Dewatering and Settlement Monitoring Plan

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	Position/Title	**Name**	**Date**
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	Pit Surface Runoff Sampling SOP	WAI-200-PRO-024
	Management of Surface Intersecting Drill Holes	WAI-400-PRO-076
	Waihi Township Piezometer Network Monitoring	WAI-200-PRO-021
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Document Issuance and Revision History

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1	2016	All	All	OceanaGold re-issue	
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1 INTRODUCTION

Consents granted by both the Waikato Regional Council (WRC) and the Hauraki District Council (HDC) for the Martha Open Pit, Favona Underground Mine, Trio Underground Mine, Correnso Underground Mine, Slevin Underground Project Area (SUPA) and Project Martha require the preparation of a Dewatering and Settlement Monitoring Plan. The relevant consent conditions are reproduced below (section 2.0) and provided in full in Appendix A.

This plan combines both the Martha Settlement and Groundwater Monitoring Plan 2004-2005 (v3) and the Favona Settlement, Dewatering and Water Quality Monitoring Plan 2006 (v1) into the one document. The Martha and Favona Plans have been combined to simplify the dewatering, groundwater and settlement monitoring which is conducted at similar monitoring networks and frequencies for Martha, Favona, Trio and Correnso/SUPA.

The plan describes the monitoring regime designed to assess the effects of:

a) Mine dewatering on the regional groundwater system;

b) Mine dewatering on settlement;

c) Leachate from the Favona Ore Stockpile and Polishing Pond Stockpile containing potentially acid forming material on shallow groundwater quality; and

d) The discharge of degraded-quality water from the Favona Underground, backfilled and flooded workings on groundwater quality.

1.1 Historic Shaft Monitoring

Under Water Right W1740 (granted July 1987, “Licensed Pit”), OceanaGold New Zealand (OGNZL) was required to monitor survey marks that have been established on, or immediately adjacent to, approximately six historic mine shafts throughout the township. However, with the expiry of W1740 OGNZL now only monitors historic shafts on company land. There are two shafts. The remaining shafts are surveyed by HDC.

These survey marks are monitored concurrently with the six-monthly settlement survey and are monitored primarily to detect ground movements due to localised collapse of shaft support and their caps. As such it is inappropriate that these marks are included in the settlement survey network as their inclusion leads to a misleading representation of present-day mine related settlement. Monitoring of the historic shaft survey marks is, therefore, not included in this monitoring plan and associated settlement reports.

1.2 Project Status

1.2.1 Martha

The Martha Mine is an open pit operation that commenced construction in 1987. Mining at Martha was planned to cease in 2006, however mining was extended for an additional 10 years (scheduled until 2016). The Martha Pit is currently in abeyance due to a slip on the North Wall.

1.2.2 Favona

The Favona Underground mine is located north and east of the existing processing plant. Site preparation works were conducted in 2004, with the construction of the Favona Exploration Decline commencing in November 2004. Groundwater was not intercepted until May 2005, with minor flows until October 2005 when large volume dewatering from the vein was required. Dewatering holes have been drilled at strategic locations throughout the mine to lower the groundwater table surrounding the Favona ore body. Water from the dewatering holes drains into sumps and is pumped to the surface for treatment. Mining of the Favona mine is concluded and backfilling completed.

1.2.3 Trio

The Trio system sits under Union Hill, about halfway between the existing process plant and the Martha open pit. Trio is accessed from the existing Favona mine and utilises existing Martha and Favona mine surface infrastructure including the already consented stockpile areas. The Trio Underground Mine involves the mining of the Trio, Union and Amaranth mineralised veins (collectively referred to as the Trio system).

Trio mining and backfilling was completed in 2014. Water levels have now been lowered past the 792mRL level, and limited mining in Trio is anticipated in 2019.

1.2.4 Correnso

Mining of Correnso began on the 20th December 2013 with the construction of a development drive in Waihi East. Access to Correnso is via the existing Trio/Favona system.

Waste rock produced by the mine is managed two ways: 1) underground stockpiling and backfilling into stopes and 2) placement on temporary surface stockpiles on the surface.

1) Open stopes are progressively backfilled with waste rock during mining operations. Backfilled stopes are not treated by any specific compaction or consolidation process, but are subjected to blast vibrations, heavy vehicular trafficking, and further backfilling during mining of subsequent stopes above.

2) Waste rock is stockpiled at two locations on the surface. A short term stockpile is maintained immediately behind the mill area, enabling easy access for back loading. A larger and longer term volume can be stored at the ‘Polishing Pond’ Stockpile (near the water treatment plant polishing ponds). Waste rock placement at this stockpile started in early February 2007.

1.2.5 Slevin Underground Project Area

SUPA was granted consent in October 2016. It is a comparatively small project area and is an offshoot of Correnso. Access to SUPA will be from the CEPA project area. There are no additional monitoring requirements as Correnso monitoring adequately encompasses SUPA also.

1.2.6 Project Martha

Project Martha was granted consent in February 2019. Underground mining commenced in mid-2019. As part of the consent pre-conditions, this monitoring plan is to be submitted and certified two months prior to

dewatering below 700mRL. Additional piezometers, planned in consultation with regulators, were drilled in 2019-2020.

2.0 RELEVANT CONSENT CONDITIONS

2.1 *Martha*

This site specific monitoring plan is required under Condition 3.30 of LUC Number 97/98-105; Water Permit Number 971286; and Condition 11 of Mining Licence 32-2388. Full copies of these Conditions are given in Appendix A.

The Conditions require a Dewatering and Settlement Monitoring Plan to address the following:

a) An overall description of the groundwater and settlement monitoring system and the measures to be adopted to meet the objectives of the groundwater and settlement management system.

b) Details of the piezometer network proposed to monitor the effects of pit dewatering on the aquifers under Waihi Township.

c) Details of the settlement monitoring network proposed to monitor the extended zone which has been, or is likely to be affected by settlement caused by mine dewatering.

d) Details of the survey facilities in the Waihi Township considered by the consent holder to be potentially "at risk" of damage from ground settlement caused by mine dewatering.

e) A settlement contingency plan to include mitigation measures to be implemented in the event that ground settlement caused by mine dewatering induces a tilt that exceeds 1 (vertical) in 1000 (horizontal) between any two network monitoring locations spaced no less than 25 m apart (i.e. Settlement no more than 25 mm over 25 m). The settlement contingency plan shall particularly address those facilities identified by the consent holder as being "at risk" from ground settlement caused by mining.

f) A dewatering contingency monitoring plan that describes the steps the consent holder shall implement in the event that dewatering results in adverse impacts on affected aquifer systems and associated groundwater supplies used for domestic, stock or other purposes.

g) In detailing the monitoring programmes, the consent holder shall provide information on the monitoring methods proposed, the parameters to be monitored and the calibration and maintenance of monitoring equipment.

The conditions allow the consent holder to review and update the plan as necessary.

Monitoring is to include:

- The daily volume of water abstracted.
- Monthly water level monitoring of the piezometer network.
- Six monthly monitoring of ground settlement.
- The chemistry of groundwater, pit runoff and dewatering water.

In the event that a tilt of greater than 1 in 1000 occurs over 25 m and such tilt is due to mine dewatering, or there is a significant variance from predicted settlement rates for the settlement zones given in Table 1 as follows:

Table 1: Maximum Zone Settlements

Zone	Maximum Total Settlement (mm), incl Project Martha (2020)
1	55
2	65
3	95
4	160
5	260
6	340
7	540

Note: Maximum Total Settlement incl. Project Martha Dewatering sourced from Project Martha Hearing Evidence, Appendix R, Table 2 (Engineering Geology Ltd, May 2018)

The consent holder is to:

a) Explain the cause of the non-conformance.

b) Agree with the consent Authorities on appropriate settlement contingency measures to be implemented.

c) Implement settlement contingency measures as appropriate.

d) Advise the councils of the steps proposed to be taken to prevent further occurrence of the situation.

2.2 *Favona*

Conditions 33 to 36 of the LUC and Conditions for the Favona Underground Mine Project granted by Hauraki District Council (No. 85.050.326.E granted in 2004) and Condition 2 of Schedule 2 – General Conditions attached to the WRC Resource Consents 109742, 109743, 109744, 109745, and 109746 state the following regarding the Settlement, Dewatering and Water Quality Monitoring Plan:

Prior to exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Settlement, Dewatering and Water Quality Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement, the groundwater hydraulic regime and on water quality, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system, as proposed in the consent application. The monitoring regime shall be designed to assess the effects of:

a) mine dewatering on the regional groundwater system,

b) mine dewatering on settlement;

c) leachate from stockpiles containing potentially acid forming material on shallow groundwater quality, and

d) the discharge of degraded-quality water from the backfilled and flooded workings on groundwater quality.

e) Final details of the monitoring locations are to be agreed with the Council. The Plan shall also provide trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

The Plan shall be consistent with the recommendations included in the reports to the Council entitled;

- "Proposed Favona Underground Mine – Review of Groundwater Assessment" dated October 2003 and prepared by Pattle Delamore Partners; and
- "Technical Review of Water Quality and Geochemistry Issues - Favona Underground Project", dated October 2003 and prepared by GEOKEM.

The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed, and updated as necessary, by the consent holder at least once every two years. Any updated Plan shall be promptly forwarded to the Council for approval and following approval the updated Plan shall be implemented in place of the previous version.

In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Settlement, Dewatering and Water Quality Monitoring Plan, then the conditions of this consent shall prevail.

Condition 3 of Schedule 2 – General Conditions attached to the WRC Resource Consents 109742, 109743, 109744, 109745, 109746 and Condition 38 of the LUC and Conditions for the Favona Underground Mine Project granted by Hauraki District Council (No. 85.050.326.E granted in 2004) state the following regarding Monitoring - Tilt:

In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations, installed in accordance with the Settlement, Dewatering and Water Quality Monitoring Plan required pursuant to condition 2 above, or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Council in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then:

1. explain the cause of the non-conformance,
2. agree with the Council on the appropriate settlement contingency measures to be implemented as described,
3. implement settlement contingency measures as appropriate,
4. advise the Council on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

This latter condition is similar to that of Condition 10 (above) for the Martha Mine.

Condition 2 of WRC resource consent number 109742 states the following regarding other water users:

> *"If, in the opinion of the Council, the exercise of the consent adversely affects stock, domestic or other water supplies, then the consent holder shall, at its own cost, be responsible for providing to the owner of those water supplies an alternative equivalent water supply, to the satisfaction of Council. The consent holder shall be responsible for making an alternative water supply available within 12 hours of being directed to do so by the Council."*

Specific conditions relating to the Settlement, Dewatering and Water Quality Monitoring Programme are included in two other WRC consents for the Favona Underground Mine. These conditions relate directly to water quality monitoring as follows.

Resource Consent 109744 authorises the discharge of waste rock and ore onto land in temporary surface stockpiles and to discharge seepage from the temporary stockpiles into the ground. Condition 5 states the following:

> *"In addition to the provisions of conditions 4a) and 4b) above, PAF stockpile site preparation shall include:...*
>
> *(c) Shallow piezometers installed immediately up and down catchment of the stockpile(s) to monitor for leachate in the shallow groundwater system (as detailed in the Settlement, Dewatering & Water Quality Monitoring Plan prepared pursuant to condition 2 of Schedule Two – General Conditions."*

Resource Consent 109745 authorises the discharge of waste rock into land underground in the project area as backfill and to allow degraded quality groundwater to discharge from the flooded workings in the project

area into the surrounding ground post closure. Condition 3 states the following in relation to groundwater quality:

> *"Piezometers shall be installed at sites to be approved by the WRC for the purpose of monitoring changes in groundwater quality arising from the exercise of this consent. The groundwater monitoring system shall be detailed in the Settlement, Dewatering & Water Quality Monitoring Plan, prepared pursuant to condition 2 of Schedule Two – General Conditions."*

2.3 *Trio*

Condition 14 of the HDC Resource Consent RC-15735[1] and Condition 5 of Schedule One – General Conditions attached to the WRC Resource Consents 121416, 121417, 121418, 121446, and 121447 state the following regarding the Settlement, Dewatering and Water Quality Monitoring Plan as it relates to the Trio Development Project:

Prior to (*note: this is specific to the WRC Condition; HDC requires the plan "within 2 months of exercise of the consent"*) the exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system, as proposed in the consent application. The monitoring regime shall be designed to assess the effects of:

(i) dewatering on the regional groundwater system; and

(ii) dewatering on settlement.

(iii) the discharge of degraded quality water from the backfilled and flooded workings on groundwater quality (*note: this third requirement is unique to the WRC Condition* only)

Final details of the monitoring locations are to be agreed with the Council. The Plan shall also provide trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed and updated as necessary by the consent holder. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.

In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

[1] The HDC Trio Underground Mine consent (RC15774) does not have a requirement for a Dewatering and Settlement Monitoring Plan. The requirement for such a Plan is covered under the Trio Development Consent.

2.4 *Correnso*

Conditions 27 to 34 of the HDC Resource Consent RC-202.2012 state the following regarding the Settlement, Dewatering and Water Quality Monitoring Plan as it relates to the Correnso Underground Mine:

The objectives of the groundwater and settlement management system shall be to ensure that dewatering operations do not give rise to surface instability and differential settlement beyond that authorised by this consent.

Within 2 months of the exercise of this consent, the consent holder shall prepare, and submit to the Council/s for written approval, a Dewatering and Settlement Monitoring Plan. The purpose of the Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system set out in Condition 27. The monitoring regime shall be designed to assess the effects of:

a) Dewatering on the regional groundwater system; and

b) Dewatering on settlement.

Monitoring locations are to provide appropriate resolution of groundwater levels and surface tilt relative to the scale of surface infrastructure, particularly in the areas above and adjacent to the mining activities provided for in this consent. Final details are to be agreed with the Council. The Plan shall also provide settlement trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

The exercise of the consent must be in accordance with the Plan as approved by the Council. The Plan shall be reviewed and updated as necessary by the consent holder. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.

In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations installed in accordance with the Dewatering and Settlement Monitoring Plan required pursuant to Condition 28 of the consent, or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Hauraki District and Waikato Regional Councils in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then:

a) Explain the cause of the non-conformance;

b) Propose appropriate settlement contingency measures to the Councils and the timing of implementation thereof by the consent holder;

c) Implement settlement contingency measures as appropriate within the agreed time limit;

d) Advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

The consent holder shall promptly advise the Council of any significant anomalies identified by the regular (monthly) reading of groundwater levels in the piezometer network. Such advice is to include an explanation of the anomalous results and actions proposed to address any issues identified. This report is to be provided to the Council within 10 working days of the anomalous results being identified.

A “significant anomaly” is defined as 15m or more offset occurring in piezometer recordings over a 1 month period.

In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

Advice notes:

1. The Dewatering and Settlement Monitoring Plan shall be consistent with the Dewatering and Settlement Monitoring Plan prepared as a condition of the ground dewatering consent (RC 124860) granted by the Waikato Regional Council.

2. The monitoring undertaken in terms of the Dewatering and Settlement Monitoring Plan may need to be continued for a period beyond the term of this consent depending on recharge of the groundwater following cessation of underground mining activities and the filling of the Martha Pit.

Condition 5 of the WRC Resource Consent 124860 states the following regarding the Settlement, Dewatering and Water Quality Monitoring Plan as it relates to the Golden Link Project Area L:

Dewatering and Settlement Monitoring Plan

5. Prior to the exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

   The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system, as proposed in the consent application. The monitoring regime shall be designed to assess the effects of:

   (i) dewatering on the regional groundwater system; and
   (ii) dewatering on settlement; and
   (iii) the discharge of degraded quality water from the backfilled and flooded workings on groundwater quality.

   Monitoring locations are to provide appropriate resolution of surface tilt relative to the scale of surface infrastructure and final details are to be agreed with the Councils. The Plan shall also provide trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

   The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed and updated as necessary by the consent holder. Such updated Plans shall relate to the Correnso Mine or to any new mine within Area L. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.

   In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

2.5 *SUPA*

Dewatering and Settlement Monitoring Plan

21 The objectives of the groundwater and settlement management system shall be to ensure that dewatering operations do not give rise to surface instability and differential settlement beyond that authorised by this consent.

22 Within 2 months of the exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

23 The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system set out in Condition 21.

The monitoring regime shall be designed to assess the effects of:

a) Dewatering on the regional groundwater system; and

b) Dewatering on settlement.

24 Monitoring locations are to provide appropriate resolution of groundwater levels and surface tilt relative to the scale of surface infrastructure, particularly in the areas above and adjacent to the mining activities provided for in this consent. Final details are to be agreed with the Council. The Plan shall also provide settlement trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

25 The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed and updated as necessary by the consent holder. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.

26 In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations installed in accordance with the Dewatering and Settlement Monitoring Plan required pursuant to Condition 22 of this consent, or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Hauraki District and Waikato Regional Councils in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then:

a) Explain the cause of the non-conformance;

b) Propose appropriate settlement contingency measures to the Councils and the timing of implementation thereof by the consent holder;

c) Implement settlement contingency measures as appropriate within the agreed time limit;

d) Advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

27 The consent holder shall as a matter of urgency, advise the Council of any significant anomalies identified by the regular (monthly) reading of groundwater levels in the piezometer network. Such advice is to include an explanation of the anomalous results and actions proposed to

address any issues identified. This report is to be provided to the Council within 10 working days of the anomalous results being identified.

A "significant anomaly" is defined as 15m or more offset occurring in piezometer recordings over a 1 month period.

28 In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

Advice notes:

1. The Dewatering and Settlement Monitoring Plan shall be consistent with the Dewatering and Settlement Monitoring Plan prepared as a condition of the ground dewatering consent (RC 124860) granted by the Waikato Regional Council and may be prepared in conjunction with similar plans prepared in accordance with the consent conditions applying to the Martha, Favona, Trio and CEPPA projects.

2. The monitoring undertaken in terms of the Dewatering and Settlement Monitoring Plan may need to be continued for a period beyond the term of this consent depending on recharge of the groundwater following cessation of underground mining activities and the filling of the Martha Pit.

Dewatering and Settlement Monitoring Report

29 The consent holder shall provide to the Council an annual Dewatering and Settlement Monitoring Report. The Report shall, as a minimum, provide the following information:

a) The volume of groundwater abstracted;

b) The data from monitoring undertaken during the previous year, including groundwater contour plans (derived from the data) in respect of the piezometer network;

c) An interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions. This analysis shall be undertaken by a party appropriately experienced and qualified to assess the information;

d) Any contingency actions that may have been taken during the year; and

e) Comment on compliance with Conditions 21 to 28 of this consent including any reasons for non-compliance or difficulties in achieving conformance with the conditions of consent.

The report shall be forwarded in a form acceptable to the Council.

Advice note:

The Dewatering and Settlement Monitoring Report shall be consistent with the Dewatering and Settlement Monitoring Report prepared as a condition of the ground dewatering consent (RC 124860) granted by the Waikato Regional Council and may be prepared in conjunction with similar reports prepared in accordance with the consent conditions applying to the Martha, Favona, Trio and CEPPA projects.

2.6 *Project Martha*

Waikato Regional Council Consent

Resource Consent: AUTH139551.01.01 Water Permit - Dewatering Take

CONDITIONS

GENERAL

1 The activities to which this consent relates shall be generally undertaken in accordance with "Project Martha: Applications for Resource Consents and Assessment of Environmental Effects" and associated appendices dated 25 May 2018 and recorded as document number 12546836 on the Waikato Regional Council's document management system, and as identified in the resource consent conditions below which shall prevail in the event of any inconsistency between the aforementioned documentation and the conditions.

2 The consent holder shall notify the Waikato Regional Council in writing at least 10 working days in advance of the first exercise of this consent.

SCHEDULE ONE

3 The consent holder shall comply with the common conditions between the Waikato Regional Council and Hauraki District Council in Schedule One as relevant to the management of the mining and rehabilitation activities authorised by this consent.

DEWATERING LEVEL

4 The exercise of this consent shall not result in groundwater lowering to a level below 500mRL.

MONITORING

5 Upon commencement of this consent, the consent holder shall monitor the volume of water abstracted on a weekly basis and shall report this to the Waikato Regional Council.

6 Upon the first exercise of this consent the consent holder must telemeter – via a telemetry system developed after liaison with the Waikato Regional Council to ensure that the telemetry system is compatible with the Waikato Regional Council telemetry system standards and data protocols – continuous 15 minute values of: gross take volume (in units of cubic metres). The data must be reported once daily to the Waikato Regional Council via the telemetry system. There must be 96 values, respectively, per daily report. When no water is being taken the data must specify the gross take volume and calculated net take volume as zero.

7 The consent holder shall monitor the chemistry of the water abstracted under this consent. Prior to the commencement of this consent the sampling parameters and frequencies shall be agreed with the Waikato Regional Council, with the results forwarded to the Waikato Regional Council on an annual basis. The consent holder may change the sampling parameters and frequencies with the agreement of the Waikato Regional Council.

OTHER WATER USERS

8 If, in the opinion of the Waikato Regional Council, the exercise of this consent adversely affects any existing stock, domestic or other water supplies, then the consent holder shall, at its own cost, be responsible for providing to the owner of those water supplies an alternative equivalent water supply, to the

satisfaction of Waikato Regional Council. The consent holder shall be responsible for making an alternative water supply available within 12 hours of being directed to do so by the Council.

MONITORING OF THE SHALLOW AND DEEP AQUIFERS

9 The consent holder shall upon commencement of this consent and at five yearly intervals thereafter, provide a report to the Waikato Regional Council commenting on the effect the groundwater take and dewatering activity is having on the deep and shallow aquifers under the Martha Pit and immediate surrounds. The report shall as a minimum, provide the following information:

(a) The nature of the geology under the Martha Pit and immediate surrounds;

(b) Comment on the existing groundwater chemistry for the deep and shallow aquifers;

(c) Comment on the groundwater levels in the deep and shallow aquifers; and

(e) Provide details of any wetland areas and any other known aquatic ecological values that are dependent on the surface contribution of shallow and deep groundwater outflows.

Taking into account all of this information (and any other relevant data) the consent holder shall provide comment on the effects the dewatering activity is having on the shallow and deep aquifers under the Martha Pit and immediate surrounds.

ADMINISTRATIVE CHARGES

10 The consent holder shall pay to the Waikato Regional Council any administrative charge fixed in accordance with Section 36 of the Resource Management Act 1991, or any charge prescribed in accordance with regulations made under Section 360 of that Act.

REVIEW OF CONDITIONS

11 Pursuant to Section 128(1)(a)(i) and (iii) of the Act, the Waikato Regional Council may, 12 months from the commencement of this consent and annually thereafter, or on receipt of any of the reports required by this consent, review any or all of the conditions of this consent for the following purposes:

(a) To review the effectiveness of the conditions of this resource consent in avoiding, remedying or mitigating any adverse effects on the environment that may arise from the exercise of this consent, and if necessary to avoid, remedy or mitigate such effects by way of further or amended conditions. In deciding to undertake a review and where further or amended conditions are deemed necessary, the Waikato Regional Council shall have regard to all of the information contained in the reports required under the conditions of this consent; or

(b) To address any adverse effects on the environment which have arisen as a result of the exercise of this consent that were not anticipated at the time of commencement of this consent; or

(c) To review the adequacy of, and the necessity for, any of the monitoring programmes or management plans that are part of the conditions of this consent.

12 Pursuant to Section 128(1)(a)(i) and (iii) of the Act, the Waikato Regional Council may review Conditions 41 to 46 in Schedule One of this consent following any change made to the Trust Deed referred to in Condition 41 of Schedule One.

SCHEDULE ONE

COMMON CONDITIONS BETWEEN THE HAURAKI DISTRICT COUNCIL AND THE WAIKATO REGIONAL COUNCIL

DEWATERING AND SETTLEMENT MONITORING PLAN

14. The objectives of the groundwater and settlement management system shall be to ensure that dewatering operations do not give rise to surface instability and differential settlement beyond that authorised by this consent.

15. Two months prior to dewatering below 700 m RL (mine datum), the consent holder shall prepare, and submit to the Councils for its certification, a Dewatering and Settlement Monitoring Plan. The purpose of the Dewatering and Settlement Monitoring Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

16. The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system set out in Condition 14 of this schedule. The monitoring regime shall be designed to assess the effects of:

    Dewatering on the regional groundwater system; and

    Dewatering on settlement.

17. Monitoring locations are to provide appropriate resolution of mine inflows and pumping, groundwater levels (both for shallow and deep aquifers) and ground surface tilt relative to the scale of surface infrastructure, throughout the area within the maximum extent of the groundwater cone of depression and particularly in the areas above and adjacent to the mining activities provided for in this consent. Final details are to be agreed with the Councils but are to include additional piezometers and extensometers located along the line of upper level workings in the Rex Orebody. The Dewatering and Settlement Monitoring Plan shall also provide groundwater and settlement trigger limits that will initiate the implementation of contingency mitigation and / or monitoring measures and shall detail any linkages with the operation of the Martha Pit and Martha Underground Mine.

18. The exercise of this consent shall be in accordance with the Dewatering and Settlement Monitoring Plan as certified by the Councils. The Dewatering and Settlement Monitoring Plan shall be reviewed and updated as necessary by the consent holder. Any updated Dewatering and Settlement Monitoring Plan shall be promptly forwarded to the Councils for certification, and following this process, the updated plan shall be implemented in place of the previous version.

19. In the event that a tilt greater 1 in 1,000 occurs between any two network monitoring locations installed in accordance with the Dewatering and Settlement Monitoring Plan required pursuant to Condition 15 of this schedule, or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Councils in writing within 20 working days of receiving the results of the monitoring. The consent holder shall then:
    a) Explain the cause of the non-conformance;
    b) Propose appropriate settlement contingency measures to the Councils and the timing of implementation thereof by the consent holder;
    c) Implement settlement contingency measures as appropriate within the agreed time limit; and

d) Advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

20. The consent holder shall as a matter of urgency, advise the Councils of any significant anomalies identified by the regular reading of groundwater levels in the piezometer network. Such advice is to include an explanation of the anomalous results and actions proposed to address any issues identified. This report is to be provided to the Councils within 10 working days of the anomalous results being identified.

    A "significant anomaly" is defined as a drop in groundwater level greater than the seasonal variation in piezometers within the alluvium and younger volcanic rocks and a drop of 15 m or more in the recordings from piezometers tapping the upper 50 m of Andesite over a one month period.

21. In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

    Advice Note:

    The monitoring undertaken in terms of the Dewatering and Settlement Monitoring Plan may need to be continued for a period beyond the term of this consent depending on recharge of the groundwater following cessation of underground mining activities and filling of the Martha Pit.

DEWATERING AND SETTLEMENT MONITORING REPORT

22. The consent holder shall provide to the Councils (within one month of an agreed anniversary date) an annual Dewatering and Settlement Monitoring Report. The report shall, as a minimum, provide the following information:

    a) The volume of groundwater abstracted;
    b) The data from monitoring undertaken during the previous year, including groundwater contour plans (derived from the data) in respect of the piezometer network;
    c) An interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of the future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions, this analysis shall be undertaken by a party appropriately experienced and qualified to assess the information;
    d) Any contingency actions that may have been taken during the year; and
    e) Comment on compliance with Conditions 14 to 21 of this schedule including any reasons for non-compliance or difficulties in achieving conformance with the conditions of consent.
    f) The report shall be forwarded in a form acceptable to Councils.

PROJECT MARTHA LAND USE CONSENT FOR MARTHA UNDERGROUND MINE (LUC 202.2018.00000857.001)

71 (c). No stoping in the Rex Orebody shall occur above a depth of at least 40m below the top of the andesite, unless investigations reported to the Council demonstrate to its satisfaction that a lesser depth will ensure surface stability. Any such investigation report is to include, at least, results from groundwater monitoring above the Rex workings, results from extensometers installed from the surface above the Rex workings, and surface settlement results from markers in the area above the Rex Orebody.

OceanaGold intends to mine higher in the Rex orebody. A hydrogeological assessment (Appendix F) was conducted by GWS Ltd. They found that "dewatering of the water table at the surface is generally noted not to occur as a result of mine underdrainage. Deep dewatering has not, therefore, resulted in near surface effects nor ground settlement beyond that expected beyond the consented envelope."

Additional monitoring is proposed (Section 6.3.3).

3.0 MONITORING PLAN OBJECTIVES

3.1 *General Objectives*

The objectives of this Dewatering and Settlement Monitoring Plan are to:

- Outline the monitoring systems in place for dewatering, groundwater and settlement and the requirements for these systems in accordance with the relevant consent conditions.
- Identify trigger limits that will indicate when contingency mitigation and/or monitoring may be necessary;
- Identify what contingency mitigation and/or monitoring would be undertaken in the event that the trigger levels are exceeded, in order to ensure that adverse environmental effects are avoided, remedied or mitigated.

3.2 *Specific Objectives*

3.2.1 Dewatering Objectives

The objectives of the dewatering monitoring are to:

- Provide data on the dewatering level at the Martha Pit groundwater pumping site so that the drawdown profile can be developed as required by Condition 3.30 (h) of the LUC 97 / 98-105, Condition 13 (c) of Water Permit 971286, Condition 15 of LUC RC-15735 and Condition 6 (Schedule One) of RC 121446.
- Measure and record the daily volume of water pumped from the Martha pit as required under Condition 3.30 (d) of the LUC 97 / 98-105, Condition 7 of Water Permit 971286 and Condition 15(i) of RC-15735.
- Measure and record the daily volume of water pumped from the Favona underground required under Consent 109742, Condition 3.
- Provide data on water chemistry and pit wall run-off chemistry at the Martha pit as required by Condition 11 of Water Permit 971286.
- Provide data on the water chemistry of dewatering water from the underground.

3.2.2 Groundwater Objectives

The objectives of the groundwater monitoring system are to:

- Monitor the effects on the regional groundwater system from dewatering the Martha Pit, Trio, Favona and Correnso/SUPA Underground.
- Monitor the leachate from the Favona Ore and Polishing Pond stockpiles containing potentially acid forming material on shallow groundwater quality.
- Monitor the discharge of degraded quality water from the Underground backfilled and flooded workings on groundwater quality.

If analysis of the groundwater level data identifies that the magnitude of dewatering is likely to lead to settlement under Waihi Township that is greater than that given in Table 1, or the yield from a water supply bore is adversely affected by mine dewatering, then steps are to be taken by OGNZL to limit, or mitigate, the effects to an acceptable level.

3.2.3 Settlement Objectives

The primary objective of the Waihi Township settlement monitoring is to:

- Measure the magnitude of ground surface settlement that results from dewatering and mining the Martha, Trio, Favona and Correnso/SUPA operations.

If analysis of the settlement data identifies that a structure or service may be damaged by mine activities, steps are to be taken to limit or mitigate the adverse effects to an acceptable level.

4.0 RESPONSIBILITIES

4.1 *General Manager*

- Ensure that resources are available to meet the Dewatering and Settlement consent conditions and monitoring as outlined in the Dewatering and Settlement Monitoring Plan.

4.2 *Sustainability Manager*

- Ensure that dewatering, groundwater and settlement monitoring is carried out according to the relevant consent conditions and as outlined in this Dewatering and Settlement Monitoring Plan.
- Ensure that dewatering and settlement reports are produced and supplied to regulators on time as indicated in this Dewatering and Settlement Monitoring Plan.
- Ensure that dewatering, groundwater and settlement monitoring data are reviewed according to this Dewatering and Settlement Monitoring Plan, and contingency and mitigation plans implemented as required.

4.3 *Processing Superintendent*

- Ensure dewatering flows are monitored daily according to this Dewatering and Settlement Monitoring Plan.

4.4 *TSF Engineer*

- Ensure resources are available to complete the 6-monthly settlement surveys as outlined in this Dewatering and Settlement Monitoring Plan.

5.0 DEWATERING MONITORING

5.1 *Background*

Dewatering of the Martha Pit prior to Trio was carried out to maintain pit water levels as close as possible to the 880mRL level (± 20m) so that mining could continue and to minimize any wetting/drying cycle in the historical mine workings.

The close relationship between the Martha and Trio groundwater systems has implications for dewatering for the Trio Underground; to access the lower Trio system, the Martha system had to be lowered further. The Martha/Trio/Correnso/SUPA groundwater system was progressively lowered from 880mRL to 795mRL by the 3 dewatering wells in the Edwards Stope. After the slip in Martha, access to the pumps was severely restricted. Dewatering in Martha ceased May 5th, 2015. On May 18th 2015 dewatering began from Correnso Underground.

Correnso dewatering is conducted by draining groundwater into sumps and pumping to the surface via mono-pumps. The Project Martha dewatering consent, which allows dewatering to no lower than 500 mRL, was activated January 1^{st,} 2020. Water levels are being lowered using dewatering bores drilled from the 800 mRL level (Figure 2).

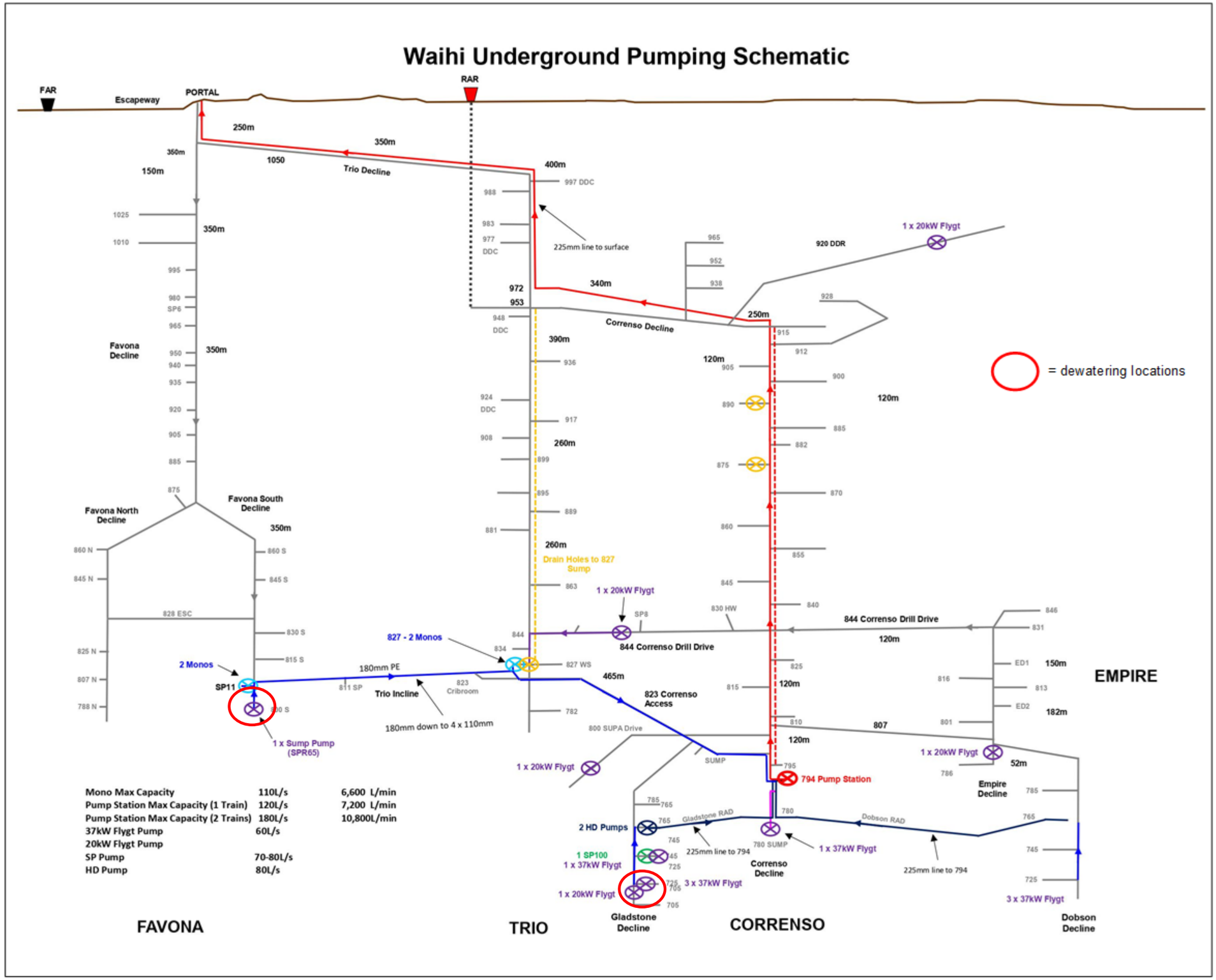

Figure 1: Underground pumping schematic December 2022

NB: Red circles indicate additional underground water quality and level sampling points

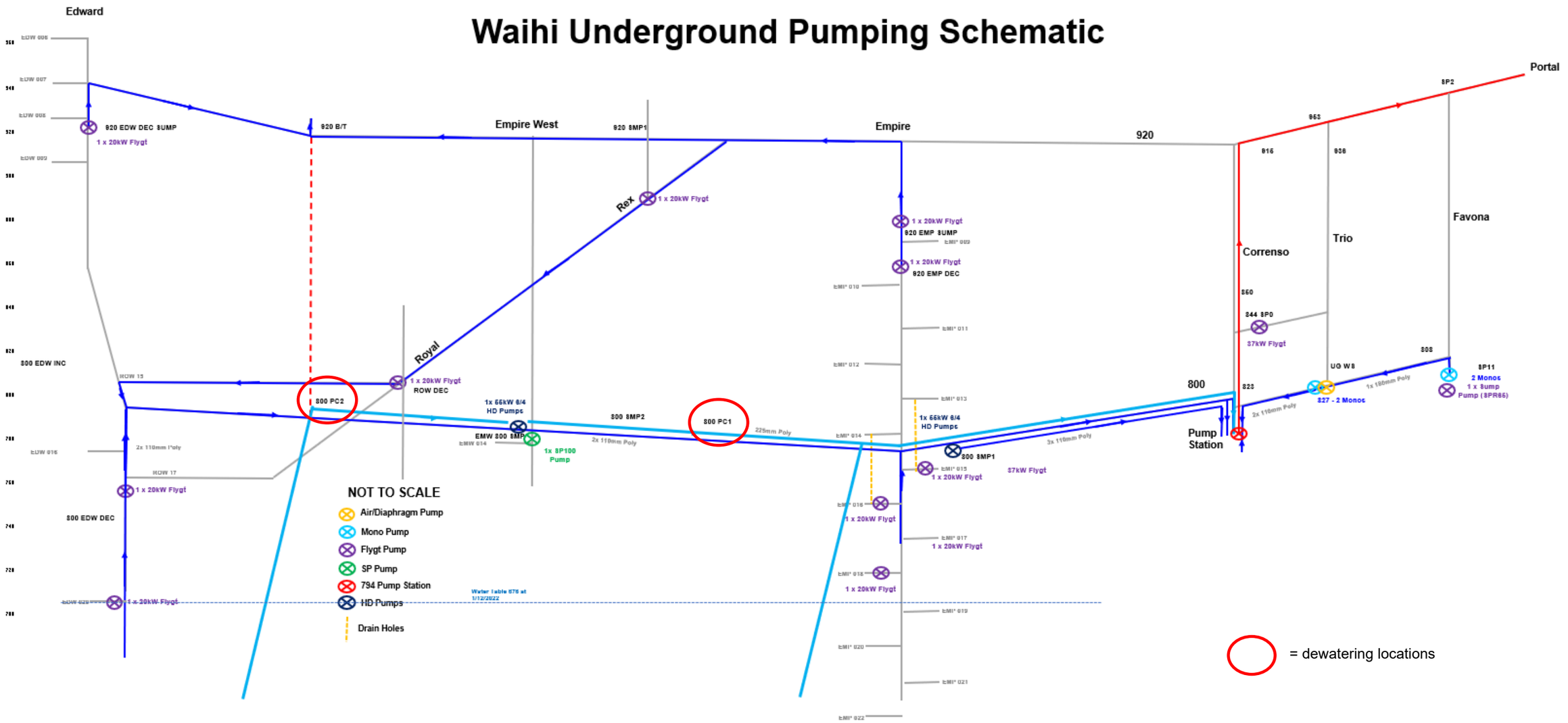

Figure 2: Martha Underground Pumping Schematic December 2022

Dewatering of the Favona mine has resulted in changes in water pressures in the rock surrounding the vein system and induced some minor surface settlement above and immediately adjacent to the vein system. Monitoring is undertaken to verify the effects predicted in the Assessment of Environmental Effects and supporting technical documents that accompanied the applications for the Favona mine consents.

The WTP will treat the dewatering water from Martha, Favona, Trio, Correnso/SUPA and Project Martha to within compliance specifications and discharges the treated water into the Ohinemuri River under consent conditions 971318, 971319 and 971320.

5.2 *Scope*

This section of the monitoring plan covers:

- Location and method of measuring daily pump volume at the Underground.
- Location and method of dewatering water sampling for chemistry analysis.
- Measurement frequencies.
- Data recording and storage.
- Reporting.

5.3 *Martha Pit Groundwater Level Monitoring*

5.3.1 Location

Pit groundwater levels are currently not monitored due to pit access and electrical issues. Dewatering now occurs from Martha underground.

5.3.2 Method and Frequency of Measurement

Martha underground groundwater levels are measured using water level probes established in the dewatering bores drilled in the 800mRL drive. Levels are frequently downloaded from the probes and dipper calibrated to ensure accuracy.

5.3.3 Further dewatering

As dewatering advances, it is expected that new bores will be drilled to achieve target depths. Current groundwater take permit 139551 allows dewatering from 700mRL to 500 mRL.

5.4 *Underground and Favona Dewatering Volume Measurement*

5.4.1 Locations

Dewatering volumes for underground are monitored at the WTP on the automated Pi system. Totalising flow meters (Figure 3) are located at dewatering outflow pipelines from the underground portal. An additional flow meter is installed on the Favona line which provides data specific to the Favona mine.

In addition to Pi, data is accessible via a web portal. Condition 6 of WRC AUTH139551.01.01 requires installation of a telemetry system on the dewatering take. Daily data provision is presented in 15-minute totals from both the Favona mine and total underground water take.

Figure 3: Dewatering totalising flow meter

5.4.2 Method and Frequency of Measurement

Dewatering water pumped to the surface from the underground operations are a combination of groundwater and service water (treated water pumped into the mine). The volume of treated service water pumped into the mine is subtracted from the total amount of water pumped from underground to give a net dewatering volume.

5.4.3 Data Management

Meter readings from SCADA are recorded on an Access database daily and values compared with previous readings to identify anomalies. Where an anomaly is identified, the data sheets are to be checked and operations personnel consulted. If the anomaly persists, the meters are to be checked for accuracy.

5.5 *Dewatering Water Chemistry Monitoring*

5.5.1 Background

Dewatering water from the underground contains a mixture of groundwater, sediment, sulphide oxidation by-products and service water. As described above, dewatering water is treated through the WTP prior to discharge.

5.5.2 Location

Martha/Favona/Trio/Correnso/SUPA dewatering water (Type 3 water) from the underground dewatering well is sampled for chemistry from a water sampling spigot on the inflow pipeline to the WTP (Figure 4).

Sampling is undertaken monthly according to the relevant sections of the Groundwater Monitoring Standard Operating Procedure (SOP) (WAI-200-PRO-012) provided in Appendix B.

Where possible, quarterly water samples are taken from the Favona mine, the bottom level of the Correnso mine and the Martha Underground dewatering bores. Results are presented in the annual Dewatering and Settlement Monitoring Report.

Figure 4: Underground dewatering sample spigot

5.5.3 Sampling Parameters and Frequency

The frequency of monitoring and parameters sampled are shown in Table 2. The number of water chemistry parameters analysed are greater than the requirements outlined in the consent conditions (Appendix A).

Table 2: Underground Dewatering Sampling Parameters and Frequency

Monthly Code 27 (RJH)		
Temp - Field	Ag	K
pH - Field	Au	Mg
EC - Field	As	Mn
Alk	Ca	TKN
Acidity	Cd	Na
Hard	Cu	Ni
HCO3	Cl	P
Ammonia	CN Total	Pb
Ammonium - N	CN Wad	Sb
NO2	Co	Se
NO3	Cr	Si
(NO3 + NO2)	Cr (VI)	Zn
SO4	Fe	COD
Al	Hg	TSS
		DRP

5.6 *Pit Water Quality Monitoring*

5.6.1 Background

Pit water quality monitoring is no longer required under Project Martha Water Take permit 139551. Pit wall runoff sampling had previously been conducted quarterly from four surface sumps on benches above the lake level (1104 mRL). From September 2004 a comprehensive monitoring regime was implemented that focused on rain events. Four additional collection sites were installed to collect runoff from below the 1000 mRL. Over 72 samples of runoff from areas of un-oxidised batters were collected and a comprehensive suite of water quality parameters analysed by RJ Hill laboratories.

OGNZL geochemistry advisors AECOM have recommended sampling to recommence when final pit walls are established after MOP4 or MOP5 (if approved).

5.7 *Dewatering Reporting*

A summary of Pit water levels were included in the annual summary of monitoring, however pit levels are no longer available. Currently water levels in the underground are recorded in Favona and the deepest point of Correnso, A summary of the underground daily dewatering pumping volumes are provided quarterly to the WRC.

Pit water chemistry data is stored for use for pit lake quality assessment and data tables are provided in annual reports. Periodic analysis of data is conducted by AECOM. Any significant trends identified in the dewatering water chemistry will be commented on in the annual Dewatering and Settlement Monitoring Report.

6.0 GROUNDWATER MONITORING

6.1 *Background*

Piezometers are used to measure the level of the groundwater table within a geologic unit and can be used to monitor groundwater chemistry. Standpipes can measure water level, and if large enough diameter, sample water for chemistry analysis. Pneumatic and vibrating wire piezometers only measure groundwater levels. A piezometer network (Network 1) has been established, maintained and monitored at monthly intervals around the Waihi Township and Martha Pit since 1987 and Favona Underground since 2004. This

network is periodically amended as additional monitoring locations are added, or as damaged monitoring locations are repaired or decommissioned. The water levels in the piezometers are monitored to assess the effects of dewatering on the regional groundwater system.

The Favona piezometer network has been designed to monitor groundwater levels in surface soils, younger volcanics (ignimbrites and rhyolitic tephras) where present and andesite bed rock. Monitoring to date has shown some depressurisation of wells in the vein systems and lesser depressurisation in the deeper wells in the bedrock (100 m deep wells). There is no indication of dewatering in shallower wells (<50 m deep) in the bedrock.

The incline from Favona Underground to the Trio system had minor groundwater inflows, which were managed by linking into the existing Favona pumping network.

The Network 2 piezometer network has been established surrounding the Favona Stockpile and the Polishing Pond Stockpile and associated collection ponds, to detect seepage and any potential impact on the shallow groundwater system.

Network 3 has been established surrounding the Favona underground to detect the discharge of degraded quality water from the backfilled and flooded workings, during operation and following closure.

Network 4 has been established for the development of Correnso/SUPA and Martha Underground. Vibrating wire piezometers were installed at six locations (between 3-4 piezometers at each location) at Waihi East in 2011. Three additional wells and piezometers were installed in 2014-2016. In 2017 a new well, P106, was drilled on the north western side of Martha Pit (Figure 6). In 2019/2020 ten new monitoring wells were installed on the southern side of Martha Pit to provide better understanding for Project Martha. Additionally, in 2020, three new piezometers were installed near Gladstone Hill, GLD 004 S, I and D (shallow, intermediate, deep).

6.2 *Scope*

This section of the monitoring plan includes:

- Locations of all piezometers within Networks 1, 2, 3 & 4.
- Piezometer monitoring methods and procedures.
- A description of monitoring frequencies.
- A description of piezometer network maintenance.
- Trigger limits and mitigation measures for piezometers (Networks 1, 2, 3 & 4).
- Guides for recording and managing data.
- Guides for reporting of the piezometer level data.
- Guides for the assessment of the piezometer level data.
- A description of the remediation and mitigation plan.

Table 3: Piezometers Currently Monitored

ALLUVIUM				
Well ID	**Depth (mRL)**	**2022 GWL (m RL)**	**Water Depth (m)**	**Type**
P2-4	1101	1108	7	Standpipe
P8-4	1113	1119	6	Standpipe
P63-S*	1113	1117	4	Standpipe
P76-S*	1109	1112	3	Standpipe
P77-S*	1110	1115	5	Standpipe
P87-S	1110	1115	5	Standpipe
P91-1	1113	1120	7	VWP
P93-1	1105	1116	11	VWP
P94-1	1114	1115	1	VWP
P101-1	1102	1109	7	VWP
P102-1	1108	1114	6	VWP
WC201-4	1103	1111	8	Standpipe
WC201-5	1109	1111	2	Standpipe
GLD004S	1080	1085	5	Standpipe
YOUNG VOLCANIC				
Well ID	**Depth (mRL)**	**2022 GWL (m RL)**	**Water Depth (m)**	**Type**
P2-3	1073	1092	19	Standpipe
P4-2	1047	1088	41	Standpipe
P7-2	1039	1090	51	Standpipe
P7-3	1080	1090	10	Standpipe
P8-3	1092	1116	24	Standpipe
P27-1	1073	1080	7	Standpipe
P63-I	1070	1090	20	Standpipe
P64-I	1086	1101	15	Standpipe
P76-I	1072	1104	32	Standpipe
P77-I & P77-I2	1045	1099	54	Standpipe
P78-I	1051	1105	54	Standpipe
P79-S	1091	1097	6	Standpipe
P79-I	1061	1093	32	Standpipe
P87-I	1070	1111	41	Standpipe
P90-1	1100	1114	14	VWP
P90-2	1020	1102	82	VWP
P91-2	1097	1118	21	VWP
P91-3	1011	1113	102	VWP
P92-1	1096	1119	23	VWP
P92-2	1000	1108	108	VWP
P93-2	1015	1090	75	VWP
P94-2	1094	1113	19	VWP
P94-3	1016	1101	85	VWP

P95-1	1091	1116	25	VWP
P95-2	1031	1102	71	VWP
P100-1	1066	1080	14	VWP
P100-2	996	1053	57	VWP
P101-2	1083	1099	16	VWP
P101-3	1068	1091	23	VWP
P102-2	1078	1097	19	VWP
P102-3	1054	1093	39	VWP
P107	1089	1111	22	Standpipe
P108	1115	1122	7	Standpipe
P109	1090	1096	6	Standpipe
P110	1097	1105	8	Standpipe
P111-1	1100	1107	7	VWP
P112-1	1058	1058	0	VWP
P113	1063	1062	0	Standpipe
P114	1054	1058	4	Standpipe
P115	1072	1095	23	Standpipe
P116	1045	1092	47	Standpipe
BH6-1	1052	1111	59	Standpipe
BH7	1078	1097	19	Standpipe
BH9-1	1073	1096	23	Standpipe
BH11	1074	1093	19	Standpipe
BH12	1090	1106	16	Standpipe
WC202-3	1090	1110	21	Pneumatic
GLD004I	1065	1087	22	Standpipe
P122-1	1092	1100	8	VWP
P122-2	1060	1060	0	VWP

ANDESITE

Well ID	Depth (mRL)	2022 GWL (m RL)	Water Depth (m)	Type
P2-2	1034	1045	11	Standpipe
P7-1	988	1003	15	Standpipe
P8-1	975	1023	48	Standpipe
P8-2	1044	1124	80	Standpipe
P9-1	1036	1118	82	Standpipe
P69-S	1114	1136	22	Standpipe
P69-D	1063	1091	28	Standpipe
P75	979	1068	89	Standpipe
P76-D	1055	1098	43	Standpipe
P77-D	1031	1098	67	Standpipe
P78-D	1052	1073	21	Standpipe
P79-D	1047	1088	41	Standpipe
P87-D	1024	1102	78	Standpipe
P90-3	982	1086	104	VWP
P91-4	970	1102	132	VWP
P92-3	965	1101	136	VWP

P93-4	974	1039	65	VWP
P94-4	976	992	16	VWP
P95-3	1000	1060	60	VWP
P100-3	981	1046	65	VWP
P100-4	956	989	33	VWP
P101-4	1036	1038	2	VWP
P102-4	1026	1032	6	VWP
P106-1	1100	1100	0	VWP
P106-2	1060	1060	0	VWP
P106-3	1010	1008	0	VWP
P106-4	974	974	0	VWP
P111-2	1088	1088	0	VWP
P111-3	1055	1060	5	VWP
P112-2	1035	1035	0	VWP
P112-3	997	999	2	VWP
BH8	1075	1078	3	Standpipe
WC201-1	1058	1064	6	Pneumatic
WC201-2	1077	1080	3	Pneumatic
WC201-3	1096	1100	4	Pneumatic
WC202-1	1031	1073	42	Pneumatic
GLD004D	1020	1087	67	Standpipe
P122-3	1032	1032	0	VWP
P122-4	932	934	2	VWP
P123-1	1044	1113	69	VWP
P123-2	1004	1007	3	VWP
P123-3	964	972	8	VWP
P123-4	924	926	2	VWP

6.3 *Groundwater Drawdown Network 1*

A piezometer network has been established within the Waihi Township and surrounding the Martha and Favona mines to monitor groundwater drawdown and the effects of dewatering on the regional groundwater system. The connectivity between the Martha Pit, Trio and Correnso/SUPA system allows this same network to effectively monitor the effects of works related to Correnso/SUPA/Martha.

6.3.1 Network 1 Piezometer Locations

The Network 1 piezometers currently monitored within the three main geological units (Alluvium, Younger Volcanics and Andesite) are listed in Table 3 and shown in Figure 6. A listing of all of the piezometers which have been installed is included in Appendix C. The piezometer network has been, and will continue to be, revised following annual reviews to remove piezometers which have gone dry, or are no longer providing accurate data. When rewatering the Martha Pit commences upon cessation of mining, water levels will rise and the currently dry piezometers will be monitored again.

6.3.2 Network 1 Monitoring Method

Network 1 piezometers are made up of a combination of standpipe, pneumatic and vibrating wire piezometers. A flow chart indicating the steps to be followed when measuring the water levels in the piezometer network is shown in Figure 6 and detailed steps are provided in the Township Piezometer Network Monitoring (WAI-200-PRO-021) SOP provided in Appendix B.

6.3.3 Network 1 Monitoring Frequencies

The piezometer network is monitored on a monthly basis. In the event of a rapid, or unusual, change in the groundwater level being detected in a piezometer, the monitoring frequency in that piezometer (and the piezometers immediately adjacent) will be increased to at least weekly. The results of this monitoring are to be continually reviewed by site Environmental staff. Weekly monitoring is discontinued when monitoring indicates that the piezometric level has stabilised.

Upper Rex Mining

Mining higher within the Rex orebody has been proposed by OceanaGold. In consultation with Hauraki District Council additional monitoring and triggers specific to the Rex area are proposed.

GWS Ltd have recommended real time monitoring and telemetry in four existing groundwater wells (Appendix F). As P113 is considered dry, a new deeper well nearby will be drilled to replace it. Three vibrating wire piezometer tips are planned to be installed, dependant on geology. (Figure 5).

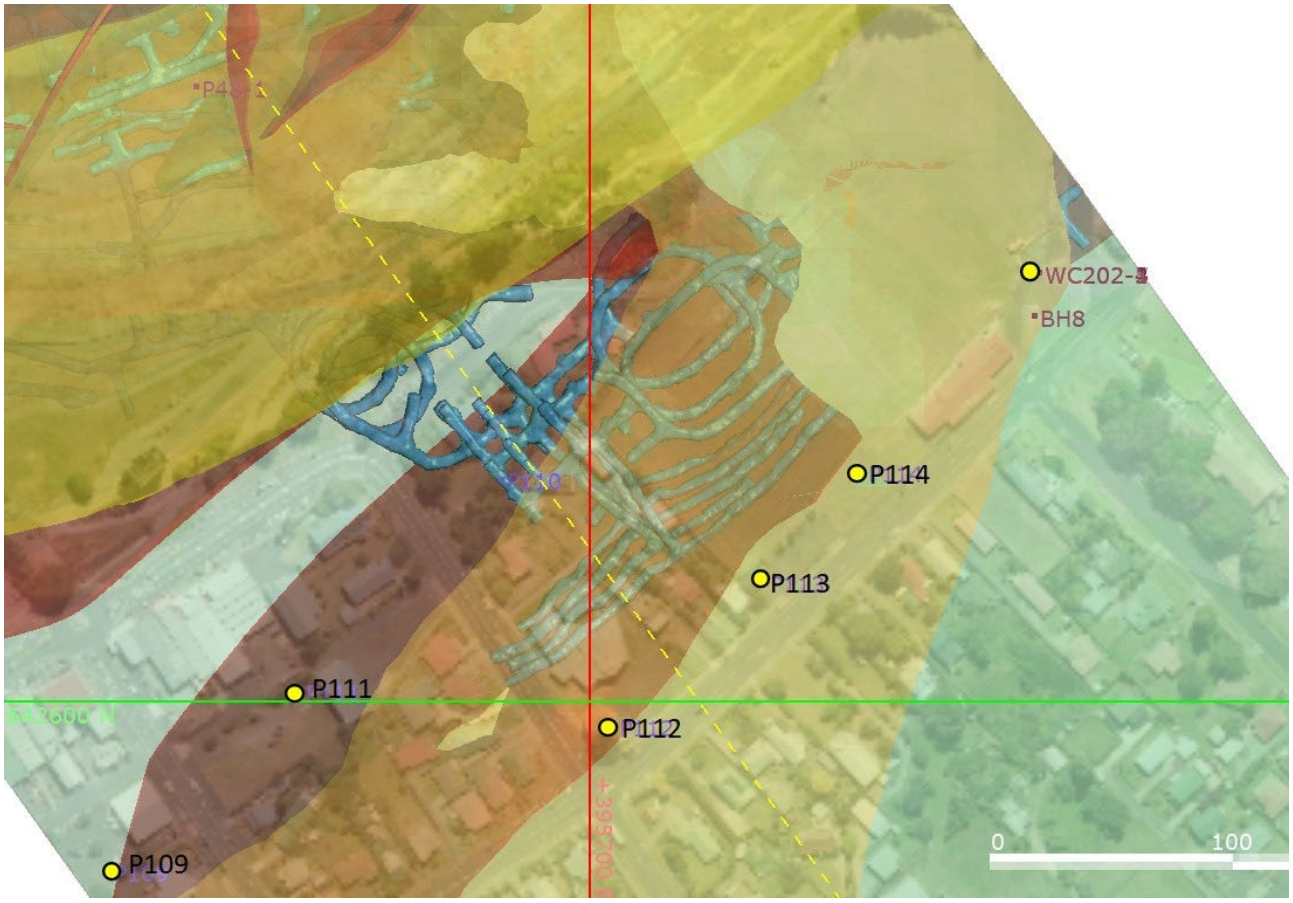

Figure 5: Monitoring wells - Rex

Trigger responses

Trigger responses are proposed at P111, P112, P113 and P114. In most cases, the natural groundwater level in the wells identified varies up to 2.0 m over the period of a season. It is considered a significant anomaly as being >2.0 m change in less than a 1-month period. If a response is triggered, the following actions should be followed:

- Verify that the instruments and data collection is accurate.
- Check that any change is not the result of a recent climatic event.
- Commence daily groundwater level measurements at P109 and WC202-1.
- Cross check the groundwater level data with the geotechnical observations.
- Investigate the cause of the anomaly including any recent underground mining activity.
- Advise the Council of the anomaly (within 5 working days) and include an explanation of the anomalous results and actions proposed to further investigate or address any issues identified (if needed)

When considering a change that might represent a significant anomaly, there should be an emphasis of the depth of the piezometer and geologic unit in which that change is occurring. The primary focus of this monitoring is to ensure effects in the near surface (notably in the Young Volcanics) are avoided, managed or mitigated.

Figure 6: Piezometer Location Plan – showing all Waihi piezometers

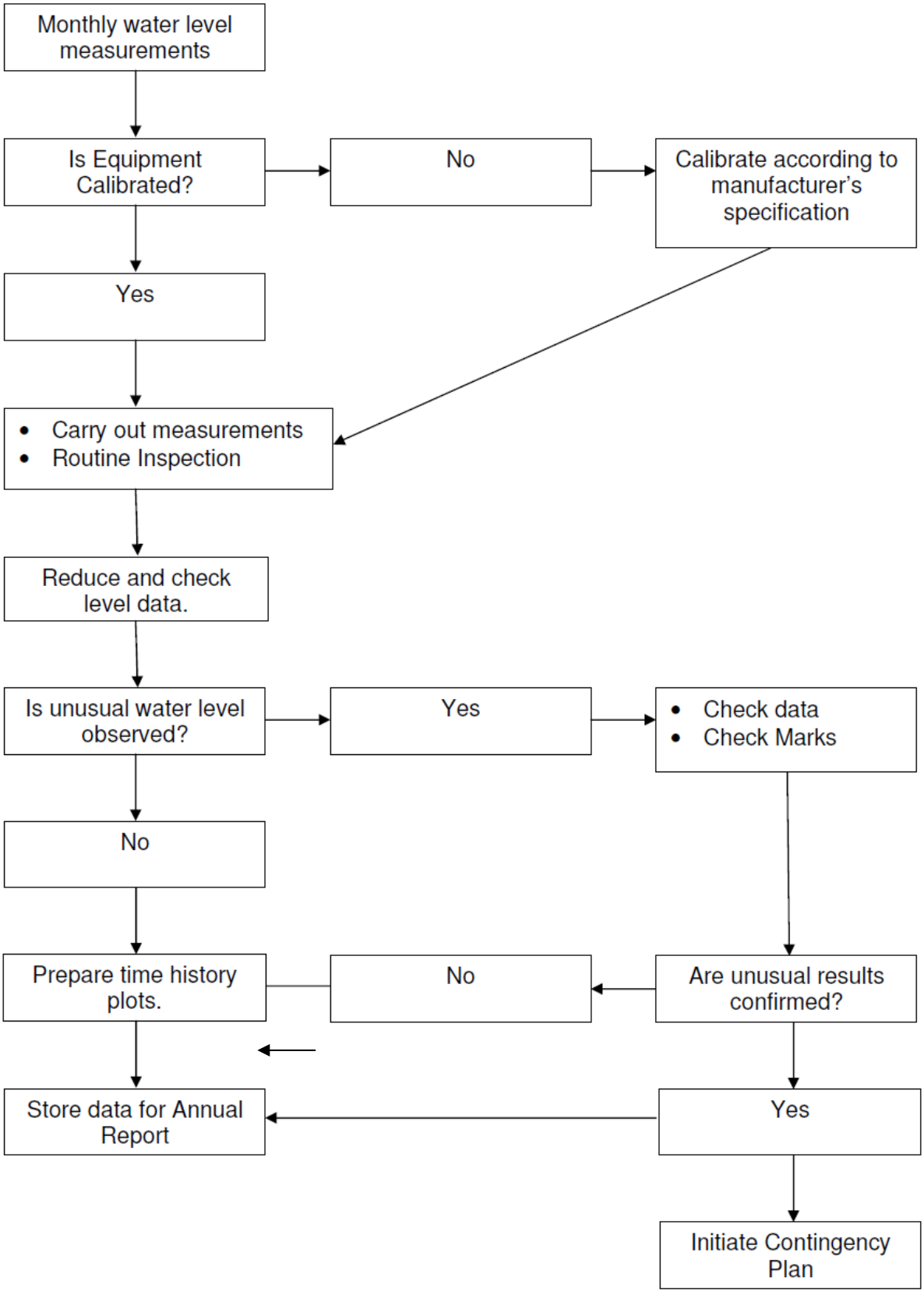

Figure 7: Flow Chart for Monthly Water Level Monitoring

6.4 *Stockpile Seepage Network 2*

The Favona Ore Stockpile and the Polishing Pond Stockpile may temporarily hold PAF material and therefore a network of shallow groundwater monitoring piezometers (Network 2) has been installed up-gradient and down-gradient of both these stockpiles. This network is designed to detect any leachate seepage from these stockpiles into the shallow groundwater system.

Two collection ponds (Favona Stockpile Collection Ponds FSPCP 1 and FSPCP 2) have been built down-gradient of the Polishing Pond Stockpile to retain both storm water runoff and leachate water discharging from beneath the stockpile. A network of leachate drains installed beneath the stockpile direct leachate water to the FSPCP 1 which is pumped to the WTP for treatment. The FSPCP 2 is an overflow pond for FSPCP 1 and stores excess water produced during rainfall events. The combined capacity of both ponds is designed for a 1 in 10 year rainfall event. When water in FSPCP 1 reaches a certain level it overflows to FSPCP 2. After a rain event FSPCP 2 water is pumped back to FSPCP 1 (and from there to the WTP for treatment).

A subsoil drain network is installed beneath the Zone A (low permeability liner) of the Polishing Pond Stockpile and reports to the ZASS manhole. Water from the manhole is pumped to FSPCP 1. FSPCP 1 has a subsoil drain and a surface pontoon that reports to the FSPCP manhole. Water from this manhole is pumped to the WTP.

6.4.1 Network 2 Piezometer Locations

The Favona Ore stockpile network of standpipe piezometers is made up of wells P70, P71 and P72 which are down-gradient of the stockpile. The Polishing Pond stockpile network of piezometers is made up of wells P67, P82, P83, P84, P86, P87 and P89 which are down-gradient of the stockpile and P88 which is up-gradient of the stockpile. Locations of the Network 2 piezometers are shown in Figure 8 and described in Table 4.

Table 4: Stockpile Seepage Detection (Network 2)

Favona Ore Stockpile	Polishing Pond Stockpile
P70 – (Down Gradient)	P67S – (Down Gradient)
P72 – (Down Gradient)	P82 – (Down Gradient)
P99 – (Down Gradient)	P83 – (Down Gradient)
	P84 – (Down Gradient)
	P86 – (Down Gradient)
	P87 – (Down Gradient)
	P88 – (Up Gradient)
	P89 – (Down Gradient)

6.4.2 Network 2 Monitoring Frequencies

The water levels and chemistries of the Network 2 piezometers are monitored 6-monthly. Water quality parameters and monitoring frequencies are described below in Table 5.

The Network 2 piezometers are planned to be monitored for water levels and quality during the operational life of the mine only, with the expectation that all ore will be processed, and waste rock material removed and used for backfill underground. pH and EC trigger values have been set. If these are exceeded, further water quality analysis is undertaken

Once the ore and waste rock has been removed, the source of leachate is gone and the monitoring requirement will become redundant. Monitoring will continue until such time that the site is rehabilitated and approval sought from WRC to discontinue monitoring. Results and analysis of monitoring are published in the Favona Water Quality Monitoring Annual Report. Favona bore data is also included in the Quarterly Water Reports sent to WRC. The majority of these bores are dry or there is insufficient water present to sample.

Table 5: Network 2 Water Quality Sampling Parameters and Frequencies

Groundwater bores		
6 Monthly Field check	**Triggered - Code 40**	
Temp - Field	Temp - Field	Co
Water Level	Water Level	Cr
pH – Field & lab	pH - Lab	F
EC – Field & lab	pH - Field	Fe
	EC - Lab	K
	EC - Field	Mg
	Hard	Mn
	HCO3	Pb
	Total Alk	Hg
	NO2	Na
	NO3	Ni
	(NO3 + NO2)	Sb
	Total Ammoniacal	Se
	SO4	SO4
	Al	Si
	Ag	Ti
	As	U
	Ca	Zn
	Cd	Sum anions
	Cu	Sum cations
	Cl	TSS
	CN WAD	

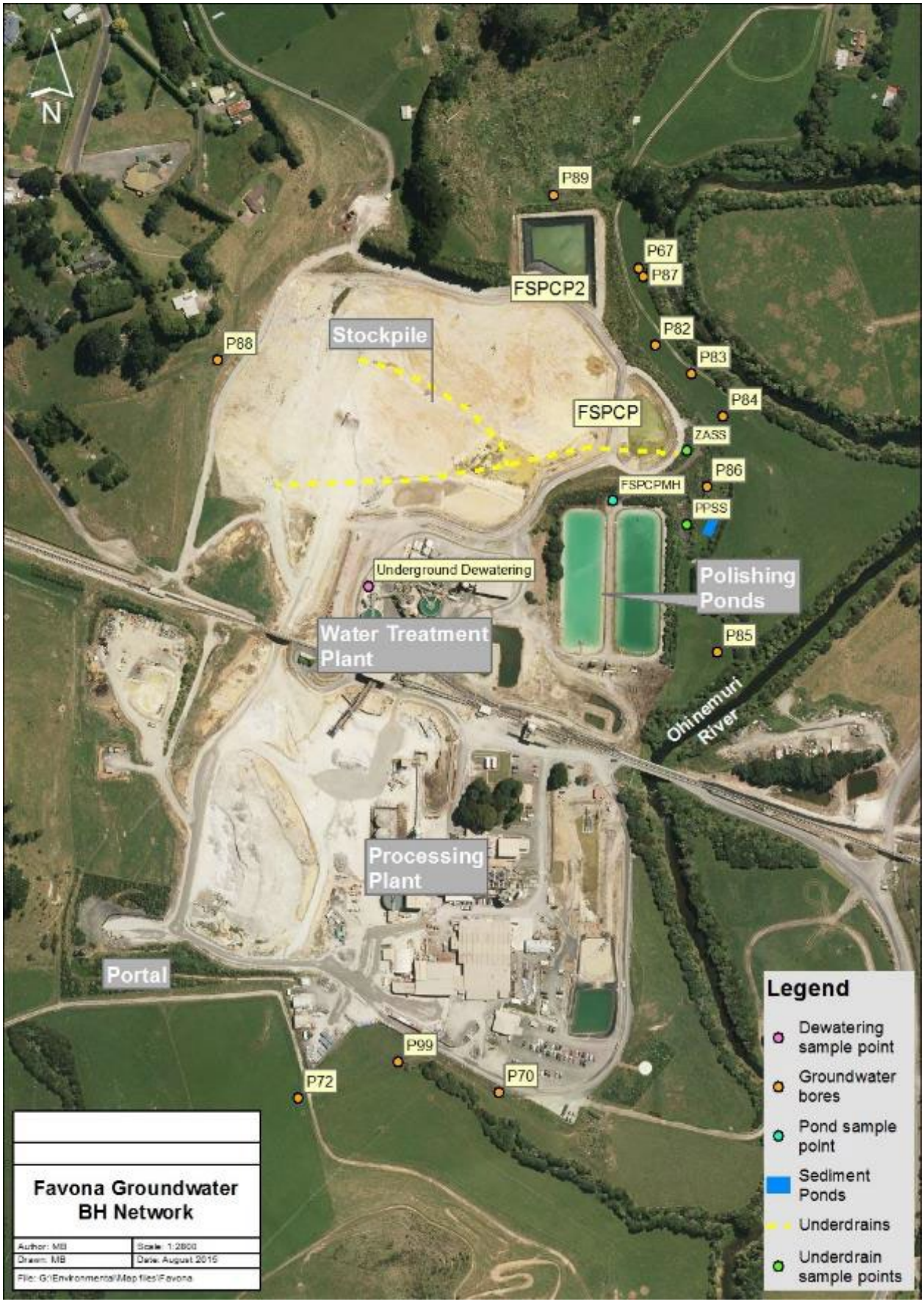

Figure 8: Location of Shallow Groundwater Piezometers (Network 2)

6.5 *Backfilled and Flooded Workings Network 3*

During mine operation, the Martha and Favona mines will be inward gradient sites i.e. groundwater will be moving towards the mine not away from the mine. As a result, there are unlikely to be any water chemistry effects of mine water on the groundwater system outside of the mine during operations. Groundwater from Martha/Trio/SUPA is controlled by Correnso and Martha Underground dewatering; any effect on water chemistry will be drawn at depth and is unlikely to have any expression in shallow groundwater.

Martha and Favona are not directly connected; the amount of groundwater from Favona that will move to Martha is small in relation to the groundwater inflow to the Martha system. With a full mine lake and flooded Favona Mine, the hydraulic gradient between Favona and Martha will be minimal, and the velocity of groundwater movement will be slow. Given the mineralization in the ground around Martha and in the ground between Martha and Favona it is very unlikely that any effect on Martha could be sourced back to Favona.

However, in order to provide an indication of the likely post-closure water chemistry in accordance with the consent conditions, samples of the underground water discharge and discharges from the Polishing Pond stockpile (as detailed in the Site Water Management Plan) will be analysed for later use in an underground geochemical model. In addition, samples will be taken from monitoring wells P76D, P76I, P77D and P77I located between Favona and Martha in order to establish baseline groundwater chemistry for that rock mass, for input to the post-closure model. If the geochemical model for post-closure indicates the possibility of significant movement from Favona towards Martha within a rational time frame, a monitoring regime would be developed.

For Trio, sampling of intercepted inflows and discharges from the Polishing Pond stockpile is undertaken for use in geochemical modelling. Monitoring for post-closure water chemistry from Trio will be addressed as part of the Trio Mine Project; monitoring data from groundwater intercepts, flow gradients and waste rock discharges will be used to model likely flow-paths and mass balances, and the need for monitoring wells. It is expected that the existing wells for monitoring Martha and Favona will provide the majority of monitoring information in relation to future Trio activities.

As Trio, Correnso/SUPA and Martha Underground are accessed from the Favona decline, there is effectively a direct connection between the Favona and Martha systems while Correnso/SUPA and Martha Underground are operating. Prior to any flooding, an option proposed is to construct a bulkhead to plug the preferential pathway.

6.5.1 Network 3 Piezometer Locations

The location of the current Network 3 piezometers is shown in Figure 9 and described below in Table 6.

Table 6: Backfilled and Flooded Workings Piezometers (Network 3)

P76D & P76I	Piezometers near Moore street to monitor groundwater levels in cover materials and upper portion (top 10m) of andesite body to west of indicated fault zone on western side of the Favona structure and south west of P62 and P63.
P77D & P77I	Piezometers adjacent to settlement marker 23B to provide geological data (during installation) and to monitor cover materials and the upper portion of the andesite for dewatering effects.
P64A	Monitoring the Favona vein structure. Piezometer dropped from October 2005 (in response to vein dewatering) until October 2006 when it went dry. Monitoring will be initiated again after mining ceases and water levels recover.
P75	Deep piezometer (up to 150 m) constructed adjacent to the Silverton vein system and workings to monitor groundwater levels in structures connected to the Silverton vein.
P62	Vertical gradient north of the proposed Favona Mine and between mine and town.
P61	Piezometer adjacent to Moore street to monitor groundwater levels to west of indicated fault zone on western side of the Favona structure and south west of P62 and P63.
P79D	Piezometers to the west of Winner Hill to monitor the andesite for effects from the Moonlight vein system.
P67D	Piezometer adjacent to the Favona Stockpile Collection Pond 2 monitoring the water levels at the top of rock adjacent to the Ohinemuri River.

Figure 9: Location of post closure monitoring piezometers (Network 3)

6.5.2 Network 3 Monitoring Method

A flow chart indicating the steps to be followed when measuring the water levels in the piezometer network is shown in Figure 7 and detailed steps are provided in the relevant sections of the Township Piezometer Network Monitoring (WAI-200-PRO-021) SOP provided in Appendix B. Water chemistry is monitored according to the relevant sections of the Groundwater Monitoring (WAI-200-PRO-012) SOP provided in Appendix B.

6.5.3 Network 3 Monitoring Frequencies

The water levels of the Network 3 piezometers are monitored monthly. Water quality sampling will be undertaken to establish background levels. When flooding is initiated, water quality parameters and monitoring frequencies will be the same as that described above in Table 5 for the Network 2 piezometers.

6.6 *Favona Contingency Plan*

In relation to effects, settlement is principally related to depressurisation of the younger volcanics. As a result, groundwater trigger levels and contingency measures in general relate to that unit. Hence, the monitoring focus is to assess whether depressurisation in the deeper andesite is able to extend up into the overlying younger volcanics and if so, whether the magnitude of depressurisation is sufficient to give rise to measurable settlement. The monitoring system and the trigger levels have been developed to that end.

6.6.1 Favona Piezometer Trigger Levels

Favona trigger levels follow the same actions as introduced with the Correnso dewatering consent. These are outlined in Section 6.8.

6.7 *Waihi Network 4*

In 2011, in order to better understand the geology and hydrological system around the predicted Correnso ore body, OGNZL commissioned the drilling and installation of 6 boreholes (P90 – P95) (Figure 10). Three additional piezometers (P100, P101 and P102) were added in 2014-2016. Each borehole contains between 3 and 4 vibrating wire piezometers and a data logger which continuously records data simultaneously from multiple aquifers, with water table depths ranging from 6 – 156 meters. The units log daily, and data is gathered in the field by connecting a laptop computer and downloading. Data gathering and trend analysis is carried out monthly.

Current settlement markers and piezometers (Figure 10) are established in and around the Correnso Extensions Project Area (CEPA)/Waihi East area to monitor any changes in settlement and water levels due to Martha/Trio/SUPA & Correnso dewatering. Further piezometers have been added to the network as discussed in Section 6.3 These provide additional information for the Martha South and Gladstone Hill areas.

Figure 10: Waihi East Vibrating Wire Piezometers and Settlement Markers

An underground operating procedure has also been developed as required in Condition 24 of the Correnso Consent to ensure mining does not drain the overlying strata via existing drill holes. Management of Surface Intersecting Drill Holes (WAI-400-PRO-076) can be found in Appendix B.

Should piezometer levels decrease more than 5m in a month, actions will take place as outlined in Table 7.

6.8 *Piezometer Action Plan*

Condition 20 of the Project Martha Common Conditions states both Councils need to be advised of any significant anomalies in groundwater levels identified in the piezometer network.

A “significant anomaly” is defined as a drop in groundwater level greater than the seasonal variation in piezometers within the alluvium and younger volcanic rocks and a drop of 15 m or more in the recordings from piezometers tapping the upper 50 m of Andesite over a one month period. Such a change would require an explanation to council within 10 working days of the issue being identified.

There is a three-stage set of triggers based upon 5m, 10m or 15m water level changes within 1 month. Some piezometers can have natural 5m changes. Actions consist of monitoring frequency increases, historic data review, increased settlement marker monitoring, visual inspections and expert geotechnical review depending on the degree of water level change discovered (Table 7).

Table 7: Piezometer responses and actions

Piezometer Response/Trigger	**Action**		
	Piezometer Monitoring	**Settlement Monitoring**	**Other Actions**
5 - 10m over 1 month	Commence weekly monitoring	-	Review historical piezometric data and note if has occurred previously.
10 - 15m over 1 month	Commence weekly monitoring	Commence weekly surveys	Undertake review to identify possible causes of change in monitoring. Undertake weekly visual inspections of area.
15m + over 1 month	Commence weekly monitoring	Commence weekly surveys	Notify Hauraki District Council as required by condition 33 of Schedule A Correnso Underground Mine Conditions of Consent.
			Undertake weekly visual inspections of area to identify evidence of settlement or damage.
			Seek independent advice from experienced geotechnical engineer
			Develop action plan to restore groundwater levels (e.g. grouting of potential drainage pathways, injection of water to maintain groundwater level).

6.9 *Groundwater Monitoring Procedures*

6.9.1 Calibration and Maintenance of the Piezometer Measurement Equipment

- Standpipe Piezometer Dipmeter

The piezometer dipmeter is to be maintained in good working condition at all times.

Calibration of the dipmeter tape against a reference tape is to be carried out at least once every twelve months by an accredited provider. If the difference between the dipmeter tape and the reference tape is found to be more than 0.1%, the dipmeter tape is to be replaced.

- Pneumatic Piezometer Readout Unit

The pneumatic piezometer readout unit is calibrated at least once every two years or after a heavy knock. All calibration is undertaken by a manufacturer approved company or service technician and calibration records retained by OGNZL. If there is evidence of unusual behaviour, prolonged flushing of the tubes with inert gas to remove moisture is also an option.

-Vibrating Wire Piezometer Logger Unit

Vibrating wire logger units do not require calibration. The unit's batteries are changed every 9 months to ensure continuity of data.

6.9.2 Collection of the Piezometer Data

- Standpipe Piezometers

Standpipe piezometers are measured according to the Township Piezometer Network Monitoring (WAI-200-PRO-021) SOP provided in Appendix B. Monitoring of standpipe piezometers is carried out by trained personnel. Water level measurements are compared with the previous monthly measurement for consistency. Where a significant difference between a current and previous measurement is noted, the measurement and field record are double checked. If an anomaly still exists the measurement datum is to be confirmed, or re-measured and recorded.

In addition the wells are sounded 6-monthly to determine any sediment build-up. Arrangement can then be made to 'jet out' any identified build-up that is considered to detrimentally affect the function of the piezometer.

- Pneumatic Piezometers

Pneumatic piezometers are to be read according to the Township Piezometer Network Monitoring (WAI-200-PRO-021) SOP provided in Appendix B.

All personnel who take readings of the pneumatic piezometers are trained in the use of the pneumatic piezometer readout unit currently operated by OGNZL. All personnel who take readings of pneumatic piezometers are familiar with the manufacturer's operation and maintenance manual.

All readings taken on the pneumatic piezometers are to be made in accordance with the manufacturer's recommendations. All results are to be immediately checked against the previous month's readings and recorded on a field sheet for future input into a computer database. The measurement and field record are to be double checked before monitoring at each location is completed.

-Vibrating Wire Piezometers

The reading of the logger units is conducted monthly by an OGNZL technician. They visit the sites and download the data manually onto a laptop. The data is then uploaded onto a spreadsheet in the office. All personnel who take readings of the vibrating wire piezometers are trained in the use of the readout unit and laptop.

6.9.3 Routine Network Inspection and Maintenance

A visual inspection of all monitoring locations is undertaken during routine monitoring of the piezometer network. If this inspection indicates that a piezometer is unreliable, damaged or malfunctioning, then steps are taken to repair, relocate, renew or decommission the monitoring site. Ongoing monitoring may be required to determine the fate of the monitoring location.

Alternatively, analysis of the monitoring data may identify a monitoring location that is unreliable or dubious. Re-measurement and a thorough inspection of this monitoring location is undertaken to ascertain the reliability of the data and the monitoring location. Ongoing monitoring may be required to determine the ultimate fate of the monitoring location.

6.9.4 Guide for Recording and Managing Piezometer Data

Once a complete set of data has been collected in the field, it is transferred from the field sheet (for standpipe and pneumatic piezometers) and from a laptop for vibrating wire piezometers to the digital database as soon as practicable (at most within one week of the monitoring round being completed).

The groundwater level data is stored digitally in a Microsoft Excel Database managed and maintained by OGNZL. The water levels are corrected to the mine datum reference level to enable comparison between bores and areas. The field records are kept and filed in the OGNZL office.

6.10 *Reporting Groundwater Monitoring Results*

6.10.1 Ongoing Analysis

Preliminary analyses of the data plots after every monitoring round are undertaken by OGNZL Environmental staff. The purpose of this analysis is to identify if there is a reading/recording error to be re-checked, if unusual dewatering has occurred during the previous monitoring period, or if excessive dewatering that leads to excessive settlement is likely to occur in the immediate future. Unusual or excessive dewatering is a noticeable and sustained change in piezometer groundwater level trend.

Figure 7 shows that if unusual water level changes are observed these are checked and if confirmed, and the contingency plan (Figure 11) initiated.

OGNZL keeps and maintains a log of complaints from the public. If appropriate, OGNZL undertakes field investigations and investigates legitimate mine dewatering and settlement related claims from the public. The complaints log is maintained by the OGNZL Community Liaison Officer.

6.10.2 Annual Summary Analysis and Reporting

A report and summary of the groundwater level data is produced annually and issued to the consenting authorities. This report includes analysis and evaluation of the data by Chartered Professional Engineer or an experienced hydrogeologist. The annual report includes:

a) The data from monitoring undertaken during the previous year including ground water contour plans (derived from the data) in respect of the piezometer network.

b) Identification of any important trends in dewatering/rewatering behaviour.

c) Interpretation and analysis of any change in groundwater profile over the previous year, any contingency actions that may have been taken during the year, predictions of future impacts on other bore users that may arise as a result of any trends that have been identified, and what contingency actions, if any, the consent holder proposes to take in response to those predictions.

d) Comment on compliance with all relevant conditions of the consent.

e) A summary and analysis of complaints relevant to the consent from the complaint log.

f) Any reasons for non-compliance or difficulties in achieving conformance with the consent conditions.

g) Any works that have been undertaken to improve environmental performance or that are proposed to be undertaken in the forthcoming year to improve environmental performance in relation to activities permitted by the consent.

h) Peer review recommendations from the most recent review and reference to how they will or have been addressed

If analysis of the groundwater level data indicates that mine dewatering is likely to result in settlement greater than that in Table 1, a detailed inspection of all settlement susceptible structures within the affected area is to be commissioned by OGNZL. This inspection is to be undertaken by a suitably qualified and experienced Chartered Professional Engineer.

6.11 *Groundwater Remediation and Mitigation*

Figure 11 summarises the actions to be taken in initiating a contingency plan. The plan covers both groundwater level changes related to settlement and effects on wells used by others. Unusual water level changes would include:

- A sharp change in the dewatering trend.
- A rapid rise of water level.
- A loss of yield from a production well accompanied by a reduction in water level.

The contingency plan for groundwater monitoring is similar to that for settlement monitoring namely:

- Monitoring will be increased, and investigations undertaken to confirm whether the effect is due to mine dewatering and to confirm the extent of the effect.
- If adverse effects are likely, the plan requires mitigation options to be developed and agreed by the parties. In the case of settlement, these are as laid out in the contingency plan developed for settlement effects as summarised in Figure 16. In the case of an affected water well, OGNZL has agreements under which it will mitigate effects due to mine dewatering.

Effects on bore users are considered only likely where bores intercept fault zones or veins connected to the Favona system. The locations of the existing wells and monitoring to date would suggest that connections are unlikely or limited. Nevertheless, the Company has agreements in place with some of the local bore owners to replace these water supplies should effects develop and mitigation be necessary. In addition, Condition 2 of Resource Consent 109742 requires action by the Company in the event that stock, domestic or other water supplies are adversely affected by the exercise of the Favona mine dewatering consent.

For water well effects, contingency options may include:

- Upgrading a pump.
- Supplying a different pump.
- Deepening a well.
- Supplying a new well.
- Supplying water from an alternative source.

In the event of groundwater contamination from the stockpiles, the most effective solution would be to install a cut-off drain to intercept the water and pump it to the WTP for treatment. If an observed trend is noted in water levels and/or chemistry, this would initiate further investigation and if necessary result in a report to WRC explaining the cause of the observed trend and proposed mitigation. Stockpiles are planned to be temporary structures and therefore removal of the source material will ultimately stop the contamination.

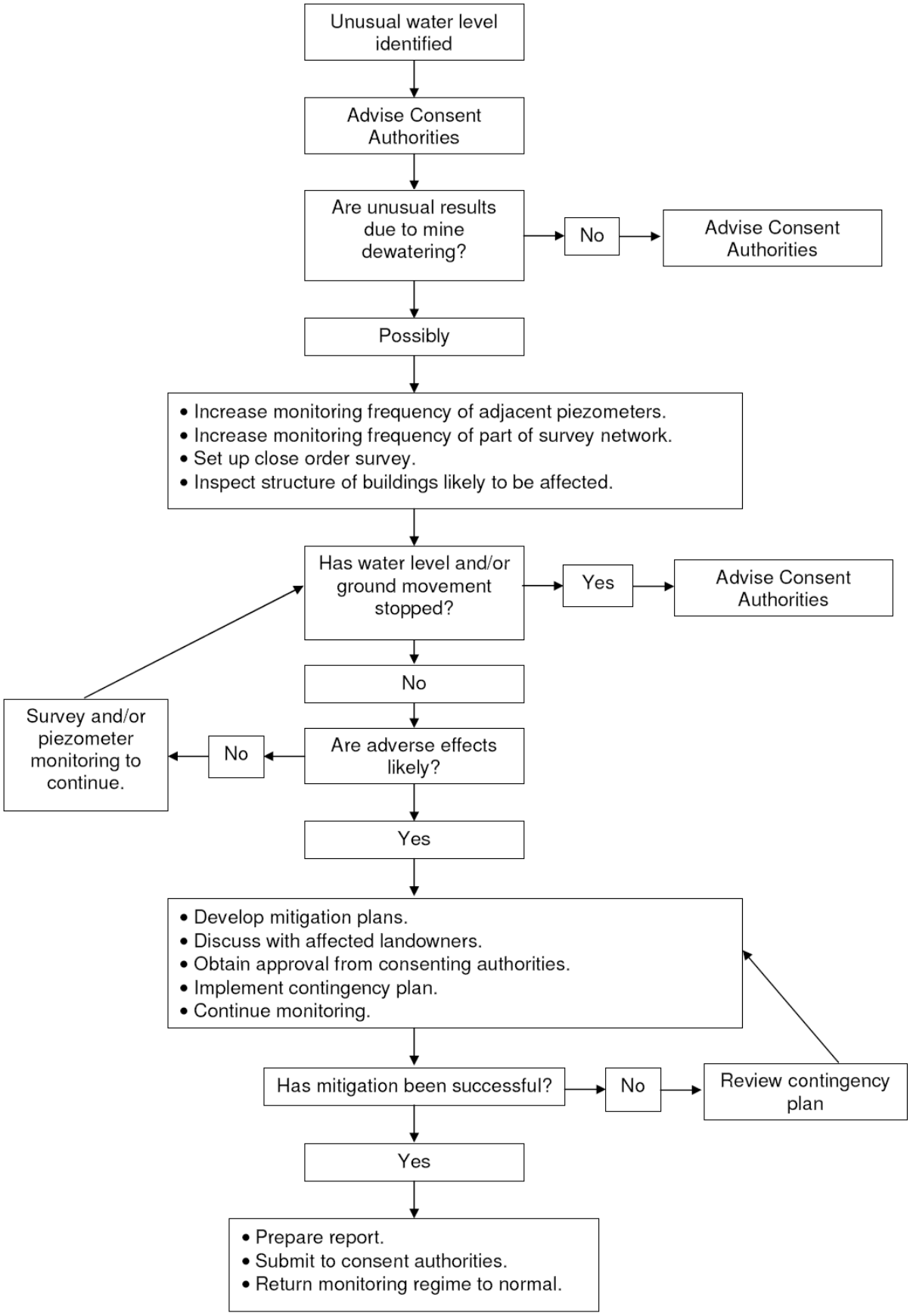

Figure 11: Flow Chart of Water Level Contingency Plan

6.12 *Review and Improvement to the Piezometer Network*

Review of the piezometer network is undertaken routinely to:

- Ensure that all areas presently affected by dewatering from Correnso, Favona and Martha Undergrounds are adequately covered and monitored by piezometers and survey marks.
- Ensure all areas likely to be affected by mine dewatering in the future, including Trio, are adequately covered and monitored by piezometers and survey marks.
- Ensure that all areas likely to be affected by leachate seepage into the shallow groundwater system surrounding the Favona and Polishing Pond stockpiles are adequately covered and monitored by piezometers.
- Ensure that all areas likely to be affected by backfilling of stopes and flooding the underground workings following closure are adequately covered and monitored by piezometers.

At each additional or replacement piezometer drill-hole location, at least one piezometer should be installed within the following geologic units, if present:

- the andesite rocks,
- the younger volcanics, and,
- The upper alluvial unit or weathered rock zone.

The above three geological units are considered to be those of greatest strategic importance from a geotechnical perspective.

6.13 *Shallow and deep aquifers*

A new requirement was included in the Martha dewatering permit 139551.01.02. Condition 9 (e) requests OGNZL *provide details of any wetland areas and any other known aquatic ecological values that are dependent on the surface contribution of shallow and deep groundwater outflows*.

A new report was created in 2019 “Martha Shallow and Deep Aquifer Report” which addresses the requirements of Condition 9 (Appendix E). The report concluded that there are currently no effects as a result of dewatering associated with Project Martha. The report is due to be updated in 2024.

7.0 SETTLEMENT MONITORING

Settlement monitoring involves monitoring, analysing and reporting on the OGNZL network of survey marks that lie within the zone affected by dewatering of the Martha Pit, Trio, Project Martha, Correnso/SUPA and Favona Underground. The current network is monitored by OGNZL at six monthly intervals with surveys in May and November. The initial settlement survey network was established in 1980 during the exploration phase of the project and has been regularly monitored since December 1988. The network is continually amended as additional monitoring locations are added, or damaged monitoring locations are repaired or relocated.

7.1 *Scope of Settlement Monitoring*

The following sections cover:

- Locations of all existing survey monitoring locations.
- Construction details for the survey network benchmarks.
- A description of monitoring frequencies.
- A description of survey network measurement procedures.
- Maintenance of the survey network.
- Guides for recording and managing data.
- Guides for the assessment of the survey data, and,
- Guides for reporting the survey data.
- A description of the remediation and mitigation plan.

7.2 *Survey Network Location*

The location of the survey network within the Waihi Township and surrounding the Martha Pit, Martha Underground, Trio, Correnso/SUPA and Favona Underground is shown in Figure 12. A blown-up view of the Favona settlement marks in relation to the underground workings is shown in Figure 14. The location of the survey network monitoring locations and benchmarks are provided in Appendix D.

Due to the existing network monitoring Martha Pit, and the close association with the Trio system, the requirement for additional settlement marks for Trio was not considered necessary. The existing network of settlement marks is extensive, and the dewatering associated with Trio is not expected to result in a significant increase in the zone of influence of dewatering and therefore zone of settlements. However, if there was an increase in the zone of influence it would be expected to be identified by the current settlement monitoring network and additional settlement marks could then be installed if there were concerns with any structures beyond the limits of the current monitoring network.

The existing survey network as shown in Figure 12 essentially covers the whole of the urban area. Extensions to the northeast and west take the network beyond the range of settlement induced by mine dewatering.

HDC and WRC have approved removal of erroneous and high-density marks outlined in a GWS review (GWS Tech Memo – Settlement Mark Removal 15.1.2021). A number of marks displayed unusual movement unrelated to dewatering settlement and some marks were deemed too close together to provide meaningful data.

Additional survey marks were required with the development of Correnso (refer Figure 10), in recognition of operating under a residential area. These were recommended by Consulting Geotechnical Engineers (for both OGNZL and HDC) to provide closer definition of settlement and any potential tilt.

7.3 *Close-Order Networks*

A number of close-order survey networks had been established within the urban area to assess, in detail, effects on specific properties. These close-order surveys are no longer undertaken, having achieved their objectives. But a number of markers, which were constructed as deep and shallow pairs to highlight seasonal shrink-swell, are incorporated into the 6-monthly survey network.

The settlement markers established for the Favona Underground project are spaced at approximately 50 metre centres, but as the lines cross the decline the survey marks close up to 10 metre centres.

No close order networks are in place for Trio. Unlike Favona, the area has been historically dewatered, and the system is already significantly dewatered from the existing Martha Pit. Further dewatering is forecast to be restricted to the andesite rock mass and is expected to have less than minor effects on differential settlements (or tilt) which are normally the concern for buildings and buried services. If the existing broader settlement network indicates any anomaly, close order networks can be subsequently installed for investigation.

7.4 *Settlement Monitoring Frequency*

Six monthly settlement surveys are conducted during May/June and November/December. Tilt summaries are reported to the Councils no later than 20 working days after results become available following each survey. An annual Dewatering and Settlement Report is provided to the Councils in each year.

Following closure and flooding of the Favona Underground, Martha Pit, Trio, Correnso/SUPA and Martha Undergrounds it is expected that OGNZL will continue settlement monitoring on an annual basis for a period of five years or until rebound (groundwater recovery) is completed.

7.5 *Settlement Monitoring Procedure*

Figure 15 sets out the procedure to be followed for settlement monitoring. Features of that monitoring procedure are set out below.

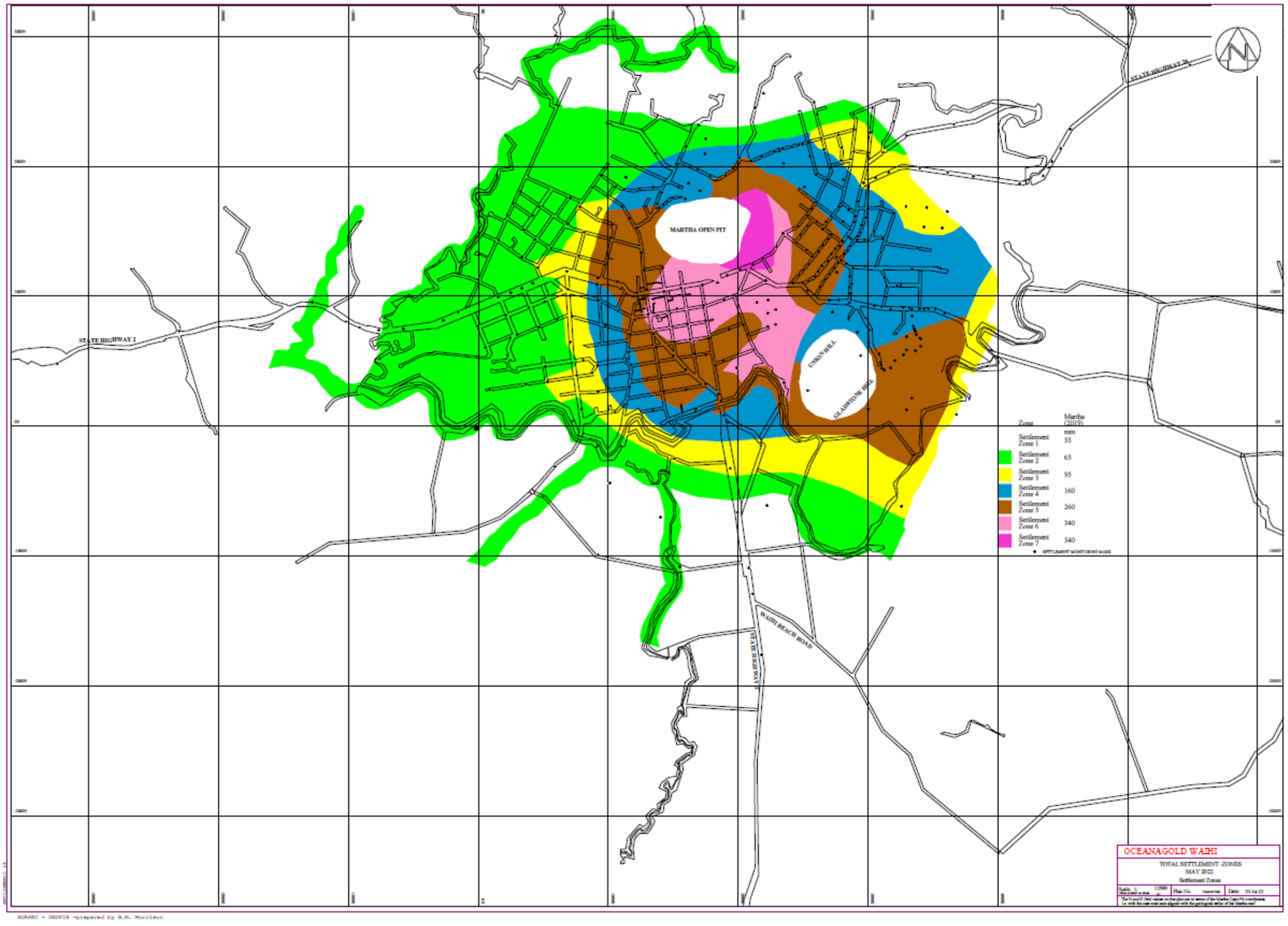

Figure 12: Location of Settlement Markers within the seven settlement zones

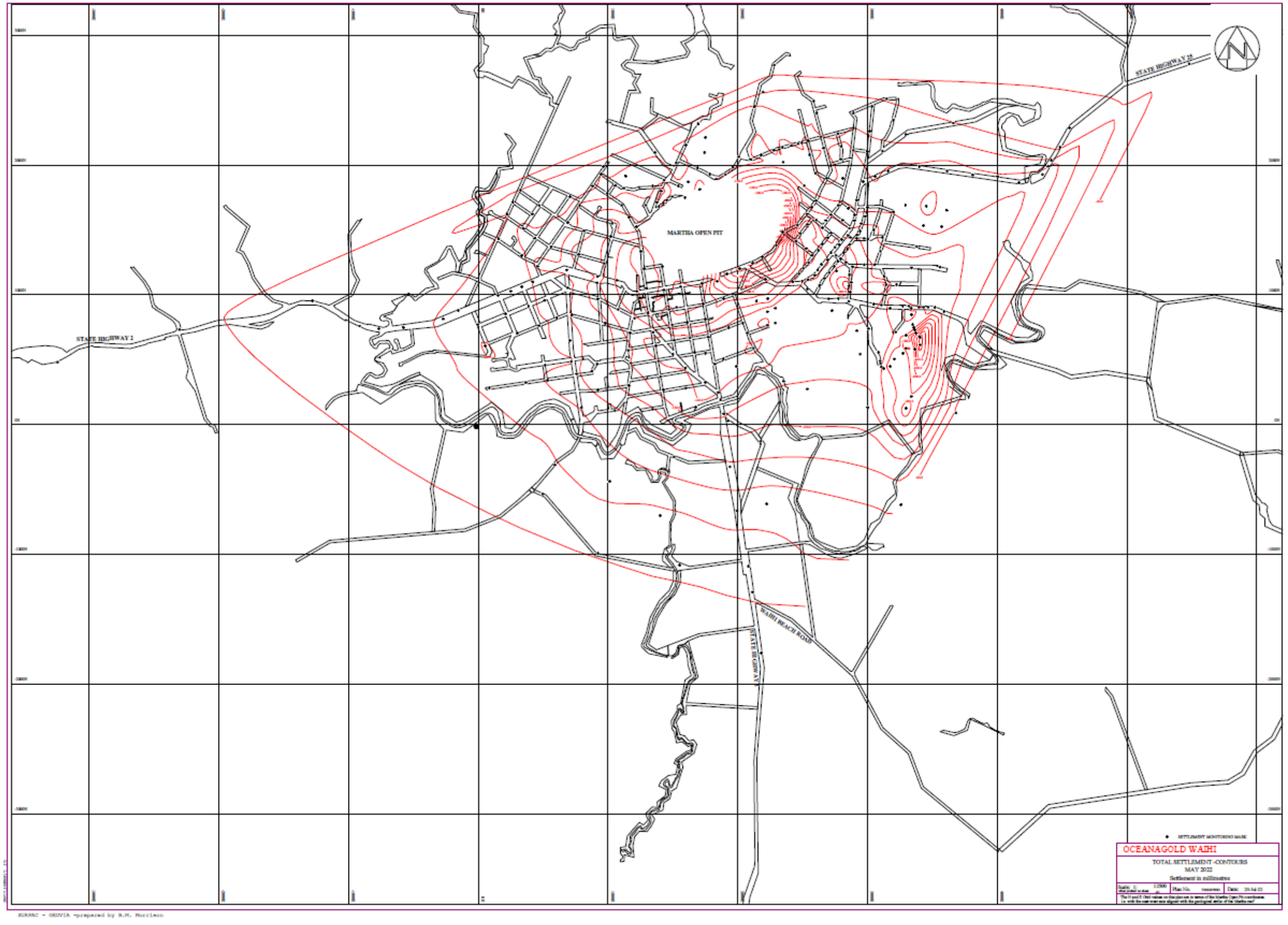

Figure 13: Total Settlement Contours

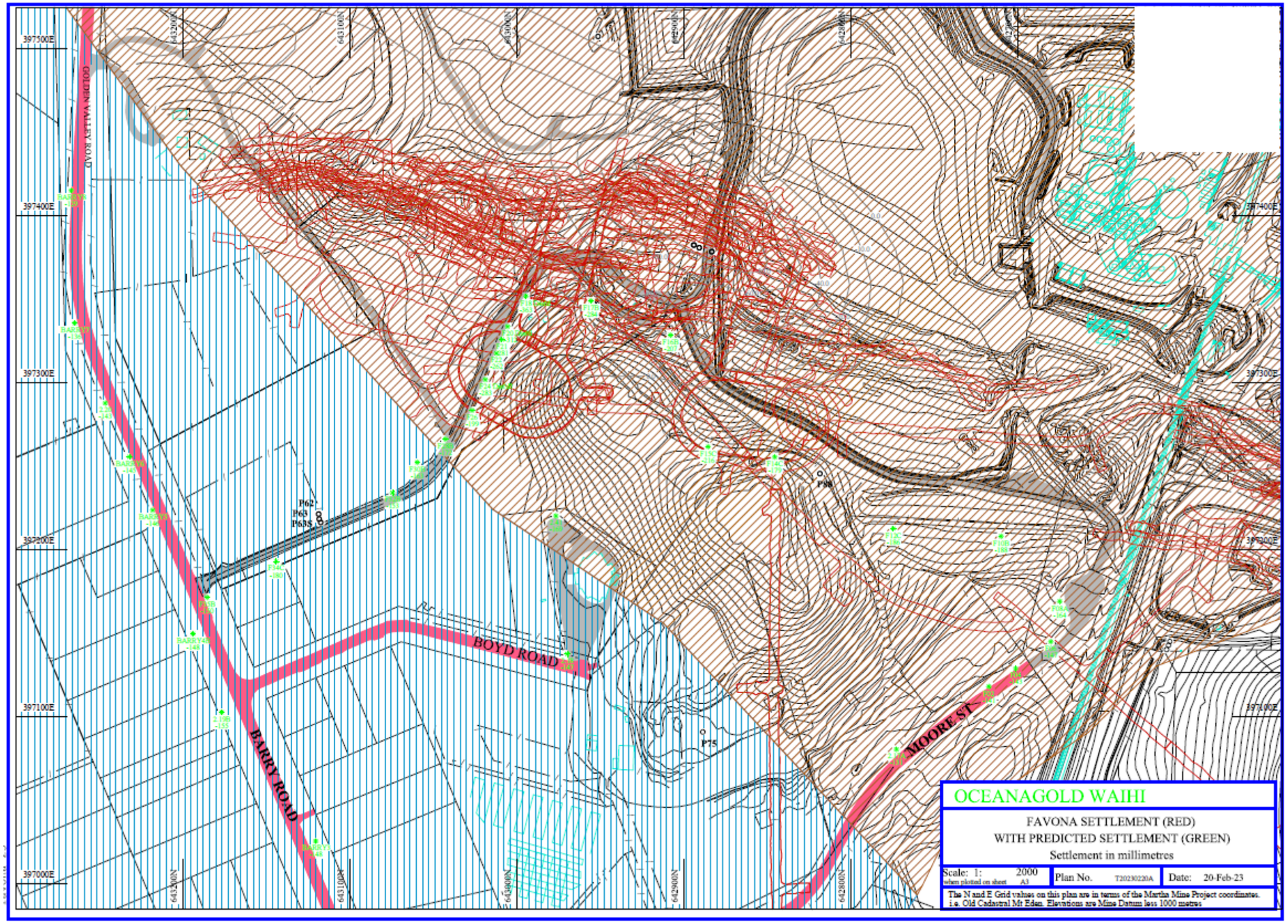

Figure 14: Favona settlement markers in relation to the underground workings and predicted settlement contours

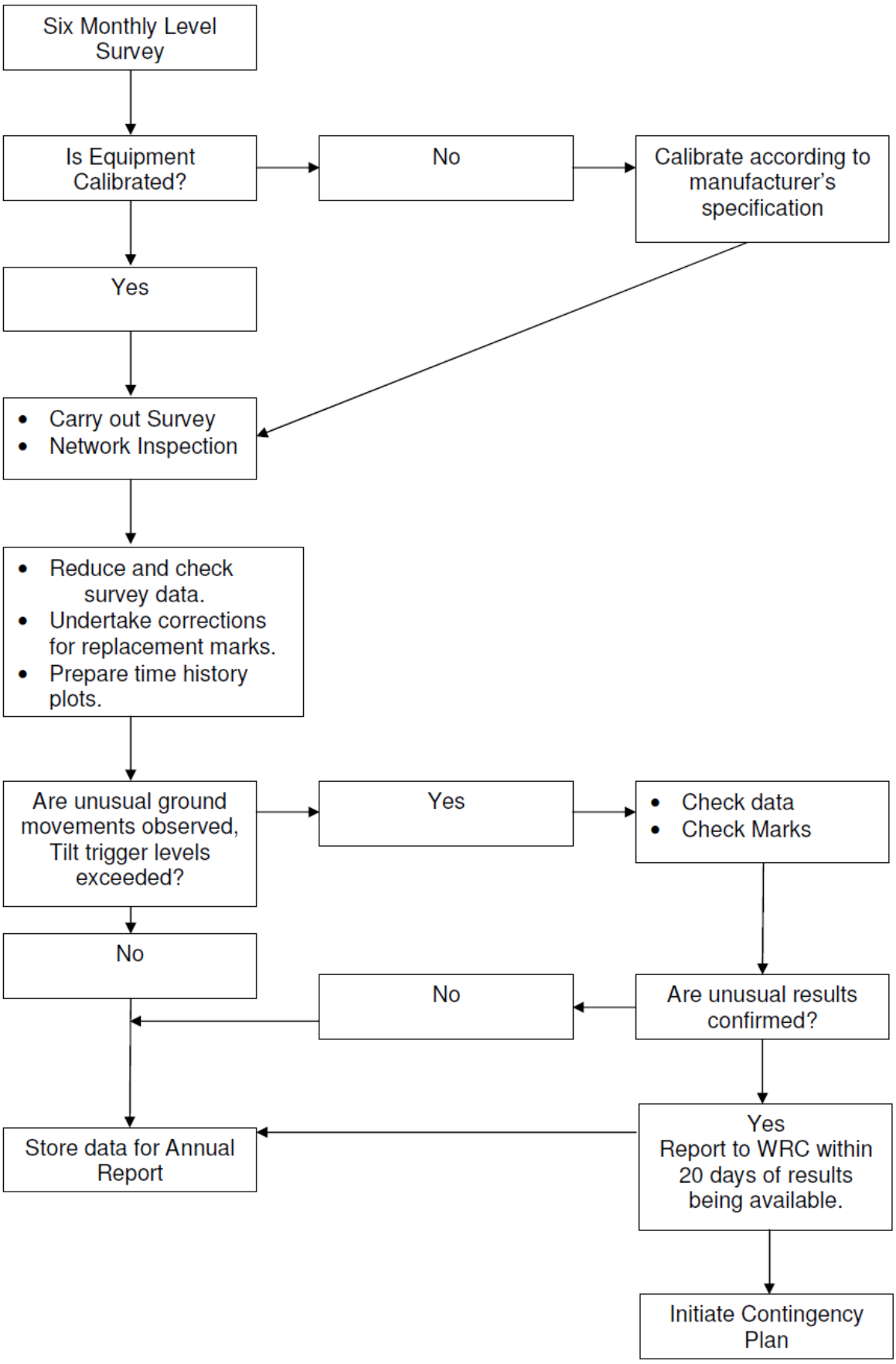

Figure 15: Flow chart for settlement monitoring

7.5.1 Equipment Maintenance and Calibration

All survey equipment used to measure the survey network is to be maintained in good working condition at all times and calibrated in accordance with the manufacturer's recommendations. Copies of the calibrations are to be retained by the OGNZL Survey Department.

7.5.2 Settlement Data Collection

Data collection is to be undertaken having regard to the following:

- All surveying and reduction of levels is performed under the supervision of a Registered Professional Surveyor.
- All levelling is completed in an industry-recognised manner that minimises misclose.
- All survey misclose is redistributed using an industry-recognised method such as a least squares adjustment method.
- All levelling is referenced back to stable benchmarks that are beyond the influence of mine dewatering.
- Levelling along roadsides is in accordance with a NZTA approved traffic management plan.

7.5.3 Routine Network Inspection and Maintenance

A visual inspection of all survey monitoring locations is undertaken during routine monitoring of the survey network. If this inspection indicates that a survey mark is unreliable, damaged or malfunctioning, then steps are taken to repair, relocate, renew or decommission the monitoring site. Ongoing monitoring may be required to determine the ultimate fate of the monitoring location.

Alternatively, analysis of the monitoring data may identify a monitoring location that is unreliable or dubious. Re-measurement and a thorough inspection of the monitoring location is undertaken to ascertain the reliability of the data and the monitoring location. Ongoing monitoring may be required to determine the ultimate fate of the monitoring location.

If it is identified that a monitoring location requires remediation such as repairs or relocation, then these are implemented as soon as practicable, before the next round of monitoring.

All new survey marks will be adjusted to allow for mine related settlement that has occurred since December 1989. This adjustment will be based on the settlement of adjacent survey marks, or, if appropriate, the average settlement of the settlement zone in which the survey mark lies (Refer to Figure 12 and Table 1 for the Settlement Zones). The level of each new survey mark, and each superseded survey mark, will be measured during the same survey round at least once. The length of survey "overlap" will be decided upon on an individual basis by the surveyor.

7.5.4 Data Checking and Storage

Once a complete set of data has been collected in the field, it is transferred to a master database for storage and the production of data plots. Checks involve updating of the time-history graphs (cumulative change in ground surface over time) for each mark and checking the settlement trends produced against the zone trends. Where a settlement trend differs from a zone trend, that trend is compared with the trends of adjacent marks.

Where a settlement trend is different from those of adjacent marks, the mark is revisited and examined. If no damage to the mark is apparent, the mark and adjacent marks are check-levelled to confirm the measurement made before accepting the value and confirming on the database.

7.5.5 Survey Corrections

Where a survey mark has been replaced and a new record has been started, a correction is applied to provide a continuous record at each site from the time of the initiation of dewatering. The corrections are made as follows:

- The corrections are based on trend analysis where sufficient data exists.
- Where insufficient data for reliable trend analysis exists, corrections are based on the behaviour of surrounding marks.
- Where satisfactory corrections are not able to be applied, the mark is not included in the settlement contouring or in the calculation of tilt.

7.5.6 Time-History Plots

Corrected settlement data is plotted onto time-history graphs, together with the Zone maximum settlement and the Zone maximum rate of settlement to the end of mining. This is required to provide a visual check as to whether settlement is likely to exceed Zone maxima by the end of mining.

7.6 *Reporting Survey Data*

A number of reports are required in the conditions of the consents. These are as set out below.

7.6.1 Surveyors Reports

Current practice is for the surveyor to prepare a report following each 6-monthly survey. This report will continue and will include:

- Survey data.
- A plan of the total settlement values and contours at 20 mm intervals of total settlement.
- Comment on survey marks which are showing unusual behaviour.
- Changes made to the survey network, specifically marks that have been removed and replacement marks added to the network.

The two survey reports for each year are included in the annual summary report.

7.6.2 Annual Summary Report

A report and summary of the survey data is produced by OGNZL and submitted to the consenting authorities. This report is produced on an annual basis and includes analysis and evaluation of the data. The annual report includes:

a) Summary data and graphs of monitoring undertaken during the previous year.

b) Identification of any environmentally important trends in settlement behaviour.

c) Interpretation and analysis of any change in ground surface profile and associated tilt over the previous year, any contingency actions that may have been taken during the year, predictions of future trends that have been identified, and what contingency actions, if any, the consent holder proposes to take in response to those predictions.

d) A comparison of the average zone settlement with that predicted in Table 8.

e) A summary of the settlement related complaints that were received during the previous year, and a description of the Company's response to each complaint.

f) Comment on compliance with the conditions of the consents.

g) Any reasons for non-compliance, or difficulties in achieving conformance, with the conditions of the consent.

h) Any works that have been undertaken to improve environmental performance or that are proposed to be undertaken in the forthcoming year to improve environmental performance in relation to activities permitted by the consent.

If analysis of the data indicates that the magnitude and type of settlement within a part of Waihi is undesirable, then a detailed inspection of all settlement susceptible structures within the zone is to be commissioned by OGNZL. This inspection is to be undertaken by a suitably experienced person or persons.

7.6.3 Network Review and Analysis

A detailed review and analysis of the survey network has been undertaken at least once every two years to ensure that the global aspects of the survey network, such as the monitoring frequency and extent of the monitoring network, remains satisfactory. This review is now redundant. The current practice is that the survey marks are checked by the survey team each survey round and the network performance is reviewed by the responsible person at the same time as the preparation of the annual report for that year.

Reviews of the network are undertaken independently by the surveyor, the report author, the consultant reviewer, and the peer reviewer. Discrepancies and gaps are investigated during deliberation of the data and, if necessary, resolved with modifications for future monitoring.

Currently, OGNZL maintains a photographic record of the individual survey mark locations. This speeds up finding marks in the field and allows a prompt assessment of any modifications near marks that may cause an artificial movement in a survey mark. This record is updated as alterations are made to marks.

7.7 *Unusual Ground Movements*

7.7.1 Change in Settlement Rate

In the event of a rapid, or unusual, change in the rate of settlement being identified, Figure 15 shows that the results are to be checked. If the unusual level change is confirmed, the contingency plan described below in Section 7.8 and summarised in Figure 16 is initiated.

7.7.2 Exceedance of Tilt or Zone Maximum

In the event that survey marks exceed the zone maximum or a tilt is indicated to exceed 1 vertical in 1000 horizontal over a distance of no less than 25 m, Figure 15 shows the measurements are to be checked. If confirmed, the contingency plan described below in Section 7.8 and summarised in Figure 16 is to be initiated.

7.7.3 Favona Markers - Settlement and Tilt Trigger Levels

With 10 metre separation between close-order markers, the 1 in 1000 tilt is accomplished by a differential settlement of 10mm. This is close to the survey error. With 50 metre separation between markers, the

differential increases to 50mm. This is twice the seasonal fluctuation and beyond survey error and so can be considered potentially to provide a realistic trigger.

The settlement analysis indicates that expected settlement is focused over the vein system where up to 80 mm has been predicted. No settlement is calculated to extend over the ridge towards town. As a result, Favona induced settlement is not expected in the markers along Moore Street.

Where markers are 50 m or more apart, settlement in excess of 50 mm would be needed to initiate the tilt trigger. For this reason, a 50 mm trigger for settlement is appropriate as this would be activated at or before activation of the tilt trigger. This is approximately twice the seasonal fluctuation so would be defensible in determining a real effect. The proposed settlement trigger limit is equivalent to the Martha Settlement Zone 3, and based on experience with Martha, no adverse effects are anticipated. Figure 16 describes the process that would be undertaken in the event that the trigger levels for tilt or settlement are exceeded.

The settlement trigger levels may need to be revisited in the light of ongoing survey results. Changes to the trigger levels would be expected only in response to unexpected settlement behaviour, and would be an outcome of a contingency action, e.g. review of the settlement model. Any change to the trigger levels are to be agreed with the Councils prior to their adoption.

7.8 *Remediation and Mitigation of Settlement Effects*

A contingency plan to be applied for unusual ground movements is summarised in Figure 16. If monitoring data and field investigations confirm that:

- The magnitude of ground movements due to dewatering the Martha Pit, Martha Underground, Trio, Correnso/SUPA and Favona Underground has exceeded those given in Table 1,
- Mine dewatering has resulted in a tilt greater than 1 in 1000 between any two network monitoring locations spaced no less than 25 metres apart.

OGNZL is to:

a) Notify the Consenting Authorities within 20 working days of receiving the results of the monitoring.

b) Explain the cause of the non-conformance.

c) Agree with the consenting authorities on the appropriate settlement contingency measures to be implemented as described.

d) Implement settlement contingency measures as appropriate.

e) Advise the Consenting Authorities on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

Current practice is for OGNZL to increase monitoring frequency; undertake geotechnical investigations; and/or to set up a close order survey around the mark or area of exceedance as a means to comply with requirement b) above. This is indicated by the first action box on the flow diagram in Figure 16.

Where agreed, remediation and mitigation plans are to be developed by OGNZL and forwarded to the consenting authorities for approval prior to their implementation. Such plans should also be agreed to by affected landowners.

The final composition of the remediation and mitigation plan, if required, will depend upon:

- The magnitude of ground movement.
- The size of the affected area.
- The soil conditions under the affected area.
- The type of structure affected, if any

- Environmental and social issues.
- The wishes of the affected parties and land owners, and:
- A cost-benefit analysis of the various mitigation options.

Figure 16 shows that these mitigation plans are to be monitored in terms of success and if necessary, revised.

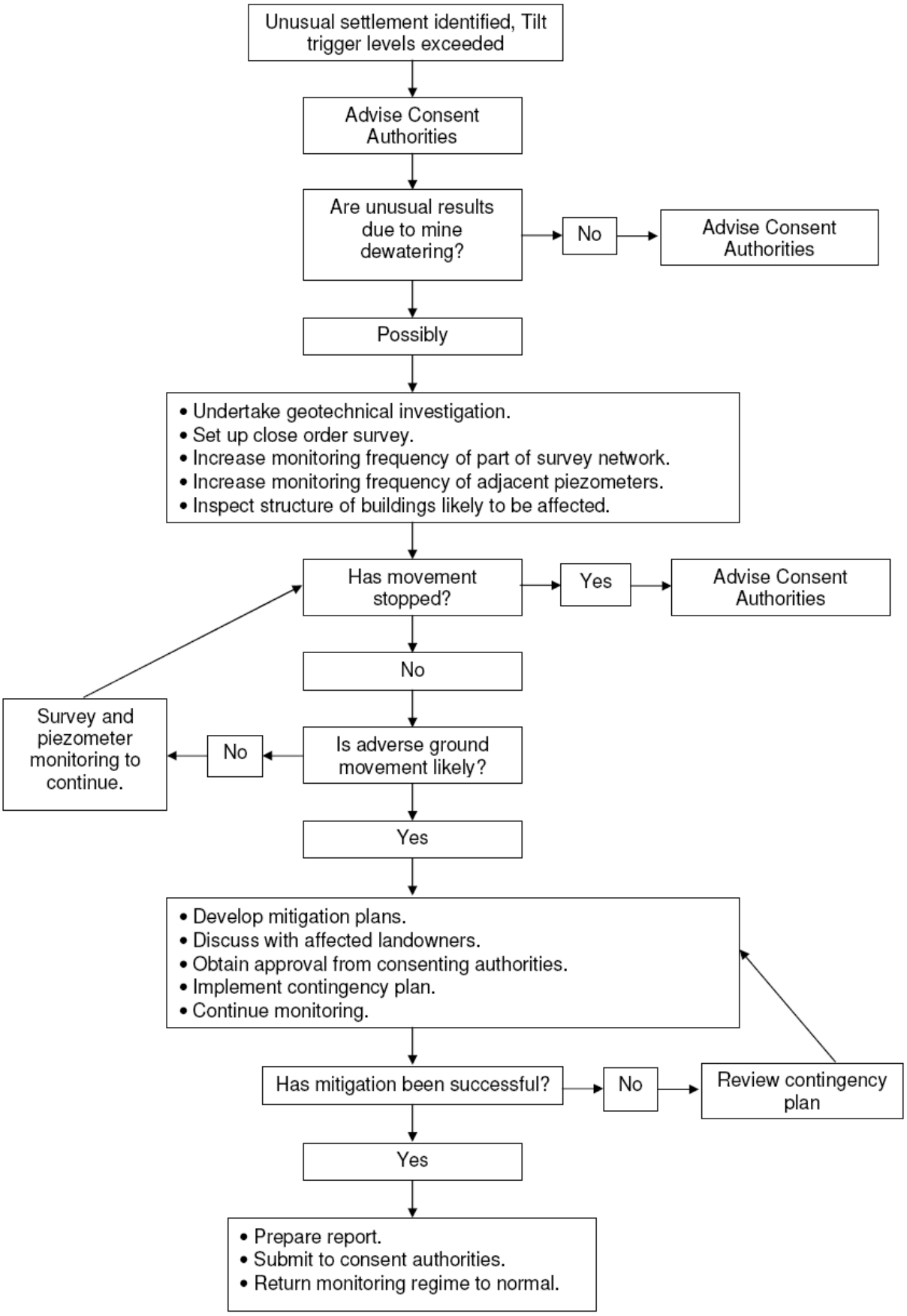

Figure 16: Flow chart of Settlement Contingency Plan

(After Table 5, evidence of Dr Semple

as presented to the joint hearing committee dated 13 November 1997.)

Appended with trigger levels for Trio recommended by EGL (2010), trigger levels for Correnso recommended by EGL (2012) and trigger levels for Project Martha recommended by EGL (2018).

Refer to Figure 12 of this Document for a Plan of the Settlement Zones.

Table 8: Predicted Settlement by Zone

Settlement Zone	Range of Surface Movement (mm) Measured Dec. 1989 to May 1997	Measured Average Surface Settlement (mm) due to Mine Dewatering Dec.1989 to May 1997	Predicted Range in Surface Settlement (mm) due to the Extended Mining Operations	Predicted Average Surface Settlement (mm) at cessation of the Extended Mining Operations	Trigger Levels for Settlement (including dewatering for Trio Development) (mm)	Maximum Total Settlement, incl Correnso Dewatering (mm)	Maximum Total Settlement, incl Project Martha Dewatering (mm)
1	+2 to -10	0	0 to 10	0	25	35	55
2	+10 to -10	0	0 to 20	10	35	45	65
3	0 to -25	10	0 to 40	20	60	70	95
4	-15 to -35	25	30 to 80	45	110	125	160
5	-25 to -50	50	70 to 130	85	175	195	260
6	-55 to -85	65	100 to 180	120	220	240	340
7	-95 to -125	110	180 to 260	200	350	400	540

8.0 REFERENCES

Engineering Geology Ltd, 2010. Proposed Trio Development Project – Assessment of Ground Settlement. Ref. 6723. Prepared for Newmont Waihi Gold, June 2010.

Engineering Geology Ltd, 2012. Evidence of Trevor Matuschka at Correnso Hearing. Prepared for Newmont Waihi Gold, November 2012.

GEOKEM, 2003: Report No. 0234 Technical review of water quality and geochemistry issues, Favona Underground Project. Prepared for Environment Waikato, October 2003

GWS Ltd, 2010. Proposed Trio Development Project – Assessment of Groundwater Inflows and Throughflows. Prepared for Newmont Waihi Gold, June 2010.

Pattle Delamore Partners Ltd, 2003: Proposed Favona Underground Mine – Review of Groundwater Assessment. Prepared for Environment Waikato, October 2003.

Pells Sullivan Meynink, 2010. Trio Development Project – Effects of Dewatering. Report PSM125.R40. Prepared for Newmont Waihi Gold, May 2010.

Engineering Geology Ltd, 2018. Evidence of Trevor Matuschka at Project Martha Hearing. Prepared for OceanaGold, November 2018.

APPENDIX A – Resource Consents

Resource Consent Certificate

Resource Consent: AUTH124860.01.02

File Number: 61 54 92A

Pursuant to the Resource Management Act 1991, the Waikato Regional Council hereby grants consent to:

Waihi Gold Company Limited
PO Box 190
Waihi 3641

(hereinafter referred to as the Consent Holder)

Consent Type: Water permit

Consent Subtype: Ground water take

Activity authorised: Undertake dewatering of underground workings (including groundwater and mine water) within the Golden Link Project Area, including the Correnso Underground Mine

Location: Golden Link Project Area - Area L

Spatial Reference: NZTM 1853105 E 5857374 N

Consent Duration: This consent shall commence on the date stated in condition 2 and expire twenty years from the date of commencement

Subject to the conditions overleaf:

General

1. This consent is subject to the conditions listed in Schedule One – General Conditions.

2. This consent shall commence five years from the date of grant unless the consent holder has by notification in writing to the Council nominated an earlier commencement date.

3. This consent shall lapse five years from the date of commencement if not exercised prior.

Monitoring - Abstraction Volume

4. The consent holder shall monitor the volume of water abstracted on a weekly basis and shall report this to the Waikato Regional Council on a quarterly basis.

Dewatering and Settlement Monitoring Plan

5. Prior to the exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

   The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system, as proposed in the consent application. The monitoring regime shall be designed to assess the effects of:

   (i) dewatering on the regional groundwater system; and
   (ii) dewatering on settlement; and
   (iii) the discharge of degraded quality water from the backfilled and flooded workings on groundwater quality.

   Monitoring locations are to provide appropriate resolution of surface tilt relative to the scale of surface infrastructure and final details are to be agreed with the Councils. The Plan shall also provide trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

   The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed and updated as necessary by the consent holder. Such updated Plans shall relate to the Correnso Mine or to any new mine within Area L. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.

   In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

Dewatering and Settlement Monitoring Report

6. The consent holder shall provide to the Councils an annual Dewatering and Settlement Monitoring Report. The Report shall, as a minimum, provide the following information:
   (i) The volume of groundwater abstracted;
   (ii) The data from monitoring undertaken during the previous year, including groundwater contour plans (derived from the data) in respect of the piezometer network;
   (iii) An interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to

those predictions. This analysis shall be undertaken by a party appropriately experienced and qualified to assess the information;

(iv) Any contingency actions that may have been taken during the year; and

(v) Comment on compliance with condition 5 of this consent including any reasons for non-compliance or difficulties in achieving conformance with the conditions of consent.

The report shall be forwarded in a form acceptable to the Councils.

Monitoring - Tilt

7. In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations installed in accordance with the Dewatering and Settlement Monitoring Plan required pursuant to condition 5 of this consent, and such tilt is caused by the de-watering and/or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Councils in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then engage in a process with the Councils:

   (i) explain the cause of the non-conformance,

   (ii) Propose appropriate settlement contingency measures for discussion with Councils and agree with the Councils on the appropriate settlement contingency measures and the timing for their implementation as described,

   (iii) implement agreed settlement contingency measures as appropriate within the agreed time limit,

   (iv) advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

Monitoring – Water Quality

8. The consent holder shall monitor throughout the period of operation, the chemistry of the groundwater, pit run-off and pit discharge water abstracted from the open pit. The monitoring data is to be used to correlate these inflows with pit lake water quality predictions, and to provide a database for input into the closure plans. The sampling parameters and frequencies shall be described in the Martha Extended Project dewatering consent (unless agreed otherwise with the Waikato Regional Council) with the results forwarded to the Waikato Regional Council on an annual basis.

Other Water Users

9. If, in the opinion of the Waikato Regional Council, the exercise of this consent adversely affects stock, domestic or other water supplies, then the consent holder shall, at its own cost, be responsible for providing to the owner of those water supplies an alternative equivalent water supply, to the satisfaction of Waikato Regional Council. The consent holder shall be responsible for making an alternative water supply available within 12 hours of being directed to do so by the Waikato Regional Council.

For and on behalf of the
Waikato Regional Council

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Advice notes

1. This resource consent does not give any right of access over private or public property. Arrangements for access must be made between the consent holder and the property owner.
2. This resource consent is transferable to another owner or occupier of the land concerned, upon application, on the same conditions and for the same use as originally granted (s.134-137 RMA).
3. The consent holder may apply to change the conditions of the resource consent under s.127 RMA.
4. The reasonable costs incurred by Waikato Regional Council arising from supervision and monitoring of this/these consents will be charged to the consent holder. This may include but not be limited to routine inspection of the site by Waikato Regional Council officers or agents, liaison with the consent holder, responding to complaints or enquiries relating to the site, and review and assessment of compliance with the conditions of consents.
5. Note that pursuant to s333 of the RMA 1991, enforcement officers may at all reasonable times go onto the property that is the subject of this consent, for the purpose of carrying out inspections, surveys, investigations, tests, measurements or taking samples.
6. If you intend to replace this consent upon its expiry, please note that an application for a new consent made at least 6 months prior to this consent's expiry gives you the right to continue exercising this consent after it expires in the event that your application is not processed prior to this consent's expiry.

SCHEDULE ONE – GENERAL CONDITIONS

Resource consents **124859 - 124864 (inclusive)** are subject to the following general conditions, which are applicable to all consents.

General

1. Except as otherwise provided for by subsequent conditions of consent, all activities to which this consent relates shall be undertaken generally in accordance with the information contained in the document titled **"Golden Link Project including the Correnso Underground Mine: Application for WRC for resource consent and AEE Volumes 1 and 2""** dated June 2012 and the s92 further information recorded as documents 2214077, 2214082 and 2265673 on the Waikato Regional Council's document system for the Golden Link Project.

2. The consent holder shall notify the Council in writing, at least two weeks in advance of the first exercise of this consent.

Annual Work Programme

3. The consent holder shall, within six months after the commencement of this consent and annually thereafter, prepare and submit to Council for information, an Annual Work Programme that outlines the anticipated activities to be performed during the following year and the management systems under which those activities will be undertaken. The Annual Work Programme shall include the following :
   (i) (i) Mining operations proposed for the forthcoming year.

   (ii) Description of the sequencing of works, and description of the environmental procedures to be adopted during construction and the maintenance and management of facilities.

   (iii) Proposed progressive rehabilitation and revegetation of the active areas of the mine operation.

   The Annual Work Programme may also include any other information that the consent holder wishes, and may be combined with any other document which the consent holder is required to produce.

Liaison Officer

4. Within two weeks of the exercising of this consent, the consent holder shall appoint a person (the "Liaison Officer"), and any replacement person subject to the approval of the Hauraki District Council and the Waikato Regional Council (the "Councils"), to liaise between the consent holder, the community and the Councils. The Liaison Officer shall have sufficient delegated power to be able to deal immediately with complaints received and shall be required to investigate those complaints as soon as possible after receipt. The Liaison Officer shall be appointed for the duration of this consent. The name of the Liaison Officer together with the contact phone numbers for that person shall be publicly notified in local newspapers by the consent holder prior to the exercising of this consent and at least once a year thereafter.

Rehabilitation Plan

5. The consent holder shall prepare a Rehabilitation Plan covering all areas that may be affected by the construction and use of the workings associated with the underground mining within Area L of the Golden Link Project Area. This plan shall be submitted to the Waikato Regional Council and the Hauraki District Council (the "Councils") for written approval prior to the exercise of this consent. The Plan shall set out details on backfilling and flooding the underground workings, backfilling the vent shaft and access decline, and removal of surface infrastructure. The consent holder may amend the Plan at any time. No amendments shall be made to the Plan without the written approval of the Councils.

Unless otherwise agreed in writing by the Councils, the consent holder shall undertake the rehabilitation works in accordance with the approved Rehabilitation Plan.

Bond

6. Unless otherwise agreed in writing by the Councils, the consent holder shall provide and maintain in favour of the Councils a rehabilitation bond to:
   (ii) secure compliance with the conditions of this consent and to enable any adverse effect on the environment resulting from the consent holder's activities and not authorised by a resource consent to be avoided, remedied, or mitigated;

   (iii) secure the completion of rehabilitation and closure of the activities authorised by this consent in accordance with the Rehabilitation Plan approved by the Councils;

   (iv) ensure the performance of any monitoring obligations of the consent holder under this consent.

7. The bond shall be in a form approved by the Councils and shall, subject to these conditions, be on the terms and conditions required by the Councils.

8. The bond shall provide that the consent holder remains liable under the Resource Management Act 1991 for any breach of the conditions of consent which occurs before expiry of this consent and for any adverse effects on the environment which become apparent during or after the expiry of the consent.

9. Unless the bond is a cash bond, the performance of all of the conditions of the bond shall be guaranteed by a guarantor acceptable to the Councils. The guarantor shall bind itself to pay for the carrying out and completion of any condition in the event of any default of the consent holder, or any occurrence of any adverse environmental effect requiring remedy.

10. The amount of the bond shall be fixed prior to the exercise of this consent or as otherwise agreed and thereafter at least annually by the Councils who shall take into account any calculations and other matters submitted by the consent holder which are relevant to the determination of the amount. The amount of the bond shall be advised in writing to the consent holder at least one month prior to the review date.

11. The amount of the bond shall include:
   (i) the estimated costs (including any contingencies necessary) of rehabilitation and closure in accordance with the conditions of this consent, on completion of the operations proposed for the next year;

   (ii) any further sum which the Councils consider necessary to allow for remedying any adverse effect on the environment that may arise from the exercise of this consent;

   (iii) the estimated costs of monitoring, in accordance with the monitoring conditions of this consent, until the consent expires; and

   (iv) any further sum which the Councils consider necessary for monitoring any adverse effect on the environment that may arise from the exercise of this consent including monitoring anything which is done to avoid, remedy, or mitigate an adverse effect.

12. Should the consent holder not agree with the amount of the bond fixed by the Councils then the matter shall be referred to arbitration in accordance with the provisions of the Arbitration Act 1996. Arbitration shall be commenced by written notice by the consent holder to each of the Councils advising that the amount of the bond is disputed, such notice to be given by the consent holder within two weeks of notification of the amount of the rehabilitation bond. If the parties cannot agree upon an arbitrator within a week of receiving the notice from the consent holder, then an arbitrator shall be appointed by the President of the Institute of Professional Engineers of New Zealand. Such arbitrator shall give an award in writing within 30 days after his or her appointment, unless the consent holder and the Councils agree that time shall be extended. The parties shall bear their own costs in connection with

the arbitration. In all other respects, the provisions of the Arbitration Act 1996 shall apply. Pending the outcome of that arbitration, and subject to condition 8.8, the existing bond shall continue in force. That sum shall be adjusted in accordance with the arbitration determination.

13. If, for any reason other than default of the Councils, the decision of the arbitrator is not made available by the 30th day referred to above, then the amount of the bond shall be the sum fixed by the Councils, until such time as the arbitrator does make his/her decision. At that stage the new amount shall apply. The consent holder shall not exercise this consent if the variation of the existing bond or new bond is not provided in accordance with this condition.

14. The bond may be varied, cancelled, or renewed at any time by agreement between the consent holder and the Councils provided that cancellation will not be agreed to unless a further or new bond acceptable to the Councils is available to replace immediately that which is to be cancelled (subject however to the condition below as to release of the bond on the completion of the rehabilitation).

15. The Councils shall release the bond on the completion of the rehabilitation. This means when the rehabilitation has been completed in accordance with the approved Rehabilitation Plan and demonstrated to be successful, to the satisfaction of the Councils

16. All costs relating to the bond shall be paid by the consent holder.

17. This consent shall not be exercised unless and until the consent holder provides the bond to the Councils or provides such sureties as may be acceptable to the Councils until the bond is received.
    Note: The bond covers only those elements of the Golden Link Project not already subject to the rehabilitation bond imposed by the land use consent and resource consents granted for the Martha Mine Extended Project and Favona and Trio Underground Mine Projects.

18. These conditions form an integrated whole and are not severable.

Review

19. The Waikato Regional Council may within the six month period following the anniversary of the commencement of this consent and annually thereafter, serve notice on the consent holder under section 128 of the Resource Management Act 1991, of its intention to review the conditions of this resource consent for the following purposes:
    (i) to review the effectiveness of the conditions of this resource consent in avoiding, or mitigating, any adverse effects on the environment from the operation and, if considered appropriate by the Council, to avoid, remedy or mitigate such effects by way of further or amended conditions; and/or

    (ii) if necessary and appropriate, in relation to discharges of contaminants, to require the holder of this resource consent to adopt the best practicable option to remove, or reduce, adverse effects on the environment resulting from the exercise of this consent; and/or

    (iii) review the monitoring requirements in light of the results obtained from monitoring in preceding years

    Costs associated with any review shall be borne by the consent holder.

Change to Consent

20. The consent holder may apply to the Council for a change or cancellation of any of the conditions of this consent in accordance with section 127 (1)(a) of the Resource Management Act 1991 at any time.

Administration

21. The consent holder shall pay to the Council any administrative charge fixed in accordance with section 36 of the Resource Management Act 1991, or any charge prescribed in accordance with regulations made under section 360 of the Resource Management Act.

WAIKATO REGIONAL COUNCIL

CONSENTS AND CONDITIONS

AS AMENDED BY THE ENVIRONMENT COURT

FOR THE EXTENDED MARTHA MINE PROJECT

BY WAIHI GOLD COMPANY

17 November 2008

4.0 Dewatering

That water permit 971286 be granted to Waihi Gold Company to dewater the pit (Areas A and B as identified on Waihi Gold Company plan no. T70725A dated 25 July 1997), and surrounding areas, at a rate of up to 15,000 m3 of surface water and groundwater per day, at or about map reference NZMS260 T13:620-202:

Term:	Expires 15 July 2017
Lapse Period:	2 years from date of commencement

1. This consent is subject to each of the conditions set out in Schedule 1.

2. The annual average daily extraction rate shall be not greater than 10,000 m3 per day.

3. The consent holder shall prepare a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to be designed to monitor and assess the effects of dewatering on land settlement and the effects of the mining activities on the subsurface hydraulic regime. The Dewatering and Settlement Monitoring Plan shall address at least the following:

   a) An overall description of the groundwater and settlement monitoring system and the measures to be adopted to meet the objectives of the groundwater and settlement management system.
   b) Details of the piezometer network proposed to monitor the effects of pit dewatering on the aquifers under Waihi township.
   c) Any monitoring bores additional to the existing piezometer network shall be installed and operational prior to the exercising of this consent.
   d) Details of the settlement monitoring network proposed to monitor the extended zone which has been, or is likely to be, affected by settlement caused by mine dewatering.

      Any settlement monitoring network locations additional to the existing monitoring locations shall be installed and operational prior to exercising this consent.

   e) Details of the survey of facilities in the Waihi township considered by the consent holder to be potentially "at risk" of damage from ground settlement caused by mine dewatering. The survey to be completed shall include collection of information about the facility location, the nature of construction materials, the nature of sensitive equipment that might be potentially "at risk", and the sensitivity of this equipment to ground settlement caused by mine dewatering and/or tilt.

      This survey shall be completed prior to exercise of this consent.

   f) A settlement contingency plan to include mitigation measures to be implemented in the event that ground settlement caused by mine dewatering induces a tilt that exceeds 1 in 1000 between any two network monitoring locations spaced no less than 25 metres apart. The settlement contingency plan shall particularly address those facilities identified by the consent holder as being potentially "at risk" of damage from ground settlement caused by mine dewatering.

   g) A dewatering contingency plan that describes the steps the consent holder shall implement in the event that dewatering results in adverse impacts on affected aquifer systems and associated groundwater supplies used for domestic, stock or other purposes.

h) In detailing the monitoring programmes the consent holder shall provide information on the monitoring methods proposed, the parameters to be monitored, and the calibration and maintenance of monitoring equipment.

In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

4. The Dewatering and Settlement Monitoring Plan shall be submitted to the Waikato Regional Council for approval at least one month prior to the exercise of this consent. The Waikato Regional Council shall consult with the Hauraki District Council prior to approving the Dewatering and Settlement Monitoring Plan. The consent holder shall review and update (as necessary) the Plan and shall provide promptly such updated Plan to the Waikato Regional Council annually for approval.

5. If in the opinion of Waikato Regional Council the exercise of this permit adversely affects stock, domestic or other water supplies, then the consent holder shall at its own cost be responsible for providing to the owner of those water supplies an alternative equivalent water supply, to the satisfaction of Council. The consent holder shall be responsible for making an alternative water supply available within 12 hours of being directed to do so by Waikato Regional Council.

6. If in the opinion of Waikato Regional Council the exercise of this permit adversely affects land or facilities, then the consent holder shall at its own cost be responsible for reinstating the facilities to an equivalent standard to the reasonable satisfaction of Council.

7. The consent holder shall measure and record the daily volume of water abstracted from the pit.

8. The consent holder shall undertake monthly water level monitoring of the piezometer network in accordance with the Dewatering and Settlement Monitoring Plan.

9. The consent holder shall monitor ground settlement at a minimum of six monthly intervals in accordance with the Dewatering and Settlement Monitoring Plan.

10. In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations spaced no less than 25 metres apart, and such tilt is caused by mine dewatering, or there is a significant variance from the predicted settlement rates described in the evidence of Dr Semple (Table 5, Figure 8 dated 13 November 1997 as presented to the joint hearing committee), the consent holder shall notify the Waikato Regional Council and the Hauraki District Council, in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then:

a) explain the cause of the non-conformance,
b) agree with the Waikato Regional Council and Hauraki District Council on the appropriate settlement contingency measures to be implemented as described,

c) implement settlement contingency measures as appropriate,
d) advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

11. The consent holder shall monitor throughout the period of operation, the chemistry of the groundwater, pit run-off and pit discharge water abstracted from the open pit. The monitoring data is to be used to correlate these inflows with pit lake water quality predictions, and to provide a database for input into the closure plans. The sampling parameters and frequencies (unless agreed otherwise) shall be as described in Table 1 and 2 below with the results forwarded to Waikato Regional Council on an annual basis.

Sampling of water types shall be as follows:

Type 1: Groundwater (a representative sample of the pit groundwater inflows taken at a site unaffected by surface water inflows).

Type 2: Surface water (various locations on the pit benches and floor) selected to provide individual representative samples of run-off over oxidised and unoxidised rock.

Type 3: Combined (discharge end of pipeline from pit at the Water Treatment Plant).

Sampling groups and frequencies shall be as described in Table 1 and sampling parameters shall be as set out in Table 2 below.

Table 1: Sampling Groups and Frequencies

Type	Automatic/Daily	Quarterly	Annually
1		Groups 1 & 2	Groups 1, 2 & 3
2		Groups 1 & 2	Groups 1, 2 & 3
3	Group 1	Groups 1 & 2	Groups 1, 2 & 3

Table 2: Sampling Parameters

Group 1	Group 2	Group	3
pH	Cations (Na, K, Ca, Mg)	Cu	Ag
Conductivity	Anions	Zn	Fe (total) Mn (total)
	(alkalinity/acidity, Cl, SO4)	Pb	
	Fe	As	Cd
	Mn	Al	Se
	Suspended solids	Sb	
	Temperature	Ni	
	(Type 1 only)	Co	

Note:

Monitoring of metals shall be based on the soluble test method, defined as the concentration of dissolved metals measured in that fraction which passes through a 0.45 um filter except those metals designated as totals which shall be based on acid soluble concentrations determined on unfiltered samples.

12. All water quality sampling and analysis shall be undertaken using Standard Methods for the Examination of Water and Wastewater (19th Edition 1995, or updates), APHA, AWWA and WEF, unless otherwise agreed in writing by Waikato Regional Council. Analyses shall be undertaken at an appropriately qualified laboratory. All other measuring, testing, recording and analytical methods as may be required from time to time shall be to the satisfaction of Council.

13. The consent holder shall provide to the Waikato Regional Council and the Hauraki District Council an annual dewatering and settlement monitoring report. The report shall include at least the following information:

a) The data from monitoring undertaken during the previous year including ground water contour plans (derived from the data) in respect of the piezometer network.

b) Identification of any environmentally important trends in settlement and dewatering behaviour.

c) Interpretation and analysis of any change in ground water profile over the previous year, any contingency actions that may have been taken during the year, predictions of future impacts on other bore users that may arise as a result of any trends that have been identified, and what contingency actions, if any, the consent holder proposes to take in response to those predictions.

d) A comparison of the settlement survey data with that predicted in Table 5 and Figure 8 (dated 13 November 1997) by Dr Semple of Woodward-Clyde (NZ) Ltd as provided in evidence to the joint hearing committee.

e) Comment on compliance with all conditions of this consent.

f) A summary and analysis of complaints relevant to this consent from the complaint log (refer Schedule 1).

g) Any reasons for non-compliance or difficulties in achieving conformance with the conditions of this consent.

h) Any works that have been undertaken to improve environmental performance or that are proposed to be undertaken in the forthcoming year to improve environmental performance in relation to activities permitted by this consent.

The report shall be forwarded in a format acceptable to the Waikato Regional Council.

Resource Consent

Certificate

Resource Consent Number: 109742

File Number: 61 25 21A

Pursuant to the Resource Management Act 1991, the Waikato Regional Council hereby grants consent to:

Welcome Gold Mines Ltd & Auag Resources Ltd

P O Box 190

WAIHI 2981

(hereinafter referred to as the Consent Holder)

Consent type: Water Permit

Consent subtype: Groundwater take

Activity authorised: To take groundwater and mine water for dewatering the underground mine.

Location: Baxter Rd - Waihi

Map Reference: NZMS 260 T13:636-195

Consent duration: Granted for a period expiring 31 December 2028.

Subject to the conditions overleaf:

CONDITIONS

General

1. This consent is subject to the conditions listed in Schedule One –General Conditions and Schedule Two – General Conditions.

Other Water Users

2. If, in the opinion of the Waikato Regional Council (the **"Council"**), the exercise of this consent adversely affects stock, domestic or other water supplies, then the consent holder shall, at its own cost, be responsible for providing to the owner of those water supplies an alternative equivalent water supply, to the satisfaction of Council. The consent holder shall be responsible for making an alternative water supply available within 12 hours of being directed to do so by the Council.

Monitoring – Abstraction Rate

3. The consent holder shall monitor the volume of water abstracted from the mine on a weekly basis and shall report this to the Council on a quarterly basis.

*Dated at Hamilton this **13** day of **April 2004***

For and on behalf of the

Waikato Regional Council

.....

109742

SCHEDULE TWO – GENERAL CONDITIONS

The granting of consents (109742 to 109746 inclusive) is subject to the following conditions, which shall apply to each individual consent.

Water Management Plan

1. Prior to exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Water Management Plan describing the water management system to be applied across the project area, with emphasis on management of stormwater including water storage options, decline and mine dewatering, and stockpile runoff.

   The consent holder shall exercise this consent in accordance with the approved Water Management Plan.

Settlement, Dewatering and Water Quality Monitoring Plan

2. Prior to exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Settlement, Dewatering & Water Quality Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement, the groundwater hydraulic regime and on water quality, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

   The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system, as proposed in the consent application. The monitoring regime shall be designed to assess the effects of:

   a) mine dewatering on the regional groundwater system,
   b) mine dewatering on settlement;
   c) leachate from stockpiles containing potentially acid forming material on shallow groundwater quality, and
   d) the discharge of degraded-quality water from the backfilled and flooded workings on groundwater quality.

   Final details of the monitoring locations are to be agreed with the Council. The Plan shall also provide trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

   The Plan shall be consistent with the recommendations included in the reports to the Council entitled;

   - *"Proposed Favona Underground Mine – Review of Groundwater Assessment" dated October 2003 and prepared by Pattle Delamore Partners; and*

- *"Technical Review of Water Quality and Geochemistry Issues - Favona Underground Project", dated October 2003 and prepared by GEOKEM.*

The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed, and updated as necessary, by the consent holder at least once every two years. Any updated Plan shall be promptly forwarded to the Council for approval and following approval the updated Plan shall be implemented in place of the previous version.

In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Settlement, Dewatering & Water Quality Monitoring Plan, then the conditions of this consent shall prevail.

3. In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations, installed in accordance with the Settlement, Dewatering & Water Quality Monitoring Plan required pursuant to condition 2 above, or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Council in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then:

   a) explain the cause of the non-conformance,
   b) agree with the Council on the appropriate settlement contingency measures to be implemented as described,
   c) implement settlement contingency measures as appropriate,
   d) advise the Council on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

Settlement, Dewatering & Water Quality Monitoring Report

4. The consent holder shall provide to the Council (with a copy provided to the Hauraki District Council) an annual Settlement, Dewatering & Water Quality Monitoring Report. The report shall include at least the following information:

   a) the volume of groundwater abstracted,
   b) the data from monitoring undertaken during the previous year including groundwater contour plans (derived from the data) in respect of the piezometer network,
   c) an interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions. This analysis shall be undertaken by a party appropriately experienced and qualified to assess the information,
   d) any contingency actions that may have been taken during the year,
   e) comment on compliance with all conditions of this consent including any reasons for non-compliance or difficulties in achieving conformance with the conditions of this consent.

   The report shall be forwarded in a format acceptable to the Council.

HAURAKI
DISTRICT COUNCIL

LAND USE CONSENT AND CONDITIONS

FOR THE EXTENDED MARTHA MINE PROJECT

BY WAIHI GOLD COMPANY

(NO. 97/98 - 105)

CONSENT ORDER

50 109 59

15 June 1999

3.30 Settlement

a) The consent holder shall prepare a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of dewatering on land settlement and the effects of the mining activities on the subsurface hydraulic regime. The Dewatering and Settlement Monitoring Plan shall address at least the following:

i) An overall description of the groundwater and settlement monitoring system and the measures to be adopted to meet the objectives of the groundwater and settlement monitoring system.

ii) Details of the piezometer network proposed to monitor the effects of pit dewatering on the aquifers under Waihi Township.

Any monitoring bores additional to the existing piezometer network shall be installed and operational prior to the exercising of this consent.

iii) Details of the settlement monitoring network proposed to monitor the extended zone which has been, or is likely to be, affected by settlement caused by mine dewatering.

Any settlement monitoring network locations additional to the existing monitoring locations shall be installed and operational prior to exercising this consent.

iv) Details of the survey of facilities in the Waihi township considered by the consent holder to be potentially "at risk" of damage from ground settlement caused by mine dewatering. The survey to be completed shall include collection of information about the facility's location, the nature of construction materials, the nature of sensitive equipment that might be potentially "at risk", and the sensitivity of this equipment to ground settlement caused by mine dewatering and/or tilt.

This survey shall be completed prior to exercise of the Waikato Regional Council consent number 971286.

v) A settlement contingency plan to include mitigation measures to be implemented in the event that ground settlement caused by mine dewatering induces a tilt that exceeds 1 in 1000 between any two network monitoring locations spaced no less than 25 metres apart. The settlement contingency plan shall particularly address those facilities identified by the consent holder as being potentially "at risk" of damage from ground settlement caused by mine dewatering.

vi) A dewatering contingency plan that describes the steps the consent holder shall implement in the event that dewatering results in adverse impacts on affected aquifer systems and associated groundwater supplies used for domestic, stock or other purposes.

In detailing the monitoring programmes the consent holder shall provide information on the monitoring methods proposed, the parameters to be monitored, and the calibration and maintenance of monitoring equipment.

In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of Waikato Regional Council consent number 971286 shall prevail.

b) The Dewatering and Settlement Monitoring Plan shall be submitted to Hauraki District Council for approval at least one month prior to the exercise of this consent. The Hauraki District Council shall consult with the Waikato Regional Council prior to approving the Dewatering and Settlement Monitoring Plan. The consent holder shall review and update (as necessary) the Plan and shall provide promptly such updated Plan to the Hauraki District Council annually for approval.

c) If in the opinion of Hauraki District Council the dewatering adversely affects land or facilities, then the consent holder shall at its own cost be responsible for reinstating the facilities to an equivalent standard to the reasonable satisfaction of Council.

d) The consent holder shall measure and record the daily volume of water abstracted from the pit.

e) The consent holder shall undertake monthly water level monitoring of the piezometer network in accordance with the Dewatering and Settlement Monitoring Plan.

f) The consent holder shall monitor ground settlement at a minimum of six monthly intervals in accordance with the Dewatering and Settlement Monitoring Plan.

g) In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations spaced no less than 25 metres apart, and such tilt is caused by mine dewatering, or there is a significant variance from the predicted settlement rates described in the evidence of Dr Semple (Table 5, Figure 8 dated 13 November 1997 as presented to the Joint Hearing Committee – attached hereto as Appendix C), the consent holder shall notify the Hauraki District Council and the Waikato Regional Council, in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then:

- explain the cause of the non-conformance,

- agree with the Hauraki District Council and Waikato Regional Council on the appropriate settlement contingency measures to be implemented as described,

- implement settlement contingency measures as appropriate,

- advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

h) The consent holder shall provide to the Hauraki District Council and the Waikato Regional Council an annual dewatering and settlement monitoring report. The report shall include at least the following information:

- The data from monitoring undertaken during the previous year including ground water contour plans (derived from the data) in respect of the piezometer network.

- Identification of any environmentally important trends in settlement and dewatering behaviour.

- Interpretation and analysis of any change in ground water profile over the previous year, any contingency actions that may have been taken during the year, predictions of future impacts on other bore users that may arise as a result of any trends that have been identified, and what

contingency actions, if any, the consent holder proposes to take in response to those predictions.

- A comparison of the settlement survey data with that predicted in Table 5 and Figure 8 (dated 13 November 1997) by Dr Semple of Woodward Clyde (NZ) Ltd as provided in evidence to the Joint Hearing Committee.

- Comment on compliance with this condition.

- A summary and analysis of complaints relevant to this condition.

- Any reasons for non-compliance or difficulties in achieving conformance with this condition.

- Any works that have been undertaken to improve environmental performance or that are proposed to be undertaken in the forthcoming year to improve environmental performance in relation to activities permitted by this condition.

The report shall be forwarded in a format acceptable to the Hauraki District Council.

(Note: This condition is complementary to Waikato Regional Council consent number 971286).

Extract from conditions of Hauraki District Council Resource Consent RC-15735, as pertaining to Dewatering and Settlement:

Dewatering and Settlement Monitoring Plan

14. Within 2 months of the exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

    The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system, as proposed in the consent application. The monitoring regime shall be designed to assess the effects of:

    (i) dewatering on the regional groundwater system; and

    (ii) dewatering on settlement.

    Final details of the monitoring locations are to be agreed with the Council. The Plan shall also provide trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

    The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed and updated as necessary by the consent holder. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.

    In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

Dewatering and Settlement Monitoring Report

15. The consent holder shall provide to the Council an annual Dewatering and Settlement Monitoring Report. The Report shall, as a minimum, provide the following information:

    (i) The volume of groundwater abstracted;

    (ii) The data from monitoring undertaken during the previous year, including groundwater contour plans (derived from the data) in respect of the piezometer network;

    (iii) An interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions. This analysis shall be undertaken by a party appropriately experienced and qualified to assess the information;

    (iv) Any contingency actions that may have been taken during the year; and

    (v) Comment on compliance with condition 14 of this consent including any reasons for non-compliance or difficulties in achieving conformance with the conditions of consent.

The report shall be forwarded in a form acceptable to the Council.

Monitoring – Tilt

16. In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations installed in accordance with the De-watering and Settlement Monitoring Plan required pursuant to condition 14 of this consent, or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Hauraki District and Waikato Regional Councils in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then:

    (i) Explain the cause of the non-conformance,

    (ii) Agree with the Councils on the appropriate settlement contingency measures to be implemented as described,

    (iii) Implement settlement contingency measures as appropriate,

    (iv) Advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

Extract from conditions of Waikato Regional Council Resource Consents 121416, 121417, 121418, 121446, and 121447, as pertaining to Dewatering and Settlement:

SCHEDULE ONE – GENERAL CONDITIONS

Resource Consents **121416, 121417, 121418, 121446, and 121447** are subject to the following general conditions, which are applicable to all consents.

Dewatering and Settlement Monitoring Plan

5 Prior to exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system, as proposed in the consent application. The monitoring regime shall be designed to assess the effects of:

(i) dewatering on the regional groundwater system; and
(ii) dewatering on settlement, and
(iii) the discharge of degraded quality water from the backfilled and flooded workings on groundwater quality.

Final details of the monitoring locations are to be agreed with the Council. The Plan shall also provide trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed and updated as necessary by the consent holder. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.

In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

Dewatering and Settlement Monitoring Report

6. The consent holder shall provide to the Councils an annual Dewatering and Settlement Monitoring Report. The Report shall, as a minimum, provide the following information:

(i) The volume of groundwater abstracted;
(ii) The data from monitoring undertaken during the previous year, including groundwater contour plans (derived from the data) in respect of the piezometer network;
(iii) An interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions. This analysis shall be undertaken by a party appropriately experienced and qualified to assess the information;
(iv) Any contingency actions that may have been taken during the year; and
(v) Comment on compliance with condition 5 of this schedule including any reasons for non-compliance or difficulties in achieving conformance with the conditions of consent.

The report shall be forwarded in a form acceptable to the Council.

Monitoring – Tilt

7. In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations installed in accordance with the De-watering and Settlement Monitoring Plan required pursuant to condition 5 of this schedule, and such tilt is caused by the de-watering and/or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Councils in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then engage in a process with the Councils:

   (i) explain the cause of the non-conformance,
   (ii) agree with the Councils on the appropriate settlement contingency measures to be implemented as described,
   (iii) implement settlement contingency measures as appropriate,
   (iv) advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

Extract from conditions of HDC RC 202.2012, as pertaining to Dewatering and Settlement:

Surface Stability

23 Underground mining within the Correnso Underground Mine shall be conducted to ensure ground surface stability. This shall include adoption of the following measures:

a) Mining methods shall be restricted to those that require stope voids to be backfilled to provide an operating floor for further stoping to proceed.

b) No stoping shall occur above whichever of the following criteria sets the lower (deeper) level:

i) A depth of at least 130m below the ground surface.

ii) A depth of at least 40m below the top of the andesite, unless geotechnical investigations reported to the Council demonstrate to its satisfaction that a greater or lesser depth is appropriate to ensure surface stability.

c) Backfilling of any other underground workings where geotechnical conditions require backfilling to ensure long-term stability.

d) Seismic monitoring and rock movement monitoring of underground mine workings for the duration of mining including backfilling and any other underground rehabilitation work.

e) Grouting of all future surface-drilled holes to a depth below the top of the andesite.

f) Any surface drillhole having significant and sustained water flows into the workings shall be grouted from underground within three shifts (36 hours) of being intersected. The hole shall be grouted to at least 30 metres from the collar using the same method used to grout uphole cable bolts.

Additional measures to be adopted to ensure ground surface stability shall be reported to the Council in accordance with Conditions 25 and 26.

24 Prior to the first exercise of this consent, the consent holder shall provide to the Council for its written approval, a report describing preventative and mitigation actions that would be implemented to ensure that the mining provided for under this consent does not drain the strata overlying the andesite via existing drillholes and structures. Preventative and mitigation actions may include:

a) Avoiding intercepting the drillholes with mine workings;

b) Grouting drillholes from underground where underground development intercepts holes that are making water or geological defects with significant and sustained water flows;

c) Undertaking geotechnical investigations to demonstrate to the satisfaction of Council that draining of the drillhole(s) will not adversely affect surface stability.

25 The consent holder shall provide to the Council on an annual basis (within one month of the agreed anniversary) a report:

a) Describing the location, depth height and volume (m3) of stopes; and a summary of the data required by Condition 26 regarding unfilled stope voids; and

b) Describing the lengths of development that, due to the encountered geotechnical conditions or where multiple levels overlap, will require backfilling prior to mine closure; and

c) Describing the backfilling and compaction associated with each stope; and

d) Describing the ground conditions revealed by the mine excavations; and

e) Describing the monitoring and measures adopted to ensure ground surface stability, particularly as provided for in Condition 23 and the outcomes of such measures; and

f) Describing the location and depth of exploratory drives;

g) Confirming that the extent of the mining works is confined to CEPPA, as defined in Figure 1.

26 Reporting on Filled/Unfilled Stopes and Seismic Monitoring

a) The consent holder shall report to the Council on a monthly basis on the total stope volume and volume of filled stopes for that month for each mining method employed namely: cut and fill area; transverse stope area; and all Avoca areas combined. The report shall be in a form acceptable to the Council and the data shall be for the situation as at the 20th day of the reporting month. The report shall be delivered on or before the end of the calendar month covered.

b) The consent holder shall report to the Council on a monthly basis detailing any anomalous results from the seismic monitoring and rock movement monitoring required by Condition 23. The report shall be delivered on or before the end of the calendar month covered.

Dewatering and Settlement Monitoring Plan

27 The objectives of the groundwater and settlement management system shall be to ensure that dewatering operations do not give rise to surface instability and differential settlement beyond that authorised by this consent.

28 Within 2 months of the exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

29 The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system set out in Condition 27. The monitoring regime shall be designed to assess the effects of:

a) Dewatering on the regional groundwater system; and

b) Dewatering on settlement.

30 Monitoring locations are to provide appropriate resolution of groundwater levels and surface tilt relative to the scale of surface infrastructure, particularly in the areas above and adjacent to the mining activities provided for in this consent. Final details are to be agreed with the Council. The Plan shall also provide settlement trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

31 The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed and updated as necessary by the consent holder. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.

32 In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations installed in accordance with the Dewatering and Settlement Monitoring Plan required pursuant to Condition 28 of this consent, or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Hauraki District and Waikato Regional Councils in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then:

a) Explain the cause of the non-conformance;

b) Propose appropriate settlement contingency measures to the Councils and the timing of implementation thereof by the consent holder;

c) Implement settlement contingency measures as appropriate within the agreed time limit;

d) Advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

33 The consent holder shall as a matter of urgency, advise the Council of any significant anomalies identified by the regular (monthly) reading of groundwater levels in the piezometer network. Such advice is to include an explanation of the anomalous results and actions proposed to address any issues identified. This report is to be provided to the Council within 10 working days of the anomalous results being identified.

A “significant anomaly” is defined as 15m or more offset occurring in piezometer recordings over a 1 month period.

34 In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

Advice notes:

1. The Dewatering and Settlement Monitoring Plan shall be consistent with the Dewatering and Settlement Monitoring Plan prepared as a condition of the ground dewatering consent (RC 124860) granted by the Waikato Regional Council.

2. The monitoring undertaken in terms of the Dewatering and Settlement Monitoring Plan may need to be continued for a period beyond the term of this consent depending on recharge of the groundwater following cessation of underground mining activities and the filling of the Martha Pit.

Condition 5 of the WRC Resource Consent 124860 states the following regarding the Settlement, Dewatering and Water Quality Monitoring Plan as it relates to the Golden Link Project Area L:

Dewatering and Settlement Monitoring Plan

1. Prior to the exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

   The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system, as proposed in the consent application. The monitoring regime shall be designed to assess the effects of:

   (iv) dewatering on the regional groundwater system; and
   (v) dewatering on settlement; and
   (vi) the discharge of degraded quality water from the backfilled and flooded workings on groundwater quality.

   Monitoring locations are to provide appropriate resolution of surface tilt relative to the scale of surface infrastructure and final details are to be agreed with the Councils. The Plan shall also provide trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

   The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed and updated as necessary by the consent holder. Such updated Plans shall relate to the Correnso Mine or to any new mine within Area L. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.

   In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

Extract from conditions of RESOURCE CONSENT APPLICATION LUSE-202.2016.00000544.001 -SLEVIN UNDERGROUND PROJECT AREA (SUPA), as pertaining to Dewatering and Settlement:

Surface Stability

15 Underground mining within the Slevin Underground Mine shall be conducted to ensure ground surface stability. This shall include adoption of the following measures:

a) Mining methods shall be restricted to those that require stope voids to be backfilled to provide an operating floor for further stoping to proceed.

b) No stoping shall occur above whichever of the following criteria sets the lower (deeper) level:

i) A depth of at least 130m below the ground surface.

ii) A depth of at least 40m below the top of the andesite, unless geotechnical investigations reported to the Council demonstrate to its satisfaction that a greater or lesser depth is appropriate to ensure surface stability.

c) Backfilling of any other underground workings where geotechnical conditions require backfilling to ensure long-term stability.

d) Seismic monitoring and rock movement monitoring of underground mine workings for the duration of mining including backfilling and any other underground rehabilitation work.

e) Grouting of all future surface-drilled holes to a depth below the top of the andesite.

f) Any surface drillhole having significant and sustained water flows into the workings shall be grouted from underground within three shifts (36 hours) of being intersected. The hole shall be grouted to at least 30 metres from the collar using the same method used to grout uphole cable bolts.

Additional measures to be adopted to ensure ground surface stability shall be reported to the Council in accordance with Conditions 19 and 20.

16 Unless otherwise approved by the Council, the following stand-off distances shall apply for mining in the vicinity of historical development and stoping:

Planned Mining	Historical Mining	Proposed Stand *Off* Distances
Development Drives	Development, rises and access drives	Historical development shall not be intentionally intersected
Development Drives	Unfilled portions of Stopes	Development drives shall have a minimum standoff distance of 10 m to unfilled portions of historical stopes.
AVOCA Stopes	Unfilled portions of Stopes	Stoping shall not occur within 25m of unfilled portions of historical stopes
AVOCA Stopes	Crown pillars	Standoff distance shall be increased to 30m, unless mitigation measures can be put in place. Mitigation measures include monitoring with laser scanning devices such as CAL-S, or filling of the unfilled void. via one or more boreholes from a location outside the standoff zone.

17 Prior to the first exercise of this consent as provided for by condition 4, the consent holder shall provide to the Council for its written approval a Void Management Plan. The objective of this Plan is to confirm the location and shape of old unfilled and filled mine voids and to identify the risks and controls required to ensure ground surface stability. The Plan will include, but will not be limited to modelling, probe drilling, stand *off* distances, monitoring and operating procedures. The consent holder shall review and update the Plan as necessary including whenever there is any change to the methods or procedures used for void detection monitoring or operating procedures and shall provide the updated Plan to the Council for approval.

18 Prior to the first exercise of this consent as provided for by condition 4, the consent holder shall provide to the Council for its written approval, a report describing preventative and mitigation actions that would be implemented to ensure that the mining provided for under this consent does not drain the strata overlying the andesite via existing drillholes and structures. Preventative and mitigation actions may include:

a) Avoiding intercepting the drillholes with mine workings;

b) Grouting drillholes from underground where underground development intercepts holes that are making water or geological defects with significant and sustained water flows;

c) Undertaking geotechnical investigations to demonstrate to the satisfaction of Council that draining of the drillhole(s) will not adversely affect surface stability.

19 The consent holder shall provide to the Council an annual report (within one month of the anniversary date established by condition 4 or as otherwise agreed in writing by the Council):

a) Describing the location, depth height and volume (m^3) of stopes; and a summary of the data required by Condition 20 regarding unfilled stope voids; and

b) Describing the lengths of development that, due to the encountered geotechnical conditions or where multiple levels overlap, will require backfilling prior to mine closure; and

c) Describing the backfilling and compaction associated with each stope; and d) Describing the ground conditions revealed by the mine excavations; and

e) Describing the monitoring and measures adopted to ensure ground surface stability, particularly as provided for in Condition 15 and the outcomes of such measures; and

f) Describing the location and depth of exploratory drives;

g) Confirming that the extent of the mining works is confined to SUPA, as defined in Figure 1.

These reports may be prepared in conjunction with similar reports prepared in accordance with the consent conditions applying to the Correnso Underground Mine.

20 Reporting on Filled/Unfilled Stopes and Seismic Monitoring

a) The consent holder shall report to the Council on a monthly basis on the total stope volume and volume of filled stopes for that month for each mining method employed namely: cut and fill area; transverse stope area; and all Avoca areas combined. The report shall also include the probe drilled metres for the month, and longitudinal sections showing sterilised zones as a result of the stand-off distances as specified in Condition 16. The report shall also include the minimum stand off distance for each stope mined during the month where adjacent to an unfilled historic stope void. The report shall be in a form acceptable to the Council and the data shall be for the situation as at the 20th day of the reporting month. The report shall be delivered on or before the end of the calendar month covered.

b) The consent holder shall report to the Council on a monthly basis detailing any anomalous results from the seismic monitoring and rock movement monitoring required by Condition 15. The report shall be delivered on or before the end of the calendar month covered.

These reports may be prepared in conjunction with similar reports prepared in accordance with the consent conditions applying to the Correnso Underground Mine.

Dewatering and Settlement Monitoring Plan

21 The objectives of the groundwater and settlement management system shall be to ensure that dewatering operations do not give rise to surface instability and differential settlement beyond that authorised by this consent.

22 Within 2 months of the exercise of this consent, the consent holder shall prepare, and submit to the Council for its written approval, a Dewatering and Settlement Monitoring Plan. The purpose of this Plan is to monitor and assess the effects of the activities on land settlement and the groundwater hydraulic regime, and also to detail the contingency measures that will be actioned should groundwater or surface settlement triggers be exceeded.

23 The Plan shall, as a minimum, provide an overall description of the groundwater and settlement monitoring system and the measures to be adopted, including contingency measures, to meet the objectives of the groundwater and settlement management system set out in Condition 21.

The monitoring regime shall be designed to assess the effects of:

a) Dewatering on the regional groundwater system; and

b) Dewatering on settlement.

24 Monitoring locations are to provide appropriate resolution of groundwater levels and surface tilt relative to the scale of surface infrastructure, particularly in the areas above and adjacent to the mining activities provided for in this consent. Final details are to be agreed with the Council. The Plan shall also provide settlement trigger limits that will initiate the implementation of contingency mitigation and/or monitoring measures and shall detail any linkages with the Martha pit operation.

25 The exercise of this consent shall be in accordance with the Plan as approved by the Council. The Plan shall be reviewed and updated as necessary by the consent holder. Any updated Plan shall be promptly forwarded to the Council for written approval and following approval, the updated Plan shall be implemented in place of the previous version.

26 In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations installed in accordance with the Dewatering and Settlement Monitoring Plan required pursuant to Condition 22 of this consent, or there is a significant variance from the predicted settlement rates, the consent holder shall notify the Hauraki District and Waikato Regional Councils in writing, within 20 working days of receiving the results of the monitoring. The consent holder shall then:

a) Explain the cause of the non-conformance;

b) Propose appropriate settlement contingency measures to the Councils and the timing of implementation thereof by the consent holder;

c) Implement settlement contingency measures as appropriate within the agreed time limit;

d) Advise the Councils on the steps the consent holder proposes to take in order to prevent any further occurrence of the situation.

27 The consent holder shall as a matter of urgency, advise the Council of any significant anomalies identified by the regular (monthly) reading of groundwater levels in the piezometer network. Such advice is to include an explanation of the anomalous results and actions proposed to address any issues identified. This report is to be provided to the Council within 10 working days of the anomalous results being identified.

A "significant anomaly" is defined as 15m or more offset occurring in piezometer recordings over a 1 month period.

28 In the event of any conflict or inconsistency between the conditions of this consent and the provisions of the Dewatering and Settlement Monitoring Plan, then the conditions of this consent shall prevail.

Advice notes:

1. The Dewatering and Settlement Monitoring Plan shall be consistent with the Dewatering and Settlement Monitoring Plan prepared as a condition of the ground dewatering consent (RC 124860) granted by the Waikato Regional Council and may be prepared in conjunction with similar plans prepared in accordance with the consent conditions applying to the Martha, Favona, Trio and CEPPA projects.

2. The monitoring undertaken in terms of the Dewatering and Settlement Monitoring Plan may need to be continued for a period beyond the term of this consent depending on recharge of the groundwater following cessation of underground mining activities and the filling of the Martha Pit.

Dewatering and Settlement Monitoring Report

29 The consent holder shall provide to the Council an annual Dewatering and Settlement Monitoring Report. The Report shall, as a minimum, provide the following information:

a) The volume of groundwater abstracted;

b) The data from monitoring undertaken during the previous year, including groundwater contour plans (derived from the data) in respect of the piezometer network;

c) An interpretation and analysis of the monitoring data, in particular any change in the groundwater profile over the previous year, predictions of future impacts that may arise as a result of any trends that have been identified including review of the predicted post closure effects based on actual monitoring data, and what contingency actions, if any, the consent holder proposes to take in response to those predictions. This analysis shall be undertaken by a party appropriately experienced and qualified to assess the information;

d) Any contingency actions that may have been taken during the year; and

e) Comment on compliance with Conditions 21 to 28 of this consent including any reasons for non-compliance or difficulties in achieving conformance with the conditions of consent.

The report shall be forwarded in a form acceptable to the Council.

Advice note:

The Dewatering and Settlement Monitoring Report shall be consistent with the Dewatering and Settlement Monitoring Report prepared as a condition of the ground dewatering consent (RC 124860) granted by the Waikato Regional Council and may be prepared in conjunction with similar reports prepared in accordance with the consent conditions applying to the Martha, Favona, Trio and CEPPA projects.

Resource Consent Schedule

Resource Consent:	AUTH139551.01.01
Consent Type:	Water permit
Consent Subtype:	Groundwater take
Activity authorised:	To take groundwater, including geothermal water, associated with the dewatering of the Martha Pit and associated underground workings including the Martha Underground Mine.
Location:	Waihi
Lapse Period:	Five years from the date of commencement
Spatial Reference:	NZTM 1851702 E 5858472 N
Consent Duration:	This consent shall: i) commence five years from the date of grant unless the consent holder has by notification in writing to the Waikato Regional Council nominated an earlier commencement date; and ii) expire 25 years from the date of commencement.

Subject to the conditions overleaf:

CONDITIONS

GENERAL

1 The activities to which this consent relates shall be generally undertaken in accordance with "Project Martha: Applications for Resource Consents and Assessment of Environmental Effects" and associated appendices dated 25 May 2018 and recorded as document number 12546836 on the Waikato Regional Council's document management system, and as identified in the resource consent conditions below which shall prevail in the event of any inconsistency between the aforementioned documentation and the conditions.

2 The consent holder shall notify the Waikato Regional Council in writing at least 10 working days in advance of the first exercise of this consent.

SCHEDULE ONE

3 The consent holder shall comply with the common conditions between the Waikato Regional Council and Hauraki District Council in Schedule One as relevant to the management of the mining and rehabilitation activities authorised by this consent.

DEWATERING LEVEL

4 The exercise of this consent shall not result in groundwater lowering to a level below 500mRL.

MONITORING

5 Upon commencement of this consent, the consent holder shall monitor the volume of water abstracted on a weekly basis and shall report this to the Waikato Regional Council.

6 Upon the first exercise of this consent the consent holder must telemeter – via a telemetry system developed after liaison with the Waikato Regional Council to ensure that the telemetry system is compatible with the Waikato Regional Council telemetry system standards and data protocols – continuous 15 minute values of: gross take volume (in units of cubic metres). The data must be reported once daily to the Waikato Regional Council via the telemetry system. There must be 96 values, respectively, per daily report. When no water is being taken the data must specify the gross take volume and calculated net take volume as zero.

7 The consent holder shall monitor the chemistry of the water abstracted under this consent. Prior to the commencement of this consent the sampling parameters and frequencies shall be agreed with the Waikato Regional Council, with the results forwarded to the Waikato Regional Council on an annual basis. The consent holder may change the sampling parameters and frequencies with the agreement of the Waikato Regional Council.

OTHER WATER USERS

8 If, in the opinion of the Waikato Regional Council, the exercise of this consent adversely affects any existing stock, domestic or other water supplies, then the consent holder shall, at its own cost, be responsible for providing to the owner of those water supplies an alternative equivalent water supply, to the satisfaction of Waikato Regional Council. The consent holder shall be responsible for making an alternative water supply available within 12 hours of being directed to do so by the Council.

MONITORING OF THE SHALLOW AND DEEP AQUIFERS

9 The consent holder shall upon commencement of this consent and at five yearly intervals thereafter, provide a report to the Waikato Regional Council commenting on the effect the groundwater take and dewatering activity is having on the deep and shallow aquifers under the Martha Pit and immediate surrounds. The report shall as a minimum, provide the following information:

(a) The nature of the geology under the Martha Pit and immediate surrounds;

(b) Comment on the existing groundwater chemistry for the deep and shallow

aquifers; (c) Comment on the groundwater levels in the deep and shallow aquifers; and

(e) Provide details of any wetland areas and any other known aquatic ecological values that are dependent on the surface contribution of shallow and deep groundwater outflows.

Taking into account all of this information (and any other relevant data) the consent holder shall provide comment on the effects the dewatering activity is having on the shallow and deep aquifers under the Martha Pit and immediate surrounds.

ADMINISTRATIVE CHARGES

10 The consent holder shall pay to the Waikato Regional Council any administrative charge fixed in accordance with Section 36 of the Resource Management Act 1991, or any charge prescribed in accordance with regulations made under Section 360 of that Act.

REVIEW OF CONDITIONS

11 Pursuant to Section 128(1)(a)(i) and (iii) of the Act, the Waikato Regional Council may, 12 months from the commencement of this consent and annually thereafter, or on receipt of any of the reports required by this consent, review any or all of the conditions of this consent for the following purposes:

(a) To review the effectiveness of the conditions of this resource consent in avoiding, remedying or mitigating any adverse effects on the environment that may arise from the exercise of this consent, and if necessary to avoid, remedy or mitigate such effects by way of further or amended conditions. In deciding to undertake a review and where further or amended conditions are deemed necessary, the Waikato Regional Council shall have regard to all of the information contained in the reports required under the conditions of this consent; or

(b) To address any adverse effects on the environment which have arisen as a result of the exercise of this consent that were not anticipated at the time of commencement of this consent; or

(c) To review the adequacy of, and the necessity for, any of the monitoring programmes or management plans that are part of the conditions of this consent.

12 Pursuant to Section 128(1)(a)(i) and (iii) of the Act, the Waikato Regional Council may review Conditions 41 to 46 in Schedule One of this consent following any change made to the Trust Deed referred to in Condition 41 of Schedule One.

Appendix B – Standard Operating Procedures

Standard Operating Procedure
Groundwater Monitoring
WAI-200-PRO-012

This is no longer a controlled document once printed.
This document must not be released outside of the company without permission of the Departmental Manager.

Area:	HSEC - Environment
Site:	Waihi

	Position/Title	**Name**	**Date**
Authored By:	Environmental Officer	Mark Burroughs	31/08/2016
Reviewed By:	Senior Environmental Officer	Russell Squire	23/11/2016
Approved By:	HSEC Manager	Kerry Watson	01/12/2016

	Document Name	**Document Reference**
Reference Documents	Water Management Plan	WAI-200-PLN-001
	QA-QC Data Entry	WAI-450-PRO-082

Document Issuance and Revision History

Procedure Name: **Groundwater Monitoring**

Document Reference: **WAI-200-PRO-012**

Revision No.	Revision Date	Section	Page	Description of Issuance or Revision	Effective Date
2.0	12/08/2016	All	All	OceanaGold format and update	1/12/2016

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1 PURPOSE

Groundwater surrounding the tailings storage facilities, Polishing Pond Stockpile and Favona underground workings is monitored by a network of groundwater bores. The depth of water and the water quality of these bores are monitored to ensure that there are no adverse effects on ground water quality. This programme provides data which indicates whether the tailings storage facilities (TSF) and stockpiles are performing as designed and predicted.

2 SCOPE

This procedure details the monitoring programme and procedures for collection of water samples from: Storage 1A and 2 wells and stockpile seepage detection wells.

3 RESPONSIBILITY

Environmental Technicians are responsible for the monitoring of groundwater bores.

Senior Environmental Staff are responsible for maintaining and checking monitoring data to detect any adverse effects of the TSF or stockpiles on groundwater.

4 JOB HAZARDS

- Access to sites. 4WD Vehicle required. Access by 4WD is to be reviewed at time of sampling to determine if access should be made by foot. Some paddocks are boggy and slippery in Winter.
- Sprain/Strain/Trip. Ensure safe lifting techniques when handling heavy sampling equipment. Uneven ground surfaces at Bore sites.
- Cattle. Avoid if animals are boisterous. Wait for animals to be relocated before entering area.
- Weather conditions. Seasonal precautions (warm clothing for winter, hydration and sun protection for summer). In strong winds, consider parking the vehicle to avoid door being wrenched from grip.

5 PROCEDURES

Required Labour Resources

1-2 people.

Monitoring Site Locations

The TSF groundwater monitoring locations are outlined in Figures 1 & 2 attached. The location of the stockpile seepage monitoring wells (Network 2) is shown in Figure 3.

4WD access to all groundwater monitoring locations should be reviewed prior to sampling. If conditions dictate (i.e. ground conditions, weather conditions, constricted access, etc.) access should be made by foot.

Monitoring Programme

The Tailings Storage Facility Monitoring Plan (WAI-200-PLN-010) provides a detailed monitoring programme for the groundwater bores. This is summarised below:

Selected bores:

Six Monthly Scan Wells	Scan	(Field pH, Temp and EC)
Six Monthly Scan and Sample Wells	Full Analysis	(Code 40)

The Dewatering and Settlement Monitoring Plan (WAI-200-PLN-009) provides a detailed monitoring programme for the stockpile seepage (Network 2) monitoring wells: This is summarised below:

All bores:

Monthly	Scan	Field pH, Temp and EC
Six Monthly	Full Analysis	Code 40

Six monthly scan and water sampling will endeavour to be conducted in January and July.

Field Work Preparation and Required Equipment

Equipment Checklist:

Field

- 12V Monsoon pump and compressed air cylinder and regulator AND/OR MP15 Controller and Power Pack (including CO_2 cylinder)
- Flow Cell
- Water level probe
- InViron CoC sheet
- Sample containers if required
- Filter Kits and Inline Filters
- Pen
- Chilly bin for full samples and ice packs (if required)
- 10L bucket
- Sampling fishing rod & line
- Calibration buffer solutions (pH 7.00 and 4.01)
- Disposable Bailers
- Keys to padlocks
- Calculator
- pH / conductivity / temperature meter
- Map
- Shallow bore maximum clearance depths – available on G:\Environmental\Monitoring Data\Bore depths for bailing
- Powderless sampling gloves
- Groundwater bores trigger sheet WAI-200-REG-001

General

- Mobile phone
- Wet weather gear
- P.P.E.
- Towel

Field Work Preparation

Calibrate the Flow Cell sonde and the portable pH meter using pH 4.01 and 7.0 solutions according to the instruction manual which is stored with pH meter at the environmental lab.

If sample bottles are required (January and July), sample bottles, chilly bins and cool packs need to be prepared prior to each field visit.

The compressed air cylinder for the well wizard pump controller is stored at the Enviro Lab.

The CO_2 cylinder for the MP15 Controller filled by Fire Services Ltd. Arrange with FSL to get them filled..

The sample bottles required for each groundwater bore are:

Scan Wells

6 monthly

1x 1L – field pH, conductivity and temperature – tested at Enviro Lab and in field with portable Cyberscan Meter

Scan and Sample Wells

Code 40

1x 1L General Chemical Analysis bottle

1x 250ml CN Analysis bottle

1x 100ml Filtered Trace Metals Analysis bottle and filter kit

1x 250ml TKN/COD Analysis bottle

Field Procedures

There are two types of bores that are sampled, namely shallow and deep. The deep bores can be purged automatically as they are fitted with a dedicated pump. Shallow bores not fitted with a dedicated pump require manual volumetric purging with a bailer to remove the stagnant water.

Site

- Unlock well. Remove cap and place so as not to interfere with sampling activities.
- Put on powderless gloves
- Record details in a notebook.
- Measure 'depth to water'.. All measurements are made from a measuring point taken as the top of the PVC pipe.
- Scan and Sampled samples are taken back to the Enviro lab for field measurements.

Shallow bores - Purging and sample collection

- The shallow bores require manual volumetric purging with a bailer to remove firstly the stagnant water and then the representative sample.
- The amount of water that needs to be extracted from the bore needs is dependent on the depth of water in the bore and hence varies between site visits.
- The volume of stagnant water that needs to be purged before a sample can be taken has to be calculated using the 'depth to water', 'maximum clear depth' and the 'x-sectional area of the bore'.

CALCULATION:

$$V = [(MCD) – (DTW)] * (X\text{-Sectional Area of Casing}*3000)$$

$$V = 5.8905 * [(MCD) – (DTW)]$$

Where:

V= 3 times the bore casing volume (litres)

DTW= Depth To Water (m)

X-Sect. Area of Casing*3000 = $\pi D^2/4$ (m^2)*3000 = 5.8905 *(only valid for 50mm ϕ casings)*

D= Casing diameter (m) = 0.05m

NOTE: *The factor of 3000 multiplies the casing volume by 3, and converts the casing volume from m^3 to litres.*

(For simple reckoning, a 50mm casing contains 2 litres per m.)

- Attach the sampling 'fishing' line to a clean disposable bailer using a suitable knot (i.e. a fisherman's knot, two reef knots or three granny knots).
- Lower the bailer into the water column to a depth equal to the length of the bailer. (The sound of air being forced out of the bailer will indicate that it is full of water).
- Extract the bailer from the bore with the rope and pour water into the bucket.
- Repeat steps until the required volume of water has been purged and the bucket has been rinsed well with bore water.
- If samples are required, bail more groundwater and carefully fill the appropriate sample bottles.
- Place the full samples in the chilly bin.
- Replace the lid on the shallow bore and lock it up.
- On completion of sampling run return to laboratory and place samples in refrigerator immediately, or begin lab analysis.

Deep bores - Purging and sample collection

- The flow cell needs to be calibrated for pH and EC at the start of each monitoring day.
- The deep bores require purging to remove the stagnant water. The purging is complete when the pH and conductivity readings become stable as measured by the flow cell meter.

Monsoon Pump:

- Remove any existing infrastructure already down bore. Coil hoses onto a laid-out tarpaulin to minimise contamination.
- Place hose reel above bore and slowly lower the pump/hose/cable. Minimise rubbing of the hose/cable against the side of the bore collar or standpipe.
- Once pump has been lowered to the desired depth (this will depend on the water levels, bore construction and aim of the purging) fasten the hose becket to the hose/cable so the pump is suspended off the bottom of the bore. This will reduce sediment disturbance, optimise pump performance, and reduce wear on the pump impellors.
- Connect the pump controller to the pump cable via the Anderson plug and either plug the controller into the custom plug on the LV or use the back-up battery clips if the LV has no plug installed.
- Lower the dip-meter down below the current water level. This will have to be lowered and raised as purging is undertaken to monitor the water level in the bore.
- Run the pump, delivering water into the 10L bucket to monitor both water clarity and quantity.
- Manage the pump speed, with the aim of achieving a steady-state pumping rate whereby the water level ceases to fall and an acceptable flow rate is achieved.
- *For purging less than 10 minutes, running the LV should not be required (the controller has an automatic shut-off if battery charge falls below 11V, retaining sufficient to restart vehicles). If purging continues for a sustained period, the LV should be started and run on idle occasionally to recover battery charge and continue pump operation. If vehicle is run on idle to recharge, it will not be in gear; chock vehicle wheels to prevent uncontrolled movement.*
- The goal is to extract at least three times the water volume in the bore AND have water samples of good clarity (indicating minimal sediment).
- Once purging has been completed, disconnect the controller from the LV, then the pump. Reel in the dip-meter.

- Place the hose reel above the bore, disconnect the hose becket, and slowly reel the pump up. Take care to minimize abrasion of the hose/cable against the bore collar or standpipe.
- Replace any existing infrastructure back into the bore, taking care to minimize contamination (dirt, manure, grease etc.).
- Pack equipment away. Take care to remove the wheel chocks before trying to drive away.
- Rinse the hose reel with potable water before packing it away in the Environmental lab.

OR

Using MP15 Controller and Power Pack:

- Connect Controller to deep bore
- Open the CO_2 cylinder valve
- Switch controller on and press start.
- Connect the clear plastic hose between the deep bore and the flow cell sonde.
- Turn the flow cell meter on.
- The system should start purging and water should be forced through the flow cell sonde and discharge out the clear plastic outlet hose.
- Allow the purge cycle to continue until the pH and conductivity measurements stabilise.
- Once the pH and conductivity measurements stabilise the values (along with the temperature) are recorded in the sample book.
- Disconnect the clear plastic hose leading from the deep bore to the flow cell sonde. The water should now discharge out of the short plastic hose from the bore, ready for samples to be collected if required.
- Fill the appropriate sample bottles.
- If required attach the in-line filter mechanism to the end of the hose in the correct direction. There is an arrow on the side of the filter indicating the correct direction for flow. Let one purge pulse discharge through the filter.
- Then fill the 100ml Trace metal bottle (filtered).
- Disconnect the filter before the pump is turned off.
- *If using MP15 Controller and Pump* – close CO_2 cylinder valve and switch controller off.
- Disconnect all hoses and carefully store them until the next site.
- On completion of sampling run return to laboratory and place samples in refrigerator immediately.

Sample Verification

- At the completion of each sampling run a check is made on the samples before they are put in the refrigerator. The samples are checked for numbering continuity and for total numbers.
- All sample bottles should be placed in the laboratory fridge immediately after the sample run and sample check is completed.
- For scan monitoring, enter field pH, conductivity, temperature and water level into database and check results against trigger levels (refer to the current Groundwater trigger Levels excel sheet). If a trigger level is exceeded, inform Senior Environmental Staff immediately and initiate further field checks on groundwater bore.

Sample Dispatch

- RJ Hill Laboratories, 1 Clyde Street, Hamilton
- Fill out a sample submission form. This includes instructions on laboratory analysis parameters, shipping details and courier details. A copy of this sheet is forwarded to the lab and the remaining copies are filed in the environmental office.

- Take all of the sample bottles out of the refrigerator and place in a chilly bin.
- Place submission form inside chilly bin with the samples.
- Put the lid on the chill bin and stick the address on the lid with tape.
- Stick the appropriate number of courier stickers on the lid of the chilly bin.
- Telephone the courier before 4pm and ask them to collect the chilly bin.

NOTES

- Field equipment is regularly checked for good working order.
- Field instrumentation is regularly calibrated against appropriate standards and recorded. Field instrumentation is used to determine pH, EC and Water level.
- Maxter sterile powder-free gloves are to be worn during all sampling and filtering.
- Sample equipment and workspace should be maintained in a clean condition and free of likely contamination.
- Manuals for use of Flow Cell and Monsoon pump are kept in the environmental technician's office.

Chain of Custody

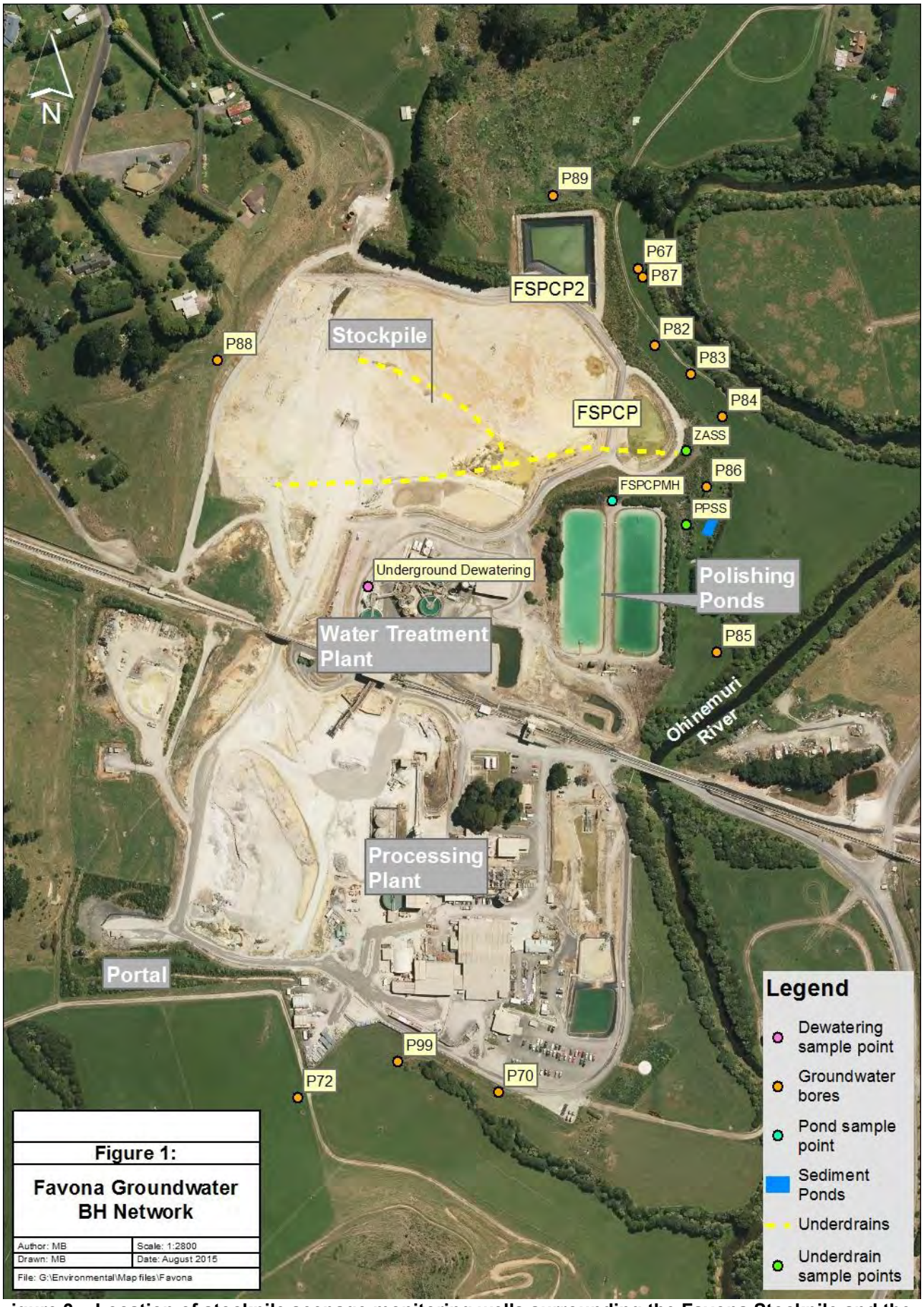
- The chain of custody and records control for groundwater sampling consists of the Waihi Gold sample submission register and sample runs recorded in InViron.

Water Quality Database

- Results from the R J Hill Laboratory are automatically imported into InViron.
- Enter field data into the sample run in InViron.

Figure 1: Scan wells

Figure 2: Scan and sample wells



igure 3 – Location of stockpile seepage monitoring wells surrounding the Favona Stockpile and the Polishing Pond Stockpile.

Standard Operating Procedure
Pit Surface Runoff Sampling
WAI-200-PRO-024

Area:	HSEC - Environment
Site:	Waihi

	Position/Title	**Name**	**Date**
Authored By:	Environmental Officer	Mark Burroughs	9/09/2016
Reviewed By:	Senior Environmental Adviser	Russell Squire	28/11/2016
Approved By:	HSEC Manager	Kerry Watson	01/12/2016

	Document Name	**Document Reference**
Reference Documents		

Document Issuance and Revision History

Procedure Name: **Pit Surface Runoff Sampling**

Document Reference: **WAI-200-PRO-024**

Revision No.	Revision Date	Section	Page	Description of Issuance or Revision	Effective Date
2.0				Review changes required	1/12/2016

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1 PURPOSE

Pit surface water runoff sampling aims to sample pit wall runoff from above final lake level 1104 mRL.

THE MONITORING PROGRAMME THIS DOCUMENT REFERS TO IS UNDER EXTERNAL REVIEW AND LIKELY TO CHANGE (09/09/2016).

To monitor the chemistry of the pit wall runoff to:

- Achieve compliance with the requirements of WRC Resource Consent 971286 (Pit Dewatering), Condition 11,
- Ensure that accurate input data is collected for the purposes of pit lake water quality modelling.

Establish the necessary precautionary measures to reduce the risk of injury to people and/or damage to equipment, when people are collecting surface water runoff from pit walls during rain events.

2 SCOPE

This procedure will apply to personnel undertaking pit surface runoff sampling in the pit in preparation for, during, and after rain events.

This may include:

- Environmental Department staff

3 ACCOUNTABILITIES

Environmental Technicians – field work preparation, sampling, sample despatch, data entry.

Senior Environmental Staff – data analysis and reporting as per consent requirement.

4 JOB HAZARDS

Sampling personnel need to be aware of the following hazards:

- Falling rocks
- Potentially unstable batters & benches
- Steep, slippery and bouldery surfaces
- Friction burns and pinches from ropes,
- Trucks and other vehicles.
- Pit blasting
- Sample preservatives (acid)
- Normally safe practises made more difficult by wet conditions

Appropriate PPE must be worn and safety equipment utilised at all times while in the pit:

- Hard hat (preferably with chin strap) or climbing helmet
- High visibility clothing
- Steel cap boots
- Safety glasses
- Two way radio (handheld, as some sites are away from the vehicle)
- Flag & flashing light on 4x4 vehicle

- Wet weather gear as necessary.
- Backpack for negotiating slopes
- A second person to spot when working under steep batters during rain events.

Sampling personnel are to be inducted for the open pit and familiar with the following documents/SOP's:

- Relevant site specific induction
- Relevant Working Adjacent to Highwalls
- Relevant Pit evacuation procedure

Liaison must be made with relevant Martha Pit personnel to make them aware of sampling personnel within the pit area and discuss any current pit protocols.

Access to sample sites O1, O2, & PM3 is down the batter from the roadway above. Utilise ropes for added security when descending and ascending the batters. Carry sampling equipment in backpack to free hands when negotiating slopes.

Access to sample sites SU1, O3 & O4 is via the western pit perimeter road.

5 PROCEDURES

5.1 Monitoring Locations

There are currently six sample sites (Attachment 1), however these may change in the future as new sites may be established or existing sites decommissioned:

- Oxidised (4 sites)
- Post Mineralised (1 site)
- Unoxidised (5 sites) – 1 on the south wall

The sampling sites consist of trial areas that are each surrounded by diversion drainage channels to ensure runoff is confined to the area of the pit wall with known geology and acid forming potential. The base of each trial site has guttering that drains to a bucket to collect the runoff from rainfall events. (Refer Attachment 3).

The sites should be inspected periodically during rainfall events to ensure the sites are operating as designed and maintenance undertaken as necessary. Faults may include but are not limited to:

- Sediment buildup in the diversion drains allowing off-site water onto the trial sites,
- Sediment buildup in collection guttering blocking collection pipe or overflowing guttering,
- Sealant in the collection guttering failing and runoff not being collected,
- Ball valve on buckets filling with sediment and not shutting off, causing overfilling.

5.2 Sampling Frequency and Methodology

Pit surface water runoff sampling is to be conducted periodically, whenever forecasts or conditions indicate a good probability of collecting enough runoff to constitute a sample, and with enough time to collect and preserve the samples during work hours.

Each sampling event shall include the following:

- Senior Environmental Staff and Environmental Technician to assess rain event for sampling potential – is there likely to be enough runoff? Once the buckets have been set up, 3-4 mm of consistent rain should provide sufficient water to enable sampling.
- When a suitable rainfall event is forecast an Environment Technician will go and connect sample buckets to collection pipes. Sample buckets are to be empty, clean (free of any iron staining), and decontaminated.
- Samples should be collected within 4 hours of runoff entering the bucket wherever possible. This is required to minimise the changes in sample chemistry from water standing in the bucket.
- Where practicable, courier samples to the lab (RJ Hill) the same day using the midday courier, again to minimise changes in sample chemistry.

Field Work Preparation and Required Sampling Equipment

Sampling Equipment Checklist:

- Sample containers (each site's requirements, pre-labelled and dated & plastic-bagged together).
- Spare filters
- Powderless latex gloves
- Sample sheet
- Pen
- Two pH/Conductivity/Temp meters and Redox meter (all instruments to be calibrated before use) Chilly bins & ice bricks
- A backpack for carrying equipment to several sample sites to enable hands to be free when climbing pit slopes.

5.3 Sample Analysis and Containers

Each site shall be monitored for the following parameter code as detailed in the Water Sampling Schedule.

Samples are to be collected for laboratory analysis (**Code 48** profile) at Hills Laboratory in Hamilton.

Sample Bottle Checklist

- UP1L Chemical analysis
- N250 Total metals analysis
- S250 TKN/COD analysis
- Filter kit with FN100 Dissolved metals analysis
- TOC125 Total Organic Carbon analysis

Chemical analysis is undertaken using Standard Methods for the Examination of Water and Wastewater (19th Edition 1995, or updates), APHA, AWWA and WEF; analyses is carried out by an appropriately qualified laboratory (referred below).

5.4 Field Procedures

- **Note**: The sample buckets should be agitated as little as possible during sample collection to avoid disturbing sediment unnecessarily. Disturbed sediment may alter the analytical result and make field filtering more difficult.
- On arriving at each monitoring site immerse monitoring probes into sample bucket to allow readings to settle. The low pH meter is to be used on the unoxidised sites (SU1, & NU1,6 & 7).

- The following sample details are to be recorded:
    - Date
    - Time
    - Site location number and if relevant, bucket number
    - If bucket full, overflowing, or amount of water in bucket if not full
    - Whether it is still raining
    - Status of sample e.g. first flush/flow from guttering
    - If bucket not full,can runoff be observed flowing into the bucket?
    - Field pH, EC, temperature, Eh
    - Whether the guttering is achieving its purpose of confining runoff from the trial area,
    - Whether any maintenance of the site is necessary,
    - Any other relevant data, e.g. high suspended solids & number of filters used, whether site is vegetated, health of vegetation, anything unusual etc,
    - Bucket sample description – water colour & clarity, & sediment (suspended or settled) quanitiy, colour and consistency
- Fill required sample containers with water. The unpreserved 1L bottle should be used to decant water from near the surface of the bucket to fill the other bottles. If insufficient sample exists to fill all of the bottles, the priority order for sampling is as follows (most important to least important): chemical analysis (UP1L) (note fill to 50% full as a minimum), filtered metals analysis (FN 100), unfiltered metals analyses (N250), nutrient analysis (S250), TOC analysis (TOC125).
- Filtering kits supplied by Hill Laboratories are to be used for the “FN100 - Trace metals - field filtered” bottle. If suspended solids are high, filtering of the sample can be difficult and several filters may be required. If filtering is difficult, it is not necessary to totally fill the bottle – 50 ml is sufficient.
- Empty the sample bucket, noting the quantity/details of any soilds in the bucket.
- Place samples in chilly bin and transport back to OceanaGold environmental laboratory. If samples cannot be couriered to reach Hill Laboratories that day, they shuld be keptin refrigerated storage (no longer than 24 hrs).

5.5 Sample Dispatch

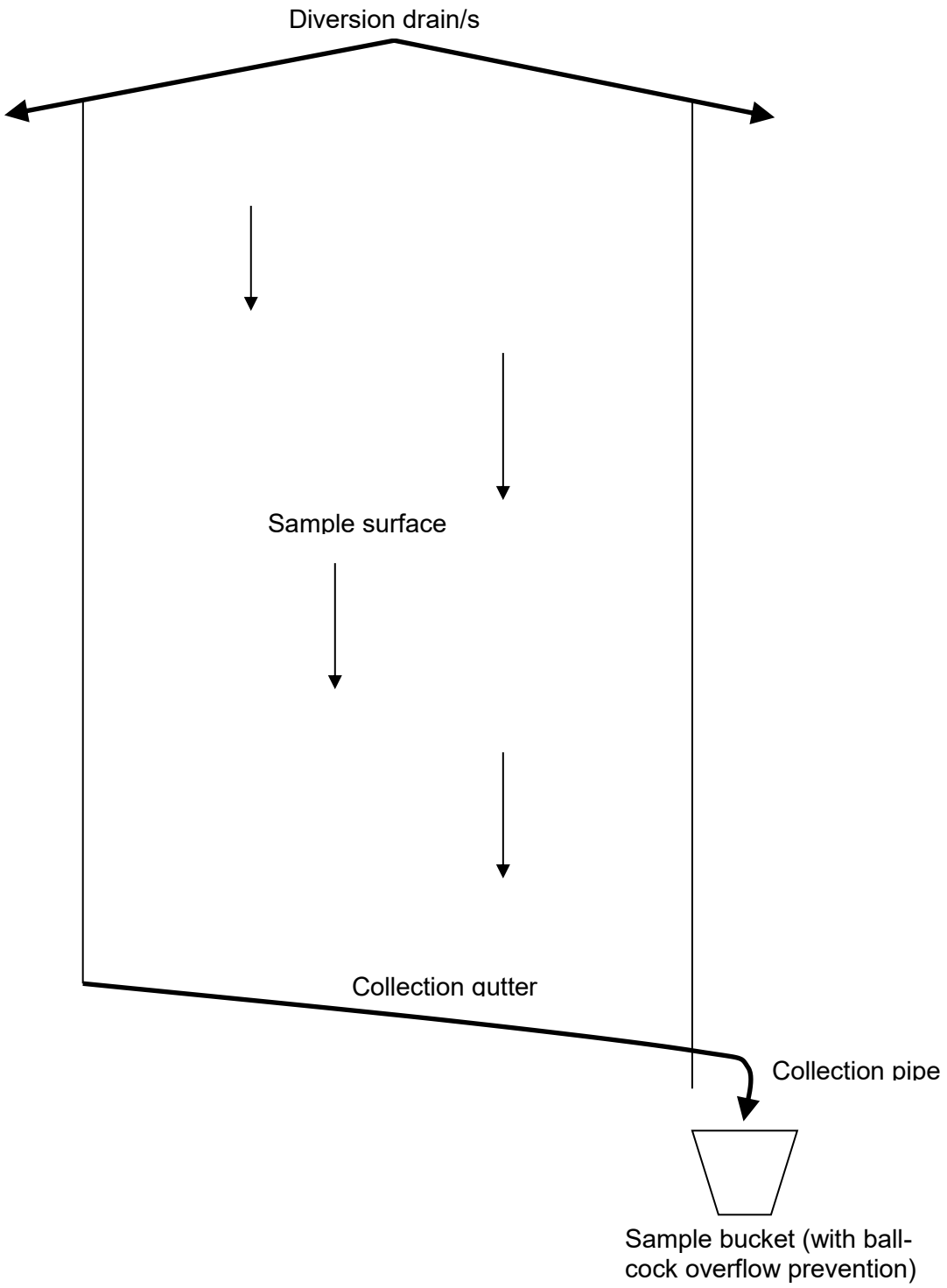
- Samples are dispatched by courier to Hill Laboratories Ltd, 1 Clyde Street, Hamilton.
- Complete a sample submission form. This includes instructions on laboratory analysis parameters, shipping details and courier details. A copy of this sheet is forwarded to the lab and the remaining copies are filed in the environmental office.
- The CoC sheet is to have the following additional notes:
    - In the comments panel below, write **"Warning: Some Samples May Contain High levels"** (to alert the lab prior to analysis)
- Take all of the sample bottles out of the refrigerator and place ice packs.
- Place submission form in a sealed plastic bag and place inside the chilly bin with the samples.
- Put the lid on the chilly bin, stick the address on the lid, and tape down the lid.
- Stick the appropriate number of courier stickers on the lid of the chilly bin.
- Contact the courier to request pick-up of samples. Using the late afternoon courier pick up should be avoided as the samples will overnight out of refrigeration (it is better to refrigerate in the OceanaGold environmental laboratory overnight and catch the first courier the following day).
- Update the Sample Submission Register spreadsheet appropriately (G:\Environmental\Water Management\Water Quality\Results Pending entry\Sample Submission Register.xls).
- Note in the Field Observation Spreadsheet the amount of rain since the beginning of the rain event, the time the rain event began and last time it rained G:\Environmental\Water Management\Pit

WQ\Pit Lake Quality Sampling\Water Quality Data\Field records. Complete the spreadsheet with the additional field data and comments. Save the spreadsheet in the manner year/month/date e.g. “Field observation 111121.xls”.

Attachment 1 – Pit Wall Sampling Sites

Note: NU1, NU5-NU7 inaccessible or lost due to pit instability. Sites to be reviewed when sampling recommences

Attachment 2 – Pit Wall Sampling Site Design



Standard Operating Procedure
Management of Surface Intersecting Drill Holes

WAI-400-PRO-076

Area:	Underground
Site:	Waihi

	Position/Title	**Name**	**Date**
Authored By:	Underground Mine Manager	Charlie Gawith	December 2013
Reviewed By:	Mine Geologist	Tyler White	14 November 2016
Approved By:	Underground Technical Services Superintendent	David Townsend	14 November 2016

	Document Name	**Document Reference**
Reference Documents		

Document Issuance and Revision History

Procedure Name: **Management of Surface Intersecting Drill Holes**

Document Reference: **WAI-400-PRO-076**

Revision No.	Revision Date	Section	Page	Description of Issuance or Revision	Effective Date
1.0		All	All	New Document	20/1/2014
2.0	1/11/2015	All	All	Reformat to OGNZL	1/11/2015
3.0	14/11/2016	6 3, 5	7 4, 5	Wording added relating to record keeping and the provision of results to HDC. Minor wording changes to sections 3 and 5 to correct errors.	14/11/2016

Table of Contents

1 PURPOSE

This standard defines the procedure to be followed when a diamond drillhole from surface (RC or diamond drill holes) is intersected in development excavations underground. It differentiates between the treatment of drill holes that are dry (or contain limited water) and those that are producing significant quantities of water. Also included are references to the design and treatment of drill holes intended specifically as de-watering holes that have a long service life.

2 SCOPE

This standard applies to all personnel working in the Waihi Underground Operations (OceanaGold/LCMD employees and contractors). People responsible for initiating, designing and laying-out of de-watering drillhole programs also need to be aware of this procedure.

3 BACKGROUND

Un-grouted drillholes of all sizes pose a problem in the underground workings because they may serve as a conduit for the inflow of water into the workings from surface sources or from natural water sources underground or from man-made dams or sumps.

The current underground diamond drilling contract requires that all diamond drillholes will be collar grouted to a minimum depth of six metres unless specified otherwise. Examples of exceptions would be drain holes or piezometer holes which have no grouting or holes that specifically require full-hole grouting. Holes drilled for long-term de-watering purposes are also not grouted.

Current and past surface drillholes are capped (poly-pipe inserted in the upper hole with a cement block placed over the collar at a 1 metre down-hole depth and covered by dirt) but not fully grouted.

All drillholes that are not fully grouted can potentially act as conduits connecting sources of water (fissures, dams, pits etc) with new or pre-existing development headings or stopes. These drillholes need to be dealt with to minimise or prevent the risk of water inrush to the underground workings or the effects of localised surface dewatering.

4 REQUIREMENTS

4.1 Permits

- OceanaGold Waihi Site Induction
- General underground induction

4.2 Equipment

- Flygt pumps
- Solo
- Extension cables
- Personal DANGER lock and tag

4.3 Additional PPE Requirements

Nil

4.4 Signage

4.5 Major Hazards

- Flooding/Inrush
- Surface Subsidence
- Breach of Consent Conditions

5 PROCEDURE

Steps	Procedure	Important Information
Intersecting "Dry" Diamond Drillholes	All surface drillholes that are expected to intersect underground development headings will be clearly marked on development mine plan approval documents by the engineer designing them. This will serve as a means of alerting the production personnel that there may be water present in these drillholes and will allow the shift supervisor to plan for the grouting of the expected drillholes if required. All surface drillholes that are intersected in underground development headings are to be inspected by the shift supervisors and closely monitored to ensure they are not producing an excessive volume of water.	**An excessive volume of water will be considered as a constant flow of water that is more than could be expected from the void volume of the drillhole.**
Intersecting Water Producing Diamond Drillholes	This portion of the procedure refers only to drillholes that continue to produce water once the initial water present in the drillhole should have drained out i.e. only those holes that are somehow connected to a source of water such as the upper aquifer. Once monitoring has determined that a drillhole is producing more water than can reasonably be expected to have been contained in the original	

Steps	Procedure	Important Information
	drillhole volume the hole will require plugging and grouting. The Underground Supervisor will immediately notify the Underground Manager of any intersected surface hole that has significant and sustained water flows. An incident will be raised in order to track all facets of the management of the drillhole plugging and the Geology and Engineering functions will determine the most likely surface hole that has been intersected. Following identification of the surface drillhole geology will notify the environmental department with the location of the collar of the hole and the estimated volume of water that the hole is producing. The Environmental Department will then identify the closest piezometer locations and review the piezometer levels in the vicinity to ascertain if there was any water pressure response to the interception of the drillholes. It is expected pressures will return to pre interception levels. A minimum of thirty metres of grout should be placed to ensure that it will withstand the high water pressure heads expected in long surface drillholes once the plug is in place and the hole is flooded with water. If the water-producing hole cannot be grouted by normal means due to water flow then a van Ruth plug (grout and water control packer variety) with a pipe extension and a tap fitting should be inserted into the hole and locked in place. The tap can then be used to control the water flow. The plug is there to control the water flow until alternative arrangements can be made to deal with the water volumes encountered. All installed van Ruth plugs need to be sealed with suitable grout within two days of the date that they were installed. This seal comprises injecting cement (under pressure if necessary) to fill at least thirty meters of the drillhole immediately behind the plug.	**The flow of water must be controlled within 36 hours of being intersected.** **In the event that the recovery in water pressures does not return fully to the pre-drained state, geotechnical advice will be sought regarding the need for more immediate investigations.** **The tap of the van Ruth plug should not be left closed for extended periods as significant pressure build-up behind the van Ruth is possible.** **All completed grouting operations, where van Ruth plugs are involved, are to be reported to and recorded by the geology department.**

Steps	Procedure	Important Information
	If holes are unable to be grouted normally a specialist in the field of pressure grouting drillholes should be employed to seal holes. Once completed piezometer levels in the vicinity should be rechecked to ascertain there is subsequent recovery of pressures.	

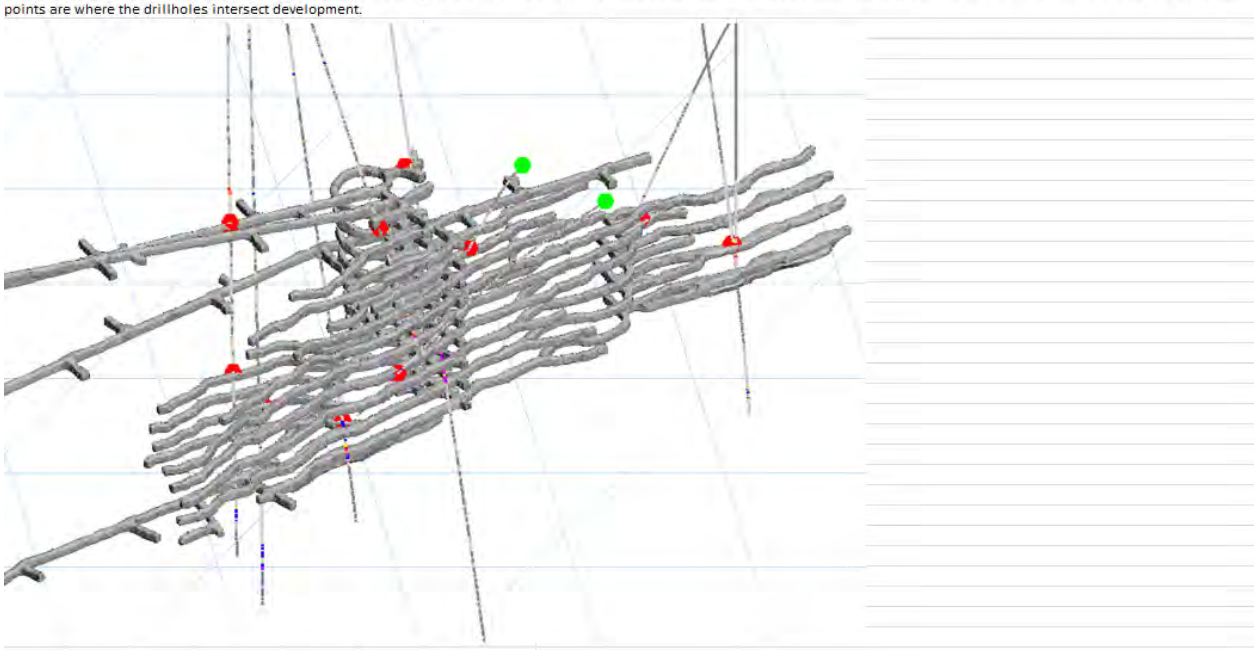
6 DOCUMENTATION

A record of surface drillholes intersected by underground workings is kept in the following location: G:\Mining\Geology\Correnso\Drilling\Surface Drill Holes Intersected. The report contains information such as: date of intersection, co-ordinates of intersection, water status – whether it is producing water or not and at what rate.

The following is an example taken from the document which has been completed for the Correnso underground mine:

Hole ID	Level	Drive	E	N	m.R.L	Date intersected	Pickup	Grouting status	Comments
CGD008	810	C4-FW	396488.5	643473.4	821.4	13/06/2015	Estimated	Not grouted	Hole dry - no evidence of being a water conduit at this level: no Fe staining
UW320	912	ACC	396431.997	643265.11	917.774	13/04/2015	Surveyed	Not grouted	Hole dry
UW348	900	C1-N	396520.5	643263.45	907.62	14/12/2015	Estimated	Grouted	Trickling water which ceased within a day - grouted 16/12/2015
UW358A	900	C1-S	396586.70	643035.20	910.55	25/07/2016	Estimated	Grouted	Low flow, originally grouted within 12 hours, re-grouted after 36 hours. Surrounding split sets grouted as were acting as a conduit. Flow was approximately 1ltr/min
UW365	810	C4-FW	396488.4	643474.8	821.4	9/06/2015	Estimated	Not grouted	Hole dry
UW368	825	C7-S	396515.304	643114.23	833.067	26/08/2015	Surveyed	Grouted	Minor flow - hole re-grouted 16/12/2015
UW386	915	ORE PASS	396482.291	643218.53	914.937	4/02/2015	Surveyed	Not grouted	Hole dry - now in ore pass
UW390	840	C1-S	396541.39	643198.97	844.082	25/03/2015	Surveyed	Not grouted	Hole dry - no evidence of being a water conduit at this level: no Fe staining
UW393	840	C4-HW	396472.922	643416.31	851.398	16/08/2015	Estimated	Not grouted	Hole dry
UW402	953	CDD	396449.3	643126.9	930.5	17/12/2014	Surveyed	Grouted	Hole was producing minimal water for only a few hours
UW402	855	C7-S	396515.03	643092.42	864.645	18/10/2015	Surveyed	Not grouted	Dry - second time intersecting hole with development - was grouted on the 953

Below is an oblique view looking north-west of Correnso development with surface drillholes intersected and their pierce points. Green points are the drillhole collars in view while the red points are where the drillholes intersect development.



The spreadsheet record will be updated within 48 hours of intersecting a drillhole.

These records will be available for review upon request by Hauraki District Council.

7 MONITORING AND REVIEW

This procedure is to be reviewed every 36 months as a minimum and immediately following any related incident.

Standard Operating Procedure
Township Piezometers Network Monitoring
WAI-200-PRO-021

Area:	Environment
Site:	Waihi

	Position/Title	**Name**	**Date**
Authored By:	Senior Environmental Advisor	Mark Burroughs	9/7/2018
Reviewed By:			
Approved By:	HSE Manager	Dan Calderwood	11/7/2018

	Document Name	**Document Reference**
Reference Documents		

Document Issuance and Revision History

Procedure Name: **Township Piezometers Network Monitoring**

Document Reference: **WAI-200-PRO-021**

Revision No.	Revision Date	Section	Page	Description of Issuance or Revision	Effective Date
1.0				Transition to OG	1/11/2015
2.0	9/7/2018		5-10	Add procedure for filing pneumatic slope indicator with nitrogen. Review fields procedure for pneumatic piezometer reading for new slope indicator.	11/7/2018

Table of Contents

1 PURPOSE

To monitor monthly the piezometer network around the open pit within the Waihi Township in accordance with the Dewatering and Settlement Monitoring Plan, in order to comply with the requirements of Water Permit 971286 Condition 8.

Monitoring is also in accordance with the Favona Settlement, Dewatering & Water Quality Monitoring Plan, which is a requirement of Waikato Regional Council Resource Consents 109742, 109743, 109744, 109745 and 109746.

2 SCOPE

The deep mark ("DM"), bore hole ("BH"), and "P" series piezometers, and pneumatic piezometers are part of a network of piezometers commissioned by OceanaGold to monitor the local and regional effects of dewatering of Martha Mine and Favona Underground Mine. OceanaGold also monitors selected private water bores to monitor potential effects of dewatering.

3 ACCOUNTABILITIES

Environmental Technician - Field work preparation, data collection and entry.

Environmental Officer - Analyses data and reports to Council as per consent requirement.

4 JOB HAZARDS

Traffic – When working near the roadside ensure that you are wearing hi-viz clothing and your vehicle is parked safely off the roadside.

Meteorological conditions –

- **Sun-** Wear a hat and apply sunscreen when exposed to intense UV rays. Ensure you have a sufficient supply of water to avoid dehydration.
- **Cold-** Wear adequate warm clothing when working in cold conditions and wet weather gear when working in the rain.
- **Livestock/Horses-** Before entering a paddock where livestock or horses are present, watch the animals behavior for a few minutes to ensure the animals are not agitated or acting aggressively. If the animals are acting aggressively avoiding entering paddock until they have been removed from the paddock.

5 PROCEDURES

Required Labour Resources

1 Person

Monitoring Site Locations

The piezometer site locations are outlined in: G:\Environmental\Monitoring\Data\Piezometers\PIEZOMETER NETWORK – Data Entry.xls and are documented in the "Dewatering & Settlement Monitoring Plan".

The piezometer sites are labelled with a 'P', 'BH','DM' and 'WC' prefix. The privately owned bores are identified by their location.

Field Work Preparation

Equipment Checklist:

- Screwdriver/ Water meter lid opener
- Clipboard and blank 'Field Sheet' (NWO-ENV-009-F7) - see example in G:\Environmental\Monitoring Data\Piezometers\PIEZOMETER NETWORK - Data Entry.xls
- Pen
- Security Gate Key (M1) , V Key and K Key
- Piezometer Allen key
- Security socket key
- Water Level Meter/"AquaDipper"
- Macqua Dipper stand
- Location Map
- Pneumatic Piezometer Readout Unit
- Last month's field sheet to compare data whilst in the field

Field Procedures – 'DM', 'BH' and 'P' Series

- On arrival to site, assess safety.
- Leave gates as they are found.
- Unlock padlock if present.
- Using a screwdriver, remove lid of meter box (some boxes require the Allen key or special socket wrench).
- Remove cap off PVC pipe in numerical order. One cap at a time to avoid confusion of results.
- Turn the dipper switch to 'On'
- Lower dipper probe down hole slowly. Be careful to ensure that the cable does not rub against the sharp edge of the steel standpipe casing (this can damage the cable insulation and expose/break the wires). Additionally, allowing the reel to free fall at great speed may damage the reel axle.
- When dipper beeps you have reached the water level. Raise and lower the probe until the beeper just comes on.
- Record this measurement (to the nearest cm, recorded at the highest part of the PVC pipe) on the field sheet in appropriate column. Wind the cable back up, (again ensuring the cable does not rub against the steel standpipe). In addition, slow down your wind up towards the end of the wind as you may get hit by the probe.
- Replace cap of piezometer to avoid mixing up numbered caps.
- Repeat for remaining piezometers.
- Replace lid of meter box.
- Padlock lid (if present).
- Turn the dipper switch to 'Off" to conserve battery power.
- Periodically check the end of the probe to ensure the contacts are clean and clear.

NB: Every six months (Feb, Aug) the piezometers are to be measured for "Depth to Bottom". At this time, after each piezometer water level is recorded, the water level probe is lowered until it hits bottom. This measurement is recorded on the field sheet in the appropriate column.

Checking the end of the probe is particularly important during this measuring, as the probe may hit mud at the bottom. This impedes the measuring capability of the meter and it may need to be cleaned in water.

Additionally it is useful to update the field sheet “Depth to bottom” column each quarter as this information can change.

Field Procedures – Pneumatic Piezometers

- At least 750psi of Nitrogen is required to take a reading. If the psi is low, refilling can be done at the Environmental lab at Kenny Street. Filling is to be carried out by qualified approved handlers.
- Fill no higher than 2000 psi.

Filling the Tank

1. Use the filler hose to charge the internal tank with nitrogen gas from the small nitrogen bottle. Use the screw-in fitting to connect to the external nitrogen cylinder. Connect the socket end of the hose to the tank fill plug on the indicator.
2. Turn the tank control valve to the Off position to prevent gas from escaping from the tank. Turn the regulator knob counterclockwise until the regulated pressure gauge reads zero. This protects the regulator.
3. Slowly open the valve of the nitrogen cylinder - typically less than one full turn - and begin filling tank.
4. When the tank pressure gauge reads 2,000 psi(maximum fill), close the valve on the external cylinder.
5. Check that the valve on the external cylinder is turned off, then carefully loosen the hose fitting at the cylinder to release pressure from the filler hose. The filler hose connection to the indicator is made so that no gas will escape from the indicator tank.
6. Disconnect the filler hose from the indicator, and finally, disconnect the filler hose from the cylinder.
7. Record date of filling in Fillers Log for Pneumatic Pressure Indicator

Note: Tank pressure normally drops 100 to 200 psi after the gas in the tank cools.

- It is recommended to measure each piezometer in order and one at a time to reduce the chance of a mix up-occurring.

Set Up

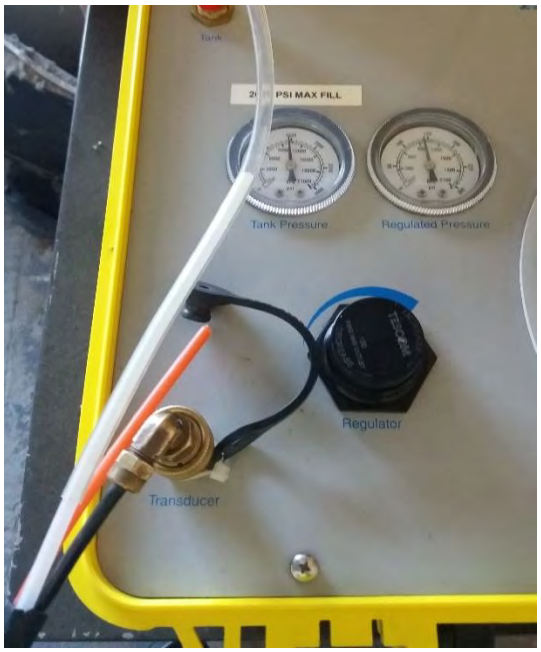
1. Before leaving for the site, check that you have enough gas in the tank. The tank pressure should be higher than 52 bar or 750 psi. Refill the tank, if necessary.

2. Check the regulated pressure. As a general rule, it should be no higher than the pressure rating of your pressure gauge. Turn the knob clockwise to increase the pressure or counter-clockwise to decrease the pressure.

3. Turn the tank control valve to the On position to supply gas to the indicator. You can leave the valve in this position most of the time.

4. As a general rule, you should zero the pressure gauge on site.

Connect Tubing



1. The twin-tubing from the transducer contains a black tube, nitrogen fill, and a clear (whitish) tube for the return flow. Both Ends have quick-connect plugs (female) to connect to the piezometer male ends. Connect black to black and white to white.

2. The black tube is terminated with a quick-connect male plug. Connect the black tube to the indicator's transducer socket.

3. The white tube is the vent tube. Connect the vent tube to the return flow indicator clear tube.


256 Pneumatic Pressure Indicator
SLOPE INDICATOR
2000 PSI MAX FILL
Tank
Tank Pressure
Regulated Pressure
Regulator
TEST GAUGE
ASHCROFT
psi
Off
On
Tank Control
Flow Rate
Off
On
Flow Control

Activate

1. Turn the flow control valve to the On position.
2. If necessary, adjust the flow rate with the flow rate valve. The reading on the pressure gauge should increase at about 1 psi per second (slightly faster than 0.05 bar per second).

   Tip: Transducers with longer lengths of tubing take more time to activate and read. Increasing the flow rate will not significantly reduce this time. In fact, a faster flow rate may result in a longer wait for the reading to stabilize because additional gas must flow through the transducer.

Read

1. Wait for a return flow of gas from the vent tube.
2. When you detect a return flow, turn the flow control valve to the Off position.
3. Wait for the pressure reading to stabilize and return to zero.
4. Tap the gauge and write down the reading.

Verify

It is a good practice to verify the reading.

1. Turn the flow control valve On.
2. Wait for a return flow, then turn the flow control valve Off.
3. Wait for the reading to stabilize and compare it to the first reading. Repeat this process until you have repeatable readings.
4. Record this value on the field sheet.

Shut Down

1. Disconnect the tubing from the indicator and replace any dust caps.
2. If this is the last reading for the day, turn the tank control valve Off, turn the flow control to Vent, and turn the regulator knob counter-clockwise to reduce the regulated pressure to zero.

Chain of Custody

The chain of custody and records control for the DM, BH, P series and pneumatic piezometers consists of field sheets and recording on the computer database.

Field Readings

The field readings are recorded on the 'Waihi Town Piezometer Water Levels' field sheet. Field sheets are filed in the "Deep Mark and Piezo Data" folder in the Environmental Technicians' office.

Inputting Piezometer data to Spreadsheet

Data from the field sheets are entered in: G:\Environmental\Monitoring Data\Piezometers\Piezometer Network - Data Entry.xls

Pneumatic field readings must be converted from psi to mH_2O 4^oC before being entered in the spreadsheet.

Trigger Limits

None

Reporting Requirements

Water levels to be reviewed on a monthly basis by Environmental Officer/Coordinator. If a significant change, >5m, is detected, the measurement/s are to be verified and confirmed. If a significant change is confirmed, the Environmental Manager is to be informed (an investigation or specialist advice may be required).

Annual data is included in the Annual Dewatering and Settlement Report.

Contingency Corrective Action

- Investigate any significant changes in water levels and identify actions that may be required.
- Seek advice from approved external consultant (i.e. GWS Ltd).
- Enter corrective action in Corrective Action Register or incident database.

Appendix C – Listing of Piezometers

Piezometer No.	Ground Elevation (mRL)	Piezometer Type	Date Piezometer Installed	Piezometer Depth (m)	Screened Zone (m)
P1-1	1112.43	Standpipe	September-84	45.52	45.20-45.52
P1-2	1112.43	Standpipe	September-84	21.42	21.10-21.42
P2-1	1110.26	Standpipe	April-89	136	134-136
P2-2	1110.26	Standpipe	April-89	75.7	73.7-75.7
P2-3	1110.26	Standpipe	April-89	37	35-37
P2-4	1110.26	Standpipe	April-89	8.6	7.6-8.6
P4-1	1101.57	Standpipe	March-89	107	105-107
P4-2	1101.57	Standpipe	March-89	53.6	51.6-53.6
P4-3	1101.57	Standpipe	March-89	8	6.0-8.0
P7-1	1092.7	Standpipe	April-89	104	102-104
P7-2	1092.7	Standpipe	April-89	53.5	51.5-53.5
P7-3	1092.7	Standpipe	April-89	12	10.0-12.0
P8-1	1125.73	Standpipe	April-89	150.05	148.05-150.05
P8-2	1125.73	Standpipe	April-89	81	79-81
P8-3	1125.73	Standpipe	April-89	32.8	30.8-32.8
P8-4	1125.73	Standpipe	April-89	13.9	11.9-13.9
P9-1	1122.08	Standpipe	April-89	85.1	83.1-85.1
P9-2	1122.08	Standpipe	April-89	37.9	35.9-37.9
P9-3	1122.08	Standpipe	April-89	8.4	6.4-8.4
P27-1	1107.8	Standpipe	August-91	34.2	32.2-34.2
BH6-1	1117.7	Standpipe	April-80	74	59-65
BH7-1	1111.75	Standpipe	April-80	35.3	27-33
BH8-1	1110.53	Standpipe	April-80	64.5	57.7-61.7
BH9-1	1106.7	Standpipe	April-80	35.1	26.2-32.2
BH11-1	1112.8	Standpipe	May-80	37	29.6-35.6
BH12-1	1109.01	Standpipe	May-80	33.3	24.7-30.7
WC201-1	1112.6	Pneumatic	July-95	53.8	N/A
WC201-2	1112.6	Pneumatic	July-95	35.4	N/A
WC201-3	1112.6	Pneumatic	July-95	16	N/A
WC201-4	1112.66	Standpipe	July-95	9.1	7.10-9.10
WC201-5	1112.66	Standpipe	July-95	2.7	1.70-2.70
WC202-1	1110.54	Pneumatic	June-95	78.8	N/A
WC202-2	1110.54	Pneumatic	June-95	61.8	N/A
WC202-3	1110.54	Pneumatic	June-95	20	N/A
WC202-4	1110.58	Standpipe	June-95	12	10.0-12.0
WC202-5	1110.58	Standpipe	June-95	4.4	3.4-4.4
WC203-4	1103.65	Standpipe	May-95	4.4	3.4-4.4
WDH147-1	1114.77	Standpipe	March-95	14.8	13.8-14.8
DM21-1	1108.73	Standpipe	January-96	5.2	4.2-5.2
DM31-1	1117.66	Standpipe	January-96	5	4.0-5.0
DM71-1	1101.07	Standpipe	January-96	3	2.0-3.0
DM81-1	1122.23	Standpipe	March-96	4.5	3.5-4.5
DM82-1	1118.33	Standpipe	March-96	4.05	3.05-4.05
DM83-1	1120.14	Standpipe	March-96	4.05	3.05-4.05
DM85-1	1119.29	Standpipe	March-96	4	3.0-4.0
P60	1125.69	Standpipe	June-01	96.6	82.3-96.6
P61	1125.95	Standpipe	June-01	49.5	37.1-49.5
P62	1120.37	Standpipe	June-01	99.1	85.1-99.1
P63	1120.32	Standpipe	June-01	50.1	38.4-50.1

Piezometer No.	Ground Elevation (mRL)	Piezometer Type	Date Piezometer Installed	Piezometer Depth (m)	Screened Zone (m)
P63S	1119.75	Standpipe	November-01	6.7	2.55-6.70
P69S	1165.42	Standpipe	June-05	50.95	47.45-50.95
P69D	1165.34	Standpipe	June-05	101.15	97.65-101.15
P64A	1116.6	Standpipe	November-01	184.47	156.44-184.47
P64I	1115.971	Standpipe	July-04	30.5	30-30.5
P64D	1116.55	Standpipe	July-04	71.96	47.85-53.60
P75	1130.04	Standpipe	August-04	150.6	64-70, 84-88, 109-113, 116.8-118.2, 120.3-121.5, 123-125
P76S	1113.066	Standpipe	June-04	5	4.5-5.0
P76I	1112.531	Standpipe	July-04	40.6	38.6-40.6
P76-D	1113.043	Standpipe	July-04	58	55-58
P77-S	1117.541	Standpipe	July-04	6	5.5-6.0
P77-I	1117.547	Standpipe	July-04	77	70-72
P77-I2	1117.5	Standpipe	July-07	66.5	64.4-66.4
P77-D	1117.547	Standpipe	July-04	86.5	83.5-86.5
P78-S	1115.403	Standpipe	July-04	6.5	6-6.5
P78-I	1115.299	Standpipe	July-04	49.5	47.5-49.5
P78-D	1115.165	Standpipe	July-04	63	60-63
P79-S	1102.11	Standpipe	July-04	12	11.0-12.0
P79-I	1102.18	Standpipe	July-04	41.5	40.5-41.5
P79-D	1102.28	Standpipe	July-04	55	52-55
P87-S		Standpipe	July-07	9.4	7.4-9.4
P87-I		Standpipe	July-07	49.9	47.9-49.9
P87-D		Standpipe	July-07	94.9	92.9-94.9
P70	1096.95	Standpipe	May-04	1.7	1.2-1.7
P71	1100.19	Standpipe	May-04	1.9	1.4-1.9
P72	1099.64	Standpipe	May-04	2	1.5-2.0
P73	1130.043	Standpipe	May-04	3.35	2.85-3.35
P74	1130.743	Standpipe	May-04	5.8	5.0-5.6
P67-D	1098.81	Standpipe	November-01	14.2	8.65-13.80
P67-S	1098.76	Standpipe	November-01	5.05	2.05-5.05
P82		Standpipe	November-06	6.2	5.2-6.2
P83		Standpipe	November-06	6.4	5.4-6.4
P84		Standpipe	November-06	5.9	4.9-5.9
P85				4.78	
P86				4.8	
P87		Standpipe	August-09	6.3	4.8-6.3
P88		Standpipe	July-09	43.5	41.2-42.7
P89		Standpipe	August-09	7.5	5.95-7.35
Wharry				31.45	
Mataura Rd				50.7	
Whangamata Rd				45.54	

Name	X_text	Y_text
BH11	395384.44	642487.79
BH12	394854.03	642752.442
BH6	396131.44	643565.575
BH7	396278.55	642920.122
BH9	396040.95	642574.84
DM31	396706.51	643325.332
DM71	396552.15	640101.833
EPW	396507.9	643493.593
P2	394839.21	642818.059
P27	396103.79	642987.591
P4	395279.61	641927.271
P61	397143.47	642607.053
P63	397220.2	643120.412
P64	397392.45	642887.248
P67	397574.57	642883.62
P69	395522.1	643503.927
P7	396164.64	642219.636
P70	397474.79	642246.50
P72	397318.69	642238.83
P75	397085.26	642889.1
P76	396902.7	642971.782
P77	396678.73	643038.524
P78	397435.42	643274.555
P79	396720.27	642306.949
P8	396145.33	643831.415
P82	397584.43	642830.41
P83	397613.29	642808.67
P84	397638.47	642776.03
P85	397637.79	642592.38
P86	397626.99	642720.77
P87	397570.45	642890.23
P87	396850.97	643382.879
P88	397244.41	642812.10
P89	397502.83	642945.76
P9	396471.83	643916.064
P90	396339.07	643591.718
P91	396472.42	643571.609
P92	396573.33	643539.859
P93	396347.01	643345.126
P94	396545.82	643306.496
P95	396624.31	643310.076
P100	396213.6	643136.786
P101	396463.35	643039.79
P102	396614.51	643013.89
P106	395215.28	643264.919
P107	395286.65	642630.078
P108	395376.44	642644.923
P109	395502.58	642530.267
P110	395663.66	642691.061

P111	395581.06	642604.381
P112	395710.03	642589.961
P113	395771.86	642648.989
P114	395811.95	642694.16
P115	395752.08	642444.096
P116	395849.84	642352.27
P122	395391.39	642450.283
P123	395136.52	643319.169
WC201	394750.31	642714.342
WC202	395880.64	642769.035
WDH147	395010.93	642829.701

Appendix D – Survey Network Monitoring Locations

Zone	station i.d.	X	Y	Z
Zone7	BM19B	2117.17	1244.36	35.6016
Zone7	19BB	2191.56	1292.02	35.5995
Zone7	17CB	2014.23	1201.01	35.5303
Zone6	17BB	1919.52	1160.79	37.4264
Zone6	17AB	1841.32	1104.80	36.946
Zone6	34GC	2211.33	1119.52	32.1856
Zone6	2.04B	1893.21	968.34	29.1404
Zone6	18EE	1750.73	809.33	23.4741
Zone6	34H	2233.59	970.56	32.2007
Zone6	18IB	1611.19	784.79	25.8716
Zone6	18C	1494.95	767.19	27.5147
Zone6	34BE	1732.56	931.60	28.3813
Zone6	2.10	2143.92	950.39	30.3369
Zone6	34C	1968.90	982.67	30.1496
Zone6	BM34	1528.38	903.30	30.366
Zone6	11AC	1308.26	859.51	29.3843
Zone6	18AB	1632.39	667.73	22.1794
Zone6	2.11	2280.71	858.98	26.5197
Zone6	18B	1510.36	650.58	23.6006
Zone6	1.28B	1987.03	447.71	12.1386
Zone6	10BC	1560.13	1062.92	38.1616
Zone6	2.08	2289.44	777.68	24.4929
Zone6	10AB	1430.61	1037.00	35.0498
Zone6	2.09	2225.28	865.44	28.0662
Zone6	BM16	1418.09	1218.03	46.4995
Zone6	BM17A	1724.44	1088.92	40.0954
Zone6	34I	2229.55	765.53	28.5065
Zone6	2.06	2351.95	334.47	11.3106
Zone6	34AD	1470.88	886.92	29.8096
Zone5	BM20	2342.50	1476.25	35.6675
Zone5	BM20A	2345.50	1484.90	35.8217
Zone5	19CB	2296.71	1381.40	34.9911
Zone5	20C	2450.61	1413.86	36.3742
Zone5	A10B	1298.62	1049.61	30.7349
Zone5	A11D	1277.04	1017.33	30.8995
Zone5	16BC	1252.81	1336.47	39.5055
Zone5	BM25	2424.91	1100.25	33.5294
Zone5	21O	2527.366	1356.342	36.0612
Zone5	25E	2472.348	1162.013	34.8304

Zone5	10DB	1276.64	1194.54	35.1911
Zone5	2.03	1930.08	745.94	22.6312
Zone5	18F	1752.28	551.03	17.3691
Zone5	21DC	2573.96	1304.15	37.8284
Zone5	34EB	2073.93	705.95	24.6779
Zone5	25D	2547.045	1248.02	36.9314
Zone5	25A	2505.13	1203.77	36.0007
Zone5	2.02	1992.61	536.10	15.3129
Zone5	1.28A	1888.26	505.89	13.2469
Zone5	20D	2482.07	1473.478	36.6097
Zone5	18G	1669.05	554.60	18.5154
Zone5	12CE	1499.92	543.08	21.0281
Zone5	10CB	1222.46	1025.86	29.8252
Zone5	13AC	1751.98	327.38	18.6391
Zone5	34D	2038.90	783.43	25.3808
Zone5	BM18	1771.96	674.53	19.4676
Zone5	13BC	1850.36	246.59	13.7585
Zone5	BM12	1370.27	607.74	24.0049
Zone5	18HB	1826.79	471.19	14.9273
Zone5	25B	2497.67	1105.83	34.8761
Zone5	21N	2623.251	1342.435	38.3507
Zone5	25F	2542.534	1116.24	36.0549
Zone5	2A	1069.03	1111.86	23.8463
Zone5	12DC	1596.95	435.49	20.0094
Zone5	12AC	1388.32	488.89	19.0895
Zone5	25G	2594.599	1149.415	37.6491
Zone5	25I	2537.197	1045.036	34.7375
Zone5	25H	2648.484	1232.956	38.9831
Zone5	25CB	2615.91	1190.50	38.3595
Zone5	AP22A	1868.44	188.57	12.4477
Zone5	24I	2692.57	1269.713	39.3468
Zone5	20AC	2461.04	1536.91	37.0713
Zone5	24DC	2718.29	1323.13	39.6932
Zone5	15A	1204.79	818.86	28.8213
Zone5	24CD	2603.21	987.72	34.8818
Zone5	24L	2761.668	1181.326	39.3914
Zone5	12BC	1405.27	368.30	14.961
Zone5	20E	2535.651	1542.672	37.1741
Zone5	1.10A	1599.70	278.94	16.6769
Zone5	BM13	1426.61	269.34	13.619
Zone5	21C	2651.57	1389.82	38.5268

Zone5	22F	2815.914	1325.407	40.2926
Zone5	24J	2749.392	1365.756	40.2869
Zone5	24K	2783.888	1387.719	40.6743
Zone5	24E	2758.433	1303.234	40.4249
Zone5	15BC	1169.90	708.86	26.383
Zone5	24AC	2743.58	1218.90	40.1539
Zone5	24H	2630.7	1072.279	36.2125
Zone5	24B	2667.67	1126.40	39.4402
Zone5	11BB	1348.57	710.57	26.9778
Zone5	21EB	2799.95	1429.09	41.6928
Zone5	4DB	1033.26	1550.66	32.2994
Zone5	24G	2705.961	1170.464	39.8632
Zone5	24F	2772.803	1257.274	40.1942
Zone5	BM24	2794.55	1279.36	40.4646
Zone5	21M	2694.898	1439.648	39.2401
Zone5	2BC	970.20	1241.90	30.4328
Zone5	4B	1021.54	1448.63	31.3017
Zone5	BM2	915.74	1091.80	24.8785
Zone5	20F	2605.794	1575.98	37.63
Zone5	BM21	2654.80	1515.40	39.4822
Zone5	20BB	2533.26	1622.29	37.94
Zone5	21BC	2719.27	1477.80	41.3279
Zone5	21K	2681.109	1572.207	40.0591
Zone5	30C	2573.538	1675.395	38.4917
Zone5	BM9B	1220.25	1523.29	34.7997
Zone5	7CB	1161.74	1597.63	30.6584
Zone5	AP3	918.94	1140.59	26.1142
Zone5	26EE	1343.86	1621.82	44.3434
Zone5	26F	1392.77	1680.26	43.908
Zone4	23AB	3145.42	1078.73	37.254
Zone4	2.14A	2853.28	838.67	41.3707
Zone4	23B	2856.49	949.79	38.8046
Zone4	23C	2856.143	1068.014	37.6708
Zone4	BANK1	2866.214	1023.248	37.8595
Zone4	22C	2846.39	1352.54	40.3849
Zone4	BARRY1	3047.74	926.576	38.1706
Zone4	23E	2774.821	972.514	37.7678
Zone4	BARRY3	3176.849	895.991	37.737
Zone4	22G	2866.818	1385.229	41.0971
Zone4	2.25	2874.51	1097.26	38.0465
Zone4	23F	2700.766	968.793	36.7092

Zone4	23D	2861.417	1154.885	38.9288
Zone4	BM23	3107.42	921.05	38.1398
Zone4	2HB	1078.24	886.85	24.439
Zone4	2.13	2725.42	874.95	47.2702
Zone4	STAFORD	3139.861	998.179	37.3686
Zone4	2.24	2885.91	1215.47	41.3615
Zone4	2.16	3007.62	739.64	33.6438
Zone4	BARRY2	2936.955	944.224	38.4146
Zone4	MATAURA1	2831.84	1250.81	41.1389
Zone4	22BC	2916.75	1435.77	42.1631
Zone4	22E	3055.20	1231.50	40.8453
Zone4	2.15	2918.94	723.52	38.4192
Zone4	22I	2918.977	1461.367	41.9738
Zone4	GW	3128.83	1140.94	38.595
Zone4	CUBA	3224.319	1079.177	35.8788
Zone4	22M	2973.44	1434.656	41.7318
Zone4	21P	2849.169	1456.9	41.9096
Zone4	22L	3047.698	1499.876	41.048
Zone4	22H	2869.252	1441.796	41.6835
Zone4	2.28	3076.72	1555.99	42.9981
Zone4	MORTON	2975.42	1231.91	40.7878
Zone4	22A	3003.28	1429.77	41.7013
Zone4	22J	2944.467	1489.763	42.4804
Zone4	22D	3100.02	1335.44	41.5071
Zone4	21FB	2861.65	1512.21	42.7066
Zone4	2.26	3241.22	1380.89	39.2699
Zone4	BM22	3115.79	1442.95	40.6718
Zone4	1.09B	1344.14	117.48	9.9627
Zone4	21L	2806.788	1575.074	43.1424
Zone4	2GB	922.38	967.66	22.7246
Zone4	1.06	1159.34	302.26	17.2704
Zone4	21AC	2716.64	1617.77	39.7492
Zone4	2.29	2955.27	1547.42	42.5671
Zone4	30BB	2604.86	1726.50	41.5987
Zone4	21Q	2899.598	1571.317	43.1815
Zone4	SM822	2512.906	1841.132	41.5042
Zone4	21I	2854.699	1668.793	41.6974
Zone4	22K	2985.121	1610.908	42.7459
Zone4	BM15	976.94	783.00	20.5658
Zone4	26BE	1408.78	1800.55	38.8656
Zone4	21GC	2901.12	1614.05	43.4966

Zone4	2.31B	3201.23	1637.29	42.1437
Zone4	21J	2773.436	1688.923	40.0178
Zone4	26CE	1377.77	1711.89	40.6574
Zone4	27E	2494.09	2171.62	50.393
Zone4	2.30	3000.42	1672.37	43.26
Zone4	27KB	2320.23	2120.21	63.4016
Zone4	21HC	2916.84	1728.84	42.9328
Zone4	15DB	917.56	466.15	15.6372
Zone4	7BB	1105.69	1689.90	35.9855
Zone4	27N	2179.57	2075.99	71.973
Zone4	4.08	2350.64	2022.32	73.2698
Zone4	4.07	2554.47	2079.24	45.0966
Zone4	26AE	1432.47	1883.48	37.5976
Zone4	3.04	1132.43	1822.85	38.4166
Zone4	27H	2413.27	2149.76	57.0759
Zone4	27G	2440.97	2157.30	54.6106
Zone4	4.09	2249.27	2029.94	78.9744
Zone4	3.01	1291.95	1690.33	37.346
Zone4	27J	2344.14	2136.14	62.1841
Zone4	4.05	2809.68	1897.68	40.6697
Zone4	BM30	2715.36	1996.21	44.1336
Zone4	3.02	1344.87	1837.74	34.9885
Zone4	27F	2466.48	2164.03	52.3679
Zone4	27I	2385.10	2141.94	59.579
Zone4	26H	1452.90	1729.59	50.0126
Zone4	26G	1425.06	1706.75	47.0488
Zone4	3.11A	1786.17	1929.22	62.1968
Zone4	30AB	2685.64	1898.44	46.2839
Zone4	26PB	1834.84	1893.11	67.9986
Zone4	26Q	1963.00	1982.71	73.7275
Zone4	27DC	2541.24	2190.71	48.2364
Zone4	26I	1481.67	1750.49	52.7784
Zone4	3.09	1618.51	1870.17	51.9706
Zone4	3.10A	1689.03	1978.29	53.4836
Zone4	27M	2224.38	2095.26	69.2084
Zone4	27L	2280.24	2115.41	65.8916
Zone4	3.13	1744.89	2097.49	53.8085
Zone4	BM26	1542.45	1837.81	45.4704
Zone4	27AB	2009.08	2064.33	73.5351
Zone4	27O	2101.57	2042.82	75.0793
Zone4	3.6A	1526.28	2015.74	38.9633

Zone3	2.41	3296.32	685.40	46.3045
Zone3	34FC	2120.79	587.93	19.1005
Zone3	2.19B	3270.21	916.06	38.6062
Zone3	2.18	3218.04	712.76	44.5908
Zone3	BARRY4B	3320.164	912.693	38.9355
Zone3	BARRY5	3397.585	904.647	41.0405
Zone3	BARRY6	3432.52	904.356	42.527
Zone3	2.23	3560.02	1212.80	36.686
Zone3	2.20	3467.69	904.56	43.835
Zone3	2.21	3563.088	1045.181	34.0787
Zone3	2.17A	3085.76	555.87	36.949
Zone3	BARRY8	3592.279	871.451	37.9817
Zone3	BARRY7	3518.868	901.897	43.662
Zone3	2.22	3339.13	1206.60	40.4041
Zone3	1.05	1176.96	473.45	21.8678
Zone3	2.27	3379.40	1371.48	37.8059
Zone3	15C	1156.82	571.08	24.2613
Zone3	2.34	3452.45	1683.50	37.7605
Zone3	2.36	3433.14	1534.88	35.9695
Zone3	2.40B	3572.85	1526.45	33.196
Zone3	2.33	3294.51	1691.95	40.3516
Zone3	4.02	2797.90	2143.57	45.8083
Zone3	4.03B	2794.90	2044.78	43.8427
Zone3	BM31	2967.04	1873.48	43.3295
Zone3	31BC	3159.33	1954.86	45.548
Zone3	4.04	2662.60	2131.77	45.9635
Zone3	4.01C	2891.78	2113.15	47.3495
Zone3	31AC	3059.04	1910.63	44.1144
Zone3	29DB	2996.63	2106.66	47.8525
Zone3	26JB	1495.71	1756.55	53.7813
Zone3	26MB	1593.46	1750.66	59.0225
Zone3	31CC	3248.97	1989.89	47.0798
Zone3	26NB	1645.68	1770.04	62.7499
Zone3	3.25	3116.90	2107.06	49.8592
Zone3	29CE	2891.84	2285.59	51.617
Zone3	29AC	2641.62	2218.07	48.5635
Zone3	3.24	3017.29	2258.71	51.9787
Zone3	29B	2772.84	2242.22	50.0393
Zone3	26O	1708.94	1807.17	67.2144
Zone2	1.11B	1675.83	133.62	9.0626
Zone2	2CE	774.75	1313.19	34.6605

Zone2	14DB	876.99	411.22	15.1946
Zone2	1.07	924.43	267.49	12.5382
Zone2	A33C	456.03	1219.23	35.8978
Zone2	14CB	759.10	389.77	18.8542
Zone2	14EA	808.56	504.72	17.1298
Zone2	2FC	720.33	843.06	23.9678
Zone2	14BC	535.45	340.67	20.949
Zone2	1.08	1052.91	107.17	16.5626
Zone2	4A	815.01	1494.15	40.7374
Zone2	4EC	782.01	1687.78	41.1783
Zone2	14FB	705.60	649.14	20.1895
Zone2	2DA	682.15	1189.58	35.8589
Zone2	2EB	689.02	1054.62	29.3029
Zone2	1K	511.74	957.17	29.642
Zone2	1.12	800.71	-50.23	10.8205
Zone2	1.04	795.98	129.36	12.8333
Zone2	3.03	1134.46	1917.24	39.3895
Zone2	7AC	994.54	1781.82	43.5673
Zone2	3.12	1599.68	2152.41	40.3078
Zone2	1JB	604.79	822.76	26.4508
Zone2	33F	347.95	1511.68	42.0902
Zone2	BM7	1057.32	1843.07	44.1582
Zone2	BM4	689.21	1555.55	42.3228
Zone2	3.14	1752.75	2214.32	48.7988
Zone2	BM14	718.16	485.96	19.8699
Zone2	1SC	-674.31	739.27	14.476
Zone2	1I	468.34	761.23	27.3123
Zone2	4FB	562.51	1370.97	39.4167
Zone2	33A	338.15	1303.89	36.763
Zone2	14AC	515.17	457.62	24.0577
Zone2	1C	421.48	1098.89	34.8337
Zone2	3.07	1362.08	2096.82	48.0852
Zone2	33E	437.71	1437.52	41.0334
Zone2	6A	946.43	1928.12	47.5552
Zone2	1B	337.50	1062.94	34.0475
Zone2	1FB	210.46	850.78	29.868
Zone2	1O	-271.35	814.18	22.7485
Zone2	33DB	265.40	1714.72	46.4097
Zone2	1HC	299.70	702.80	27.0825
Zone2	1.03	364.38	325.77	19.4827
Zone2	1EB	388.60	912.09	30.4718

Zone2	BM6	881.86	1837.08	46.2773
Zone2	1.14	496.74	-535.10	8.4636
Zone2	3.15	1696.24	2315.82	39.1421
Zone2	1LC	-100.09	901.97	28.3673
Zone2	1MC	-154.95	879.09	25.8184
Zone2	1GB	-2.87	769.74	29.3309
Zone2	1.02B	86.19	282.80	18.6512
Zone2	5C	705.43	1754.71	45.2139
Zone2	33GA	415.95	1621.64	45.3984
Zone2	1A	249.92	1026.38	33.3737
Zone2	1.01	56.47	604.08	25.4853
Zone2	1RA	-579.06	750.36	16.7674
Zone2	1.16	1552.97	-1086.27	18.3777
Zone2	AP2	-1276.40	954.13	5.796
Zone2	BM29	2608.80	2400.76	56.0084
Zone2	3.22A	2891.15	2398.65	56.7049
Zone2	BM1	152.75	994.87	32.8158
Zone2	33B	156.88	1430.80	34.4551
Zone2	5BC	547.16	1824.60	49.1821
Zone2	1QC	-466.05	769.15	18.1834
Zone2	1PA	-351.51	787.24	20.1035
Zone2	BM5	325.93	1806.47	47.8501
Zone2	3.05	966.29	1990.77	47.2376
Zone2	5AC	470.30	1688.45	47.0834
Zone2	33C	222.53	1621.24	44.4547
Zone2	1D	-32.05	911.59	30.0825
Zone2	1NA	-206.98	842.12	24.847
Zone1	2.44	2734.64	421.03	27.3842
Zone1	AP100	1893.80	81.27	11.8167
Zone1	1.26	1926.81	30.05	15.1289
Zone1	2.05	2535.68	272.68	20.8061
Zone1	31MD	4275.09	1884.55	30.7441
Zone1	31ND	4345.57	1917.81	33.5324
Zone1	31LC	4168.53	1862.11	32.1091
Zone1	1.25	2175.94	-129.11	20.0891
Zone1	31KC	4076.39	1883.20	34.5026
Zone1	31FC	3614.22	1954.15	43.4536
Zone1	2.35	3609.80	1652.68	34.1391
Zone1	1.21	1944.45	-334.62	19.6268
Zone1	31JD	4005.65	1911.42	35.5768
Zone1	31IC	3909.03	1909.90	37.8677

Zone1	31HC	3810.83	1924.65	40.3531
Zone1	1.22	1510.00	-249.93	15.8914
Zone1	31GC	3711.83	1939.28	42.2037
Zone1	31PC	4393.52	1991.66	37.7468
Zone1	31DD	3400.43	1989.83	46.7266
Zone1	31QC	4417.71	2035.37	39.6435
Zone1	31EC	3495.33	1971.48	45.6994
Zone1	1.20A	2010.78	-657.65	21.586
Zone1	1.24	2225.16	-613.23	16.711
Zone1	1.23	1013.01	-440.77	13.2873
Zone1	31OD	4374.76	1958.38	36.0812
Zone1	1VA	-994.62	800.62	6.4541
Zone1	1.27B	1401.56	-701.57	15.3482
Zone1	1.13	591.36	-310.80	7.0805
Zone1	AP2A	-766.18	738.51	12.3429
Zone1	27CD	2122.89	2374.36	85.0993
Zone1	1.17B	2082.20	-1093.92	25.5997
Zone1	3.30	3296.29	2235.94	50.4191
Zone1	AP1	4486.29	2137.01	41.3925
Zone1	AP6	2111.57	-1268.48	27.375
Zone1	1UA	-914.75	759.05	8.7549
Zone1	3.28A	3212.99	2636.00	53.8704
Zone1	3.26B	3200.09	2347.92	55.4559
Zone1	1.15	923.35	-995.41	14.3738
Zone1	3.29	3662.64	2323.53	44.9533
Zone1	1TB	-832.77	738.92	11.2597
Zone1	3.23	3035.80	2453.65	59.6648
Zone1	3.21	2585.77	2493.38	64.9835
Zone1	3.27B	3148.37	2510.53	60.319
Zone1	28AC	2120.29	2447.12	85.829
Zone1	3.16	2195.60	2563.08	95.6614
Zone1	BM28/2	2282.46	2770.68	101.9429
Favona	F18	3423.83	648.30	40.0995
Favona	F23	3393.93	684.82	40.6761
Favona	F24	3388.13	690.85	40.6831
Favona	F20	3411.70	665.72	41.0052
Favona	F21	3405.99	672.00	40.8368
Favona	F17B	3405.48	613.912	44.0635
Favona	F25	3381.55	697.88	40.649
Favona	F22	3399.79	678.39	40.7706
Favona	BLOCK-S	3295.816	124.324	24.8474

Favona	F16B	3367.379	578.696	46.4261
Favona	BLOCK-N	3336.449	215.694	24.3238
Favona	F11C	3192.52	479.44	51.4731
Favona	F26	3374.47	705.54	40.632
Favona	F27B	3372.41	717.52	40.5454
Favona	F34C	3339.492	849.569	40.2172
Favona	F09A	3157.20	388.28	45.1849
Favona	F12C	3207.322	503.824	53.5328
Favona	F10B	3176.88	446.75	49.3084
Favona	F15C	3297.171	585.319	57.3982
Favona	F14C	3275.289	551.312	60.6915
Favona	F28B	3365.208	727.17	40.5441
Favona	F13C	3236.432	533.631	57.9409
Favona	F30B	3359.36	748.26	40.7294
Favona	F31B	3354.47	756.84	41.2734
Favona	F08A	3126.97	430.49	42.7724
Favona	F29B	3363.2	738.71	40.5268
Favona	F33	3348.56	812.51	40.6594
Favona	F32B	3348.78	769.103	40.8924
Favona	F07	3110.57	437.24	41.4288
Favona	F35B	3336.677	896.063	39.8012
Favona	ITXCIVB	2943.85	542.17	32.6312
Favona	F04	3100.96	470.88	38.7454
Favona	F06	3107.08	445.21	40.5295
Favona	F02	3097.60	490.00	38.2228
Favona	F03	3099.03	480.33	38.42
Favona	F05	3104.66	455.54	39.4829
Favona	FP1	3004.154	131.25	45.4393
Favona	TRIG 24	3260.756	-615.678	25.6907
Favona	TRIG 22	3681.965	89.358	26.1613

APPENDIX E – Martha Shallow and Deep Aquifer Report

Martha Shallow and Deep Aquifer Report

2019

Document Reference: WAI-200-REP-011-001

MARTHA SHALLOW AND DEEP AQUIFER REPORT 2019

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Approvals

OGC Designation	Name	Designation	Signature	Date
HSE Manager	Daniel Calderwood	Mr		05/06/2019
Operations Manager –Waihi	Richard Carlton	Mr		06/06/2019

Revision History

Date	Revision No.	Issued for	By
28/05/2019	1.0	OceanaGold New Zealand Waihi Operations	Cassie Craig

EXECUTIVE SUMMARY

This Martha Shallow and Deep Aquifer Report is a requirement of the consent conditions for the Project Martha mining project, Waihi, New Zealand. This report is provided prior to the commencement of Project Martha activities and provides an overview of the current state of the shallow and deep aquifers under the Martha pit and immediate surrounds.

On 01 February 2019, Project Martha Groundwater Take Consent 139551 was granted by Waikato Regional Council. This consent allows the taking of groundwater associated with the dewatering of Martha Pit and associated underground workings to a level no lower than 500mRL.

Groundwater chemistry samples are currently collected as a combined sample from Favona, Martha, Correnso and Trio dewatering water. During the reporting period, pH and EC averaged 7.5 and 264 g/m^3 respectively. Sulphates averaged 1496 g/m^3. Fe and Mn are at levels above receiving water criteria. Other metals are at low concentrations.

Two areas of wetland in the surrounds of Martha Pit have been identified as being reliant on groundwater contribution. These areas are located north east of Martha Pit and south east of Martha Pit, near Union Hill and Black Hill.

1 INTRODUCTION

In 2019 the Waikato Regional Council (WRC) granted consent (No. 139551) to take groundwater to dewater the Martha Pit and associated underground workings to a level no lower than 500mRL.

Condition 9 of the consent requires that upon commencement of the consent holder and at five yearly intervals thereafter, OGNZL provides a shallow and deep aquifer monitoring report to the WRC. The report is to include, at least, the following information:

- The nature of the geology under the Martha Pit and immediate surrounds;
- Comment on the existing groundwater chemistry for the deep and shallow aquifers;
- Provide details of any wetland area and any other known aquatic ecological values that are dependent on the surface contribution of shallow and deep groundwater outflows; and
- Comment on the groundwater levels in the deep and shallow aquifers
- Comment on the effects the dewatering activity is having on the shallow and deep aquifers under the Martha Pit and immediate surrounds.

Dewatering from the Martha Pit was discontinued on 04 May 2015 after a slip in the pit. As a result, access and power supply to the dewatering pumps became limited. Dewatering from within the Correnso area was initiated on 18 May 2015. The Martha, Trio, Correnso and SUPA groundwater systems are hydraulically linked and water levels are currently controlled by Correnso underground dewatering. Levels are currently being maintained at 700mRL. When dewatering occurs below this level, consent 139551 will be activated.

2 GEOLOGICAL SETTING

This section is provided to meet Condition 9 a of the Project Martha consent:

- The nature of the geology under the Martha Pit and immediate surrounds.

The mineralised vein deposits of the Martha, Favona, Trio and Correnso zones are hosted by altered andesitic lava flows, breccias and tuffs (Figure 1a). The host andesites of Miocene age extend to depths greater than 600m and are extensively modified in places by weathering and hydrothermal alteration. Paleo-weathering and hydrothermal alteration have created an extensive low-permeability clay-rich cap within the upper part of the andesite sequence. This cap generally separates the andesites hydrogeologically from a younger overlying sequence of rhyolitic ignimbrite flows and alluvial boulder beds and prevents the younger volcanic deposits from being fully dewatered. Exposure of the altered andesite in the southern wall of the Martha Pit indicates that the weathered clay cap may extend up to 30 metres in thickness. Dewatering of the andesites is considered to contribute little to the development of settlement around the mine site due to the stiffness of these rocks.

Groundwater levels in the andesite are controlled in the vicinity of the Martha Pit by old underground mine workings and shafts as well as the structural controls of faults and veins in the area. The old mine workings extend mainly in a SW-NE orientation following the Martha lode (Figure 1b). The historical mine workings act as effective conduits allowing groundwater inflow of water from an area surrounding the current mine pit. Investigation drilling at Union Hill has identified similar water levels in permeable vein systems to those in the historical workings, with water levels at higher elevations in less permeable ground. This pattern of groundwater depressurisation is consistent through the older andesites in the vicinity of Martha Mine (Figure 1c).

Davies (2002) defined district-scale northeast trending grabens based on general stratigraphic patterns and fault data. The western margin of one of these, informally referred to as the Waihi Graben, hosts the Martha-Favona epithermal system. This system has developed on the graben boundary faults dominated by the Waihi and Martha faults. A mantle of younger ignimbrite cover means that the actual dimensions of the Waihi Graben remain unknown (Davies, 2004).

Principal veins and faults at both Martha and Favona dip to the south-east while the Correnso vein that strikes north-north-west with an easterly dip connects the Martha and Union systems. Subsidiary splay veins dip back to the north-west and west, defining a mine-scale horst-graben geometry in which veins coincide with the graben margins. Union and Amaranth veins are located on a paleotopographic high, informally referred to as the Union

Horst that separates the Martha graben from the smaller-scale Favona-Moonlight graben. Davies identified north-trending veins and faults such as Trio, which links the Union and Amaranth veins, as structural fault relays. At district scale, the north-trending Favona fault-vein system may represent a structural relay between northeast-trending boundary faults of the Waihi graben. Relays represent domains of strain transfer between fault segments (e.g. between the Union and Amaranth faults) that may or may not be physically linked. These relay systems are important from a mineralization point of view as they represent areas that were foci for hydrothermal fluid flow. From a hydrogeological perspective today, these areas may store significant quantities of groundwater. During underground mining at Favona, dewatering rates increased for a time when access drives cut across the fault-fracture zones which drain more freely than the country rock.

The upstanding Union Horst block probably acts as a barrier between the more structurally permeable areas of the Martha Graben and Favona-Moonlight fault system. The hydrogeological connectivity of the Martha Graben faults, facilitated by the connecting Correnso structure, was demonstrated by the rise and fall of water levels in the Union Hill shaft in unison with the rise and fall of water levels in the Martha Pit. The connectivity of the Martha system with the Favona fault system, however, is very weak as shown by the lack of response in measured water levels. The zone of separation of the two groundwater systems is not well defined, but may be due to a fault boundary, either the No 9 fault or the Favona footwall fault (Figure 1d), both of which are north to northeast trending and have been observed in drilling to extend over one kilometre in strike. The Favona footwall fault is observed as a broken quartz gouge zone encountered 30 m west of the main vein system at Favona, where it occasionally has strong inflows of water (P. Keall, pers comm.) and the No 9 fault is located further again to the west. However, some aquitards and associated pressurisation are also present in some sections of the underground workings.

Under the Waihi East residential area the Union Horst may be more responsive to the Martha groundwater system as indicated by water level increases in wells in conjunction with a rise in pit water levels in 2007. Nevertheless, some early Favona dewatering effect is evident in monitoring data. Faults associated with the Martha and Favona vein systems may intersect in the Waihi East area although their potential connectivity is not well understood, due to a lack of drilling data.

The andesites are overlain by a series of younger rhyolitic volcanics, which are highly variable in thickness and composition. These deposits draped an eroded graben-horst landscape. The younger volcanics consist of rhyolitic tephras and ignimbrites in the form of flows, breccias and tuffs. Paleosols (buried soils) and sedimentary deposits such as alluvium and boulder alluvium mark the top of successive eruption sequences. The ignimbrite deposits underlie much of Waihi township and outcrop to the east and south of the mine pit.

Groundwater inflow is, predominantly, controlled by infiltration from overlying layers and through outcrops of welded ignimbrite in the beds of streams and at the ground surface. The rhyolitic sequence is considered to be compressible, in parts, and to give rise to much of the dewatering induced settlement around the mine site. This is indicated by settlement magnitude generally corresponding to the thickness of and the magnitude of dewatering in these materials.

The uppermost layer of alluvium is discontinuous beneath Waihi township (Figure 1a) and is located in areas where old streams and river channels are cut into the top of the ignimbrites, rhyolitic tephras and andesite. Alluvial deposits are extensive east of Waihi where they are associated with the drainage systems of the Ohinemuri River catchment. Groundwater in the alluvial formation (and the upper weathered contact of the younger volcanics) is monitored to depths of less than 10m.

Figure 1 - Summary of Geology - Maps 1(a)-(d)

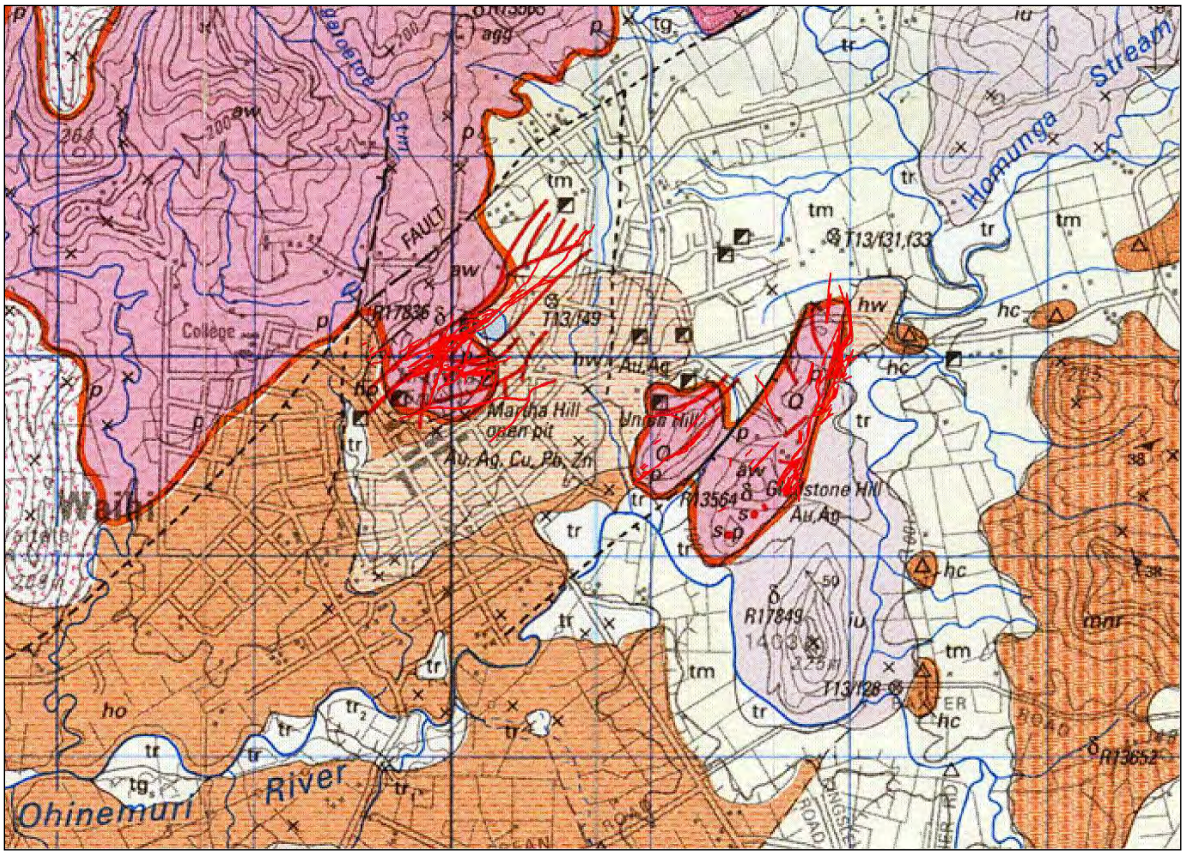

Figure 1(a) Geology Map of Waihi showing distribution of andesite (aw), younger volcanics (ho & hw) and alluvium (tm & tr). The Martha and Favona vein systems (Gladstone Hill area) are defined as fine red lines (derived by exploration and mining surveys).

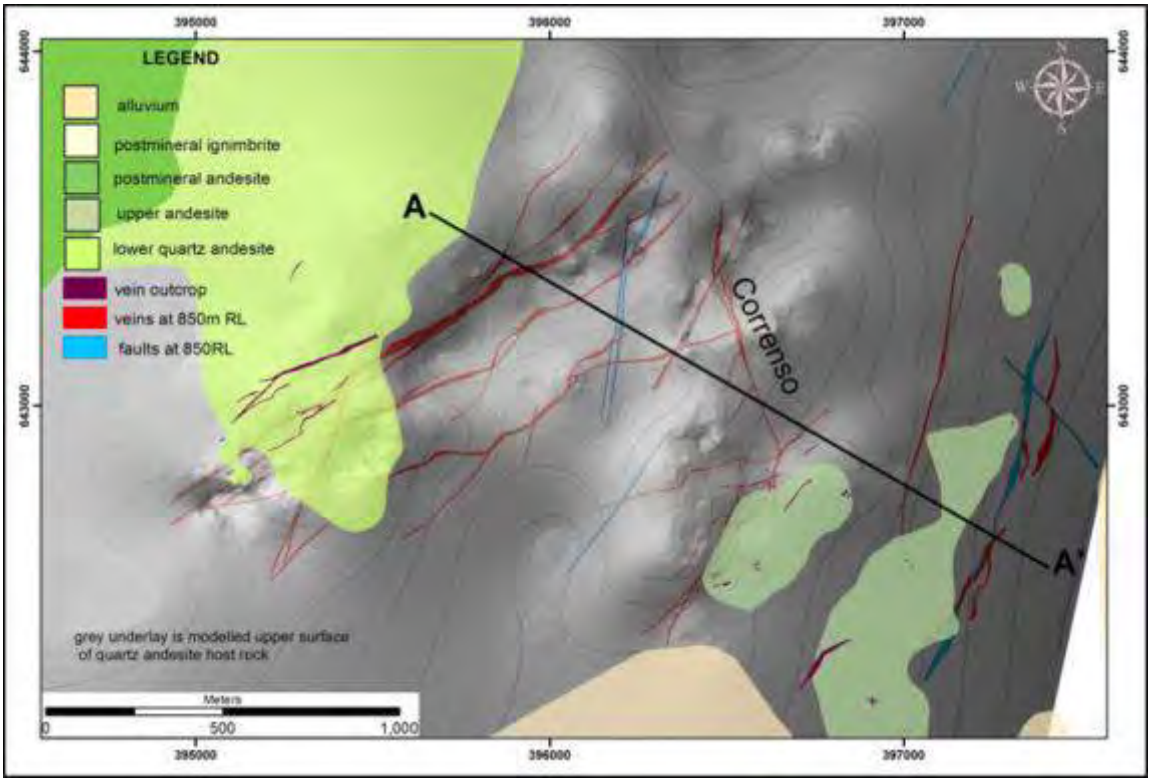

Figure 1(b) Veins and faults from around Martha & Favona mines, showing projected Correnso (J Hobbins, OGNZL Exploration Dept.).

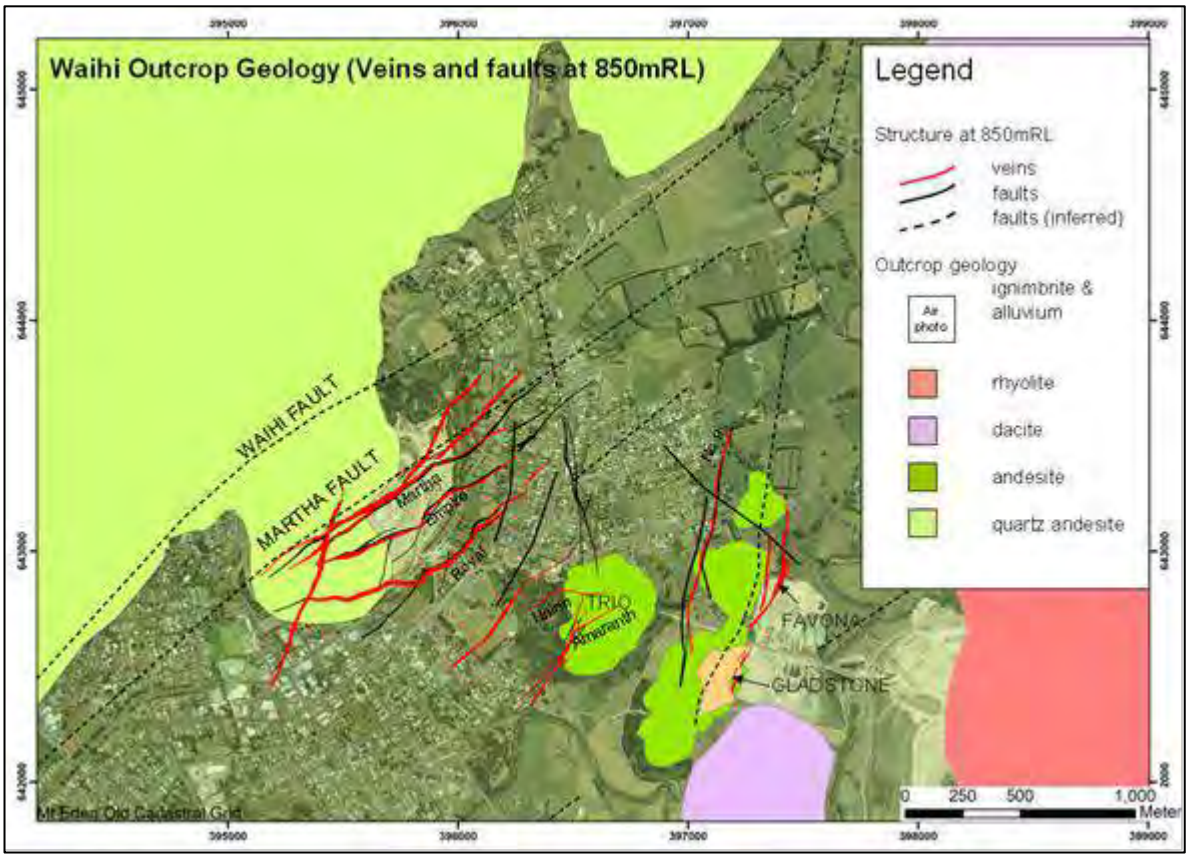

Figure 1(c) Faults and geology at 850 m RL showing main structural elements

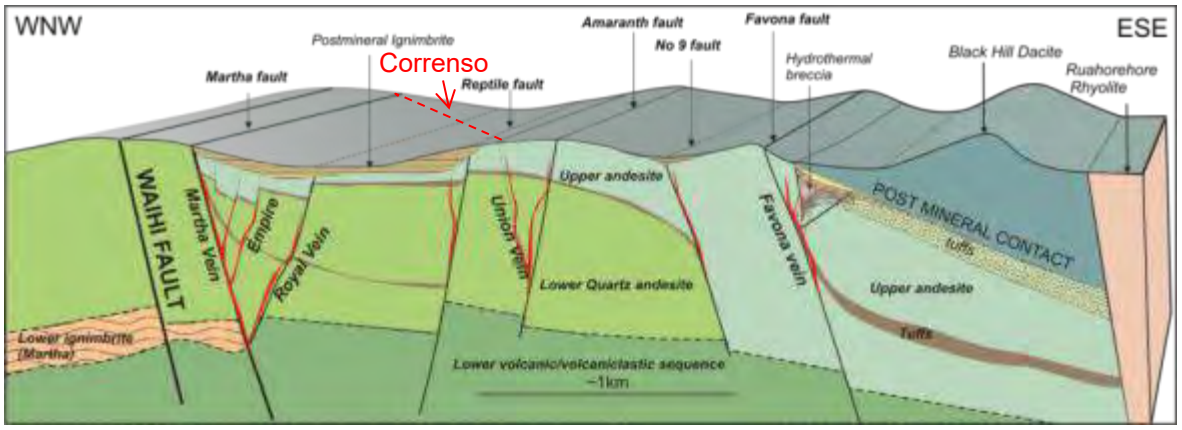

Figure 1(d) Schematic cross section illustrating key elements of fault structures in the Waihi area, including projected surface trace of Correnso.

3 GROUNDWATER CHEMISTRY

This section is provided to meet Condition 9 b of the Project Martha consent:

- Comment of the groundwater chemistry for the deep and shallow aquifers.

While access to the pit is restricted and dewatering of the pit occurs from underground, the most representative sample of Martha groundwater currently available is the combined underground dewatering water. This is a composite of Favona, Correnso, Trio and Martha water. Underground dewatering water quality results from 01 January 2018 to 08 March 2019 are included as Appendix B. During this period, pH and EC have remained stable, averaging 7.5 and 264 g/m^3 respectively. Sulphates averaged 1496 g/m^3. Fe and Mn are at levels above receiving water criteria. Other metals are at low concentrations.

4 GROUNDWATER LEVELS

This section is provided to meet Condition 9 c of the Project Martha consent:

- Comment on the groundwater levels in the deep and shallow aquifers,

and:

- Comment on the effects the dewatering activity is having on the shallow and deep aquifers under the Martha Pit and immediate surrounds.

OGNZL has maintained a piezometer network within and around Martha Mine since 1987. Additional Correnso/SUPA piezometers were installed in 2011, 2014 and 2016. Table 1 lists the piezometers currently operational that are assigned to each of the three main geological units.

Table 1 - Current Waihi Piezometer Network

Alluvium	Depth (mRL)	Younger Volcanics	Depth (mRL)	Martha Andesite	Depth (mRL)	Favona Andesite	Depth (mRL)
~~DM21-1 dry~~	~~1103~~	BH6-1	1052	BH11	1074	~~P60 ** dry~~	~~1075~~
~~DM31-1~~	~~1112~~	BH7-1	1078	BH12	1090	P61	1076
~~DM81-1~~	~~1117~~	~~BH8-1 dry~~	~~1048~~	~~P1-1 dry~~	~~1065~~	P64-D dry	1062
~~DM82-1~~	~~1114~~	BH9-1	1073	P2-1 dry	974	P75	979
~~DM83-1~~	~~1116~~	~~P1-2~~	~~1091~~	P2-2	1034	P76-D	1055
~~DM85-1~~	~~1115~~	P2-3	1073	~~P4-1~~	~~994~~	P77-D	1031
P2-4	1111	P4-2	1047	P7-1	988	P78-D	1052
~~P4-3*~~	~~1093~~	P7-2	1039	P8-2	1044	P79-D	1047
P8-4	1113	P7-3	1080	P8-1	975	P87-D	1024
~~P9-3~~	~~1108~~	P8-3	1092	P9-1	1036		
P63-S*	1111	~~P9-2~~	~~1084~~	~~P62 dry~~	~~1021~~		
P76-S*	1109	P27-1	1073	P69-S	1114		
P77-S*	1110	P63-1	1070	P69-D	1063		
P78-S	1103	P64-I	1086	WC201-1	1058		
P87-S	1110	P76-I	1072	WC201-2	1077		
WC201-4	1103	P77-I and	1045	WC201-3	1096		
WC201-5	1109	P77-I2	1051	WC202-1	1031		
~~WC202-4 dry~~	~~1099~~	P78-I	1066	P90-3	982		
~~WC202-5 dry~~	~~1112~~	P79-I	1061	P91-4	970		
P90-1	1096	P79-S	1090	P92-3	965		
P91-1	1105	P87-I	1069	P93-4	974		

P92-1	1114	~~WC202-2~~	~~1048~~	P94-4	976		
P93-1	1102	P90-2	1019	P95-3	1000		
P94-1	1108	P91-2	1096	P100-3	981		
P101-1	1102	P91-3	1010	P100-4	956		
P102-1	1108	P92-2	1000	P101-4	1037		
		~~P93-2~~	~~1091~~	P102-4	1026		
		P93-3	1014	P106-1	1100		
		P94-2	1094	P106-2	1060		
		P94-3	1016	P106-3	1010		
		P95-1	1090	P106-4	974		
		P95-2	1030				
		P100-1	1066				
		P100-2	996				
		P101-2	1083				
		P101-3	1068				
		P102-2	1078				
		P102-3	1054				

* - at or just below the contact with weathered young volcanics
** - collapsed piezometer
WC – Pneumatic piezos
~~P93~~ – Strikethrough indicates failed or lost piezometer

All piezometers are monitored on a monthly basis as required by Waikato Regional Council Correnso Dewatering Consent 124860. The water levels are translated to the mine datum reference level to enable comparison between bores or areas.

4.1 Groundwater Monitoring Results

The Waihi town piezometer network currently has 41 dipped piezometers and six pneumatic piezometers. Additional vibrating wire piezometers are installed at 10 locations around Waihi East, with up to four piezometers at each location. On the north east side of the pit, seven real time loggers are installed in wells (Figure 2). Groundwater contour plans have been included for the three principal geological units: alluvium (plus shallow groundwater in weathered younger volcanic materials); younger volcanics (including ignimbrite); and andesite. The groundwater plans are presented in Figure 3, Figure 5 and Figure 8 respectively. Discussion of results for each unit follows.

Only the andesite contour map includes data from the vibrating wire piezometers. Alluvium and younger volcanics contour maps have not included vibrating wire piezometers as the vertical gradients evident do not provide a unique water level.

Figure 2: Piezometer Location Plan

Figure 3: Alluvium Water Level Contours

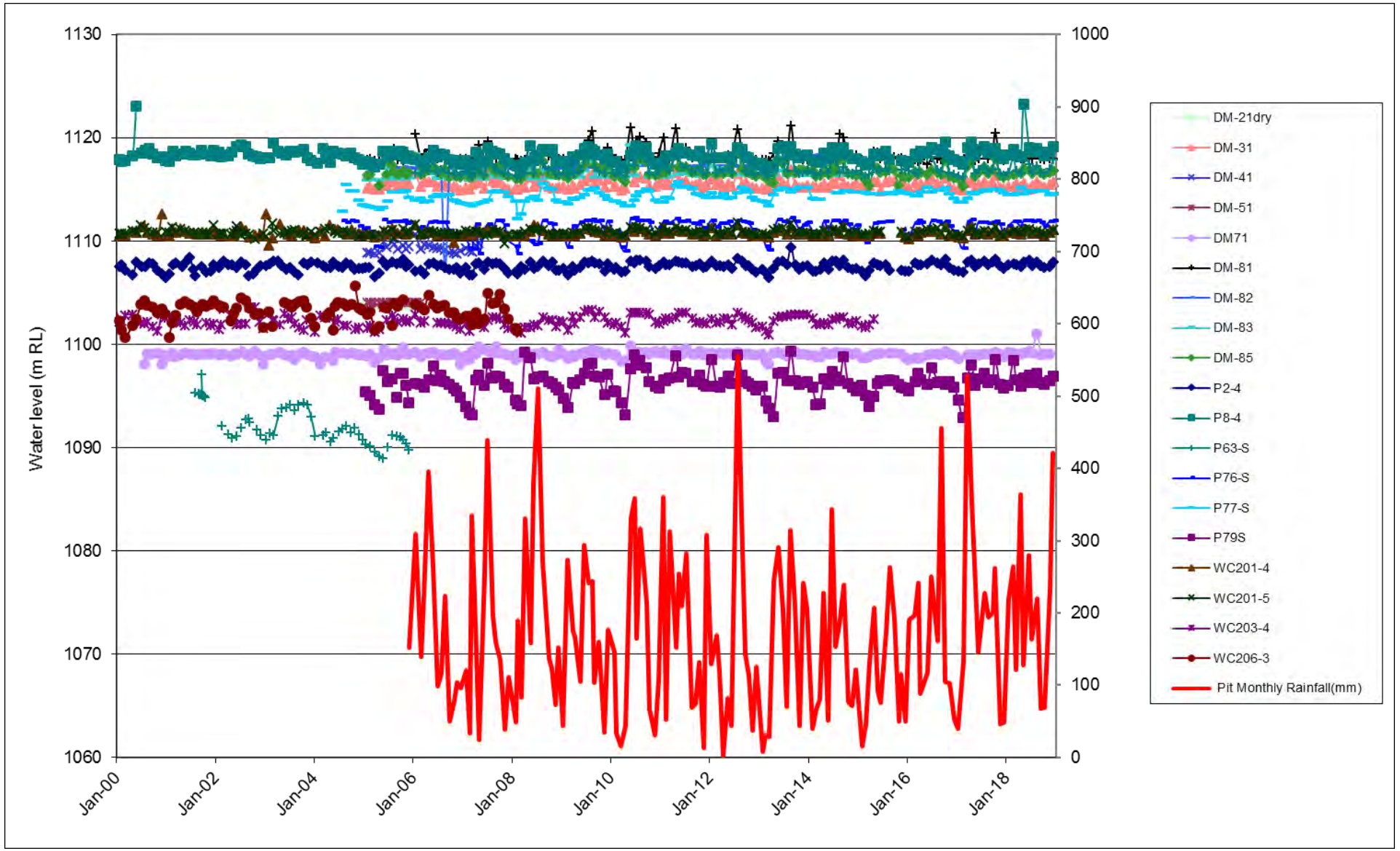

Figure 4: Groundwater Level Trends – Shallow Groundwater (Alluvium & Weathered Contact of Young Volcanics

4.1.1 *Shallow Groundwater*

Figure 3 shows the inferred contours for shallow groundwater in alluvium and in weathered younger volcanic materials and Figure 4 shows the water level trends over time. The overall contour pattern and the trend plots demonstrate that the shallow groundwater system remains essentially unaffected by dewatering of the surface and underground mining operations. Shallow groundwater levels are controlled principally, by rainfall infiltration, low surface soil permeability and natural and assisted drainage to surface water systems.

Contouring of the lobe southwest of Martha Mine (Figure 3) has been restricted by the loss of access to the wells at sites WC203 and WC206. For the purposes of completing the contour plan it was assumed that groundwater levels in the alluvium at these locations has remained the same as in previous years.

4.1.2 *Younger Volcanics*

Groundwater contours in the deeper portions of the younger volcanic materials below the shallow groundwater system are shown on Figure 5 and trends are graphed on Figure 6.

The younger volcanic materials infill topographic depressions in the surface of the andesite rock body in which the open pit and underground mines are constructed.

Groundwater level change and the associated consolidation of the varying thickness of these relatively weak younger volcanic materials is considered to be responsible for much of the settlement and for the settlement patterns around Martha and Favona mines.

The dewatering pattern in the younger volcanics around Martha Mine indicates drainage towards the open pit. The limited groundwater discharge at the contact of the younger volcanic materials with the underlying andesite in the pit (see Figure 5) suggests drainage is affected by features other than the contact (which defines a paleovalley in the andesite). The most likely additional drain point is a substantial block cave evident in the pit wall. This block cave, referred to as the Milking Cow, was active during historical underground operations and resulted in substantial settlement of the ground surface, down-folding of fill and younger volcanic strata and close fracturing of the welded ignimbrite layers.

Prior to the start of dewatering at Martha Mine, groundwater levels in all rock units were similar. With the onset of mine dewatering, water levels in the veins and historic workings were drawn down. Groundwater levels in the various rock units below the shallow aquifer showed increasing vertical separation until about the mid to late 1990's. Thereafter, the water levels (in other than the veins and workings) stabilised and have remained stable since. This pattern is demonstrated in monitoring wells at site P2. With piezometer P2-1 following the vein water levels until water level dropped below the piezometer tip, P2-2 the upper andesite water levels P2-3, younger volcanic rock water levels and P4-2 alluvium (shallow aquifer) (Figure 6).

The development of the settlement pattern has shown a similar behaviour with an initial higher rate of settlement followed by a much-reduced rate of settlement once groundwater levels in the upper rock layers stabilised. These patterns are discussed in the following sections.

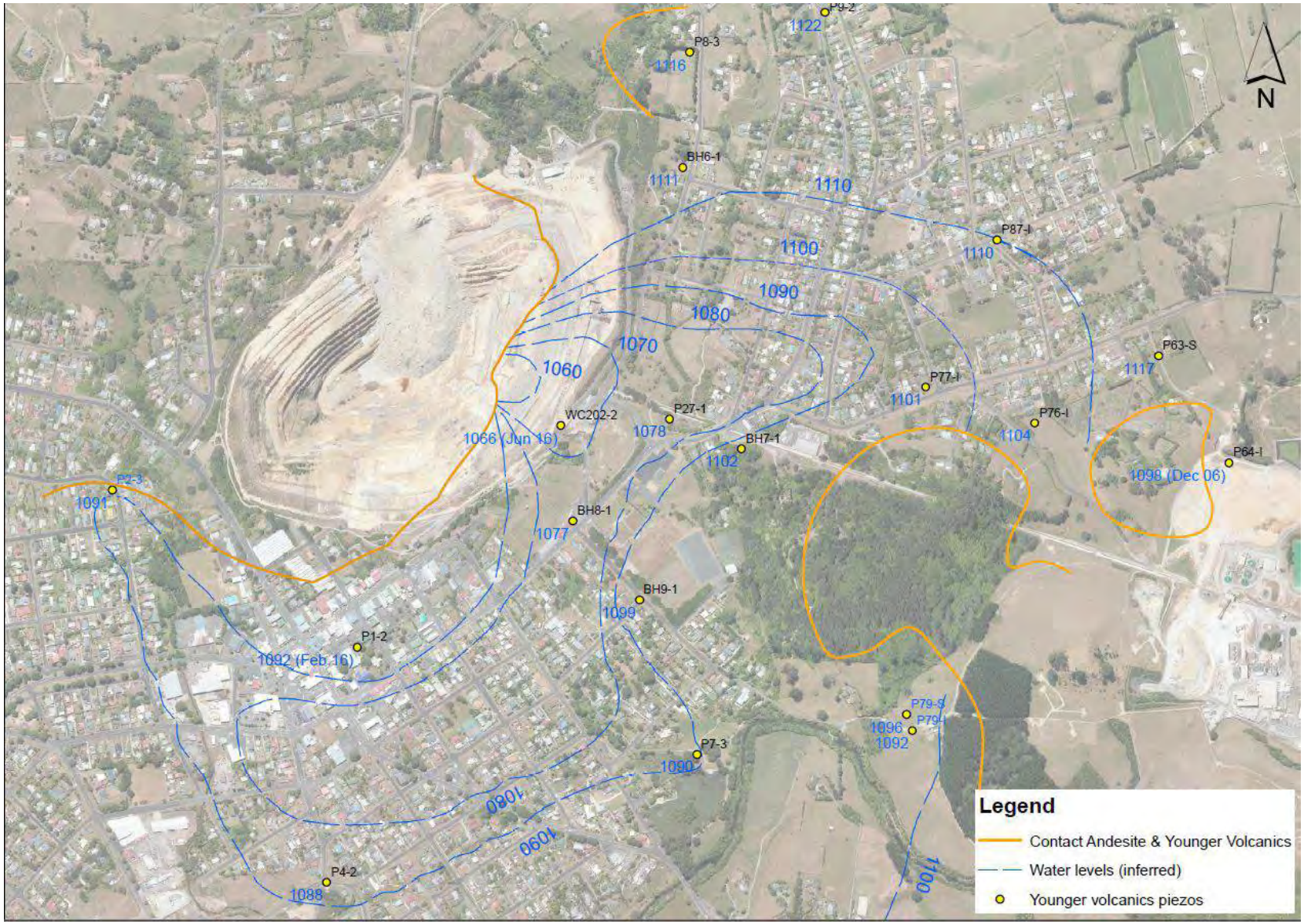

Figure 5: Deeper Younger Volcanic Water Level Contours

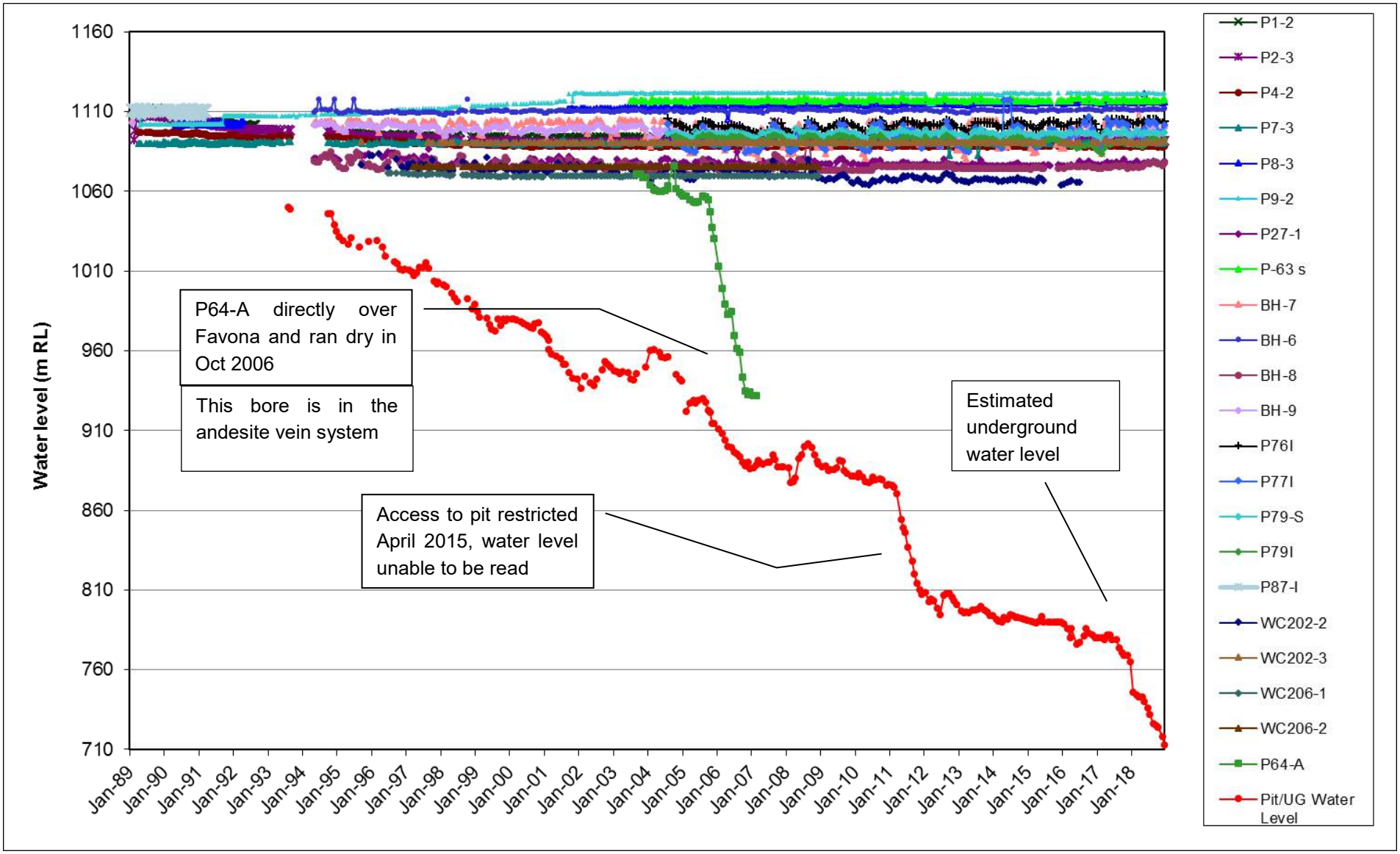

Figure 6: Groundwater Level Trends - Deeper Younger Volcanic Materials

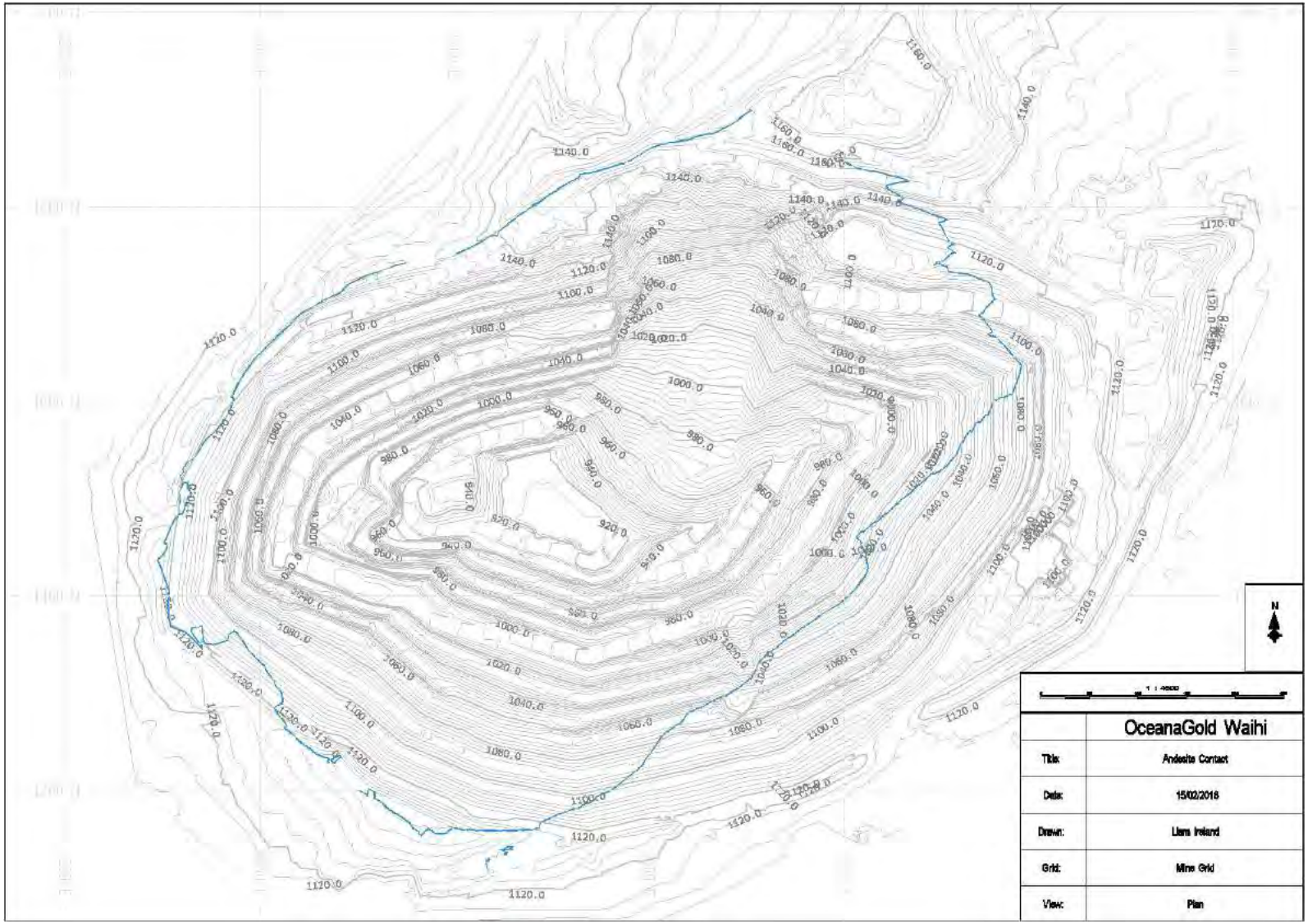

Figure 7: Andesite Younger Volcanic Materials Contact in Martha Pit

4.1.3 *Andesite*

Andesite rock forms the local basement rock body for the area and hosts the mineralisation which was being mined at Martha Pit and is mined in the Underground.

Figure 8 shows the scope of the dewatering effects in the andesite rock body as a result of dewatering to date. Data from the Waihi East vibrating wire piezometer units has been included. Figure 9 provides the water level trends in the andesite rock body. While groundwater level data is available for the vein systems and the shallower andesite rock, no monitoring data is available for intermediate depths within the andesite rockmass outside of development areas. Hence, groundwater levels between the vein and the shallow rockmass has been interpolated.

Groundwater levels in the andesite vein systems have responded rapidly and substantially to mine dewatering along the strike of the Martha Vein system, along the strike of the Trio vein system beneath Union Hill, and also along the strike of the Favona/Moonlight vein systems. An area of dewatering indicated between Martha Mine and Trio/Correnso vein systems suggests a relatively close linkage. Outside of these structures, the dewatering effect in the andesite rock is attenuated or absent. This is illustrated by the different responses shown on Figure 9.

The Martha Mine dewatering effect continues to be abruptly attenuated to the north of the mine and also to the west of the mine. This is considered to be the result of faulting which truncates the veining. A lobe of dewatering extends to the southwest of Martha Mine and this is considered to be due to the drainage effect along the N-S Edward lode structure. Dewatering is shown to reduce eastwards along the Martha system but may extend further at depth as the host rocks are more deeply buried in that direction and no deep monitoring wells are available for confirmation.

Figure 8 also indicates the dewatering centralised on the Favona system with the restriction of connection between Favona and the Union systems. The geological model in Section 1 indicates an up-thrown block (Union Horst Figure 1d and Figure 8) between the Union and Favona systems. This structural hiatus is likely to account for the restricted groundwater interconnection between the Martha-Union and Favona systems.

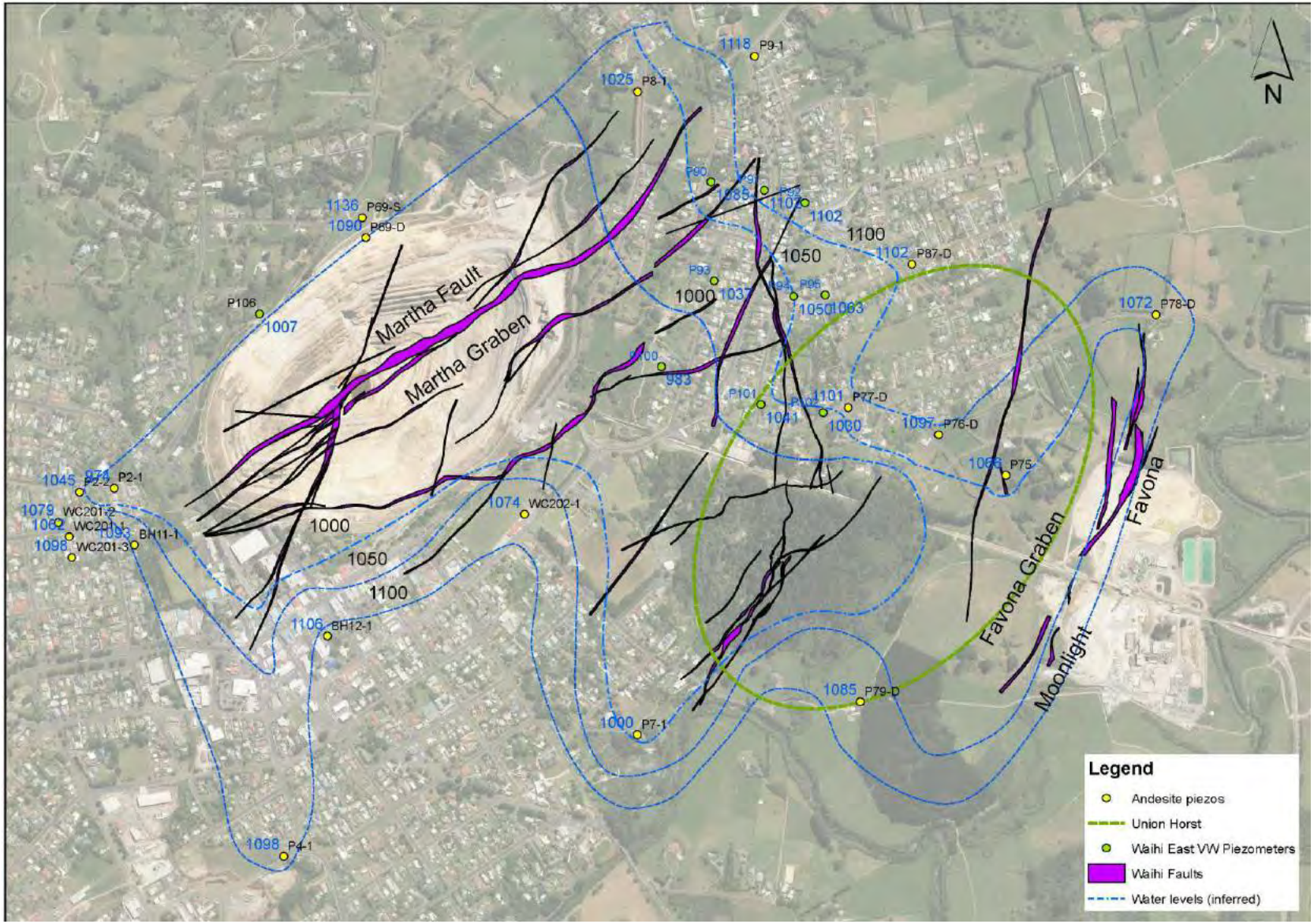

Figure 8: Andesite Water Level Contours

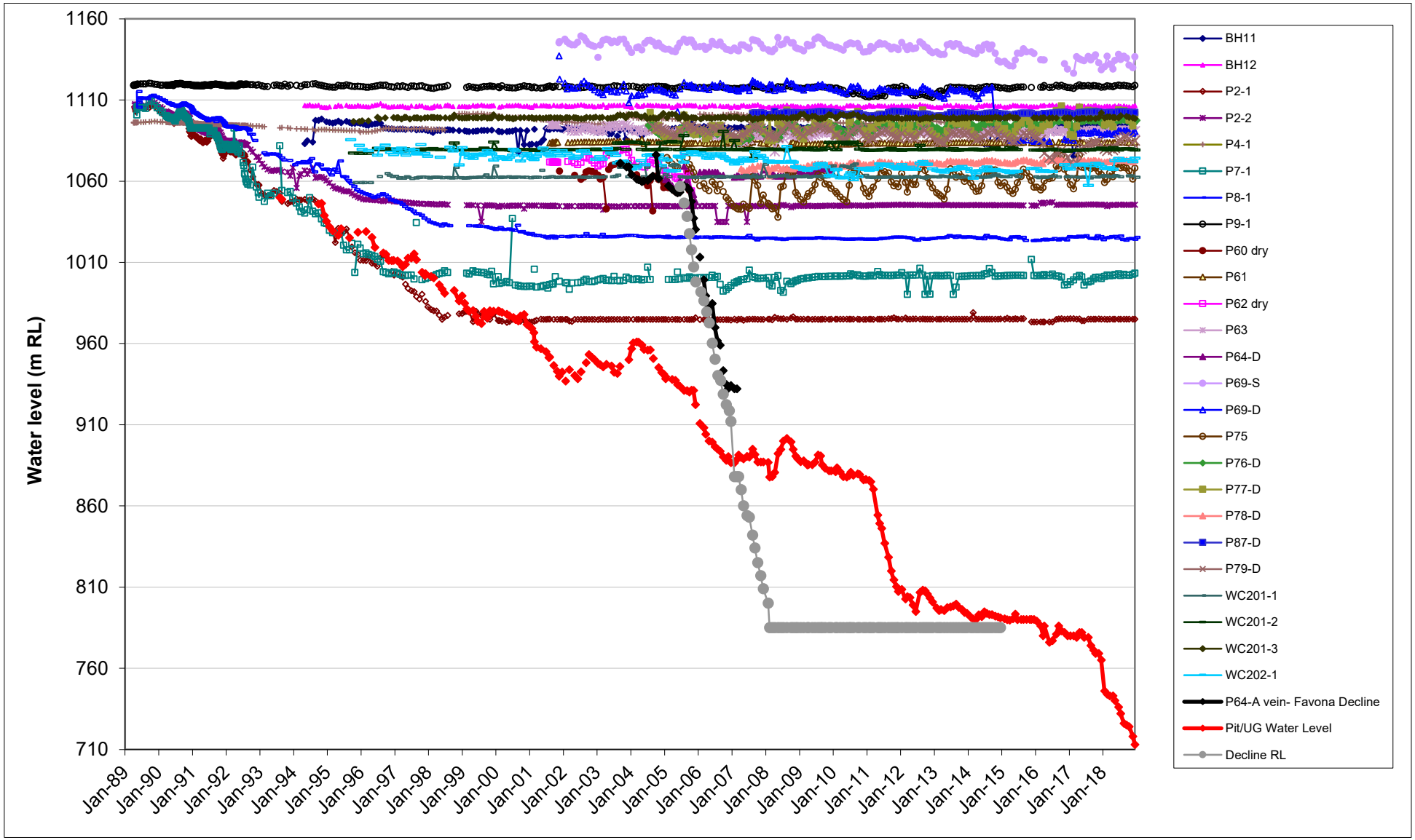

Figure 9: Groundwater Level Trends – Andesite

4.1.1 *Waihi East*

Six groundwater monitoring boreholes were installed between July – September 2011. They are located east of the Martha Pit to provide improved groundwater information in an area with few existing wells and in the vicinity of the Correnso Project. Two additional vibrating wire piezometer boreholes were installed in early 2014. One further borehole was installed in 2016 for monitoring related to the Daybreak/SUPA orebody.

The piezometers were located across and perpendicular to the Correnso vein system in three lines (P90, P91 and P92 forming one line, P93, P94 and P95 a second line and P100, P101 and P102 the third). Separation distance between the northern and southern lines is some 500m (Figure 2). The piezometers were constructed to intercept the shallow aquifer, younger volcanics, and andesite rock (Table 2).

Table 2: Geological Units and Depths P90-P95, P100-P102 Piezometers

Bore	Shallow	Younger Volcanics		Andesite	
		Upper	Basal Zone		
P90	-	20	100	137	
P91	9.3	25.5	111.3	151.3	
P92	-	23.3	121.3	156.3	
P93	12.3	26	100	143	
P94	6	25	104	144	
P95	-	35	90	120	
P100	-	50	120	135	160
P101	12.8	32	47	78	
P102	8	38	62	90	

Figures 10 to 18 provide the records from the piezometers expressed as mRL. The charts also display the depth of the piezometer tips. Separation between the shallow and deeper piezometers is evident in the records. The nine groundwater monitoring boreholes have indicated stable water levels in Waihi East.

Note: Gaps in the data are due to either brief logger malfunction issues or flat batteries in the unit

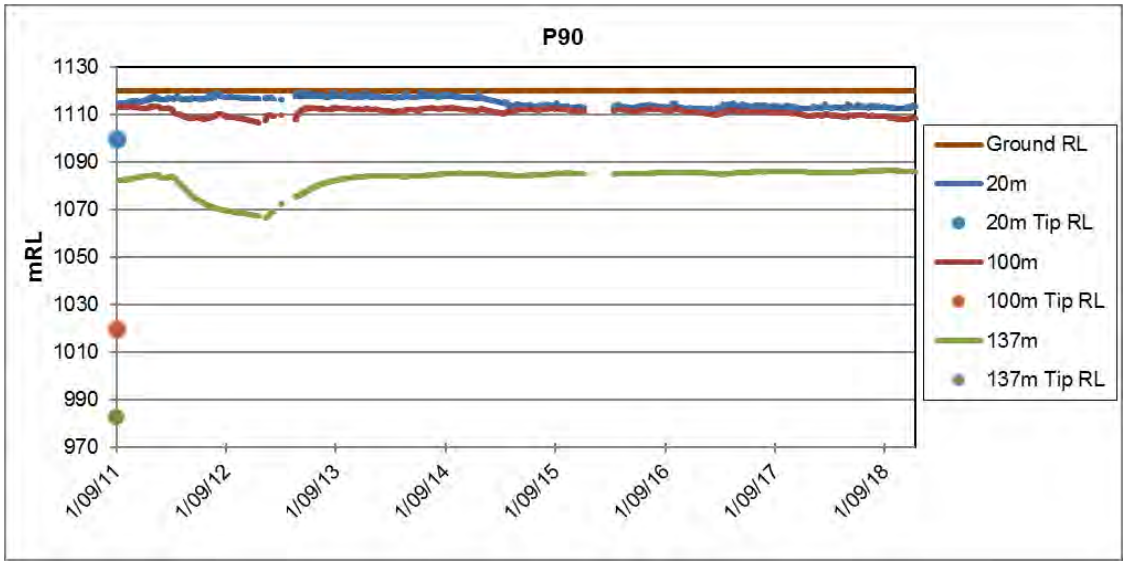

Figure 10: P90 Vibrating Wire Piezometer

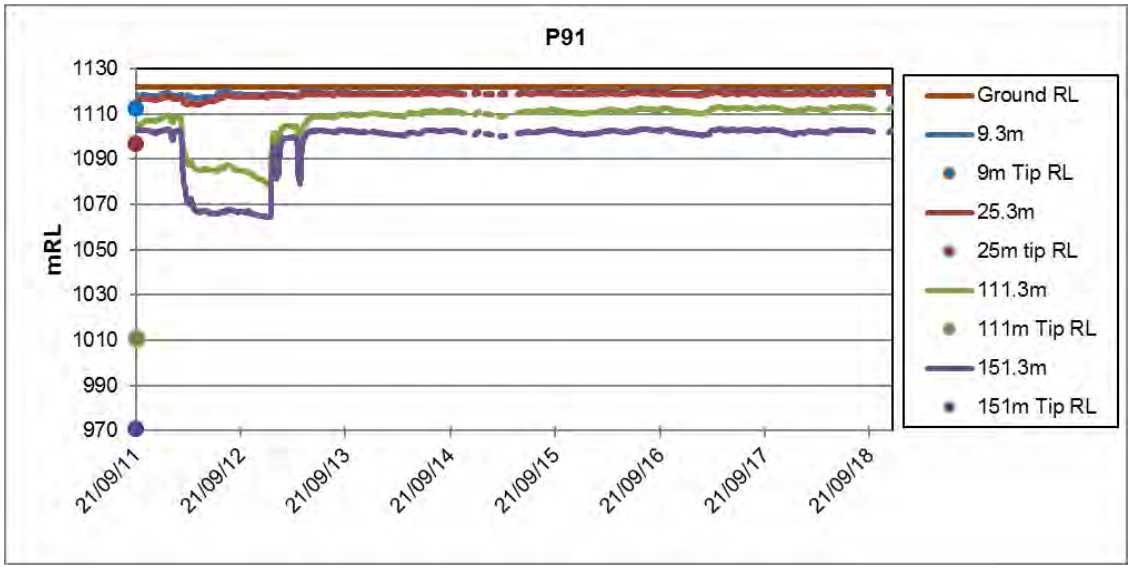

Figure 11: P91 Vibrating Wire Piezometer

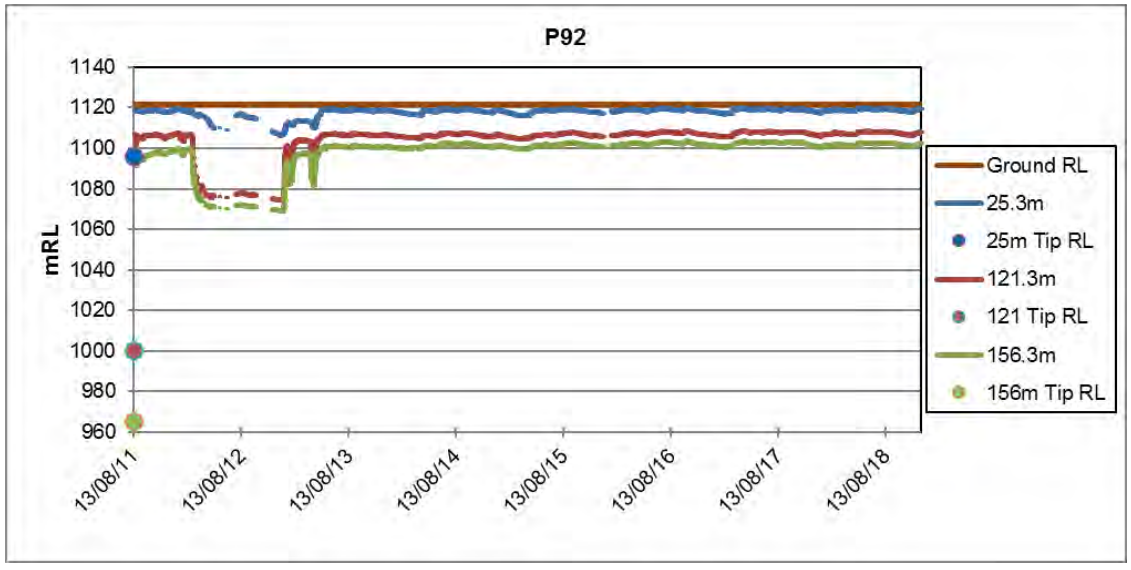

Figure 12: P92 Vibrating Wire Piezometer

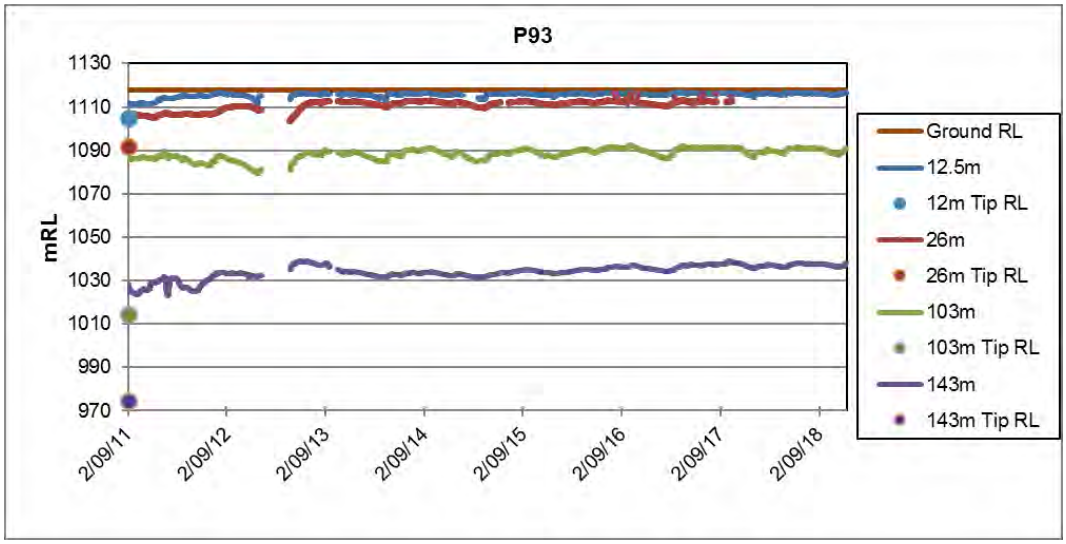

Figure 13: P93 Vibrating Wire Piezometer

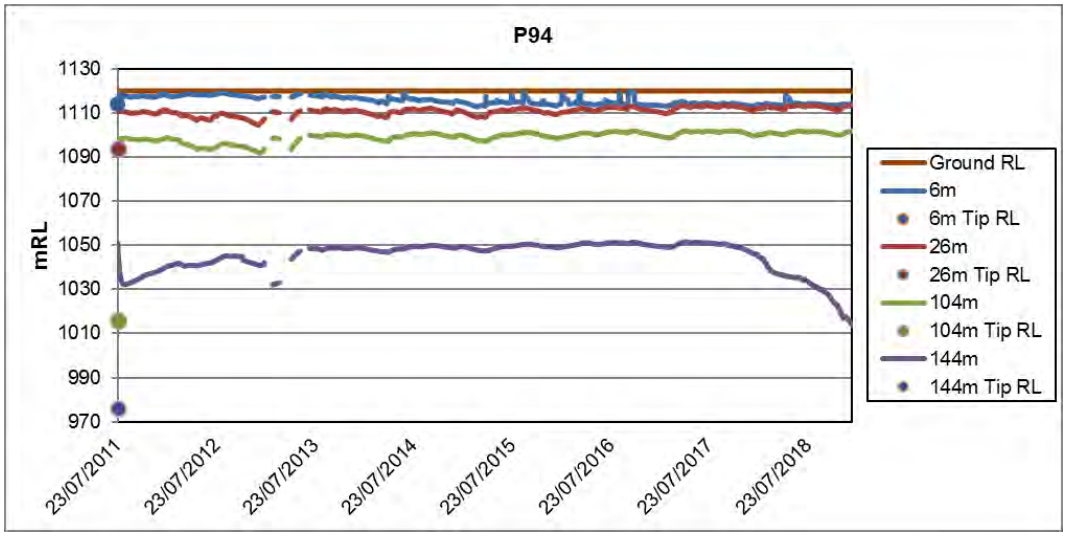

Figure 14: P94 Vibrating Wire Piezometer

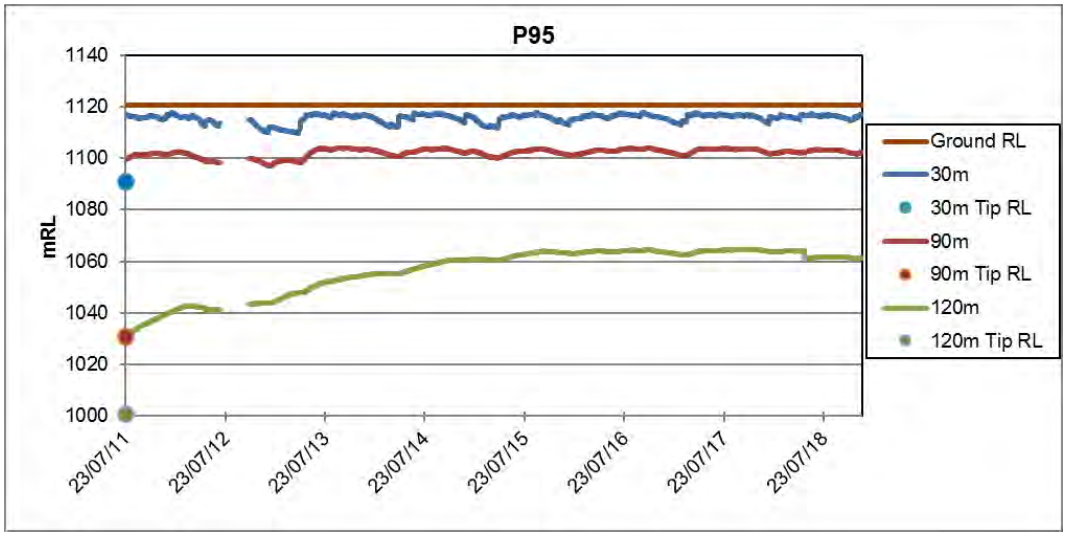

Figure 15: P95 Vibrating Wire Piezometer

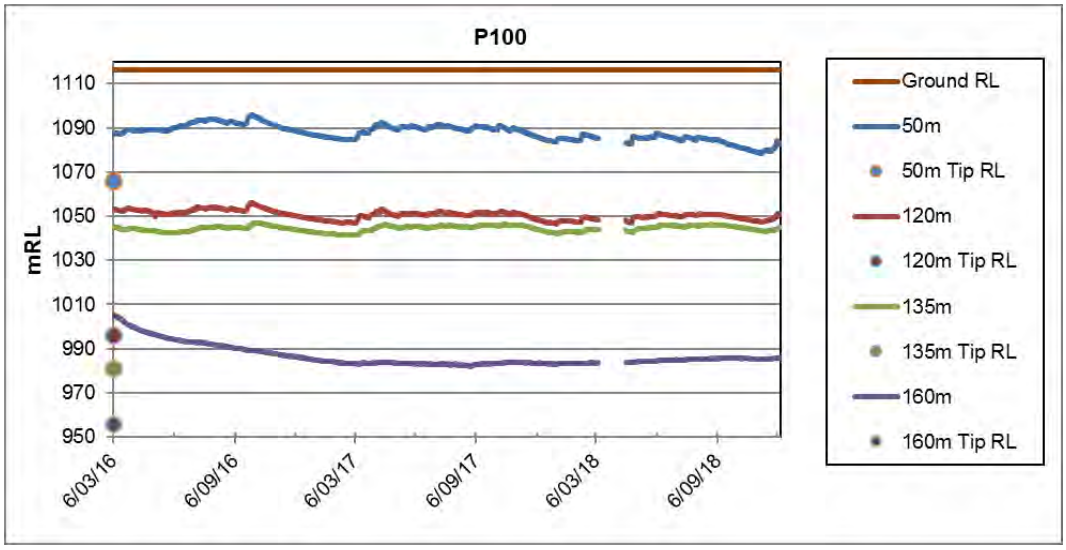

Figure 16: P100 Vibrating Wire Piezometer

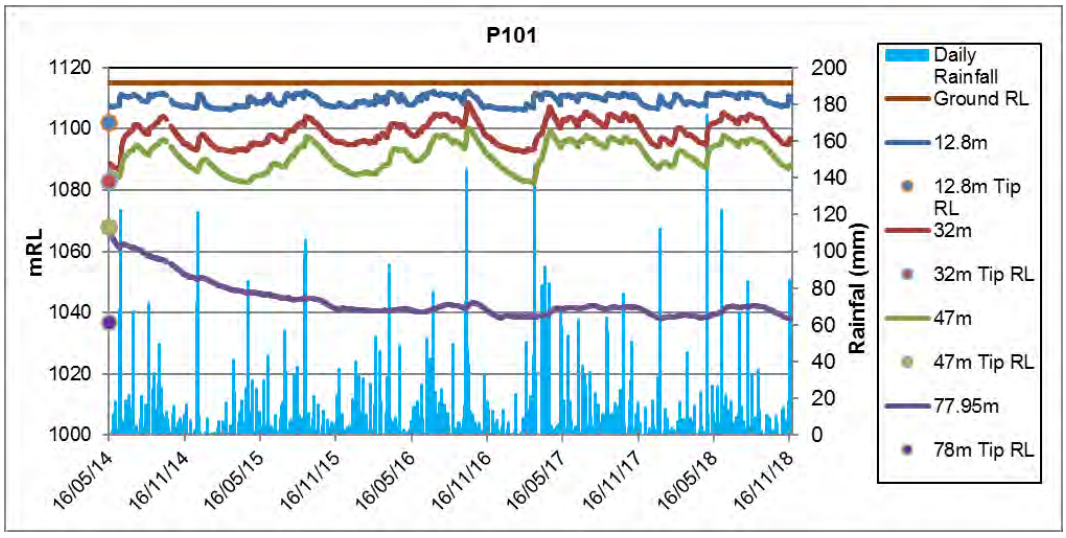

Figure 17: P101 Vibrating Wire Piezometer including daily rainfall

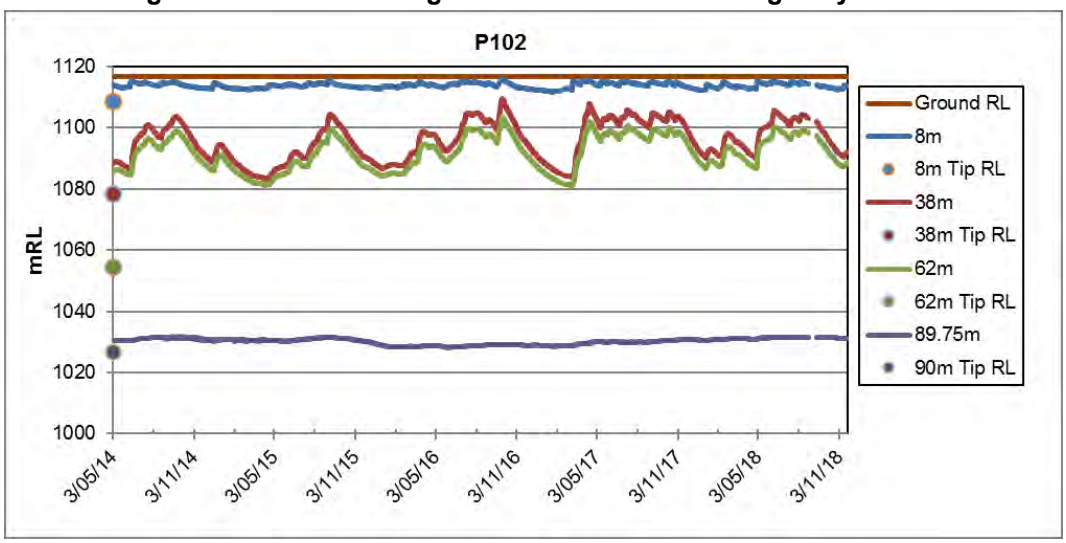

Figure 18: P102 Vibrating Wire Piezometer

Water levels were disrupted during 2012 to 2013 in P90, P91 and P92 by leakage down an incompletely sealed drill hole annulus. Pressures returned to normal after comprehensive effort to seal the leakage pathway.

During 2018, the 1050mRL piezometer in well P94 showed a drop in pressure believed to be a result of nearby mining causing relaxation in the country rock host rock surrounding the piezometer tip. The shallower piezometers at this location have not displayed any corresponding drop in pressure (Figure 14). The depressurisation is expected to stabilise once mining has passed the area.

4.1.2 *Martha Pit Piezometers*

P69D & P69S were installed in 2001 and are located close to the rim of the North Wall of Martha Pit. They were considered control bores and previously uninfluenced by dewatering. Geotechnical stability work in the North Wall was undertaken in October 2014, partly due to excessive water. Drainage holes were drilled into the lower wall. Localised drainage of the wall resulted, and the water levels in P69D and P69S declined. By March 2015 the piezometers had stabilized with P69D and P69S declined by 32m and 12m respectively (Figure 19). With the large North Wall slip in April 2016, access to the piezometers was briefly restricted. Real time loggers were installed in mid-2017 and are currently programmed to record hourly.

In September 2017, a piezometer hole (well P106) was drilled on the north-west side of Martha Pit (Figure 2). Four piezometers were installed to depths between 37 and 163m. The piezometers tips are in dewatered andesite and results indicate the majority of the rockmass is dry with little or no water pressure.

In mid-2018, five real time loggers recording hourly were installed in new wells (wells P117 – P121) to investigate the source of an area of seepage on the north wall of the pit (Figure 2). Water levels in well P119 appear to fluctuate with rainfall while in wells P 120 and P 121, levels follow long term seasonal trends within the andesite (Figure 20). These will continue to be monitored in 2019.

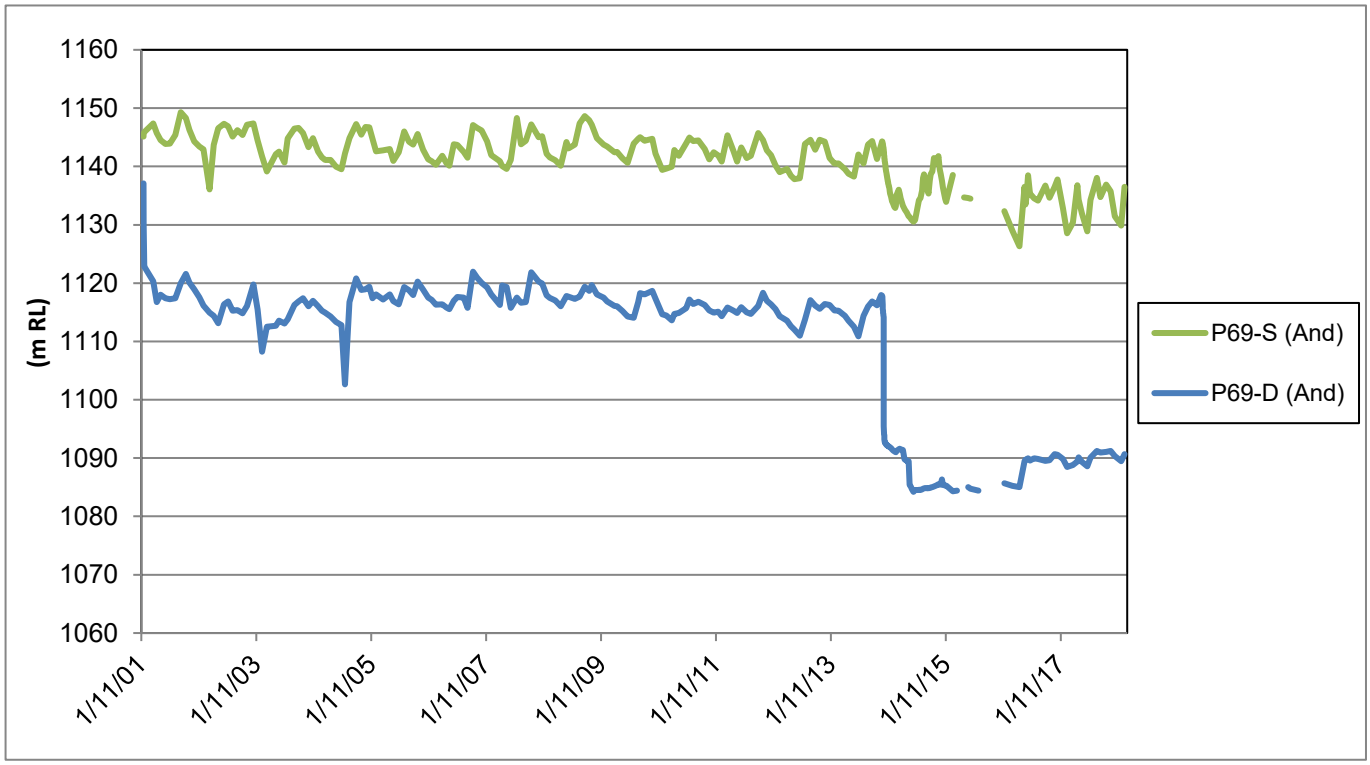

Figure 19: Water Levels P69 Pit North Wall

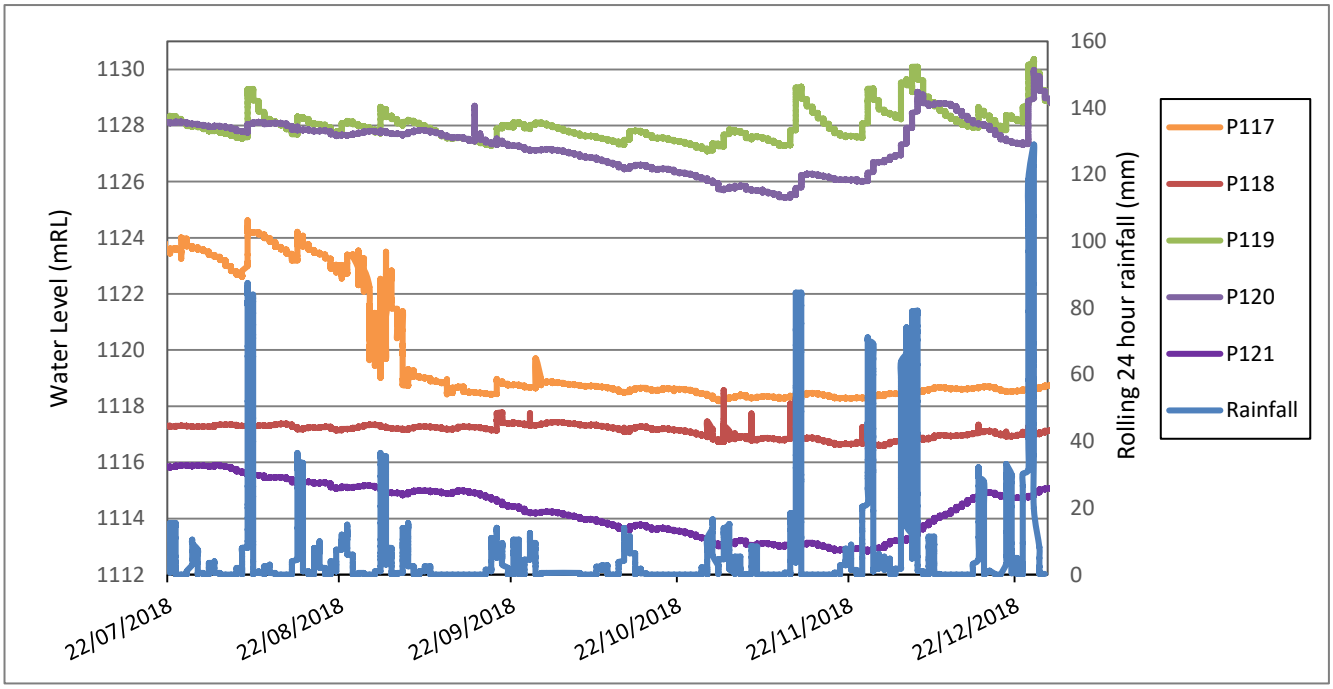

Figure 20: Water Levels in North Wall Piezometers

4.1.3 *Project Martha Piezometers*

During 2019, three dipped and three vibrating wire piezometers were added to the piezometer network to measure groundwater levels on the southern edge of the pit. Data collection from these piezometers is yet to begin. A further five may be added later in 2019.

5 WETLANDS AND ECOLOGICAL VALUES

This section is provided to meet Condition 9 e of the Project Martha consent:

- Provide details of any wetland areas and any other known aquatic ecological values that are dependent on the surface contribution of shallow and deep groundwater outflows.

Two distinct areas of wetland in the surrounds of Martha Pit have been identified as possibly being dependant on the surface contribution of shallow groundwater outflows by GWS. A memorandum outlining GWS's assessment of groundwater fed wetlands is included as Appendix C.

The first is located north of Martha Pit and is referred to hereafter as the Northern Area. The second area is located in the Union Hill, Winner Hill and Black Hill surrounds and is referred to as the Southern Area (Figure 21).

Figure 21: Northern and Southern Wetland Area

5.1 Northern Area

The Northern Area is located to the north of Martha Pit where younger volcanics/alluvium are located near the surface. Two separate areas of springs located between Williams Street and Bulltown Road drain south east into a wetland alongside the Pit Rim Walkway before joining the Eastern Stream. The area of wetland immediately northeast of the pit and the riparian margins of the Eastern Stream near the pit are maintained by OGNZL. No flow monitoring of this location has been undertaken in the past, however baseline flow monitoring further downstream on the Eastern Stream has begun at sampling point ES04 Weir (Figure 22).

5.2 Southern Area

The Southern Area consists of a collection of ephemeral springs that flow during winter or after heavy rainfall. Up to four separate springs flow from the south eastern side of Winner Hill (Figure 23). The springs run through a gully planted in natives and maintained by OGNZL, before eventually joining the Ohinemuri River. Flows from the springs are typically low and consequently, collecting flow rates at the springs themselves has not been possible. Collection of baseline flow data has instead commenced at TB4, where the springs join the Ohinemuri River (Figure 23). Initial monitoring has shown TB4 does not flow in summer.

A further possible groundwater fed wetland identified by GWS is located south of Union Hill. Preliminary observations have shown this area is usually dry, however further monitoring is required in winter to confirm if it is in fact groundwater fed, or if the channel only accommodates storm water flows following rainfall.

Water quality samples have sporadically been taken from the springs and TB4 when possible. Water quality data is attached as Appendix D.

Figure 22: Northern Area Wetland

Figure 23: Southern Area Wetlands

6 CONCLUSION

As dewatering below 700 mRL has not yet occurred, there are currently no effects as a result of dewatering associated with Project Martha. Effects of dewatering associated with previous dewatering consents is addressed in the Dewatering and Settlement Report 2018. Further comment on the effects of dewatering related to Project Martha activities will be included in subsequent reports.

APPENDIX A –

CONSENT CONDITIONS

Extract from conditions of Waikato Regional Council Consent 139551

MONITORING OF THE SHALLOW AND DEEP AQUIFERS

9 The consent holder shall upon commencement of this consent and at five yearly intervals thereafter, provide a report to the Waikato Regional Council commenting on the effect the groundwater take and dewatering activity is having on the deep and shallow aquifers under the Martha Pit and immediate surrounds. The report shall as a minimum, provide the following information:

(a) The nature of the geology under the Martha Pit and immediate surrounds;

(b) Comment on the existing groundwater chemistry for the deep and shallow aquifers;

(c) Comment on the groundwater levels in the deep and shallow aquifers; and

(e) Provide details of any wetland areas and any other known aquatic ecological values that are dependent on the surface contribution of shallow and deep groundwater outflows.

Taking into account all of this information (and any other relevant data) the consent holder shall provide comment on the effects the dewatering activity is having on the shallow and deep aquifers under the Martha Pit and immediate surrounds.

APPENDIX B –

UNDERGROUND DEWATERING WATER QUALITY

Date	Data Point	FLS pH	FLS EC (mS/m)	FLS Temp	Acidity (ph 8.3)(g/m3 as CaCO3)	Acidity (pH 3.7)	Alk-Bicarb	Alk-T	Alkalinity (pH4.5)(g/m3 as CaCO3)	AlS	SbS
25/01/2018	Underground Dewatering	7.3	324	24.8		1	300	300		0.008	0.0067
27/02/2018	Underground Dewatering	7.05	233.2	28.4	1				206		
14/03/2018	Underground Dewatering				1				169		
26/04/2018	Underground Dewatering	7	283.6	27.4	1				188		
18/05/2018	Underground Dewatering					1	193	193		0.012	0.0041
17/07/2018	Underground Dewatering				1				536		
6/08/2018	Underground Dewatering	7.24	33.7	29.7		1	490	490		0.013	0.0139
19/09/2018	Underground Dewatering	7.08	33.5	28.4	1				192		
10/10/2018	Underground Dewatering				1				184		
7/11/2018	Underground Dewatering				1				163		
11/12/2018	Underground Dewatering					1	330	330		0.021	0.0093
9/01/2019	Underground Dewatering				1				164		
8/02/2019	Underground Dewatering					1	200	200		0.018	0.0069
8/03/2019	Underground Dewatering				1				276		

Date	Data Point	AsS	Bicarb	CdS	CaSO	COD	Cl	CrS	Cr6col	CoS	CuS	CNTOT	EC (mS/m)	NH3	AuS	Hard	FeA	FeT	PbS	MgSO
25/01/2018	Underground Dewatering	0.034	360	0.0001	540	32	15.8	0.001	0.01	0.0053	0.001	0.057	276	0.024	0.0006	1610	2.3	8.4	0.0008	63
27/02/2018	Underground Dewatering				594		13						273			1800	3.5			73
14/03/2018	Underground Dewatering				540		13						270			1700	7.2			76
26/04/2018	Underground Dewatering				539		13.7						258			1600	5.1			70
18/05/2018	Underground Dewatering	0.01	230	0.00083	510	6	14	0.001	0.01	0.022	0.001	0.0029	269	0.01	0.0006	1590	6.3	13.5	0.0002	74
17/07/2018	Underground Dewatering				447		16						255			1400	16			70
6/08/2018	Underground Dewatering	0.04	600	0.0001	490	35	12	0.001	0.01	0.0028	0.001	0.03	269	0.028	0.0006	1480	3.2	30	0.005	60
19/09/2018	Underground Dewatering				595		11.2						275			1800	3.7			86
10/10/2018	Underground Dewatering				520		14						261			1600	3.6			67
7/11/2018	Underground Dewatering				494		13						257			2200	6.4			70
11/12/2018	Underground Dewatering	0.013	400	0.00019	470	62	20	0.001	0.01	0.0068	0.004	0.02	258	0.081	0.0006	1390	3.9	38	0.0044	52
9/01/2019	Underground Dewatering				539		10.9						258.2			1700	2.2			75
8/02/2019	Underground Dewatering	0.018	250	0.00023	500	6	12	0.001	0.01	0.0068	0.001	0.02	265	0.0057	0.0006	1540	4.2	23	0.0005	72
8/03/2019	Underground Dewatering				504		12.4						255			1500	5.2			66

Date	Data Point	MnA	MnS	HgA	HgT	NiS	NO3-N	NOxN	NO2-N	NH4N	pH	PTO	KSO	DRP	SeS	SeT	SI	AgS	NaSO	SO4
25/01/2018	Underground Dewatering		7.1	8.00E-05	8.00E-05	0.0085	5.8	6.1	0.29	4.6	7.4	1.03	10.8	0.004	0.003	0.004	37	0.0002	71	1350
27/02/2018	Underground Dewatering	10									7.5		9		0.0094				59	1720
14/03/2018	Underground Dewatering	9.9									7.3		8.1		0.0094				56	1670
26/04/2018	Underground Dewatering	9.6									7.3		7.7		0.0094				61	1550
18/05/2018	Underground Dewatering		9	8.00E-05	8.00E-05	0.028	1.41	1.53	0.11	1.1	7.4	0.22	9.1	0.004	0.002	0.0029	47	0.0002	59	1630
17/07/2018	Underground Dewatering	11									7.4		9.3		0.0094				48	660
6/08/2018	Underground Dewatering		7	8.00E-05	0.00018	0.01	4.9	5	0.12	3.4	7.6	0.57	9.4	0.004	0.002	0.0035	42	0.0002	59	1660
19/09/2018	Underground Dewatering	8.9									7.6		8.6		0.0094				55	1780
10/10/2018	Underground Dewatering	8.2									7.5		7.3		0.0094				53	1490
7/11/2018	Underground Dewatering	8.1									7.3		7.6		0.0094				58	1460
11/12/2018	Underground Dewatering		4.4	8.00E-05	0.00029	0.0116	8.2	9	0.79	5.6	7.8	0.68	13.9	0.004	0.004	0.0055	33	0.0002	75	1500
9/01/2019	Underground Dewatering	7.5									7.7		8.5		0.0094				47	1380
8/02/2019	Underground Dewatering		7.6	8.00E-05	8.00E-05	0.013	0.85	1.01	0.16	0.54	7.7	0.23	8.4	0.004	0.002	0.0021	42	0.0002	61	1590
8/03/2019	Underground Dewatering	10									7.6		7.3		0.0094				55	1510

Date	Data Point	Sum Anion	Sum Cation	TKN	SeTR	TSS	CNWAD	ZnS
25/01/2018	Underground Dewatering	35	36	5.9		2600	0.0189	0.058
27/02/2018	Underground Dewatering				0.0094	420		
14/03/2018	Underground Dewatering				0.0094	410		
26/04/2018	Underground Dewatering				0.0094	370		
18/05/2018	Underground Dewatering	38	35	1.2		780	0.0028	0.49
17/07/2018	Underground Dewatering				0.016	8000		
6/08/2018	Underground Dewatering	45	33	4.8		2200	0.02	0.055
19/09/2018	Underground Dewatering				0.0094	530		
10/10/2018	Underground Dewatering				0.0094	430		
7/11/2018	Underground Dewatering				0.0094	570		
11/12/2018	Underground Dewatering	39	32	6.8		3800	0.02	0.1
9/01/2019	Underground Dewatering				0.0094	300		
8/02/2019	Underground Dewatering	38	34	0.77		850	0.02	0.174
8/03/2019	Underground Dewatering				0.0094	1400		

APPENDIX C –

GWS SPRINGFED WETLANDS MEMO

MEMO

GWS Limited

30th May 2019

To: Mark Burroughs

From: Chris Simpson

Subject: Waihi Spring Fed Wetlands

This memo provides a summary of our understanding of the likely remaining locations in Waihi where remaining spring fed wetland areas are expected to exits.

This review has started with a figure (Figure 1 attached) generated by Woodward-Clyde in 1996 that identified relic mining features, areas of fill and locations of "swampy ground" based on a 1942 aerial photograph (refer Figures 2). We have interpreted these swampy areas as potentially being wetlands. This pre-modern mining plan has been lain over a recent aerial photograph to show where the areas of potential wetlands may still exist (Figure 3). In summary, it appears most of the potential wetland areas within the township, particularly in the east, have been infilled and developed into residential properties. Wetland areas to the north presently still remain, as do the areas to the south surrounding Union Hill, Black Hill and adjacent to the Ohinemuri River.

To assess the likelihood of these potential areas being spring fed, a map of the geology of Waihi (Figure 4), a topographic map (Figure 5) and high resolution historic aerial photographs have been used to make an interpretation as to whether springs are expected to occur in these locations or not based on the hydrogeologic setting.

The geology to the north of the Martha Pit in Waihi is dominated by a large massive body of quartz andesite at the surface which is largely devoid of springs. There is one area, however, where young volcanics/alluvium are present at the near surface where contact springs can occur. This area is some 400 to 500 m due north of the Martha Pit wall in between Williams St and Bulltown Rd (Figure 6). Review of the aerial photographs clearly shows what are likely to be springs forming two reaches that flow eastward to wetland areas that drain to the south.

The geology to the south of Waihi consist of volcanics/alluvium at the surface and there are two exposures of andesite that protrude though the sediments that form the Union and Black Hills (Figure 7). This older andesite is weathered in the near surface which has allowed the development of a soil regolith cover. This regolith allows the surface infiltration of water into the soil profile, which then allows the soil moisture to move under gravity to form spring, usually at a change in slope or where it meets the contact with the volcanics/alluvium. As shown on Figure 7 there are two locations adjacent to Domain Rd where springs are indicated to be discharging into wetland areas before entering the Ohinemuri River.

In summary, it is our interpretation that there are two main locations in Waihi where spring fed wetlands still exist. These springs occur due to shallow groundwater discharging from volcanics/alluvium or from weathered andesite and we understand they are ephemeral, essentially drying up during summer months. These springs existed prior to modern mining and still exist now. As these features relate to shallow groundwater movement, dewatering associated with mining operations has not affected the spring flow to any significant degree. This observation is consistent with 30 years of shallow groundwater level monitoring as demonstrated in annual monitoring reports that shows a water table is maintained in the weathered andesite and young volcanics/ alluvium despite deeper dewatering of the andesite rockmass.

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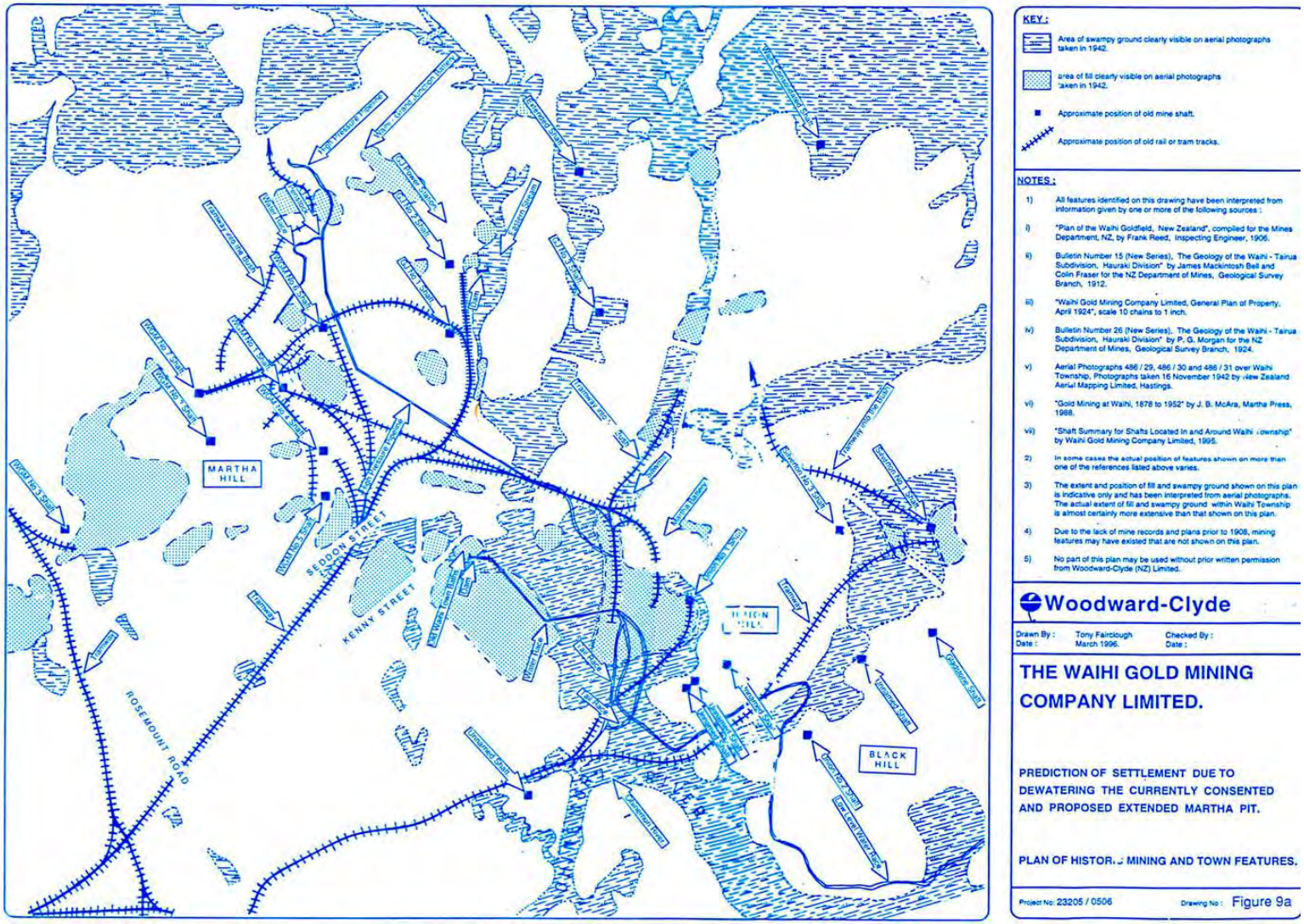

Figure 1 WWC (1996) Plan of Mining Features, Areas of Fill and Swamy Ground

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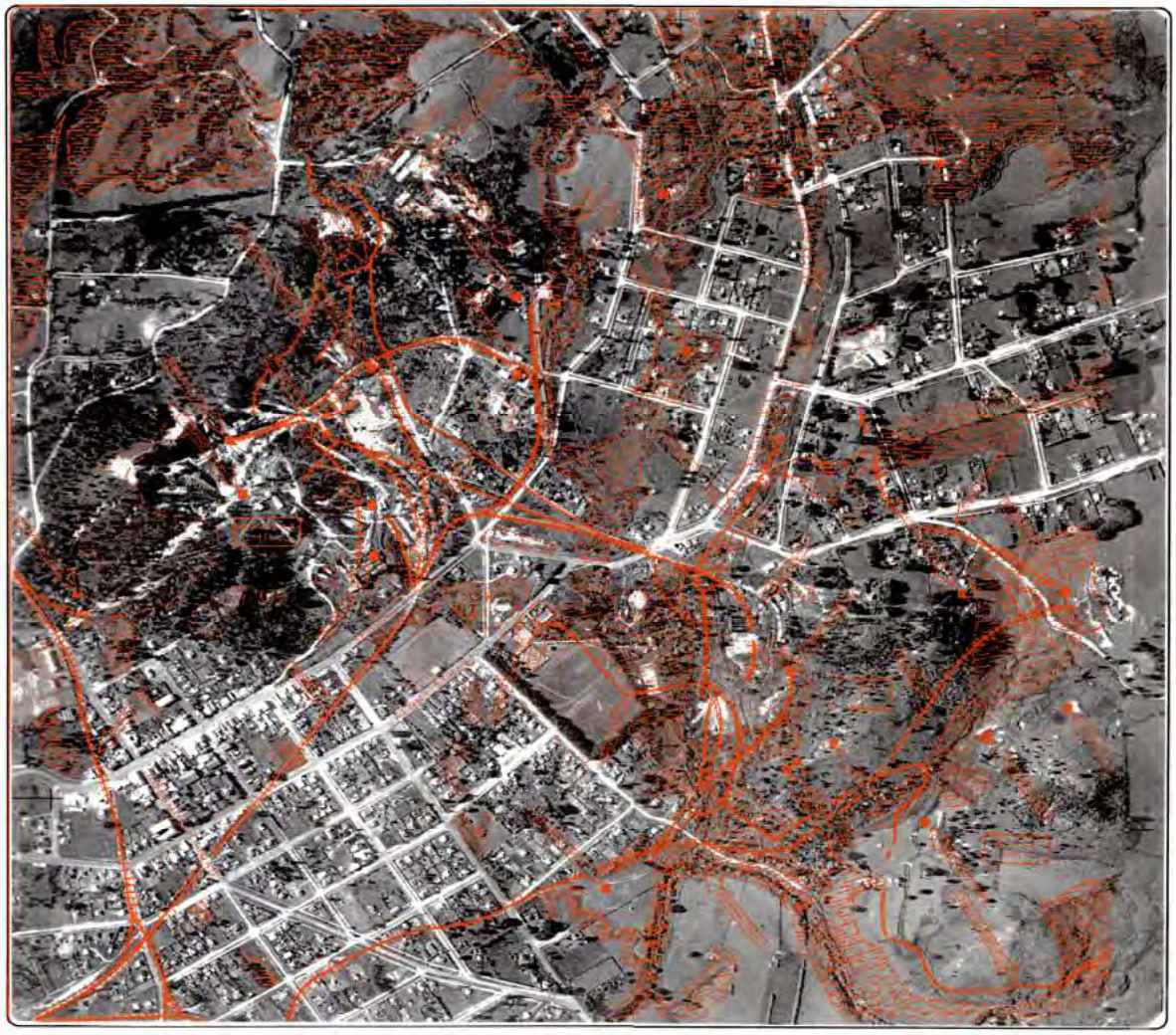

Figure 2 Swampy Areas Identified from 1942 Aerial Photographs

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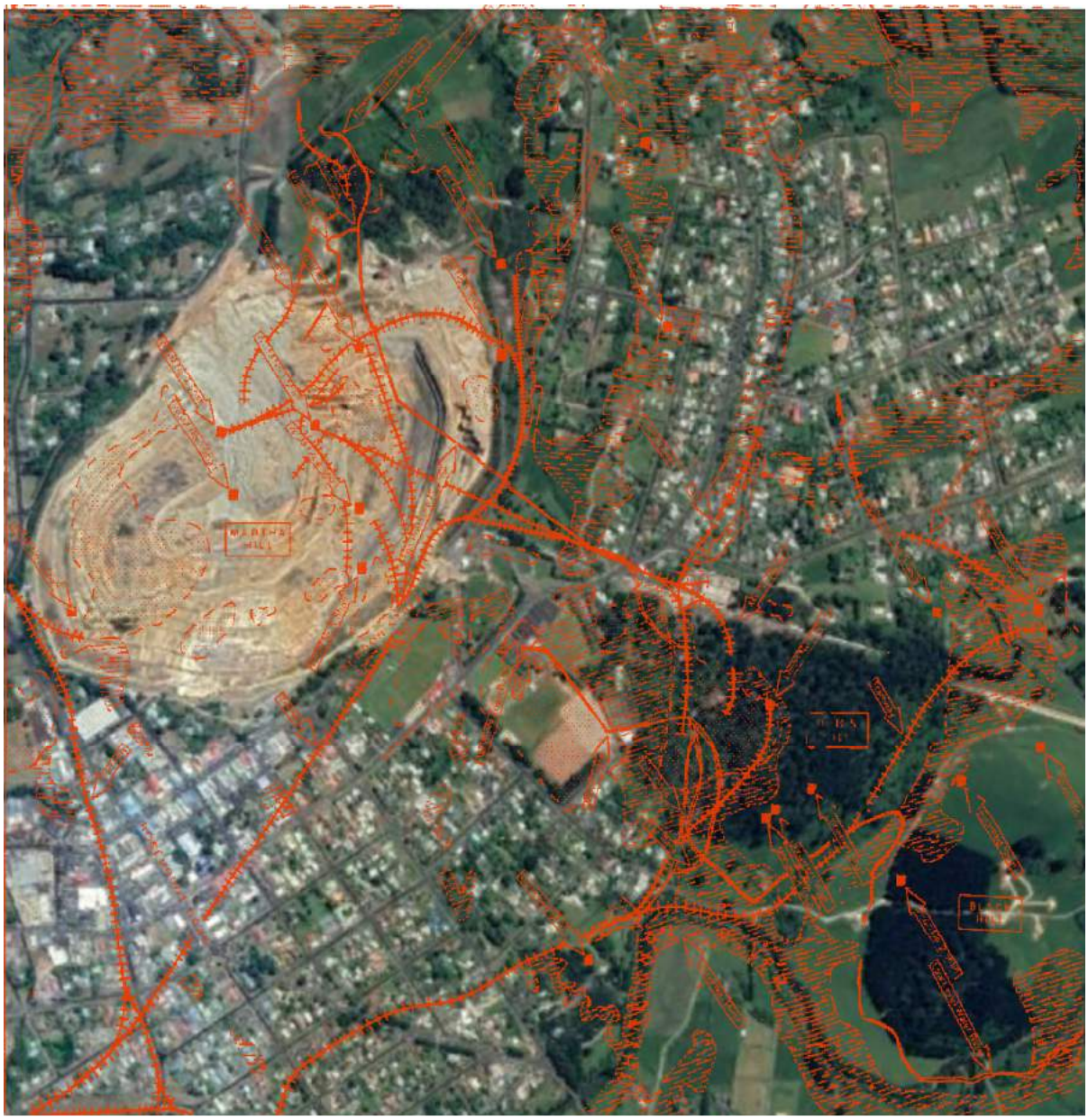

Figure 3 Swampy Areas Over Recent Aerial Photographs

4 Katote Close, The Gardens
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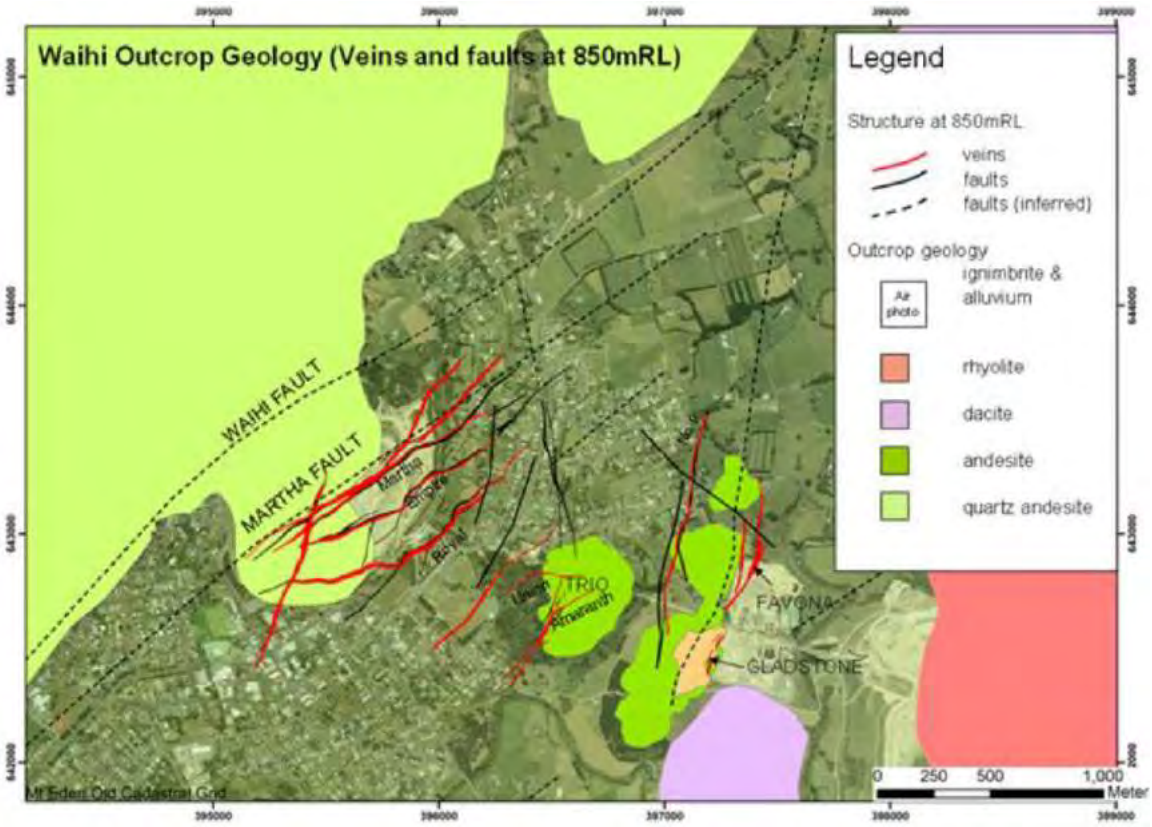


Figure 4 Geology of the Waihi Area

Figure 5 Topography of the Waihi Area

Figure 6 Northern Area Spring Fed Wetlands

Figure 7 Southern Area Spring Fed Wetlands

APPENDIX D –

GLAD SPRINGS/TB4 WATER QUALITY

Date	Data Point	FLS Comments	FLS EC (mS/m)	FLS pH	FLS Temp	Acidity (pH 3.7)	Alk-Bicarb	Alk-T	AlA	AlS	SbA	SbS	AsA	AsS	BaS	Bicarb
20/09/2017	Glad spring C	Medium Flow	6.8	6.3	14.9	1	3.8	3.8	0.04	0.025	0.0002	0.0002	0.001	0.001		4.6
20/09/2017	Glad spring A	Low Flow	10.4	6.6	14.6	1	6.9	6.9	0.051	0.031	0.0002	0.0002	0.001	0.001		8.4
20/09/2017	Glad spring B	Trickle Flow	11.2	6.6	14.3	1	4.1	4.1	2.4	0.018	0.0003	0.0002	0.0021	0.001		5
20/09/2017	Glad spring D	Medium Flow	8.5	6.3	13.9	1	9.6	9.6	0.037	0.036	0.0002	0.0002	0.001	0.001		11.7
20/09/2017	TB4	Fast Flow	6.8	7	13.1	1	7.9	7.9	0.035	0.034	0.0002	0.0002	0.001	0.001		9.6
20/09/2017	Glad ABC combined	Medium Flow	7.1	6.5	13.1	1	7.2	7.2	0.042	0.042	0.0002	0.0002	0.001	0.001		8.8
14/02/2018	Glad spring C							4.1		0.032		0.0002		0.001	0.033	5
14/02/2018	Glad spring A							5.7		0.051		0.0002		0.001	0.031	6.9
14/02/2018	TB4							7.3		0.073		0.0002		0.001	0.048	8.9
14/02/2018	Glad spring D							7.5		0.067		0.0002		0.001	0.042	9.1
14/02/2018	Glad spring B							5.3		0.044		0.0002		0.001	0.03	6.5
3/05/2018	Glad spring B		11.2	5.1	16.1			4.2		0.042		0.0002		0.001	0.029	5.1
3/05/2018	Glad spring D		10.3	4.8	16.9			6.8		0.094		0.0002		0.001	0.039	8.3
3/05/2018	Glad spring C		9.9	4.94	16.4			3.5		0.03		0.0002		0.001	0.026	4.3
3/05/2018	TB4		9.1	5.19	14.8			6.4		0.071		0.0002		0.001	0.041	7.8
3/05/2018	Glad spring A		12.2	4.95	16.3			5.9		0.028		0.0002		0.001	0.024	7.2
16/08/2018	TB4		7.3	6.6	12.5			9.3		0.07		0.0002		0.001	0.037	11.3
16/08/2018	Glad spring B		9.5	6.25	14.9			5.9		0.013		0.0002		0.001	0.02	7.2
16/08/2018	Glad spring C		7.1	6.5	15			3.6		0.019		0.0002		0.001	0.019	4.4
16/08/2018	Glad spring A		9.8	6	15.1			6.4		0.017		0.0002		0.001	0.019	7.8
16/08/2018	Glad spring D		8.6	6	13.6			8.9		0.079		0.0002		0.001	0.036	10.8
14/10/2018	TB4							19.7		0.041		0.0002		0.001		24
14/01/2019	TB4	Not Enough To Sample														
18/02/2019	Glad spring D	Dry														
18/02/2019	Glad spring C	Dry														
18/02/2019	Glad spring A	Dry														
18/02/2019	Glad spring B	Dry														
21/02/2019	TB4	No flow														
19/03/2019	TB4	No flow														

Date	Data Point	BS	CdA	CdS	CaSO	Carb	COD	Cl	CrA	CrS	Cr6col	Cr-T	CoA	CoS	CuA	CuS	CNTOT	EC (mS/m)	F-	NH3
20/09/2017	Glad spring C		5.00E-05	5.00E-05	2.4	1	6	12.7		0.0005	0.001	0.00053	0.0002	0.0002	0.0005	0.0005	0.001	7.8	0.05	0.01
20/09/2017	Glad spring A		5.00E-05	5.00E-05	7.9	1	6	10.7		0.0005	0.001	0.00053	0.0004	0.0005	0.0005	0.0005	0.001	12.7	0.05	0.01
20/09/2017	Glad spring B		7.00E-05	5.00E-05	5.8	1	6	10.2		0.0005	0.001	0.0024	0.0004	0.0004	0.0023	0.0005	0.001	11	0.05	0.01
20/09/2017	Glad spring D		5.00E-05	5.00E-05	3	1	60	17.2		0.0005	0.001	0.00053	0.0002	0.0002	0.0005	0.0005	0.001	9.7	0.05	0.01
20/09/2017	TB4		5.00E-05	5.00E-05	2.4	1	6	11.2		0.0005	0.001	0.00053	0.0002	0.0002	0.0005	0.0005	0.001	7.4	0.05	0.01
20/09/2017	Glad ABC combined		5.00E-05	5.00E-05	2.1	1	6	10		0.0005	0.001	0.00053	0.0002	0.0002	0.0005	0.0005	0.001	6.8	0.05	0.01
14/02/2018	Glad spring C	0.007		5.00E-05	3.9			15		0.0005				0.0003		0.0005		10.4		
14/02/2018	Glad spring A	0.006		5.00E-05	7.3			13		0.0005				0.0006		0.0005		13.5		
14/02/2018	TB4	0.009		5.00E-05	2.9			16		0.0005				0.0003		0.0005		9.4		
14/02/2018	Glad spring D	0.008		5.00E-05	2.8			16		0.0006				0.0002		0.0005		9.7		
14/02/2018	Glad spring B	0.005		6.00E-05	4.7			14		0.0005				0.0002		0.0005		10.4		
3/05/2018	Glad spring B	0.009		5.00E-05	4.8			14		0.0005				0.0002		0.0005		10.1		
3/05/2018	Glad spring D	0.01		5.00E-05	2.7			16		0.0005				0.0002		0.0005		9.2		
3/05/2018	Glad spring C	0.01		5.00E-05	3.3			14		0.0005				0.0003		0.0005		8.9		
3/05/2018	TB4	0.009		5.00E-05	2.8			14		0.0005				0.0002		0.0005		8.3		
3/05/2018	Glad spring A	0.009		5.00E-05	5.7			14		0.0005				0.0004		0.0005		11		
16/08/2018	TB4	0.007		5.00E-05	2.3			12		0.0005				0.0002		0.0005		7.5		
16/08/2018	Glad spring B	0.009		6.00E-05	5.3			11		0.0005				0.0002		0.0005		10.1		
16/08/2018	Glad spring C	0.009		5.00E-05	2.1			13.2		0.0005				0.0002		0.0005		7.4		
16/08/2018	Glad spring A	0.009		5.00E-05	5.4			11		0.0005				0.0003		0.0005		10.3		
16/08/2018	Glad spring D	0.008		5.00E-05	2.7			15		0.0005				0.0002		0.0005		9.1		
14/10/2018	TB4	0.007		5.00E-05	3.2			11.4		0.0005				0.0015		0.0005		8.3		
14/01/2019	TB4																			
18/02/2019	Glad spring D																			
18/02/2019	Glad spring C																			
18/02/2019	Glad spring A																			
18/02/2019	Glad spring B																			
21/02/2019	TB4																			
19/03/2019	TB4																			

Date	Data Point	Hard	FeA	FeS	FeT	PbA	PbS	MgSO	MnA	MnS	HgA	HgS	HgT	MoS	NiA	NiS	NO3-N	NOxN	NO2-N
20/09/2017	Glad spring C	11.6	0.02	0.02	0.035	0.0001	0.0001	1.38	0.0048	0.0047	8.00E-05	8.00E-05	9.00E-05		0.0005	0.0005	0.9	0.9	0.1
20/09/2017	Glad spring A	32	0.1	0.05	0.09	0.0001	0.0001	3	0.025	0.025	8.00E-05	8.00E-05	8.00E-05		0.0012	0.0011	0.78	0.78	0.1
20/09/2017	Glad spring B	24	1.24	0.2	3	0.0021	0.0001	2.3	0.053	0.042	0.00013	8.00E-05	0.00045		0.0005	0.0005	0.39	0.39	0.1
20/09/2017	Glad spring D	16.7	0.06	0.04	0.084	0.0001	0.0001	2.2	0.0175	0.0155	8.00E-05	8.00E-05	8.00E-05		0.0005	0.0005	0.63	0.63	0.1
20/09/2017	TB4	12.3	0.37	0.23	0.38	0.0001	0.0001	1.55	0.029	0.027	8.00E-05	8.00E-05	8.00E-05		0.0005	0.0005	0.23	0.23	0.1
20/09/2017	Glad ABC combined	10.7	0.36	0.2	0.38	0.0001	0.0001	1.33	0.022	0.0183	8.00E-05	8.00E-05	8.00E-05		0.0005	0.0005	0.15	0.15	0.1
14/02/2018	Glad spring C	17.9		0.02			0.0001	1.94		0.0082	8.00E-05	8.00E-05		0.0002		0.0005		1.59	
14/02/2018	Glad spring A	30		0.02			0.0001	2.8		0.0164	8.00E-05	8.00E-05		0.0002		0.0014		1.65	
14/02/2018	TB4	15		0.27			0.0001	1.89		0.025	8.00E-05	8.00E-05		0.0002		0.0005		0.65	
14/02/2018	Glad spring D	15.4		0.05			0.0001	2		0.0104	8.00E-05	8.00E-05		0.0002		0.0005		0.83	
14/02/2018	Glad spring B	19.9		0.02			0.0001	1.96		0.0147	8.00E-05	8.00E-05		0.0002		0.0005		1.27	
3/05/2018	Glad spring B			0.02			0.0001	1.82		0.0136	8.00E-05	8.00E-05		0.0002		0.0005		1.2	
3/05/2018	Glad spring D			0.05			0.0001	1.96		0.0099	8.00E-05	8.00E-05		0.0002		0.0005		0.87	
3/05/2018	Glad spring C			0.02			0.0001	1.55		0.0075	8.00E-05	8.00E-05		0.0002		0.0005		1.17	
3/05/2018	TB4			0.21			0.0001	1.56		0.028	8.00E-05	8.00E-05		0.0002		0.0005		0.55	
3/05/2018	Glad spring A			0.02			0.0001	2		0.0139	8.00E-05	8.00E-05		0.0002		0.0011		1.02	
16/08/2018	TB4			0.42			0.0001	1.46		0.039	8.00E-05	8.00E-05		0.0002		0.0005		0.33	
16/08/2018	Glad spring B			0.1			0.0001	1.7		0.015	8.00E-05	8.00E-05		0.0002		0.0007		0.54	
16/08/2018	Glad spring C			0.02			0.0001	1.12		0.0036	8.00E-05	8.00E-05		0.0002		0.0005		0.77	
16/08/2018	Glad spring A			0.02			0.0001	1.87		0.0143	8.00E-05	8.00E-05		0.0002		0.0008		0.59	
16/08/2018	Glad spring D			0.04			0.0001	1.91		0.0121	8.00E-05	8.00E-05		0.0002		0.0005		0.68	
14/10/2018	TB4	15.6		2.4			0.0001	1.86		0.33	8.00E-05	8.00E-05		0.0002		0.0005	0.049	0.051	0.003
14/01/2019	TB4																		
18/02/2019	Glad spring D																		
18/02/2019	Glad spring C																		
18/02/2019	Glad spring A																		
18/02/2019	Glad spring B																		
21/02/2019	TB4																		
19/03/2019	TB4																		

Date	Data Point	NH4N	pH	PTO	KSO	DRP	SeA	SeS	SI	AgA	AgS	NaSO	SrS	SO4	Sum Anion	Sum Cation	TiA	TiS	SnS	TDS
20/09/2017	Glad spring C	0.01	5.3	0.004	1.72	0.004	0.001	0.001	11.2	0.0001	0.0001	8.2		8	0.66	0.64	5.00E-05	5.00E-05		55
20/09/2017	Glad spring A	0.01	5.8	0.004	1.74	0.004	0.0012	0.001	14.2	0.0001	0.0001	9.5		30	1.12	1.11	6.00E-05	7.00E-05		84
20/09/2017	Glad spring B	0.012	5.6	0.018	4.3	0.004	0.001	0.001	13	0.0001	0.0001	9.5		27	0.96	1.02	6.00E-05	5.00E-05		78
20/09/2017	Glad spring D	0.01	5.8	0.006	1.77	0.004	0.001	0.001	18.6	0.0001	0.0001	10.5		7	0.87	0.84	5.00E-05	5.00E-05		81
20/09/2017	TB4	0.01	6.7	0.012	1.56	0.004	0.001	0.001	16.1	0.0001	0.0001	8.5		7	0.65	0.67	5.00E-05	5.00E-05		85
20/09/2017	Glad ABC combined	0.01	6.5	0.01	1.07	0.004	0.001	0.001	15.2	0.0001	0.0001	8		8	0.59	0.6	5.00E-05	5.00E-05		48
14/02/2018	Glad spring C	0.01	5.5		2.2			0.001			0.0001	9.9	0.0187	13				6.00E-05	0.0005	
14/02/2018	Glad spring A	0.01	5.5		1.97			0.001			0.0001	10.3	0.03	23				9.00E-05	0.0005	
14/02/2018	TB4	0.015	6		2.3			0.001			0.0001	9.3	0.021	10				5.00E-05	0.0005	
14/02/2018	Glad spring D	0.012	5.5		2.2			0.001			0.0001	10.1	0.022	9				5.00E-05	0.0005	
14/02/2018	Glad spring B	0.01	5.6		1.15			0.001			0.0001	9.5	0.021	15				5.00E-05	0.0005	
3/05/2018	Glad spring B	0.01	6.3		1.37			0.001			0.0001	9.4	0.02	14.8				5.00E-05	0.0005	
3/05/2018	Glad spring D	0.01	5.7		1.89			0.001			0.0001	9.7	0.0191	7.8				5.00E-05	0.0005	
3/05/2018	Glad spring C	0.01	5.9		1.99			0.001			0.0001	8.8	0.0148	11.5				5.00E-05	0.0005	
3/05/2018	TB4	0.017	6.6		1.78			0.001			0.0001	8.6	0.0174	8.9				5.00E-05	0.0005	
3/05/2018	Glad spring A	0.01	5.8		1.83			0.001			0.0001	9.2	0.023	18.7				7.00E-05	0.0005	
16/08/2018	TB4	0.016	6.6		1.44			0.001			0.0001	8.3	0.0163	6				5.00E-05	0.0005	
16/08/2018	Glad spring B	0.019	6.3		1.52			0.001			0.0001	8.9	0.021	17				9.00E-05	0.0005	
16/08/2018	Glad spring C	0.01	6.2		1.48			0.001			0.0001	8.3	0.0112	6.5				5.00E-05	0.0005	
16/08/2018	Glad spring A	0.01	6		1.35			0.001			0.0001	8.8	0.022	18				6.00E-05	0.0005	
16/08/2018	Glad spring D	0.01	6		1.66			0.001			0.0001	10.4	0.019	7				5.00E-05	0.0005	
14/10/2018	TB4		6.7		1.24							8.2		0.9	0.74	0.8			0.0005	
14/01/2019	TB4																			
18/02/2019	Glad spring D																			
18/02/2019	Glad spring C																			
18/02/2019	Glad spring A																			
18/02/2019	Glad spring B																			
21/02/2019	TB4																			
19/03/2019	TB4																			

Date	Data Point	TKN	TSS	UA	US	CNWAD	ZnA	ZnS
20/09/2017	Glad spring C	0.19	35	2.00E-05	2.00E-05	0.001	0.0016	0.0017
20/09/2017	Glad spring A	0.19	19	2.00E-05	2.00E-05	0.001	0.0025	0.0025
20/09/2017	Glad spring B	0.15	43	0.00022	2.00E-05	0.001	0.0046	0.0029
20/09/2017	Glad spring D	0.12	3	2.00E-05	2.00E-05	0.001	0.0024	0.0023
20/09/2017	TB4	0.13	3	2.00E-05	2.00E-05	0.001	0.0043	0.0033
20/09/2017	Glad ABC combined	0.12	3	2.00E-05	2.00E-05	0.001	0.0023	0.0024
14/02/2018	Glad spring C	0.1	3		2.00E-05	0.001		0.0049
14/02/2018	Glad spring A	0.1	3		2.00E-05	0.001		0.0038
14/02/2018	TB4	0.19	5		2.00E-05	0.001		0.004
14/02/2018	Glad spring D	0.23	11		3.00E-05	0.001		0.0024
14/02/2018	Glad spring B	0.32	28		2.00E-05	0.001		0.0031
3/05/2018	Glad spring B	0.6	57		2.00E-05	0.001		0.0037
3/05/2018	Glad spring D	0.22	16		2.00E-05	0.001		0.0024
3/05/2018	Glad spring C	0.37	71		2.00E-05	0.001		0.0025
3/05/2018	TB4	0.2	3		2.00E-05	0.001		0.0105
3/05/2018	Glad spring A	0.18	11		2.00E-05	0.001		0.004
16/08/2018	TB4	0.2	3		2.00E-05	0.003		0.0032
16/08/2018	Glad spring B	0.82	109		4.00E-05	0.002		0.0023
16/08/2018	Glad spring C	0.31	69		2.00E-05	0.002		0.002
16/08/2018	Glad spring A	0.22	40		2.00E-05	0.002		0.0021
16/08/2018	Glad spring D	0.21	10		2.00E-05	0.003		0.0028
14/10/2018	TB4							0.0043
14/01/2019	TB4							
18/02/2019	Glad spring D							
18/02/2019	Glad spring C							
18/02/2019	Glad spring A							
18/02/2019	Glad spring B							
21/02/2019	TB4							
19/03/2019	TB4							

Appendix F REX OREBODY INVESTIGATION

TECHNICAL MEMO

GWS Limited

28th March 2023

To: Mark Burroughs

From: Chris Simpson

Subject: Rex Orebody - Groundwater Monitoring and Special Investigations

1. Background

The consent conditions for the Martha Underground mine (MUG) dewatering permit require monitoring of groundwater levels / pressures around the vein systems, in the host rock and in the overlying young volcanic deposits. This is undertaken through measurements from a network of piezometers (stand pipes, vibrating wire and pneumatic piezometers). Where significant changes occur in the monitoring records that might indicate a sudden change in conditions has occurred (i.e. water level or pressure drop), there is a requirement to investigate and report the findings of those investigations back to the Regional Council.

This technical memo provides a review of groundwater conditions in the area of the Rex Orebody as recent monitoring has shown some deviation from historical trends that suggest dewatering has occurred in response to underground mining.

2. Hydrogeological Setting

The Rex Orebody is a north-east trending vein system that is located behind the Martha Pit southern wall. The Rex vein system parallels the other main vein systems that are already dewatered (Martha, Empire and Welcome Lodes) and intercepts the Royal Lode in the east (refer Figure 1). The Royal Lode is dewatered via interception with the Edward lode which is actively dewatered by current mining operation. All of these vein systems are hosted by andesite rocks. In the area surrounding the Rex vein system, post mineralisation ignimbrite volcanics overlie the andesite with the distributing being controlled by the paleo topography prior to deposition.

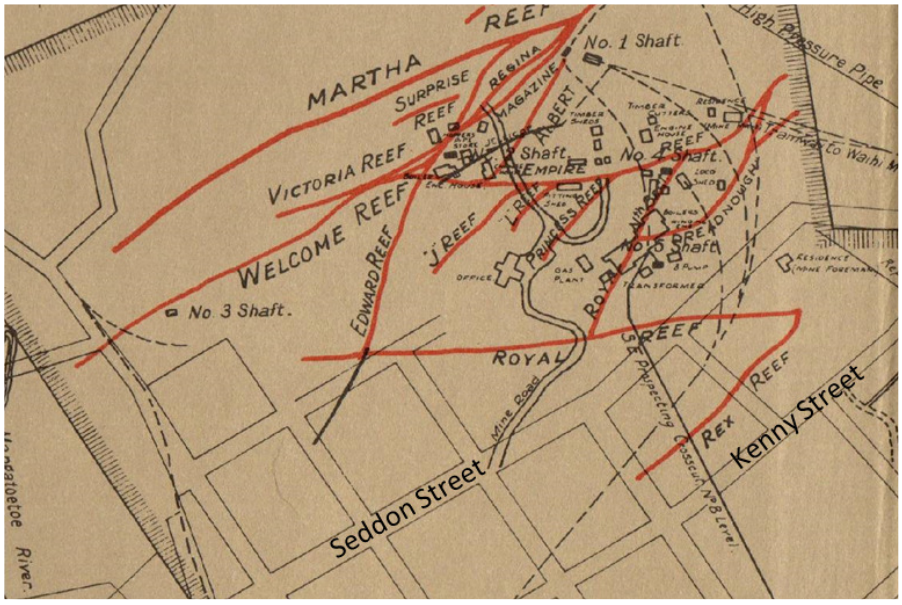


Figure 1 Location of Martha Vein Systems (after McAra, 1988)

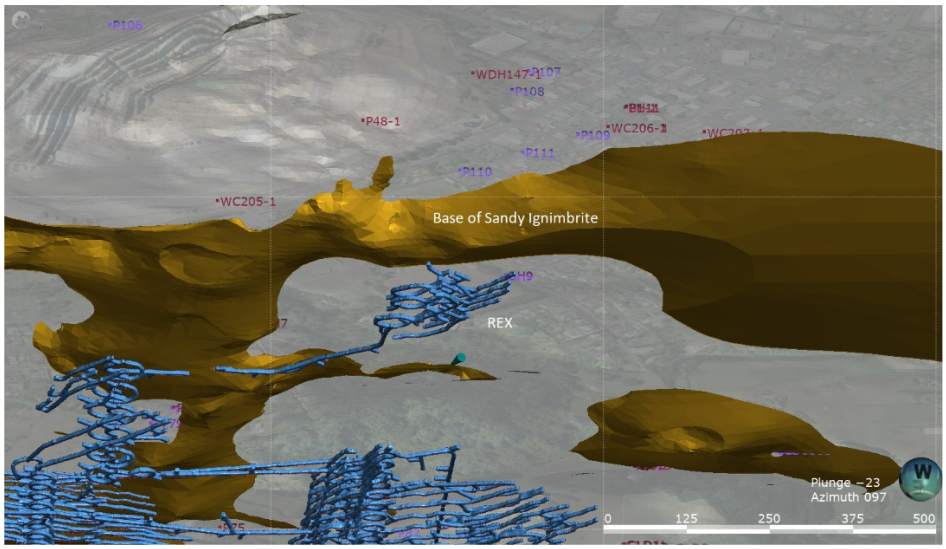


Figure 2 Sandy Ignimbrite Distribution (Viewing Up from Beneath)

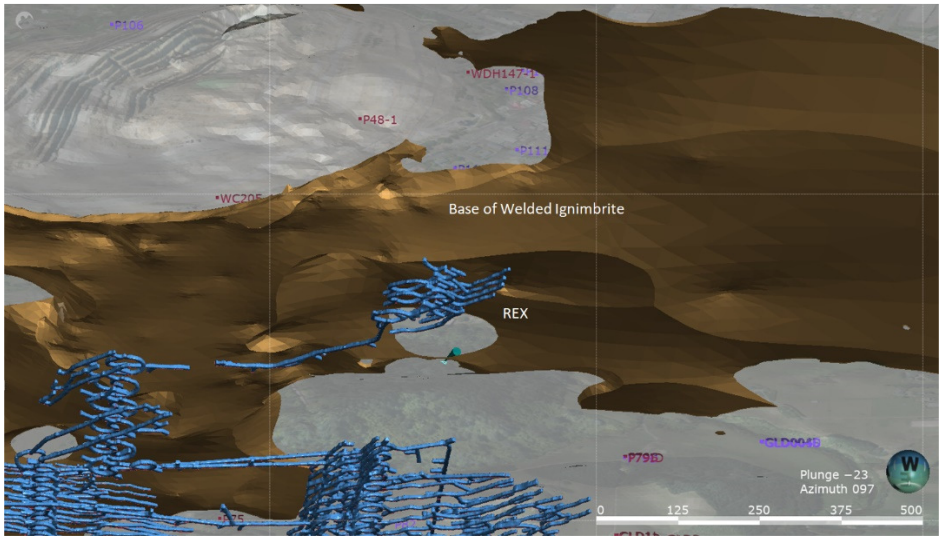


Figure 3 Welded Ignimbrite Distribution (Viewing Up from Beneath)

The sequence of young volcanic deposits consists of a fairly channelised sandy ignimbrite, overlain by a laterally extensive sheet of welded ignimbrite. Deposited on top of the welded ignimbrite is a layer of ash/regolith of variable thickness with some lake deposits present locally. This is illustrated in Figures 2 and 3.

Two separate groundwater systems exist as a function of the geologic units present; one in the andesite rockmass and one in the younger volcanics. In the vicinity of the Rex Orebody, both groundwater systems are interpreted to be draining back into the Martha Pit as shown in Figures 4 and 5. Experience has shown that the groundwater in the Young Volcanics is in a perched system that remains generally unaffected by the drainage in the underlying andesite rocks. This is due to the presence of low permeability layers that separate the systems.

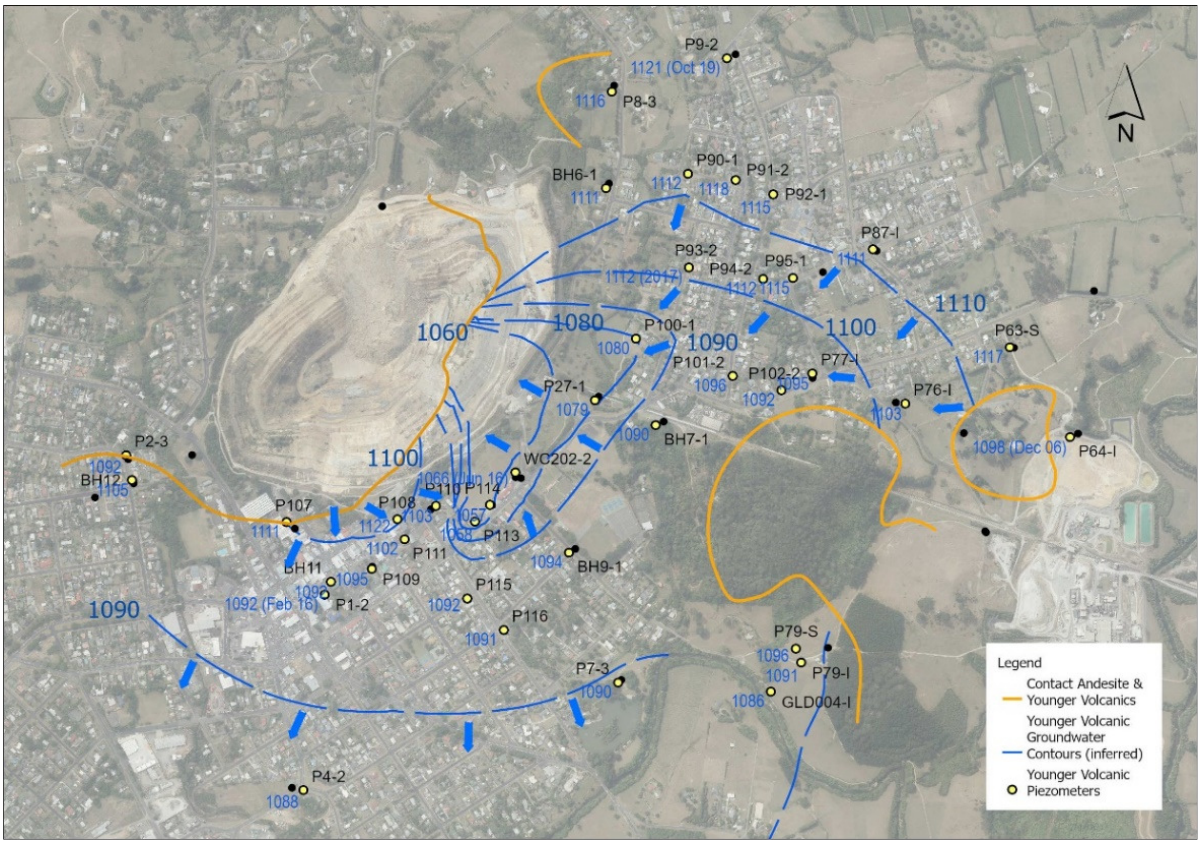


Figure 4 Young Volcanics Interpreted Piezometric Surface

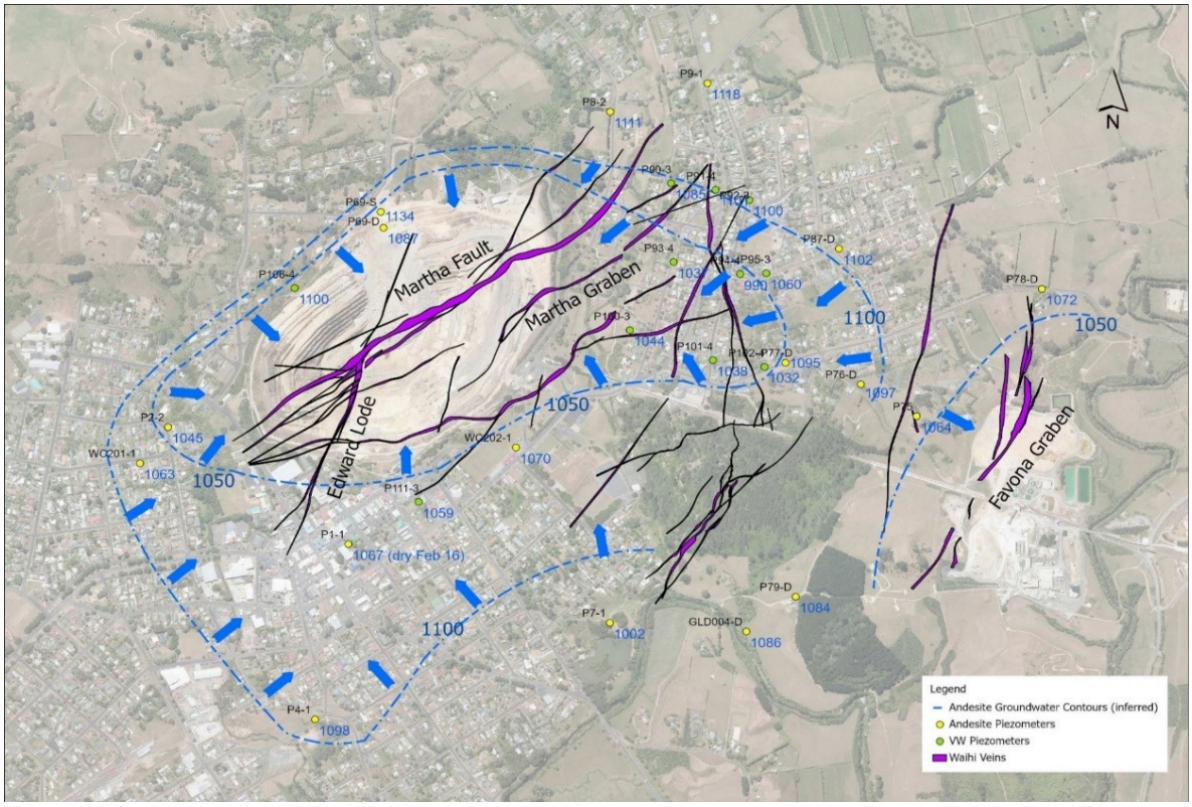


Figure 5 Andesite Piezometric Surface

3. Groundwater Monitoring Results

Groundwater monitoring is undertaken throughout Waihi and is required through conditions of consent associated with the mine dewatering permit. Monitoring in the vicinity of the Rex Orebody is undertaken at several locations as shown on Figure 6. These wells are of different depths and construction and each one is discussed individually below. The monitoring records for the piezometers are included in Attachment A of this letter report.

Figure 6 Groundwater Monitoring Well Locations near the Rex Orebody

P110

This monitoring location consists of a 17 m deep standpipe piezometer within the young volcanics with the water levels measured monthly by manual dipping. The monitoring data indicates a permanent water table exists and the groundwater level varies in response to seasonal influences by some 5-6 m. Drainage effects from the dewatered andesite rockmass have not propagated into the overlying aquifer.

P111

This monitoring location is along strike of the Rex vein system and consists of a nest of three vibrating wire piezometers. The tips are positioned; in the young volcanics (13 m depth), upper andesite (25m depth) and lower andesite (60 m depth). The groundwater pressures are automatically logged on a daily frequency. In summary, the monitoring indicates there is partial saturation in the andesite having been affected by dewatering. The groundwater system in the young volcanics is perched and demonstrates some 2.5 m of seasonal fluctuation. Drainage effects from the dewatered andesite rockmass have not propagated into the overlying aquifer.

P112

This monitoring location is along strike of the Rex vein system and consists of a nest of three vibrating wire piezometers. The tips are positioned; deep in the young volcanics (50 m depth), upper andesite (72m depth) and lower andesite (110 m depth). The groundwater pressures are automatically logged on a daily frequency. In summary, the monitoring indicates there is partial saturation in the andesite having been affected by dewatering. The groundwater system in the

young volcanics is perched and shows some 2.0 m of seasonal fluctuation. Drainage effects from the dewatered andesite rockmass have not, therefore, propagated into the overlying aquifer.

P113
This monitoring location consists of a 47 m deep standpipe piezometer within the deeper young volcanics with the water levels measured monthly by manual dipping. This monitoring well shows a limited water depth is present (<1.2 m) with minimal variation over time. The monitoring data suggests the lower younger volcanics are affected by dewatering of the andesite.

P114
This monitoring location consists of a 60 m deep standpipe piezometer within the deeper young volcanics with the water levels measured monthly by manual dipping. This monitoring well shows between 8 and 10 m water depth is present with seasonal variation over time observed. The monitoring data suggests the lower younger volcanics have limited effect from dewatering of the andesite with a permanent water table present.

BH8
This monitoring well has recorded erroneous measurements since 2009 and it is thought that the borehole has collapsed. It has not been used in this assessment.

WC202
This monitoring location is along strike of the Rex vein system and consists of a nest of three pneumatic piezometers in the deep monitoring well and two standpipe piezometers in the shallow monitoring well. The pneumatic piezo tips (1-3) are positioned; in the young volcanics (20 m depth), upper andesite (62m depth) and lower andesite (79 m depth). The groundwater pressures are automatically logged on a daily frequency. The standpipe piezometer screens (4-5) are located at 4 m and 12 m depth in the young volcanics. The monitoring data indicate the entire sequence of younger volcanics is largely dewatered above the andesite. Groundwater pressures have been present in the lowest piezo tip within the andesite and recent data has shown an increase in groundwater levels at that location.

4. Observations Underground

A site visit to the mine underground operations to view the Rex Orebody exposure from beneath was undertaken on 20/2/2023. The purpose of the site visit was to observe groundwater inflows at various locations. In summary, there is no groundwater ingress through the stope in the north-east part of the orebody in the vicinity of WC202. Between P112, P113 and P114, there is groundwater seepage through the Rex Vein and the inflow rate has remained constant during mining. These inflows are interpreted to be seepage from water contained within the basal sandy ignimbrite unit through the Rex vein “exposure”. This is illustrated in Figures 7 and 8 below.

5. Settlement Survey

Ground settlement monitoring is frequently undertaken in the area as a requirement of the MUG dewatering consent. Based on the latest survey results (November 2022) no settlement data from the area suggests any increased movement as a result of the existing underground dewatering i.e. no marks breached their respective settlement zone triggers (all Zones 6 or 7). Further, no tilt has been identified that might indicate potential differential settlement has taken place.

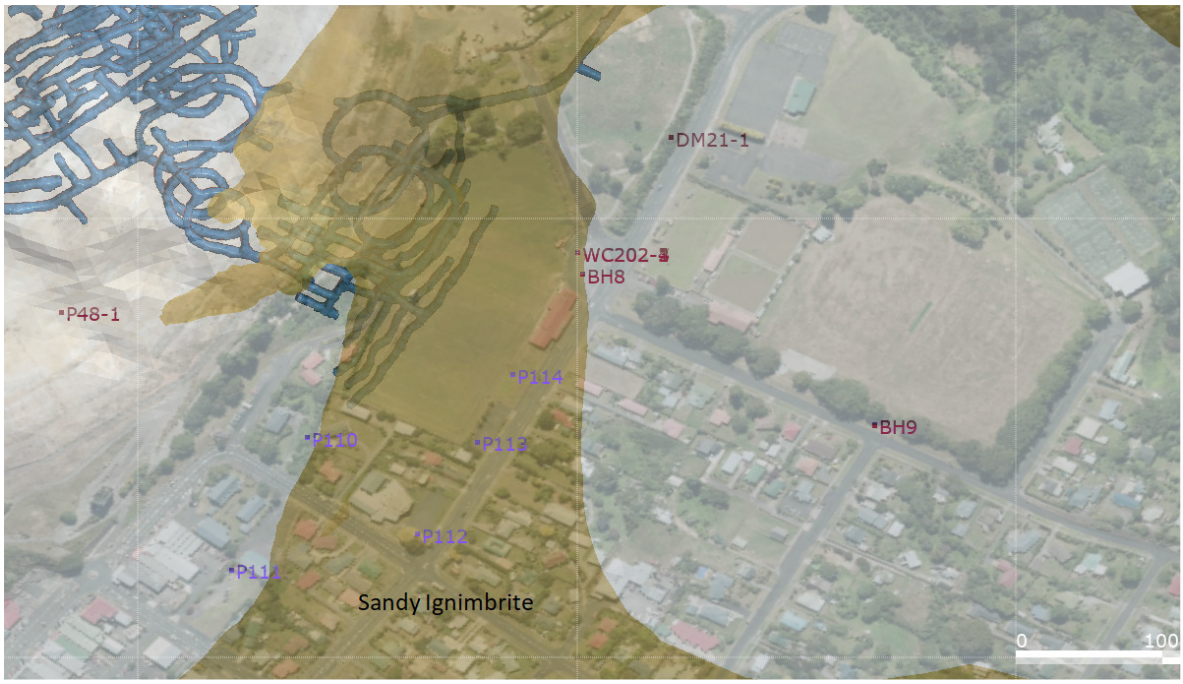


Figure 7 **Distribution of the Sandy Ignimbrite within the Paleo valley**

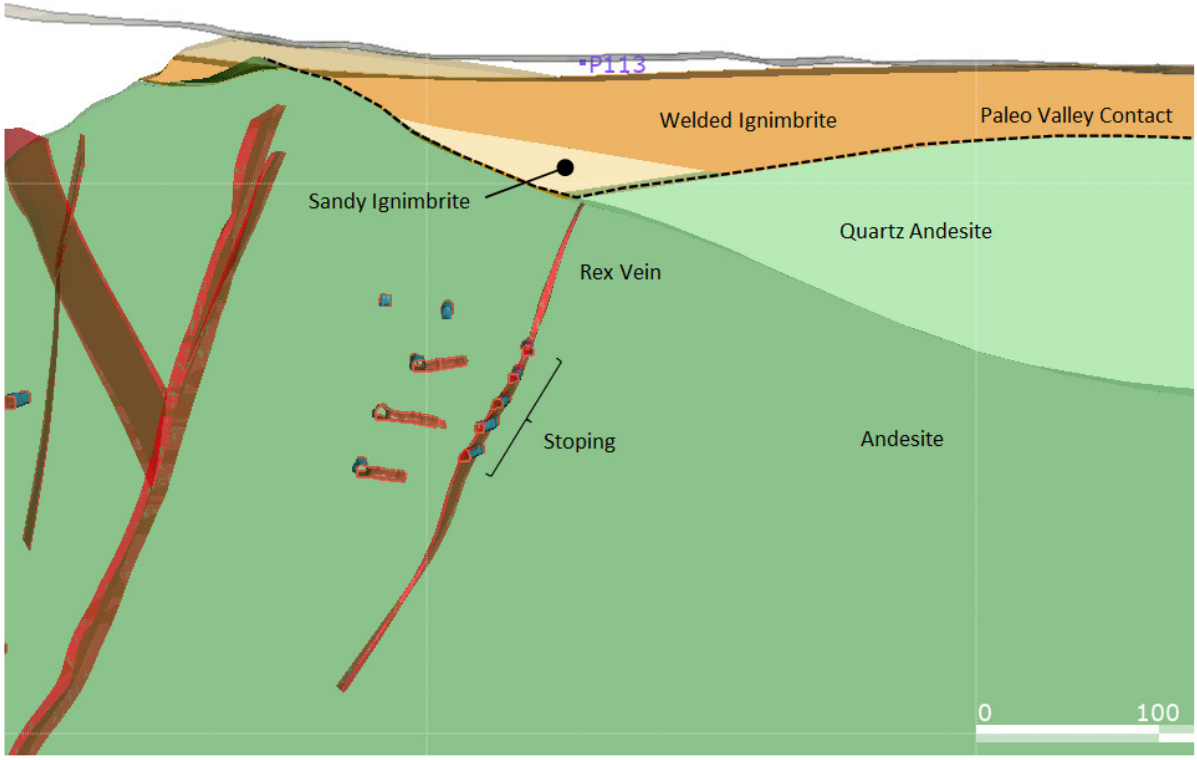


Figure 8 **Section through P113 Showing the Paleo Valley in Relation to the Rex Vein**

6. Summary and Discussion

Review of the groundwater monitoring data from around the Rex Orebody has indicated the following groundwater conditions exist.

- The andesite rocks that host the Rex Vein are dewatered.
- In the deep younger volcanics water remains present locally in association with the sandy ignimbrite.
- A water table remains present at most locations in the upper ash/Regolith/volcanics sequence (top 20 m) that is perched on the welded ignimbrite.

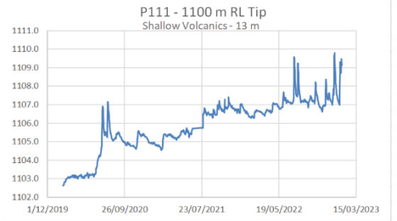
This review has shown that recent changes in some piezometers is the ongoing response to dewatering of the rockmass as a result underground mine operations. However, dewatering of the water table at the surface is generally noted not to occur as a result of mine underdrainage. Deep dewatering has not, therefore, resulted in near surface effects nor ground settlement beyond that expected beyond the consented envelope.

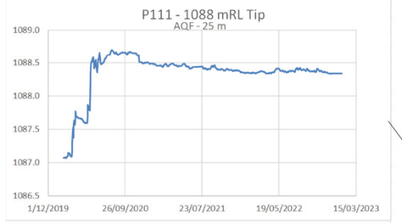
ATTACHMENTS

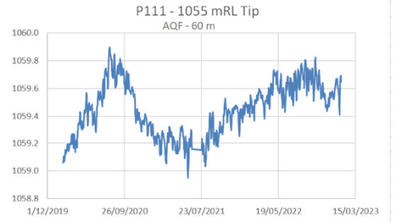
Attachment A Groundwater Monitoring Records

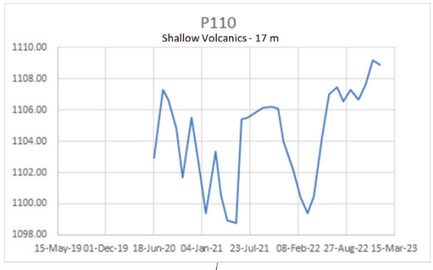
Attachment A

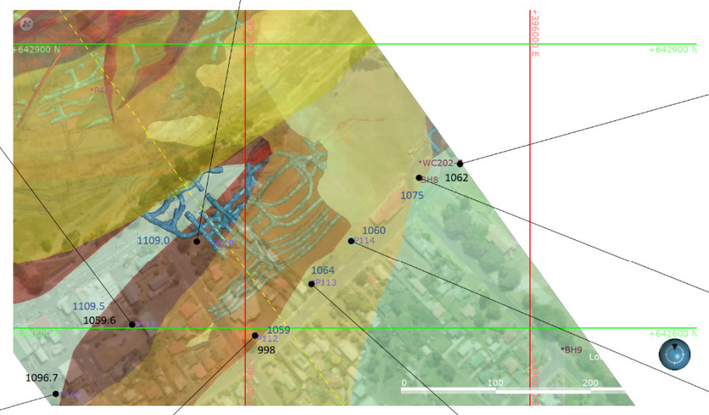
Monitoring Well Records

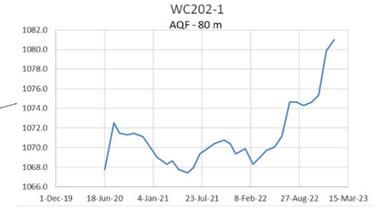

P111 - 1100 m RL Tip
Shallow Volcanics - 13 m
1111.0
1110.0
1109.0
1108.0
1107.0
1106.0
1105.0
1104.0
1103.0
1102.0
1/12/2019
26/09/2020
23/07/2021
19/05/2022
15/03/2023

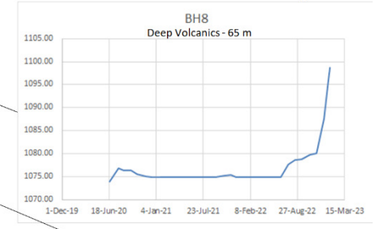

P111 - 1088 mRL Tip
AQF - 25 m
1089.0
1088.5
1088.0
1087.5
1087.0
1086.5
1/12/2019
26/09/2020
23/07/2021
19/05/2022
15/03/2023

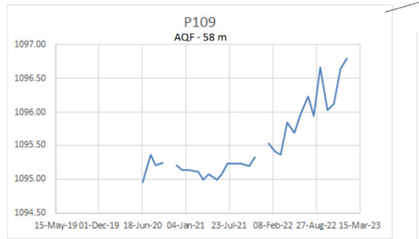

P111 - 1055 mRL Tip
AQF - 60 m
1060.0
1059.8
1059.6
1059.4
1059.2
1059.0
1058.8
1/12/2019
26/09/2020
23/07/2021
19/05/2022
15/03/2023


P110
Shallow Volcanics - 17 m
1110.00
1108.00
1106.00
1104.00
1102.00
1100.00
1098.00
15-May-19 01-Dec-19 18-Jun-20 04-Jan-21 23-Jul-21 08-Feb-22 27-Aug-22 15-Mar-23


+642900 N
+642900 N
+642900 N
+360000 E
*WC202
BH8
1062
1075
1060
P114
1064
P113
1109.0
1109.5
1059.6
P112
1059
998
1096.7
*BH9
0
100
200


WC202-1
AQF - 80 m
1082.0
1080.0
1078.0
1076.0
1074.0
1072.0
1070.0
1068.0
1066.0
1-Dec-19
18-Jun-20
4-Jan-21
23-Jul-21
8-Feb-22
27-Aug-22
15-Mar-23

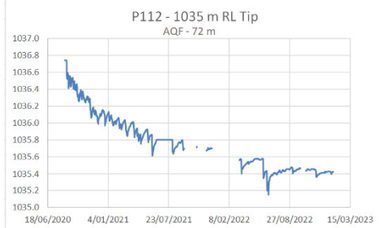

BH8
Deep Volcanics - 65 m
1105.00
1100.00
1095.00
1090.00
1085.00
1080.00
1075.00
1070.00
1-Dec-19
18-Jun-20
4-Jan-21
23-Jul-21
8-Feb-22
27-Aug-22
15-Mar-23

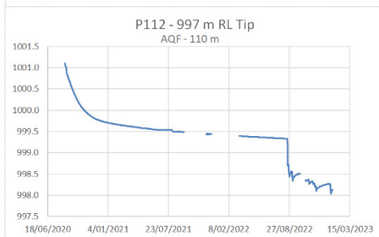

P109
AQF - 58 m
1097.00
1096.50
1096.00
1095.50
1095.00
1094.50
15-May-19 01-Dec-19 18-Jun-20 04-Jan-21 23-Jul-21 08-Feb-22 27-Aug-22 15-Mar-23

P112 - 1057 m RL Tip
Deep Volcanics - 50 m
1059.5
1059.0
1058.5
1058.0
1057.5
1057.0
18/06/2020
4/01/2021
23/07/2021
8/02/2022
27/08/2022
15/03/2023

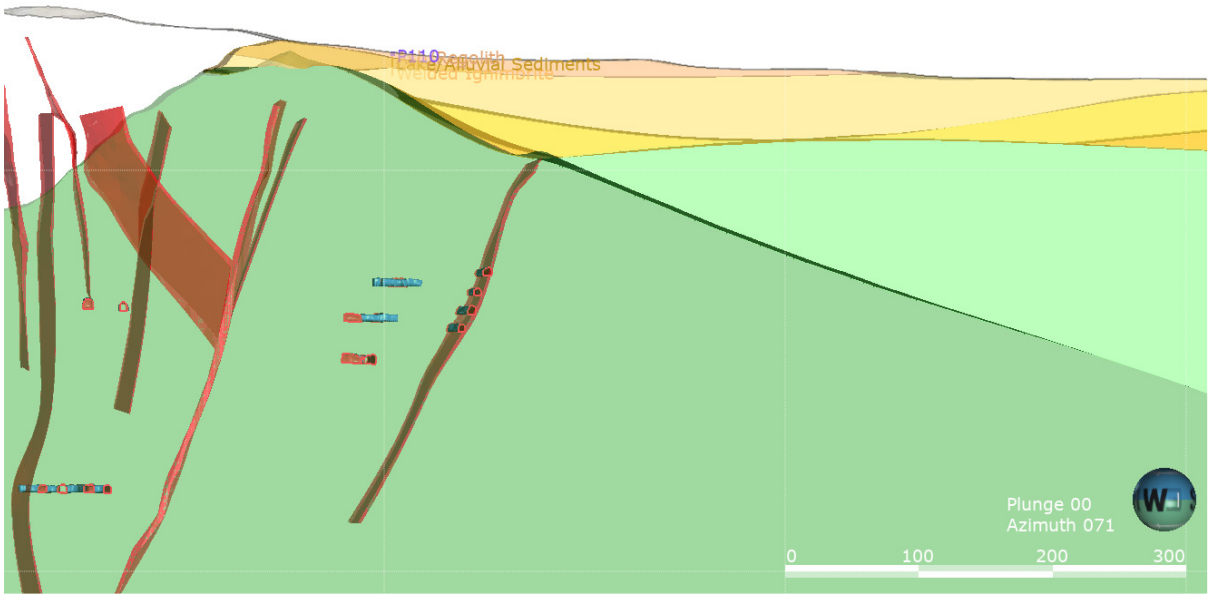
P113
Deep Volcanics - 47 m
1064.45
1064.40
1064.35
1064.30
1064.25
1064.20
1064.15
1064.10
15-May-19 01-Dec-19 18-Jun-20 04-Jan-21 23-Jul-21 08-Feb-22 27-Aug-22 15-Mar-23

P114
Deep Volcanics - 60 m
1060.50
1060.00
1059.50
1059.00
1058.50
1058.00
1057.50
15-May-19 01-Dec-19 18-Jun-20 04-Jan-21 23-Jul-21 08-Feb-22 27-Aug-22 15-Mar-2

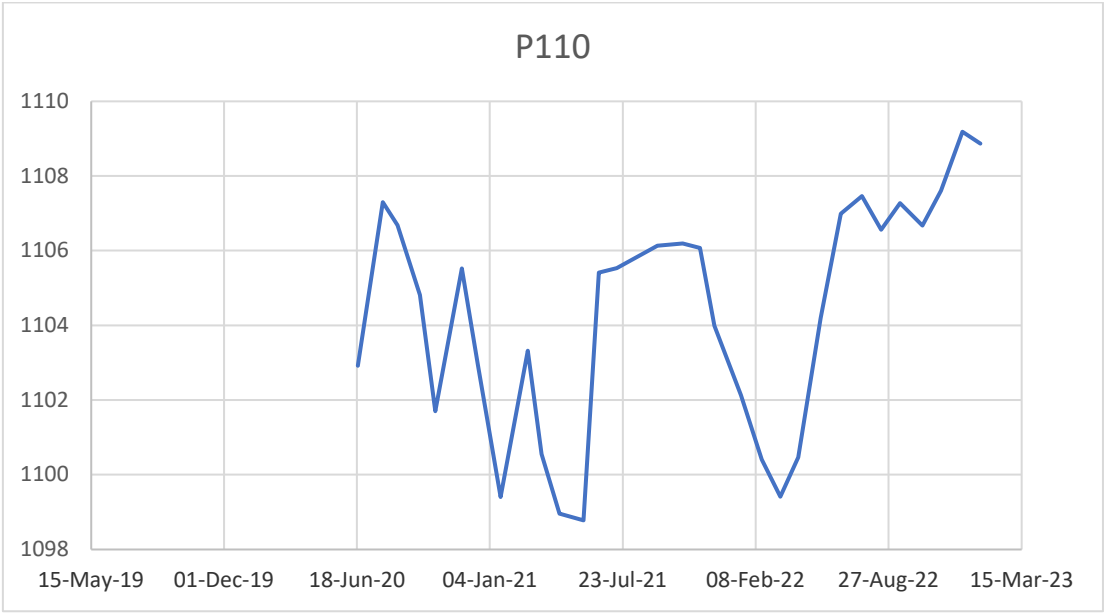

P112 - 1035 m RL Tip
AQF - 72 m
1037.0
1036.8
1036.6
1036.4
1036.2
1036.0
1035.8
1035.6
1035.4
1035.2
1035.0
18/06/2020
4/01/2021
23/07/2021
8/02/2022
27/08/2022
15/03/2023


P112 - 997 m RL Tip
AQF - 110 m
1001.5
1001.0
1000.5
1000.0
999.5
999.0
998.5
998.0
997.5
18/06/2020
4/01/2021
23/07/2021
8/02/2022
27/08/2022
15/03/2023

P110

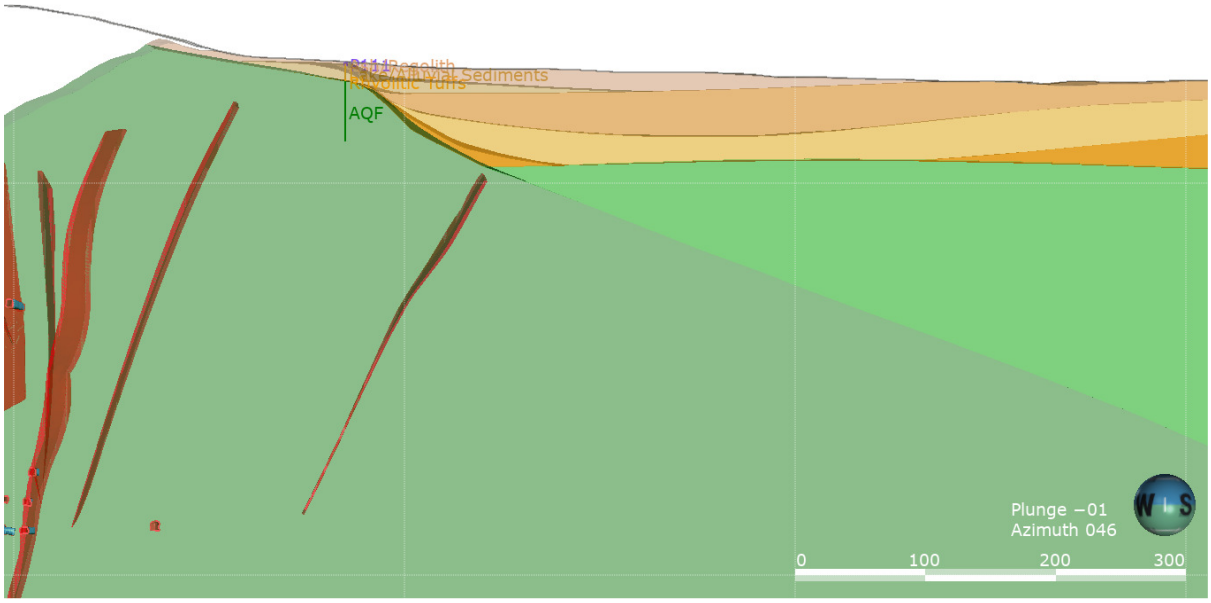


P110 Location (NW-SE Section)



P110 Groundwater Monitoring Record

P111



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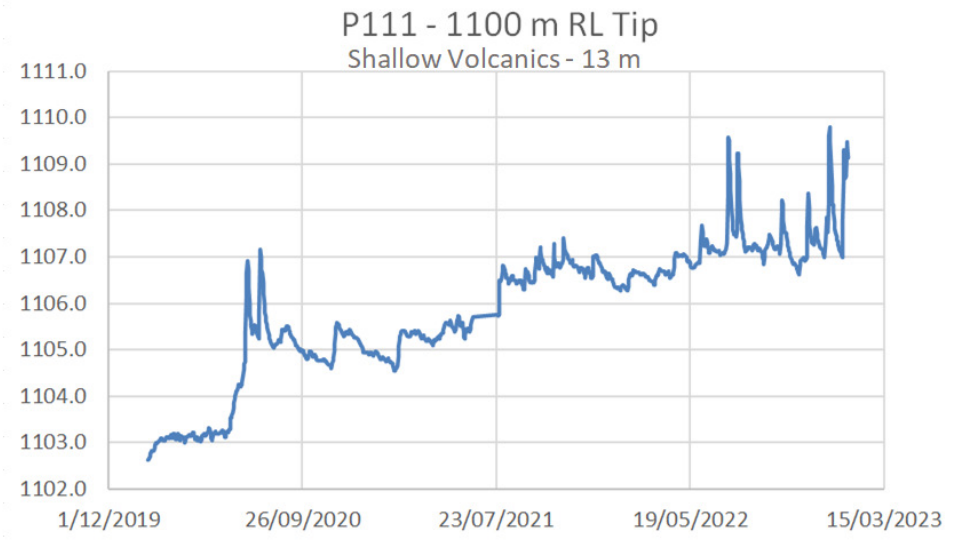
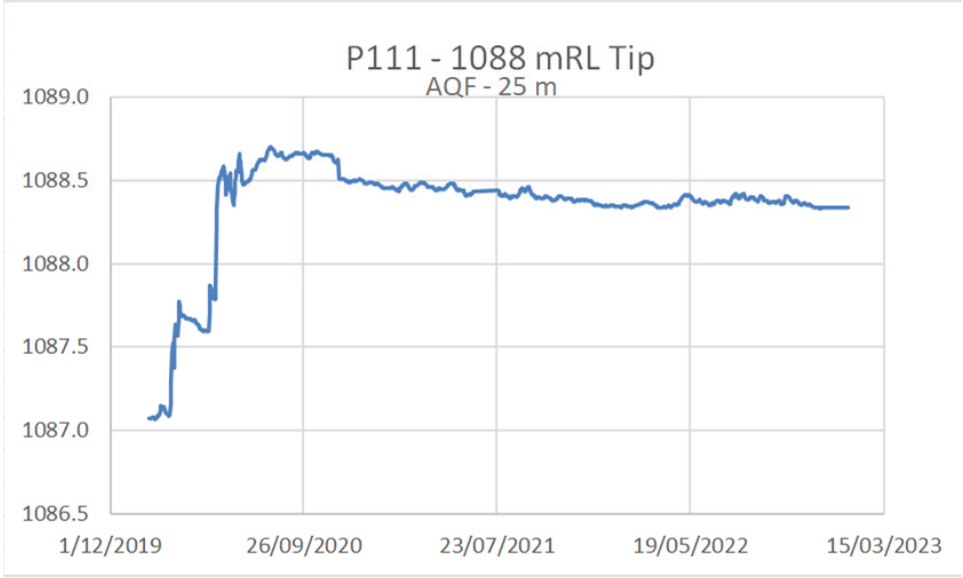
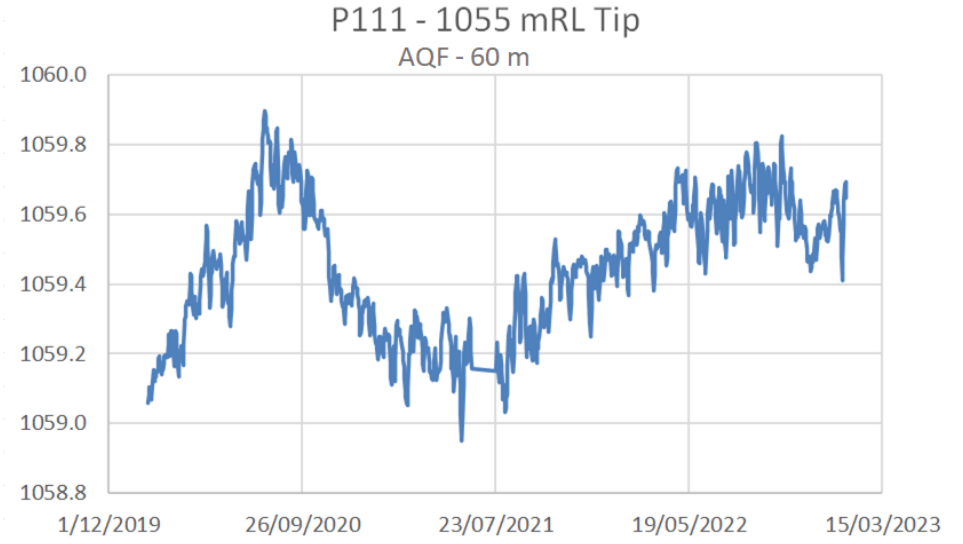
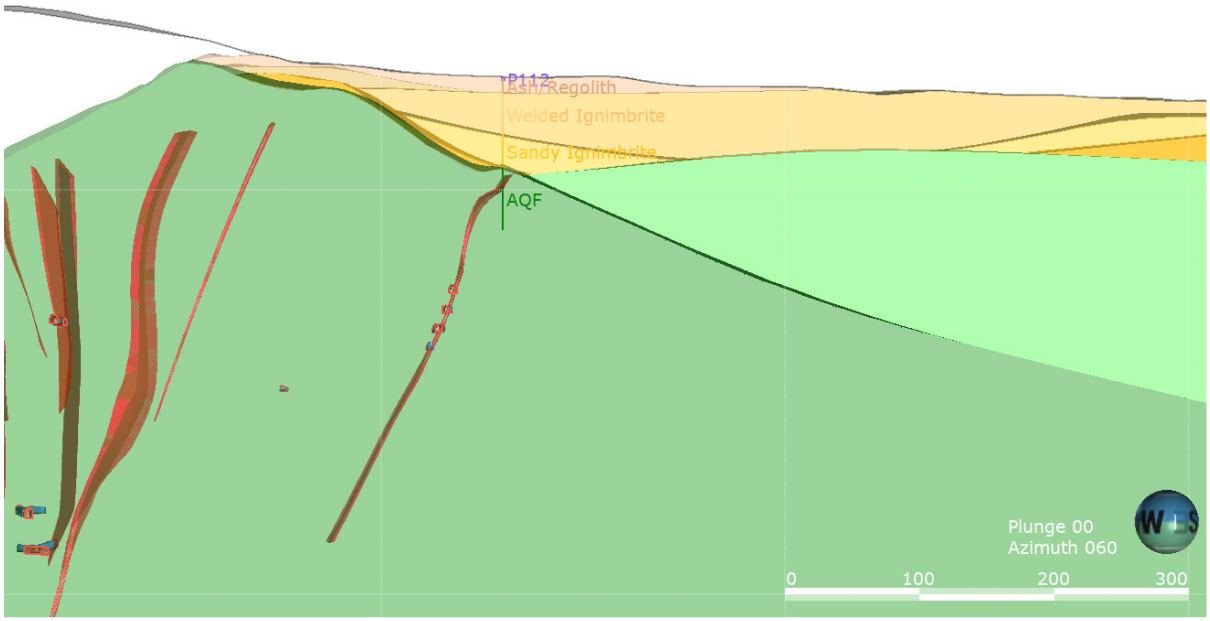






P111 Groundwater Monitoring Records

P112



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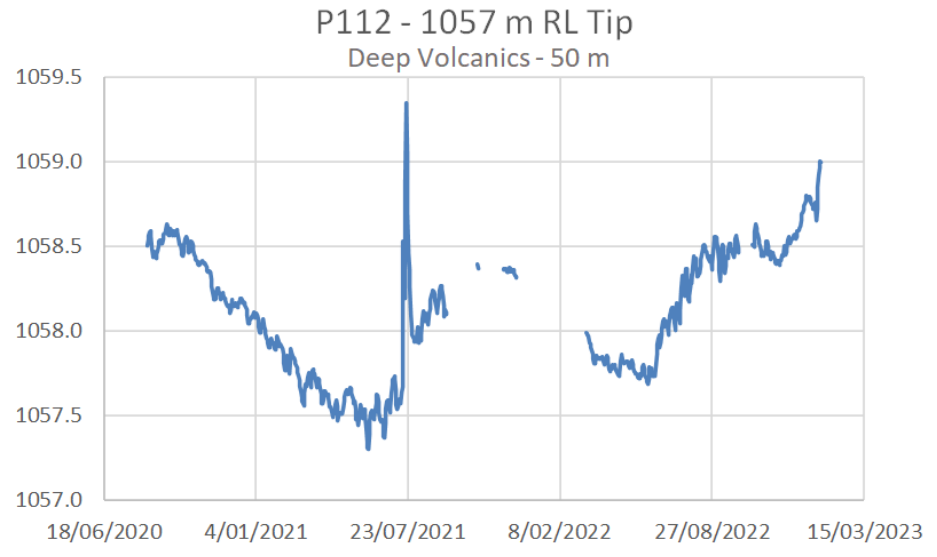
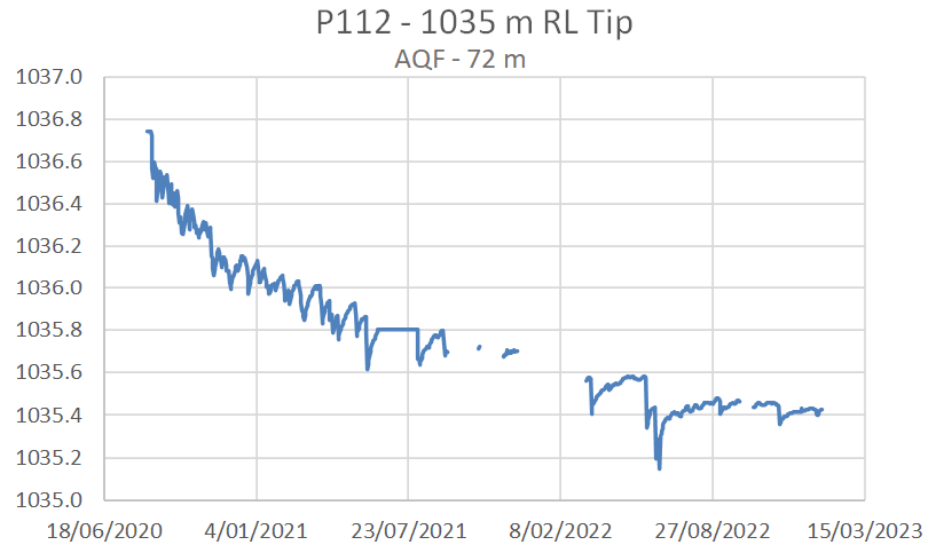
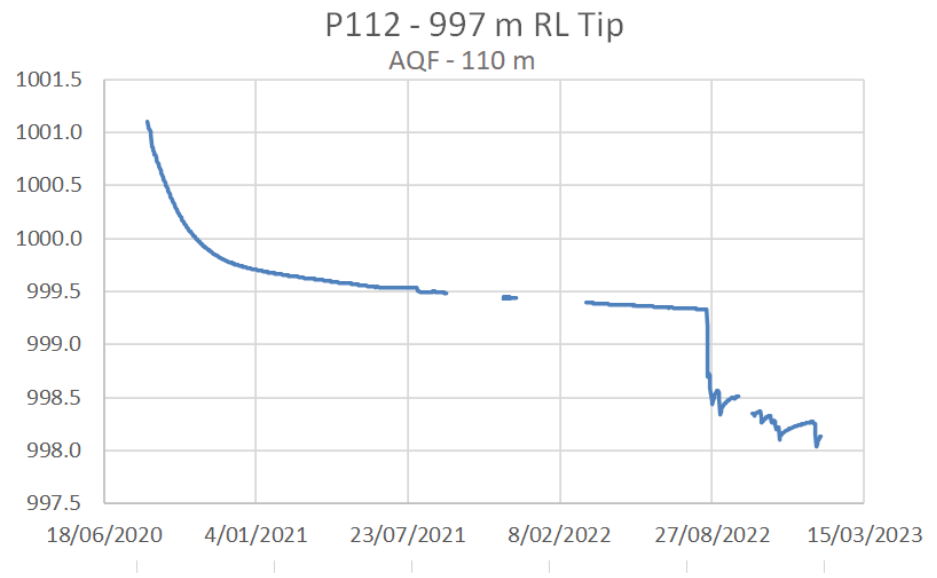
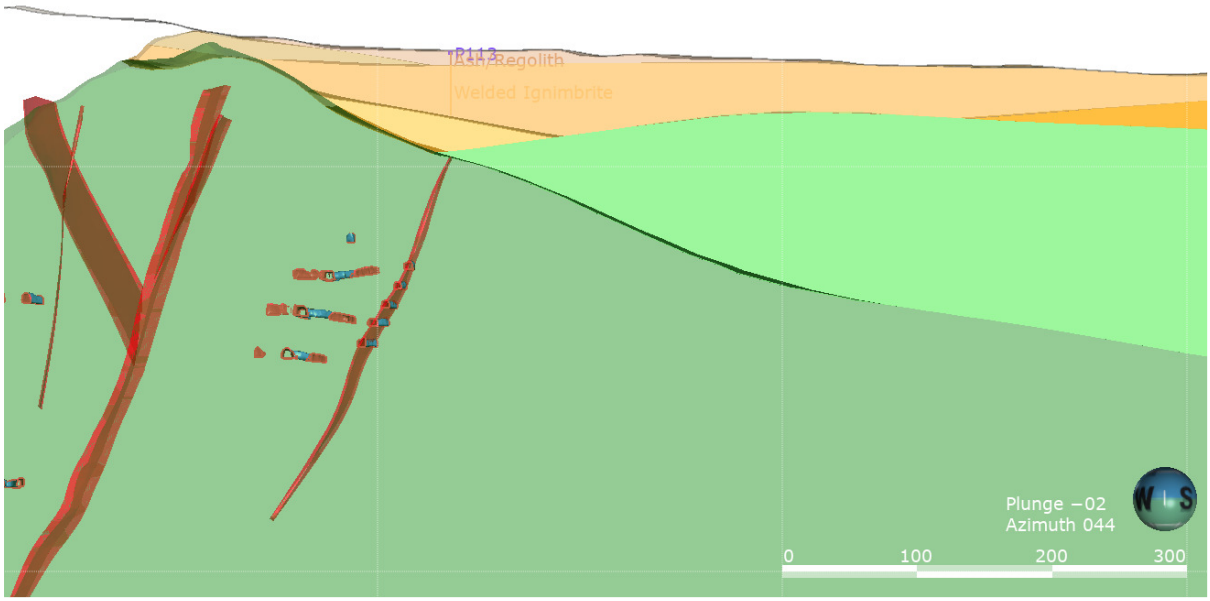




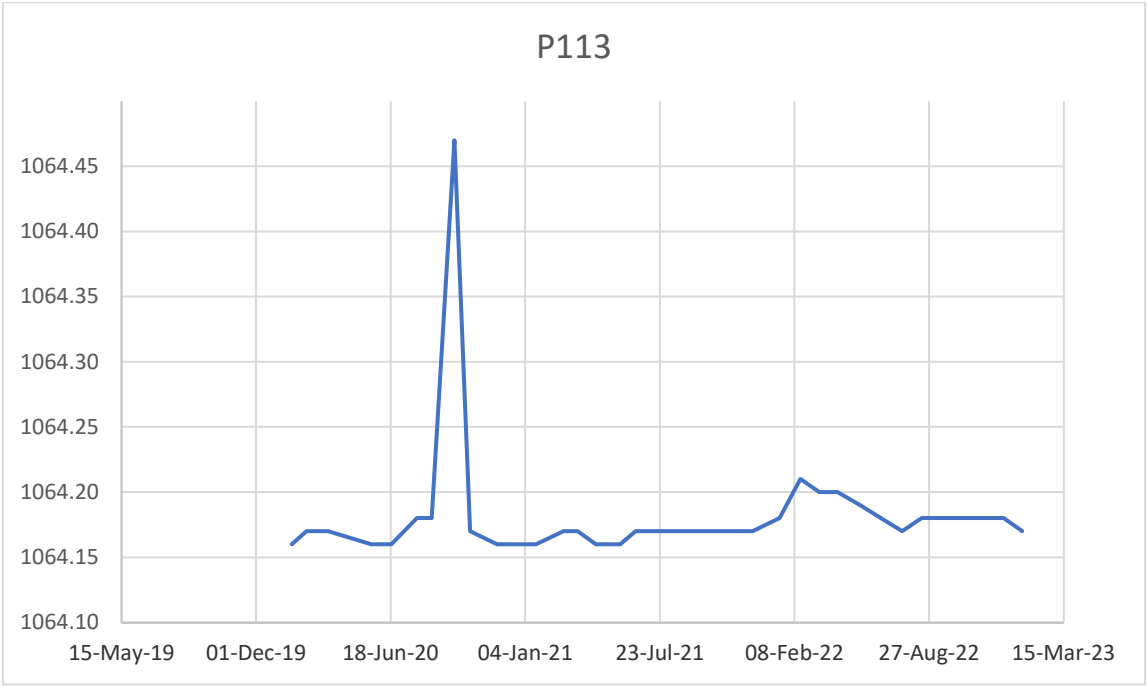


P112 Groundwater Monitoring Records

P113

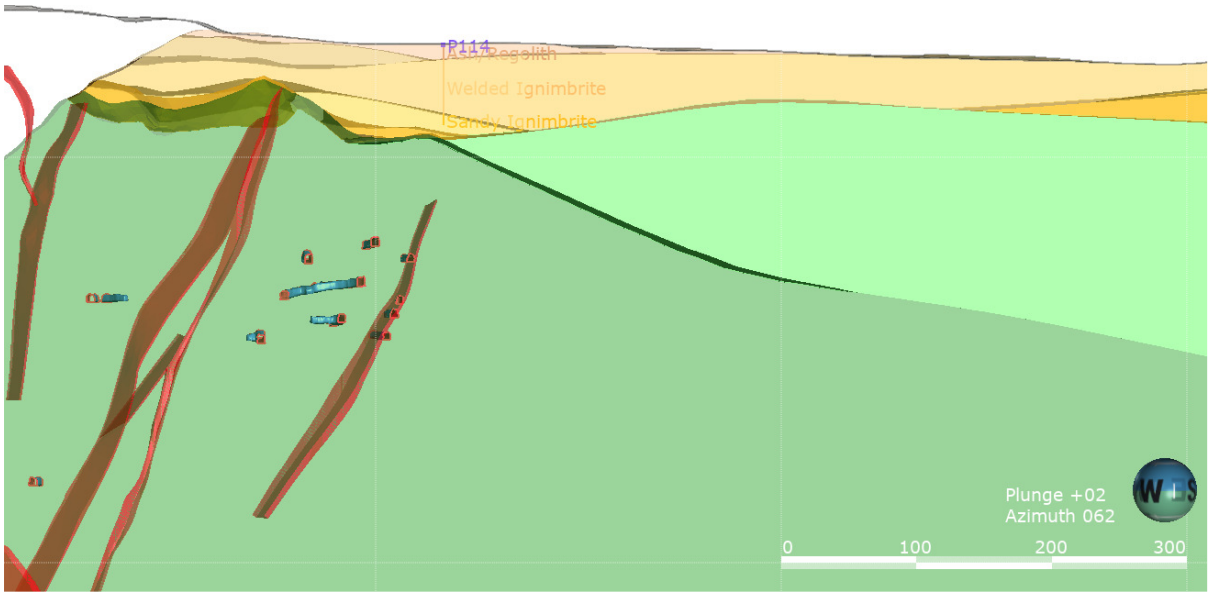


P113 Location (NW-SE Section)

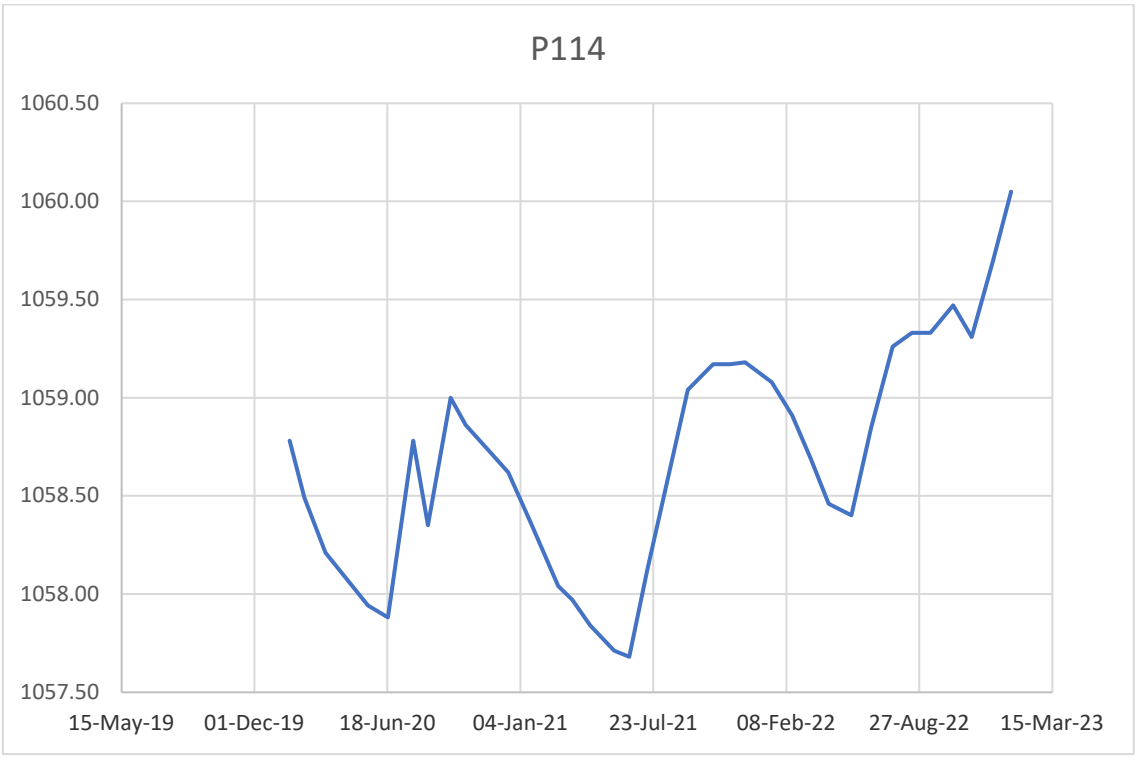


P113 Groundwater Monitoring Record

P114

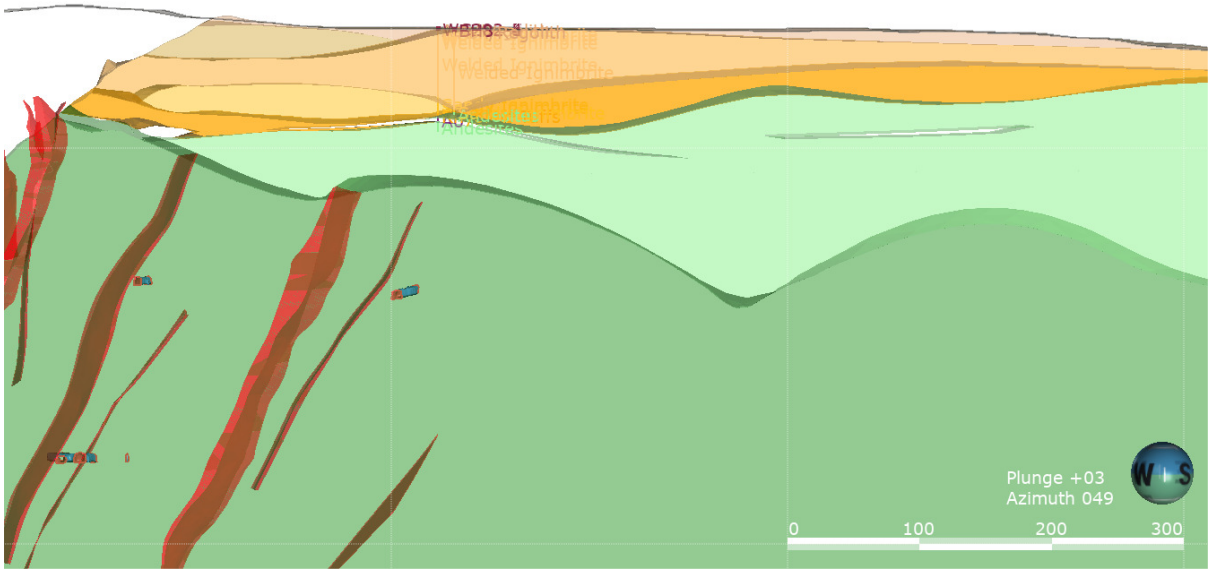


P114 Location (NW-SE Section)



P114 Groundwater Monitoring Record

BH8 & WC202



BH8 & WC202 Locations (NW-SE Section)

WC202-1 Groundwater Monitoring Record

APPENDIX G – Rex Groundwater Assessment GWS Ltd

TECHNICAL MEMO

GWS Limited

31st May 2023

To: Patrick Slagter/Andre Alipate/Mark Burroughs

From: Chris Simpson

Subject: Martha Underground – Rex Upper Orebody – Proposed Groundwater Monitoring and Trigger Actions

Background

Oceana Gold are consulting with the Hauraki District Council reviewer in relation to mining the Rex orebody to a higher elevation. The reviewer (Peter Fuller) has shown support for the proposal conditional that an appropriate level of monitoring is undertaken. Part of the monitoring seen as being necessary is groundwater level/pressure monitoring at the location of the existing piezometers in the area. This memo specifies the piezometers to be monitored going forward and assigns trigger actions should there be a sudden change in groundwater conditions.

Proposed Monitoring

The wells that are proposed to be monitored are shown in Figure 1 and are all generally located along the strike of the orebody.

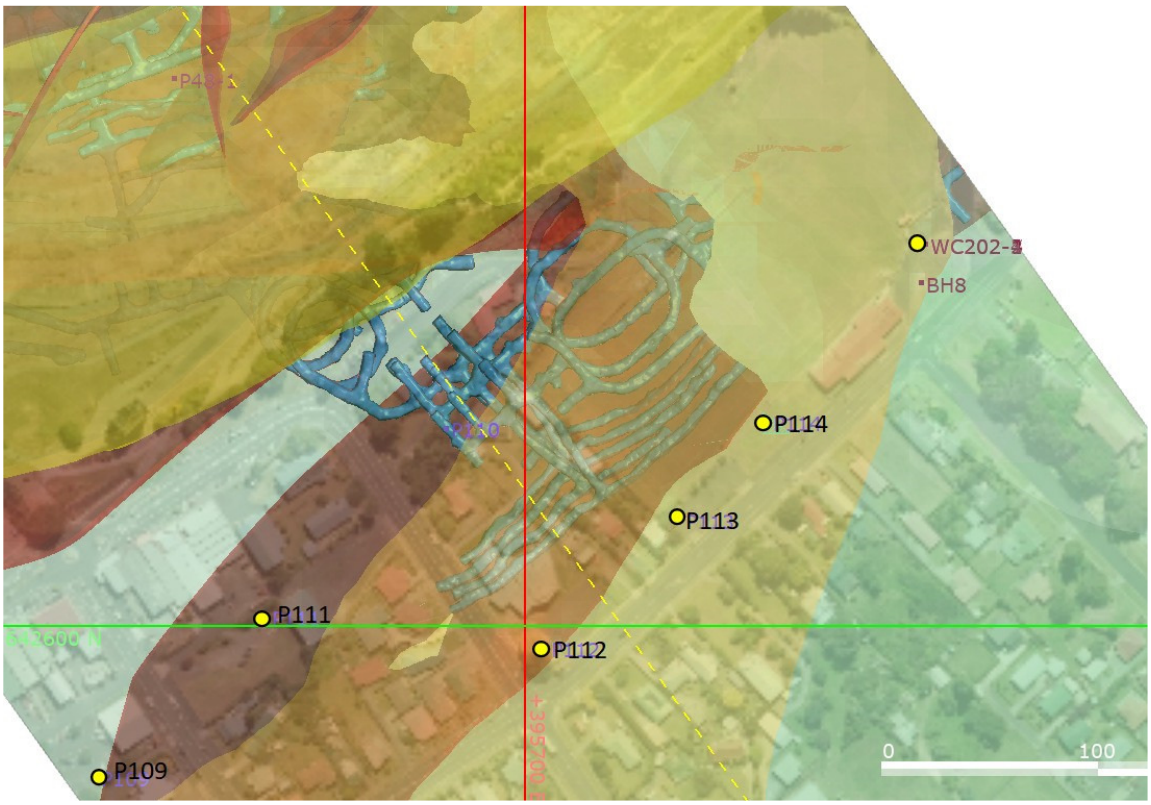


Figure 1 Proposed Locations for Groundwater Level Monitoring for the Rex Upper Stopes

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At this time, monitoring wells P111 and P112 have their water levels continuously logged which is needed to make real time observations of changes in groundwater conditions. P113 and P114 are standpipe piezometers that are manually dipped and it is proposed that water level loggers will be installed to collect data at a greater frequency. All of the piezometers will be fitted with telemetry equipment so that real time observations can be made along side the proposed geotechnical monitoring (settlement and extensometers). We recommend that the logging frequency is set to daily at a minimum. P109 and WC202-1 are manually read at this time and it is proposed that this continues unless a trigger response requires otherwise.

We note that at the time of preparing this memo, P113 is proposed to be replaced because there is insufficient water depth to enable a logger to be reliably installed.

Trigger Response

We propose setting a trigger response at P111, P112, P113 and P114 based on their being a rapid rate of change in a groundwater level that could, potentially, indicate there being a risk of ground settlement occurring. This is similar to that described in condition 33 of permit 202.2012 which defines a "significant anomaly" as being a particular rate of change within a certain period of time.

In most cases, the natural groundwater level in the wells identified varies up to 2.0 m over the period of a season. That being so, we would consider a significant anomaly as being >2.0 m change in less than a 1-month period. If a response is triggered, the following actions should be followed:

- Verify that the instruments and data collection is accurate.
- Check that any change is not the result of a recent climatic event.
- Commence daily groundwater level measurements at P109 and WC202-1.
- Cross check the groundwater level data with the geotechnical observations.
- Investigate the cause of the anomaly including any recent underground mining activity.
- Advise the Council of the anomaly (within 5 working days) and include an explanation of the anomalous results and actions proposed to further investigate or address any issues identified (if needed)

When considering a change that might represent a significant anomaly, there should be an emphasis of the depth of the piezometer and geologic unit in which that change is occurring. The primary focus of this monitoring is to ensure effects in the near surface (notably in the Young Volcanics) are avoided, managed or mitigated.

TECHNICAL MEMO

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