DEWATERING MANAGEMENT PLAN

4 DELMAR PARADE &

812 PITTWATER ROAD,

DEE WHY NSW

Prepared for:

LANDMARK GROUP AUSTRALIA PTY LTD

Reference: P3018_08 rev1

2 May 2024

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Dewatering Management Plan

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1 INTRODUCTION

1.1 Overview

Morrow Geotechnics Pty Ltd has prepared a Groundwater Management Plan for the proposed development at 4 Delmar Parade & 812 Pittwater Road, Dee Why NSW (the site) also known as SP 32071 & SP 32072. At the time of producing this report DA2022/0145 was active with a modification 2024/0083 being assessed.

The following geotechnical reports have been prepared for the site:

- AssettGeoEnviro, *Proposed Mixed-use Development, 4 Delmar Parade & 812 Pittwater Road, Dee Why, NSW;* ref 6561-G1 and dated 25 November 2021 (AGE 2021);
- Reditus Consulting Pty Ltd, *Preliminary Site Investigation, 4 Delmar Parade & 812 Pittwater Road, Dee Why;* project number 21181, version 2 and dated 1 December 2021 (RC 2021);
- Geosyntec Consultants Pty Ltd, *Detailed Site Investigation, 4 Delmar Parade & 812 Pittwater Road, Dee Why;* project number 21325 and dated 4 May 2022 (GC 2022); and
- Reditus Consulting Pty Ltd, *Dewatering Management Plan, 4 Delmar Parade & 812 Pittwater Road, Dee Why;* report number 21181RP01, version 1 and dated 7 June 2022 (RC 2022).
- Morrow Geotechnics Pty Ltd, Geotechnical Investigation Report, *4 Delmar Parade & 812 Pittwater Road, Dee Why NSW,* referenced P3018_01 rev3, and dated 2 May 2024 (MG 2024-1).
- Morrow Geotechnics Pty Ltd, Site Hydrogeology Report, *4 Delmar Parade & 812 Pittwater Road, Dee Why NSW,* referenced P3018_07, and dated 2 May 2024 (MG 2024-2).

The previous geotechnical reports present the results of a site investigation for the proposed development and geotechnical and hydrogeological recommendations for design and construction.

1.2 Proposed Development

Architectural drawings for the proposed development have been prepared by Rothe Lowman Property Pty Ltd, Project Number 221054 and dated 16 January 2024. From the drawings provided, Morrow Geotechnics understands that the proposed development involves construction of multi-storey apartment building over a two to three level basement carpark. Morrow understands the development involves excavation to a maximum depth of extends to RL 13.7 to 18.095 mAHD across the eastern half of the site and to RL 21.25 mAHD at the south-western corner of the site.

Basement geometry taken from the Rothe Lowman Architectural drawing TP01.01, project number 221054 is shown in **Figure 1** below.

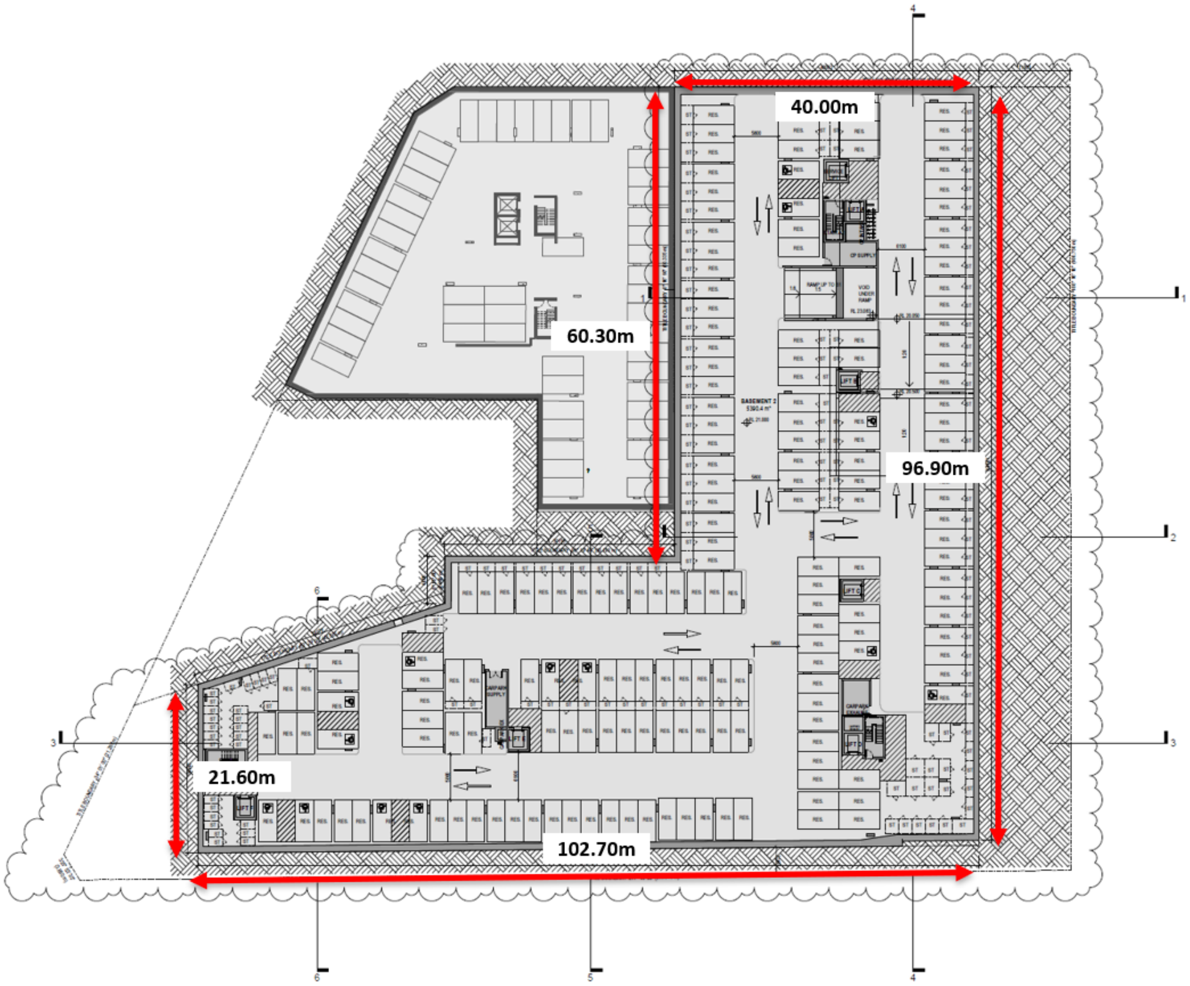


Figure 1: Proposed Basement Dimensions

1.3 Proposed Dewatering Schedule

Given the relatively low permeability of the sandstone profile encountered at depth within the geotechnical investigation it is proposed to construct a secant pile cut-off wall socketed a minimum of 1000 mm into Class III Sandstone to minimise groundwater seepage. Dewatering through spear points and pumping is not proposed for the construction period, rather the minor groundwater seepage around the cut-off wall will be collected by sump pits within the basement.

The excavation program for the proposed basement is expected to take up to 6 months. Temporary construction dewatering is expected to occur for construction seepage inflows during this 6 month period.

1.4 Objectives

The objective of this Dewatering Management Plan is to identify a methodology for construction dewatering of the site such that:

- Construction dewatering volumes are quantified to be within acceptable thresholds;
- The location of any groundwater extraction works, if required, is clearly delineated;
- The process for disposal of extracted groundwater, if required, is clearly defined;
- The quality of any groundwater is assessed in accordance with ANZEC freshwater guidelines for disposal off site, if required;
- The impact of groundwater drawdown on neighbouring properties is assessed;

- Provide a NSW Aquifer Interference Policy assessment of the proposed activity;
- Monitoring and contingency plans are outlined for safe management of construction dewatering.

2 GEOLOGICAL MODEL

The Department of Mineral Resources Geological Map Sydney 1:100,000 Geological Series Sydney (DMR 1983) indicates the site to be underlain by Hawkesbury Sandstone, which comprises medium to coarse grained quartz sandstone, very minor shale and laminite lenses.

Further discussion of the geological and geotechnical conditions at the site is provided in the Geotechnical Investigation Report MG 2024-1 and in the Site Hydrogeology Report MG 2024-2.

3 HYDROGEOLOGICAL SUMMARY

3.1 Hydrogeological Summary

A full hydrogeological assessment of the site has been carried out by Morrow Geotechnics as referenced in Section 1.1 above and hereafter referred to as MG 2024-2.

3.2 Summary of Groundwater Observations

Full details of groundwater monitoring are provided in the MG 2024-2 report for the site. A summary of the MG 2024-2 testing is reproduced below as reference.

Groundwater depths observed within BH102 and BH103 were comparable, with average water level RLs of 28.50 and 28.03 mAHD respectively at an average depth of 3.9 mBGL for BH102 and BH103. The average water level within BH101 was measured lower at RL 23.51 mAHD. Groundwater observations within the three wells indicate a phreatic water table which is dipping generally in line with surface topography.

The monitoring within the boreholes indicated low responsiveness to rainfall events during the three-month monitoring period. This is inferred to be a result of the paved areas in the vicinity of the wells limiting surface water infiltration following rainfall.

On the basis of ongoing groundwater monitoring at the site it is recommended that a design groundwater level for the stable water table within the bedrock is taken at 1.0 m above the consistent water level observed within the boreholes, i.e (2.9 mBGL dipping with topography to the north-west of the site).

4 GROUNDWATER FLOW MODELLING

4.1 Proposed Shoring and Groundwater Management

Structural drawings indicate that the structural design will comprise 600 diameter secant piles. Piles are socketed a minimum of 1 m into into Class III Sandstone to form a cutoff wall.

No spear points or wells are proposed for extraction of groundwater at the site. Any minor groundwater seepage around the cut-off wall will be collected by sump pits within the basement.

4.2 Analytical Seepage Modelling

Groundwater seepage analysis for flow into the drained basement has been calculated using a Plaxis 2D Flow Module. Plaxis is a 2D finite element and limit equilibrium software package used for design of geotechnical and hydrogeological design of structures such as excavations, dams, embankments and tunnels. PLAXIS 2D calculates deformations, soil stresses, water flow and groundwater pressures.

4.2.1 Modelling Inputs

Geological profiles, groundwater levels and hydraulic permeabilities have been entered into the analytical model as per the hydrogeological model presented in the MG 2024 SHR for the site.

For the formation of the model a mean annual deep drainage groundwater recharge flux of 20 mm per year (Australian National Water Commission, 2005) has been assumed.

Two cross sections have been modelled as shown on **Figure 2** below.

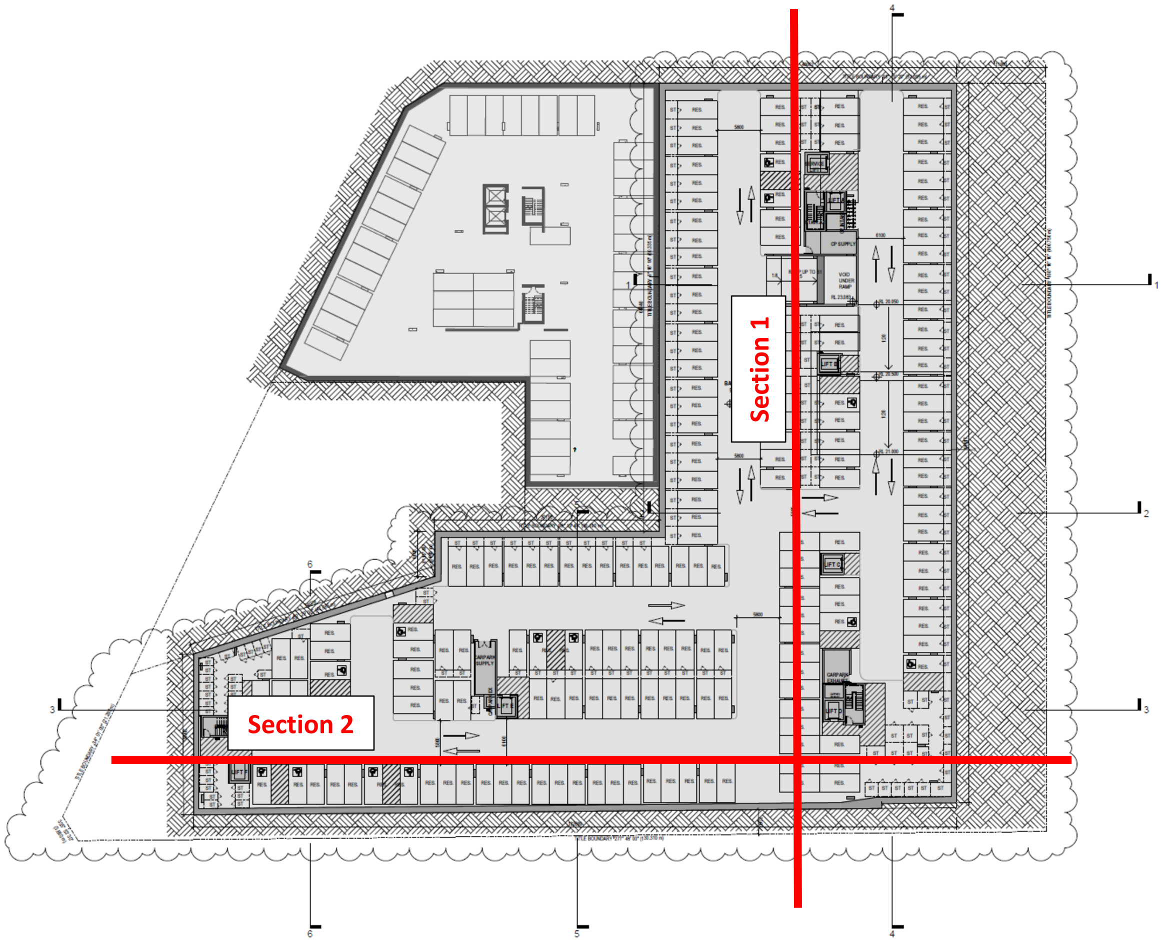


Figure 2: Modelling Sections 1 and 2

The Plaxis model has been set up as a "Flow Only" calculation using the "Transient Groundwater Flow" stage types. Given the relatively low permeability of soil and rock units obtained from the hydraulic conductivity testing, a model width of 200 m and model depth of 60 m was adequate for modelling the full extent of groundwater impacts from the proposed development.

Vertical model boundaries were set as open to allow infinite recharge of flow at model boundaries at the initial ground levels.

Short term flow modelling was based on the initial 24 hour period following excavation. The flow rates from short term modelling have been applied to the entire construction period as a worst case scenario given that flow rates reduce quickly after the initial 24 hour flow period. This has been taken as a conservative approach.

Long term flow modelling was based off stabilized flow after allowing the model to run for a 100 day period. Steady flow rates for all models had been achieved at 100 days.

4.2.2 Modelled Seepage

Typical Plaxis outputs for each groundwater flow modelling and groundwater head drawdown curves are shown in **Figures 3** and **4 below**.

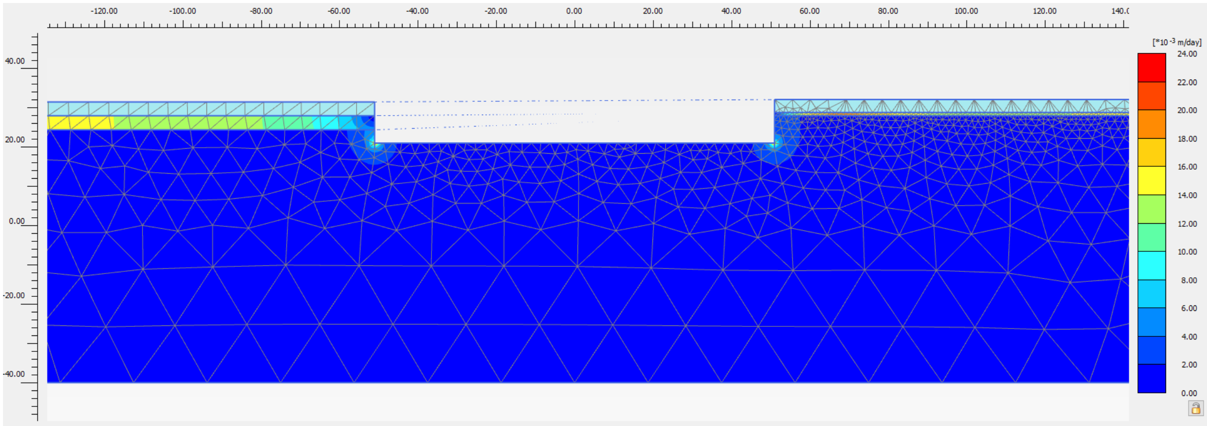


Figure 3: Typical aquifer flow conditions (Section 2 short term flow shown).

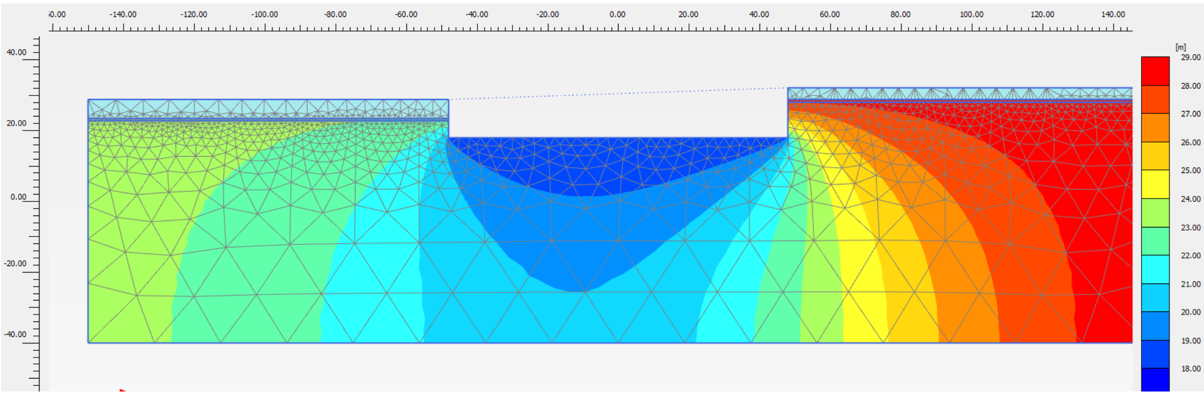


Figure 4: Typical groundwater head drawdown (Section 2 short term flow shown).

Full outputs of Plaxis results are included in the Plaxis output reports attached as **Appendix A.**

Tabulated results of seepage calculations for each of the above cases are presented in **Table 1**. Seepage through the excavation face is zero due to secant pile cutoff walls.

TABLE 1 MODELLED SEEPAGE INFLOW RATES

Analysis Case	Up Gradient Seepage to Excavation Face (L/day/m)	Down Gradient Seepage to Excavation Face (L/day/m)	Excavation Base Seepage ($L/m^2/day$)
Section 1 Short Term	0.00	0.00	0.93
Section 1 Long Term	0.00	0.00	0.83
Section 2 Short Term	0.00	0.00	1.33
Section 2 Long Term	0.00	0.00	1.21

Peak upgradient and downgradient seepage rates have been generalized across the 50% of the basement area each as a worst-case projection of groundwater flows. Calculations of total volume of seepage inflow have been based on an excavation perimeter of approximately 300 m and an excavation base area of approximately 6200 m^2.

Based on the above seepage rates and the size of the proposed excavation, the expected seepage to a drained basement is modelled to be:

- Short Term Flows for Temporary Dewatering During Construction
  2.56 ML/year
- Long Term Flows during Service Life of Structure Following Completion of Construction
  2.35 ML/year

Projected seepage inflows for a drained basement are below the WaterNSW threshold for exemption from the requirement of a Water Access License.

4.2.3 Modelled Groundwater Drawdown

Tabulated results of drawdown calculations for each of the above cases are presented in **Table 2**.

TABLE 2 MODELLED GROUNDWATER DRAWDOWN

Analysis Case	Up Gradient Drawdown (m)			Down Gradient Drawdown			Distance to Minimal Drawdown < (100 mm)
	Distance Behind Excavation Face			Distance Behind Excavation Face			
	0.5 m	5 m	10 m	0.5 m	5 m	10 m	
Section 1 Short Term	0.00	0.00	0.00	0.00	0.00	0.00	0.0 m
Section 1 Long Term	0.00	0.00	0.00	0.00	0.00	0.00	0.0 m
Section 2 Short Term	0.00	0.00	0.00	0.00	0.00	0.00	0.0 m
Section 2 Long Term	0.00	0.00	0.00	0.00	0.00	0.00	0.0 m

The Plaxis modelling of groundwater drawdown as a result of the works shows that groundwater is not drawn down noticeably outside of the excavation perimeter. This is due to the fact that the cutoff wall effectively minimises seepage rate to less than the recharge capacity of the overlying alluvial soils.

5 NSW AQUIFER INTERFERENCE POLICY IMPACT ASSESSMENT

The Water Management Act 2000 includes the concept of ensuring "no more than minimal harm" for the granting of approvals.

For the purposes of this assessment and based on the regional hydrogeological profile, the groundwater source at the site is a "less productive" source as it does not contain water supply works that can yield water at a rate greater than 5 L/sec. The Groundwater Source is assessed as a "Porous or Fractured Rock Water Source".

The impact assessment has been based on the following three assessment criteria:

- **Water Table -**
  Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any:
  (a) high priority groundwater dependent ecosystem; or
  (b) high priority culturally significant site;
  listed in the schedule of the relevant water sharing plan.
  A maximum of a 2m decline cumulatively at any water supply work.

Measured variations in the water table were shown at up to 860 mm over the monitoring period. Morrow Geotechnics has carried out a search of registered water supply works and none are present within 50 m of the proposed excavation.

Analysis presented within this DMP shows that all drawdown effects of the proposed works are less than negligible outside of the cut-off wall, therefore Morrow Geotechnics can confirm that the proposed works will have "minimal impact" on the Water Table.

- **Water Pressure -**
  A cumulative pressure head decline of not more than a 2m decline, at any water supply work.

As discussed, no registered water supply works are present within 50 m of the proposed excavation. Analysis presented within this DMP shows that all drawdown effects of the proposed works are less than negligible outside of the cut-off wall, therefore Morrow Geotechnics can confirm that the proposed works will have "minimal impact" on the Water Pressure.

- **Water Quality -**
  Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity.

Water quality monitoring will be carried out throughout the works as indicated in Section 6 of this report. The works are not projected to cause any detrimental effect to the water quality beyond 40 m from the activity.

Based on the assessment of the proposed works achieving the requirements of Level 1 minimal impact considerations, Morrow Geotechnics can confirm that the proposed works will do no more than minimal harm.

6 WATER DISCHARGE METHODOLOGY

During the works it will be necessary to discharge water from site when seepage accumulates within the sump or following heavy rainfall.

The process for assessing that water is safe for discharge to Council stormwater systems is as follows:

1. All seepage water within the proposed excavation must be detained on site for testing prior to discharge to stormwater. The site detention should comprise a sump pit which is a minimum 2 m x 2 m x 1 m deep, maintained at the lowest point of the site as shown on **Figure 7** below. The sump is only required where existing stormwater systems are removed. For existing roof catchment the stormwater discharge to council stormwater system will be maintained.
2. Prior to the discharge of water from the site, sampling of the detained water must be undertaken by an environmental specialist. **Water quality testing must take place prior to the discharge of any stormwater/groundwater from the site.**
   Water quality testing is to the published threshold values of the ANZECC (2000) and NEPM (2013) guidelines for fresh water systems.
3. If water quality testing returns analyte values within ANZECC and NEPM a threshold values then the detained water can be discharged to Council stormwater system in accordance with the following requirements:
   a. The discharge rate will be limited to 10 L/sec per pump to ensure no damage is caused to Council infrastructure. The proposed pumping rate is low in comparison to the capacity of all but the smallest stormwater drains and is highly unlikely to cause overload at any point in the drainage system.
   b. Water quality testing must be undertaken weekly during discharge. The discharge of water into Council's stormwater system is to halt immediately where water quality does not meet discharge criteria as outlined above.

- If water quality testing exceeds ANZECC and NEPM threshold values then water treatment facilities must be set up on site prior to any discharge from site. This can be achieved by either mixing the discharge water with fresh water to dilute the metal concentration. This may require water storage on site in tanks depending on the progression of the excavation works. Alternatively, water treatment facilities such as those shown below must be established on site to treat stormwater/groundwater prior to any discharge from site. The system must be verified to have reduced analyte levels to below relevant thresholds prior to discharge to stormwater. An indicative water treatment option prior to discharge to stormwater is shown in **Figure 8** below.

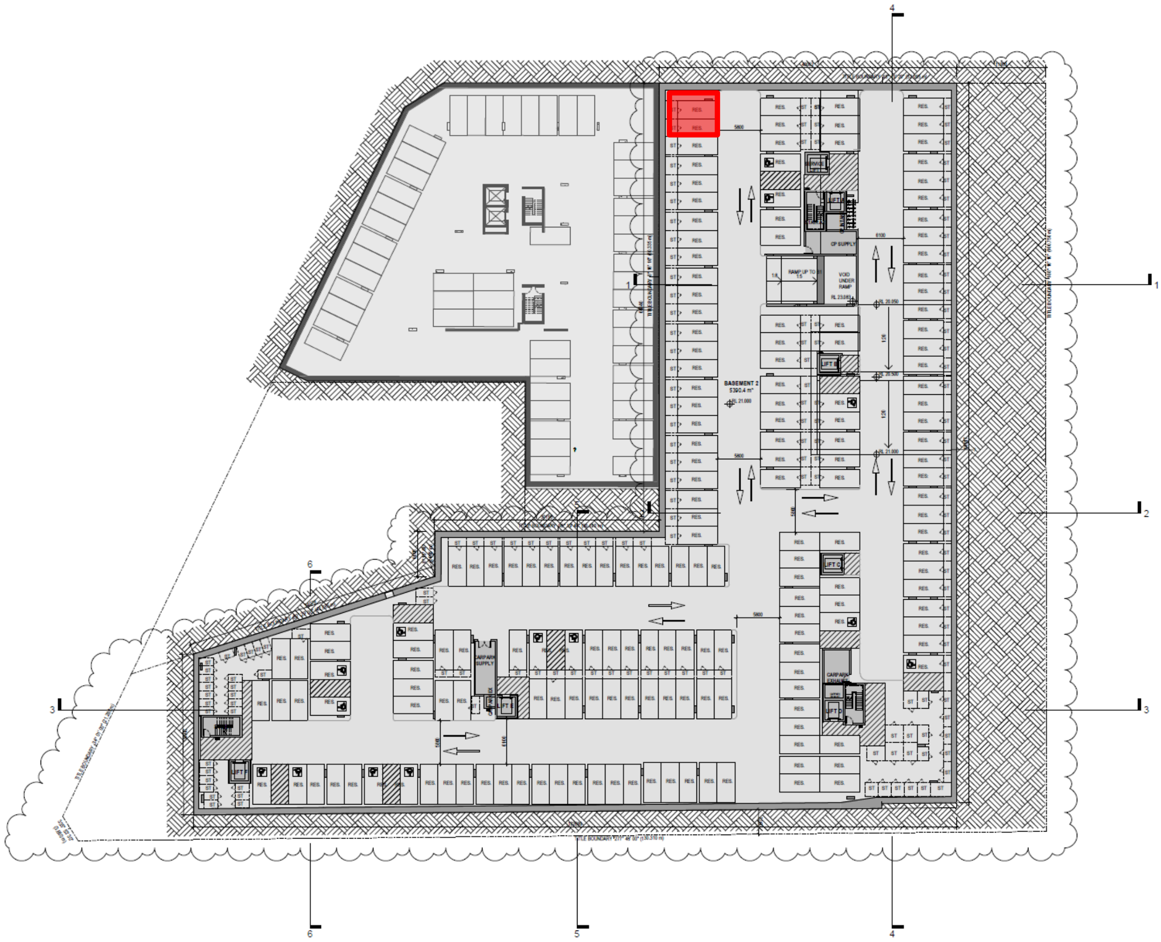


Figure 4: Proposed settlement tank location shown in red

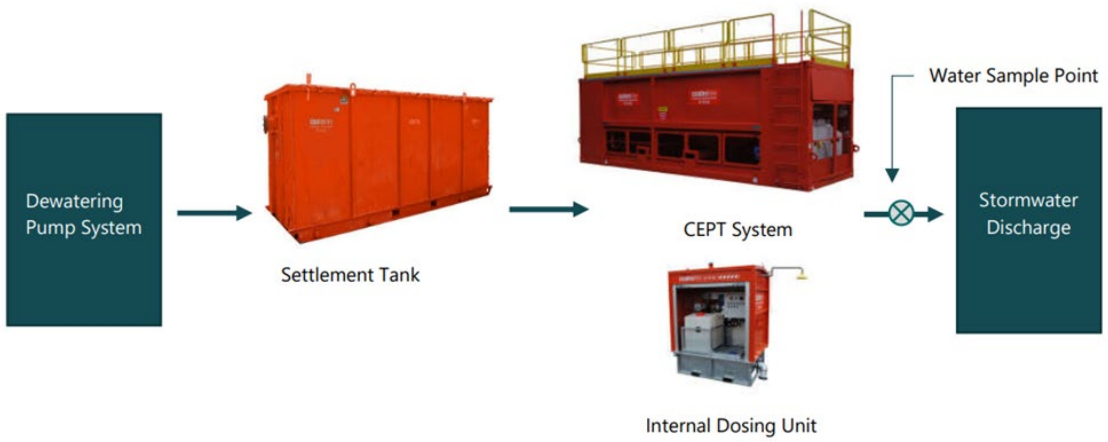


Figure 5: Indicative possible treatment system where analyte values exceed Council, ANZECC or NEPM threshold values.

7 GROUNDWATER MONITORING

7.1 Water Level Monitoring

During the excavation period the water level must be monitored **daily** within the installed groundwater monitoring wells to ensure that excessive groundwater drawdown does not occur.

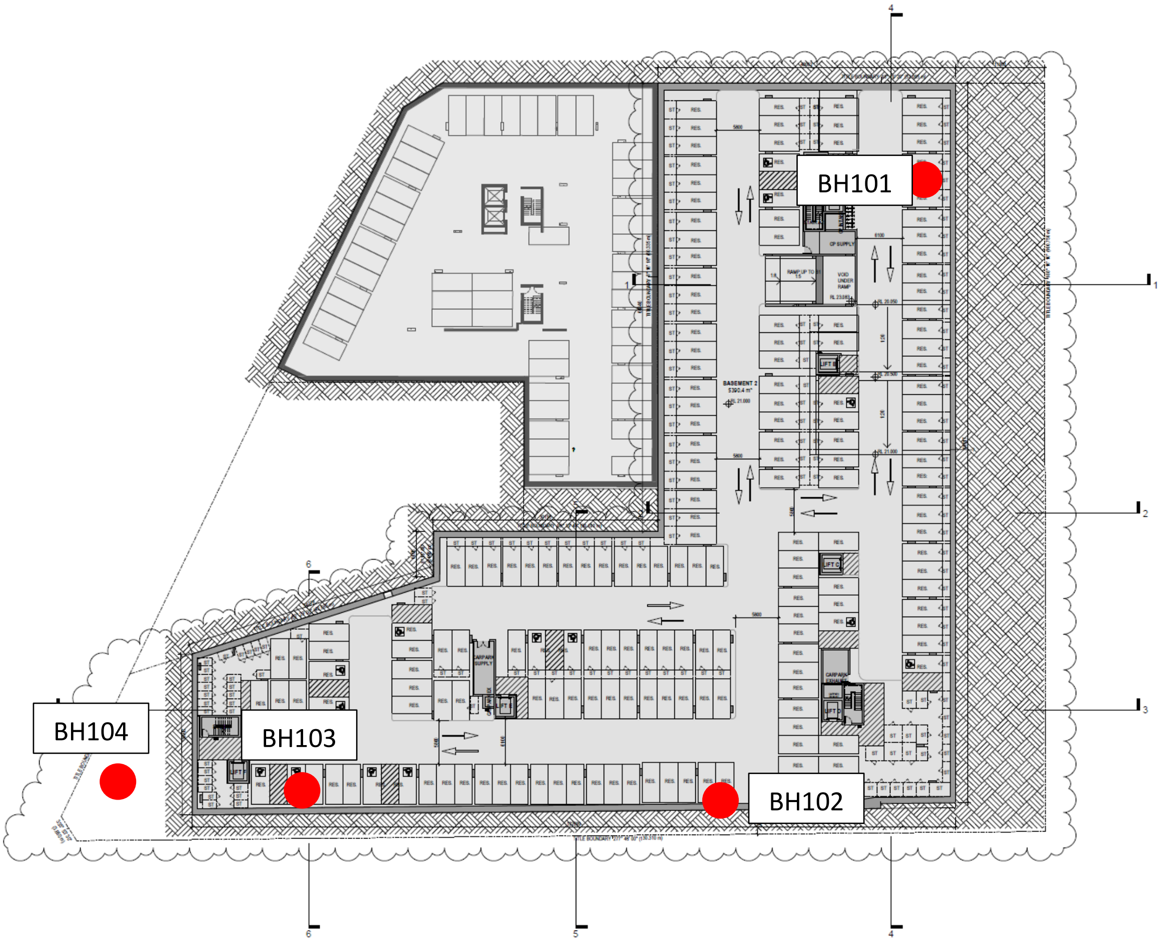


Figure 6: Groundwater level monitoring locations

● Existing Monitoring Well Location

Groundwater readings are to be taken at a minimum of three monitoring wells during construction. If any of the existing monitoring wells are damaged during construction they must be replaced with a "like for like" well. "Like for like" protocols include all aspects of well construction such as well materials, screened zone, plug depth, etc. Installation details of the existing wells can be found in Section 3.1 of the MG 2023-2 Site Hydrogeology Report.

Prior to the commencement of bulk earthworks at least one round of monitoring should be undertaken to establish baseline readings. Pre works measurements should be forwarded to the project stakeholders outlined in **Table 5**. During the works phase readings should be taken **daily** until works have been completed and no further drawdown is detected.

All groundwater data is to be presented to the project geotechnical and structural engineers along with details of the monitoring visit including:

- date of monitoring;
- time of monitoring;
- progress of works at time of monitoring;
- weather conditions during and preceding the monitoring; and
- any further comments relative to the monitoring.

Morrow Geotechnics recommends that drawdown limits are set at 1400 mm below baseline readings. Groundwater monitoring showed natural variations in groundwater level of up to approximately 860 mm over the monitoring period. The groundwater modelling also showed that the impacts of groundwater drawdown are negligible on neighbouring structures within the geological profile encountered at the site.

The following threshold criteria should be adopted during construction:

- **Alert**: If drawdown levels are less than 70% of the agreed value, works should continue. Monitoring should continue to be carried out at the nominated intervals and monitoring reports forwarded to the relevant stakeholders as outlined in **Table 6**.
- **Alarm**: If drawdown levels are greater than 70% but less than 100% of the agreed value, the geotechnical engineer, structural engineer and client representatives should be notified and the monitoring data reviewed. Ongoing monitoring events should continue undertaken at 24 hour intervals until notified otherwise by nominated engineers in consultation with client and WaterNSW.
- **Action**: If drawdown levels are greater than 100% of the agreed value excavation should cease immediately. The geotechnical engineer, structural engineer, WaterNSW and client representatives should be notified and work should cease until a risk management/contingency plan is implemented to safeguard neighbouring structures. Monitoring should continue daily during this period.

TABLE 6 SUMMARY OF MONITORING CONDITIONS

	Criteria
Monitoring Points	Survey marks as shown in Figure 3 above
Agreed Drawdown Limit	1000 mm
Alert Level	< 980 mm
Alarm Level	980 - 1400 mm
Action Level	> 1400 mm

7.2 Water Quality Monitoring

During excavation works water quality samples from the three monitoring wells and the discharge sump pit must be tested **weekly**. Water samples are to be sent to a NATA accredited laboratory for testing against the Australia and New Zealand Environment Conservation Council ANZECC (2000) guidelines for 95% protection of marine ecosystems (in the absence of guidelines the criteria for fresh waters was used) and

National Environment Protection (Assessment of Site Contamination) Measure (NEPM, 2013). Relevant water quality results are presented in **Table 7**, lab results are attached in **Appendix B**.

If analyte values exceed the published threshold values of the ANZECC (2000) and NEPM (2013) guidelines for fresh water systems then the geotechnical engineer, structural engineer, WaterNSW and client representatives should be notified.

Initial water quality testing indicated that the natural groundwater concentrations of Copper, Nickel and Zinc are above the ANZECC (2000) and NEPM (2013) freshwater guidelines. Baseline conditions at the site must be considered in preparation of a response to exceedances of ANZECC and NEPM thresholds.

7.3 Contingency Measures

Contingency measures are to be determined by the project geotechnical and structural engineers in response to groundwater drawdown behaviour observed during the excavation. Possible contingency measures may include:

- Inspection of ground conditions on neighbouring sites;
- Ceasing excavation during updates to excavation support design;
- Groundwater reinjection;
- Permeation grouting to reduce the permeability of native material.

7.4 Project Stakeholders

TABLE 7 STAKEHOLDER CONTACTS

	Contact Person	Contact Details
	Rafael Trina Landmark Group Constrction Australia Pty Ltd	rafael@landmarkgr.com 0450 100 455
Geotechnical Engineer	Andrew Butel Morrow Geotechnics	andy@morrowgeo.com.au 0427 357 856
WaterNSW		enquiries@waternsw.com.au 1300 662 077

8 CONCLUSION

This report has been prepared in response to WaterNSW General Terms of Approval for the site and the Water Management Act 2000. Licensing for temporary construction dewatering from WaterNSW and DPIE will be required for the excavation works at the site.

9 STATEMENT OF LIMITATIONS

The advice and parameters presented in this Groundwater Management Plan are for assessment of the expected groundwater seepage based upon the proposed development and encountered site conditions at the investigation locations.

We draw your attention to the document "Important Information", which is attached to this letter. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Morrow Geotechnics, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

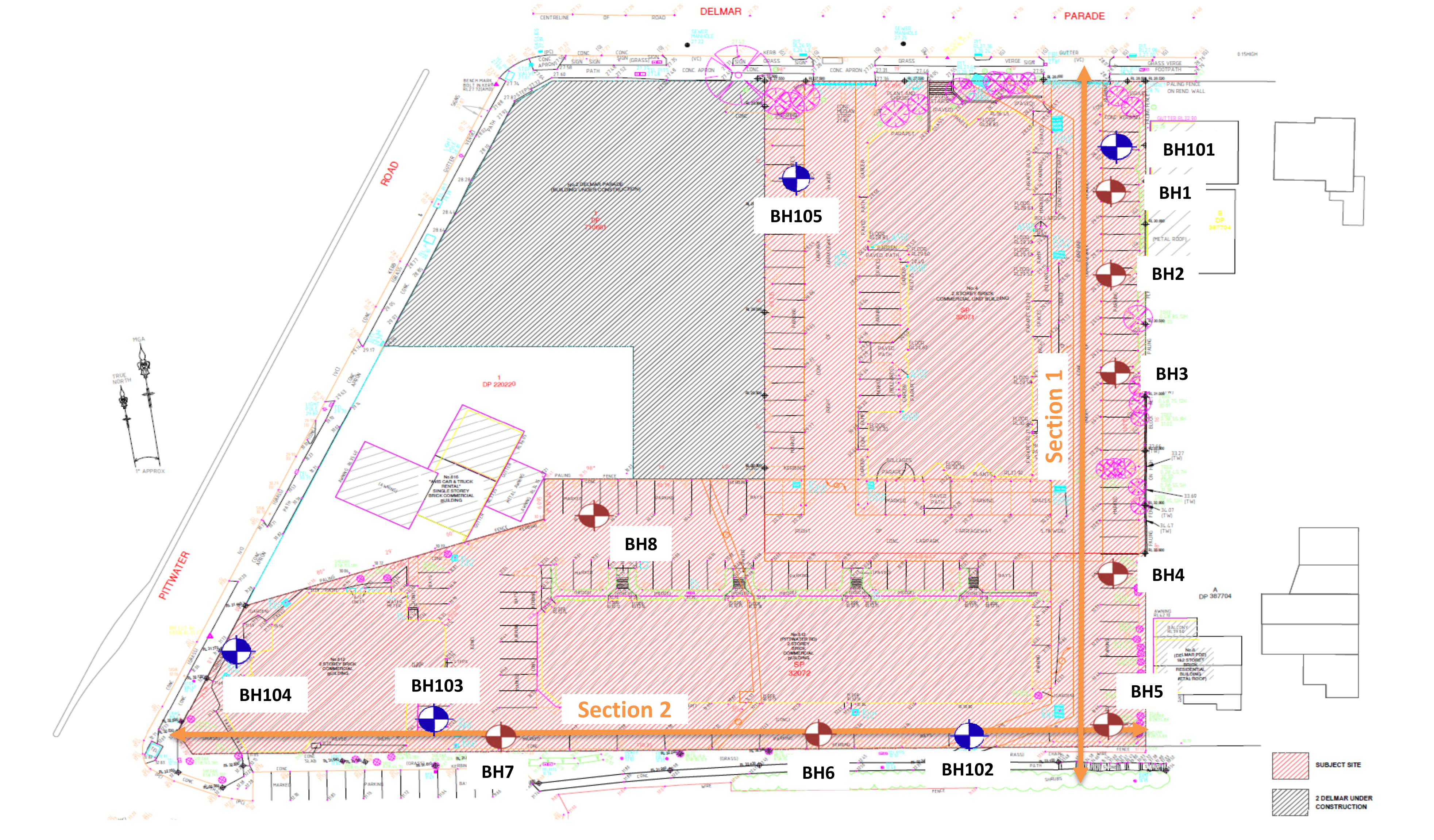
Should you have any queries regarding this report, please do not hesitate to contact the undersigned.

10 CLOSURE

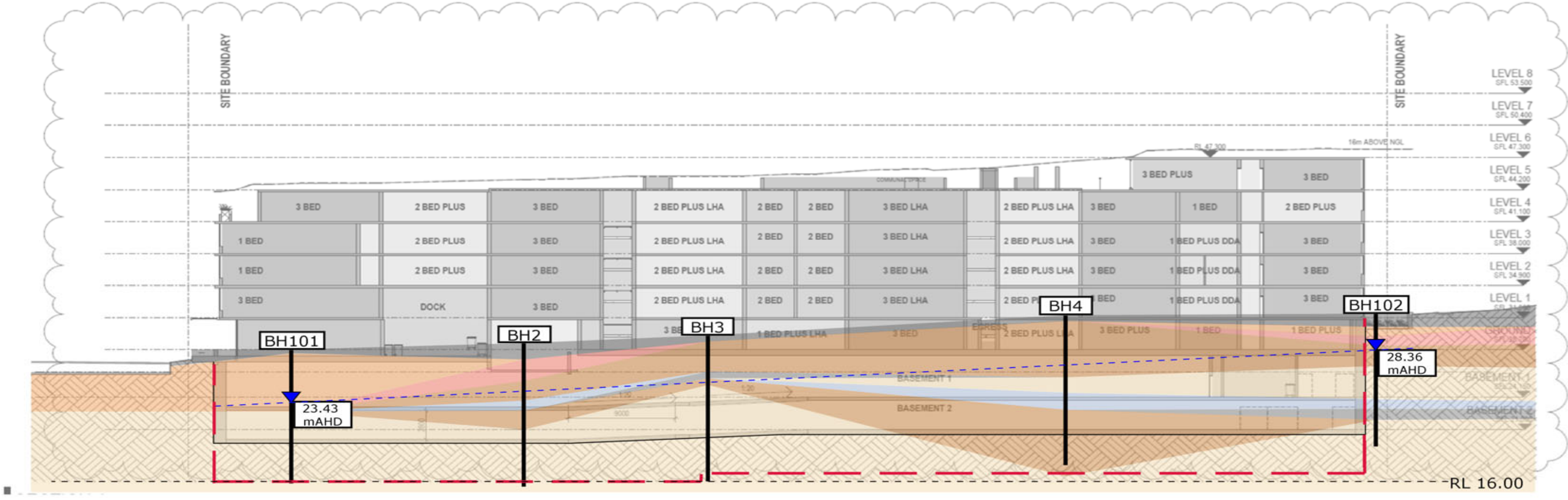
Please do not hesitate to contact the undersigned should you have any questions.

For and on behalf of Morrow Geotechnics Pty Ltd,

Andrew Butel	Alan Morrow
Hydrogeologist/Engineering Geologist	Principal Geotechnical Engineer
BSc (Geology), GradCertEngSc, MAIG	BE (Civil) BSc MIEAust CPEng NER



morrow 79/6 Bellambi Lane, Bellambi NSW 2518 P: 0405 843 933 | E: info@morrowgeo.com.au	Drawn	AB	**Landmark Group Construction Australia Pty Ltd** 4 Delmar Parade, Dee Why NSW Geotechnical Investigation Borehole Location Plan	Figure: 1
	Approved	AM		
	Date	13/10/2023		
	Scale	NTS		Project: P3018



	Unit 1 - Fill
	Unit 2 - Alluvial
	Unit 3 - Residual
	Unit 4 - Class V/IV Sandstone
	Unit 5 - Class III Sandstone
	Unit 6 - Class V Shale
	Unit 7 - Class III Shale
— — — -	Proposed Basement Outline

morrow

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Drawn	AB
Approved	AM
Date	21/02/2024
Scale	NTS

Landmark Group Construction Australia Pty Ltd

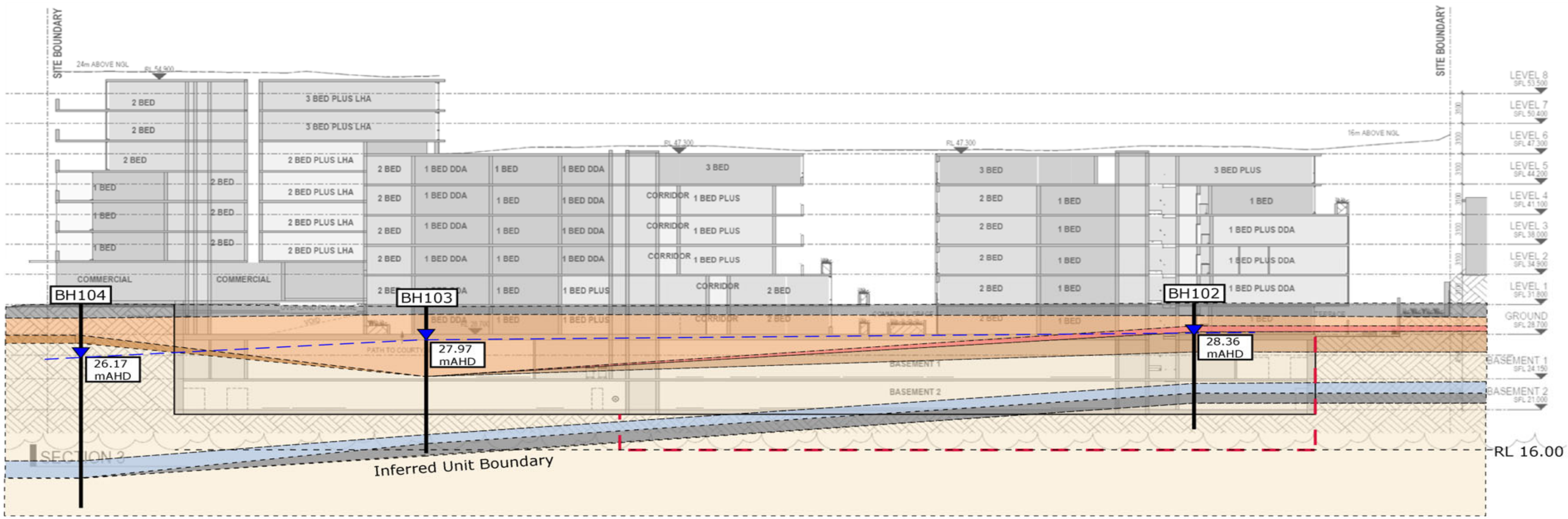
4 Delmar Parade, Dee Why NSW

Geotechnical Investigation

Cross Section 1

Figure: **2**

Project: P3018



- Unit 1 - Fill
- Unit 2 - Alluvial
- Unit 3 - Residual
- Unit 4 - Class V/IV Sandstone
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Drawn	AB
Approved	AM
Date	21/02/2024
Scale	NTS

Landmark Group Construction Australia Pty Ltd

4 Delmar Parade, Dee Why NSW

Geotechnical Investigation

Cross Section 2

Figure: 3

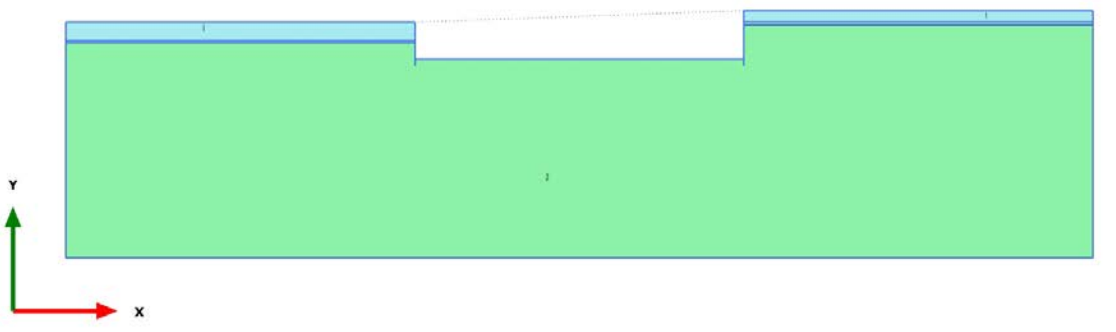
Project: P3018

Appendix A

Plaxis Flow Modelling Reports

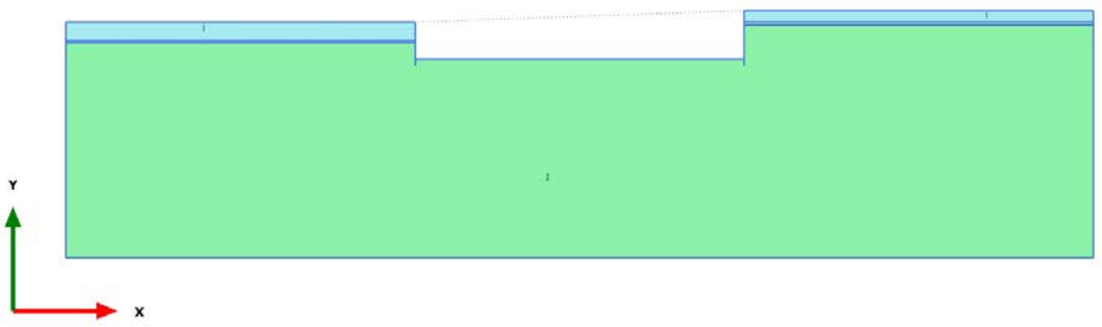
PLAXIS Report

1.1.1.1 Calculation results, Short Term [Phase_2] (2/27), Materials plot



Materials plot

1.1.1.2 Calculation results, Long Term [Phase_3] (3/40), Materials plot



Materials plot

1.1.2.1 Materials - Plates

Identification number		1	2
Identification		600 secant 40 MPa 100 percent modulus	Pipe Wall - Thin
Material type		Elastic	Elastic
Colour			
Comments			
w	kN/m/m	0.000	0.000
Input method		SDOF equivalent	SDOF equivalent
Rayleigh α		0.000	0.000
Rayleigh β		0.000	0.000
ξ_1	%	0.000	0.000
ξ_2	%	0.000	0.000
f_1	Hz	0.1000	0.1000
f_2	Hz	1.000	1.000
Prevent punching		False	False
Isotropic		True	True
EA_1	kN/m	8.225E6	840.0E3
EA_2	kN/m	8.225E6	840.0E3

Identification number		1	2
E_1	kN/m²	15.83E6	28.00E6
E_2	kN/m²	15.83E6	28.00E6
EI	kN m²/m	185.1E3	63.00
ν (nu)		0.2000	0.2000
d	m	0.5196	0.03000
c	kJ/t/K	0.000	0.000
λ	kW/m/K	0.000	0.000
ρ	t/m³	0.000	0.000
α	1/K	0.000	0.000
A_eff,T	m²	0.000	0.000

1.1.2.2 Materials - Anchors

Identification number		1
Identification		4 Strand Anchor 15.2 mm
Material type		Elastic
Colour		■
Comments		
L_spacing	m	3.900
EA	kN	145.2E3
c	kJ/t/K	0.000
λ	kW/m/K	0.000
ρ	t/m^3	0.000
α	1/K	0.000
A_eff,T	m^2	0.000

1.1.2.3 Materials - Embedded beams

Identification number		1
Identification		Anchor - Bond Length
Material type		Elastic
Colour		
Comments		
γ	kN/m³	0.000
Input method		SDOF equivalent
Rayleigh α		0.000
Rayleigh β		0.000
ξ_1	%	0.000
ξ_2	%	0.000
f_1	Hz	0.1000
f_2	Hz	1.000
L_spacing	m	3.900
Cross section type		Predefined
Predefined cross section type		Solid circular beam
Diameter	m	0.09000

Identification number		1
A	m²	6.362E-3
I	m⁴	3.221E-6
E	kN/m²	11.40E6
Axial skin resistance		Linear
T_skin, start, max	kN/m	250.0
T_skin, end, max	kN/m	250.0
Lateral resistance		Unlimited
F_max	kN	0.000
Default values		True
Axial stiffness factor		0.1480
Lateral stiffness factor		0.1480
Base stiffness factor		1.480

1.1.2.4.1 Materials - Soil and interfaces - Mohr-Coulomb

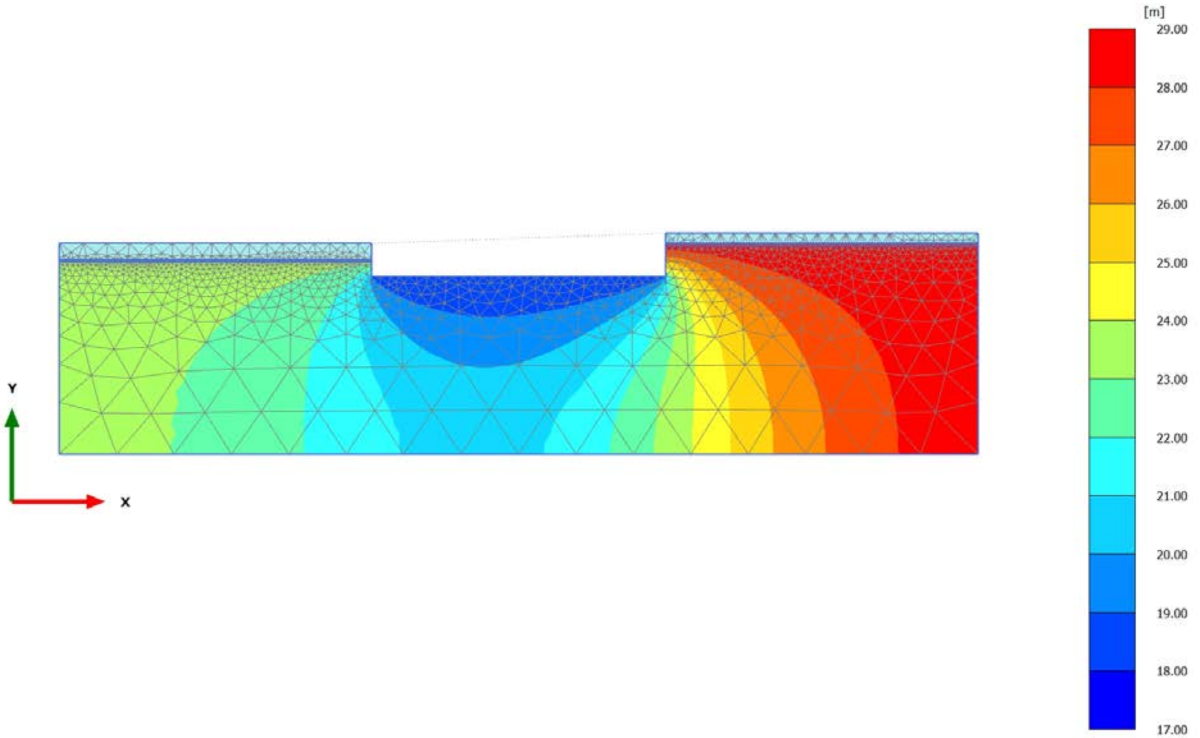
Identification number		1	2	3
Identification		Alluvial Soils	Bedrock	No Flow Boundary
Soil model		Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Drainage type		Drained	Drained	Drained
Colour				
Comments				
γ_unsat	kN/m³	20.00	24.00	24.00
γ_sat	kN/m³	20.00	24.00	24.00
e_init		0.5000	0.5000	0.5000
n_init		0.3333	0.3333	0.3333
Input method		SDOF equivalent	SDOF equivalent	SDOF equivalent
Rayleigh α		0.000	0.000	0.000
Rayleigh β		0.000	0.000	0.000
ξ_1	%	0.000	0.000	0.000
ξ_2	%	0.000	0.000	0.000
f_1	Hz	0.1000	0.1000	0.1000
f_2	Hz	1.000	1.000	1.000

Identification number		1	2	3
E'_ref	kN/m²	20.00E3	500.0E3	50.00E3
ν (nu)		0.3000	0.2000	0.3000
G_ref	kN/m²	7692	208.3E3	19.23E3
E_oed	kN/m²	26.92E3	555.6E3	67.31E3
E'_inc	kN/m²/m	0.000	0.000	0.000
y_ref	m	0.000	0.000	0.000
V_s	m/s	61.43	291.8	88.66
V_p	m/s	114.9	476.5	165.9
c'_ref	kN/m²	10.00	200.0	2.000
φ' (phi)	°	25.00	40.00	25.00
ψ (psi)	°	0.000	0.000	0.000
c'_inc	kN/m²/m	0.000	0.000	0.000
y_ref	m	0.000	0.000	0.000
Tension cut-off		True	True	True
Tensile strength	kN/m²	0.000	0.000	0.000
Determination		ν-undrained definition	ν-undrained definition	ν-undrained definition
ν_u definition method		Direct	Direct	Direct
ν_u,equivalent (nu)		0.4950	0.4950	0.4950
Skempton B		0.9783	0.9866	0.9783

Identification number		1	2	3
K_w,ref/n	kN/m²	750.0E3	20.49E6	1.875E6
Classification type		Standard	Standard	Standard
Soil class (Standard)		Coarse	Coarse	Coarse
< 2 μm	%	10.00	10.00	10.00
2 μm - 50 μm	%	13.00	13.00	13.00
50 μm - 2 mm	%	77.00	77.00	77.00
Use defaults		False	False	False
k_x	m/day	12.27	6.048E-3	0.000
k_y	m/day	12.27	6.048E-3	0.000
Void ratio dependency		False	False	False
c_k		1000E12	1000E12	1000E12
n_init		0.3333	0.3333	0.3333
-ψ_unsat	m	10.00E3	10.00E3	10.00E3
c_s	kJ/t/K	0.000	0.000	0.000
λ_s	kW/m/K	0.000	0.000	0.000
ρ_s	t/m³	2.600	2.600	2.600
Thermal expansion type		Isotropic	Isotropic	Isotropic
α_sv	1/K	0.000	0.000	0.000
Phase change		False	False	False

Identification number		1	2	3
D_v	m²/day	0.000	0.000	0.000
f_Tv		0.000	0.000	0.000
Stiffness determination		Derived	Derived	Derived
Strength determination		Rigid	Rigid	Rigid
R_inter		1.000	1.000	1.000
Consider gap closure		True	True	True
Cross permeability		Impermeable	Impermeable	Impermeable
Drainage conductivity, dk	m³/day/m	0.000	0.000	0.000
R_thermal	m² K/kW	0.000	0.000	0.000
K_0 determination		Automatic	Automatic	Automatic
K_0,x		0.5774	0.3572	0.5774
K_0,z		0.5774	0.3572	0.5774

2.1.1.1.1 Calculation results, Short Term [Phase_2] (2/27), Groundwater head

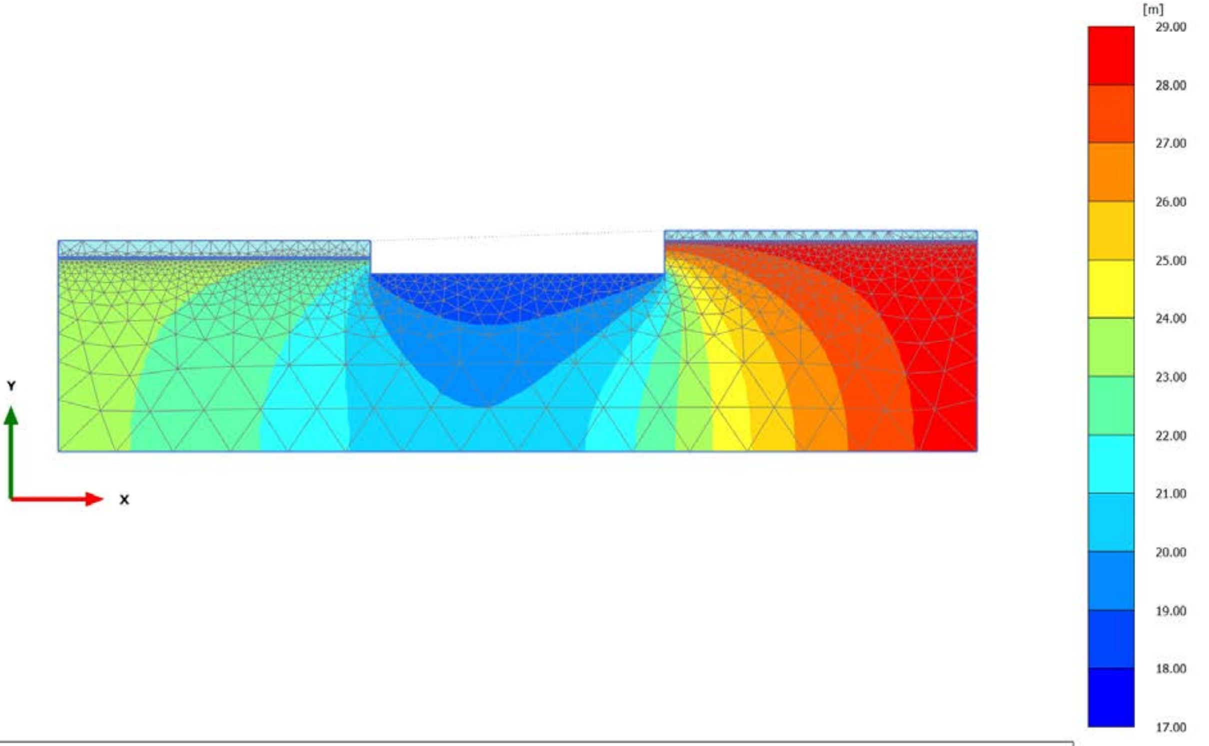


Groundwater head (scaled up 0.500 times) (Time 1.000 day)

Maximum value = 28.80 m (Element 1668 at Node 9129)

Minimum value = 17.91 m (Element 2316 at Node 10147)

2.1.1.1.2 Calculation results, Long Term [Phase_3] (3/40), Groundwater head

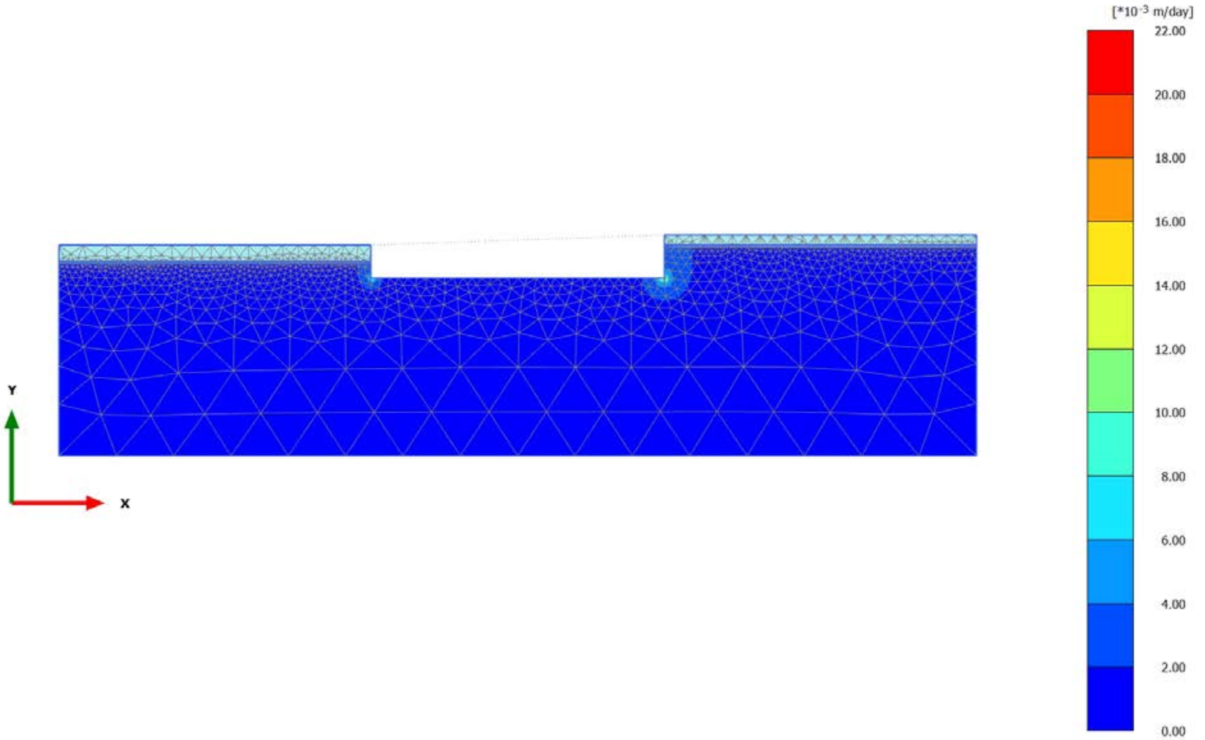


Groundwater head (scaled up 0.500 times) (Time 101.0 day)

Maximum value = 28.80 m (Element 1668 at Node 9129)

Minimum value = 17.92 m (Element 2316 at Node 10147)

2.1.2.1.1 Calculation results, Short Term [Phase_2] (2/27), Groundwater flow |q|

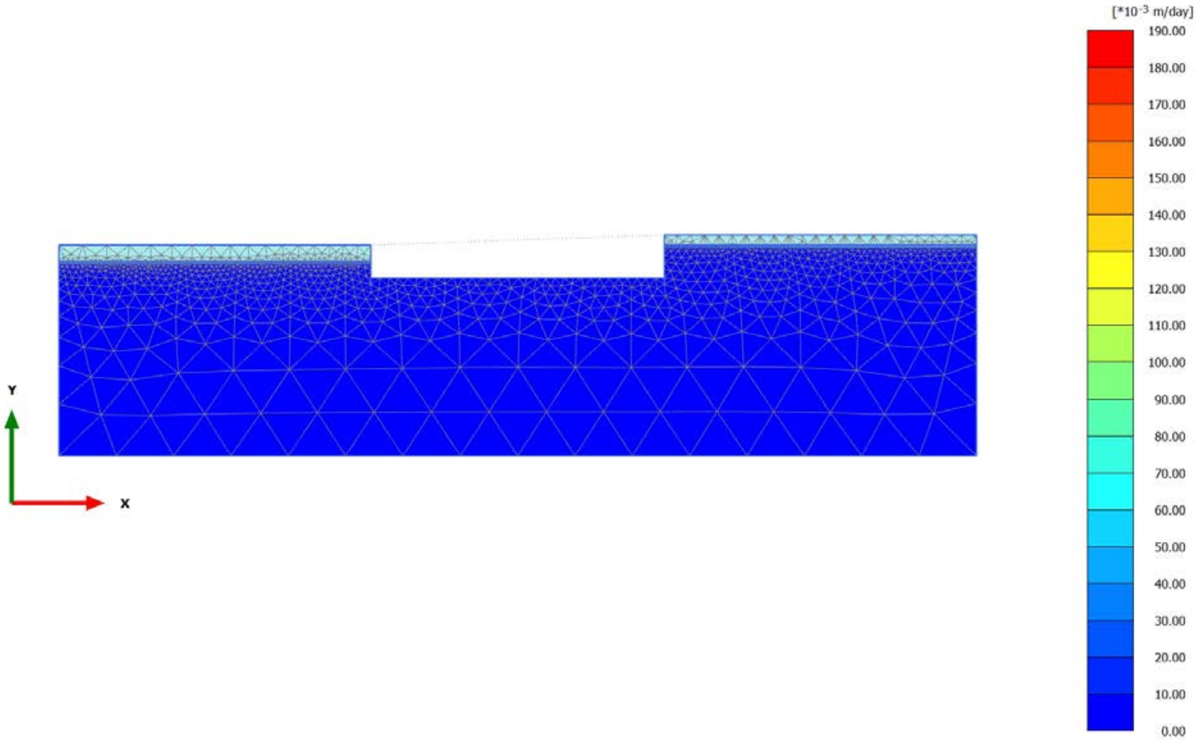


Groundwater flow |q| (scaled up 500 times) (Time 1.000 day)

Maximum value = 0.02002 m/day (Element 2404 at Node 9767)

Minimum value = 0.05724×10^{-6} m/day (Element 1643 at Node 15747)

2.1.2.1.2 Calculation results, Long Term [Phase_3] (3/40), Groundwater flow |q|



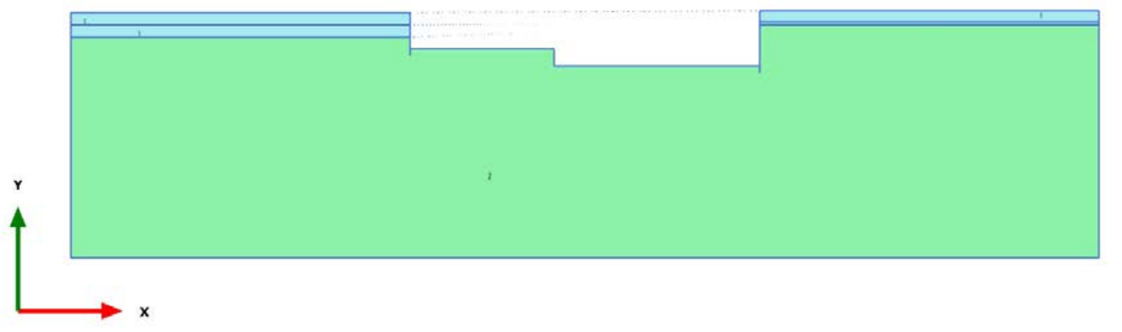
Groundwater flow |q| (scaled up 50.0 times) (Time 101.0 day)

Maximum value = 0.1814 m/day (Element 282 at Node 4617)

Minimum value = $3.294*10^{-6}$ m/day (Element 1210 at Node 16607)

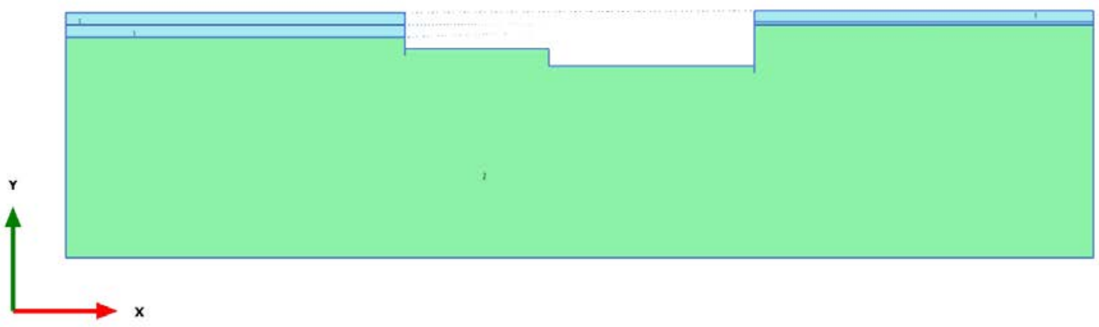
PLAXIS Report

1.1.1.1 Calculation results, Short Term [Phase_2] (2/11), Materials plot



Materials plot

1.1.1.2 Calculation results, Long Term [Phase_3] (3/24), Materials plot



Materials plot

1.1.2.1 Materials - Plates

Identification number		1	2
Identification		600 secant 40 MPa 100 percent modulus	Pipe Wall - Thin
Material type		Elastic	Elastic
Colour			
Comments			
w	kN/m/m	0.000	0.000
Input method		SDOF equivalent	SDOF equivalent
Rayleigh α		0.000	0.000
Rayleigh β		0.000	0.000
ξ_1	%	0.000	0.000
ξ_2	%	0.000	0.000
f_1	Hz	0.1000	0.1000
f_2	Hz	1.000	1.000
Prevent punching		False	False
Isotropic		True	True
EA_1	kN/m	8.225E6	840.0E3
EA_2	kN/m	8.225E6	840.0E3

Identification number		1	2
E_1	kN/m²	15.83E6	28.00E6
E_2	kN/m²	15.83E6	28.00E6
EI	kN m²/m	185.1E3	63.00
ν (nu)		0.2000	0.2000
d	m	0.5196	0.03000
c	kJ/t/K	0.000	0.000
λ	kW/m/K	0.000	0.000
ρ	t/m³	0.000	0.000
α	1/K	0.000	0.000
A_eff,T	m²	0.000	0.000

1.1.2.2 Materials - Anchors

Identification number		1
Identification		4 Strand Anchor 15.2 mm
Material type		Elastic
Colour		■
Comments		
L_spacing	m	3.900
EA	kN	145.2E3
c	kJ/t/K	0.000
λ	kW/m/K	0.000
ρ	t/m³	0.000
α	1/K	0.000
A_eff,T	m²	0.000

1.1.2.3 Materials - Embedded beams

Identification number		1
Identification		Anchor - Bond Length
Material type		Elastic
Colour		
Comments		
γ	kN/m³	0.000
Input method		SDOF equivalent
Rayleigh α		0.000
Rayleigh β		0.000
ξ_1	%	0.000
ξ_2	%	0.000
f_1	Hz	0.1000
f_2	Hz	1.000
L_spacing	m	3.900
Cross section type		Predefined
Predefined cross section type		Solid circular beam
Diameter	m	0.09000

Identification number		1
A	m^2	6.362E-3
I	m^4	3.221E-6
E	kN/m^2	11.40E6
Axial skin resistance		Linear
T_skin, start, max	kN/m	250.0
T_skin, end, max	kN/m	250.0
Lateral resistance		Unlimited
F_max	kN	0.000
Default values		True
Axial stiffness factor		0.1480
Lateral stiffness factor		0.1480
Base stiffness factor		1.480

1.1.2.4.1 Materials - Soil and interfaces - Mohr-Coulomb

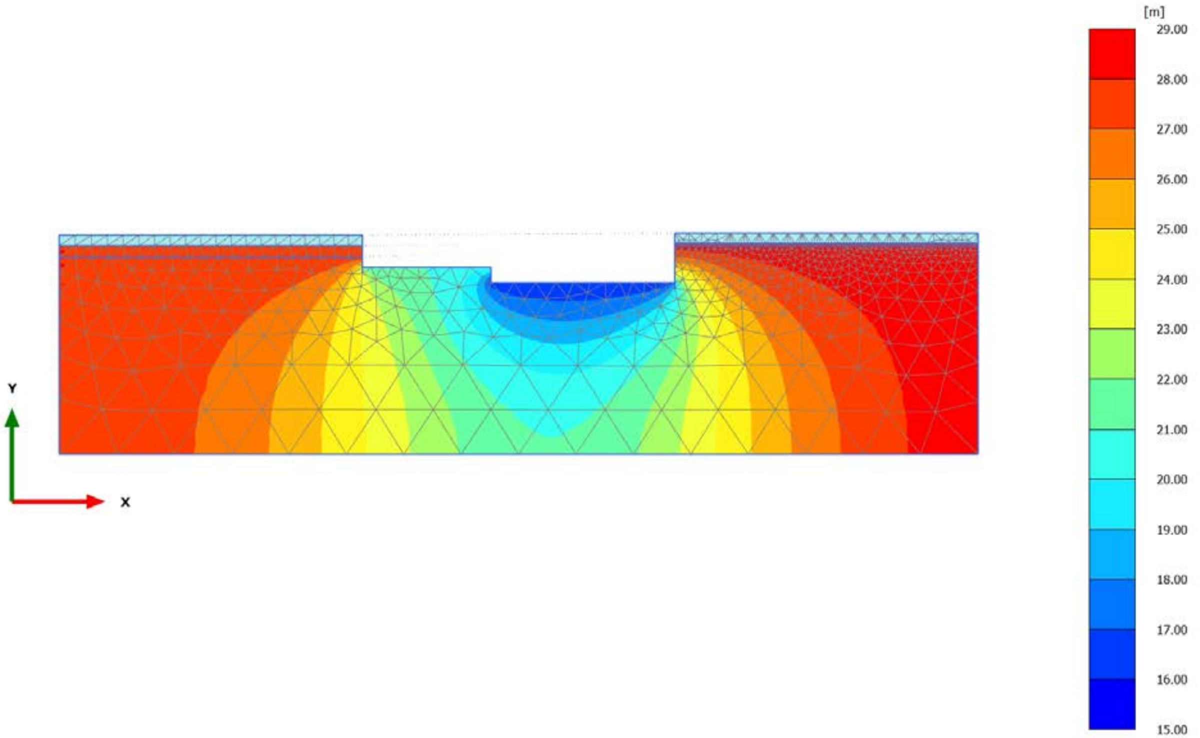
Identification number		1	2	3
Identification		Alluvial Soils	Bedrock	No Flow Boundary
Soil model		Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Drainage type		Drained	Drained	Drained
Colour				
Comments				
γ_unsat	kN/m³	20.00	24.00	24.00
γ_sat	kN/m³	20.00	24.00	24.00
e_init		0.5000	0.5000	0.5000
n_init		0.3333	0.3333	0.3333
Input method		SDOF equivalent	SDOF equivalent	SDOF equivalent
Rayleigh α		0.000	0.000	0.000
Rayleigh β		0.000	0.000	0.000
ξ_1	%	0.000	0.000	0.000
ξ_2	%	0.000	0.000	0.000
f_1	Hz	0.1000	0.1000	0.1000
f_2	Hz	1.000	1.000	1.000

Identification number		1	2	3
E'_ref	kN/m²	20.00E3	500.0E3	50.00E3
ν (nu)		0.3000	0.2000	0.3000
G_ref	kN/m²	7692	208.3E3	19.23E3
E_oed	kN/m²	26.92E3	555.6E3	67.31E3
E'_inc	kN/m²/m	0.000	0.000	0.000
y_ref	m	0.000	0.000	0.000
V_s	m/s	61.43	291.8	88.66
V_p	m/s	114.9	476.5	165.9
c'_ref	kN/m²	10.00	200.0	2.000
φ' (phi)	°	25.00	40.00	25.00
ψ (psi)	°	0.000	0.000	0.000
c'_inc	kN/m²/m	0.000	0.000	0.000
y_ref	m	0.000	0.000	0.000
Tension cut-off		True	True	True
Tensile strength	kN/m²	0.000	0.000	0.000
Determination		ν-undrained definition	ν-undrained definition	ν-undrained definition
ν_u definition method		Direct	Direct	Direct
ν_u,equivalent (nu)		0.4950	0.4950	0.4950
Skempton B		0.9783	0.9866	0.9783

Identification number		1	2	3
K_w,ref/n	kN/m²	750.0E3	20.49E6	1.875E6
Classification type		Standard	Standard	Standard
Soil class (Standard)		Coarse	Coarse	Coarse
< 2 µm	%	10.00	10.00	10.00
2 µm - 50 µm	%	13.00	13.00	13.00
50 µm - 2 mm	%	77.00	77.00	77.00
Use defaults		False	False	False
k_x	m/day	12.27	6.048E-3	0.000
k_y	m/day	12.27	6.048E-3	0.000
Void ratio dependency		False	False	False
c_k		1000E12	1000E12	1000E12
n_init		0.3333	0.3333	0.3333
-ψ_unsat	m	10.00E3	10.00E3	10.00E3
c_s	kJ/t/K	0.000	0.000	0.000
λ_s	kW/m/K	0.000	0.000	0.000
ρ_s	t/m³	2.600	2.600	2.600
Thermal expansion type		Isotropic	Isotropic	Isotropic
α_sv	1/K	0.000	0.000	0.000
Phase change		False	False	False

Identification number		1	2	3
D_v	m²/day	0.000	0.000	0.000
f_Tv		0.000	0.000	0.000
Stiffness determination		Derived	Derived	Derived
Strength determination		Rigid	Rigid	Rigid
R_inter		1.000	1.000	1.000
Consider gap closure		True	True	True
Cross permeability		Impermeable	Impermeable	Impermeable
Drainage conductivity, dk	m³/day/m	0.000	0.000	0.000
R_thermal	m² K/kW	0.000	0.000	0.000
K_0 determination		Automatic	Automatic	Automatic
K_0,x		0.5774	0.3572	0.5774
K_0,z		0.5774	0.3572	0.5774

2.1.1.1.1 Calculation results, Short Term [Phase_2] (2/11), Groundwater head

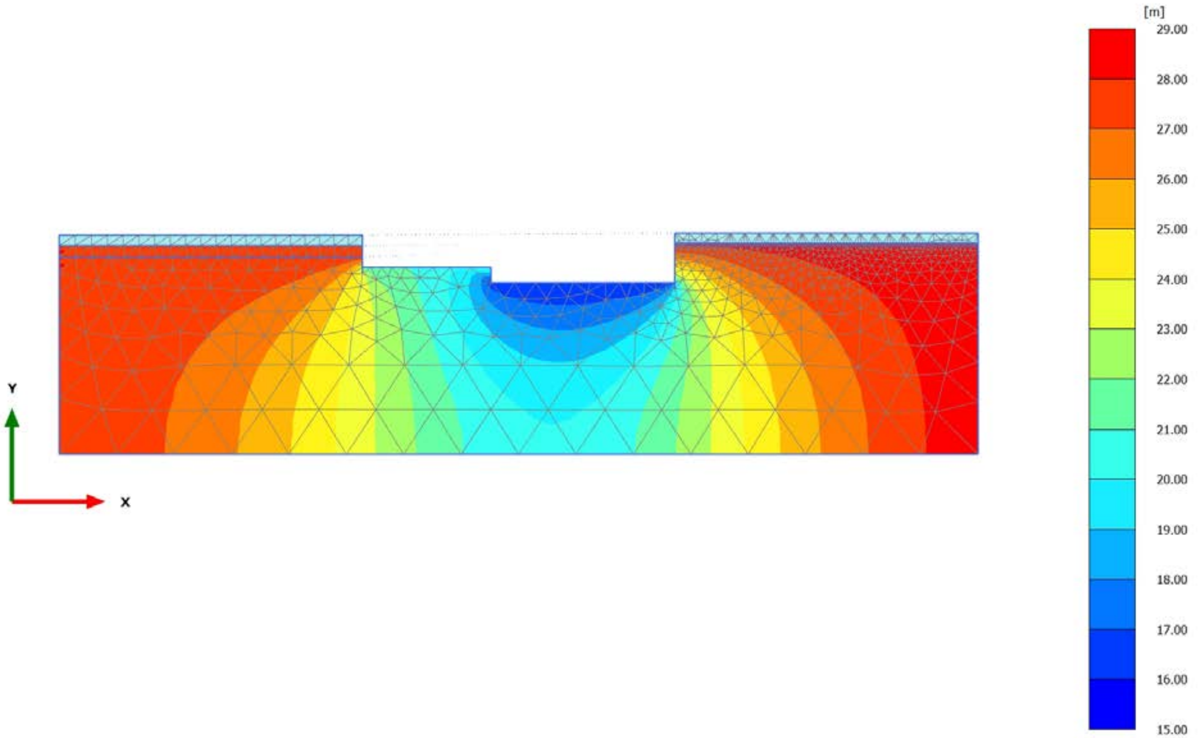


Groundwater head (scaled up 0.500 times) (Time 1.000 day)

Maximum value = 28.80 m (Element 720 at Node 9511)

Minimum value = 15.90 m (Element 1147 at Node 5839)

2.1.1.1.2 Calculation results, Long Term [Phase_3] (3/24), Groundwater head

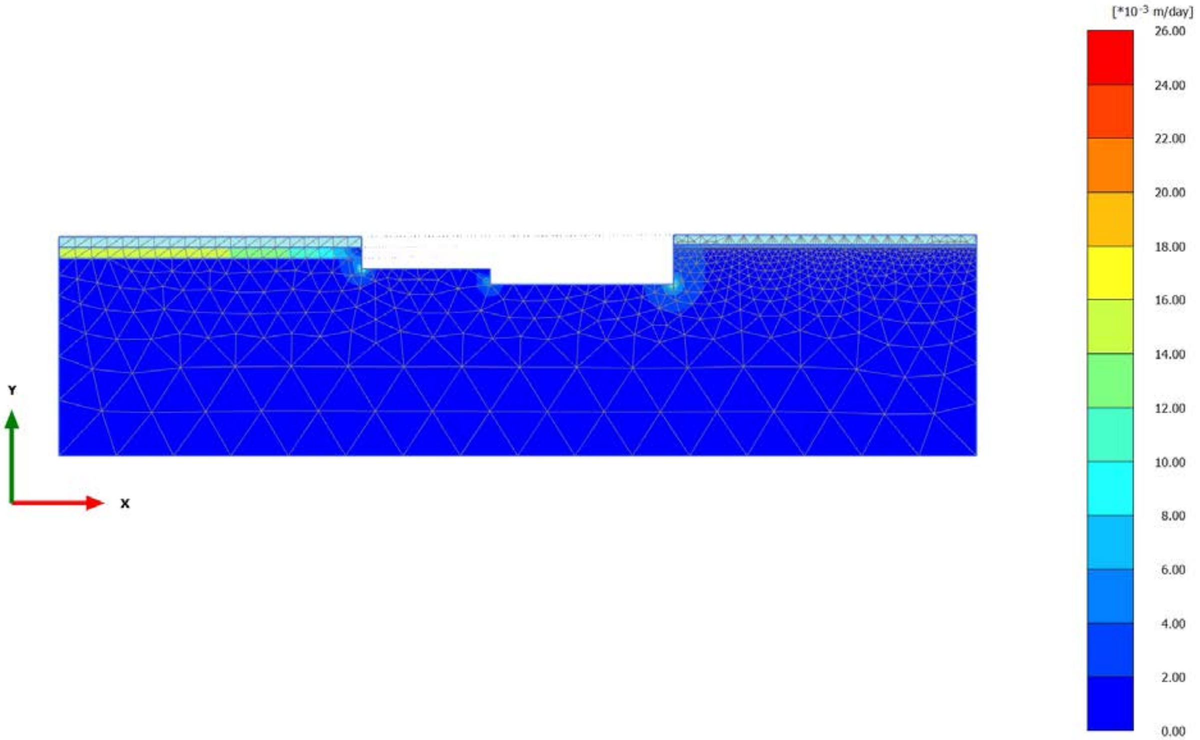


Groundwater head (scaled up 0.500 times) (Time 101.0 day)

Maximum value = 28.80 m (Element 720 at Node 9511)

Minimum value = 15.90 m (Element 1147 at Node 5839)

2.1.2.1.1 Calculation results, Short Term [Phase_2] (2/11), Groundwater flow |q|

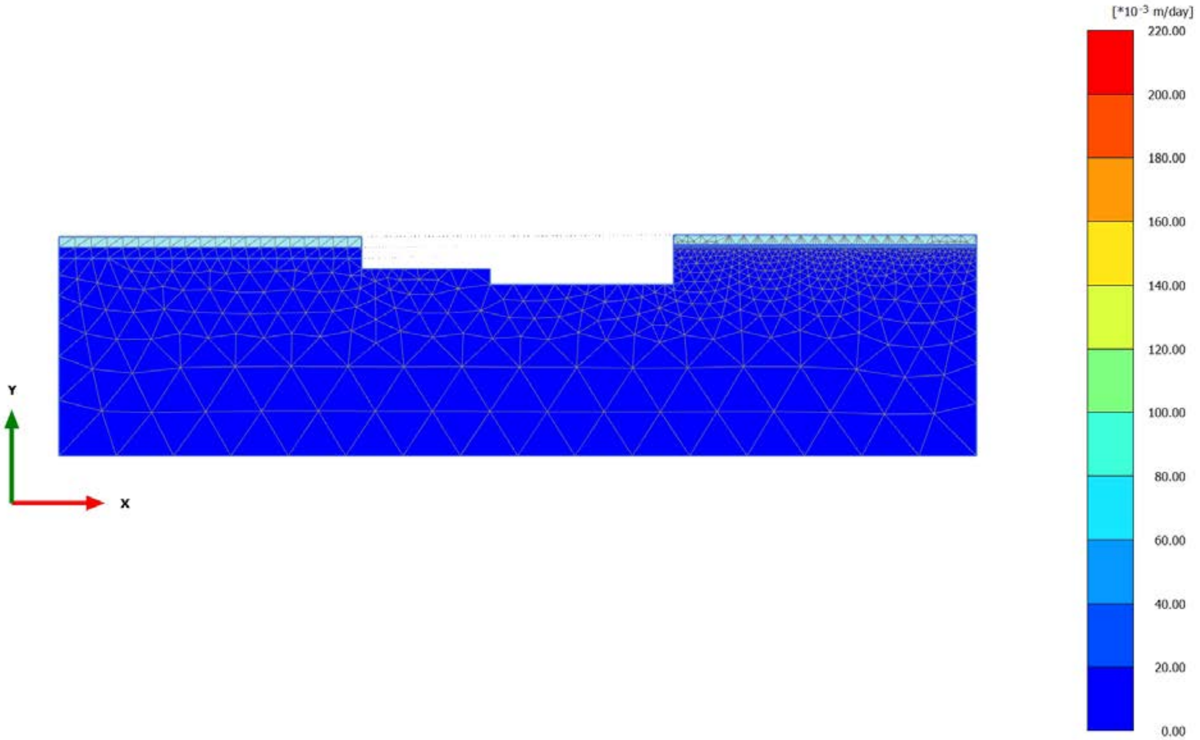


Groundwater flow |q| (scaled up 500 times) (Time 1.000 day)

Maximum value = 0.02577 m/day (Element 1223 at Node 5849)

Minimum value = $7.625*10^{-6}$ m/day (Element 1006 at Node 43)

2.1.2.1.2 Calculation results, Long Term [Phase_3] (3/24), Groundwater flow |q|



Groundwater flow |q| (scaled up 50.0 times) (Time 101.0 day)

Maximum value = 0.2105 m/day (Element 363 at Node 6788)

Minimum value = $3.438*10^{-6}$ m/day (Element 410 at Node 5025)

Appendix B

IMPORTANT INFORMATION

morrow

Important Information

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