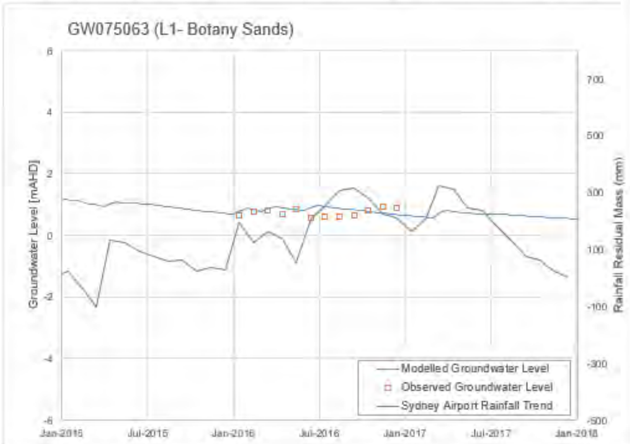
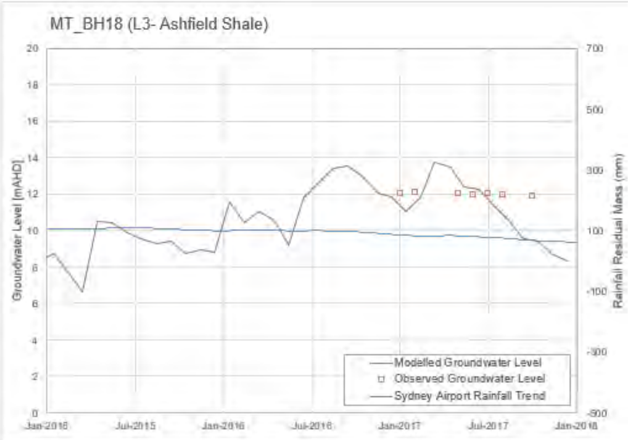
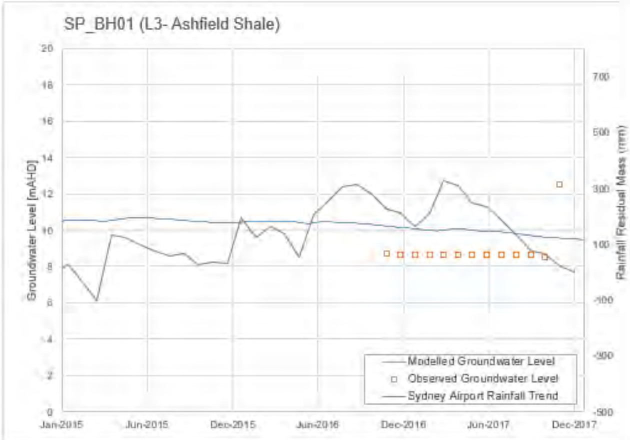
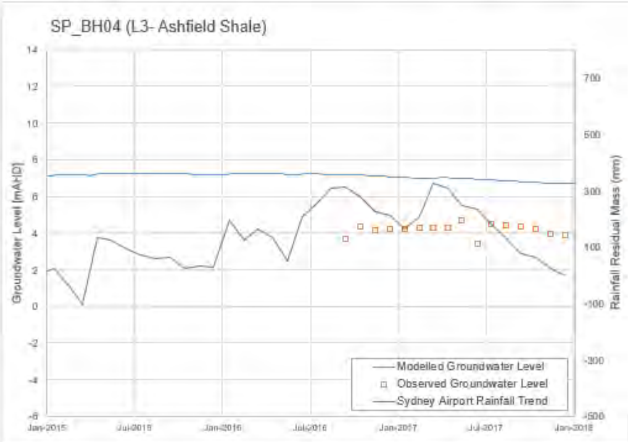
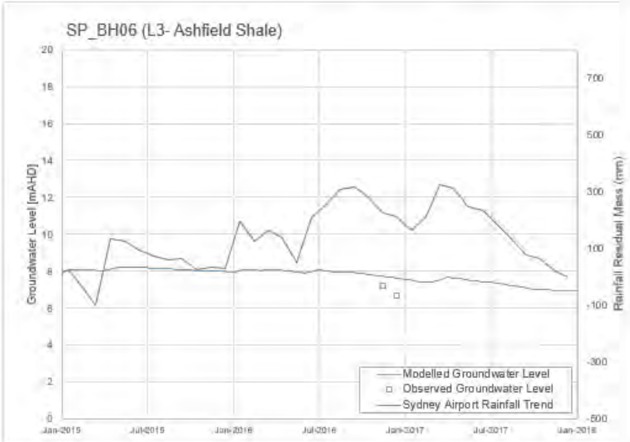
Jan-2017
Jul-2017
Jan-2018


GW075063 (L1- Botany Sands)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
Jan-2015
Jul-2015
Jan-2016
Jul-2016
Jan-2017
Jul-2017
Jan-2018


MT_BH18 (L3- Ashfield Shale)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend


SP_BH01 (L3- Ashfield Shale)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend


SP_BH04 (L3- Ashfield Shale)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend


SP_BH06 (L3- Ashfield Shale)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend

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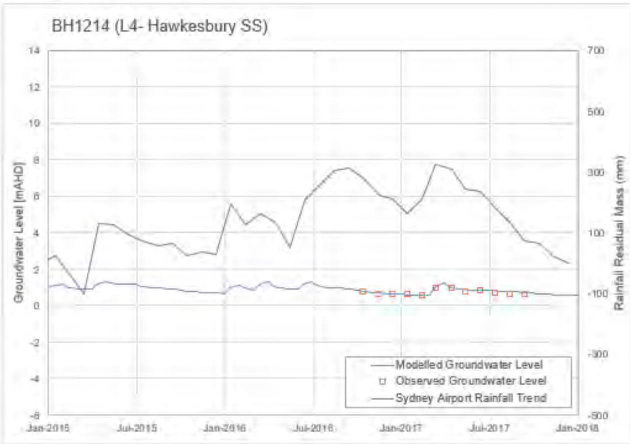
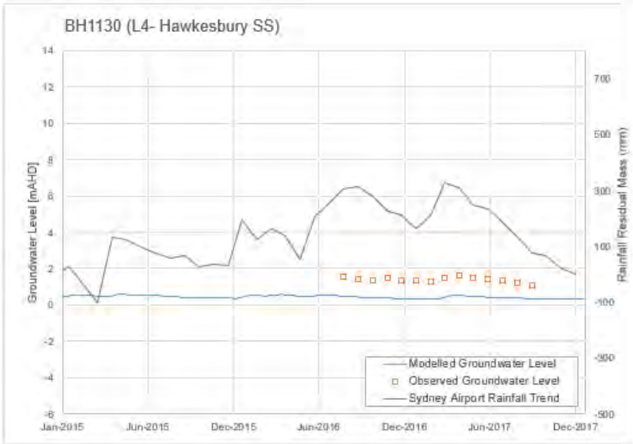
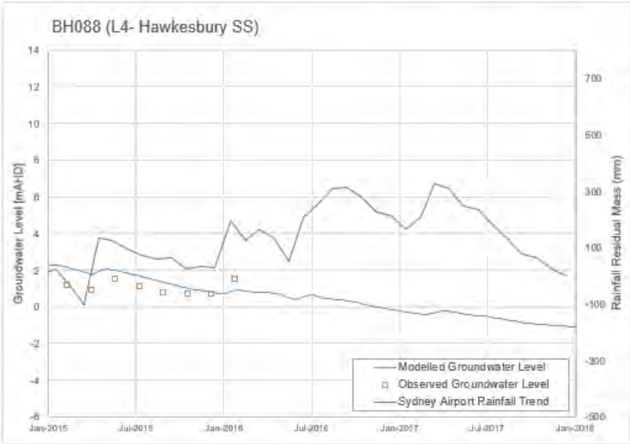
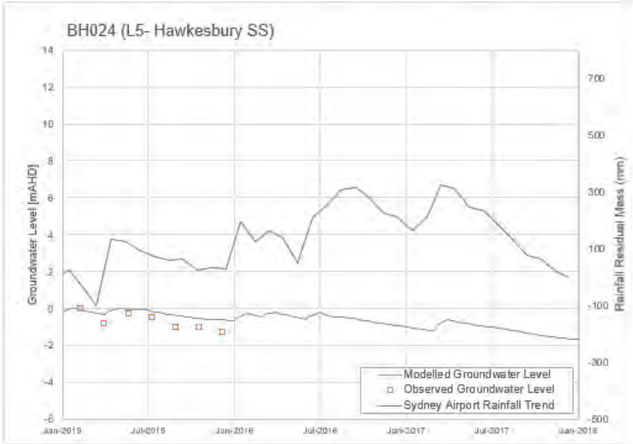
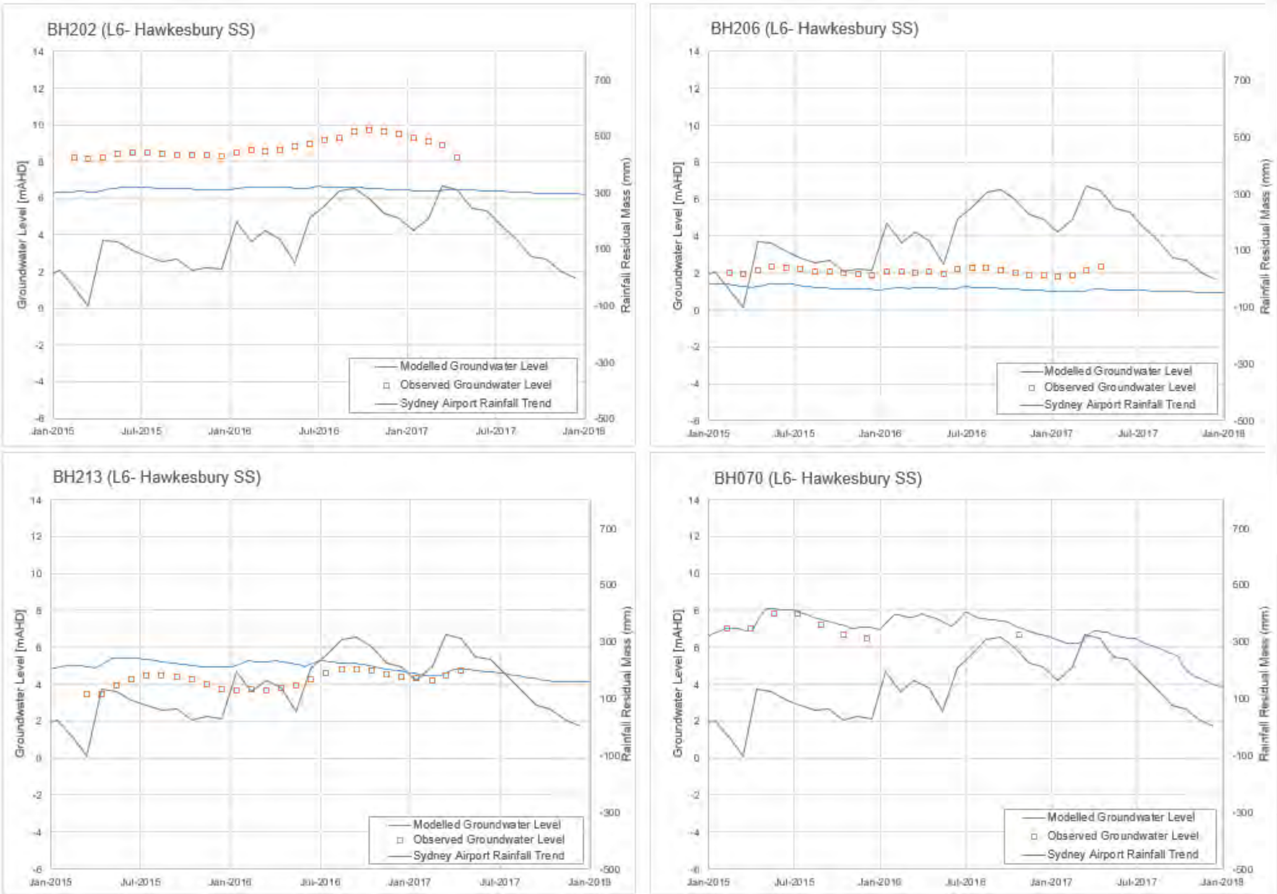

BH1214 (L4- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend


BH1130 (L4- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend

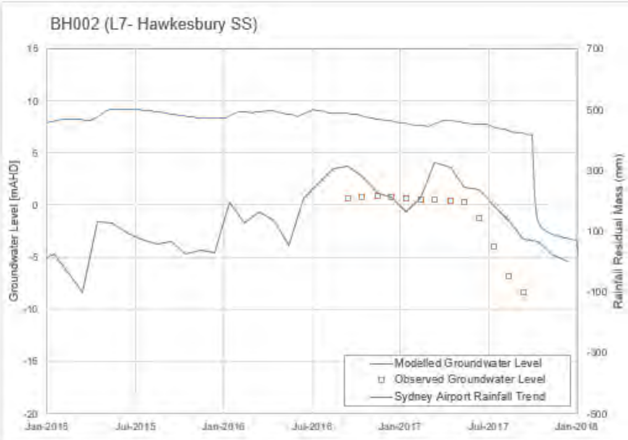

BH088 (L4- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend

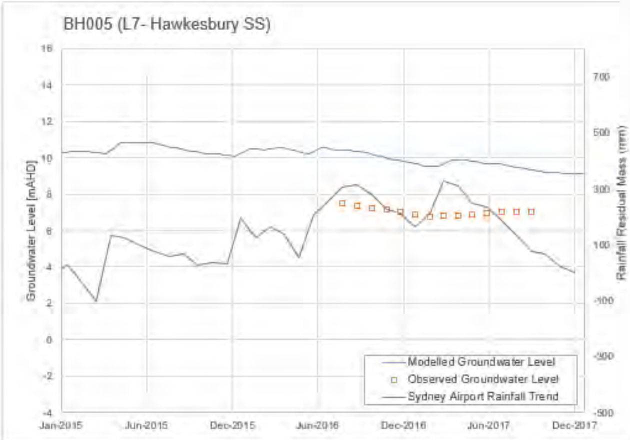

BH024 (L5- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend

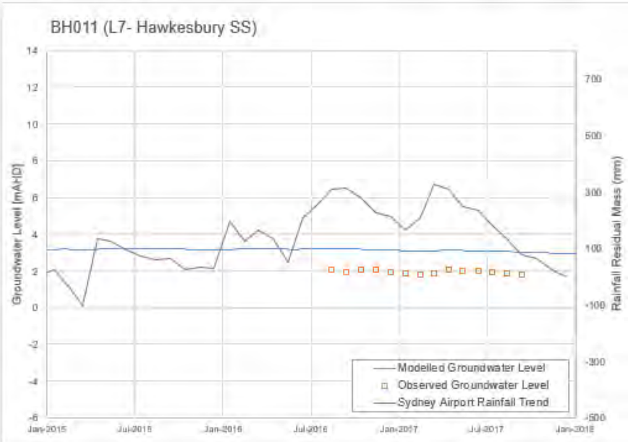
RPS

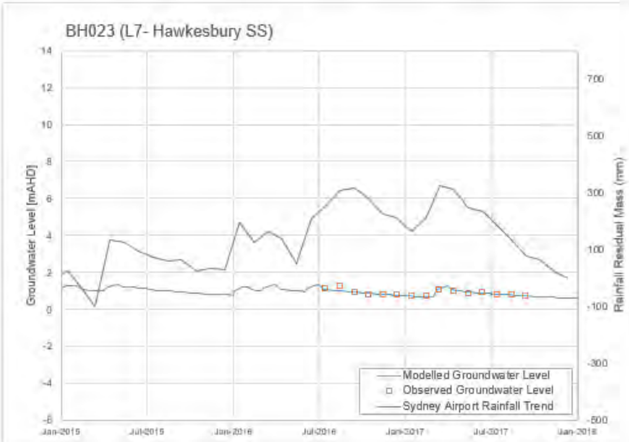

BH202 (L6- Hawkesbury SS)
BH206 (L6- Hawkesbury SS)
BH213 (L6- Hawkesbury SS)
BH070 (L6- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
Jan-2015
Jul-2015
Jan-2016
Jul-2016
Jan-2017
Jul-2017
Jan-2018

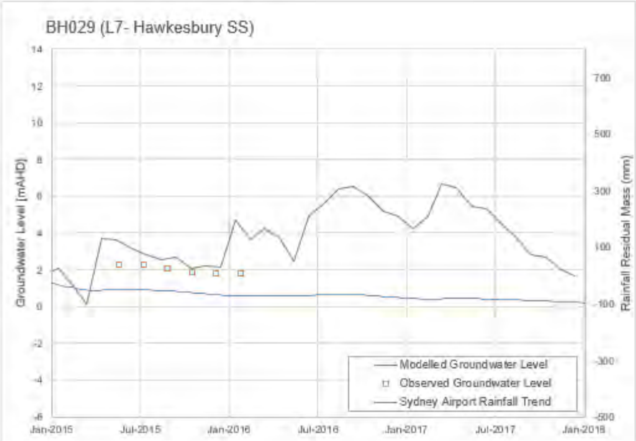
RPS

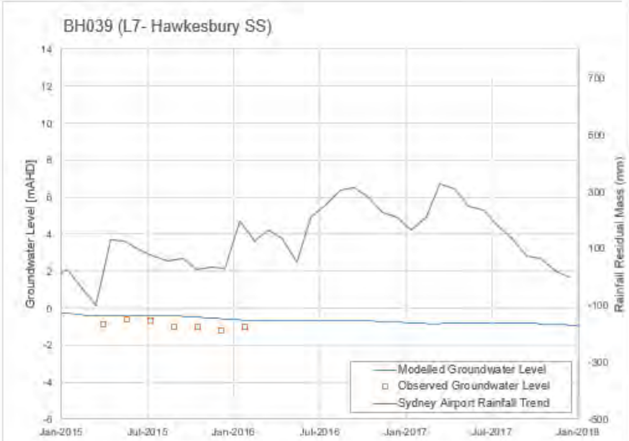

BH002 (L7- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend


BH005 (L7- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend


BH011 (L7- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend


BH023 (L7- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend


BH029 (L7- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
Jan-2015
Jul-2015
Jan-2016
Jul-2016
Jan-2017
Jul-2017
Jan-2018


BH039 (L7- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
Jan-2015
Jul-2015
Jan-2016
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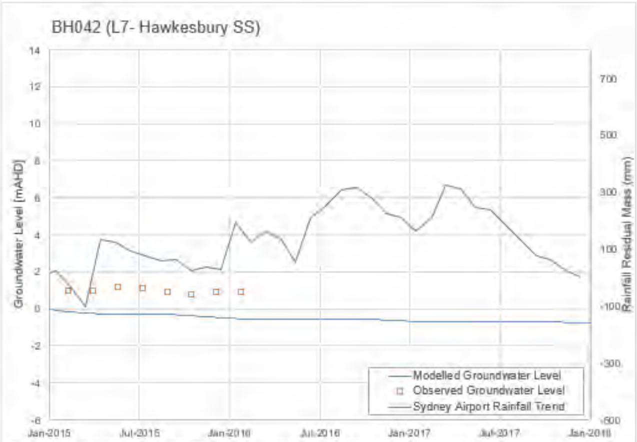
Jul-2017
Jan-2018


BH042 (L7- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
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Jul-2015
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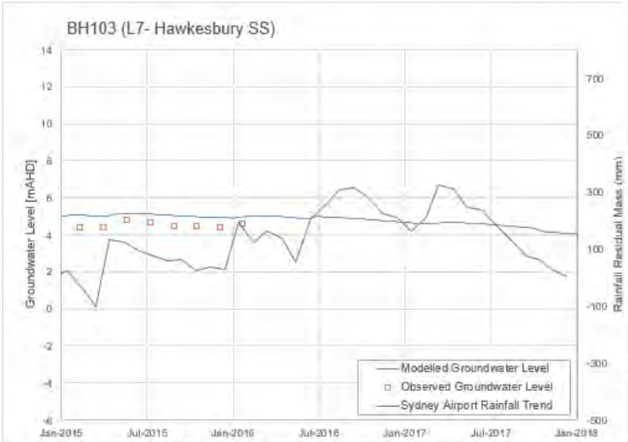
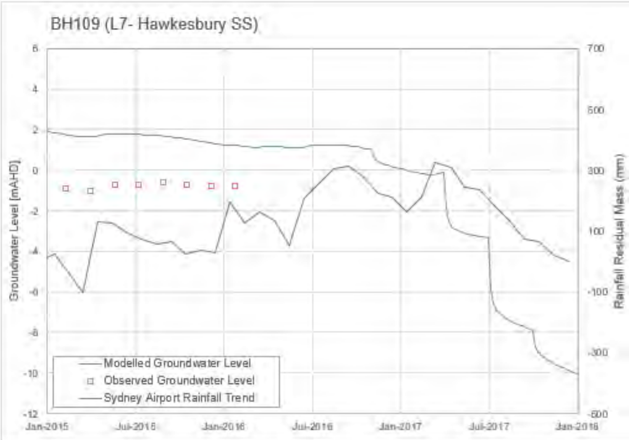
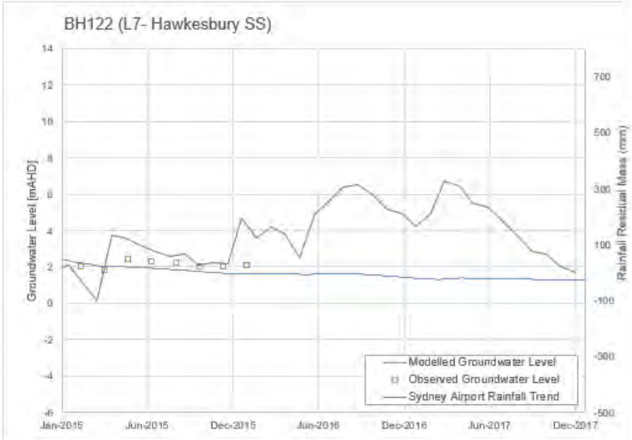
Jan-2017
Jul-2017
Jan-2018


BH103 (L7- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
Jan-2015
Jul-2015
Jan-2016
Jul-2016
Jan-2017
Jul-2017
Jan-2018


BH109 (L7- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
Jan-2015
Jul-2015
Jan-2016
Jul-2016
Jan-2017
Jul-2017
Jan-2018


BH122 (L7- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
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Dec-2015
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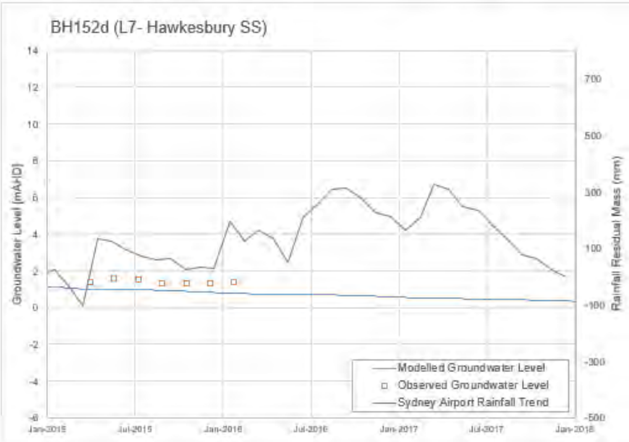
Dec-2016
Jun-2017
Dec-2017


BH152d (L7- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
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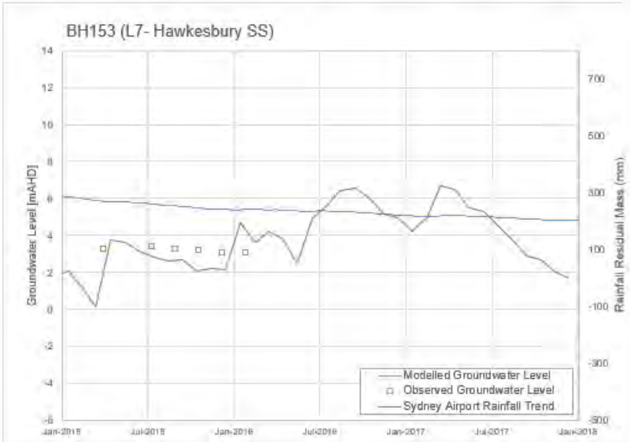
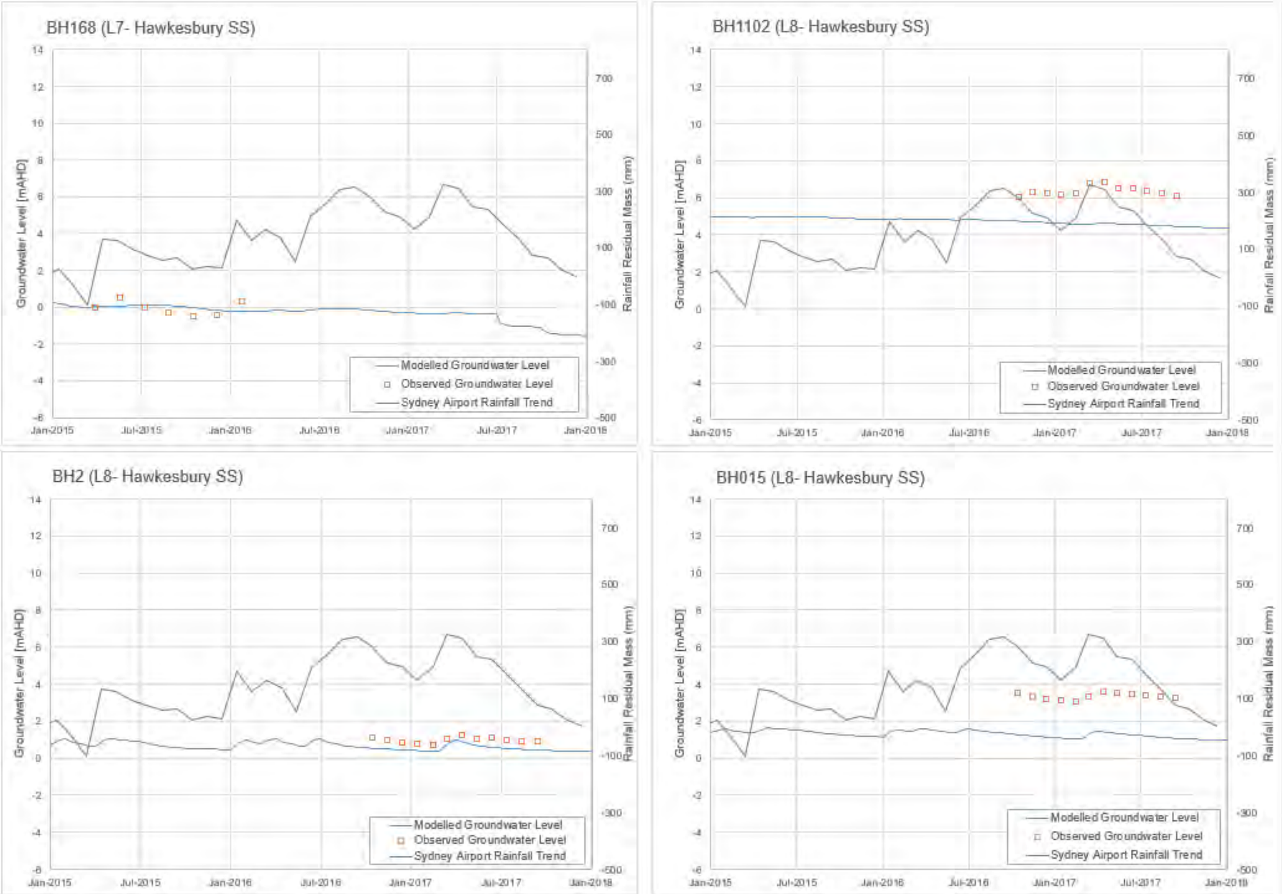
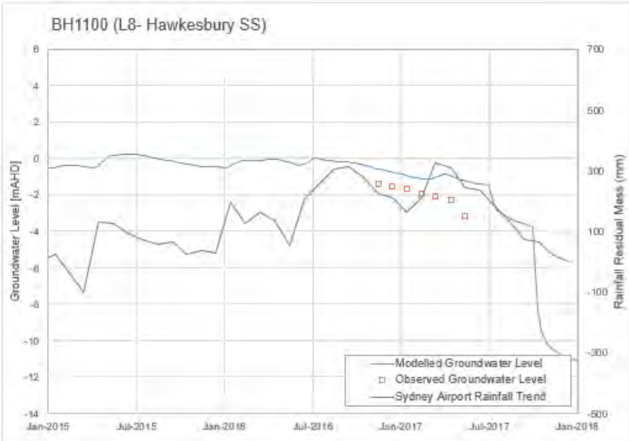
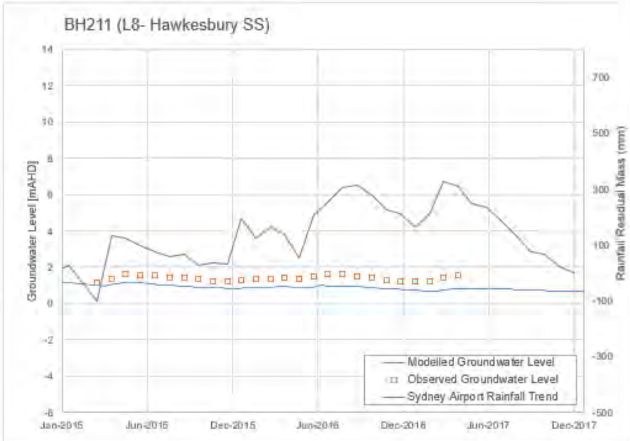
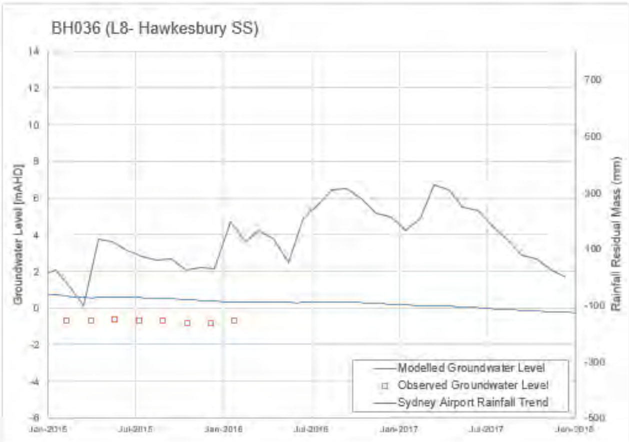
Jan-2017
Jul-2017
Jan-2018

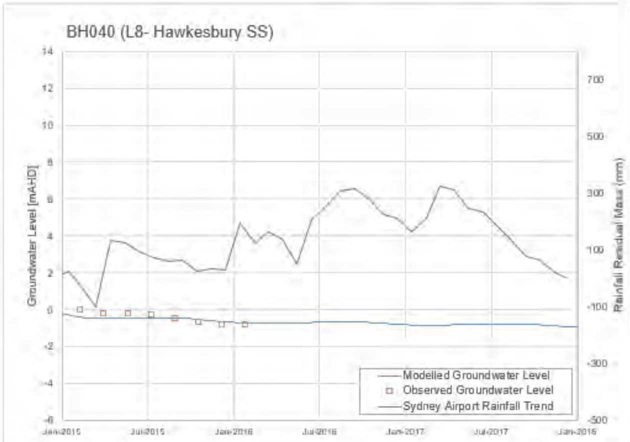

BH153 (L7- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
Jan-2015
Jul-2015
Jan-2016
Jul-2016
Jan-2017
Jul-2017
Jan-2018

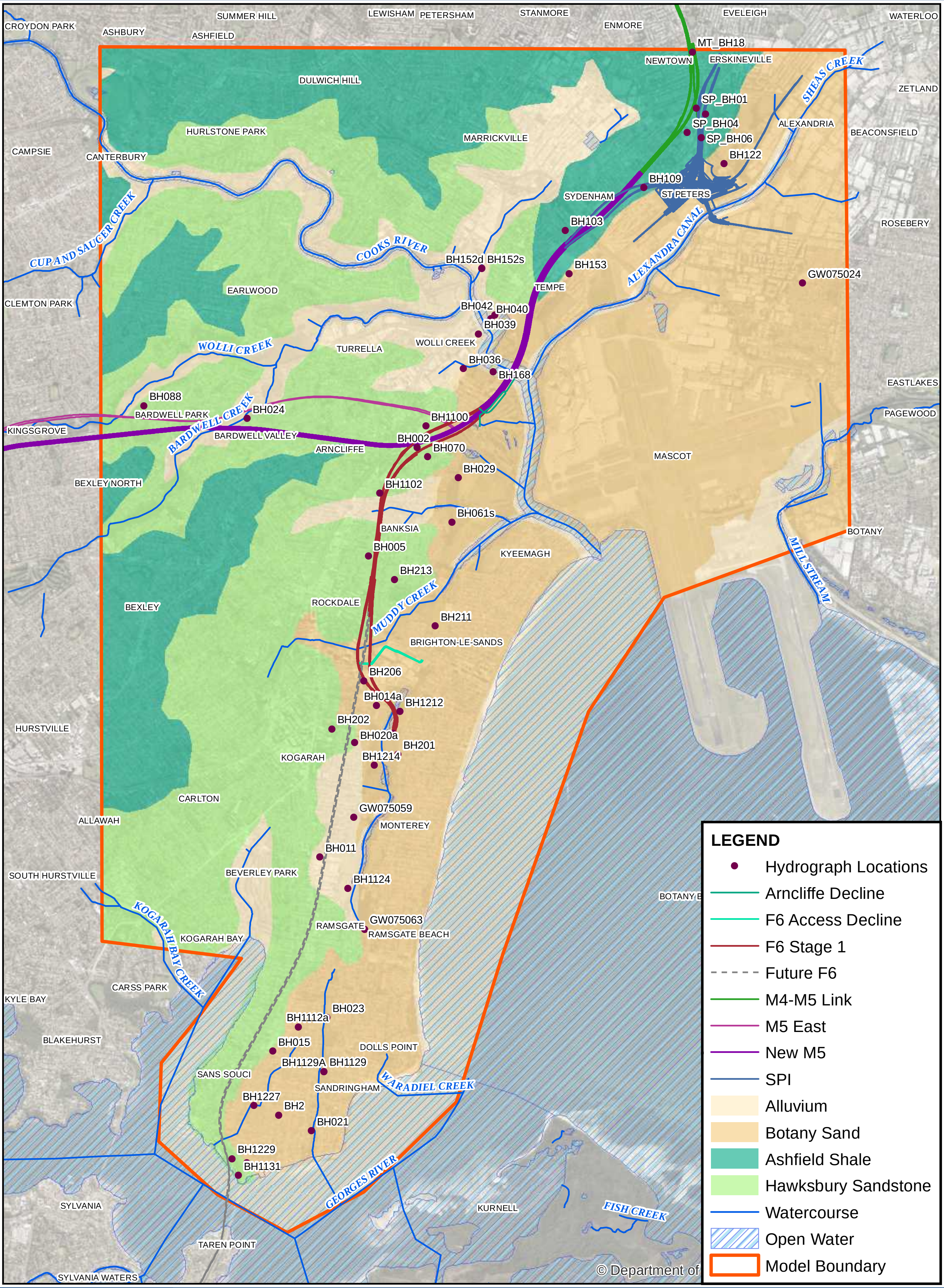

BH168 (L7- Hawkesbury SS)
BH1102 (L8- Hawkesbury SS)
BH2 (L8- Hawkesbury SS)
BH015 (L8- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend
Jan-2015
Jul-2015
Jan-2016
Jul-2016
Jan-2017
Jul-2017
Jan-2018


BH1100 (L8- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend


BH211 (L8- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend


BH036 (L8- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend


BH040 (L8- Hawkesbury SS)
Groundwater Level [mAHD]
Rainfall Residual Mass (mm)
Modelled Groundwater Level
Observed Groundwater Level
Sydney Airport Rainfall Trend



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RPS

Job Number: EWP72727.001
Doc Number: 001
Date: 29.03.2018
Scale: 1:50,000 @ A4
Created by: CT
Source: RPS 2018

GDA 1994 MGA Zone 56

0 250 500 1,000 1,500 2,000 m

Figure A1

Calibration Hydrograph Locations

G:\Jobs\E_Jobs\EWP72727 F6 Extension\Figures\EWP72727_G_FigA1_CalibrationHydrograph_180416.mxd

Appendix B

Drawdown at Registered Bores

Appendix B Drawdown at Registered Bores

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW013331	14.9	INDS	332765	6245200	0.00	0.00	0.01	0.02
GW013505	9.1	WSUP	330166	6241621	0.01	0.01	0.01	0.02
GW013515	8.2	HUSE	333075	6244732	0.00	0.00	0.01	0.02
GW013657	7.6	WSUP	329393	6240352	0.12	0.21	0.12	0.22
GW013930	7.6	WSUP	328979	6240079	0.10	0.21	0.10	0.21
GW015954	20.1	INDS	332868	6245171	0.00	0.00	0.01	0.02
GW016108	7.6	WSUP	329364	6240580	0.14	0.24	0.14	0.24
GW016114	13.7	RECN	329257	6241370	0.14	0.22	0.14	0.23
GW016836	6.4	WSUP	326997	6238933	0.00	0.00	0.00	0.00
GW016970	7.3	WSUP	327430	6236322	0.00	0.00	0.00	0.00
GW017344	13.8	INDS	333180	6243543	0.00	0.00	0.01	0.02
GW017349	7.6	WSUP	328840	6237827	0.00	0.00	0.00	0.00
GW017443	6.0	WSUP	328878	6239954	0.06	0.18	0.06	0.18
GW017475	7.6	WSUP	329624	6241292	0.08	0.14	0.09	0.15
GW017476	7.6	WSUP	328792	6237610	0.00	0.00	0.00	0.00
GW017480	7.6	WSUP	328816	6237734	0.00	0.00	0.00	0.00
GW023125	5.1	WSUP	328889	6238679	0.00	0.02	0.00	0.02
GW023134	5.3	WSUP	328994	6239325	0.02	0.07	0.02	0.07
GW023135	7.0	WSUP	329341	6241220	0.14	0.23	0.14	0.23
GW023136	3.2	WSUP	328941	6238665	0.00	0.02	0.00	0.02
GW023185	4.2	WSUP	329020	6238653	0.00	0.02	0.00	0.02
GW023191	3.6	WSUP	329041	6242525	0.28	1.12	0.53	1.46
GW023194	4.8	WSUP	329156	6242811	1.78	2.51	3.50	4.47
GW023208	5.4	WSUP	329895	6241975	0.03	0.05	0.04	0.06
GW023257	5.4	IRAG	329104	6240242	0.12	0.23	0.12	0.23
GW023262	6.7	WSUP	328046	6236302	0.00	0.00	0.00	0.00
GW023285	5.7	WSUP	329504	6241201	0.10	0.17	0.11	0.18
GW023288	5.1	WSUP	328264	6239819	0.01	0.08	0.01	0.09
GW023289	3.6	WSUP	328509	6239053	0.00	0.03	0.00	0.03
GW023291	7.6	WSUP	329694	6241725	0.05	0.08	0.05	0.09
GW023304	4.2	WSUP	329120	6240759	0.19	0.31	0.19	0.31
GW023310	3.6	WSUP	329461	6240365	0.12	0.21	0.12	0.21
GW023354	3.6	WSUP	327911	6239505	0.00	0.00	0.00	0.00
GW023423	4.5	HUSE	329195	6240915	0.18	0.29	0.18	0.29
GW023428	4.8	WSUP	328880	6239861	0.06	0.16	0.06	0.17

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW023439	5.1	WSUP	328396	6239937	0.01	0.16	0.01	0.16
GW023451	2.8	WSUP	328965	6241225	0.23	0.35	0.23	0.36
GW023455	4.8	WSUP	330191	6241952	0.01	0.02	0.02	0.03
GW023457	3.6	WSUP	328512	6237482	0.00	0.00	0.00	0.00
GW023458	4.8	WSUP	328344	6236862	0.00	0.00	0.00	0.00
GW023475	4.5	WSUP	328343	6236893	0.00	0.00	0.00	0.00
GW023477	6.4	WSUP	328987	6241065	0.22	0.35	0.23	0.36
GW023485	6.7	WSUP	329061	6239803	0.05	0.14	0.05	0.14
GW023492	5.1	WSUP	329239	6239868	0.07	0.16	0.07	0.16
GW023495	5.4	WSUP	328040	6239445	0.00	0.00	0.00	0.00
GW023508	5.4	WSUP	328492	6237204	0.00	0.00	0.00	0.00
GW023524	6.0	WSUP	329870	6241913	0.03	0.05	0.04	0.06
GW023525	5.9	WSUP	333046	6243849	0.00	0.00	0.01	0.03
GW023547	3.3	WSUP	328392	6237017	0.00	0.00	0.00	0.00
GW023571	3.6	WSUP	328142	6236643	0.00	0.00	0.00	0.00
GW023573	4.8	WSUP	328824	6238689	0.00	0.02	0.00	0.02
GW023583	8.2	WSUP	329095	6240728	0.19	0.31	0.20	0.32
GW023601	4.8	WSUP	328714	6237701	0.00	0.00	0.00	0.00
GW023603	4.5	WSUP	328811	6237980	0.00	0.01	0.00	0.01
GW023651	4.4	WSUP	328899	6240201	0.12	0.24	0.12	0.25
GW023684	7.9	WSUP	330067	6241610	0.02	0.03	0.02	0.04
GW023837	5.1	WSUP	329051	6240357	0.15	0.26	0.15	0.27
GW023840	4.5	WSUP	327516	6235830	0.00	0.00	0.00	0.00
GW023966	7.3	WSUP	328544	6237143	0.00	0.00	0.00	0.00
GW023984	6.7	WSUP	328929	6238450	0.00	0.01	0.00	0.01
GW023985	5.7	WSUP	328146	6239810	0.00	0.04	0.00	0.04
GW023986	2.4	WSUP	328354	6237250	0.00	0.00	0.00	0.00
GW023994	5.4	WSUP	327674	6237004	0.00	0.00	0.00	0.00
GW023997	4.2	WSUP	328245	6236676	0.00	0.00	0.00	0.00
GW024036	6.0	WSUP	332099	6243647	0.00	0.00	0.01	0.04
GW024059	3.6	WSUP	328743	6237486	0.00	0.00	0.00	0.00
GW024060	3.6	WSUP	327571	6237002	0.00	0.00	0.00	0.00
GW024062	3.6	WSUP	328680	6242384	0.98	3.78	1.20	4.14
GW024063	6.4	UNK	329288	6239992	0.09	0.18	0.09	0.18
GW024064	9.1	WSUP	329981	6241453	0.04	0.06	0.04	0.06
GW024068	4.2	HUSE	332846	6244382	0.00	0.00	0.01	0.03
GW024069	4.5	WSUP	328136	6237013	0.00	0.00	0.00	0.00
GW024071	4.8	WSUP	328339	6237140	0.00	0.00	0.00	0.00
GW024109	2.1	WSUP	329430	6243538	0.27	0.39	0.72	0.92

RPS

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW024117	5.4	WSUP	328979	6238630	0.00	0.02	0.00	0.02
GW024174	4.2	IRAG	328704	6238256	0.00	0.01	0.00	0.01
GW024202	6.7	WSUP	330025	6241885	0.02	0.04	0.03	0.05
GW024203	5.4	WSUP	329947	6241914	0.02	0.04	0.03	0.05
GW024245	5.4	WSUP	328549	6236897	0.00	0.00	0.00	0.00
GW024319	4.5	WSUP	329292	6241443	0.13	0.21	0.14	0.22
GW024352	5.6	WSUP	328973	6238969	0.01	0.03	0.01	0.03
GW024366	4.5	WSUP	329079	6238786	0.00	0.02	0.00	0.02
GW024371	4.2	WSUP	328672	6238594	0.00	0.02	0.00	0.02
GW024373	5.1	WSUP	328866	6239214	0.01	0.05	0.01	0.05
GW024374	5.1	WSUP	333100	6245175	0.00	0.00	0.00	0.01
GW024375	3.6	HUSE	328494	6238498	0.00	0.01	0.00	0.01
GW024376	4.8	WSUP	328517	6237204	0.00	0.00	0.00	0.00
GW024379	8.2	WSUP	330412	6241768	0.00	0.00	0.00	0.00
GW024397	3.5	WSUP	328349	6236717	0.00	0.00	0.00	0.00
GW024585	7.0	WSUP	329823	6241387	0.05	0.09	0.06	0.10
GW024591	4.8	WSUP	328320	6237440	0.00	0.00	0.00	0.00
GW024615	0.0	WSUP	327814	6239673	0.00	0.00	0.00	0.00
GW024655	9.1	WSUP	332454	6243843	0.00	0.00	0.01	0.03
GW024669	4.5	WSUP	328831	6238675	0.00	0.02	0.00	0.02
GW024674	6.0	WSUP	328714	6239690	0.02	0.11	0.02	0.11
GW024675	5.4	WSUP	328769	6239000	0.01	0.03	0.01	0.03
GW025539	4.5	WSUP	328764	6239251	0.01	0.05	0.01	0.05
GW025546	3.3	WSUP	327344	6236783	0.00	0.00	0.00	0.00
GW025551	2.5	WSUP	328320	6239644	0.00	0.06	0.00	0.06
GW025557	3.3	HUSE	328135	6236200	0.00	0.00	0.00	0.00
GW025558	5.9	WSUP	329017	6238924	0.01	0.03	0.01	0.03
GW025559	3.0	WSUP	328423	6237043	0.00	0.00	0.00	0.00
GW025565	5.4	WSUP	329189	6240321	0.14	0.24	0.14	0.25
GW025611	4.5	WSUP	327899	6235930	0.00	0.00	0.00	0.00
GW025681	6.0	WSUP	328564	6237103	0.00	0.00	0.00	0.00
GW025703	6.0	HUSE	328544	6238665	0.00	0.02	0.00	0.02
GW025711	4.8	WSUP	328854	6239135	0.01	0.05	0.01	0.05
GW025713	7.0	HUSE	329764	6241790	0.04	0.07	0.05	0.08
GW025714	3.0	WSUP	328766	6237026	0.00	0.00	0.00	0.00
GW025719	5.4	WSUP	328904	6240095	0.09	0.21	0.09	0.21
GW025721	3.0	WSUP	328464	6237041	0.00	0.00	0.00	0.00
GW025726	5.4	WSUP	329061	6240050	0.09	0.19	0.09	0.20
GW025816	6.0	WSUP	329161	6239506	0.03	0.10	0.03	0.10

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW025994	13.2	WSUP	333039	6243705	0.00	0.00	0.01	0.03
GW026323	3.6	WSUP	328369	6240340	0.18	0.39	0.18	0.39
GW026375	7.0	UNK	329865	6241130	0.07	0.11	0.07	0.12
GW026388	4.2	WSUP	328854	6239178	0.01	0.05	0.01	0.05
GW026464	5.1	WSUP	329241	6240878	0.17	0.28	0.18	0.28
GW026481	4.2	WSUP	327865	6237089	0.00	0.00	0.00	0.00
GW026485	5.3	WSUP	328921	6239030	0.01	0.04	0.01	0.04
GW026514	7.9	WSUP	330044	6241774	0.02	0.03	0.02	0.04
GW026647	10.3	WSUP	328529	6240527	0.25	0.45	0.25	0.45
GW026648	6.0	WSUP	328554	6240653	0.32	0.50	0.32	0.51
GW026651	3.6	WSUP	328564	6240614	0.31	0.48	0.31	0.49
GW026865	2.4	WSUP	328514	6236943	0.00	0.00	0.00	0.00
GW026881	6.7	WSUP	329977	6241668	0.02	0.04	0.03	0.05
GW027055	9.1	WSUP	328958	6240084	0.10	0.21	0.10	0.21
GW027248	4.8	INDS	332260	6244792	0.00	0.00	0.02	0.06
GW027330	5.4	WSUP	328134	6236653	0.00	0.00	0.00	0.00
GW027331	4.5	WSUP	327644	6235833	0.00	0.00	0.00	0.00
GW027339	3.0	WSUP	328790	6236927	0.00	0.00	0.00	0.00
GW027569	8.2	HUSE	328925	6240524	0.20	0.33	0.20	0.33
GW027570	15.2	IRAG	328954	6240315	0.15	0.27	0.15	0.27
GW027664	6.0	IRAG	329535	6243417	0.29	0.42	0.75	0.95
GW027749	16.4	RECN	332802	6244553	0.00	0.00	0.01	0.03
GW027750	17.3	RECN	332774	6244676	0.00	0.00	0.01	0.03
GW028205	6.0	IRAG	328764	6237871	0.00	0.00	0.00	0.00
GW028206	5.4	IRAG	328992	6238565	0.00	0.01	0.00	0.01
GW028208	6.0	IRAG	329030	6238581	0.00	0.01	0.00	0.01
GW028209	4.5	IRAG	328779	6237153	0.00	0.00	0.00	0.00
GW028300	2.5	WSUP	327779	6237409	0.00	0.00	0.00	0.00
GW031364	5.4	HUSE	329614	6241630	0.06	0.11	0.07	0.12
GW031412	6.4	IRAG	328430	6236702	0.00	0.00	0.00	0.00
GW031678	6.4	IRAG	328743	6238326	0.00	0.01	0.00	0.01
GW031679	6.4	IRAG	328669	6237540	0.00	0.00	0.00	0.00
GW031808	18.2	EXPR	332469	6243842	0.00	0.00	0.01	0.03
GW032031	3.0	HUSE	328154	6236615	0.00	0.00	0.00	0.00
GW033181	5.4	WSUP	328737	6237825	0.00	0.00	0.00	0.00
GW033371	11.8	INDS	332654	6243840	0.00	0.00	0.01	0.03
GW033372	11.8	INDS	332663	6243840	0.00	0.00	0.01	0.03
GW040219	6.3	INDS	332128	6245128	0.00	0.00	0.02	0.06
GW040222	7.0	INDS	333252	6243604	0.00	0.00	0.01	0.02

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW040776	8.1	UNK	333226	6242249	0.00	0.00	0.00	0.01
GW047123	18.9	RECN	333143	6244560	0.00	0.00	0.00	0.00
GW064827	7.8	HUSE	329061	6241190	0.21	0.33	0.21	0.33
GW071885	6.0	INDS	328743	6237601	0.00	0.00	0.00	0.00
GW072078	6.0	HUSE	328128	6236706	0.00	0.00	0.00	0.00
GW072161	90.5	RECN	329636	6243437	1.55	1.57	63.49	63.45
GW072283	7.3	HUSE	329810	6241891	0.03	0.06	0.04	0.07
GW072299	8.4	HUSE	329188	6239397	0.03	0.08	0.03	0.08
GW072405	8.0	HUSE	329985	6241375	0.04	0.07	0.04	0.07
GW072456	6.0	HUSE	328073	6236274	0.00	0.00	0.00	0.00
GW072484	5.0	HUSE	328733	6237167	0.00	0.00	0.00	0.00
GW072643	0.0	UNK	331951	6245584	0.00	0.00	0.10	0.15
GW072776	2.5	HUSE	327753	6237209	0.00	0.00	0.00	0.00
GW072785	7.6	HUSE	329915	6241858	0.02	0.04	0.03	0.05
GW072795	8.4	HUSE	329217	6239614	0.05	0.12	0.05	0.12
GW072901	7.0	HUSE	332915	6244474	0.00	0.00	0.01	0.03
GW072912	6.0	HUSE	328117	6237309	0.00	0.00	0.00	0.00
GW072968	8.5	HUSE	329531	6241007	0.11	0.18	0.12	0.19
GW073139	8.0	HUSE	328877	6240159	0.11	0.23	0.11	0.23
GW073398	7.6	HUSE	329023	6239964	0.08	0.18	0.08	0.19
GW073521	3.0	HUSE	332994	6244389	0.00	0.00	0.01	0.02
GW075024	19.5	MON	332822	6244671	0.00	0.00	0.01	0.03
GW075059	17.5	MON	328297	6239285	0.00	0.02	0.00	0.02
GW075063	0.0	MON	328406	6238157	0.00	0.01	0.00	0.01
GW100025	6.0	HUSE	329431	6240611	0.13	0.22	0.13	0.22
GW100053	0.0	RECN	332163	6245867	0.00	0.00	0.11	0.15
GW100209	108.0	HUSE	329946	6243253	0.25	0.34	0.85	0.99
GW100297	5.0	HUSE	329353	6241293	0.13	0.21	0.13	0.22
GW100440	6.3	UNK	329023	6238810	0.00	0.02	0.00	0.02
GW100444	5.5	HUSE	329355	6241725	0.08	0.15	0.10	0.17
GW100473	6.7	HUSE	329118	6240422	0.15	0.27	0.16	0.27
GW100484	0.0	UNK	332935	6245035	0.00	0.00	0.01	0.02
GW100484	4.0	MON	332935	6245035	0.00	0.00	0.01	0.02
GW100484	0.0	UNK	332935	6245035	0.00	0.00	0.01	0.02
GW100520	7.0	RECN	328953	6239155	0.01	0.05	0.01	0.05
GW100564	10.0	HUSE	328827	6239259	0.01	0.06	0.01	0.06
GW100585	7.9	HUSE	327493	6236114	0.00	0.00	0.00	0.00
GW100664	5.8	HUSE	328697	6238860	0.00	0.02	0.00	0.02
GW100679	4.6	HUSE	328759	6239206	0.01	0.05	0.01	0.05

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW100685	6.1	HUSE	330299	6242094	0.01	0.02	0.01	0.02
GW100740	8.2	HUSE	329829	6241812	0.03	0.06	0.04	0.06
GW100754	148.0	INDS	332719	6243180	0.00	0.00	0.01	0.03
GW100965	8.2	HUSE	329789	6241346	0.07	0.11	0.07	0.12
GW101022	6.1	HUSE	330335	6241972	0.01	0.02	0.01	0.02
GW101025	5.0	HUSE	328672	6239022	0.00	0.03	0.00	0.03
GW101032	7.3	HUSE	329783	6241331	0.07	0.11	0.07	0.12
GW101056	6.0	RECN	328377	6239289	0.00	0.03	0.00	0.03
GW101137	6.7	HUSE	329079	6240597	0.18	0.30	0.18	0.30
GW101154	4.9	HUSE	328311	6237262	0.00	0.00	0.00	0.00
GW101163	5.8	HUSE	330331	6241983	0.01	0.02	0.01	0.02
GW101214	7.0	HUSE	329158	6240113	0.10	0.21	0.11	0.21
GW101222	7.8	HUSE	329521	6241352	0.10	0.16	0.10	0.17
GW101224	7.6	HUSE	329144	6239465	0.03	0.09	0.03	0.09
GW101328	7.6	HUSE	329382	6240487	0.13	0.22	0.13	0.22
GW101329	4.5	HUSE	328158	6239345	0.00	0.00	0.00	0.00
GW101350	5.9	MON	332201	6244281	0.00	0.00	0.01	0.04
GW101351	5.1	MON	332200	6244281	0.00	0.00	0.01	0.04
GW101352	5.7	MON	332200	6244281	0.00	0.00	0.01	0.04
GW101353	6.0	MON	332201	6244281	0.00	0.00	0.01	0.04
GW101354	6.0	MON	332200	6244281	0.00	0.00	0.01	0.04
GW101355	6.0	MON	332200	6244281	0.00	0.00	0.01	0.04
GW101356	5.6	MON	332201	6244281	0.00	0.00	0.01	0.04
GW101357	5.9	MON	332200	6244281	0.00	0.00	0.01	0.04
GW101358	6.0	MON	332200	6244281	0.00	0.00	0.01	0.04
GW101359	6.0	MON	332200	6244281	0.00	0.00	0.01	0.04
GW101360	6.0	MON	332200	6244281	0.00	0.00	0.01	0.04
GW101361	4.3	MON	332200	6244281	0.00	0.00	0.01	0.04
GW101362	5.9	MON	332200	6244281	0.00	0.00	0.01	0.04
GW101433	5.5	HUSE	329421	6241377	0.11	0.19	0.12	0.20
GW101474	4.3	HUSE	328786	6236925	0.00	0.00	0.00	0.00
GW101533	20.0	INDS	333064	6245358	0.00	0.00	0.00	0.01
GW101586	5.8	HUSE	328893	6236942	0.00	0.00	0.00	0.00
GW101638	7.6	HUSE	329377	6240623	0.14	0.24	0.14	0.24
GW101678	6.0	HUSE	328166	6237110	0.00	0.00	0.00	0.00
GW101756	6.1	HUSE	329452	6241376	0.11	0.19	0.12	0.20
GW101761	5.5	HUSE	328616	6238042	0.00	0.01	0.00	0.01
GW101763	6.0	HUSE	328459	6238396	0.00	0.01	0.00	0.01
GW101765	8.0	HUSE	329740	6241270	0.08	0.13	0.08	0.14

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW101797	5.8	HUSE	330307	6241995	0.01	0.02	0.01	0.02
GW101814	5.0	HUSE	328845	6238988	0.01	0.04	0.01	0.04
GW101815	5.5	HUSE	328842	6238948	0.01	0.03	0.01	0.03
GW101818	5.5	HUSE	329429	6241491	0.10	0.17	0.11	0.18
GW101826	6.1	HUSE	329141	6240060	0.10	0.20	0.10	0.20
GW101827	7.9	HUSE	329365	6241338	0.13	0.21	0.13	0.22
GW101853	6.0	HUSE	327564	6235985	0.00	0.00	0.00	0.00
GW101871	5.8	HUSE	328809	6239018	0.01	0.04	0.01	0.04
GW102137	5.0	HUSE	328905	6238475	0.00	0.01	0.00	0.01
GW102160	5.0	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102162	5.0	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102164	5.0	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102165	5.0	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102168	5.0	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102169	4.5	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102171	6.0	MON	332303	6244172	0.00	0.00	0.01	0.04
GW102172	4.5	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102173	4.5	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102176	4.5	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102178	4.4	MON	332303	6244173	0.00	0.00	0.01	0.04
GW102184	4.2	MON	332302	6244173	0.00	0.00	0.01	0.04
GW102185	4.2	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102186	4.2	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102187	4.2	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102188	4.0	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102189	4.0	MON	332303	6244172	0.00	0.00	0.01	0.04
GW102190	4.0	MON	332303	6244172	0.00	0.00	0.01	0.04
GW102191	4.0	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102192	4.0	MON	332303	6244172	0.00	0.00	0.01	0.04
GW102193	3.9	MON	332302	6244173	0.00	0.00	0.01	0.04
GW102194	3.7	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102195	3.6	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102196	3.6	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102197	3.6	MON	332303	6244172	0.00	0.00	0.01	0.04
GW102198	3.5	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102199	3.5	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102200	3.5	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102201	3.5	MON	332302	6244172	0.00	0.00	0.01	0.04
GW102203	3.5	MON	332302	6244172	0.00	0.00	0.01	0.04

RPS

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW102204	3.3	MON	332303	6244172	0.00	0.00	0.01	0.04
GW102205	3.3	MON	332303	6244172	0.00	0.00	0.01	0.04
GW102218	6.7	HUSE	330073	6242040	0.02	0.03	0.03	0.04
GW102226	7.6	HUSE	329413	6240210	0.11	0.20	0.11	0.21
GW102271	8.0	HUSE	329339	6240054	0.09	0.18	0.09	0.18
GW102356	6.0	MON	333120	6246963	0.00	0.00	0.00	0.00
GW102357	6.0	MON	333093	6246993	0.00	0.00	0.00	0.00
GW102358	6.0	MON	333145	6246994	0.00	0.00	0.00	0.00
GW102359	6.0	MON	333146	6246901	0.00	0.00	0.00	0.00
GW102360	6.0	MON	333147	6246871	0.00	0.00	0.00	0.00
GW102361	6.0	MON	333146	6246901	0.00	0.00	0.00	0.00
GW102362	3.0	MON	333171	6246963	0.00	0.00	0.00	0.00
GW102363	3.0	MON	333145	6246963	0.00	0.00	0.00	0.00
GW102364	3.0	MON	333145	6246963	0.00	0.00	0.00	0.00
GW102365	6.0	MON	333146	6246932	0.00	0.00	0.00	0.00
GW102397	30.3	UNK	325803	6239651	0.00	0.00	0.00	0.00
GW102402	90.0	UNK	326938	6246390	0.00	0.00	0.00	0.00
GW102580	40.0	MON	328186	6244163	0.00	0.02	0.02	0.14
GW102629	8.0	HUSE	328698	6237471	0.00	0.00	0.00	0.00
GW102693	7.6	HUSE	330073	6242040	0.02	0.03	0.03	0.04
GW102799	7.6	HUSE	330055	6242017	0.02	0.03	0.03	0.04
GW102991	0.0	UNK	329705	6241317	0.08	0.13	0.08	0.14
GW103152	8.2	HUSE	329847	6241753	0.04	0.07	0.05	0.08
GW103228	6.0	HUSE	328922	6238509	0.00	0.01	0.00	0.01
GW103229	6.0	HUSE	328775	6238809	0.00	0.02	0.00	0.02
GW103331	3.2	MON	328470	6244126	0.00	0.05	0.04	0.29
GW103332	3.2	MON	328470	6244126	0.00	0.05	0.04	0.29
GW103333	3.2	MON	328470	6244126	0.00	0.05	0.04	0.29
GW103504	6.1	MON	333091	6245467	0.00	0.00	0.00	0.00
GW103505	6.0	MON	333091	6245458	0.00	0.00	0.00	0.00
GW103506	6.0	MON	333091	6245458	0.00	0.00	0.00	0.00
GW103507	6.0	MON	333092	6245458	0.00	0.00	0.00	0.00
GW103508	6.0	MON	333091	6245457	0.00	0.00	0.00	0.00
GW103588	7.0	HUSE	332905	6244836	0.00	0.00	0.01	0.03
GW103705	4.7	MON	333097	6244213	0.00	0.00	0.01	0.02
GW103706	4.3	MON	333097	6244213	0.00	0.00	0.01	0.02
GW103707	4.2	MON	333097	6244213	0.00	0.00	0.01	0.02
GW103780	7.6	HUSE	329023	6238811	0.00	0.02	0.00	0.02
GW103941	21.0	MON	331742	6242348	0.00	0.00	0.01	0.02

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW103942	12.0	MON	331742	6242348	0.00	0.00	0.01	0.02
GW103943	14.0	MON	331742	6242348	0.00	0.00	0.01	0.02
GW103944	18.0	MON	331742	6242348	0.00	0.00	0.01	0.02
GW103945	21.0	MON	331742	6242348	0.00	0.00	0.01	0.02
GW103946	17.0	MON	331742	6242348	0.00	0.00	0.01	0.02
GW103947	18.0	MON	331742	6242348	0.00	0.00	0.01	0.02
GW103948	18.0	MON	331742	6242348	0.00	0.00	0.01	0.02
GW103949	21.0	MON	331742	6242348	0.00	0.00	0.01	0.02
GW103950	21.0	MON	331742	6242348	0.00	0.00	0.01	0.02
GW103951	149.0	MON	331742	6242348	0.00	0.00	0.01	0.02
GW104297	0.0	HUSE	332708	6244483	0.00	0.00	0.01	0.03
GW104333	3.5	MON	332763	6243980	0.00	0.00	0.01	0.03
GW104334	3.5	MON	332782	6243996	0.00	0.00	0.01	0.03
GW104335	3.5	MON	332753	6243978	0.00	0.00	0.01	0.03
GW104336	3.5	MON	332790	6243972	0.00	0.00	0.01	0.03
GW104337	3.5	MON	332766	6243953	0.00	0.00	0.01	0.03
GW104338	3.5	MON	332802	6243948	0.00	0.00	0.01	0.03
GW104448	3.5	MON	331715	6244936	0.00	0.00	0.03	0.10
GW104449	3.5	MON	331677	6244959	0.00	0.00	0.04	0.10
GW104450	3.5	MON	331630	6244904	0.00	0.00	0.04	0.10
GW104572	6.1	HUSE	328997	6240187	0.12	0.23	0.12	0.23
GW104637	7.3	HUSE	328654	6238564	0.00	0.02	0.00	0.02
GW104653	8.0	MON	329743	6240984	0.09	0.14	0.09	0.15
GW104654	8.0	MON	329752	6240983	0.09	0.14	0.09	0.15
GW104655	8.0	MON	329753	6240991	0.09	0.14	0.09	0.15
GW104867	8.9	HUSE	329965	6241796	0.02	0.04	0.03	0.05
GW104901	7.6	HUSE	329874	6241189	0.06	0.10	0.06	0.10
GW104902	7.1	HUSE	332787	6244151	0.00	0.00	0.01	0.03
GW104935	6.5	HUSE	327569	6236112	0.00	0.00	0.00	0.00
GW104988	7.0	HUSE	333077	6244789	0.00	0.00	0.01	0.02
GW105119	6.1	HUSE	328397	6237392	0.00	0.00	0.00	0.00
GW105120	3.7	HUSE	328362	6239869	0.01	0.12	0.01	0.12
GW105133	6.0	HUSE	328530	6237726	0.00	0.00	0.00	0.00
GW105153	5.5	HUSE	328682	6241078	0.33	0.54	0.33	0.54
GW105158	4.6	HUSE	328744	6240928	0.31	0.49	0.31	0.50
GW105249	4.0	HUSE	328208	6237644	0.00	0.00	0.00	0.00
GW105250	4.0	HUSE	328198	6237640	0.00	0.00	0.00	0.00
GW105289	5.8	RECN	328367	6240572	0.33	0.53	0.33	0.53
GW105310	4.0	HUSE	328567	6238543	0.00	0.01	0.00	0.01

RPS

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW105367	5.0	HUSE	327762	6236662	0.00	0.00	0.00	0.00
GW105460	4.0	HUSE	328511	6239170	0.00	0.03	0.00	0.03
GW105472	7.0	HUSE	328921	6239955	0.07	0.18	0.07	0.18
GW105487	3.1	HUSE	326703	6238868	0.00	0.00	0.00	0.00
GW105516	8.2	HUSE	328983	6239013	0.01	0.04	0.01	0.04
GW105517	4.0	HUSE	329074	6241166	0.20	0.31	0.20	0.31
GW105527	5.0	MON	333069	6246148	0.00	0.00	0.00	0.00
GW105529	5.0	MON	333097	6246168	0.00	0.00	0.00	0.00
GW105550	8.9	HUSE	329761	6241216	0.07	0.12	0.08	0.12
GW105565	7.6	HUSE	329779	6241844	0.03	0.06	0.04	0.07
GW105566	6.0	HUSE	327220	6236134	0.00	0.00	0.00	0.00
GW105569	4.0	HUSE	328091	6236558	0.00	0.00	0.00	0.00
GW105580	3.5	MON	328812	6244162	0.01	0.08	0.07	0.33
GW105581	3.5	MON	328792	6244173	0.00	0.08	0.06	0.32
GW105582	3.5	MON	328763	6244179	0.00	0.07	0.05	0.29
GW105583	4.0	MON	328750	6244154	0.00	0.07	0.06	0.32
GW105586	4.0	HUSE	327751	6237086	0.00	0.00	0.00	0.00
GW105587	6.0	HUSE	328278	6239572	0.00	0.03	0.00	0.03
GW105588	4.0	HUSE	328884	6241201	0.26	0.40	0.26	0.40
GW105589	4.0	HUSE	328588	6238950	0.00	0.03	0.00	0.03
GW105590	0.0	HUSE	328188	6236793	0.00	0.00	0.00	0.00
GW105591	6.0	HUSE	328713	6239790	0.02	0.13	0.02	0.13
GW105592	6.0	HUSE	328051	6236557	0.00	0.00	0.00	0.00
GW105603	4.0	HUSE	327370	6236050	0.00	0.00	0.00	0.00
GW105616	4.5	HUSE	328335	6237441	0.00	0.00	0.00	0.00
GW105629	7.9	HUSE	329353	6240848	0.15	0.25	0.15	0.25
GW105674	7.0	HUSE	329995	6241914	0.02	0.04	0.03	0.05
GW105680	6.4	HUSE	328911	6238730	0.00	0.02	0.00	0.02
GW105684	9.0	HUSE	329350	6239934	0.08	0.17	0.08	0.17
GW105686	4.9	HUSE	327096	6236188	0.00	0.00	0.00	0.00
GW105715	4.0	HUSE	328537	6236949	0.00	0.00	0.00	0.00
GW105725	8.8	HUSE	329590	6241499	0.07	0.12	0.08	0.13
GW105728	6.0	HUSE	329005	6239077	0.01	0.04	0.01	0.04
GW105741	4.0	HUSE	328160	6237130	0.00	0.00	0.00	0.00
GW105742	4.0	HUSE	328078	6239024	0.00	0.00	0.00	0.00
GW105752	7.3	HUSE	328149	6237264	0.00	0.00	0.00	0.00
GW105753	4.0	HUSE	328744	6237245	0.00	0.00	0.00	0.00
GW105761	7.0	HUSE	329037	6238997	0.01	0.04	0.01	0.04
GW105767	5.0	HUSE	328851	6238159	0.00	0.01	0.00	0.01

RPS

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW105768	7.0	HUSE	329827	6241521	0.05	0.09	0.06	0.10
GW105769	4.0	HUSE	328164	6236602	0.00	0.00	0.00	0.00
GW105772	4.0	HUSE	328224	6237641	0.00	0.00	0.00	0.00
GW105773	4.0	HUSE	328580	6237120	0.00	0.00	0.00	0.00
GW105774	7.3	HUSE	330002	6241929	0.02	0.04	0.03	0.05
GW105819	4.0	HUSE	328410	6236756	0.00	0.00	0.00	0.00
GW105822	4.0	HUSE	328256	6236726	0.00	0.00	0.00	0.00
GW105855	0.0	UNK	329878	6241456	0.05	0.08	0.05	0.08
GW105880	0.0	UNK	329509	6240360	0.12	0.21	0.12	0.21
GW105935	0.0	UNK	327178	6236332	0.00	0.00	0.00	0.00
GW105952	0.0	UNK	328499	6237217	0.00	0.00	0.00	0.00
GW105972	5.0	HUSE	327409	6236584	0.00	0.00	0.00	0.00
GW105975	8.2	HUSE	329414	6240258	0.11	0.21	0.11	0.21
GW105976	8.2	HUSE	328026	6236202	0.00	0.00	0.00	0.00
GW105982	7.0	HUSE	329420	6241109	0.13	0.21	0.13	0.21
GW105991	6.0	HUSE	330141	6242067	0.02	0.03	0.02	0.04
GW105995	4.6	HUSE	329542	6241725	0.06	0.10	0.07	0.12
GW105998	4.0	HUSE	327341	6235803	0.00	0.00	0.00	0.00
GW106007	7.0	HUSE	329067	6239076	0.01	0.04	0.01	0.04
GW106009	4.0	HUSE	328127	6236121	0.00	0.00	0.00	0.00
GW106014	7.3	HUSE	330038	6242086	0.02	0.03	0.03	0.04
GW106020	4.0	HUSE	328137	6236685	0.00	0.00	0.00	0.00
GW106032	4.0	HUSE	327757	6236230	0.00	0.00	0.00	0.00
GW106034	4.0	HUSE	328158	6236654	0.00	0.00	0.00	0.00
GW106038	7.0	HUSE	328470	6236992	0.00	0.00	0.00	0.00
GW106053	6.1	HUSE	328810	6238841	0.00	0.02	0.00	0.02
GW106054	6.1	HUSE	328685	6238844	0.00	0.02	0.00	0.02
GW106056	6.0	HUSE	327359	6236000	0.00	0.00	0.00	0.00
GW106067	10.1	HUSE	329949	6241325	0.05	0.08	0.05	0.08
GW106084	6.0	HUSE	328794	6239284	0.01	0.06	0.01	0.06
GW106092	4.6	HUSE	328597	6238680	0.00	0.02	0.00	0.02
GW106101	5.0	HUSE	327581	6236891	0.00	0.00	0.00	0.00
GW106104	7.0	HUSE	328734	6238801	0.00	0.02	0.00	0.02
GW106105	4.0	HUSE	327967	6235964	0.00	0.00	0.00	0.00
GW106112	4.0	HUSE	328260	6239629	0.00	0.04	0.00	0.04
GW106113	5.2	HUSE	328742	6237771	0.00	0.00	0.00	0.00
GW106115	4.0	UNK	328384	6237806	0.00	0.00	0.00	0.00
GW106117	4.0	HUSE	327685	6236396	0.00	0.00	0.00	0.00
GW106128	7.0	HUSE	329370	6240283	0.12	0.21	0.12	0.22

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW106133	4.9	HUSE	327813	6236136	0.00	0.00	0.00	0.00
GW106136	4.0	HUSE	328782	6236939	0.00	0.00	0.00	0.00
GW106152	6.0	HUSE	328722	6238361	0.00	0.01	0.00	0.01
GW106153	6.0	HUSE	328690	6238353	0.00	0.01	0.00	0.01
GW106167	6.0	HUSE	328965	6241148	0.23	0.36	0.24	0.37
GW106170	8.0	HUSE	327605	6235901	0.00	0.00	0.00	0.00
GW106172	0.0	UNK	328284	6237697	0.00	0.00	0.00	0.00
GW106175	6.0	HUSE	328902	6239529	0.03	0.09	0.03	0.09
GW106179	4.5	HUSE	328875	6240243	0.13	0.26	0.13	0.26
GW106185	0.0	UNK	329081	6239666	0.05	0.13	0.05	0.13
GW106189	5.0	HUSE	327756	6236584	0.00	0.00	0.00	0.00
GW106204	6.0	HUSE	328062	6237181	0.00	0.00	0.00	0.00
GW106206	5.2	HUSE	328768	6241114	0.30	0.48	0.31	0.48
GW106208	7.0	HUSE	329191	6240099	0.10	0.20	0.10	0.20
GW106222	4.0	HUSE	328383	6237423	0.00	0.00	0.00	0.00
GW106223	6.0	HUSE	327393	6236171	0.00	0.00	0.00	0.00
GW106224	6.0	HUSE	329218	6239628	0.05	0.12	0.05	0.12
GW106227	8.0	HUSE	327648	6235956	0.00	0.00	0.00	0.00
GW106229	6.0	HUSE	327945	6237102	0.00	0.00	0.00	0.00
GW106233	5.0	HUSE	329311	6241492	0.11	0.19	0.12	0.20
GW106234	5.0	HUSE	328502	6237347	0.00	0.00	0.00	0.00
GW106238	5.0	HUSE	328770	6237708	0.00	0.00	0.00	0.00
GW106251	7.0	HUSE	328508	6238657	0.00	0.02	0.00	0.02
GW106252	0.0	UNK	327943	6237063	0.00	0.00	0.00	0.00
GW106262	6.0	HUSE	328843	6238365	0.00	0.01	0.00	0.01
GW106263	6.0	HUSE	328810	6236957	0.00	0.00	0.00	0.00
GW106270	5.0	HUSE	328024	6239330	0.00	0.00	0.00	0.00
GW106271	6.1	HUSE	329875	6241968	0.03	0.05	0.04	0.06
GW106274	8.2	HUSE	329645	6241416	0.08	0.14	0.09	0.15
GW106275	5.0	HUSE	328091	6236203	0.00	0.00	0.00	0.00
GW106276	5.0	HUSE	328525	6239047	0.00	0.03	0.00	0.03
GW106277	6.5	HUSE	329531	6241108	0.10	0.17	0.11	0.18
GW106280	6.4	HUSE	328772	6238739	0.00	0.02	0.00	0.02
GW106301	4.3	HUSE	327615	6236623	0.00	0.00	0.00	0.00
GW106308	8.5	HUSE	328108	6236468	0.00	0.00	0.00	0.00
GW106309	8.8	HUSE	329621	6241126	0.09	0.15	0.10	0.16
GW106316	4.0	HUSE	327698	6235871	0.00	0.00	0.00	0.00
GW106317	0.0	UNK	327924	6237450	0.00	0.00	0.00	0.00
GW106319	6.0	HUSE	327383	6236191	0.00	0.00	0.00	0.00

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW106324	5.0	HUSE	328785	6237785	0.00	0.00	0.00	0.00
GW106325	5.0	HUSE	328785	6238172	0.00	0.01	0.00	0.01
GW106331	5.0	HUSE	328339	6237630	0.00	0.00	0.00	0.00
GW106352	9.2	HUSE	329575	6240942	0.11	0.18	0.11	0.19
GW106356	4.0	HUSE	328128	6236654	0.00	0.00	0.00	0.00
GW106360	0.0	UNK	329109	6240513	0.17	0.28	0.17	0.29
GW106367	4.0	HUSE	328248	6236610	0.00	0.00	0.00	0.00
GW106368	6.0	HUSE	327842	6236852	0.00	0.00	0.00	0.00
GW106369	6.0	HUSE	327839	6236860	0.00	0.00	0.00	0.00
GW106371	5.0	HUSE	328725	6238839	0.00	0.02	0.00	0.02
GW106375	6.0	HUSE	328832	6239031	0.01	0.04	0.01	0.04
GW106377	4.0	HUSE	328186	6237126	0.00	0.00	0.00	0.00
GW106379	6.0	HUSE	329036	6239582	0.04	0.11	0.04	0.11
GW106382	6.0	HUSE	329042	6238665	0.00	0.01	0.00	0.02
GW106384	6.1	HUSE	328534	6238459	0.00	0.01	0.00	0.01
GW106387	7.3	HUSE	328994	6238893	0.01	0.03	0.01	0.03
GW106388	4.0	HUSE	328095	6239397	0.00	0.00	0.00	0.00
GW106392	6.0	HUSE	327946	6236202	0.00	0.00	0.00	0.00
GW106393	6.0	HUSE	327936	6236194	0.00	0.00	0.00	0.00
GW106396	6.0	HUSE	327919	6236912	0.00	0.00	0.00	0.00
GW106399	6.0	HUSE	328673	6238359	0.00	0.01	0.00	0.01
GW106400	4.0	HUSE	328209	6236502	0.00	0.00	0.00	0.00
GW106408	4.0	HUSE	328302	6236821	0.00	0.00	0.00	0.00
GW106411	4.0	HUSE	328186	6237561	0.00	0.00	0.00	0.00
GW106413	6.1	HUSE	328804	6238886	0.01	0.03	0.01	0.03
GW106415	6.1	HUSE	328774	6238835	0.00	0.02	0.00	0.02
GW106416	5.0	HUSE	327733	6236555	0.00	0.00	0.00	0.00
GW106419	4.0	HUSE	328773	6237753	0.00	0.00	0.00	0.00
GW106420	0.0	UNK	328326	6237537	0.00	0.00	0.00	0.00
GW106421	0.0	UNK	327982	6239435	0.00	0.00	0.00	0.00
GW106422	0.0	UNK	328613	6238874	0.00	0.02	0.00	0.02
GW106424	4.0	HUSE	328106	6236123	0.00	0.00	0.00	0.00
GW106425	7.0	HUSE	329546	6241654	0.07	0.12	0.08	0.13
GW106431	7.6	HUSE	329015	6239351	0.02	0.07	0.02	0.07
GW106434	6.0	HUSE	328824	6238521	0.00	0.01	0.00	0.01
GW106450	2.0	HUSE	329137	6242025	0.10	0.28	0.19	0.38
GW106456	6.0	HUSE	328943	6239096	0.01	0.04	0.01	0.04
GW106458	4.0	HUSE	328341	6237102	0.00	0.00	0.00	0.00
GW106461	6.0	HUSE	329034	6239938	0.08	0.18	0.08	0.19

RPS

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW106474	7.6	HUSE	329326	6240237	0.12	0.22	0.12	0.22
GW106481	4.0	HUSE	327736	6236508	0.00	0.00	0.00	0.00
GW106482	4.0	HUSE	328265	6237675	0.00	0.00	0.00	0.00
GW106484	4.0	HUSE	328112	6236734	0.00	0.00	0.00	0.00
GW106485	4.0	HUSE	328190	6236520	0.00	0.00	0.00	0.00
GW106507	7.0	HUSE	329430	6241185	0.12	0.20	0.13	0.21
GW106544	4.0	HUSE	328360	6237444	0.00	0.00	0.00	0.00
GW106557	6.1	HUSE	330335	6242085	0.01	0.02	0.01	0.02
GW106561	4.0	HUSE	328555	6236893	0.00	0.00	0.00	0.00
GW106563	6.7	HUSE	329183	6240180	0.12	0.23	0.12	0.23
GW106564	3.1	HUSE	328179	6237654	0.00	0.00	0.00	0.00
GW106570	4.3	HUSE	327521	6235819	0.00	0.00	0.00	0.00
GW106578	4.0	HUSE	328493	6237165	0.00	0.00	0.00	0.00
GW106579	6.1	HUSE	328907	6239857	0.06	0.16	0.06	0.17
GW106587	4.0	HUSE	328835	6241165	0.28	0.43	0.28	0.44
GW106603	6.1	HUSE	328868	6239861	0.05	0.15	0.05	0.15
GW106618	6.0	HUSE	329055	6239602	0.04	0.11	0.04	0.11
GW106619	4.0	HUSE	328298	6236860	0.00	0.00	0.00	0.00
GW106631	8.8	HUSE	329709	6241559	0.06	0.11	0.07	0.12
GW106655	4.0	HUSE	328114	6236640	0.00	0.00	0.00	0.00
GW106659	7.6	HUSE	329809	6241529	0.05	0.09	0.06	0.10
GW106672	5.5	HUSE	328816	6240059	0.08	0.21	0.08	0.21
GW106703	4.0	HUSE	328602	6237130	0.00	0.00	0.00	0.00
GW106712	7.0	HUSE	329908	6241983	0.02	0.04	0.03	0.05
GW106713	4.0	HUSE	327821	6237209	0.00	0.00	0.00	0.00
GW106716	4.0	HUSE	327221	6236070	0.00	0.00	0.00	0.00
GW106720	6.0	HUSE	329877	6241654	0.04	0.07	0.05	0.08
GW106726	6.0	HUSE	327607	6235925	0.00	0.00	0.00	0.00
GW106729	4.0	HUSE	328581	6237010	0.00	0.00	0.00	0.00
GW106732	6.0	HUSE	328333	6237593	0.00	0.00	0.00	0.00
GW106755	4.0	HUSE	328080	6235966	0.00	0.00	0.00	0.00
GW106767	6.0	HUSE	328632	6238968	0.00	0.03	0.00	0.03
GW106769	7.0	HUSE	327577	6236190	0.00	0.00	0.00	0.00
GW106778	7.6	HUSE	329584	6241122	0.10	0.17	0.11	0.18
GW106780	7.3	HUSE	328998	6239777	0.05	0.14	0.05	0.15
GW106799	6.0	HUSE	329915	6241983	0.02	0.04	0.03	0.05
GW106804	4.0	HUSE	328666	6237105	0.00	0.00	0.00	0.00
GW106805	4.0	HUSE	328657	6237107	0.00	0.00	0.00	0.00
GW106807	4.0	HUSE	328130	6235989	0.00	0.00	0.00	0.00

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW106809	6.0	HUSE	328324	6237464	0.00	0.00	0.00	0.00
GW106811	4.0	MON	327101	6239128	0.00	0.00	0.00	0.00
GW106826	6.0	HUSE	329417	6241116	0.13	0.21	0.13	0.21
GW106832	5.8	HUSE	328829	6239002	0.01	0.04	0.01	0.04
GW106834	4.0	HUSE	328072	6236095	0.00	0.00	0.00	0.00
GW106837	3.0	HUSE	328351	6237113	0.00	0.00	0.00	0.00
GW106840	4.0	HUSE	328331	6237481	0.00	0.00	0.00	0.00
GW106842	4.0	HUSE	327083	6236155	0.00	0.00	0.00	0.00
GW106843	4.5	HUSE	327794	6235973	0.00	0.00	0.00	0.00
GW106846	7.9	HUSE	328748	6239328	0.01	0.06	0.01	0.06
GW106847	7.0	HUSE	327594	6236288	0.00	0.00	0.00	0.00
GW106848	4.0	HUSE	328240	6237408	0.00	0.00	0.00	0.00
GW106849	4.3	HUSE	328392	6237670	0.00	0.00	0.00	0.00
GW106850	5.0	HUSE	327757	6236448	0.00	0.00	0.00	0.00
GW106851	3.5	HUSE	329472	6240194	0.11	0.19	0.11	0.20
GW106860	6.0	HUSE	328204	6239444	0.00	0.00	0.00	0.00
GW106861	4.0	HUSE	328080	6236186	0.00	0.00	0.00	0.00
GW106869	0.0	UNK	330363	6241967	0.01	0.01	0.01	0.02
GW106873	7.6	HUSE	329367	6240956	0.15	0.24	0.15	0.25
GW106876	6.0	UNK	328884	6240224	0.13	0.25	0.13	0.25
GW106879	5.5	HUSE	328338	6236968	0.00	0.00	0.00	0.00
GW106881	6.0	HUSE	328108	6239152	0.00	0.00	0.00	0.00
GW106882	5.0	HUSE	328073	6239462	0.00	0.00	0.00	0.00
GW106883	6.0	HUSE	328884	6239547	0.03	0.09	0.03	0.09
GW106889	7.9	HUSE	329365	6240403	0.13	0.22	0.13	0.23
GW106891	6.0	HUSE	329358	6241076	0.15	0.24	0.15	0.24
GW106894	4.0	HUSE	327595	6236557	0.00	0.00	0.00	0.00
GW106896	6.0	HUSE	328871	6238473	0.00	0.01	0.00	0.01
GW106897	6.0	HUSE	329482	6241175	0.12	0.20	0.13	0.21
GW106898	4.0	HUSE	328113	6236721	0.00	0.00	0.00	0.00
GW106899	9.5	HUSE	329673	6240861	0.10	0.17	0.10	0.17
GW106907	4.0	HUSE	328303	6239624	0.00	0.05	0.00	0.05
GW106920	6.1	HUSE	328651	6238411	0.00	0.01	0.00	0.01
GW106922	3.7	HUSE	328073	6236652	0.00	0.00	0.00	0.00
GW106932	4.0	HUSE	327929	6235951	0.00	0.00	0.00	0.00
GW106939	3.0	HUSE	327775	6236660	0.00	0.00	0.00	0.00
GW106940	6.0	HUSE	330261	6242169	0.01	0.02	0.02	0.03
GW106946	6.0	HUSE	329194	6240220	0.12	0.23	0.12	0.23
GW106948	0.0	UNK	329901	6241537	0.04	0.07	0.05	0.08

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW106949	5.8	HUSE	328894	6239957	0.07	0.18	0.07	0.18
GW106954	5.0	HUSE	328319	6239839	0.01	0.11	0.01	0.11
GW106955	4.2	HUSE	327582	6242038	0.00	0.02	0.00	0.09
GW106956	5.5	HUSE	328329	6240575	0.34	0.54	0.34	0.54
GW106957	7.3	HUSE	328778	6238704	0.00	0.02	0.00	0.02
GW106961	7.0	HUSE	329072	6238758	0.00	0.02	0.00	0.02
GW106963	6.0	HUSE	328749	6238734	0.00	0.02	0.00	0.02
GW106964	0.0	UNK	327838	6236491	0.00	0.00	0.00	0.00
GW106975	4.0	HUSE	328996	6241009	0.23	0.35	0.23	0.36
GW106976	4.0	HUSE	327893	6237112	0.00	0.00	0.00	0.00
GW106980	4.0	HUSE	327231	6236100	0.00	0.00	0.00	0.00
GW106982	5.0	RECN	329381	6241829	0.06	0.11	0.08	0.13
GW106984	6.0	HUSE	328224	6239335	0.00	0.01	0.00	0.01
GW106986	7.0	HUSE	329144	6240440	0.15	0.27	0.16	0.27
GW106989	5.0	IRAG	329673	6241800	0.05	0.08	0.06	0.09
GW106990	5.0	IRAG	329862	6242021	0.03	0.05	0.04	0.06
GW106991	5.0	IRAG	330026	6242126	0.02	0.04	0.03	0.05
GW106992	5.0	IRAG	329768	6241959	0.03	0.06	0.04	0.07
GW106993	5.0	IRAG	329737	6241878	0.03	0.06	0.04	0.07
GW107019	7.0	HUSE	329032	6238802	0.00	0.02	0.00	0.02
GW107020	5.0	HUSE	328145	6238942	0.00	0.00	0.00	0.00
GW107023	6.0	HUSE	327542	6236722	0.00	0.00	0.00	0.00
GW107026	9.8	HUSE	329415	6240060	0.09	0.18	0.09	0.19
GW107045	6.0	HUSE	328194	6239475	0.00	0.00	0.00	0.00
GW107051	7.0	HUSE	328759	6238838	0.00	0.02	0.00	0.02
GW107052	5.8	HUSE	330307	6242060	0.01	0.02	0.01	0.02
GW107053	9.0	HUSE	329711	6241051	0.09	0.15	0.09	0.15
GW107060	4.0	HUSE	328025	6236135	0.00	0.00	0.00	0.00
GW107077	4.0	HUSE	328493	6237492	0.00	0.00	0.00	0.00
GW107078	4.0	HUSE	327554	6236883	0.00	0.00	0.00	0.00
GW107086	4.5	HUSE	327677	6236662	0.00	0.00	0.00	0.00
GW107095	5.8	HUSE	327770	6236254	0.00	0.00	0.00	0.00
GW107101	9.0	HUSE	330065	6241549	0.02	0.04	0.03	0.05
GW107105	7.3	HUSE	329190	6240288	0.13	0.23	0.13	0.23
GW107114	5.9	HUSE	328266	6239739	0.01	0.07	0.01	0.07
GW107118	6.0	HUSE	328700	6238680	0.00	0.02	0.00	0.02
GW107121	5.0	HUSE	329511	6241572	0.08	0.14	0.09	0.15
GW107136	0.0	UNK	328138	6236066	0.00	0.00	0.00	0.00
GW107148	5.8	HUSE	328708	6241067	0.32	0.52	0.32	0.53

RPS

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW107149	6.0	HUSE	328373	6237680	0.00	0.00	0.00	0.00
GW107153	8.2	HUSE	329416	6240935	0.14	0.22	0.14	0.23
GW107156	0.0	UNK	328720	6238678	0.00	0.02	0.00	0.02
GW107157	6.0	HUSE	328645	6237308	0.00	0.00	0.00	0.00
GW107166	4.0	HUSE	328933	6241077	0.24	0.37	0.24	0.38
GW107169	6.0	HUSE	327947	6236088	0.00	0.00	0.00	0.00
GW107170	4.0	HUSE	328233	6237188	0.00	0.00	0.00	0.00
GW107172	6.1	HUSE	327178	6236450	0.00	0.00	0.00	0.00
GW107177	7.6	HUSE	328919	6238805	0.01	0.02	0.01	0.02
GW107183	5.5	HUSE	328600	6237366	0.00	0.00	0.00	0.00
GW107184	5.0	HUSE	328279	6239370	0.00	0.01	0.00	0.01
GW107185	7.0	HUSE	328167	6236255	0.00	0.00	0.00	0.00
GW107192	7.3	HUSE	328990	6239782	0.05	0.14	0.05	0.15
GW107195	4.0	HUSE	328317	6240495	0.28	0.48	0.29	0.49
GW107206	4.0	HUSE	327743	6236360	0.00	0.00	0.00	0.00
GW107207	4.0	HUSE	328937	6241261	0.23	0.35	0.23	0.36
GW107208	4.0	HUSE	328792	6237040	0.00	0.00	0.00	0.00
GW107210	6.0	HUSE	330050	6241975	0.02	0.03	0.02	0.04
GW107215	4.0	HUSE	328212	6237250	0.00	0.00	0.00	0.00
GW107216	6.0	HUSE	328880	6239521	0.03	0.09	0.03	0.09
GW107236	8.0	HUSE	329412	6240443	0.13	0.22	0.13	0.22
GW107269	7.5	HUSE	328962	6241329	0.22	0.33	0.22	0.34
GW107270	5.5	HUSE	328050	6236807	0.00	0.00	0.00	0.00
GW107273	4.0	HUSE	327847	6237328	0.00	0.00	0.00	0.00
GW107275	6.0	HUSE	327599	6236500	0.00	0.00	0.00	0.00
GW107279	5.0	HUSE	327563	6236883	0.00	0.00	0.00	0.00
GW107281	6.0	HUSE	327399	6236579	0.00	0.00	0.00	0.00
GW107297	5.0	HUSE	328311	6239819	0.01	0.09	0.01	0.09
GW107298	6.0	HUSE	328972	6239075	0.01	0.04	0.01	0.04
GW107299	5.6	HUSE	328296	6239787	0.01	0.09	0.01	0.09
GW107301	5.0	HUSE	327656	6235830	0.00	0.00	0.00	0.00
GW107302	6.0	HUSE	329544	6241578	0.08	0.14	0.09	0.15
GW107306	6.0	HUSE	329547	6241554	0.08	0.14	0.09	0.15
GW107313	9.2	HUSE	329721	6240952	0.09	0.16	0.10	0.16
GW107317	7.3	HUSE	329441	6241199	0.12	0.20	0.13	0.21
GW107318	7.6	HUSE	329657	6241439	0.07	0.11	0.07	0.12
GW107333	10.4	HUSE	329986	6241411	0.04	0.07	0.04	0.07
GW107341	6.0	HUSE	328858	6238092	0.00	0.01	0.00	0.01
GW107344	4.0	HUSE	328694	6241062	0.32	0.53	0.33	0.54

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW107346	9.8	HUSE	329604	6241570	0.07	0.12	0.08	0.13
GW107349	7.3	HUSE	329051	6240534	0.18	0.30	0.18	0.30
GW107350	9.5	HUSE	329606	6240889	0.11	0.18	0.11	0.19
GW107356	6.0	HUSE	329677	6241701	0.05	0.09	0.06	0.10
GW107357	6.1	HUSE	328318	6239655	0.00	0.06	0.00	0.06
GW107364	5.2	HUSE	328345	6239700	0.01	0.08	0.01	0.08
GW107367	7.0	HUSE	329571	6241227	0.09	0.15	0.10	0.16
GW107370	7.0	HUSE	329367	6241228	0.14	0.23	0.14	0.23
GW107371	6.7	HUSE	328928	6240229	0.12	0.25	0.13	0.25
GW107372	5.8	HUSE	328314	6239656	0.00	0.06	0.00	0.06
GW107373	6.0	HUSE	328203	6239678	0.00	0.04	0.00	0.04
GW107374	10.0	HUSE	328181	6239739	0.00	0.05	0.00	0.05
GW107375	4.0	HUSE	328199	6237502	0.00	0.00	0.00	0.00
GW107406	5.0	MON	329048	6245678	0.00	0.00	0.00	0.00
GW107407	7.0	MON	329063	6245678	0.00	0.00	0.00	0.00
GW107422	4.0	HUSE	328180	6236466	0.00	0.00	0.00	0.00
GW107423	5.8	HUSE	328849	6240112	0.09	0.22	0.09	0.22
GW107425	9.0	HUSE	329782	6241168	0.07	0.12	0.08	0.13
GW107426	4.0	HUSE	328493	6237226	0.00	0.00	0.00	0.00
GW107428	4.0	HUSE	328251	6237427	0.00	0.00	0.00	0.00
GW107442	9.2	HUSE	329526	6241380	0.10	0.16	0.10	0.17
GW107445	5.0	HUSE	328096	6236012	0.00	0.00	0.00	0.00
GW107450	4.0	HUSE	328822	6239543	0.02	0.09	0.02	0.09
GW107456	4.0	HUSE	327638	6236425	0.00	0.00	0.00	0.00
GW107458	6.0	HUSE	327784	6236980	0.00	0.00	0.00	0.00
GW107482	6.0	HUSE	327493	6236438	0.00	0.00	0.00	0.00
GW107484	15.0	HUSE	328152	6239688	0.00	0.03	0.00	0.03
GW107493	7.3	HUSE	329235	6239646	0.05	0.12	0.05	0.12
GW107505	5.0	HUSE	328834	6238817	0.00	0.02	0.00	0.02
GW107506	4.0	HUSE	328113	6239223	0.00	0.00	0.00	0.00
GW107507	9.0	HUSE	329967	6241352	0.04	0.08	0.05	0.08
GW107511	8.2	HUSE	329520	6241428	0.08	0.14	0.09	0.15
GW107513	4.0	HUSE	328574	6239180	0.00	0.03	0.00	0.03
GW107516	8.0	HUSE	329907	6241502	0.05	0.08	0.05	0.08
GW107531	14.0	INDS	328900	6240860	0.25	0.40	0.25	0.40
GW107532	5.5	HUSE	328058	6239058	0.00	0.00	0.00	0.00
GW107540	7.0	HUSE	328955	6241057	0.23	0.36	0.24	0.37
GW107541	6.0	HUSE	329529	6241518	0.08	0.14	0.09	0.15
GW107542	7.3	HUSE	329294	6240211	0.11	0.21	0.11	0.21

RPS

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW107552	9.2	HUSE	329475	6240311	0.12	0.21	0.12	0.21
GW107553	4.0	HUSE	327737	6236386	0.00	0.00	0.00	0.00
GW107576	8.5	HUSE	328594	6239213	0.01	0.04	0.01	0.04
GW107580	20.0	HUSE	327849	6242015	0.02	0.09	0.04	0.20
GW107589	4.0	HUSE	327142	6236051	0.00	0.00	0.00	0.00
GW107590	4.0	HUSE	328574	6238980	0.00	0.03	0.00	0.03
GW107595	5.5	HUSE	328806	6239279	0.01	0.06	0.01	0.06
GW107599	6.0	HUSE	328500	6238517	0.00	0.01	0.00	0.01
GW107605	8.5	HUSE	329758	6241799	0.04	0.07	0.05	0.08
GW107606	7.0	HUSE	328128	6239694	0.00	0.03	0.00	0.03
GW107622	7.0	HUSE	328963	6239523	0.03	0.10	0.03	0.10
GW107626	9.0	HUSE	329981	6241334	0.04	0.07	0.05	0.08
GW107628	7.0	HUSE	329560	6241041	0.11	0.18	0.12	0.19
GW107636	6.0	HUSE	329869	6241224	0.06	0.11	0.07	0.11
GW107637	4.0	HUSE	328770	6237938	0.00	0.00	0.00	0.00
GW107648	4.0	HUSE	328084	6236840	0.00	0.00	0.00	0.00
GW107650	4.0	HUSE	328941	6241205	0.25	0.38	0.25	0.38
GW107662	6.0	HUSE	329184	6240359	0.14	0.25	0.14	0.25
GW107664	6.0	HUSE	327571	6236477	0.00	0.00	0.00	0.00
GW107667	7.0	HUSE	328237	6237509	0.00	0.00	0.00	0.00
GW107669	6.0	HUSE	328856	6239097	0.01	0.04	0.01	0.04
GW107682	4.0	HUSE	328180	6239195	0.00	0.00	0.00	0.00
GW107684	6.0	HUSE	329089	6239736	0.05	0.14	0.05	0.14
GW107689	7.0	HUSE	329337	6241134	0.15	0.23	0.15	0.24
GW107690	4.0	HUSE	327636	6236874	0.00	0.00	0.00	0.00
GW107695	7.5	HUSE	329033	6239134	0.01	0.05	0.01	0.05
GW107720	0.0	UNK	329542	6240987	0.12	0.20	0.13	0.21
GW107722	6.7	HUSE	328836	6239176	0.01	0.05	0.01	0.05
GW107724	4.0	HUSE	328758	6237420	0.00	0.00	0.00	0.00
GW107729	5.0	HUSE	328815	6236985	0.00	0.00	0.00	0.00
GW107731	7.0	HUSE	329182	6239636	0.04	0.12	0.04	0.12
GW107743	6.0	HUSE	328152	6239755	0.00	0.04	0.00	0.04
GW107744	4.0	HUSE	328942	6241134	0.24	0.37	0.24	0.37
GW107746	8.0	HUSE	329533	6241286	0.10	0.16	0.10	0.17
GW107747	6.0	HUSE	328127	6239325	0.00	0.00	0.00	0.00
GW107753	5.0	MON	328820	6244219	0.00	0.07	0.05	0.27
GW107754	4.8	MON	328806	6244202	0.00	0.07	0.05	0.28
GW107755	4.8	MON	328797	6244223	0.00	0.06	0.04	0.26
GW107756	5.0	MON	328784	6244215	0.00	0.06	0.04	0.26

RPS

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW107772	5.0	HUSE	327113	6236200	0.00	0.00	0.00	0.00
GW107773	6.1	HUSE	327869	6237161	0.00	0.00	0.00	0.00
GW107775	6.7	HUSE	328929	6239382	0.02	0.08	0.02	0.08
GW107776	6.0	HUSE	327264	6236007	0.00	0.00	0.00	0.00
GW107780	8.5	HUSE	329441	6241029	0.13	0.20	0.13	0.21
GW107788	5.2	HUSE	327682	6235865	0.00	0.00	0.00	0.00
GW107799	5.5	HUSE	328094	6239675	0.00	0.02	0.00	0.02
GW107803	6.1	HUSE	328889	6239828	0.05	0.14	0.05	0.15
GW107824	5.0	HUSE	328306	6236849	0.00	0.00	0.00	0.00
GW107836	5.0	HUSE	328409	6236857	0.00	0.00	0.00	0.00
GW107845	5.0	HUSE	328567	6237034	0.00	0.00	0.00	0.00
GW107846	6.0	HUSE	328098	6238666	0.00	0.00	0.00	0.00
GW107847	4.0	HUSE	328091	6236383	0.00	0.00	0.00	0.00
GW107849	7.0	HUSE	328229	6239463	0.00	0.01	0.00	0.01
GW107851	4.0	HUSE	328288	6236710	0.00	0.00	0.00	0.00
GW107852	6.0	HUSE	329559	6241261	0.09	0.15	0.10	0.16
GW107857	7.0	HUSE	329237	6240787	0.17	0.28	0.17	0.28
GW107859	7.0	HUSE	328213	6239468	0.00	0.00	0.00	0.00
GW107861	6.0	HUSE	328798	6238650	0.00	0.02	0.00	0.02
GW107864	5.0	HUSE	327491	6236058	0.00	0.00	0.00	0.00
GW107870	4.3	HUSE	329385	6241380	0.11	0.19	0.12	0.20
GW107876	6.0	HUSE	328714	6239772	0.02	0.12	0.02	0.12
GW107878	4.0	HUSE	328240	6237476	0.00	0.00	0.00	0.00
GW107879	4.0	HUSE	327497	6236586	0.00	0.00	0.00	0.00
GW107880	4.0	HUSE	328440	6236840	0.00	0.00	0.00	0.00
GW107883	7.0	HUSE	328999	6240317	0.14	0.26	0.14	0.26
GW107887	6.0	HUSE	328910	6239609	0.03	0.10	0.03	0.11
GW107889	6.0	HUSE	329076	6239363	0.02	0.07	0.02	0.07
GW107890	5.0	HUSE	328920	6241019	0.25	0.38	0.25	0.39
GW107891	7.0	HUSE	329017	6238826	0.00	0.02	0.00	0.02
GW107896	6.0	HUSE	329011	6239785	0.06	0.15	0.06	0.16
GW107911	5.5	HUSE	328301	6239811	0.01	0.09	0.01	0.09
GW107920	6.0	HUSE	328936	6238727	0.00	0.02	0.00	0.02
GW107953	4.0	HUSE	328171	6237480	0.00	0.00	0.00	0.00
GW107972	7.0	HUSE	329505	6241483	0.08	0.14	0.09	0.15
GW107973	7.0	HUSE	329119	6240321	0.14	0.24	0.14	0.25
GW107974	3.0	HUSE	328703	6237069	0.00	0.00	0.00	0.00
GW107976	3.5	DRNG	333211	6244864	0.00	0.00	0.01	0.02
GW107977	5.8	HUSE	329847	6241924	0.03	0.05	0.04	0.06

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW107985	5.5	HUSE	329378	6241455	0.10	0.17	0.11	0.18
GW107993	13.6	RECN	328242	6243424	0.03	0.36	8.98	14.29
GW108005	4.0	HUSE	327710	6236340	0.00	0.00	0.00	0.00
GW108006	4.0	HUSE	328936	6241091	0.24	0.37	0.24	0.38
GW108007	5.0	HUSE	327894	6239363	0.00	0.00	0.00	0.00
GW108015	5.0	HUSE	328193	6236428	0.00	0.00	0.00	0.00
GW108028	6.0	HUSE	328170	6236038	0.00	0.00	0.00	0.00
GW108035	4.0	HUSE	328092	6236024	0.00	0.00	0.00	0.00
GW108037	6.0	HUSE	327202	6236057	0.00	0.00	0.00	0.00
GW108049	4.0	HUSE	328254	6236826	0.00	0.00	0.00	0.00
GW108050	4.0	HUSE	328788	6239952	0.05	0.18	0.05	0.18
GW108084	6.0	HUSE	328028	6239282	0.00	0.00	0.00	0.00
GW108096	7.3	HUSE	329617	6241369	0.08	0.14	0.09	0.15
GW108097	5.8	HUSE	327461	6236630	0.00	0.00	0.00	0.00
GW108104	0.0	INDS	333038	6245307	0.00	0.00	0.00	0.01
GW108109	4.0	HUSE	327963	6235989	0.00	0.00	0.00	0.00
GW108171	9.0	HUSE	329923	6241280	0.05	0.09	0.05	0.09
GW108173	5.0	HUSE	328628	6238349	0.00	0.01	0.00	0.01
GW108174	4.0	HUSE	328789	6237972	0.00	0.01	0.00	0.01
GW108176	4.0	HUSE	328139	6236152	0.00	0.00	0.00	0.00
GW108179	9.8	HUSE	330124	6241797	0.01	0.03	0.02	0.03
GW108222	6.0	HUSE	328801	6239028	0.01	0.04	0.01	0.04
GW108239	7.6	HUSE	330065	6241860	0.02	0.03	0.02	0.04
GW108252	9.2	HUSE	329732	6241411	0.07	0.11	0.07	0.12
GW108266	6.0	HUSE	328805	6238698	0.00	0.02	0.00	0.02
GW108268	4.0	HUSE	328506	6238430	0.00	0.01	0.00	0.01
GW108273	6.0	HUSE	327569	6236149	0.00	0.00	0.00	0.00
GW108274	4.9	HUSE	328339	6237100	0.00	0.00	0.00	0.00
GW108277	6.0	HUSE	329276	6241219	0.15	0.24	0.16	0.25
GW108288	4.0	HUSE	328032	6239430	0.00	0.00	0.00	0.00
GW108290	6.0	HUSE	328976	6238693	0.00	0.02	0.00	0.02
GW108292	4.0	HUSE	328650	6237327	0.00	0.00	0.00	0.00
GW108295	8.0	HUSE	328907	6242466	0.43	2.07	0.66	2.42
GW108298	6.0	HUSE	329243	6240927	0.17	0.27	0.17	0.28
GW108299	4.0	HUSE	328647	6237753	0.00	0.00	0.00	0.00
GW108300	7.3	HUSE	329162	6240444	0.15	0.26	0.15	0.26
GW108301	6.0	HUSE	327900	6236673	0.00	0.00	0.00	0.00
GW108302	4.6	HUSE	328213	6236612	0.00	0.00	0.00	0.00
GW108304	16.0	HUSE	328165	6236869	0.00	0.00	0.00	0.00

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW108311	4.0	HUSE	328753	6238391	0.00	0.01	0.00	0.01
GW108321	5.6	HUSE	328669	6239261	0.01	0.05	0.01	0.05
GW108349	4.0	HUSE	328361	6236671	0.00	0.00	0.00	0.00
GW108350	4.0	MON	327001	6238945	0.00	0.00	0.00	0.00
GW108351	4.0	MON	326978	6238916	0.00	0.00	0.00	0.00
GW108352	4.0	MON	326959	6238939	0.00	0.00	0.00	0.00
GW108353	4.5	MON	326985	6238961	0.00	0.00	0.00	0.00
GW108402	8.5	HUSE	328614	6239040	0.00	0.03	0.00	0.03
GW108404	7.6	HUSE	328864	6241100	0.27	0.41	0.27	0.42
GW108406	8.0	HUSE	329510	6243455	0.29	0.42	0.75	0.95
GW108411	8.5	HUSE	329643	6241227	0.09	0.15	0.10	0.16
GW108416	5.0	HUSE	328340	6239814	0.01	0.11	0.01	0.11
GW108432	7.9	HUSE	329311	6241070	0.16	0.25	0.16	0.26
GW108434	8.5	HUSE	329705	6241356	0.07	0.11	0.07	0.12
GW108438	8.0	HUSE	327869	6237097	0.00	0.00	0.00	0.00
GW108439	8.0	HUSE	328893	6242478	0.56	2.32	0.87	2.79
GW108441	8.5	HUSE	329358	6241335	0.13	0.21	0.13	0.22
GW108449	7.0	HUSE	328964	6240138	0.10	0.22	0.11	0.22
GW108454	9.5	HUSE	329548	6241384	0.10	0.16	0.10	0.17
GW108473	6.0	HUSE	328845	6239990	0.07	0.19	0.07	0.19
GW108488	9.8	HUSE	329743	6241168	0.08	0.14	0.09	0.15
GW108489	4.0	HUSE	327315	6235831	0.00	0.00	0.00	0.00
GW108490	12.5	RECN	328494	6238122	0.00	0.01	0.00	0.01
GW108493	6.0	HUSE	328676	6238522	0.00	0.02	0.00	0.02
GW108495	9.5	HUSE	329500	6240430	0.12	0.21	0.12	0.21
GW108496	6.1	HUSE	328859	6239799	0.05	0.15	0.05	0.15
GW108497	8.0	UNK	332753	6245547	0.00	0.00	0.00	0.00
GW108513	4.0	HUSE	328263	6236609	0.00	0.00	0.00	0.00
GW108516	6.0	HUSE	327270	6236140	0.00	0.00	0.00	0.00
GW108521	6.0	HUSE	327295	6236061	0.00	0.00	0.00	0.00
GW108522	3.0	HUSE	328134	6237547	0.00	0.00	0.00	0.00
GW108529	6.0	HUSE	328827	6238713	0.00	0.02	0.00	0.02
GW108531	4.0	HUSE	328391	6237448	0.00	0.00	0.00	0.00
GW108533	6.0	HUSE	328912	6238796	0.01	0.02	0.01	0.02
GW108534	7.0	HUSE	329526	6241155	0.10	0.17	0.11	0.18
GW108536	4.0	HUSE	327852	6237409	0.00	0.00	0.00	0.00
GW108539	7.0	HUSE	329614	6241597	0.06	0.11	0.07	0.12
GW108547	7.0	HUSE	329821	6241586	0.04	0.07	0.05	0.08
GW108549	7.0	HUSE	329020	6239136	0.01	0.05	0.01	0.05

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW108550	7.0	HUSE	329025	6239159	0.01	0.05	0.01	0.05
GW108551	6.0	HUSE	328057	6239823	0.00	0.02	0.00	0.02
GW108554	4.0	HUSE	328232	6237633	0.00	0.00	0.00	0.00
GW108559	7.0	HUSE	328966	6239821	0.06	0.16	0.06	0.16
GW108560	4.0	HUSE	328736	6237693	0.00	0.00	0.00	0.00
GW108563	8.2	HUSE	328657	6239128	0.01	0.04	0.01	0.04
GW108568	7.0	HUSE	328939	6239625	0.04	0.12	0.04	0.12
GW108570	7.9	HUSE	327495	6236360	0.00	0.00	0.00	0.00
GW108571	8.8	HUSE	330211	6241854	0.01	0.02	0.01	0.02
GW108573	7.9	HUSE	329427	6241203	0.12	0.20	0.13	0.21
GW108574	6.1	HUSE	328912	6239180	0.01	0.05	0.01	0.05
GW108578	6.0	HUSE	329443	6241562	0.09	0.16	0.10	0.17
GW108582	8.5	HUSE	330054	6241853	0.02	0.03	0.02	0.04
GW108584	5.8	HUSE	329397	6240226	0.11	0.20	0.11	0.21
GW108585	6.4	HUSE	327380	6236228	0.00	0.00	0.00	0.00
GW108588	8.0	HUSE	329440	6243429	0.31	0.44	0.80	1.00
GW108590	4.0	HUSE	328570	6241219	0.43	0.66	0.43	0.66
GW108591	6.1	HUSE	328775	6237544	0.00	0.00	0.00	0.00
GW108597	8.5	HUSE	329370	6241136	0.15	0.23	0.15	0.24
GW108598	5.2	HUSE	328593	6237480	0.00	0.00	0.00	0.00
GW108599	12.0	HUSE	329856	6241211	0.06	0.11	0.07	0.11
GW108600	5.8	HUSE	328288	6239718	0.01	0.07	0.01	0.07
GW108623	6.0	HUSE	329103	6240951	0.20	0.32	0.20	0.32
GW108625	9.5	HUSE	329558	6241349	0.10	0.16	0.10	0.17
GW108627	6.0	HUSE	328763	6237405	0.00	0.00	0.00	0.00
GW108631	7.0	HUSE	329473	6240918	0.13	0.22	0.13	0.22
GW108633	7.3	HUSE	329170	6239502	0.03	0.10	0.03	0.10
GW108644	4.0	HUSE	328383	6237472	0.00	0.00	0.00	0.00
GW108646	7.0	HUSE	328032	6236139	0.00	0.00	0.00	0.00
GW108648	4.0	HUSE	327272	6236129	0.00	0.00	0.00	0.00
GW108649	6.0	HUSE	327686	6236263	0.00	0.00	0.00	0.00
GW108650	4.0	HUSE	328183	6239118	0.00	0.00	0.00	0.00
GW108652	7.0	HUSE	329028	6239115	0.01	0.04	0.01	0.04
GW108655	7.0	HUSE	327472	6236614	0.00	0.00	0.00	0.00
GW108658	4.0	HUSE	328389	6237459	0.00	0.00	0.00	0.00
GW108661	7.0	HUSE	327805	6236935	0.00	0.00	0.00	0.00
GW108689	4.0	HUSE	327561	6236429	0.00	0.00	0.00	0.00
GW108690	7.0	HUSE	327537	6236500	0.00	0.00	0.00	0.00
GW108694	7.0	HUSE	327507	6236333	0.00	0.00	0.00	0.00

RPS

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW108696	7.0	HUSE	328916	6238819	0.01	0.02	0.01	0.02
GW108697	4.0	HUSE	328259	6237480	0.00	0.00	0.00	0.00
GW108701	6.1	HUSE	328803	6238174	0.00	0.01	0.00	0.01
GW108702	6.0	HUSE	330126	6242073	0.02	0.03	0.02	0.04
GW108713	9.2	HUSE	329758	6241662	0.05	0.09	0.06	0.10
GW108715	7.9	HUSE	329037	6239384	0.02	0.07	0.02	0.07
GW108716	5.0	HUSE	328108	6239196	0.00	0.00	0.00	0.00
GW108717	5.2	HUSE	329344	6241680	0.09	0.16	0.10	0.18
GW108718	4.0	HUSE	328839	6238128	0.00	0.01	0.00	0.01
GW108721	8.5	HUSE	329886	6241486	0.05	0.08	0.05	0.08
GW108733	6.0	HUSE	328817	6238732	0.00	0.02	0.00	0.02
GW108735	4.0	HUSE	328171	6236217	0.00	0.00	0.00	0.00
GW108743	7.3	HUSE	328946	6239487	0.03	0.09	0.03	0.09
GW108744	9.2	HUSE	329763	6241678	0.04	0.07	0.05	0.08
GW108745	7.0	HUSE	328766	6238453	0.00	0.01	0.00	0.01
GW108747	4.0	HUSE	328094	6236478	0.00	0.00	0.00	0.00
GW108763	6.0	HUSE	328748	6238372	0.00	0.01	0.00	0.01
GW108777	6.0	HUSE	328043	6239450	0.00	0.00	0.00	0.00
GW108795	6.1	HUSE	330378	6242127	0.01	0.02	0.01	0.02
GW108796	7.6	HUSE	329087	6240315	0.14	0.25	0.14	0.25
GW108810	6.0	HUSE	328846	6238410	0.00	0.01	0.00	0.01
GW108812	4.0	HUSE	328604	6237692	0.00	0.00	0.00	0.00
GW108814	8.2	HUSE	329636	6241391	0.08	0.14	0.09	0.15
GW108816	8.5	HUSE	328545	6239149	0.00	0.03	0.00	0.03
GW108832	6.1	HUSE	329422	6241318	0.11	0.19	0.12	0.20
GW108870	5.0	IRAG	329102	6242290	0.11	0.32	0.23	0.46
GW108887	8.0	HUSE	329208	6239637	0.05	0.12	0.05	0.12
GW108915	6.0	HUSE	329066	6239806	0.06	0.15	0.06	0.15
GW108924	4.6	HUSE	327544	6235825	0.00	0.00	0.00	0.00
GW108925	6.0	HUSE	328080	6237396	0.00	0.00	0.00	0.00
GW108927	5.8	HUSE	328196	6239644	0.00	0.03	0.00	0.03
GW108935	8.0	HUSE	327793	6237309	0.00	0.00	0.00	0.00
GW108937	7.3	HUSE	329073	6240329	0.14	0.25	0.14	0.25
GW108947	7.0	HUSE	328691	6238525	0.00	0.02	0.00	0.02
GW108948	4.0	HUSE	328368	6236921	0.00	0.00	0.00	0.00
GW108949	4.0	HUSE	327166	6236354	0.00	0.00	0.00	0.00
GW108965	6.0	HUSE	330196	6242204	0.01	0.03	0.02	0.03
GW108970	8.2	HUSE	329882	6241473	0.05	0.08	0.05	0.08
GW108977	4.0	HUSE	328654	6236964	0.00	0.00	0.00	0.00

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW108980	6.0	HUSE	328090	6236836	0.00	0.00	0.00	0.00
GW108982	6.0	HUSE	329203	6240194	0.12	0.23	0.12	0.23
GW108993	7.9	HUSE	329294	6240852	0.16	0.26	0.17	0.27
GW108999	3.1	HUSE	328409	6239933	0.01	0.15	0.01	0.15
GW109004	6.0	HUSE	329531	6241191	0.10	0.17	0.11	0.18
GW109015	6.1	HUSE	328719	6241398	0.49	0.69	0.50	0.70
GW109023	7.0	HUSE	327730	6236293	0.00	0.00	0.00	0.00
GW109027	4.0	HUSE	327961	6239346	0.00	0.00	0.00	0.00
GW109028	8.0	HUSE	330147	6241910	0.02	0.03	0.02	0.03
GW109029	4.0	INDS	328114	6238861	0.00	0.00	0.00	0.00
GW109031	4.0	HUSE	328693	6237197	0.00	0.00	0.00	0.00
GW109045	7.9	HUSE	329220	6240772	0.17	0.28	0.17	0.28
GW109053	5.8	HUSE	328753	6237077	0.00	0.00	0.00	0.00
GW109063	4.0	HUSE	327760	6236391	0.00	0.00	0.00	0.00
GW109092	4.0	RECN	329139	6241374	0.16	0.26	0.17	0.27
GW109093	7.0	HUSE	329883	6241508	0.04	0.07	0.05	0.08
GW109094	7.0	HUSE	329049	6239076	0.01	0.04	0.01	0.04
GW109095	7.0	HUSE	329068	6239201	0.02	0.05	0.02	0.05
GW109102	6.0	HUSE	328185	6239406	0.00	0.00	0.00	0.00
GW109103	6.0	HUSE	328953	6239794	0.05	0.14	0.05	0.15
GW109105	4.0	HUSE	328003	6235968	0.00	0.00	0.00	0.00
GW109106	6.7	HUSE	328993	6238723	0.00	0.02	0.00	0.02
GW109111	5.0	HUSE	330295	6242023	0.01	0.02	0.01	0.02
GW109113	4.0	HUSE	328125	6237563	0.00	0.00	0.00	0.00
GW109114	7.0	HUSE	327578	6236832	0.00	0.00	0.00	0.00
GW109121	5.8	HUSE	328852	6241189	0.27	0.41	0.27	0.42
GW109122	6.0	HUSE	328676	6239200	0.01	0.04	0.01	0.04
GW109123	3.1	HUSE	328404	6239910	0.01	0.14	0.01	0.15
GW109124	7.0	HUSE	327319	6236166	0.00	0.00	0.00	0.00
GW109129	4.0	HUSE	328285	6236771	0.00	0.00	0.00	0.00
GW109130	6.0	HUSE	327718	6236512	0.00	0.00	0.00	0.00
GW109131	6.0	HUSE	328763	6239718	0.03	0.12	0.03	0.12
GW109134	4.0	HUSE	328561	6236941	0.00	0.00	0.00	0.00
GW109136	4.0	HUSE	327648	6236963	0.00	0.00	0.00	0.00
GW109137	6.0	HUSE	328778	6238908	0.01	0.03	0.01	0.03
GW109138	4.0	HUSE	328350	6236791	0.00	0.00	0.00	0.00
GW109144	8.8	HUSE	328788	6239705	0.03	0.12	0.03	0.12
GW109145	4.0	HUSE	328761	6237549	0.00	0.00	0.00	0.00
GW109148	4.0	HUSE	328192	6236576	0.00	0.00	0.00	0.00

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW109152	204.0	MON	327323	6238563	0.00	0.00	0.00	0.00
GW109154	5.5	HUSE	327592	6235846	0.00	0.00	0.00	0.00
GW109155	8.8	HUSE	330069	6241900	0.02	0.03	0.02	0.03
GW109160	5.5	HUSE	328759	6237777	0.00	0.00	0.00	0.00
GW109166	8.2	HUSE	329700	6241454	0.07	0.11	0.07	0.12
GW109167	8.0	HUSE	327538	6236031	0.00	0.00	0.00	0.00
GW109183	8.0	HUSE	328021	6239584	0.00	0.01	0.00	0.01
GW109223	6.0	HUSE	329284	6240992	0.16	0.26	0.17	0.27
GW109227	8.0	HUSE	328901	6238411	0.00	0.01	0.00	0.01
GW109236	5.2	HUSE	328540	6237326	0.00	0.00	0.00	0.00
GW109246	11.6	HUSE	329817	6241067	0.08	0.13	0.08	0.13
GW109256	36.0	RECN	327056	6238989	0.00	0.00	0.00	0.00
GW109258	7.9	HUSE	329488	6241384	0.10	0.16	0.10	0.17
GW109267	8.0	HUSE	329057	6239468	0.03	0.10	0.03	0.10
GW109268	6.5	HUSE	329178	6240237	0.12	0.23	0.12	0.23
GW109273	6.0	HUSE	328835	6239889	0.05	0.16	0.05	0.16
GW109280	7.0	HUSE	330139	6241785	0.01	0.03	0.02	0.03
GW109311	7.0	HUSE	327391	6236135	0.00	0.00	0.00	0.00
GW109314	9.2	HUSE	329361	6240075	0.10	0.19	0.10	0.19
GW109318	6.1	HUSE	328605	6238312	0.00	0.01	0.00	0.01
GW109419	7.9	HUSE	329176	6240490	0.15	0.26	0.16	0.26
GW109455	9.2	HUSE	329611	6241110	0.09	0.15	0.10	0.16
GW109491	4.0	HUSE	328109	6235980	0.00	0.00	0.00	0.00
GW109559	6.0	HUSE	328174	6239686	0.00	0.04	0.00	0.04
GW109581	7.3	HUSE	329447	6241199	0.12	0.20	0.13	0.21
GW109641	6.7	HUSE	328668	6238328	0.00	0.01	0.00	0.01
GW109642	6.7	HUSE	328662	6238301	0.00	0.01	0.00	0.01
GW109643	6.7	HUSE	328686	6238296	0.00	0.01	0.00	0.01
GW109645	8.5	HUSE	329354	6240594	0.14	0.24	0.14	0.24
GW109654	8.2	HUSE	330022	6241975	0.02	0.04	0.03	0.05
GW109657	7.0	HUSE	328796	6239850	0.04	0.15	0.04	0.15
GW109665	6.0	HUSE	329066	6240095	0.10	0.21	0.10	0.21
GW109666	10.7	HUSE	329476	6240244	0.11	0.20	0.11	0.20
GW109673	7.0	HUSE	330001	6241966	0.02	0.04	0.03	0.05
GW109674	6.0	HUSE	329940	6241598	0.03	0.05	0.03	0.05
GW109697	6.1	HUSE	329463	6241451	0.10	0.17	0.11	0.18
GW109775	5.0	HUSE	328120	6239194	0.00	0.00	0.00	0.00
GW109821	35.0	MON	331819	6245899	0.00	0.00	4.97	5.50
GW109822	10.5	MON	331806	6245594	0.00	0.00	1.23	1.42

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW109823	29.0	MON	331819	6245594	0.00	0.00	1.08	1.27
GW109824	20.7	MON	331393	6245635	0.00	0.00	3.69	3.66
GW109825	22.0	MON	331689	6245853	0.00	0.00	6.75	7.42
GW109925	6.0	HUSE	327825	6236420	0.00	0.00	0.00	0.00
GW109926	9.0	HUSE	329790	6241487	0.05	0.09	0.06	0.10
GW109932	7.3	HUSE	329742	6241763	0.05	0.08	0.05	0.09
GW109934	6.0	HUSE	329135	6240770	0.19	0.30	0.19	0.31
GW109935	7.6	HUSE	329018	6239515	0.03	0.10	0.03	0.10
GW109936	7.5	HUSE	328164	6236832	0.00	0.00	0.00	0.00
GW109938	6.0	HUSE	327676	6236246	0.00	0.00	0.00	0.00
GW109939	6.1	HUSE	328705	6238313	0.00	0.01	0.00	0.01
GW109942	6.7	HUSE	328865	6238802	0.00	0.02	0.00	0.02
GW109945	7.5	HUSE	329184	6239519	0.04	0.11	0.04	0.11
GW109947	7.0	HUSE	328811	6238355	0.00	0.01	0.00	0.01
GW109958	5.2	MON	327033	6242227	0.00	0.01	0.12	0.45
GW109959	5.9	MON	327028	6242217	0.00	0.01	0.12	0.45
GW109960	8.0	MON	327018	6242245	0.00	0.01	0.12	0.45
GW109961	5.8	MON	327025	6242240	0.00	0.01	0.12	0.45
GW109963	8.0	HUSE	329446	6243406	0.32	0.45	0.80	1.01
GW109964	8.0	HUSE	329426	6243419	0.32	0.45	0.81	1.01
GW109965	8.0	HUSE	329489	6243467	0.29	0.41	0.75	0.95
GW109966	3.0	HUSE	329373	6243465	0.31	0.44	0.79	1.00
GW110010	8.5	MON	329035	6245672	0.00	0.00	0.00	0.00
GW110011	8.7	MON	329061	6245687	0.00	0.00	0.00	0.00
GW110012	8.0	MON	329035	6245705	0.00	0.00	0.00	0.00
GW110013	5.0	MON	329049	6245718	0.00	0.00	0.00	0.00
GW110014	7.0	MON	329069	6245707	0.00	0.00	0.00	0.00
GW110097	6.7	HUSE	329101	6240265	0.13	0.24	0.13	0.24
GW110098	8.2	HUSE	329837	6241771	0.03	0.06	0.04	0.06
GW110118	6.0	MON	329422	6245830	0.00	0.00	0.00	0.00
GW110119	3.5	MON	329372	6245821	0.00	0.00	0.00	0.00
GW110120	6.0	MON	329413	6245861	0.00	0.00	0.00	0.00
GW110121	3.5	MON	329454	6245840	0.00	0.00	0.00	0.00
GW110122	3.5	MON	329500	6245833	0.00	0.00	0.00	0.00
GW110133	8.5	HUSE	330488	6242094	0.01	0.01	0.01	0.02
GW110167	6.0	HUSE	328939	6239799	0.05	0.14	0.05	0.15
GW110189	6.0	HUSE	328722	6239752	0.02	0.12	0.02	0.12
GW110202	6.0	HUSE	328180	6239431	0.00	0.00	0.00	0.00
GW110206	5.8	HUSE	328068	6239001	0.00	0.00	0.00	0.00

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW110219	6.0	HUSE	328220	6239754	0.01	0.06	0.01	0.06
GW110220	6.0	HUSE	329530	6241302	0.10	0.16	0.10	0.17
GW110223	5.0	MON	327006	6239078	0.00	0.00	0.00	0.00
GW110224	4.0	MON	327014	6239053	0.00	0.00	0.00	0.00
GW110225	4.0	MON	327023	6239054	0.00	0.00	0.00	0.00
GW110226	4.0	MON	327021	6239062	0.00	0.00	0.00	0.00
GW110227	7.0	HUSE	327487	6236308	0.00	0.00	0.00	0.00
GW110228	8.8	HUSE	328613	6238844	0.00	0.02	0.00	0.02
GW110229	7.3	HUSE	328974	6240193	0.12	0.24	0.12	0.24
GW110271	6.0	HUSE	328305	6239786	0.01	0.09	0.01	0.09
GW110272	7.0	HUSE	329207	6240776	0.18	0.28	0.18	0.29
GW110274	3.0	HUSE	328930	6241147	0.24	0.38	0.25	0.38
GW110276	9.0	HUSE	330267	6242178	0.01	0.02	0.02	0.03
GW110302	5.5	HUSE	328110	6236491	0.00	0.00	0.00	0.00
GW110323	9.2	HUSE	328714	6239108	0.01	0.04	0.01	0.04
GW110382	8.0	HUSE	328330	6236643	0.00	0.00	0.00	0.00
GW110418	6.0	HUSE	328943	6239351	0.02	0.07	0.02	0.07
GW110420	6.0	HUSE	327792	6237138	0.00	0.00	0.00	0.00
GW110422	6.0	HUSE	328883	6239721	0.04	0.13	0.04	0.13
GW110440	9.0	HUSE	329813	6241117	0.07	0.12	0.07	0.12
GW110441	8.5	HUSE	329844	6241669	0.04	0.07	0.05	0.08
GW110442	6.0	HUSE	329055	6239779	0.05	0.14	0.05	0.14
GW110445	6.0	HUSE	329879	6241501	0.05	0.08	0.05	0.08
GW110446	6.0	HUSE	328803	6238941	0.01	0.03	0.01	0.03
GW110456	3.2	MON	332781	6246011	0.00	0.00	0.00	0.00
GW110457	3.6	MON	332822	6245945	0.00	0.00	0.00	0.00
GW110458	2.8	MON	332909	6245992	0.00	0.00	0.00	0.00
GW110490	8.0	HUSE	328242	6236872	0.00	0.00	0.00	0.00
GW110493	4.0	HUSE	328210	6236445	0.00	0.00	0.00	0.00
GW110528	6.7	HUSE	329441	6241326	0.11	0.19	0.12	0.20
GW110541	7.0	HUSE	329062	6239952	0.08	0.18	0.08	0.19
GW110554	9.0	HUSE	329942	6241385	0.04	0.08	0.05	0.08
GW110558	7.0	HUSE	329484	6241043	0.13	0.20	0.13	0.21
GW110566	4.0	HUSE	328228	6236905	0.00	0.00	0.00	0.00
GW110652	5.5	HUSE	328857	6239608	0.03	0.11	0.03	0.11
GW110654	7.9	HUSE	329432	6241300	0.13	0.21	0.13	0.22
GW110655	8.0	HUSE	328129	6236884	0.00	0.00	0.00	0.00
GW110656	7.9	HUSE	329515	6241283	0.10	0.16	0.10	0.17
GW110657	5.5	HUSE	328716	6237438	0.00	0.00	0.00	0.00

RPS

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW110659	9.0	HUSE	329621	6241116	0.09	0.15	0.10	0.16
GW110670	5.8	HUSE	330299	6242190	0.01	0.02	0.02	0.03
GW110691	8.5	HUSE	329325	6240058	0.09	0.18	0.09	0.18
GW110710	6.0	HUSE	327620	6236477	0.00	0.00	0.00	0.00
GW110727	6.0	HUSE	328703	6239259	0.01	0.05	0.01	0.05
GW110728	6.0	HUSE	328145	6236926	0.00	0.00	0.00	0.00
GW110735	8.0	HUSE	328935	6242529	0.54	2.16	0.89	2.67
GW110777	4.0	HUSE	328360	6237591	0.00	0.00	0.00	0.00
GW110781	8.5	HUSE	329378	6240951	0.15	0.24	0.15	0.25
GW110842	8.5	HUSE	328580	6238848	0.00	0.02	0.00	0.02
GW110844	5.5	HUSE	329560	6241653	0.07	0.12	0.08	0.13
GW110845	8.5	HUSE	329387	6240643	0.14	0.24	0.14	0.24
GW110846	8.0	HUSE	329842	6241836	0.03	0.06	0.04	0.06
GW110855	9.2	HUSE	329306	6240081	0.10	0.20	0.10	0.20
GW110865	4.0	HUSE	328020	6239442	0.00	0.00	0.00	0.00
GW110866	6.0	HUSE	327930	6236922	0.00	0.00	0.00	0.00
GW110867	6.0	HUSE	328873	6238573	0.00	0.02	0.00	0.02
GW110868	6.0	HUSE	329137	6240784	0.19	0.30	0.19	0.30
GW110876	6.0	HUSE	328245	6237356	0.00	0.00	0.00	0.00
GW110877	6.0	HUSE	327805	6236822	0.00	0.00	0.00	0.00
GW110878	6.0	HUSE	327376	6236211	0.00	0.00	0.00	0.00
GW110897	8.5	HUSE	329613	6241414	0.08	0.14	0.09	0.15
GW110898	8.5	HUSE	329382	6240137	0.10	0.19	0.10	0.20
GW110906	5.8	MON	332088	6242532	0.00	0.00	0.01	0.02
GW110907	5.8	MON	332102	6242440	0.00	0.00	0.01	0.02
GW110908	6.0	MON	332064	6242423	0.00	0.00	0.01	0.02
GW110909	5.8	MON	332220	6242618	0.00	0.00	0.01	0.02
GW110910	6.0	MON	332245	6242521	0.00	0.00	0.01	0.02
GW110911	6.0	MON	332184	6242497	0.00	0.00	0.01	0.02
GW110917	8.5	HUSE	329725	6241387	0.07	0.11	0.07	0.12
GW110953	8.0	HUSE	329514	6241305	0.10	0.16	0.10	0.17
GW111003	4.0	HUSE	328452	6236904	0.00	0.00	0.00	0.00
GW111017	6.0	HUSE	328855	6240163	0.11	0.23	0.11	0.24
GW111020	4.0	HUSE	328889	6238890	0.01	0.03	0.01	0.03
GW111037	6.0	HUSE	329106	6240273	0.14	0.25	0.14	0.25
GW111083	9.0	MON	326154	6241199	0.00	0.00	0.00	0.00
GW111084	9.0	MON	326141	6241200	0.00	0.00	0.00	0.00
GW111085	5.0	MON	326131	6241184	0.00	0.00	0.00	0.00
GW111091	7.0	MON	329330	6241134	0.15	0.23	0.15	0.24

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW111117	8.5	HUSE	329570	6241128	0.10	0.17	0.11	0.18
GW111121	10.7	HUSE	330067	6241580	0.02	0.04	0.03	0.05
GW111123	8.0	HUSE	328507	6238644	0.00	0.02	0.00	0.02
GW111139	11.0	HUSE	330070	6241566	0.02	0.04	0.03	0.05
GW111140	7.0	HUSE	328884	6239488	0.02	0.08	0.02	0.08
GW111149	7.0	HUSE	329281	6240894	0.16	0.26	0.16	0.26
GW111164	8.0	HUSE	332686	6246860	0.00	0.00	0.05	0.06
GW111172	10.0	HUSE	329222	6240202	0.11	0.21	0.11	0.21
GW111186	6.0	MON	328883	6237844	0.00	0.00	0.00	0.00
GW111187	5.3	MON	328862	6237888	0.00	0.00	0.00	0.00
GW111188	6.0	MON	328852	6237931	0.00	0.00	0.00	0.00
GW111224	6.0	HUSE	329456	6241720	0.07	0.12	0.08	0.13
GW111225	8.0	HUSE	328662	6239197	0.01	0.04	0.01	0.04
GW111226	5.5	HUSE	328355	6237000	0.00	0.00	0.00	0.00
GW111227	8.5	HUSE	329406	6240221	0.11	0.20	0.11	0.21
GW111229	6.0	HUSE	327983	6239461	0.00	0.00	0.00	0.00
GW111231	5.5	HUSE	329911	6241329	0.05	0.09	0.06	0.10
GW111237	6.0	HUSE	328813	6238850	0.00	0.02	0.00	0.02
GW111282	6.0	HUSE	328559	6237494	0.00	0.00	0.00	0.00
GW111285	9.0	HUSE	328179	6239304	0.00	0.00	0.00	0.00
GW111295	9.0	HUSE	328838	6239304	0.01	0.06	0.01	0.06
GW111296	5.5	HUSE	329337	6241594	0.10	0.17	0.11	0.19
GW111308	8.0	HUSE	329565	6240820	0.12	0.19	0.12	0.20
GW111311	9.2	HUSE	329838	6241448	0.05	0.09	0.06	0.10
GW111315	4.0	HUSE	328466	6236859	0.00	0.00	0.00	0.00
GW111316	162.0	MON	329333	6242538	0.29	0.52	0.59	0.87
GW111320	5.2	MON	332305	6245845	0.00	0.00	0.09	0.12
GW111321	5.0	MON	332322	6245742	0.00	0.00	0.08	0.12
GW111344	4.0	MON	329132	6244166	0.02	0.09	0.09	0.30
GW111345	4.0	MON	329154	6244179	0.01	0.08	0.08	0.27
GW111346	4.0	MON	329177	6244147	0.02	0.09	0.09	0.29
GW111376	7.0	HUSE	328904	6238278	0.00	0.01	0.00	0.01
GW111414	6.0	HUSE	328189	6239302	0.00	0.00	0.00	0.00
GW111420	9.2	HUSE	329075	6238809	0.00	0.02	0.00	0.02
GW111437	4.9	HUSE	328208	6236581	0.00	0.00	0.00	0.00
GW111439	7.3	HUSE	329060	6238870	0.01	0.02	0.01	0.02
GW111440	5.2	HUSE	328333	6237031	0.00	0.00	0.00	0.00
GW111441	6.1	HUSE	327787	6235947	0.00	0.00	0.00	0.00
GW111442	4.3	HUSE	328287	6237105	0.00	0.00	0.00	0.00

Name	Bore Depth (mBGL)	Use	Easting	Northing	Project Drawdown 2024 (m)	Project Drawdown 2100 (m)	Cumulative Drawdown 2024 (m)	Cumulative Drawdown 2100 (m)
GW111443	9.2	HUSE	329318	6240144	0.10	0.20	0.10	0.20
GW111456	5.2	MON	333201	6242889	0.00	0.00	0.00	0.01
GW111457	6.2	MON	333244	6242859	0.00	0.00	0.00	0.01
GW111467	6.0	HUSE	328504	6238529	0.00	0.01	0.00	0.01
GW111475	4.0	HUSE	328510	6237257	0.00	0.00	0.00	0.00
GW111482	7.6	HUSE	329300	6240987	0.16	0.26	0.17	0.27
GW111497	6.0	HUSE	328776	6239805	0.04	0.14	0.04	0.14
GW111498	11.6	HUSE	329810	6241091	0.07	0.12	0.07	0.12
GW111540	8.5	HUSE	330466	6242052	0.01	0.01	0.01	0.01
GW111558	6.0	HUSE	328867	6241185	0.26	0.41	0.27	0.41
GW111561	6.0	HUSE	328049	6239682	0.00	0.02	0.00	0.02
GW111562	6.0	HUSE	328299	6237249	0.00	0.00	0.00	0.00
GW111580	5.8	HUSE	328890	6239865	0.06	0.16	0.06	0.17
GW111590	7.0	HUSE	329445	6240253	0.11	0.21	0.11	0.21
GW111598	9.0	HUSE	330146	6241628	0.01	0.02	0.02	0.03
GW111613	6.0	HUSE	328604	6238620	0.00	0.02	0.00	0.02
GW111622	4.0	HUSE	327636	6236093	0.00	0.00	0.00	0.00
GW111666	7.6	HUSE	329316	6240243	0.12	0.22	0.12	0.22
GW111682	9.0	HUSE	329618	6241130	0.09	0.15	0.10	0.16
GW111686	3.5	MON	329728	6246909	0.00	0.00	0.00	0.00
GW111687	4.3	MON	329742	6246916	0.00	0.00	0.00	0.00
GW305694	5.0	HUSE	326438	6244811	0.00	0.00	0.00	0.01

Appendix C

Sensitivity Drawdown at GDEs

Appendix C Sensitivity Drawdown at GDEs

Table 1 Sensitivity Runs - Drawdown due to Project at GDE's at Project Opening

BoM Identifier	Potential for GW Interaction	Location	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy - 20%	Sy +20%	Kh -1 order	Kh +1 order
1976236	High	Bardwell Valley Parklands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
1976242	Moderate	Bardwell Valley Parklands	0.00	0.00	0.00	0.00	0.03	0.03	0.00	0.00	0.00	0.11
1978363	High	Rockdale Bicentennial Park	0.19	0.05	0.43	0.19	0.14	0.23	0.20	0.18	0.09	0.33
1978643	Low	Rockdale Bicentennial Park	0.10	0.03	0.22	0.10	0.07	0.12	0.10	0.09	0.04	0.17
Total >0.1m			**2**	**0**	**2**	**2**	**1**	**2**	**2**	**1**	**0**	**4**

Table 2 Sensitivity Runs - Drawdown due to Project at GDE's at 2100

BoM Identifier	Potential for GW Interaction	Location	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy - 20%	Sy +20%	Kh -1 order	Kh +1 order
1974035	Moderate	Wolli Creek Turrella	0.02	0.01	0.08	0.02	0.02	0.06	0.02	0.02	0.00	0.55
1974062	Low	Wolli Creek Turrella	0.02	0.01	0.06	0.02	0.02	0.05	0.02	0.02	0.00	0.53
1974071	Moderate	Wolli Creek Turrella	0.02	0.01	0.07	0.02	0.02	0.06	0.02	0.02	0.00	0.58
1974116	Low	Wolli Creek Turrella	0.01	0.00	0.01	0.01	0.01	0.03	0.01	0.01	0.00	0.45
1974138	Low	Wolli Creek Turrella	0.01	0.00	0.02	0.01	0.01	0.04	0.01	0.01	0.00	0.49
1974150	High	Wolli Creek Turrella	0.02	0.01	0.05	0.02	0.02	0.05	0.02	0.02	0.00	0.55
1974223	High	Wolli Creek Turrella	0.01	0.00	0.02	0.01	0.01	0.04	0.01	0.01	0.00	0.49
1974416	High	Wolli Creek Turrella	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.60
1974462	Low	Wolli Creek Turrella	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.44

RPS

BoM Identifier	Potential for GW Interaction	Location	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy - 20%	Sy +20%	Kh -1 order	Kh +1 order
1974496	Low	Wolli Creek Turrella	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.42
1974540	High	Wolli Creek Turrella	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.58
1975149	Low	Bardwell Valley Golf Club	0.00	0.02	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.24
1975200	Moderate	Bardwell Valley Golf Club	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.10
1975211	Moderate	Bardwell Valley Golf Club	0.00	0.03	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.40
1975237	Moderate	Bardwell Valley Golf Club	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.11
1975262	Moderate	Bardwell Valley Golf Club	0.00	0.01	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.16
1975273	Low	Bardwell Valley Golf Club	0.00	0.01	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.15
1975433	Moderate	Bardwell Valley Stotts Reserve	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.10
1976236	High	Bardwell Valley Parklands	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.48
1976242	Moderate	Bardwell Valley Parklands	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.25
1978363	High	Rockdale Bicentennial Park	0.32	0.10	0.71	0.32	0.32	0.40	0.32	0.32	0.16	0.57
1978514	High	Rockdale Bicentennial Park	0.28	0.08	0.62	0.28	0.28	0.34	0.28	0.28	0.13	0.47
1978549	High	Rockdale Bicentennial Park	0.27	0.08	0.60	0.27	0.27	0.33	0.27	0.27	0.13	0.45
1978643	Low	Rockdale Bicentennial Park	0.23	0.07	0.51	0.23	0.23	0.29	0.23	0.23	0.11	0.41
1979115	Moderate	Scarborough Park	0.11	0.03	0.24	0.11	0.11	0.13	0.11	0.11	0.05	0.19
1979157	Moderate	Scarborough Park	0.12	0.03	0.26	0.12	0.12	0.14	0.12	0.12	0.06	0.21

RPS

BoM Identifier	Potential for GW Interaction	Location	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy - 20%	Sy +20%	Kh -1 order	Kh +1 order
1979308	Low	Scarborough Park	0.07	0.02	0.16	0.07	0.07	0.09	0.07	0.07	0.03	0.13
1979335	Low	Scarborough Park	0.07	0.02	0.16	0.07	0.07	0.09	0.07	0.07	0.03	0.12
Total >0.1m			**6**	**1**	**8**	**6**	**6**	**9**	**6**	**6**	**4**	**28**

Table 3 Sensitivity Runs – Cumulative Drawdown at GDE's at Project Opening

BoM Identifier	Potential for GW Interaction	Location	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy - 20%	Sy +20%	Kh -1 order	Kh +1 order
1974035	Moderate	Wolli Creek Turrella	0.01	0.01	0.02	0.01	0.00	0.02	0.02	0.01	0.00	0.16
1974062	Low	Wolli Creek Turrella	0.01	0.01	0.02	0.01	0.00	0.02	0.02	0.01	0.00	0.15
1974071	Moderate	Wolli Creek Turrella	0.01	0.01	0.02	0.01	0.00	0.02	0.02	0.01	0.00	0.16
1974138	Low	Wolli Creek Turrella	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.13
1974150	High	Wolli Creek Turrella	0.01	0.01	0.01	0.01	0.00	0.02	0.01	0.00	0.00	0.15
1974223	High	Wolli Creek Turrella	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.13
1974416	High	Wolli Creek Turrella	0.04	0.10	0.01	0.04	0.03	0.24	0.05	0.04	0.00	0.49
1974462	Low	Wolli Creek Turrella	0.00	0.01	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.23
1974496	Low	Wolli Creek Turrella	0.00	0.01	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.29
1974540	High	Wolli Creek Turrella	0.02	0.02	0.01	0.02	0.01	0.04	0.03	0.01	0.00	0.44
1975149	Low	Bardwell Valley Golf Club	4.03	3.69	3.31	4.04	3.95	2.85	4.11	3.96	1.48	4.47
1975200	Moderate	Bardwell Valley Golf Club	4.62	2.86	4.72	4.63	4.47	4.07	4.74	4.49	1.51	4.96
1975206	Low	Bardwell Valley Golf Club	5.05	3.10	5.47	5.06	4.91	4.53	5.16	4.93	1.79	5.67
1975211	Moderate	Bardwell Valley Golf Club	7.71	5.28	2.08	7.72	7.60	5.76	7.77	7.64	3.61	4.75

RPS

BoM Identifier	Potential for GW Interaction	Location	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy - 20%	Sy +20%	Kh -1 order	Kh +1 order
1975237	Moderate	Bardwell Valley Golf Club	6.88	3.86	7.66	6.89	6.83	6.53	6.93	6.84	2.58	6.77
1975262	Moderate	Bardwell Valley Golf Club	4.25	2.93	2.68	4.26	4.15	3.03	4.34	4.16	1.40	4.24
1975273	Low	Bardwell Valley Golf Club	17.22	9.13	25.38	17.23	17.11	15.19	17.31	17.11	37.81	8.51
1975433	Moderate	Bardwell Valley Stotts Reserve	23.56	25.32	21.82	23.57	23.56	21.52	23.58	23.57	41.07	13.70
1975481	Moderate	Bardwell Valley Stotts Reserve	24.64	26.35	22.89	24.64	24.64	16.60	24.66	24.64	40.42	12.61
1976236	High	Bardwell Valley Parklands	0.02	0.03	0.06	0.02	0.01	0.01	0.03	0.02	0.00	1.48
1976242	Moderate	Bardwell Valley Parklands	0.41	0.20	0.33	0.41	0.35	0.26	0.45	0.36	0.00	1.05
1978363	High	Rockdale Bicentennial Park	0.19	0.05	0.43	0.19	0.14	0.23	0.20	0.18	0.09	0.33
1978643	Low	Rockdale Bicentennial Park	0.10	0.03	0.22	0.10	0.07	0.12	0.10	0.09	0.04	0.17
Total >0.1m			**12**	**11**	**12**	**12**	**11**	**15**	**12**	**11**	**9**	**23**

Table 4 Sensitivity Runs – Cumulative Drawdown at GDE's at 2100

BoM Identifier	Potential for GW Interaction	Location	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy - 20%	Sy +20%	Kh -1 order	Kh +1 order
1974035	Moderate	Wolli Creek Turrella	0.10	0.05	0.20	0.10	0.10	0.22	0.10	0.10	0.052	1.208
1974062	Low	Wolli Creek Turrella	0.09	0.05	0.17	0.09	0.09	0.20	0.09	0.09	0.050	1.151
1974071	Moderate	Wolli Creek Turrella	0.10	0.05	0.18	0.10	0.10	0.21	0.10	0.10	0.054	1.224
1974116	Low	Wolli Creek Turrella	0.04	0.03	0.05	0.04	0.04	0.33	0.04	0.04	0.022	1.192
1974138	Low	Wolli Creek Turrella	0.06	0.04	0.07	0.06	0.06	0.42	0.06	0.06	0.038	1.326

RPS

BoM Identifier	Potential for GW Interaction	Location	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy -20%	Sy +20%	Kh -1 order	Kh +1 order
1974150	High	Wolli Creek Turrella	0.09	0.05	0.14	0.09	0.09	0.26	0.09	0.09	0.054	1.299
1974223	High	Wolli Creek Turrella	0.05	0.04	0.06	0.05	0.05	0.33	0.05	0.05	0.030	1.326
1974416	High	Wolli Creek Turrella	0.13	0.16	0.08	0.13	0.13	2.01	0.13	0.13	0.030	3.176
1974462	Low	Wolli Creek Turrella	0.01	0.02	0.01	0.01	0.01	1.18	0.01	0.01	0.000	2.549
1974496	Low	Wolli Creek Turrella	0.01	0.03	0.00	0.01	0.01	1.27	0.01	0.01	0.000	2.674
1974540	High	Wolli Creek Turrella	0.10	0.06	0.08	0.10	0.10	1.34	0.10	0.10	0.005	3.253
1975149	Low	Bardwell Valley Golf Club	4.19	4.49	3.43	4.19	4.19	3.16	4.19	4.19	2.035	5.443
1975200	Moderate	Bardwell Valley Golf Club	4.93	3.24	4.87	4.93	4.93	4.34	4.93	4.93	2.309	5.236
1975206	Low	Bardwell Valley Golf Club	5.33	3.43	5.60	5.33	5.33	4.77	5.33	5.33	2.545	5.905
1975211	Moderate	Bardwell Valley Golf Club	10.53	6.02	6.47	10.53	10.53	10.29	10.53	10.53	10.723	6.900
1975237	Moderate	Bardwell Valley Golf Club	6.97	4.09	7.68	6.97	6.97	6.60	6.97	6.97	2.992	6.988
1975262	Moderate	Bardwell Valley Golf Club	4.51	3.56	2.78	4.51	4.51	3.37	4.51	4.51	1.749	4.785
1975273	Low	Bardwell Valley Golf Club	17.45	9.54	25.35	17.45	17.45	15.36	17.45	17.45	37.088	8.705
1975433	Moderate	Bardwell Valley Stotts Reserve	23.61	25.32	21.81	23.61	23.61	21.52	23.61	23.61	40.558	13.796
1975481	Moderate	Bardwell Valley Stotts Reserve	24.69	26.40	22.93	24.69	24.69	16.65	24.69	24.69	40.766	12.661
1976236	High	Bardwell Valley Parklands	0.06	0.05	0.19	0.06	0.06	0.04	0.06	0.06	0.000	2.019
1976242	Moderate	Bardwell Valley Parklands	0.51	1.00	0.39	0.51	0.51	0.32	0.51	0.51	0.036	1.251
1978363	High	Rockdale Bicentennial Park	0.33	0.10	0.72	0.33	0.33	0.40	0.33	0.33	0.159	0.576

RPS

BoM Identifier	Potential for GW Interaction	Location	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy - 20%	Sy +20%	Kh -1 order	Kh +1 order
1978514	High	Rockdale Bicentennial Park	0.28	0.08	0.62	0.28	0.28	0.34	0.28	0.28	0.130	0.468
1978549	High	Rockdale Bicentennial Park	0.27	0.08	0.60	0.27	0.27	0.33	0.27	0.27	0.126	0.457
1978643	Low	Rockdale Bicentennial Park	0.23	0.07	0.52	0.23	0.23	0.29	0.23	0.23	0.113	0.417
1979115	Moderate	Scarborough Park	0.11	0.03	0.25	0.11	0.11	0.13	0.11	0.11	0.051	0.193
1979157	Moderate	Scarborough Park	0.12	0.03	0.27	0.12	0.12	0.15	0.12	0.12	0.056	0.209
1979308	Low	Scarborough Park	0.07	0.02	0.16	0.07	0.07	0.09	0.07	0.07	0.034	0.128
1979335	Low	Scarborough Park	0.07	0.02	0.16	0.07	0.07	0.09	0.07	0.07	0.033	0.124
Total >0.1m			**20**	**12**	**23**	**20**	**20**	**27**	**20**	**20**	**13**	**30**

Appendix D

Sensitivity Drawdown at Registered Bores

RPS

Appendix D Sensitivity Drawdown at Bores

Table 1 Sensitivity Runs - Drawdown due to Project at Registered Bores at Project Opening

Registered ID	Depth (m)	Use	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy - 20%	Sy +20%	Kh -1 order	Kh +1 order
GW107580	20.0	Domestic	0.02	0.16	0.01	0.02	0.02	0.03	0.03	0.05	0.00	2.39
GW106955	4.2	Domestic	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	1.51
GW024062	3.6	Water Supply	0.98	0.15	3.34	0.99	0.54	0.96	1.13	0.06	0.50	1.70
GW108295	8.0	Domestic	0.43	0.10	1.14	0.44	0.19	0.50	0.52	0.04	0.20	1.03
GW108439	8.0	Domestic	0.56	0.13	1.41	0.56	0.26	0.63	0.67	0.06	0.27	1.20
GW023191	3.6	Water Supply	0.28	0.08	0.66	0.29	0.13	0.56	0.35	0.03	0.12	0.85
GW110735	8.0	Domestic	0.54	0.13	1.30	0.54	0.26	0.65	0.65	0.07	0.26	1.20
GW023194	4.8	Water Supply	1.78	0.18	2.43	1.79	1.65	1.91	1.90	0.05	0.02	1.77
GW100209	108.0	Domestic	0.25	1.54	0.70	0.25	0.20	0.51	0.26	0.00	0.11	1.44
GW027664	6.0	Irrigation	0.29	0.04	1.06	0.29	0.23	0.76	0.31	0.01	0.16	0.54
GW072161	90.5	Recreation	1.55	0.66	1.10	1.55	1.54	1.39	1.55	0.00	0.52	2.50
GW109963	8.0	Domestic	0.32	0.04	1.17	0.32	0.26	0.81	0.33	0.01	0.17	0.57
GW109964	8.0	Domestic	0.32	0.05	1.11	0.32	0.26	0.78	0.33	0.01	0.17	0.58
GW108588	8.0	Domestic	0.31	0.04	1.12	0.31	0.25	0.79	0.33	0.01	0.17	0.57
GW108406	8.0	Domestic	0.29	0.04	1.02	0.29	0.23	0.74	0.30	0.01	0.15	0.54
GW109965	8.0	Domestic	0.29	0.04	1.00	0.29	0.23	0.71	0.30	0.01	0.15	0.54
GW109966	3.0	Domestic	0.31	0.04	1.32	0.31	0.25	0.72	0.32	0.01	0.16	0.58
GW024109	2.1	Water Supply	0.27	0.04	0.88	0.27	0.21	0.63	0.28	0.01	0.14	0.53
GW107993	13.6	Recreation	0.03	0.06	0.00	0.03	0.01	0.02	0.05	2.56	0.00	0.89
Total >2m			**0**	**0**	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**2**

Table 2 Sensitivity Runs - Drawdown due to Project at Registered Bores at 2100

Registered ID	Bore Depth	Use	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy - 20%	Sy +20%	Kh -1 order	Kh +1 order
GW107580	20.0	Domestic	0.02	0.16	0.01	0.02	0.02	0.03	0.03	0.03	0.00	2.39

Registered ID	Bore Depth	Use	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy -20%	Sy +20%	Kh -1 order	Kh +1 order
GW106955	4.2	Domestic	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.51
GW024062	3.6	Water Supply	0.09	0.24	0.14	0.09	0.09	0.20	0.09	0.09	0.00	4.44
GW108295	8.0	Domestic	0.02	0.07	0.03	0.02	0.02	0.08	0.02	0.02	0.00	3.26
GW108439	8.0	Domestic	3.78	0.28	12.07	3.78	3.75	4.32	3.78	3.78	1.02	7.25
GW023191	3.6	Water Supply	2.07	0.20	5.65	2.07	2.05	2.58	2.07	2.07	0.53	4.74
GW110735	8.0	Domestic	2.32	0.25	6.08	2.32	2.30	2.83	2.32	2.32	0.68	4.97
GW023194	4.8	Water Supply	1.12	0.16	2.88	1.12	1.11	1.76	1.12	1.12	0.34	2.95
GW100209	108.0	Domestic	2.16	0.25	5.43	2.16	2.15	2.68	2.16	2.16	0.67	4.64
GW027664	6.0	Irrigation	2.51	0.24	4.09	2.51	2.51	2.85	2.51	2.51	0.03	3.32
GW072161	90.5	Recreation	0.34	1.55	1.24	0.34	0.34	0.76	0.34	0.34	0.14	1.74
GW109963	8.0	Domestic	0.42	0.05	1.69	0.42	0.42	1.11	0.42	0.42	0.20	1.18
GW109964	8.0	Domestic	1.57	0.66	1.44	1.57	1.57	1.45	1.57	1.57	0.53	2.64
GW108588	8.0	Domestic	0.45	0.06	1.84	0.45	0.45	1.18	0.45	0.45	0.21	1.23
GW108406	8.0	Domestic	0.45	0.06	1.78	0.45	0.45	1.14	0.45	0.45	0.21	1.25
GW109965	8.0	Domestic	0.44	0.06	1.77	0.44	0.44	1.15	0.44	0.44	0.21	1.23
GW109966	3.0	Domestic	0.42	0.05	1.64	0.42	0.42	1.09	0.42	0.42	0.19	1.18
GW024109	2.1	Water Supply	0.41	0.05	1.61	0.41	0.41	1.06	0.41	0.41	0.19	1.18
GW107993	13.6	Recreation	0.44	0.06	2.76	0.44	0.44	1.09	0.44	0.44	0.19	1.38
Total >2m			**5**	**0**	**7**	**5**	**5**	**5**	**5**	**5**	**0**	**10**

Table 3 Sensitivity Runs – Cumulative Drawdown at Registered Bores at Project Opening

Registered ID	Bore Depth	Use	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy -20%	Sy +20%	Kh -1 order	Kh +1 order
GW107580	20.0	Domestic	0.04	0.22	0.02	0.04	0.02	0.04	0.05	0.06	0.00	3.81
GW106955	4.2	Domestic	0.00	0.03	0.00	0.00	0.00	0.02	0.01	0.02	0.00	3.00
GW024062	3.6	Water Supply	1.20	0.27	3.60	1.21	0.68	1.16	1.39	0.25	0.50	2.48
GW108439	8.0	Domestic	0.87	0.28	1.85	0.87	0.49	0.95	1.02	0.34	0.27	2.05
GW110735	8.0	Domestic	0.89	0.29	1.80	0.89	0.52	1.01	1.04	0.38	0.26	2.12
GW023194	4.8	Water Supply	3.50	0.49	5.08	3.51	3.32	3.00	3.64	1.73	0.02	3.98
GW100209	108.0	Domestic	0.85	10.94	1.92	0.85	0.76	1.33	0.86	0.58	0.11	8.52
GW027664	6.0	Irrigation	0.75	0.13	2.76	0.76	0.66	1.66	0.78	0.46	0.16	1.51

RPS

Registered ID	Bore Depth	Use	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy -20%	Sy +20%	Kh -1 order	Kh +1 order
GW072161	90.5	Recreation	63.49	70.58	34.47	63.49	63.46	61.93	63.50	61.93	0.52	53.92
GW109963	8.0	Domestic	0.80	0.13	2.90	0.80	0.70	1.76	0.83	0.49	0.17	1.58
GW109964	8.0	Domestic	0.81	0.16	2.83	0.81	0.71	1.71	0.84	0.49	0.17	1.61
GW108588	8.0	Domestic	0.80	0.14	2.83	0.80	0.70	1.71	0.82	0.49	0.17	1.58
GW108406	8.0	Domestic	0.75	0.13	2.71	0.75	0.65	1.62	0.78	0.46	0.15	1.52
GW109965	8.0	Domestic	0.75	0.13	2.67	0.75	0.65	1.59	0.78	0.47	0.15	1.53
GW109966	3.0	Domestic	0.79	0.14	2.99	0.79	0.69	1.61	0.82	0.49	0.16	1.64
GW024109	2.1	Water Supply	0.72	0.13	2.49	0.72	0.61	1.45	0.75	0.46	0.14	1.53
GW107993	13.6	Recreation	8.98	3.06	10.01	9.07	8.01	2.95	10.16	10.44	0.00	9.12
Total >2m			**3**	**4**	**12**	**3**	**3**	**3**	**3**	**2**	**0**	**14**

Table 4 Sensitivity Runs – Cumulative Drawdown at Registered Bores at 2100

Registered ID	Bore Depth	Use	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy -20%	Sy +20%	Kh -1 order	Kh +1 order
GW107580	20.0	Domestic	0.20	0.34	0.25	0.20	0.20	0.34	0.20	0.20	0.00	6.32
GW106955	4.2	Domestic	0.09	0.17	0.08	0.09	0.09	0.20	0.09	0.09	0.00	5.24
GW024062	3.6	Water Supply	4.14	0.48	12.49	4.14	4.11	4.65	4.14	4.14	0.63	8.30
GW108295	8.0	Domestic	2.42	0.37	6.14	2.42	2.40	2.94	2.42	2.42	0.32	5.66
GW108439	8.0	Domestic	2.79	0.49	6.69	2.79	2.77	3.30	2.79	2.79	0.44	6.08
GW023191	3.6	Water Supply	1.46	0.31	3.47	1.46	1.45	2.21	1.46	1.46	0.23	3.85
GW110735	8.0	Domestic	2.67	0.51	6.10	2.67	2.65	3.20	2.67	2.67	0.44	5.82
GW023194	4.8	Water Supply	4.47	0.60	6.97	4.47	4.46	4.09	4.47	4.47	0.03	5.76
GW100209	108.0	Domestic	0.99	10.94	2.56	0.99	0.98	1.65	0.99	0.99	0.24	8.89
GW027664	6.0	Irrigation	0.95	0.15	3.54	0.95	0.95	2.12	0.95	0.95	0.36	2.34
GW072161	90.5	Recreation	63.45	70.50	34.86	63.45	63.45	61.94	63.45	63.45	52.19	54.04
GW109963	8.0	Domestic	1.01	0.16	3.73	1.01	1.00	2.24	1.01	1.01	0.38	2.44
GW109964	8.0	Domestic	1.01	0.19	3.65	1.01	1.01	2.18	1.01	1.01	0.37	2.48
GW108588	8.0	Domestic	1.00	0.17	3.64	1.00	1.00	2.19	1.00	1.00	0.37	2.44
GW108406	8.0	Domestic	0.95	0.16	3.48	0.95	0.95	2.08	0.95	0.95	0.35	2.35
GW109965	8.0	Domestic	0.95	0.16	3.43	0.95	0.95	2.04	0.95	0.95	0.34	2.37
GW109966	3.0	Domestic	1.00	0.17	4.60	1.00	1.00	2.09	1.00	1.00	0.35	2.65

Registered ID	Bore Depth	Use	Base Model	Kv -1 order	Kv +1 order	Ss -1 order	Ss +1 order	Faults	Sy -20%	Sy +20%	Kh -1 order	Kh +1 order
GW024109	2.1	Water Supply	0.92	0.16	3.24	0.92	0.92	1.90	0.92	0.92	0.32	2.38
GW107993	13.6	Recreation	14.29	5.61	13.29	14.29	14.28	4.98	14.29	14.29	1.01	12.50
Total >2m			**7**	**4**	**17**	**7**	**7**	**15**	**7**	**7**	**1**	**24**