



Dewatering and Settlement Monitoring Plan

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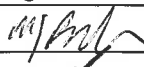

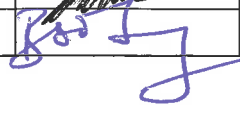
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DEWATERING AND SETTLEMENT

MONITORING PLAN

At the time of writing Slevin Underground Project Area (SUPA) is being consented and no changes to existing environmental management or monitoring schedules is required.

1.0 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 and Correnso Underground Mine 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.

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) is required to monitor survey marks that have been established on, or immediately adjacent to, approximately ten historic mine shafts throughout the township. 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 has been 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).

Mining of the Trio underground is concluded and backfilling completed. If water levels can be lowered past the 792mRL level, there could be opportunities to re-initiate mining in Trio.

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 is stored at the 'Polishing Pond' Stockpile (near the water treatment plant polishing ponds). Waste rock placement at this stockpile started in early February 2007.

Access to Correnso is via Trio and Favona.

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, incl Correnso Dewatering (mm)
1	35
2	45
3	70
4	125
5	195
6	240
7	400

Note: Maximum Total Settlement incl. Correnso Dewatering sourced from Correnso Hearing Evidence, Table 3 (Engineering Geology Ltd, November 2012)

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 the 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 ¹and 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

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.

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.

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.

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 Favona/Trio 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 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 Favona and Trio 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 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 HSEC 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 Manager

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

4.4 Site Services Manager

- 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 ($\pm 20\text{m}$) 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 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 dewatering began from Correnso Underground.

Dewatering is conducted by draining groundwater into sumps and pumping to the surface via mono-pumps.

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 treats the dewatering water from Martha, Favona, Trio and Correnso 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 Correnso underground.

5.3.2 Method and Frequency of Measurement

Pit groundwater levels were measured using an electrical water level sounder from a datum established at the wellheads and monitored through the automated SCADA system at the WTP. This system is currently not operational due to the Martha slip and the resulting access and electrical issues.

5.3.3 Datum Elevation

The elevation of wellheads may alter as the pit develops. Datum elevations are periodically checked by survey methods and the electrical water level sounder and automated SCADA system are adjusted if necessary to represent any change in datum.

5.4 *Martha and Favona Dewatering Volume Measurement*

5.4.1 Locations

Dewatering volumes for underground are monitored at the WTP on the automated SCADA system. Totalising flow meters (Figure 1) are located at dewatering outflow pipelines from the underground portal.



Figure 1: Totalising flow meters used to monitor dewatering volumes

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 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 2). Sampling is undertaken monthly according to the relevant sections of the Groundwater Monitoring Standard Operating Procedure (SOP) () provided in Appendix B.



Figure 2: 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.

Underground Dewatering	
Monthly Code 3	Quarterly Code 27
Temp - Field	Temp - Field
pH - Lab	pH - Field
EC - Lab	EC - Field
Alk	Alk
Acidity	Acidity
Hard	Hard
SO ₄	HCO ₃
Ca	Ammonia
Cl	Ammonium - N
Fe	NO ₂
K	NO ₃
Mg	(NO ₃ + NO ₂)
Mn	SO ₄
Na	Al
Se	Ag
TSS	Au
	As
	Ca
	Cd
	Cu
	Cl
	CN Total
	CN Wad
	Co
	Cr
	Cr (VI)
	Fe
	Hg
	K
	Mg
	Mn
	TKN
	Na
	Ni
	P
	Pb
	Sb
	Se
	Si
	Zn
	COD
	TSS
	DRP

5.6 Pit Water Quality Monitoring

5.6.1 Background

Pit water quality (Type 2) is required to be monitored (Condition 11) to verify the predicted final pit lake water quality following closure. To date this has included the monitoring of pit wall runoff (described below) and dewatering water quality (described above).

Pit wall runoff sampling had previously been conducted quarterly as per the consent 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 and SGS laboratories.

5.6.2 Location

The locations of the pit water sample sites are shown in Figure 3 and described below:

- PM3 - Post Mineralised batters on the southern rim of the pit.
- O1, O2, O3 and O4 - Oxidised batters on the southern rim of the pit.
- SU1 – Un-oxidised, one on the southern rim and four on the northern rim of the pit.

With mining of the Eastern Layback and the North Wall slip several pit water sample sites have been lost. AECOM are currently assessing and revising the Pit Lake WQ Monitoring methodology.

Further details will be updated in the Pit Surface Runoff Sampling SOP (WAI-200-PRO-024) in Appendix B.



Figure 4: Location of pit water quality monitoring sites.

5.6.3 Sampling Parameters and Frequency

Pit surface water runoff sampling is conducted periodically, and initiated whenever weather conditions indicate a good probability of collecting enough runoff to constitute a sample, and there is enough time to collect and preserve the samples during work hours. Depending on suitable weather conditions occurring, sampling aims to capture one sample episode per month.

The current water chemistry parameters to be analysed for are shown in Table 3 below. However this is under review by AECOM.

Table 3: Pit Water Quality Sampling Parameters.

CODE 48				
Temperature - Field	NO2	Ca Dissolved	K	Se Dissolved
pH - Field, Lab	NO3	Cd Dissolved	Mg	Si
EC - Field, Lab	(NO3 + NO2)	Cu Dissolved	Mn Dissolved / Total	Sn Dissolved
Eh - Field	SO4	Cl	Na	Zn Dissolved
Alk	Ag Dissolved	Co Dissolved	Ni Dissolved	TSS
Acidity	Al Dissolved	Cr Dissolved	P Total	TOC
Hard	As Dissolved	Fe Dissolved / Total	Pb Dissolved	Anion Cation Sum
Ammonium - N	B Dissolved	Hg Total	Sb Dissolved	

5.7 Dewatering Reporting

A summary of Pit water levels were included in the annual summary of monitoring, however pit levels are currently unavailable. 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 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 by OGNZL 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 tephra) 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. 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.

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 4: Piezometers Currently Monitored

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
DM41	1108	BH8-1 dry	1048	P1-1 dry	1065	P64-D dry	1062
DM51	1104	BH9-1	1073	P2-1 dry	974	P75	979
DM71	1098	P1-2	1091	P2-2	1034	P76-D	1055
DM81-1	1117	P2-3	1073	P4-1	994	P77-D	1031
DM82-1	1114	P4-2	1047	P7-1	988	P78-D	1052
DM83-1	1116	P7-2	1039	P8-2	1044	P79-D	1047
DM85-1	1115	P7-3	1080	P8-1	975	P87-D	1024
P2-4	1111	P8-3	1092	P9-1	1036		
P4-3*	1093	P9-2	1084	P62 dry	1021		
P8-4	1113	P27-1	1073	P69-S	1114		
P9-3	1108	P63-1	1070	P69-D	1063		
P63-S*	1111	P64-I	1086	WC201-1	1058		
P76-S*	1109	P76-I	1072	WC201-2	1077		
P77-S*	1110	P77-I and	1045	WC201-3	1096		
P78-S	1103	I2	1051	WC202-1	1031		
P87-S	1110	P78-I	1066	P90-3	982		
WC201-4	1103	P79-I	1061	P91-4	970		
WC201-5	1109	P79-S	1090	P92-3	965		
WC202-4 dry	1099	P87-I	1069	P93-4	974		
WC202-5 dry	1112	WC202-2	1048	P94-4	976		
P90-1	1096	P90-2	1019	P95-3	1000		
P91-1	1105	P91-2	1096	P100-3	981		
P92-1	1114	P91-3	1010	P100-4	956		
P93-1	1102	P92-2	1000	P101-4	1037		
P94-1	1108	P93-2	1091	P102-4	1026		
P101-1	1102	P93-3	1014				
P102-1	1108	P94-2	1094				
		P94-3	1016				
		P95-1	1090				
		P95-2	1030				
		P100-1	1066				
		P100-2	996				
		P101-2	1083				
		P101-3	1068				
		P102-2	1078				
		P102-3	1054				

WC - Pneumatic piezometers

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. Because of the connectivity between the Martha Pit, Trio and Correnso system, this same network will also effectively monitor the effects of works related to Correnso.

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 4 and shown in Figure 5. 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 and pneumatic piezometers. They are part of an older network, some installed decades ago. 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 to be 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.



Figure 5: Piezometer Location Plan – showing all Waihi piezometers and Favona Stockpile bores



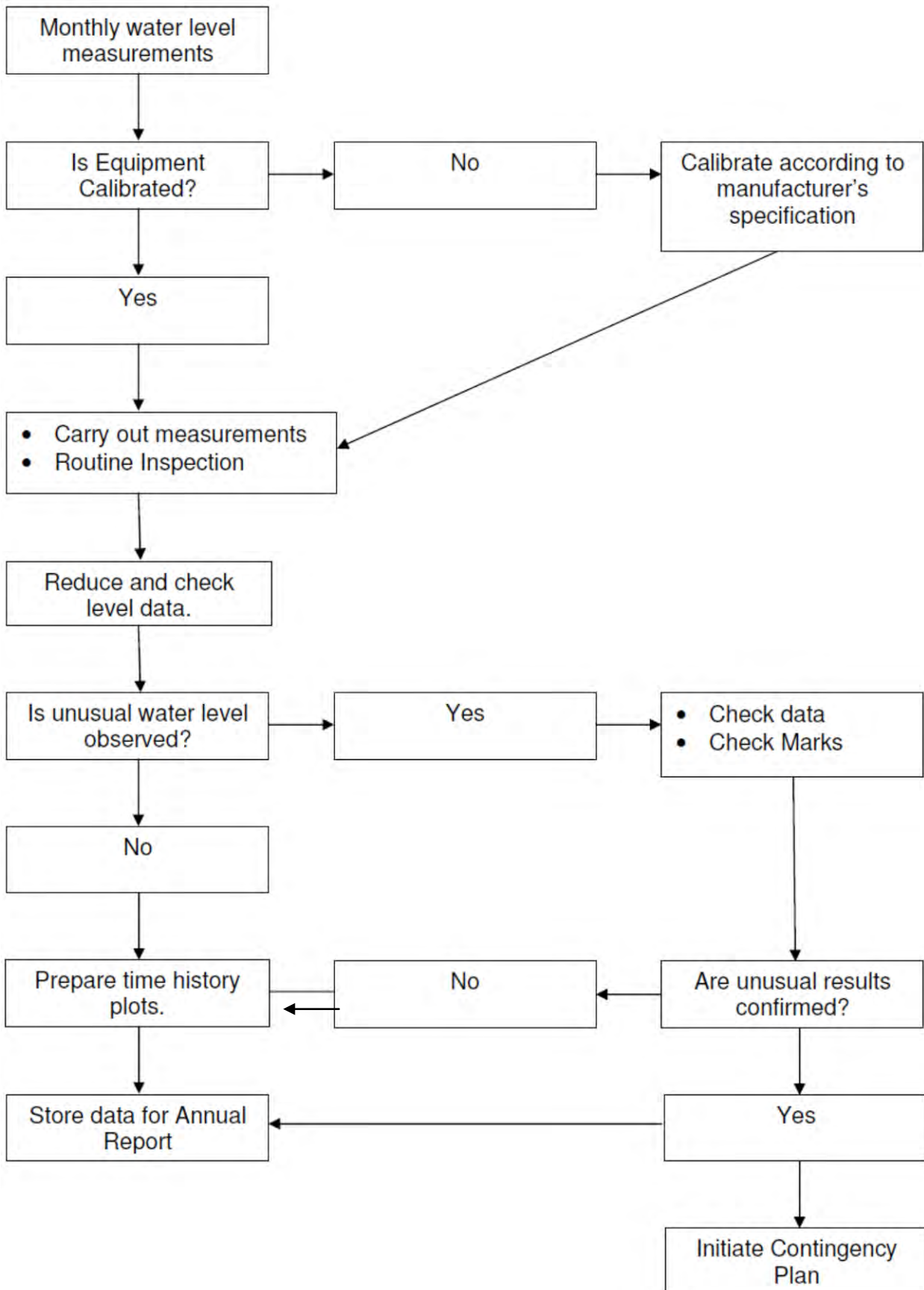


Figure 6: Flow Chart for Monthly Water Level Monitoring

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 7 and described in Table 5.

Table 5: 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 Method

The Network 2 piezometers are standpipe 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 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.

6.4.3 Network 2 Monitoring Frequencies

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

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. 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.

Table 6: Network 2 Water Quality Sampling Parameters and Frequencies

Groundwater bores	
Monthly Field check	6 Monthly Code 40
Temp - Field	Temp - Field
Water Level	Water Level
pH - Field	pH - Lab
EC - Field	pH - Field
	EC - Lab
	EC - Field
	Hard
	HCO ₃
	Total Alk
	NO ₂
	NO ₃
	(NO ₃ + NO ₂)
	Total Ammoniacal
	SO ₄
	Al
	Ag
	Ca
	Cd
	Cu
	Cl
	CN WAD
	Co
	Cr
	F
	Fe
	K
	Mg
	Mn
	Pb
	Hg
	Na
	Ni
	Sb
	Se
	SO ₄



	Si
	Ti
	U
	Zn
	Sum anions
	Sum cations
	TSS



Figure 7: Location of Shallow Groundwater Piezometers (Network 2) surrounding the Underground Ore Stockpile and Polishing Pond Stockpile.

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 is controlled by Correnso 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 are accessed from the Favona decline, there is effectively a direct connection between the Favona and Martha systems while Favona, Trio & Correnso 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 are shown in Figure 8 and described below in Table 7.

Table 7: Network 3 Backfilled and Flooded Workings Piezometers

P76D & P76I	Piezometers adjacent to 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.
P76D	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 8: 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 6 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 6 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

The Favona piezometer groundwater trigger levels are based on the observation that settlement around Martha Pit results principally from depressurisation of the younger volcanics (ignimbrites and rhyolitic tephra). The amount of settlement depends on the thickness and stiffness of the younger volcanics and the amount of depressurisation that occurs.

In relation to Favona, the underground workings do not expose the younger volcanics to lateral drainage as occurs at Martha Pit. Hence, depressurisation of the younger volcanics in response to Favona dewatering requires depressurisation of the andesite rock to occur first. This is the basis of the trigger levels developed.

TIER 1 TRIGGER

This is initiated when groundwater monitoring shows depressurisation extending into the upper layers of the andesite rock. This will be identified by a drop in the water levels greater than seasonal fluctuations in wells tapping the upper 50 m of andesite in response to a water level drop in deeper wells (100 m) in the andesite rock.

TIER 1 ACTION

- Increase monitoring in intermediate depth wells i.e. the wells tapping the younger volcanics. This may be assisted by installing Level Trolls in the wells to provide “continuous” water level records. Data from the Trolls would be downloaded fortnightly.
- Advise regulator that Tier 1 action has been initiated.

TIER 2 TRIGGER

This occurs when depressurisation from Favona Mine (as separate from Martha Mine) begins to extend into the younger volcanics within or adjacent to urban areas. (e.g. wells P77 and P76).

TIER 2 ACTION

In response to the monitoring observation, one or more of the following will be initiated:

- Geotechnical survey of the area likely to be impacted (say, the vicinity of the Barry Road / Moore Street intersection). Survey may include core drilling to obtain younger volcanic thickness and samples for consolidation testing in order to more precisely assess the potential settlement and tilt likely to develop in this limited area.
- Initiate close order survey around structures likely to be affected as defined by the geotechnical survey in order to confirm the settlement predictions made.
- Undertake regular visual inspections for evidence of settlement e.g. cracking in pavement.
- Where differential settlement is likely to lead to damage of structures, undertake an investigation of those structures to record current condition.
- The regulator will be advised that Tier 2 action has been initiated and will identify the program of work that will be undertaken.

Where damage occurs, mitigation measures could include:

- Purchase of the property at fair market value if owner agreeable.
- Improving foundation strength, re-levelling foundations or improving structural strength of building
- Initiating rewatering using excess water from the mine site. Rewatering may be accomplished using recharge wells, recharge sumps or recharge ponds. Appropriately constructed recharge wells would likely allow water access to the consolidating layers. Water could also be distributed through fractured ignimbrite layers where they exist.

Once the Tier 2 investigations are concluded, mitigation measures as considered necessary will be developed. These mitigation measures will be provided to the regulator. Once acceptance of the mitigation measures has been provided by the regulator, the mitigation measures will be implemented.

6.7 Waihi East 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 9). 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 9) 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 & Correnso dewatering.

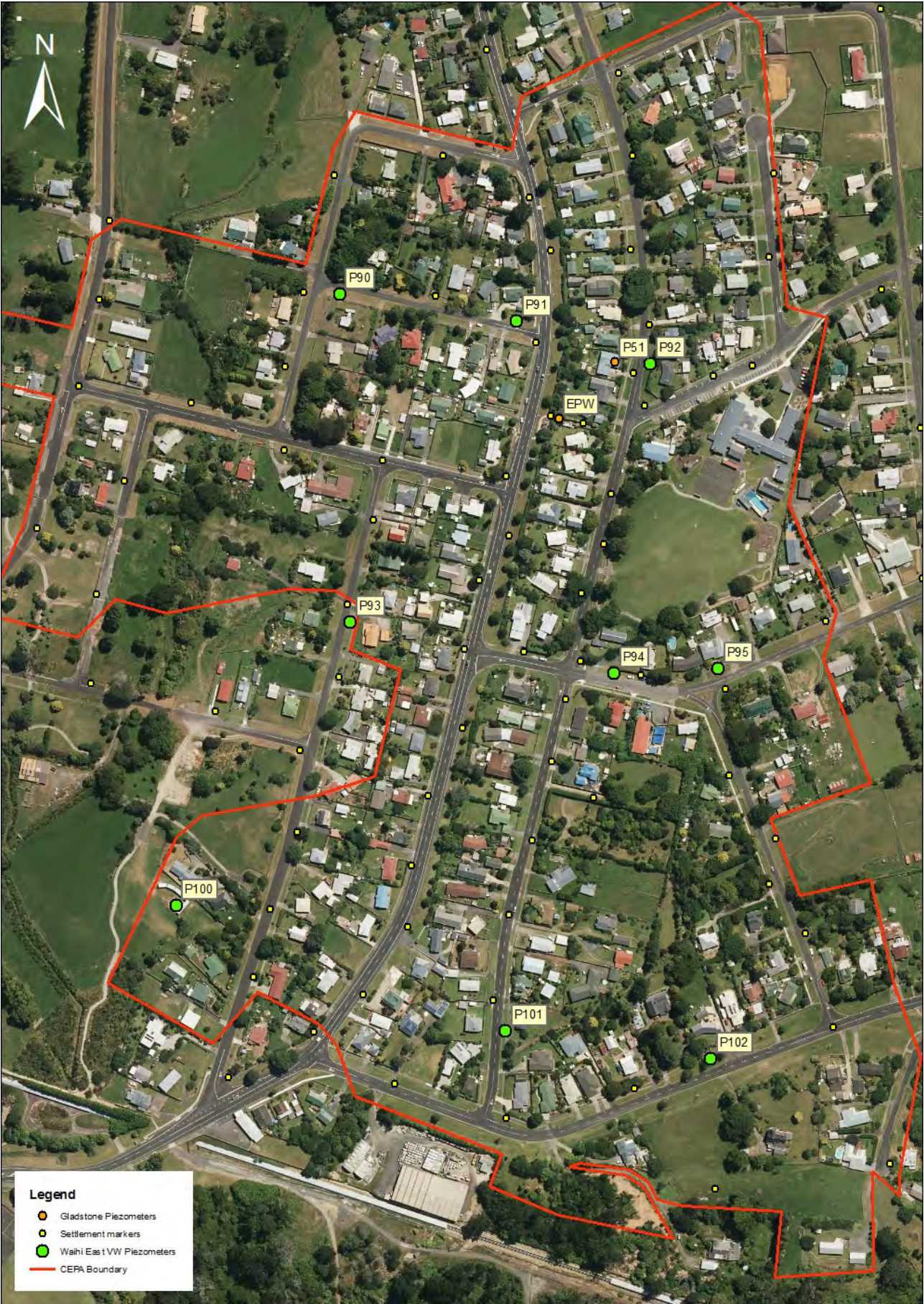


Figure 9: Waihi East Vibrating Wire Piezometers and Settlement Markers

A new 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 8.

6.8 Piezometer Action Plan

Condition 33 of the HDC LUC RC 202.2012 states that a 15m change in 1 month in piezometer levels is a significant anomaly. Such a change would require an explanation to council within 10 working days of the issue being identified.

OGNZL proposes a three stage set of triggers based upon 5m, 10m or 15m water level changes within 1 month. Actions will consist of monitoring frequency increases, increased settlement marker monitoring, visual inspections and expert geotechnical review depending on the degree of water level change discovered (Table 8).

Table 8: Piezometer responses and actions

Piezometer Response/Trigger	Action		
	Piezometer Monitoring	Settlement Monitoring	Other Actions
5 - 10m over 1 month	Commence weekly monitoring	-	No action
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 but data can be compared with another readout unit. This task will be carried out on an annual basis by OGNZL personnel. The unit's batteries are changed every 3-months to ensure continuity of data and silica crystals are enclosed to help remove moisture from the unit.

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 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 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 6 shows that if unusual water level changes are observed these are checked and if confirmed, and the contingency plan (Figure 12) 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.

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 12 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 (G. Bell -previous owner C. Des Forges, and R. Des Forges) 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.

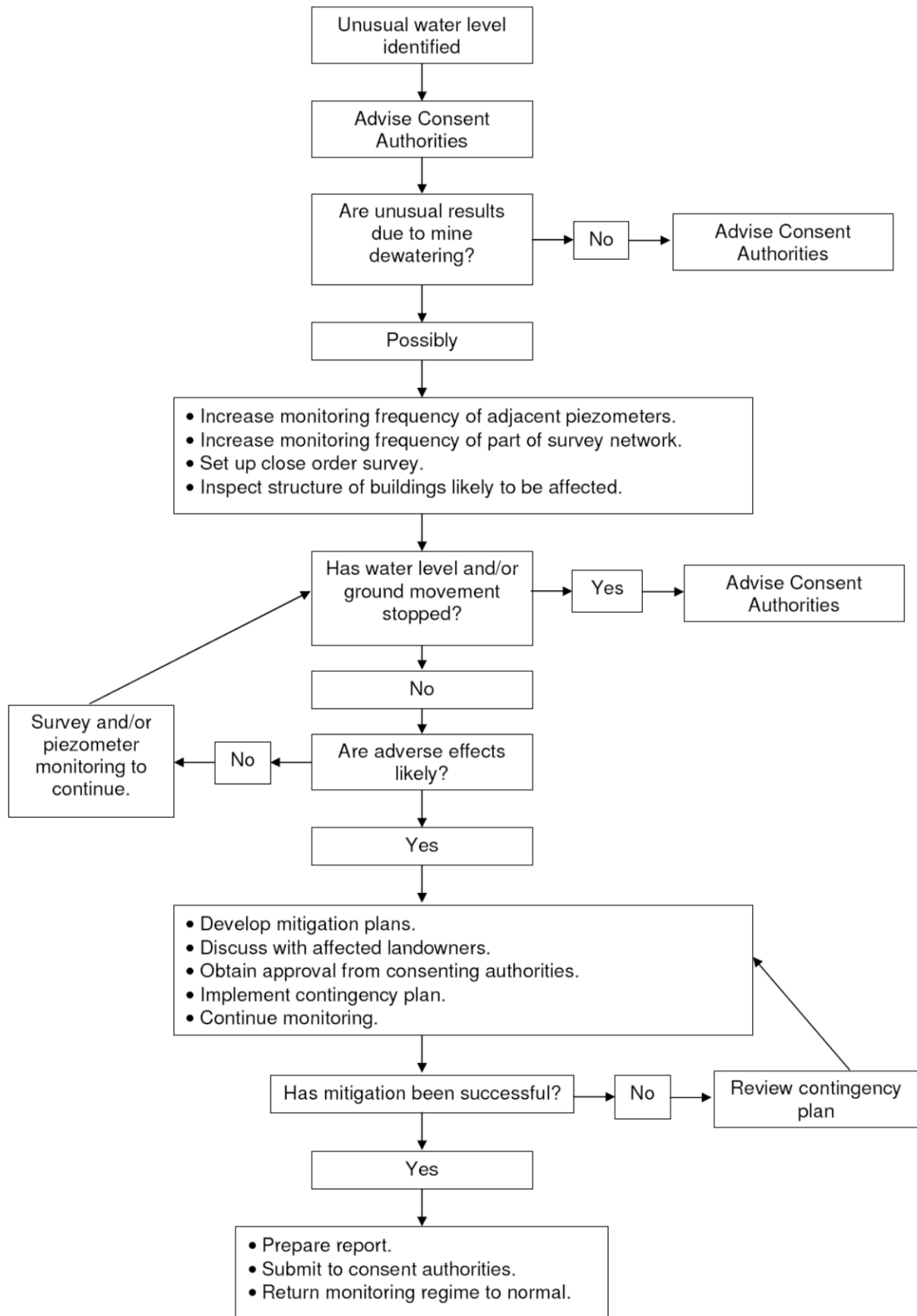


Figure 12: Flow Chart of Water Level Contingency Plan

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 the Martha Pit and Favona Underground 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.

6.12.1 Two-yearly Town Network Inspection, Review and Analysis.

The consent conditions require an inspection of the piezometer installations and appraisal of the global aspects of the piezometer network to be conducted each two yearly period. Unsatisfactory piezometers are to be rectified as soon as practicable after that inspection and generally before the next round of monitoring.

This biennial appraisal is now redundant as a detailed review is effectively conducted during preparation of every annual report. 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.

In addition, soundings to the bottom of all standpipe piezometers are now undertaken on a 6-monthly basis. This data has been compared with previous soundings to determine if any bores are silting up and need to be flushed to remove excess silt and mud. A piezometer requires flushing if the amount of silt that has collected in the screened section of the piezometer restricts groundwater movement into and out of the well. This will generally be the case where silt fills more than 75% of the screen zone.

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, Correnso 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 and Favona Underground is shown in Figure 13. 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 13 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.

Additional survey marks are required with the development of Correnso (refer Figure 11), in recognition of operating under a residential area. These have been 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 the Trio Development. 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 April/May and October/November. 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 and the Trio and Correnso 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.

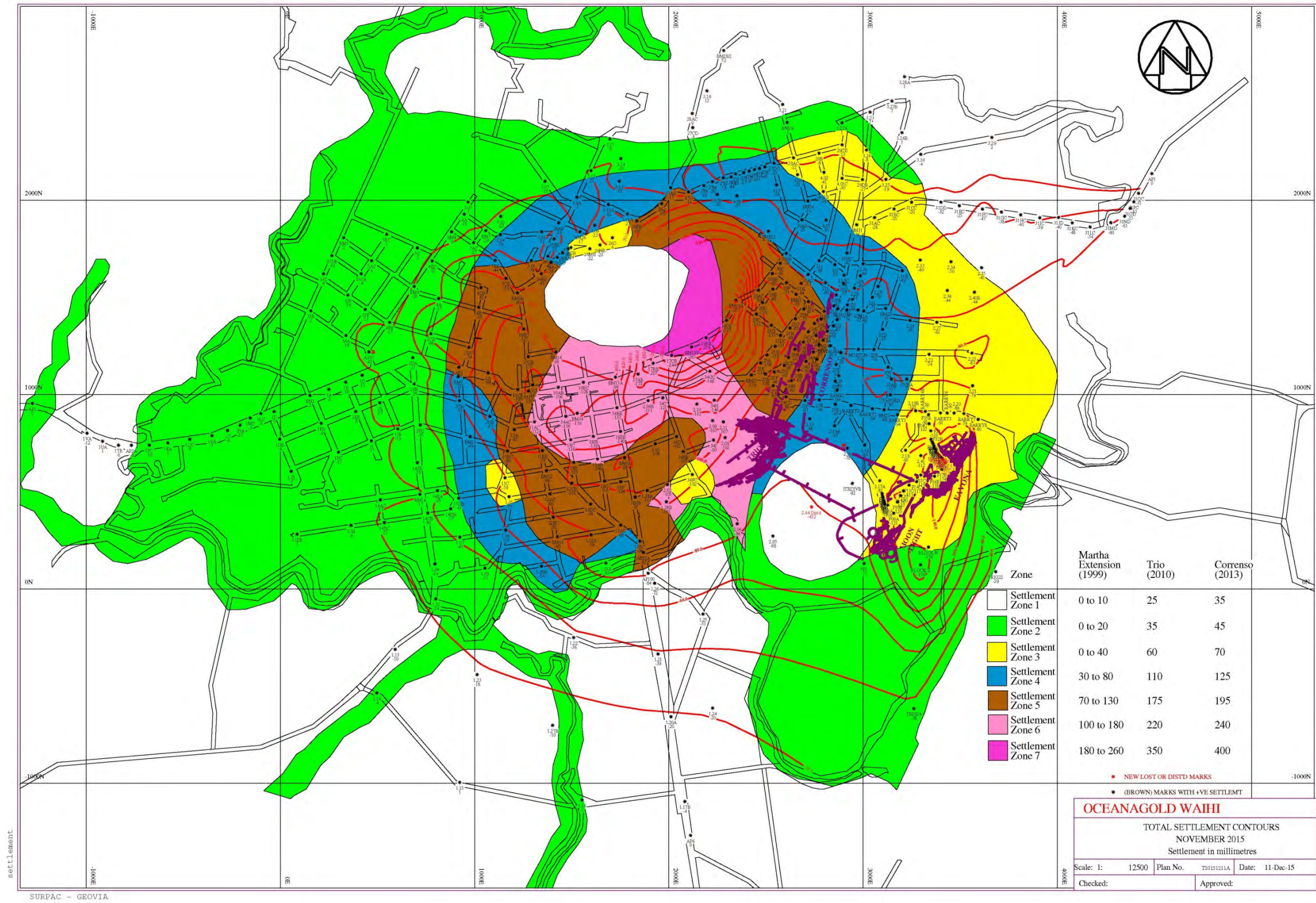


Figure 13: Location of Settlement Markers within the seven settlement zones



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

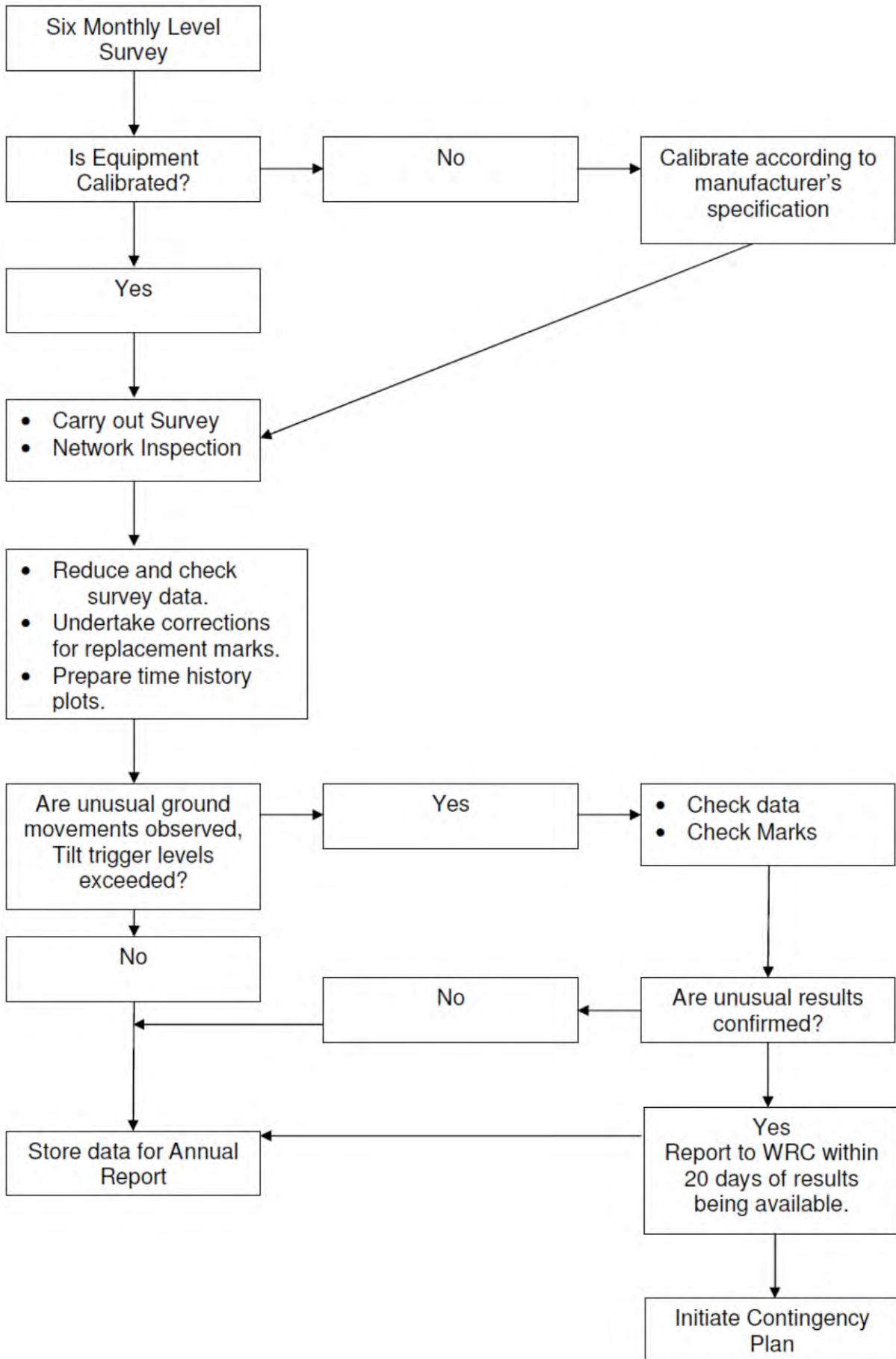


Figure 15: Flow chart for settlement monitoring

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 13 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 9.

- 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 (including for Trio and Correnso Development) 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.

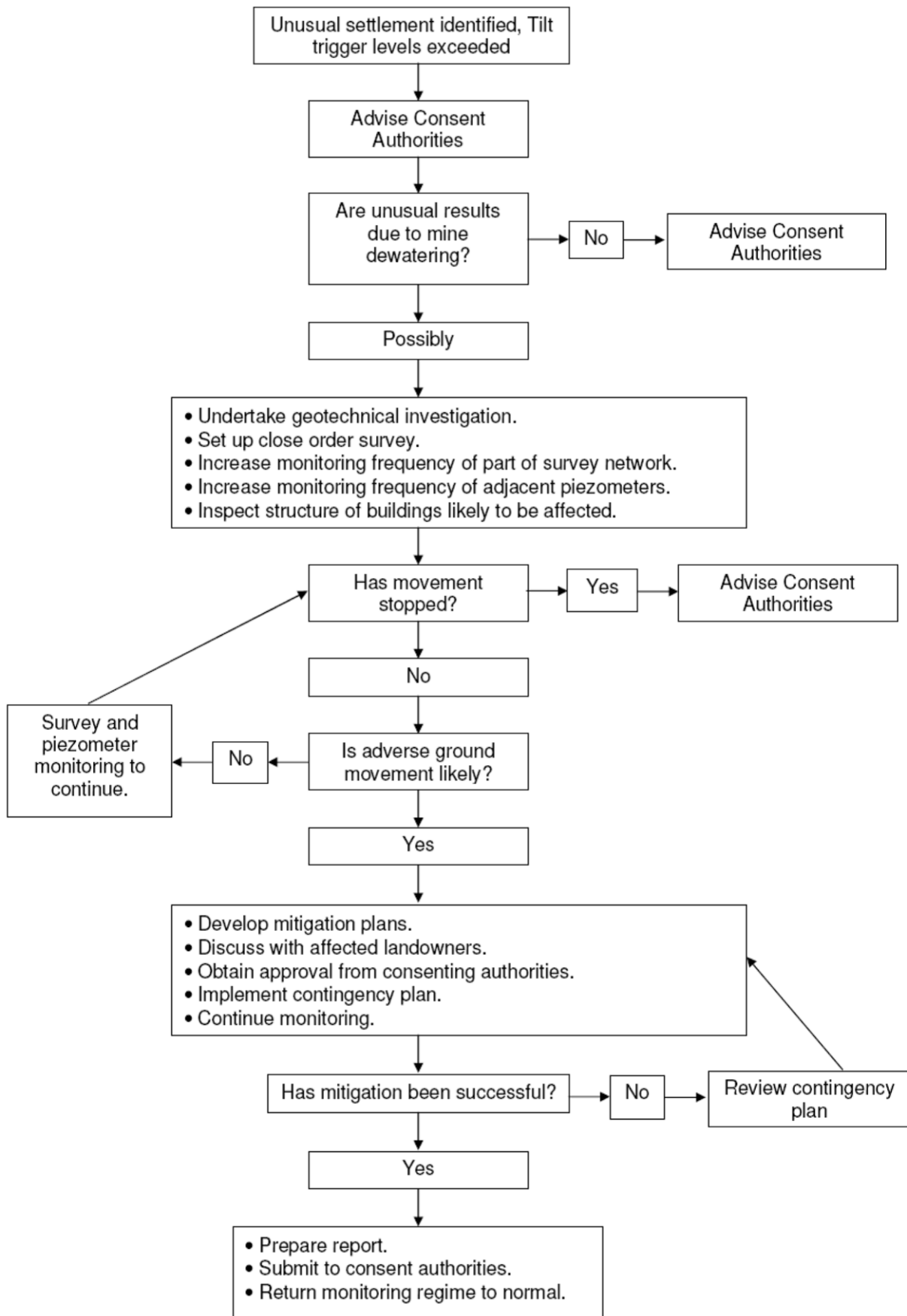


Figure 16: Flow chart of Settlement Contingency Plan

Table 9: Predicted Settlement by Zone

(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), and new trigger levels for Correnso recommended by EGL (2012).

Refer to Figure 13 of this Document for a Plan of the Settlement Zones.

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)
1	+2 to -10	0	0 to 10	0	25	35
2	+10 to -10	0	0 to 20	10	35	45
3	0 to -25	10	0 to 40	20	60	70
4	-15 to -35	25	30 to 80	45	110	125
5	-25 to -50	50	70 to 130	85	175	195
6	-55 to -85	65	100 to 180	120	220	240
7	-95 to -125	110	180 to 260	200	350	400

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.

APPENDIX A – Resource Consents



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	Group 1	Groups 1 & 2	Groups 1, 2 & 3
2		Groups 1 & 2	Groups 1, 2 & 3
3		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, SO ₄)	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 µm 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

DR

.....

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.

109742

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.

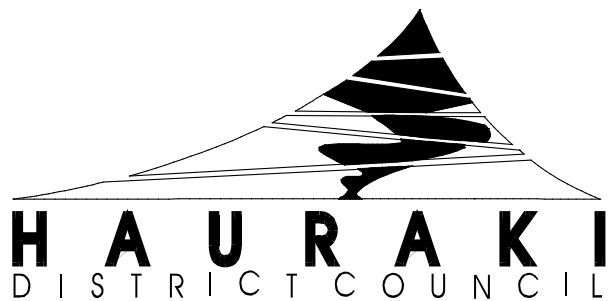
3. In the event that a tilt greater than 1 in 1000 occurs between any two network monitoring locations, installed in accordance with the Settlement, Dewatering & Water Quality Monitoring Plan required pursuant to condition 2 above, or there is a significant variance from the predicted settlement rates, 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.



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

6. 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.

Appendix B – Standard Operating Procedures



Standard Operating Procedure Groundwater Monitoring

WAI-200-PRO-012

NWO-ENV-SO-70-9789

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:	
Site:	

	Position/Title	Name	Date
Authored By:			
Reviewed By:			
Approved By:			

Reference Documents	Document Name	Document Reference

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

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1 PURPOSE

Groundwater surrounding the tailings storage facilities, Favona Stockpile, 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 compliance and detection wells, stockpile seepage detection wells (Network 2) and Favona backfilled workings detection wells (Network 3).

3 RESPONSIBILITY

Environmental Technicians are responsible for the monitoring of groundwater bores.

Environmental Coordinator is responsible for maintaining and checking monitoring data to detect any adverse effects of the TSF, stockpiles or Favona backfilled workings on groundwater.

The responsibility for the performance of the tailings storage facilities lies with the Development Department (Embankment Construction).

4 JOB HAZARDS

- Access to sites. 4WD Vehicle required. Access by 4WD is to be reviewed at time of sampling to assess if access should be made by foot.
- Sprain/Strain/Trip. Ensure safe lifting techniques when handling heavy sampling equipment. Uneven ground surfaces at Bore sites.

5 PROCEDURES

Required Labour Resources

1-2 people.

Monitoring Site Locations

The TSF groundwater monitoring locations are outlined in Figure 1 attached (also available on S:\Environmental\Graphics\TSF MP figures and appendices\Comp & Det wells 2007 reduced file size.JPG). The location of the stockpile seepage monitoring wells (Network 2) are shown in Figure 2 attached. Locations of the backfilled workings monitoring wells (Network 3) are shown in Figure 3 attached.

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 (NWO-ENV-017-SYS-G3) provides a detailed monitoring programme for the groundwater bores. This is summarised below:

All bores:

Monthly	Scan	(Code 42 – Field pH, Temp and EC)
Six Monthly	Categorising	(Code 41)

Annual	Full Analysis	(Code 40)
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Monthly scan monitoring will be conducted in Feb, Mar, Apr, May, Jun, Aug, Sep, Oct, Nov, Dec.

Six monthly categorising monitoring will be conducted in July

Annual full analysis monitoring will be conducted in January.

The Dewatering and Settlement Monitoring Plan (NWO-ENV-064-SYS-M8) provides a detailed monitoring programme for the stockpile seepage (Network 2) and backfilled workings (Network 3) monitoring wells: This is summarised below:

All bores:

Monthly	Scan	(Code 42 – Field pH, Temp and EC)
Six Monthly	Categorising	(Code 47)

Monthly scan monitoring will be conducted in Feb, Mar, Apr, May, Jun, Aug, Sep, Oct, Nov, Dec.

Six monthly categorising monitoring will be conducted in January and July.

Field Work Preparation and Required Equipment

Equipment Checklist:

Field

- Well Wizard, pneumatic tubing and compressed air cylinder and regulator AND/OR MP15 Controller and Power Pack (including CO₂ cylinder)
- Flow Cell
- Water level probe
- Sample Sticker book and labels
- 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
- Maxter Powderless Surgical Gloves

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 and refilled at the Mines Rescue office.

The CO₂ cylinder for the MP15 Controller and pump is sent to be refilled by the Environmental Coordinator.

The sample bottles required for each groundwater bore are:

Compliance and Detection Wells – Shallow/Deep (Storage 1A and 2)¹

Feb-Jun, Aug-Dec – Code 42 (scan analysis)

No bottles – field pH, conductivity and temperature

January – Code 40 (full analysis)

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

July – Code 41 (categorising analysis)

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

MW16S and MW17S also analysed for bio-parameters monthly (Faecal coliforms, Enterococci and E.coli) using specific sample jars provided by RJ Hill Laboratories and dissolved oxygen using specific sample jars provided by SGS Laboratories.

Remove three (3) cool packs or iced water bottles out of the freezer and place them in an empty chilly bin.

Place the chilly bin with cool packs in the back of the vehicle.

Stockpile Seepage (Network 2) and Backfilled Workings (Network 3)

Feb-Jun, Aug-Dec – Code 42 (scan analysis)

No bottles – field pH, conductivity and temperature

January and July – Code 47

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

Remove three (3) cool packs out of the freezer and place them in an empty chilly bin.

Place the chilly bin with cool packs in the back of the vehicle.

¹ Including MW16S and MW17S located between the MCP and the Ohinemuri River (Figure 1).

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 sterile gloves
- Record well number in the sample book.
- Measure 'depth to water'. Record results in the 'sample book'. All measurements are made from a measuring point taken as the top of the PVC pipe.
- Note sample numbers must be allocated to both monthly field measurements and full/categorising parameter analysis.

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 = $\pi D^2/4$ (m²)*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 m³ to litres.

- 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 8 and 9 until the required volume of water has been purged and the bucket has been rinsed well with bore water.
- A portion of water is then discharged by the bailer and retained in the bucket. This water is used to test the temperature, pH and electrical conductivity (EC) of the groundwater.
- Turn the temperature, pH and EC probes on and submerge the probes in the bucket. Allow the readings to stabilise. (Note: The pH & EC probes need to be calibrated at the start of each monitoring day).

- Record the temperature, pH and conductivity readings in the 'sample book'.
- If samples are required, bail more groundwater and carefully fill the appropriate sample bottles.
NOTE: Sample must be filtered with the filter kit before filling the RJ Hill Trace Metal Analysis Bottle (filtered). Instructions are included in the kit.
- Place the full samples in the chilly bin in the rear of the vehicle.
- 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.

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.

Using Well Wizard Pump:

- Connect the pneumatic hose between the compressed air cylinder and the pump box.
- Connect the pneumatic hose between the pump box and the deep bore.
- Check all hoses are connected correctly and turn the compressed air bottle on.

OR

Using MP15 Controller and Power Pack:

- Connect Controller to deep bore
- Open the CO₂ 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 Well Wizard* - turn compressed air off at the cylinder.
- *If using MP15 Controller and Pump* – close CO₂ 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 and conductivity into database and check results against trigger levels (refer to **NWO-INT-009-ENV-S23** Water Quality Database Management for data entry procedures). If a trigger level is exceeded, inform the Environmental Coordinator immediately and initiate further field checks on groundwater bore. Trigger levels are also defined in the Tailings Storage Facility Management Plan – Part D (**NWO-ENV-017-SYS-G3**).

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 a courier sticker on the lid of the chilly bin.
- Telephone the courier before 9:30am 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 Well Wizard 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 sticker book system, submission sheet records, sample submission register, entering water quality results into the water quality database and archiving water quality results.

Sample Sticker book System

- On arriving at the monitoring site the sample card must be filled out clearly and unambiguously. The information recorded on the sample card must include as a minimum the date, time and site location (or site number). In addition other information may be recorded such as weather conditions or anything that may bias the sample.

Water Quality Database

- Results from the RJHill Laboratory are received in both electronic and hard copy form.
- Enter data into the computer database.
- Entered data is then stamped and recorded as such.
- File hard copies of results in both the Environmental Office and the Records Room.

Archiving Water Quality Results

Hard copies of the water quality results are archived in the Environmental Coordinator's office and archived in the Records Room.

REFERENCES: TSF Monitoring Plan – **NOW-ENV-017-SYS-G3**



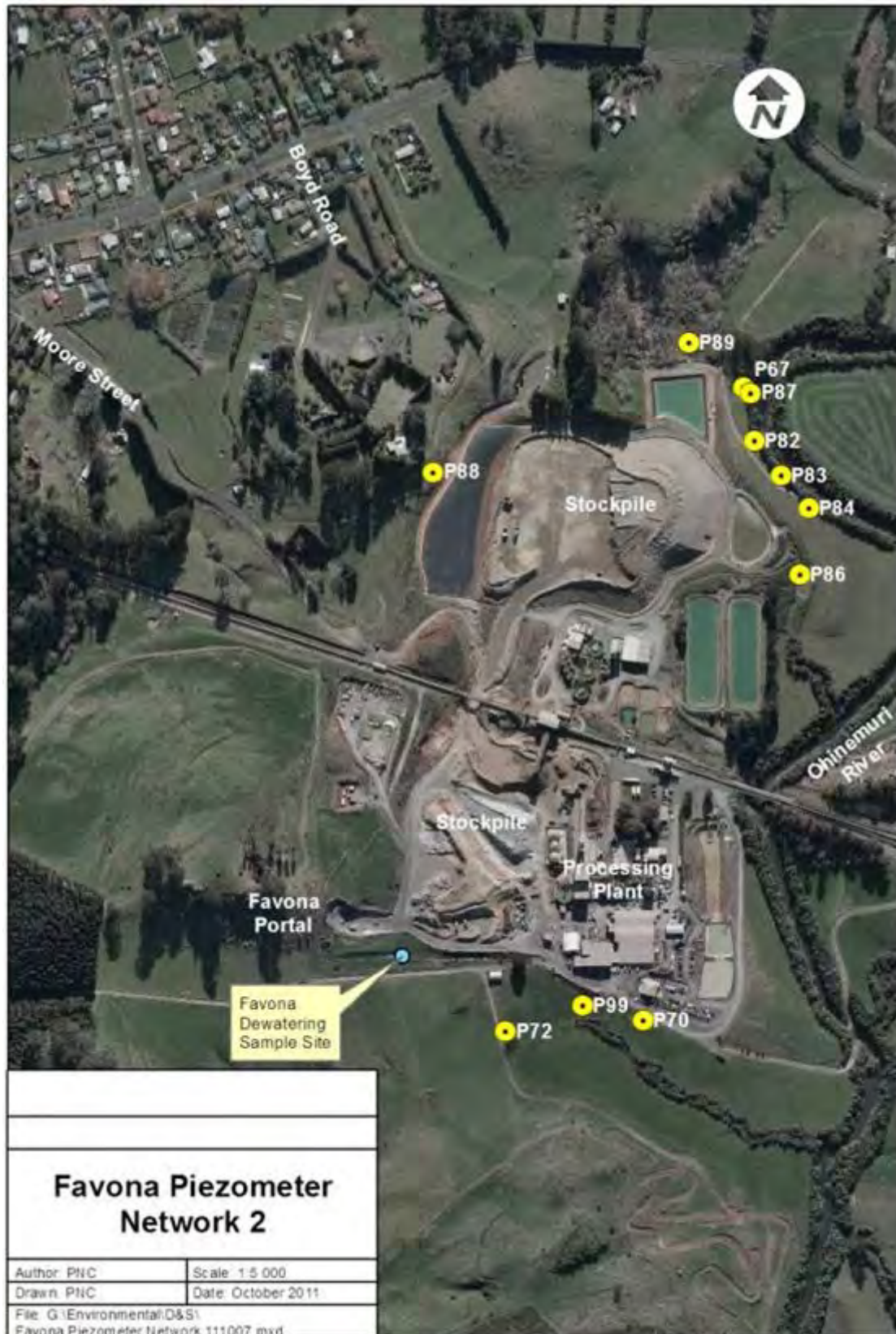


Figure 2 – Location of stockpile seepage monitoring wells surrounding the Favona Stockpile and the Polishing Pond Stockpile.



Figure 3 – Location of backfilled and flooded workings monitoring wells surrounding the Favona Underground workings.



Standard Operating Procedure

Township Piezometers Networking Monitoring

WAI-200-PRO-021

NWO-ENV-SO-70-9799

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Authored By:			
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Reference Documents	Document Name	Document Reference

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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 three 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/"Dipper"
- 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 three months (Feb, May, Aug, Nov) 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 500psi of Nitrogen is required to take a reading. If the psi is low, refilling can be done at the Geotechnics lab at the Mill, check with the Stores supervisor for access. Filling is to be carried out by qualified approved handlers.
- It is recommended to measure each piezometer in order and one at a time to reduce the chance of a mix up-occurring.
- The following instructions on the use of the pneumatic piezo meter read-out unit are laminated and taped to the inside of the unit:
 - *Check that the readout unit is clean and that the tank is full of Nitrogen gas. The tank pressure gauge on the unit indicates how full the nitrogen tank is.*
 - *Upon arriving at a piezometer site, clean and dry each brass fitting thoroughly before connecting it to the readout unit. Dirt and water inside the PVC cable is difficult to remove and can cause incorrect readings to be taken.*
 - *Connect the transducers.*
 - *The black input tube on jumper hose connects to INPUT TO TRANSDUCER socket and to the black tube of the piezometer. (black to black)*
 - *The clear vent tube on the jumper hose has a small clear tube (0.5cm) to connect with the clear meter with a red ball inside it, located on the left hand side of the lid of the unit. The other end of the jumper hose connects to the clear hose of the piezometer. (clear to clear)*
 - *Turn SUPPLY PRESSURE to 90psi and turn Slope Indicator knob from “Off” to “mH₂O”.*
 - *Carefully zero using “Zero” knob.*
 - *Turn INPUT CONTROL to “Input” and turn GAS SUPPLY to “On”.*
 - *Adjust the FLOW RATE knob until reading on main gauges increases to 1 psi/sec.*
 - *The silver ball in the black gauge on right hand side of the lid of the unit is adjusted by turning the flow rate knob - this must be set at 0.1 on the gauge.*
 - *Then wait for red ball in the gauge on the left-hand side of lid to float.*
 - *Adjust the FLOW RATE knob until the silver ball in the black gauge maintains a constant reading of 0.1. Continue to adjust FLOW RATE knob as necessary to maintain this reading.*
 - *Wait for a stable reading on the gauge.*
 - *Record the measurement in the ‘Pneumatic Piezometer Readout’ logbook.*
 - *Turn off gas supply off, disconnect transducer tubing, and turn INPUT CONTROL to vent.*

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.

Computer Entry

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

Trigger Limits

None

Reporting Requirements

Water levels to be reviewed on a monthly basis by Environmental Officer/Coordinator. If a significant change 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.



Standard Operating Procedure Pit Surface Runoff Sampling

WAI-200-PRO-024

NWO-ENV-SO-70-9802

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1 PURPOSE

To monitor the chemistry of the pit wall runoff to:

- Achieve compliance with the requirements of EW 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 (Coordinator, Officer, Technicians)

3 ACCOUNTABILITIES

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

Environmental Coordinator – 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,
- Haul 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.
- 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:

- [Martha Mine Project Open Pit \(OceanaGold\) Induction rev.4 14.04.08](#) (Macmahon Contractors (NZ) Ltd)
- NWO-INT-009-PIT-S17 Working Adjacent to Highwalls
- NWO-INT-009-PIT-S18 Pit evacuation procedure

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

Personnel sampling sites along the north wall (NU1,5,6,7) are exposed to the potential of rocks being dislodged from the walls above. While sampling at these locations, extra caution is required and (an additional person) should act as a spotter while the other undertakes collection. Walking between NU1 and NU5 is to be avoided as it involves an extended presence under the exposed high-wall; NU1 is accessed from the western pit perimeter road while NU5, 6, & 7 are accessed from the east.. For radio protocols see [MARTHA MINE PROJECT OPEN PIT \(OceanaGold\) INDUCTION rev.4 14.04.08](#) (Macmahon Contractors (NZ) Ltd).

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

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

5 PROCEDURES

5.1 Monitoring Locations

Pit surface water runoff sampling aims to sample pit wall runoff from above final lake level 1104 mRL. There are currently ten 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, 4 on the north 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. Depending on suitable weather conditions occurring, sampling aims at taking up to two sample episodes per month at least two weeks apart.

Each sampling event shall include the following:

- Environmental Coordinator/Officer 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 a 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.
- Try to 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 Sticker book
- 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 Extended Project Water Sampling Schedule held by the Environmental Officer or Environmental Technician.

Samples are to be collected for laboratory analysis (Newmont **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 sample book must be filled out with relevant details:
 - **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) quantity, 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 Hills 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 solids in the bucket.
- Place samples in chilly bin and transport back to OceanaGold environmental laboratory for refrigerated storage (no longer than 24 hrs).

5.5 Wall Wash Plot Sampling

- Conducted non-concurrently with the pit surface water sampling is wall wash trial plot sampling. Four sample plots (Wall Wash Stations) have been established on three different batters of the north wall (Attachment 2). Access to WWS1 is via the Magazine Ramp (radio protocols apply).
- Sampling will be done on a monthly basis.
- The plots (WWS1-WWS4) are designed to control and imitate the weathering process with the aim of sampling the resulting artificial runoff from the four plot faces.
- Equipment:
 - Back-pack spray unit filled with de-ionised water (obtained from Enviro Lab).
 - Additional de-ionised water as back-up supply (Blue plastic jerry can)
 - Man-gate key for WWS1 access
 - Cable ties
 - Scissors or auto-retracting box cutter
 - 3 or 4 extra sampling filters

- Carry basket for sampling equipment.
 - Sample bottle. UP1L Chemical analysis (Code 63).
 - Sample sticker book.
 - pH meter.
 - Two way radio (Channel 8).
 - Powderless latex gloves.
 - Pen.
 - Camera.
 - Appropriate PPE.
- With equipment, approach the WWS site. Sampling the four sites in numerical order is a logical procedure. Untie or cut ties that are holding the bottom edge of the station lid. Lever the lid open exposing the pit wall face.
 - Take a picture of the exposed pit wall face.
 - Ensure the frame's hose connection is free of sediment before commencing spraying.
 - Evenly spray the de-ionised water repeatedly across the sample plot. Place the UP1L bottle beneath and collect the sample. Once near full, remove the sample bottle and take the field readings by putting the probes in the bottle. Remove the probes.
 - Replace UP1L bottle in position and continue spraying until bottle is full as much as possible
 - Close the sample station lid and re-tie any broken or missing ties.
 - Place samples in the chilly bin with the ice bricks and continue to the next site.

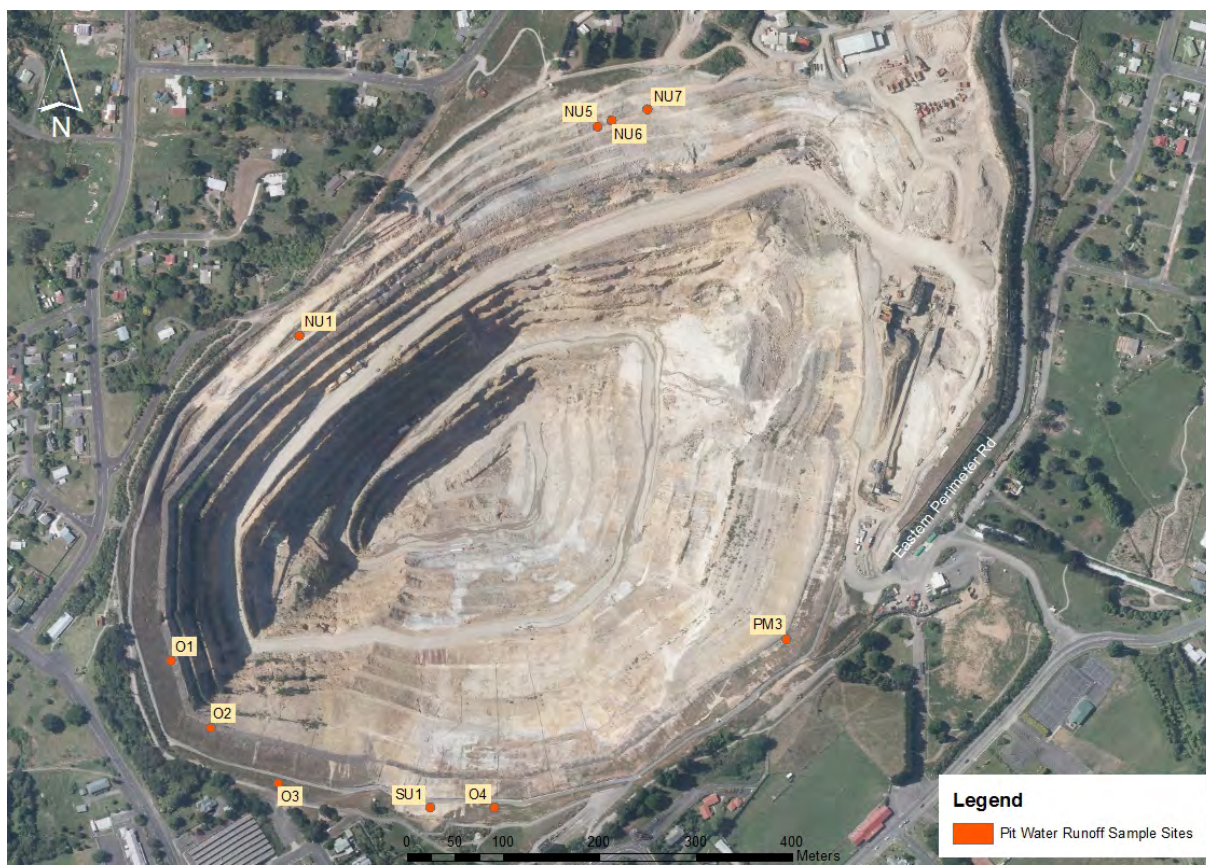
5.6 Sample Dispatch

- Samples are dispatched by courier to Hill Laboratories Ltd, 1 Clyde Street, Hamilton.
- Complete a sample submission form (pads of forms found at technicians' workstation). 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 sample submission 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".

6 DOCUMENT CONTROL

Version	Date	Description	Author	Approved
1.0	19 Oct 2004	New SOP	K Dunning	
2.0	July 2005	Revised for new permanent locations	AJ	PF
3.0	June 2009	Revised incorporating new locations and protocols	RS	PF
4.0	December 2011	Revised new sites, location map, trail plot sampling	M Burroughs	PF
4.1	Spetember 2013	Revised access methodology and minor other changes	S Perkinson	R Squire

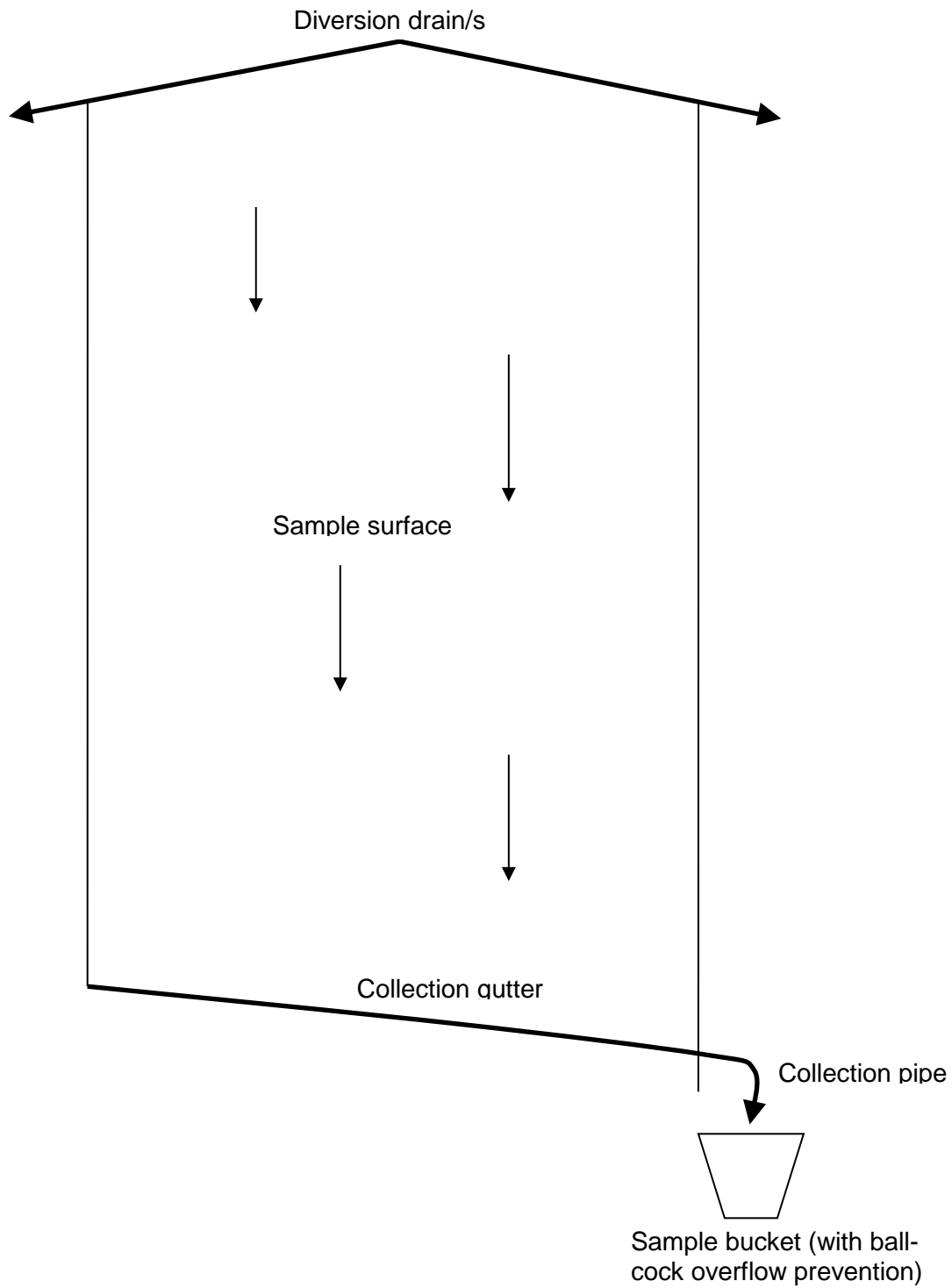
Attachment 1 – Pit Wall Sampling Sites



Attachment 2 – Pit Wash Water Sampling Sites



Attachment 3 – Pit Wall Sampling Site Design





Standard Operating Procedure

Management of Surface Intersecting Drill Holes

WAI-400-PRO-076

NWO-MNU-SO-70-16391

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Area:	
Site:	

	Position/Title	Name	Date
Authored By:			
Reviewed By:			
Approved By:			

Reference Documents	Document Name	Document Reference

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

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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 meters unless specified otherwise. Examples of exceptions would be drain holes or piezometer holes which have no grouting or holes that have a 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 meter 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

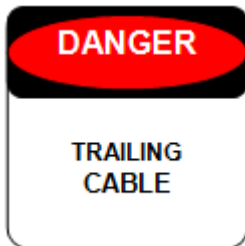
4.2 Equipment

- 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	<p>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.</p> <p>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.</p> <p>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.</p>	<p>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.</p>
Intersecting Water Producing Diamond Drillholes	<p>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.</p> <p>Once monitoring has determined that a drillhole is producing more water than can reasonably be expected to have been contained in the original</p>	

Steps	Procedure	Important Information
	<p>drillhole volume the hole will require plugging and grouting.</p> <p>The Underground Supervisor will immediately notify the Underground Manager of any intersected surface hole that has significant and sustained water flows.</p> <p>An incident will be raised 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.</p> <p>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.</p> <p>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.</p> <p>A minimum of thirty meters 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.</p> <p>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.</p> <p>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.</p>	<p>The flow of water must be controlled within 36 hours of being intersected.</p> <p>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.</p> <p>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.</p> <p>All completed grouting operations, where van Ruth plugs are involved, are to be reported to and recorded by the geology department.</p>

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 MONITORING AND REVIEW

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

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	

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