

6th September 2005

Auckland Regional Council
Vodafone House
Private Bag 92012
Auckland.

Attention: Alastair Smail

Dear Alastair

Re: Three Kings Quarry, Cessation of Settlement.

Further to your letter dated 1 September 2005, as requested please find attached a report on surface level monitoring points AP17C and AP24. Included in the report is the March 2004 to June 2005 survey data for all surface level monitoring points together with changes in surface level of monitoring points compared with baseline and the March 2004 levels.

The analysis of adjacent survey marks found that while the settlements recorded in surface level monitoring points AP17C and AP24 are generally in keeping with the overall trend of adjacent surface level monitoring points, the settlement recorded from September 2004 to March 2005 in AP17C and AP24 are the result of survey anomalies or other surface loading. They are not the result of dewatering Three Kings Quarry.

As such, it is maintained that "cessation of settlement" for precise level survey network has occurred.

It is important to note that AP17C and AP24 are in a minor settlement zone (Settlement Zone I). The areas of greater settlements, and steeper differential settlements (for example Settlement Zone IIA - Hillsborough Road), have clearly recorded "cessation of settlement".

I will be available to accompany ARC staff to view the surface level monitoring points should a site visit be required.

If you require any clarification or further information, please contact the undersigned.

Yours faithfully
for **WINSTONE AGGREGATES**



Michael Harris
Engineering Geologist.



WINSTONE
AGGREGATES

Report on Surface Level Monitoring Points AP17C and AP24

Three Kings Quarry

September 2005

Report on Surface Level Monitoring Points AP17C and AP24

This report has been prepared to support "cessation of settlement" being achieved within the Three Kings Quarry surface level survey network.

Cessation of settlement is defined in the consent to dewater Three Kings Quarry as –

Cessation of settlement: means that there has been no settlement caused by dewatering greater than 5mm during any 12 month continuous period at any of the monitoring points required by this Consent (to dewater Three Kings Quarry).

As at August 2005, settlements at all surface level monitoring points with the exception of AP17C and AP24 adjacent to the Three Kings Quarry have been within 5mm of the March 2004 levels. Monitoring point AP17C has recorded 10mm of settlement compared with March 2004 levels, and AP24 has recorded 6mm of settlement.

AP17C and AP24 are both located adjacent to the Three Kings Quarry. The area adjacent to Three Kings Quarry is not, and never has, recorded significant total settlements or differential settlements resulting from the dewatering of Three Kings Quarry.

The area in the vicinity of Three Kings Quarry is generally underlain by scoria and basalt although substantial thickness of fill has been placed in former quarry areas including in the former Hunters Pit on the northern boundary of the present quarry area. These former quarry areas were not excavated below the original groundwater table and the resulting fill has not been subject to dewatering.

In comparison, settlements in Settlement Zone IIA (Hillsborough Road) at the June 2005 survey were all 4mm or less compared with the March 2004 survey. Settlement Zone IIA has historically recorded the greatest total settlements and is an area where the steepest differential settlements are being recorded.

The consultant who undertakes the precise level survey of surface level monitoring points (Harrison Grierson) has been contacted. With regard to the recent movement of AP17C, Harrison Grierson commented that they have no explanation for its movement saying that it is set in a concrete driveway and there is no evidence of cracking or movement in the concrete and that the level on AP17C is established from M220 in Mt Eden Road which is stable.

With regard to AP24, Harrison Grierson commented that while they are achieving acceptable closes, with the difference in level between AP24 and surrounding marks, it is difficult to level to the limits required (plus or minus 2mm between adjacent marks in any survey).

The precise level survey data for all surface level monitoring points (from March 2004) is attached to this report. Also attached are the change in levels of all surface level monitoring points compared with baseline (original) levels and March 2004 levels. A location plan showing the surface level monitoring points is attached (Dwg 6451_101 dated 7/4/05).

Surface Monitoring Point AP17C

AP17C is a relatively recent replacement surface level monitoring point installed in a concrete pavement beyond the end of Hunter Park Drive immediately to the north of Three Kings Quarry. AP17C replaced AP17 and AP17A after the first two marks were disturbed by surface works associated with the redevelopment of this area.

The immediate area surrounding AP17C is used for access and parking and is subject to heavy traffic movements associated with the Danske Mobler factory and Perron Storage facilities.

The ground conditions to the north of Three Kings Quarry is fill overlying Three Kings volcanic centre scoria and basalt. Below AP17C, substantially more fill has been placed compared with surface level monitoring points along Mt Eden Road. The scoria has been excavated to the original groundwater level prior to backfilling (part of the former Hunters Pit excavations). The fill has been placed above the original groundwater table and has not been subject to dewatering. Groundwater levels within the Three Kings volcanic centre have been held at above RL34m since October 2002.

The changes in surface level of AP17A and adjacent monitoring points (AP10, AP18A, M220, M221 and AP11) are summarised in the following tables. A graph plotting changes in levels since monitoring commenced is attached. Differential settlements recorded between adjacent monitoring points are summarised in Table 3.

Table 1: Change in Level Compared with Baseline Levels

Monitoring Point	Location	Mar 04	Sep 04	Mar 05
AP17C	Hunters Park Dr	-3	-2	-13
AP10	Roskill Way	-9	-6	-12
AP11	Mt Eden Rd	-6	-5	-8
AP18A	Mt Eden Rd	-10	-8	-13
M220	Mt Eden Rd	-9	-7	-11
M221	Mt Eden Rd	-11	-8	-13

Table 2: Change in Level Compared with March 04 Levels

Monitoring Point	Location	Sep 04	Mar 05
AP17C	Hunters Park Dr	1	-10
AP10	Roskill Way	3	-3
AP11	Mt Eden Rd	1	-2
AP18A	Mt Eden Rd	2	-3
M220	Mt Eden Rd	2	-2
M221	Mt Eden Rd	3	-2

Table 3: Differential Settlements

Monitoring Points	March 04	Sept 04	March 05
AP17C to M221	-	1:75893	1:18973
AP17C to M220	1:99401	1:62266	1:17177

AP17C to AP10	1:113353	1:51626	1:21842
AP10 to AP18A	1:22422	1:17937	1:22422
M220 to M221	1:76591	1:191476	1:76591
M220 to AP11	1:19431	1:27758	1:19431

Note: an 8.0mm adjustment has been made to AP17C in the differential settlement calculation.

The original surface level monitoring points (AP17 and AP17A) recorded settlements of 2mm and 6mm respectively. These settlements were consistent with adjacent surface level monitoring points and with the settlement model for dewatering basalt and scoria material. AP17C, on the other hand, recorded 11mm of settlement between September 2004 and March 2005 compared with its total settlement since installation in March 2003 of 13mm. This magnitude of settlement is anomalous with surrounding surface level monitoring points and the previous settlement history.

The change in surface level in AP17C generally follows the same trend to those recorded in adjacent marks. The survey data for these points shows a general downward trend in levels however this has been in the range of plus or minus 5mm for any 12 month period since precise level surveying commenced. It is the magnitude of the change in level in AP17C between September 2004 and March 2005 that is anomalous.

The variation in level in AP17C was initially considered to be a result of the movement of the surface level rather than settlement resulting from dewatering. A more detailed analysis of the surface level history of AP17C together with the surface level history of adjacent marks suggests that it may also be an artefact of survey accuracy rather than a "real" surface settlement over the period of September 2004 and March 2005. The settlement history of this and surrounding points have a gradual lowering of surface levels which has continued in adjacent surface level monitoring points in the March 2005 survey.

There is no evidence to suggest that the movement of AP17C over the period September 2004 to March 2005 is the result of settlement from dewatering Three Kings Quarry. If real, the movement of AP17C over the period September 2004 and March 2005 is more likely to be the result of heavy traffic movements associated with the Danske Mobler factory or the Perron Storage facilities.

Surface Monitoring Point AP24

AP24 is located on outlet structure to the water reservoir at the top of Big King. It is an original surface level monitoring point and its level has varied considerably since precise level surveys were commenced. It is currently 9mm below its baseline level (last surveyed March 2005) compared with 2mm above its baseline level in the September 2004 survey.

The geology making up the Big King is scoria. The groundwater level has been held above RL34m since October 2002.

The changes in surface level of AP24 and adjacent monitoring points (RM3905, RM3907, RM3908, RM3924, AP14 and AP15) are summarised in the following tables. A graph plotting changes in levels since monitoring commenced is attached. Table 3 details the differential settlements recorded between adjacent monitoring points.

Table 1: Change in Level Compared with Baseline Levels

Monitoring Point	Location	Mar 04	Sep 04	Mar 05
AP24	Big King	-3	2	-9
RM3905	Fyvie Avenue	-5	-5	-7
RM3907	Fyvie Avenue	-4	-3	-8
RM3908	Fyvie Avenue	-3	-2	-5
RM3924	Connelly Avenue	-10	-9	-13
AP14	Churches Avenue	-10	-6	-11
AP15	Dally Terrace	-7	-3	-9

Table 2: Change in Level Compared with March 04 Levels

Monitoring Point	Location	Sep 04	Mar 05
AP24	Big King	5	-6
RM3905	Fyvie Avenue	0	-2
RM3907	Fyvie Avenue	1	-4
RM3908	Fyvie Avenue	1	-2
RM3924	Connelly Avenue	1	-3
AP14	Churches Avenue	4	-1
AP15	Dally Terrace	4	-2

Table 3: Differential Settlements

Monitoring Points	March 04	Sept 04	March 05
AP24 to RM3908	1:432813	1:33293	1:39347
AP24 to AP15	1:29804	1:24544	1:208628
RM3907 to RM3908	1:80536	1:80536	1:26845
RM3907 to RM3905	1:98823	1:56471	1:197647
AP14 to AP15	1:40761	1:40761	1:71332
AP15 to RM3924	1:38075	1:17918	1:27691

The change in surface levels for AP24 has been variable showing a significant apparent change in level with each survey. The overall trend is however that of adjacent surface level marks which have shown a general downward trend in levels however adjacent marks have been within 5mm for the 12month period March 2004 to March 2005.

The variation in level of AP24 may result from the volume of water in the reservoir at the time of the survey rather than from settlement associated with the dewatering of Three Kings Quarry. The surveyor has noted that while acceptable closes for this benchmark are being achieved it may not have been possible to survey this monitoring point to the tolerances required by the consent to dewater Three Kings Quarry.

There is no evidence to suggest that the movement of AP24 over the period September 2004 to March 2005 is the result of settlement from dewatering Three Kings Quarry.

Summary of Observations

Analysis of the survey data has shown that while there is a general downward trend in

levels in surface level monitoring points, the magnitude of the trend is insignificant and that "cessation of settlement" has been recorded in all but two monitoring points.

Analysis of the survey data associated with these two monitoring points (AP17C and AP24) show these points to be trending in general accordance with surrounding marks. However the absolute data is anomalous for the period September 2004 and March 2005 and is the result of survey accuracy or other effect rather than a result of settlement associated with the dewatering of Three Kings Quarry.

In comparison, settlements in Settlement Zone IIA (Hillsborough Road) at the June 2005 survey were all 4mm or less compared with the March 2004 survey. Settlement Zone IIA has historically recorded the greatest total settlements and is an area where the steepest differential settlements are being recorded.

Conclusions

The apparent settlements of 10 and 6mm respectively of surface level monitoring points AP17C and AP24 for the 12 month period ending March 2005 are the result of survey anomalies or other surface loading. They are not the result of dewatering Three Kings Quarry.

AP17C and AP24 are located in Settlement Zone I and have not been subject to significant total settlements or differential settlements.

Settlements in Settlement Zone IIA (Hillsborough Road) at the June 2005 survey were all 4mm or less compared with the March 2004 survey. Settlement Zone IIA has historically recorded the greatest total settlements and is an area where the steepest differential settlements are being recorded.

Cessation of settlement within the Three Kings surface level survey network has been recorded for the period March 2004 to June 2005.

Precise Levels Compared with Baseline Levels

* AP 24 ● RM 3905 RM 3907 * RM 3908 ● AP 14 + AP 15 — RM 3924

