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Groundwater & Settlement Monitoring & Contingency Plan

538 Karangahape Road, Auckland Central

DRAFT (B) **23 August 2024** **Job No. 20111**

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GROUNDWATER & SETTLEMENT MONITORING & CONTINGENCY PLAN
538 KARANGAHAPE ROAD, AUCKLAND CENTRAL
BUN604227502

Job Number:	20111
Name of Project:	538 Karangahape Road, Auckland Central
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Document Version:	DRAFT (B)
Published:	23 August 2024
Author Signature:	
Authoriser Signature:	

Table of Contents

Appendices:

1.0 Introduction

Soil & Rock Consultants (S&RC) were engaged by James Kirkpatrick Ltd to carry out a detailed groundwater drawdown and settlement assessment at 538 Karangahape Road with regard to proposed excavations near/at the site boundaries and/or adjacent structures.

This Groundwater & Settlement Monitoring & Contingency Plan (GSMCP) has been prepared in relation to the findings of the above assessment and details the proposed monitoring requirements with regards to ground movements induced by excavation and related groundwater drawdown.

This GSMCP should be read in conjunction with the following reports for the development:

- '*Geotechnical Investigation for Multi-Level Commercial Building at 538 Karangahape Road, Newton*' Revision A, dated 22 August 2023, Job No. 20111
- '*Groundwater Drawdown and Settlement Assessment at 538 Karangahape Road, Auckland City'* Revision E, dated 21 August 2024, Job No. 20111
- '*Request for Information Response for Proposed Commercial Development 538 Karangahape Road, Auckland City BUN60427502*' dated 8 July 2024, Job No. 20111

This GSMCP sets two threshold levels and details the required notification or action for each. *Alert Triggers* are levels that are close to, but below, the design value, and below the level where damage is expected to occur. *Alarm Triggers* are levels at or near the design value and immediate assessment and contingency action is required. The monitored parameters are:

- Lateral and vertical ground displacement
- Wall deformation
- Damage to neighbouring buildings (Detailed Condition Surveys/Visual Inspection)
- Changes in groundwater levels

1.1 Limitations

This GSMCP has been prepared by S&RC for the sole benefit of James Kirkpatrick Ltd (the client), their appointed consultants, and Council with respect to the proposed development at 538 Karangahape Road, Auckland Central and the brief given to us. This GSMCP may be used by Council when considering any proposed applications (such as the Resource Consent) in association with the proposed development outlined herein. The data and/or opinions contained in this GSMCP may not be used in other contexts, for any other purpose or by any other party without our prior review and agreement. This plan may only be read or transmitted in its entirety, including the appendices.

The procedures provided in this plan are based on data and results in the reports referenced above. Further, a 'Condition Survey' (Damage Audit) shall be carried out by a Chartered Structural Engineer prior to the commencement of any construction work to assess the structural condition and sensitivity of the named surrounding buildings/adjacent structures to the estimated differential settlement.

The procedures presented in this GSMCP shall be reviewed to consider the data gained from the 'Condition Survey' above and is to be submitted to Auckland Council for approval prior to commencement of construction/site excavation.

2.0 Notice of Dewatering

Council will be advised in writing at least 10 working days prior to the date of Commencement of Construction Phase Dewatering.

3.0 Excavation Limit

Bulk excavation will not extend more than 0.8m below the Finished Floor Levels.

4.0 Damage Avoidance

All excavations, dewatering systems, retaining structures, and works associated with the diversion or taking of groundwater, will be designed, constructed and maintained so as to avoid damage to buildings, structures and services on the site or adjacent properties, unless otherwise agreed in writing with the asset owner/manager.

5.0 Construction Monitoring

5.1 General Requirements

- The ground deformation survey shall be undertaken by a registered surveyor.
- The ground survey monitoring is to be to a vertical accuracy of +/- 2mm.
- A minimum of two rounds of baseline monitoring are to be carried out prior to commencement of dewatering excavation.
- Benchmark survey positions are to be established at least 50m from the site works.
- The groundwater level monitoring is to be to an accuracy of +/-50mm.
- Survey monitoring data is to be provided to S&RC within 24 hours of measurement.
- The contractor is to ensure that the survey monitoring points and piezometers are protected from disturbance.

5.2 Monitoring Location Plan

The proposed groundwater and settlement monitoring locations are shown on S&RC Drawing 20111/301 provided in Appendix A.

The plan shows the locations of structures for detailed condition surveys and visual inspections, monitoring points for settlement and deflection monitoring, and piezometers for groundwater monitoring.

6.0 Alert and Alarm Levels

The Alarm and Alert levels shown in Schedule A have been developed from the groundwater level data currently available and our deflection analysis results for the maximum excavation depths. Alarm and Alert levels are triggered if the thresholds in Schedule A are exceeded.

Our analyses indicate that *damage tolerances* for the differential settlement, total settlement, and wall deflections are higher, and that the *predicted* differential settlement, total settlement, and wall deflections are lower, than the values below.

The 'Alert Trigger' and 'Alarm Trigger' levels presented in Schedule A shall be revisited following the 'Detailed Condition Survey' of the neighbouring structure at 582 Karangahape Road and 'Visual Inspection' of the carpark, footpaths, and roads, to be carried out prior to dewatering/excavation.

Schedule A - Alarm and Alert Levels

Locations	Deflection / Settlement Trigger Thresholds (+/-)	
	Alarm	**Alert**
Deflection / Settlement		
<u>Differential Ground Surface Deformation:</u> • GS01A to GS01B • GS01 to GS02 • GS02 to GS03 • GS03 to GS04 • GS04A to GS04B • GS06A to GS06B • GS06A to GS07 • GS07 to GS08 • GS08 to GS09A	1:500	1:750

Locations		Deflection / Settlement Trigger Thresholds (+/-)	
		Alarm	**Alert**
Deflection / Settlement			
a)	Differential Ground Surface Deformation: • GS09A to GS09B • GS10A to GS10B • GS11A to GS11B • GS12A to GS12B	1:500	1:750
b)	Total Ground Surface Settlement: • GS01A • GS01B • GS02 • GS03 • GS04A • GS04B • GS05 • GS06A • GS07 • GS08 • GS09A • GS10A • GS11A • GS12A	 10mm [1] 10mm [1] 11mm 11mm 11mm 10mm [1] 10mm [1] 10mm [1] 10mm [1] 10mm [1] 10mm [1] 10mm [1] 10mm [1] 10mm [1]	 7mm 7mm 8mm 8mm 8mm 7mm 7mm 7mm 7mm 7mm 7mm 7mm 7mm 7mm
c)	Differential Building Settlement: • BM01 to BM04 • BM03 to BM06 • BM04 to BM05	 1:750 1:750 1:750	 1:1000 [1] 1:1000 [1] 1:1000 [1]
d)	Total Building Settlement: • BM01 (A-C) • BM02 (A-C) • BM03 (A-C) • BM04 • BM05 • BM06	 10mm (1:500) 10mm (1:500) 10mm (1:500) 10mm [1] 10mm [1] 10mm [1]	 7mm (1:750) 7mm (1:750) 7mm (1:750) 7mm 7mm 7mm

Locations		Deflection / Settlement Trigger Thresholds (+/-)	
		Alarm	**Alert**
Deflection / Settlement			
e)	Retaining Wall Deflection: • RWA1-1 • RWA1-2 • RWA1-3 • RWA1-4 • RWA1-5 • RWAA-1 • RWAA-2 • RWAA-3 • RWB6-1 • RWB6-2 • RWB6-3 • RWB6-4 • RWBF-1 • RWBF-2 • RWBF-3	 8mm 8mm 8mm 10mm 10mm 15mm 15mm 15mm 15mm 15mm 15mm 15mm 12mm 12mm 12mm	 6mm 6mm 6mm 8mm 8mm 12mm 12mm 12mm 12mm 12mm 12mm 12mm 9mm 9mm 9mm
f)	Inclinometer Deflection: • I01 • I02	 8mm 8mm	 6mm 6mm
Locations		**Trigger Thresholds (+/-)**	
		Alert 2	**Alert 1**
Groundwater Drawdown			
g)	Depth below the pre-dewatering Seasonal Low Groundwater Level and any subsequent groundwater reading at monitoring bores: • PZ05	(below baseline groundwater level – 100% of maximum drawdown) 1.4m [2]	(below baseline groundwater level – 80% of maximum drawdown) 1.1m [2]

The 'Alert Trigger' and 'Alarm Trigger' levels presented above shall be revisited following the 'Detailed Condition Survey' of the neighbouring buildings and 'Visual Inspection' of the footpaths/roadways, to be carried out prior to dewatering/excavation.

[1] Predicted settlement at these locations is less than damage tolerances (i.e. very slight to negligible damage is anticipated at these values.

[2] Drawdown depth to be updated based on pre-dewatering/excavation depth to groundwater measurements.

7.0 Exceedances

In the event that the alarm and/or alert levels presented in Schedule A are exceeded, the following actions are to be taken.

7.1 Alert Level Actions

- Notify the project engineer (SQEP) within 24 hours.
- Notify Council and the asset owner within two working days.
- The project engineer shall carry out a site observation visit for the purposes of observing obvious visual signs of distress in the ground and nearby structures.
- Re-measure all monitoring stations in the vicinity of the affected monitoring location(s) to confirm the extent of apparent movement.
- The project engineer is to review the data and provide advice on the need for mitigation measures or other actions necessary to avoid further deformation. The advice is to include recommended measures or other actions to mitigate further movement. The above should be submitted to Council in a written report (by the project geotechnical engineer) within five working days of alert level exceedance.
- Measure and record all monitoring stations of the location(s) of any alert level exceedance every two days until the written report referred to above is submitted to Council.

7.2 Alarm Level Actions

- Immediately notify the project engineer (SQEP).
- The engineer (SQEP) shall carry out a visual inspection for the purposes of observing obvious visual signs of distress in the ground and nearby structures and, if appropriate, further detailed condition survey(s) of potentially affected dwelling(s)/structure(s).
- Immediately halt construction activity, including excavation, dewatering, or any other works in the area that may result in increased deformation, unless halting the activity is considered, by a suitably qualified person, likely to be more harmful (in terms of effects on the environment) than continuing to carry out the activity.
- Notify Council and the asset owner within one working day of the alarm level exceedance being detected and provide details of the measurements taken.
- The engineer shall submit a written report to Council within five working days of alarm level

exceedance. The report shall provide an analysis of all monitoring data relating to the exceedance (including wall deflection), actions taken to date to address the issue, and recommendations for mitigating the adverse effects of the ground movement.

- Construction activities (or any associated activities) in the area shall not resume, subject to any contrary recommendation made in accordance with the paragraphs above, until mitigation measures have been implemented to the satisfaction of the project geotechnical engineer and Council, which will avoid damage if this is considered likely.
- Measure and record all monitoring stations of the location(s) of any alarm level exceedance every two days until the written report referred to above is supplied to Council.
- Not resume construction activities that may result in increased deformation until recommended mitigation measures have been implemented to the satisfaction of the SQEP.
- Report to Council on the mitigation measures implemented and any remedial works and/or agreements with affected parties within 10 working days of the recommencement of works.

7.3 Contingency Actions

If the project team become aware of damage to buildings, structures, or services potentially caused wholly, or in part, by the works, the following actions are to be taken:

- Immediately notify the project engineer (SQEP);
- Immediately halt construction activity, including excavation, dewatering, or any other works that may result in increased deformation, unless halting the activity is considered, by a suitably qualified person, likely to be more harmful (in terms of effects on the environment) than continuing to carry out the activity;
- Notify Council and the affected asset owner(s) within five working days of the consent holder becoming aware of the damage;
- The project engineer (SQEP) shall carry out a site visit (subject to owner access approval) to observe the damage, assess the likely cause(s), and provide initial recommendations to remedy or mitigate the damage, to be implemented on-site;
- The project engineer shall then prepare a report that describes the damage, identifies the cause of the damage, identifies methods to remedy and/or mitigate the damage that has been caused, identifies the potential for further damage to occur, and describes actions that have and will be taken to avoid further damage. This may require the input of the project structural engineer; and
- Provide a copy of the report to Council and the effected asset owner(s) within 10 working days of notifying the damage to them.

8.0 Building and Structure Surveys

Structures/buildings/Carparks and the extent of underground services that require visual inspections or detailed condition survey are summarised in Schedule B and shown on S&RC Drawing 20111/301 provided in Appendix A.

Visual inspection of the carpark at 582 Karangahape Road and the footpath, kerb, and roadway along Karangahape Road, Gundry Street, and Abbey Street is to be undertaken within approximately 20m of the subject site.

Given the minimal settlement and negligible effects expected we consider visual assessment of the exposed excavation for evidence of leaks to be sufficient with regard to the 200mmØ water pipe immediately adjacent to the southern edge of the excavation.

For health and safety reasons due to the high traffic volume, visual inspection of the roadway along Karangahape Road will extend only as practical as possible from the footpath.

Schedule B – Summary of Structures/Buildings and Areas to be Surveyed

Description	Address	Legal Description	Survey Type	Number (IDs) of Deformation Stations
Ground Surface / Footpath & Kerb / Roadway	Karangahape Rd, Gundry St, Abbey St	N/A	Visual Inspection	15 (GS01 – GS10)
Existing Building (within ~20m of development site)	582 Karangahape Rd	PT ALLOT 11 SEC 7 DP 21097	Detailed Condition Survey	12 (BM01 – BM06) (Incl. (BM01-A to BM01-C, BM02-A to BM02-C, and BM03-A to BM03-C)
Carpark	582 Karangahape Rd	PT ALLOT 11 SEC 7 DP 21097	Visual Inspection	4 (GS11 – GS12)
Public Wastewater and Stormwater Lines (Extent per Monitoring Plan in Appendix A)	Gundry St	N/A	CCTV	N/A
200mmØ Cast Iron Water Pipe	Gundry St, Abbey St	N/A	Visual Inspection	N/A

The detailed condition survey should include, but not be limited to, the following details:

a) Confirmation of the installation of building deformation pins.
b) Type of foundations.
c) Existing levels of aesthetic damage.
d) Existing levels of serviceability damage.
e) Existing level of structural damage.
f) Susceptibility of structure to further movement.
g) Photographic evidence of (c), (d) and (e).
h) Following the structural assessment, review of the proposed alert and alarm levels to confirm ground settlement less than the alarm level will not cause damage.
i) An assessment of whether monitoring frequency is appropriate.
j) An assessment of the location and density of pins is adequate for the effective detection of change to the building and structural condition.
k) Any other requirement stated within Resource Consent Conditions.

The extent of the detailed condition survey is to be determined on site in coordination with the contractor, building owner, building tenant(s), geotechnical engineer, and surveyor, however has been indicatively shown to extend 20m from the development site where settlement expected to be less than 4mm.

8.1 Pre-Dewatering Construction Building and Structure Surveys

No more than six months prior to the commencement of excavation/dewatering, a visual inspection of the footpath and utilities and a detailed condition survey of the neighbouring structure at 582 Karangahape Road shall be undertaken by a SQEP or SQBS and a written report shall be prepared and reviewed by the SQEP.

Prior to the commencement of earthworks/dewatering, the report shall be submitted to Council for approval.

8.2 During Construction Building and Structure Surveys

Throughout construction dewatering (ie. from the commencement of excavation dewatering to the completion of excavation dewatering), weekly visual inspections of the footpath, utilities, and external areas of the neighbouring structure at 582 Karangahape Road shall be undertaken for the purpose of detecting any new damage or deterioration. Internal visual inspections will be undertaken on an ‘as requested’ basis by the building owner/tenant in coordination with the client/contractor.

A photographic record will be kept, including time and date of each inspection and all observations made during the inspection. The results of the external visual inspection and an assessment of the result will be reviewed by the SQEP and included in the bimonthly monitoring report.

8.3 Post Completion of Construction Building and Structure Surveys

Between six and 12 months following the completion of excavation dewatering, a visual inspection of the footpath and utilities and detailed condition survey of the neighbouring structure at 582 Karangahape Road shall be undertaken by a SQEP or SQBS and a written report shall be prepared and reviewed by the SQEP. The report shall be submitted to Council within one month following completion of the surveys.

8.4 Additional Surveys

Additional visual inspections and/or detailed condition surveys may be completed, if deemed appropriate by the SQEP or requested by Council, for the purpose of investigating any damage potentially caused by ground movement resulting from construction phase excavation dewatering or retaining wall deflection. The requirement of any such additional surveys at the request of Council will cease 12 months after the completion of excavation dewatering.

9.0 Groundwater Monitoring

Three piezometers (PZ04, PZ05, and PZ06) were installed to monitor groundwater levels during the Resource Consent application process. However, it is expected that PZ04 and PZ06 will be destroyed during excavation works. PZ05 is located on the property boundary and is expected to remain in place during the proposed works for the purposes of ongoing monitoring during and post construction. Groundwater monitoring locations and monitoring frequency are provided in Schedule C. Locations are shown in S&RC Drawing 20111/301 provided in Appendix A.

Schedule C – Groundwater Monitoring Frequency

Piezo	Location		Groundwater Level Monitoring Frequency (to an accuracy of 10mm)		
	Easting (mE)	Northing (mN)	Pre-Commencement of Dewatering	From Commencement to Completion of Dewatering	From Completion of Dewatering until 3 Months Following Completion of Dewatering
PZ05	1756319.845	5919298.063	Monthly (minimum of three monthly readings)	Weekly	Monthly (minimum of three monthly readings)

Should PZ05 be destroyed during construction, a replacement piezometer should be installed in collaboration with Council and Auckland Transport as installation within the road reserve is likely to be required.

10.0 Ground Surface and Building Deformation Monitoring

Ground surface and building deformation monitoring points will be established and maintained at the approximate locations shown in S&RC Drawing 20111/301 provided in Appendix A and will be monitored at the frequencies summarised in Schedule D.

Nine mini-prisms or tilt meters (BM01-A to BM01-C, BM02-A to BM02-C, and BM03-A to BM03-C) are proposed to be attached to the unreinforced concrete masonry wall along the eastern wall of the structure at 582 Karangahape Road. The markers are to be evenly spaced in three horizontal lines at:

- 71.0mRL (approximately 0.5m above existing ground level)
- 72.5mRL (approximately 2.0m above existing ground level)
- 74.5mRL (approximately 4.0m above existing ground level)

Schedule D – Ground Surface and Building Deformation Monitoring Points

Monitoring Station and Type	Frequency		
	Pre-Commencement of Dewatering/Excavation	Commencement to Completion of Dewatering/Excavation	Post-Completion of Dewatering/Excavation
GS01 – GS12	Twice pre-commencement of dewatering and/or excavation	Weekly	Monthly for 6 months post-completion of dewatering/excavation
BM01 – BM06 BM01-A to BM01-C BM02-A to BM02-C BM03-A to BM03-C	Twice pre-commencement of dewatering and/or excavation	Weekly	Monthly for 6 months post-completion of dewatering/excavation

11.0 Retaining Wall Monitoring

Retaining wall deflection stations and inclinometers will be installed as shown in S&RC Drawing 20111/301 provided in Appendix A and will be monitored at the frequencies summarised in Schedule E.

Schedule E – Retaining Wall Monitoring Points

Monitoring Station and Type	Frequency		
	Pre-Commencement of Dewatering/Excavation	Commencement to Completion of Dewatering/Excavation	Post-Completion of Dewatering/Excavation
Retaining Wall Deflections Stations RWA1-1 – RWA1-5 RWAA-1 – RWAA-3 RWB6-1 – RWB6-4 RWBF-1 – RWBF-3	Twice pre-commencement of dewatering/excavation below capping beam	Weekly	Fortnightly for 1 month post-completion of dewatering
Inclinometers I01 – I02	NA	Weekly	Fortnightly for 1 month post-completion of dewatering

12.0 Access to Third Party Property

Where any monitoring, inspection, or condition survey requires access to properties owned by a third party, and access is declined or subject to unreasonable terms, a report will be prepared by the SQEP identifying an alternative monitoring programme.

Written approval from Council must be obtained before an alternative monitoring option is implemented.

13.0 Contingency Actions

If the project team become aware of damage to buildings, structures, or services potentially caused wholly, or in part, by the works, the following actions are to be taken:

- Immediately halt construction activity, including excavation, dewatering, or any other works that may result in increased deformation, unless halting the activity is considered, by a suitably qualified person, likely to be more harmful (in terms of effects on the environment) than continuing to carry out the activity;
- Notify Council and the affected asset owner(s) within two working days of the consent holder becoming aware of the damage;

- The SQEP shall carry out a site visit (subject to owner access approval) to observe the damage, assess the likely cause(s), and provide initial recommendations to remedy or mitigate the damage, to be implemented on-site;
- The SQEP shall then prepare a report that describes the damage, identifies the cause of the damage, identifies methods to remedy and/or mitigate the damage that has been caused, identifies the potential for further damage to occur, and describes actions that have and will be taken to avoid further damage. This may require the input of the project structural engineer; and
- Provide a copy of the report to Council and the effected asset owner(s) within 10 working days of notifying the damage to them.

14.0 Surveys and Inspections

Prior to commencement of construction dewatering/excavation, a copy of all pre-construction survey must be submitted to Council with the Final GSMCP.

All other surveys and photographic records required by Council must be provided upon request.

15.0 Reporting

At two monthly intervals, a report containing all monitoring data required by Conditions of the Consent shall be submitted to the Team Leader Compliance Monitoring Central.

The bi-monthly report shall include a construction progress timeline, the monitoring data (including the results of condition surveys and survey and monitoring results) recorded in that period, and a comparison of that data with previously recorded data and with the alert and alarm levels for each monitoring station.

Upon Completion of Construction, one electronic data file (excel workbook) containing digital data for all groundwater monitoring bores shall be provided to the Team Leader Compliance Monitoring Central.

Data shall include the monitoring bore name, type, location (NZTM easting/northing and elevation), screened depth for groundwater monitoring bores, absolute and relative readings (and their units of measure) and the date / time of each reading.

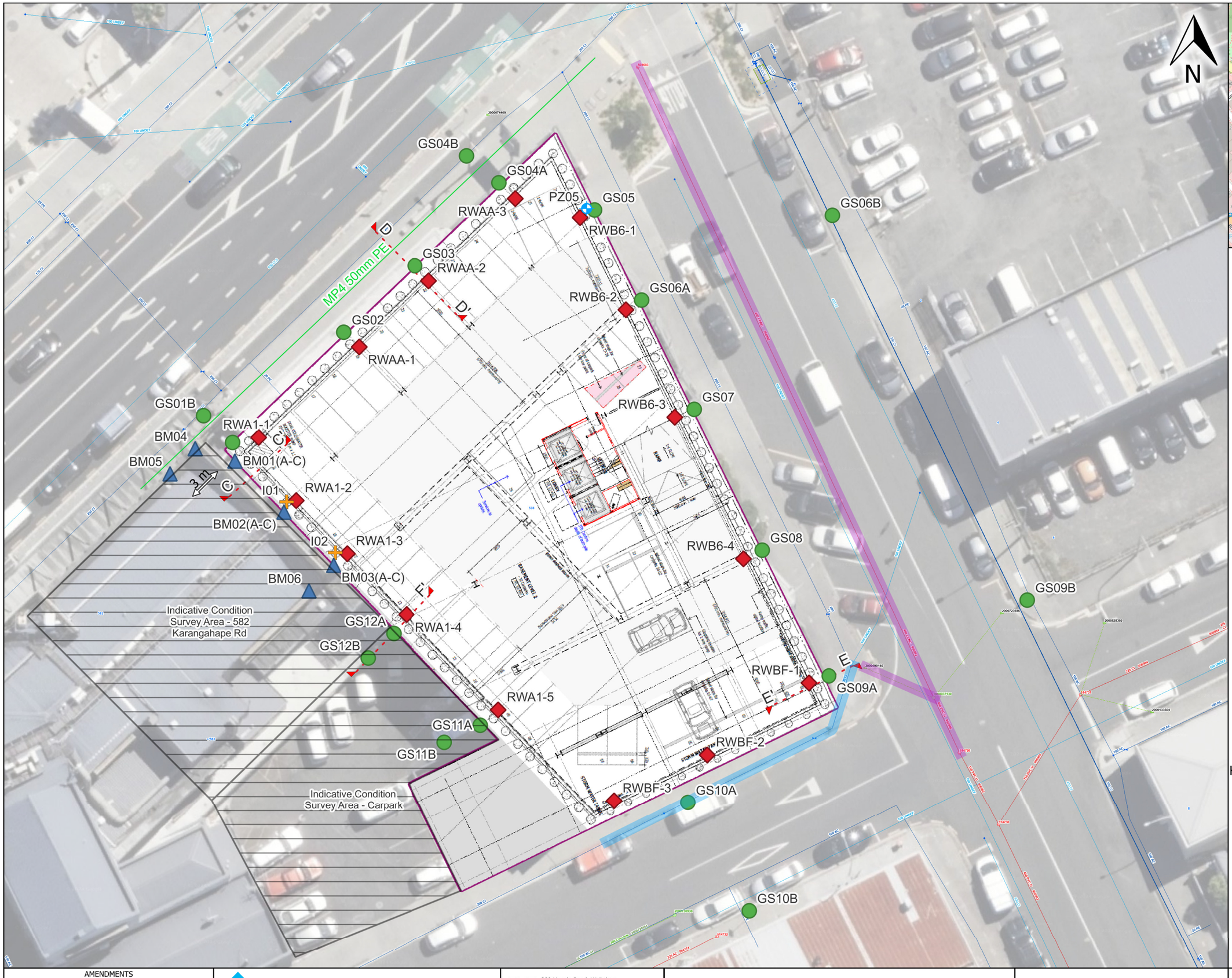
The worksheets shall contain data values only (no formulas, circular references or links to other sheets). The Team Leader Compliance Monitoring Central shall be advised in writing within 10 working days of when excavation and dewatering has been completed.

16.0 Notice of Completion

Council must be advised in writing within 10 working days of completion of construction dewatering/excavation.

The procedures presented in this GSMCP shall be reviewed and finalised during the Building Consent stage in the light of the data to be retrieved from the 'Detailed Condition Survey' discussed above. This GSMCP shall be reviewed and approved by Auckland Council before construction commences.

End of Report Text – Appendices Follow



NOTES:

1. Locations of features approximate only.
2. Buried service locations to be verified on site.
3. Original sheet size A3.
4. Boundary data obtained from Council GIS.

Key:

- Site Boundary
- Watermain Visual Excavation Inspection Extent
- S&RC Retaining Wall Marker Locations
- S&RC Ground Marker Locations
- S&RC Building Marker Locations
- S&RC Inclinometer Locations
- S&RC Piezometer Locations
- Proposed CCTV Extent

AMENDMENTS		
Rev	Date	Description

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Monitoring Plan

Dwg No.	20111 /301		
Scale:	1:300	Drawn By:	B.Smith
Date:	23/08/2024	Revision:	B
Filename:	O:\Auckland\20---\100 - 199\20111\QGIS\20111 - GSMCP - Jul2024.qgz		