NANT-Y-GWYDDON LANDFILL SITE RHONDDA CYNON TAF

2019 Inert Bund Stability Assessment

Report Number 1983r1v1d0320

Commissioned by

Amgen Rhondda Limited
Bryn Pica Waste Management Facility
Llwydcoed
Aberdare
Rhondda Cynon Taf
CF44 0BX

Prepared by

Geotechnology Ltd
Ty Coed
Cefn-yr-Allt
Aberdulais
SA10 8HE

March 2020

Table of Contents

List of Tables

List of Figures

List of Appendices

1 INTRODUCTION

Amgen Rhondda Limited (ARL) is responsible for monitoring and maintaining the Nant-y-Gwyddon closed landfill on behalf of Rhondda Cynon Taf County Borough Council. The landfill no longer accepts wastes and has been returned to rough grassland. Whilst the site was operational, a containment bund was placed across the small valley occupied by the waste mass and the site permit requires that the stability of the land is monitored.

Geotechnology Limited (Geotechnology) has been commissioned by ARL to undertake an independent stability assessment of the monitoring data collected from the inert bund and the waste mass it retains. This report is the fourth assessment of the inert bund and waste mass carried out by Geotechnology and follows on from a comprehensive review completed in April 2012 (Geotechnology Report 1155r1v1d0412) and additional reviews completed in April 2015 (Geotechnology Report 1404r1v1d0415) and December 2017 (Geotechnology Report 1684r1v1d1217). Further assessments will be carried out by Geotechnology at biennial intervals to confirm the continued stability of the inert bund.

This stability assessment incorporates observations made during a site walkover, and data produced by routine monitoring which has been ongoing since the closure of the site. Of the data included in the report, ARL are responsible for monthly groundwater and leachate level monitoring and survey monitoring of a network of movement markers. Geotechnology is responsible for monitoring two piezometers and one inclinometer position within the inert bund.

This review specifically examines monitoring records for the 2018 - 2019 period. This report also reviews the conclusions and recommendations of the previous stability assessment review.

2 THE SITE

2.1 Site Location

Nant-y-Gwyddon Landfill Site is located at Mynydd y Gelli on the west side of Rhondda Fawr Valley at Ordnance Survey (OS) National Grid Reference (NGR) SS 980 940. The nearest populated areas to the landfill are the village of Gelli, approximately 1km to the north and Tonypandy, approximately 1.6km to the southeast.

The site entrance is located at NGR SS 9782 9468, just off the B4223 (Nant-y-Gwyddon Road). The landfill site is connected to the B4223 by a purpose-built access road.

Nant-y-Gwyddon landfill site covers an area of approximately 24 Ha which can be broken down into 3 separate zones:

- Phase 1 Landfill – Covering approximately 9 Ha and containing approximately 1.4 million tonnes of waste. A full capping and restoration scheme has been put in place in this area. This zone also contains the Inert Bund which is the primary consideration of this stability assessment review.
- Phase 2 Landfill – This area consists of approximately 3.5 Ha of sloping grassland with a small surface water lagoon and associated drainage. The area was previously occupied by an engineered barrier system and leachate storage facility, which has since been removed.
- Infrastructure Area – This area, located to the northeast of Phases 1 and 2, consists of site offices, a weighbridge, car park and landfill gas compound.

2.2 Site History

Nant-y-Gwyddon landfill was constructed by Rhondda Borough Council during the mid-late 1980's and was ready to accept waste by 1988. Whilst the landfill was initially operated without significant issues, problems followed. A later amendment to the waste disposal licence allowed the intake of 'non-special industrial wastes' in the form of filter cakes and similar materials. This move led to issues arising regarding odour and gas production at the landfill.

A local community action group was established with the aim of stopping waste disposal at the site. Following a number of troubled years it was finally recommended by the Purchon Report (December 2001) that the site should be closed due to its unsuitable location.

The site was closed to the acceptance of waste from March 2002 and has since undergone monitoring. A more detailed history of the site may be found in Encia Environmental Report Number AM5571/01.

2.3 Site Engineering

The initial engineering work carried out at the site was the construction of an inert bund along the eastern edge of the proposed waste disposal area, now known as Phase 1. The construction of this bund along with the natural topography created a bowl shaped void which was then lined with an engineered barrier system.

The Phase 1 landfill cell has a leachate collection system consisting of a geotextile-protected cuspated membrane and pipework, channelling leachate to leachate collection sumps. A similar system comprising cuspated membrane and pipework is in place below the cap to collect landfill gas and discharge it to gas well heads.

Phase 1 has been capped using a geotextile-protected, continuous (welded), double-textured, 1mm LLDPE geomembrane. Above the cap a geotextile-protected cuspated membrane works in conjunction with surface water collection pipework to collect and discharge surface water. The cap also includes a 1m thick layer of processed colliery spoil, which has been graded to suitable falls. A system of channels and ditches has also been put in place on top of this cap to accommodate surface water. The restored topography of the site can be seen in Figure 1 along with the current monitoring infrastructure.

3 SITE INSPECTION & DATA REVIEW

3.1 Review of Previous Reports

A number of reports have been carried out since the construction of the landfill focusing on both the environmental impacts of the site and the stability of the Phase 1 waste mass and the inert bund. The relevant findings of those reports concerning the stability of the inert bund are considered below. It is important that these are reiterated in this review as they provide information on key elements that directly affect the stability of the bund and should be clearly understood for future reference and assessment.

3.1.1 Halcrow 1990

The earliest report on the stability of the inert bund was carried out by Halcrow (June 1990). A stability section was developed using the computer program 'SLIP5' to represent a critical cross section of the bund. Two water tables were used in the analysis, WT1 representing the maximum recorded water levels in the piezometers and WT2 representing the maximum recorded water levels plus an additional head of 3m.

Both water tables modelled were found to have an adequate factor of safety for significant circular slips, producing factors of safety of 1.90 and 1.43 for water tables WT1 and WT2 respectively. It was found however, that shallow circular slips may occur in localised areas of the bund for both water tables.

Halcrow concludes that stability should be adequate, provided action is taken to regrade the profile of the bund in order to reduce the risk of shallow slope failure. It is also stated that water levels in the bund should be managed to ensure they do not exceed the levels considered in the stability analysis.

3.1.2 David P Smith 1997

A stability analysis was carried out using a similar critical section to that previously analysed by Halcrow. This analysis was carried out using SLOPE Version 7.53. As with the Halcrow analysis a maximum observed water level was used. The analysis found that the factor of safety of the inert bund remains in excess of 1.4

3.1.3 ARUP 2003/2004

The stability analysis carried out in this report follows a similar critical section to that analysed previously, with two water tables being analysed. WT1 represents the maximum recorded water levels, while WT2 assumes a hydrostatic profile at ground level. Working on an Ultimate Limit State basis, WT1 is found to have an adequate factor of safety of 1.35, whilst WT2 has an unacceptable factor of safety of 0.72.

Interpolation between the two water tables finds WT1+4m to be an appropriate upper limit to maintain an adequate margin of stability. ARUP concludes that continued monitoring should be undertaken to ensure leachate levels do not rise above this.

3.1.4 ARUP 2006

The Arup report concludes that no further stability analysis is required beyond that conducted in the 2003/2004 report. This conclusion is based on the observation that water levels in the waste mass and inert bund remain below the levels modelled in the previous analysis. It was recommended that monitoring continues to ensure this situation does not change.

3.1.5 Encia 2009

No further stability analysis has been carried out on the grounds that monitoring data appears to show no negative changes in ground condition since the 2003/2004 analysis. It is regarded that the capping and restoration works carried out since this analysis will have had a positive effect on overall stability. It is also concluded that the decreasing amounts of movement seen in the monitoring pegs are a result of self-weight consolidation rather than instability.

3.1.6 Geotechnology 2012

A review of past reports and data up to the assessment period was undertaken in 2012, together with a site inspection. The report concluded that movement of the inert bund was indiscernible from survey noise and the data offered no cause for concern. Furthermore, the leachate levels recorded up to the assessment date all fell below the levels used for slope stability modelling by Halcrow; this also raises no cause for concern. The report recommended ongoing monitoring.

3.1.7 Geotechnology 2014

The review carried out in 2014 also noted that groundwater and leachate levels remained well below those used in stability modelling and were actively reducing through the assessment period. Thus, it was concluded that no further slope modelling was required. Small scale movement of the monitoring pins was noted though the movement was not consistent with instability within the bund. The loss of monitoring infrastructure was noted and recommendations were made to supplement the remaining infrastructure with replacement groundwater monitoring piezometers and also the provision of an inclinometer into the inert bund.

3.2 Geotechnology 2017

A review carried out in 2017 found that groundwater and leachate levels remain below those analysed in the Halcrow and Arup stability modelling. Accordingly, there was no evidence to suggest bund stability may have been adversely affected, and no need for further stability analysis at the time. The review identified a continuation of small-scale movement in the displacement monitoring data and inclinometers. Though this movement was not considered characteristic of slope failure, the report recommended that monitoring should continue. The report also recommends that new monitoring positions should be found for water levels in the waste mass, due to the loss of previously available positions.

3.3 Site Walkover November 2019

A geotechnical specialist visited the site on 13 November 2019 to carry-out a site inspection accompanied by a member of Amgen Rhondda staff. During the walkover survey the monitoring infrastructure was examined, the overall topography was viewed, and the ground surface inspected. The inspection was made in order to look at all features which could have an influence on stability.

The inert bund was found to be well covered in grass, with gorse bushes, bramble and numerous small trees on the lower sections. It should be noted that some clearance work has been undertaken since the last review to remove many of the larger shrubs and trees. This has improved access to the bund and associated infrastructure. As stated previously, the bund has been constructed following a stepped profile, with slopes and berms forming the front face. The rear face cannot be seen, as it underlies the restored waste mass.

All the berms forming the stepped front profile were walked over during the inspection. The top berm, where many of the displacement markers are located, continues to hold surface water in a series of ruts. A continuous flow of water was observed on the lower access tracks, particularly in the vicinity of NYG3 and GMBH8. This water appeared to originate partly from run-off from the bund and partly from surface water run-off from the south of the site. Similar features were seen in Geotechnology's previous inspections and subsequent efforts were made to re-grade the berms to allow the water to run-off. This work is likely to need repeating due to the rutting caused by vehicular access to the berm for monitoring infrastructure installation. Any work to improve the top berm should be undertaken in good weather conditions and under close supervision to ensure no disruption of the monitoring infrastructure.

As noted in previous reports, these wet areas are unlikely to indicate raised water levels within the bund but are instead perched water. However, it is recommended that these areas are monitored and regraded where possible.

Slope faces between the berms proved difficult to inspect as the surfaces were heavily vegetated with gorse and bramble. Where the ground was visible, there were no signs consistent with instability or slope movement.

The monitoring and reference points were examined on stable external ground. These were all found to be functional and fit for purpose and required no maintenance work.

Evidence of seepage or creep of the waste mass behind the front face was not seen and the surface water system was generally clean, open and functional as can be seen in a number of the photos in Appendix 4. Small areas of vegetation were seen in the base of some drains, but no evidence of blockage of flowing water could be seen. Some evidence of cracking was observed in the surface water drains on the front face of the restored waste mass. These cracks have been identified in previous inspections and appear to result from settlement of the waste mass. The cracks do not appear to have increased considerably in size between inspections. Despite the cracks, water is continuing to flow freely, suggesting these cracks have had a minimal impact on the efficacy of the culverts. There is no evidence of bulging or displacement of the drainage system. It is therefore unlikely that this localised cracking of the drains represents downhill movement of the waste.

As can be seen in the photographs, the primary drains carrying surface water away from the landfill are in good working condition. Removal of overhanging vegetation from the surrounding area has reduced the risk of the culverts becoming blocked.

The head detail of wells installed into the inert bund and leachate wells used for water level monitoring were inspected and considered to be functional. Gas infrastructure running along the ground surface was also seen to be intact with no visible evidence of deflection.

3.4 Groundwater Monitoring

Leachate and groundwater monitoring results have been supplied to Geotechnology by ARL for the period 2018 – 2019. These follow on from data recorded in previous periods, providing a total period of 13 years monitoring. This sub-section assesses the fluctuations in levels observed between 2018 – 2019 and compares them to previous readings.

3.4.1 Water levels in the Inert Bund

Groundwater level monitoring data has been supplied by ARL for 4 standpipe piezometers located in the Inert Bund, identified as GMBH 5, 6, 7, and 8. The locations of these installations can be seen on Figure 1. The data provided is summarised below in Table 3-1 and graphically in Figure 2. The raw monitoring data for the period 2018 - 2019 can be found in Appendix 1.

Table 3-1 Summary of Water Levels

Position	Max Level (2006-2017)	Min Level (2006-2017)	Range (2006-2017)	Max Level (2018-2019)	Min Level (2018-2019)	Range (2018-2019)	Comment
GMBH5	304.5	302.81	1.69	303.71	302.88	0.83	Within range
GMBH6	313.15	Dry	0.11	Dry	Dry		Dry
GMBH7	309.17	Dry	0.18	Dry	Dry		Dry
GMBH8	308.30*	306.64	1.66	308.75	307.75	1.00	Anomaly

* This excludes an anomalous datapoint of 308.67m seen on 12/11/2008

The water level summary shows that throughout the period 2018 – 2019, most of the boreholes have showed a decrease in maximum water levels from historic maxima, with no water observed in either GMBH6 or GMBH7. There was, however, a small increase of 5cm in the maximum water level observed in GMB8, this follows an increase of 3cm recorded during the last reporting period.

A plot of water elevation against time is presented in Figure 2. During the 2006 – 2017 period, water was only observed in GMBH6 and GMBH7 on four occasions. Water was last observed in GMBH6 on 12 November 2008 and in GMBH7 on 18 May 2012, with both remaining dry for the entirety of the 2018 – 2019 period.

During the 2006 – 2009 period, water levels in GMBH5 showed considerable fluctuation with 3 observations of levels in excess of 304mAOD. Following a hiatus in monitoring of the borehole through 2010 and 2011, levels have become more consistent with no observations exceeding 304mAOD. The steady trend has continued throughout the 2018 – 2019 period with occasional lows dipping below 303mAOD.

GMBH8 has proven to have consistent monitoring data, with a consistent water level from installation through to the assessment period. The maximum water level prior to this assessment period was 308.30m AOD after a single anomalous measurement of 308.67 was removed. However, in May 2019 a single measurement of 308.75mAOD was noted,

returning to normal on the following measurement. The levels have remained in line with historic levels since. The single point high may be an erroneous reading as there is no obvious explanation and the corresponding data from GMBH5 and the vibrating wire piezometers shows no such trend. It is recommended that ARL inspects the headworks to ensure no surface water can infiltrate the installation.

The water levels in GMBH8 all fall below those on the original Halcrow stability model WT1, with the exception of the anomalous reading. The anomalous reading though exceeding water levels on WT1 falls below the water levels of the WT2 analysis. This suggests that the factor of safety if water levels were taken at the anomalous level remains between 1.90 and 1.43 and is therefore not of immediate concern. Levels should be monitored on an ongoing basis, with additional inspections carried out should levels continue to rise.

3.4.2 Leachate Levels in the Waste Mass

Leachate level monitoring data was originally supplied by ARL for 3 installations in the Phase 1 waste mass identified as LMP 6, 7, and 8. The locations of these installations can be seen on Figure 1. Unfortunately, all three monitoring locations have been blocked since May 2013. It is suspected that this is not due to material accumulation within the piezometer but most likely due to mis-alignment or "a kink" within the 19mm piezometer tubing caused by settlement of the surrounding wastes.

Leachate level data from these points will no longer be available for scrutiny. As an alternative during the 2015-2017 monitoring period, Amgen forwarded data from leachate inspection sumps located at L5a and at LS1. Unfortunately, monitoring of these positions has not continued through the 2018-2019 period and as a consequence there is no data available for leachate levels in the waste mass during this time. Access issues have reportedly prevented the monitoring of these positions, it is strongly recommended that these positions or reasonable alternatives are monitored in the coming period. The location of all sumps and gas wells is shown on Figure 1. The data from previous monitoring is summarised in Table 3-2.

Table 3-2 Summary of Leachate Levels in Chambers

Chamber	Datum Elevation mAOD	Chamber Depth (m)	Max Level (2007-2017)	Min Level (2007-2017)	Max Level (2018-2019)	Min Level (2018-2019)
LPS1	336.581	6.4	331.081	330.551	No Data	No Data
L5a	329.500	19.8	<329.5	<329.5	No Data	No Data

A plot of leachate elevation against time for the former and current leachate monitoring positions is presented in Figure 3.

L5a – As stated in previous reports, this chamber has been inspected routinely and dipped for leachate level. On every monitoring occasion from 2007-2014 the chamber was recorded as being dry. However, it has been noted by Amgen staff that a small basal flow can be seen at the bottom of the chamber. This continued to be the case in the period 2015 – 2017 which indicates the continued free flow of leachate in this area. No new data is available.

LS1 – This chamber was dipped for leachate level from January 2011 to October 2017. Leachate has been recorded and measured as head above the base of the chamber. The data shows that steady rise of approximately 0.3m occurred from January 2011 to October 2014, excluding seasonal dips. In the 2015 – 2017 monitoring period, levels showed a more

variable readings ranging between 330.871 & 331.081mAOD, with no evidence of an increasing or decreasing trend. No data has been recorded for the 2018-2019 period.

As no new data has been provided for the level of leachate within the waste mass, it is impossible to comment on how the current condition of the landfill compares to the state analysed in previous stability reports. It is therefore of critical importance that existing monitoring points are brought back into use during the next monitoring period or replaced by reasonable alternatives.

3.5 Displacement Monitoring

In order to monitor movement and settlement, 12 movement markers were installed in March 2003. The positions of these markers were established by a precision survey instrument and are monitored on a routine basis to establish changes in easting, northing and elevation. The original data from 2003 to 2014 was provided to Geotechnology for analysis in the previous stability reviews. Prior to the last review an additional 8 markers were installed, 7 on the inert bund and 1 on the waste mass.

Further information has now been provided for the 2018 – 2019 period. The original data set has therefore been expanded to accommodate this new information. Analysis of this new information has been made and is discussed below.

The location of these markers can be seen in Figure 1. SM1 – 6 & SM13 - 19 are located on the inert bund while SM7 – SM12 & SM20 are located on the restored waste mass.

3.5.1 Graphical Monitoring Data Display

The data has been split into horizontal east/west movement, horizontal north/south movement and vertical movement. Movement has been defined as the monitored position relative to the very first position, reported when the infrastructure was installed.

Examination of Figures 4 to 23 shows the relative plan movement of the monitoring pins in both the east/west direction (horizontal axis) and the north/south direction (vertical axis). Each diagram is, in effect, a plan of pin movement since the pin was first placed in 2003 (point No. 1).

In order to understand a time history the pin positions are numbered, with the largest number being the most recent measurement. As the original pins have a large number of readings some of the plots are too crowded to clearly make out the numbering, the most recent reading has therefore been marked in red to show the current pin position.

So that the vertical movement of the pin can also be examined, a graph below each plan has been produced. This is a simple time versus displacement graph and shows the amount of vertical displacement since monitoring began. If the line falls below the datum, this indicates settlement and if the line rises above the datum, then heave is indicated.

3.5.2 Inert Bund Monitoring Data

SM1 – Each reading is found to be within 21mm of the start position. The most recent reading lies within the spread of the previous data. All data points are scattered around the origin with no clear trend of progressive movement in one direction. SM1 has seen a total level change of -44mm, while the most recent reading is -41mm.

SM2 – Each reading is found to be within 22mm of the start position. The most recent points potentially indicate a slight movement towards the east; however the data is scattered with no clear trend of progressive movement in one direction. The total level change over the monitoring period is -20mm, though more recent readings appear to show change has levelled out.

SM3 – Each reading is found to be within 29mm of the start position. Whilst there is no clear trend to this movement, it is noted that the latest datapoints appear to cluster to the southeast of the start position, the most recent reading sits within this cluster. This position has seen a total level change of -55mm.

SM4 – Each reading is found to be within 33mm of the start position. There is no clear trend to the movement, although the majority of data points are located to the east of the original position, the most recent reading is closer to the origin than many others. The total change in elevation at this point is -68mm.

SM5 – This monitoring point shows displacement of up to 54mm toward the northeast. Successive datapoints do not align along a clear trend line (which would indicate consistent movement in a particular direction) but it is noted that more recent data generally lies furthest to the east. A careful analysis of the data reveals that when successive points are clustered (i.e. 1-10, 10-20, 20-30, >30) the clusters follow a consistent east-northeasterly trend. This suggests that amongst the 'noise' of data, there is an underlying trend since the commencement of monitoring of very slow movement directly away from the landfill. Movement cannot be said to be accelerating or moving rapidly and the continuous progression of this indicates that this is not a slope failure mechanism. The elevation decrease of this point follows a similar trend to the others with a total change of -52mm and settlement reducing in more recent data.

SM6 – This point shows a displacement pattern that is very similar to SM5. A maximum displacement of 54mm has been recorded, although this was not among the more recent data points, with the most recent reading only 25mm from the origin. When analysed in the same way as SM5 a similar trend in the successive point clusters can be seen, even though the trend is less pronounced than SM5. The total change in elevation of this point is -39mm, showing the same stepped pattern as the other points.

SM7-SM12 – These monitoring points are situated on the waste mass rather than the inert bund and accordingly are considered in the next section.

SM13 – Each reading is found to be within 29mm of the start position. While the majority of datapoints are located to the east of the origin the sequence of data points shows no clear progression in that direction. The most recent reading plots just to the northwest of the origin. A total level change of 8mm has been observed at this position.

SM14 – Each reading is found to be within 20mm of the start position. The data points show no clear trend and are scattered loosely around the origin. A total elevation change of -13mm has been observed at this position.

SM15 – Each reading is found to be within 16mm of the start position. There is no trend to the data, with all data points scattered to the north and west of the origin. A total elevation change of +9mm has been observed at this position, although the most recent observation is only +4mm from the base reading.

SM16 – Each reading is found to be within 16mm of the start position. There is no trend to the data, with all data points scattered to the north of the origin. A total elevation change of +9mm has been observed at this position, although the most recent observation is only +5mm from the base reading.

SM17 – Each reading is found to be within 20mm of the start position. There is no trend to the data, with all data points scattered to the north of the origin. A total elevation change of -1mm has been observed at this position.

SM18 – Each reading is found to be within 20mm of the start position. A total elevation change of -10mm has been observed at this position. There is no clear trend to the data, though most data points are scattered to the west of the origin.

SM19 – Each reading is found to be within 38mm of the start position. All of the date points are located to the northwest of the origin, there is no clear order of progression to the data, though the most recent reading is the furthest from the origin. A total elevation change of -7mm has been observed at this position.

SM20 – This monitoring point is situated on the waste mass rather than the inert bund and accordingly is considered in the next section.

The collective data for the inert bund monitoring pins has not identified any large or sudden displacements which might indicate instability. As the dataset becomes larger and trends can be better analysed, a picture is emerging of the bund settling very slowly over time, with greatest settlement where the bund is deepest. This is accompanied by a limited amount of displacement, which typically indicates movement toward east-northeast. The monitoring data appears to be revealing small scale movements associated with long term consolidation or creep of the bund.

Heave has been identified in a number of survey points over the course of 3 visits, the pattern seen in the graph for each of these points is very similar and may be an indication of survey error rather than actual heave.

3.5.3 Waste Mass Monitoring Data

The displacements seen in the historic dataset for SM7-SM12 are of greater magnitude than those seen in SM1-SM6 and this continues to be the case in this period. There is also more clear evidence of individual trends in the magnitude and direction of displacement of these monitoring positions. In each case, the sequence of data points does not show a continuous movement in one direction due to survey 'noise', but when analysed as clusters of successive datapoints, trends emerge.

SM7 – This monitoring position continues to show a trend towards east-northeast. The maximum horizontal displacement of this monitoring pin is 80mm. The most recent data points appear to show a more northern movement than the previous cluster. The vertical displacement is recorded as being -269mm, a -11mm increase since 2017, indicating a slowing trend to the settlement.

SM8 – This position follows a similar east-northeast trend to SM7 with a maximum displacement of 60mm. As can be seen in Figure 11, vertical displacement at this location is now -236mm, with a slower rate than the previous period.

SM9 – The trend in the movement at this position is less clear. The maximum displacement of this marker from its original position has not exceeded 38mm. The data points are generally clustered to the southeast of the origin, with the most recent points clustered closer to the origin than the previous set. This may indicate a change in direction of movement over time. Vertical displacement at this point is now -407mm, an increase of -10mm since 2017.

SM10 – Each reading at this position has been within 51mm of the origin. All points are located to the southwest of the origin with the most recent readings showing the greatest distance. The vertical displacement at this location is now -261mm, an increase of -5mm since 2017.

SM11 – The monitoring point shows displacements up to 35mm. There is no clear trend to this movement with the majority of survey points clustered between the southeast and southwest. The more recent readings are clustered closer to the origin than the majority of points. Vertical displacement at this position has reached -261mm, an increase of -3mm since 2017.

SM12 – The horizontal displacement of this position appears to continue following an easterly trend with a maximum displacement of 72mm. Almost all of the data points are located to the east of the origin, with the most recent readings among the furthest away. The vertical displacement at this location is now -278mm which is an increase of -9mm since 2017.

SM20 – Each reading is found to be within 24mm of the start position. The majority of the data points are located to the northwest of the origin, however there is no clear order of progression. A total elevation change of -19mm has been observed at this position.

The monitoring pins above the restored waste mass have continued to show a greater magnitude of vertical displacement than those in the bund. All of the vertical displacement graphs have shown an initial period of rapid vertical displacement which has then slowed over time. This slowdown is continued in the period 2018-2019 and a greater flattening of the curve is observed. Large magnitude settlement of the waste mass and the decreasing settlement trends seen over the last 2 years is entirely in-line with expectation.

3.6 Pressure Transducer Monitoring

In accordance with the recommendations made in the 2014 stability review a borehole was extended through the bund and into the bedrock below to facilitate the installation of two pressure transducers (piezometers) for the monitoring of piezometric pressure in the base of the bund and shallow bedrock. This work was undertaken in February 2016 with monitoring starting immediately following installation. In order to monitor the piezometer readings, a data logger was attached to each piezometer, capable of taking readings at a set interval and storing them for later download. The data loggers were set at a reading frequency of 6 hours and are downloaded during monitoring visits by Geotechnology.

The data acquired by both piezometers is presented in Figure 24, while the installation details are included in Appendix 3. The piezometer data shown in red on the figure is from the piezometer located at the base of the inert bund, while the piezometer data shown in blue is from the piezometer installed approximately 1.5m into the bedrock.

The vibrating wire data is gathered as a frequency and is then converted to pressure. For this project, pressure units of metres head of water have been selected so that the data is more easily understood in terms of the fluctuation of groundwater levels.

Both vibrating wire piezometers indicate that groundwater levels fluctuate rapidly but that fluctuations are of small magnitude. Large differences in level between summer and winter are not seen with the fluctuations characteristically occurring over several days. This suggests that groundwater levels are being influenced locally by weather events. However, the principle finding from the piezometer monitoring is that groundwater levels remain within a very narrow band throughout the year.

It should be noted that neither the deep nor shallow vibrating wire piezometer indicated a significant change in groundwater levels during May 2019 when the historic high was measured in GMBH8.

A significant reduction in water level is identified during the summer months of 2018 and winter levels remain at or below levels observed during previous monitoring periods.

Unfortunately, due to a battery failure during the 2018/2019 winter period, no data is available for the remainder of 2019. These batteries have been replaced and monitoring has resumed.

The readings obtained from both piezometers suggest minimal water pressures at the base of the inert bund.

3.7 Inclinometer Monitoring

Following the recommendations of the previous stability report, a single string of inclinometer casing was installed in the inert bund between survey monitoring positions SM5 & SM6. This work was carried out in February 2016 at the same time as the piezometer installations. The inclinometer extends to a depth of 13mbgl, with the bottom 2m secured in the bedrock. Following an initial base reading taken in March 2016, monitoring has been undertaken by Geotechnology using a digital vertical inclinometer system. Using the base of the inclinometer casing as a fixed point, this system provides readings of deflection at 0.5m intervals.

The deflection readings can be converted by means of specialist software to provide graphical representations of inclinometer deflection. Two figures have been produced from this data. The first, Figure 25 shows the absolute profile of the inclinometer against time. The figure comprises two graphs, the first shows the A axis where a positive reading represents the downhill direction (approximately NE) whilst a negative reading represents the uphill direction (approximately SW). The second graph shows the B axis where a positive B value is 90° clockwise to a positive A reading (approximately SE) and a negative B value 90° anti-clockwise to a positive A reading (approximately NW).

Figure 25 shows that there is approximately 150mm of deflection between the bottom of the inclinometer casing and the top in both the negative A and positive B directions. This suggests a backwards lean to the inclinometer casing facing in a southerly direction. However, there is no clear sign of any change in this profile between the varying readings.

In order to look at smaller scale changes which may be taking place, a plot of profile change is presented in Figure 26. This plot obeys the same rules with regards to the direction of A

and B, however the initial inclinometer reading is treated as a completely vertical 0 point with subsequent readings showing change from the original. As can be seen from the figure this allows for a much smaller scale on the X axis of the graph and therefore quantifies very small magnitude movements.
As can be seen in Figure 26 there is a general positive direction of movement on the A axis, with prominent negative change in the profile of the inclinometer casing at 3m below datum level and at 8-8.5m below datum level. It should also be noted that the changes are not consistently in sequence and the most recent set of readings show less movement in the positive direction than the previous reading. This is likely due to survey "noise" overriding the very small amounts of movement being measured by the instrument. As can be seen on Figure 26, the maximum displacement is approximately 4.5mm on the A axis and 2.5mm on the B axis.

Despite the total displacements remaining small, the general trend of data does suggest some movement in a downhill direction.

3.8 Current Stability

The level of water in the inert bund and the level of leachate within the waste mass is considered to be the most significant influence affecting overall stability, as discussed in previous Geotechnology stability reviews. The water level data gathered during this 2-year monitoring period reveals that levels have, with one exception, remained below historic highs and also below the levels determined by previous modelling to adversely affect bund stability. It is considered safe to conclude that the results of those previous analyses are still valid and that no further modelling is required at this time.

The leachate levels exhibited in LS1 were identified as increasing steadily over the 2011-2014 monitoring period, remaining steady through the 2015-2017 period. However, as no monitoring data is available for the 2018-2019 period, it is not possible to comment on the current status.

The pressure transducer monitoring of the base of the bund has not revealed any increases in pressure which are likely to impact the stability of the bund. The fluctuations in pressure experienced by the piezometers result from small changes in groundwater levels at the base of the bund which appear to be seasonal.

The displacement monitoring dataset has not revealed any sudden increases in movement. Ongoing small displacements of the type and magnitude seen since the commencement of monitoring are continuing. A clear distinction between the displacement of the bund monitors and those on the waste mass can be made and the different behaviour can be expected from the different material types. The dataset does not provide any evidence of instability.

The inclinometer monitoring continues to indicate some small-scale deflections. Although these movements are currently much smaller than those observed in the survey monitoring markers, they should not be discounted as insignificant and monitoring should continue.

4 CONCLUSIONS & RECOMMENDATIONS

4.1 Conclusions

This report has been produced to examine the displacement and groundwater data gathered between 2018 and 2019 as it influences the stability of the front bund and the waste mass behind. It builds upon the understanding of the site developed in previous monitoring and stability reports and provides an update to Geotechnology's previous reports written in 2012, 2015, and 2017.

All available information, including site monitoring data and previous reports on stability have been assessed. The findings of the recent site walkover survey completed on 13 November 2019 have also been taken into consideration.

The stability risk assessments carried out by Halcrow, Arup and others quantified the levels of leachate and groundwater that would be considered to be a threat to stability. During this monitoring period, groundwater elevations remained below the level found to be detrimental to stability. Accordingly, there is no evidence to suggest that bund stability may have been adversely affected by groundwater levels during the monitoring period.

In the case of the waste mass, although no data is available for this period, leachate levels would have to rise significantly higher than those observed during the 2015-2017 period to approach the levels modelled in the Arup (2004) stability analysis. While it is unlikely this is the case it is imperative that leachate level monitoring is resumed as soon as possible.

Displacement monitoring data has shown that slow ongoing movements of a small magnitude and type seen since the earliest monitoring data are continuing. Displacements are greatest within the waste mass as would be expected due to settlement and outward displacement. Very small magnitude movements of the bund continue but these do not have the characteristics of slope failure.

Inclinometer monitoring of the bund has provided readings which indicate small scale deflection of the inclinometer casing. Monitoring of this should continue in the coming monitoring period.

4.2 Recommendations

All the leachate monitoring infrastructure which has been available for previous stability reviews has been lost and there is now no data available on the leachate levels within the waste mass. This is of particular concern as leachate and groundwater levels are of critical importance in the analysis of stability. Geotechnology, therefore, recommends that new positions should be selected for ongoing leachate monitoring. Where possible, the new monitoring positions should utilise existing infrastructure.

The displacement pins provide good coverage of the inert bund and should be monitored on an ongoing basis.

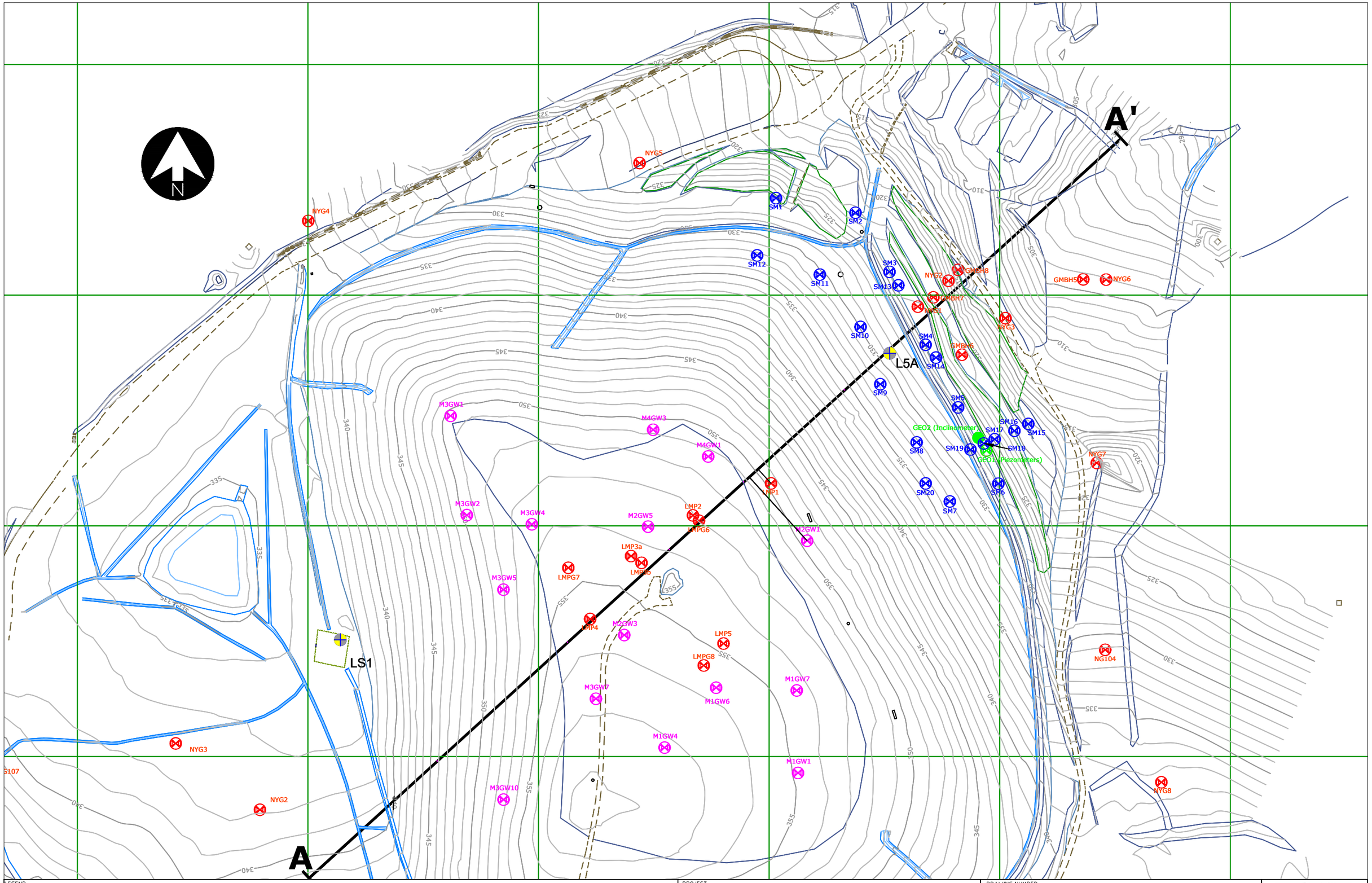
As the monitoring of the inclinometer system in the centre of the bund has revealed small magnitude deflection of the inclinometer casing, Geotechnology recommends that monitoring

of the inclinometer should continue during the next monitoring period. Multiple readings should be taken during each visit to determine the magnitude of instrument error.

Vibrating wire piezometer logging should continue with data downloads carried out during every monitoring visit by Geotechnology. Batteries should be changed at greater regularity to ensure no loss of monitoring data during the coming monitoring period.

Work should also be undertaken to remediate the rutting which has occurred on the top berm of the bund. Where possible, the surface should be graded to shed surface water away from the landfill. This work should be carried out under close supervision of the engineer to ensure no disturbance of the monitoring infrastructure.

Inspection work should be carried out on GMBH8 to determine whether surface water ingress is a possible cause of the anomalous readings seen in May 2019 and the previous monitoring period. If any defects are identified, repairs should be undertaken.



LEGEND

- M1GW7 — Gas Well
- LMP5 — Leachate Well
- GMBH5 — Gas Monitoring Borehole
- Survey Monitoring Marker
- SM9 — Vibrating Wire Piezometer
- Inclinometer
- 350 — Prominent Contour (5m)
- Normal Contour (1m)

PROJECT: Nantygwyddon - 2019 Inert Bund Stability Assessment		DRAWING NUMBER: 1983/1	
		SCALE AT A3: 1:1500	DATE: 03.20 / DRAWN: KJT
TITLE: Detailed Site Plan		NOTE:	

Geo TECHNOLOGY

Figure 2 Graph of Water Levels in the Inert Bund

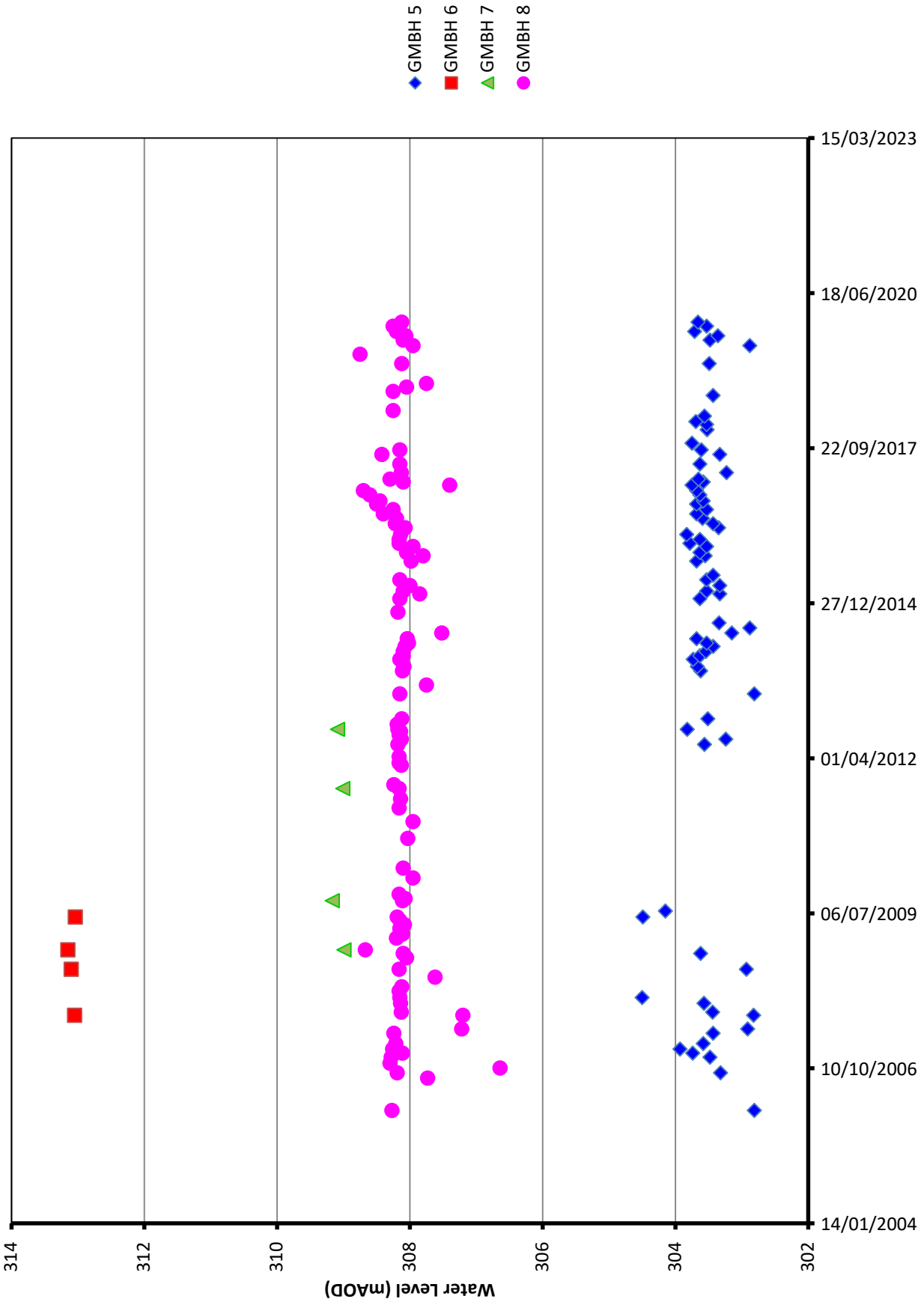


Figure 3 Graph of Leachate Levels in the Waste Mass

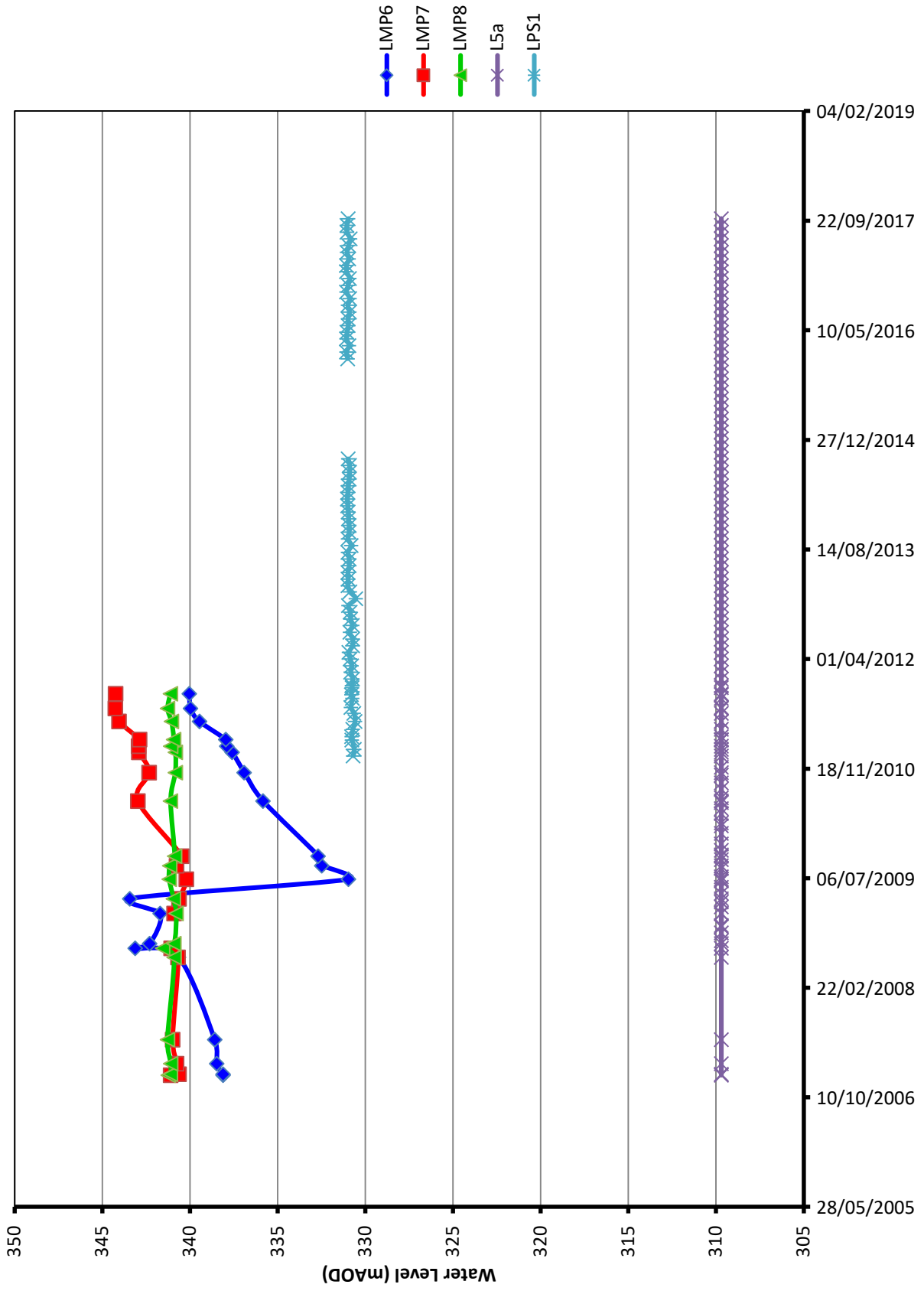
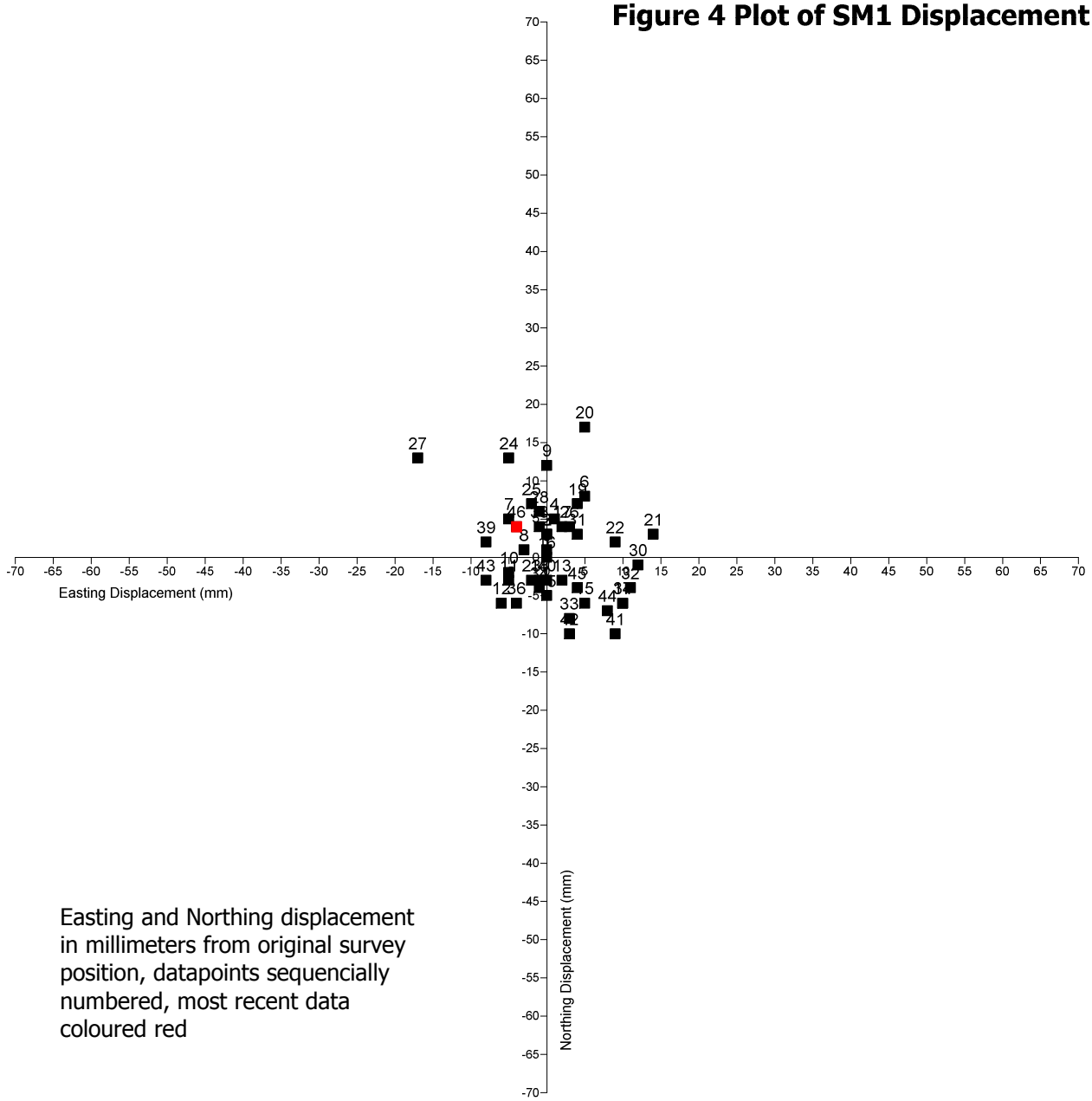
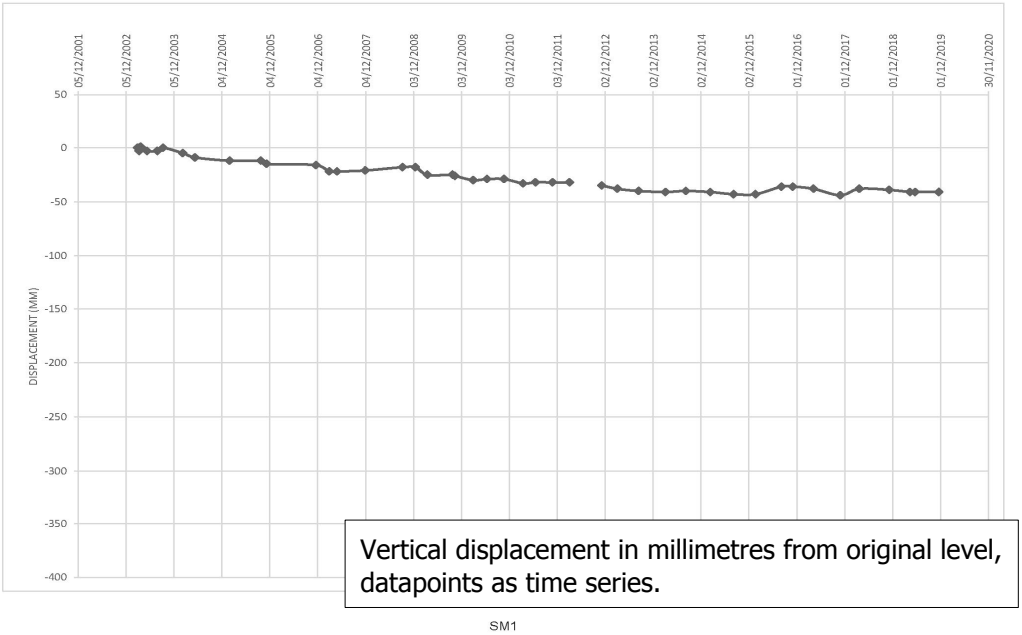


Figure 4 Plot of SM1 Displacement

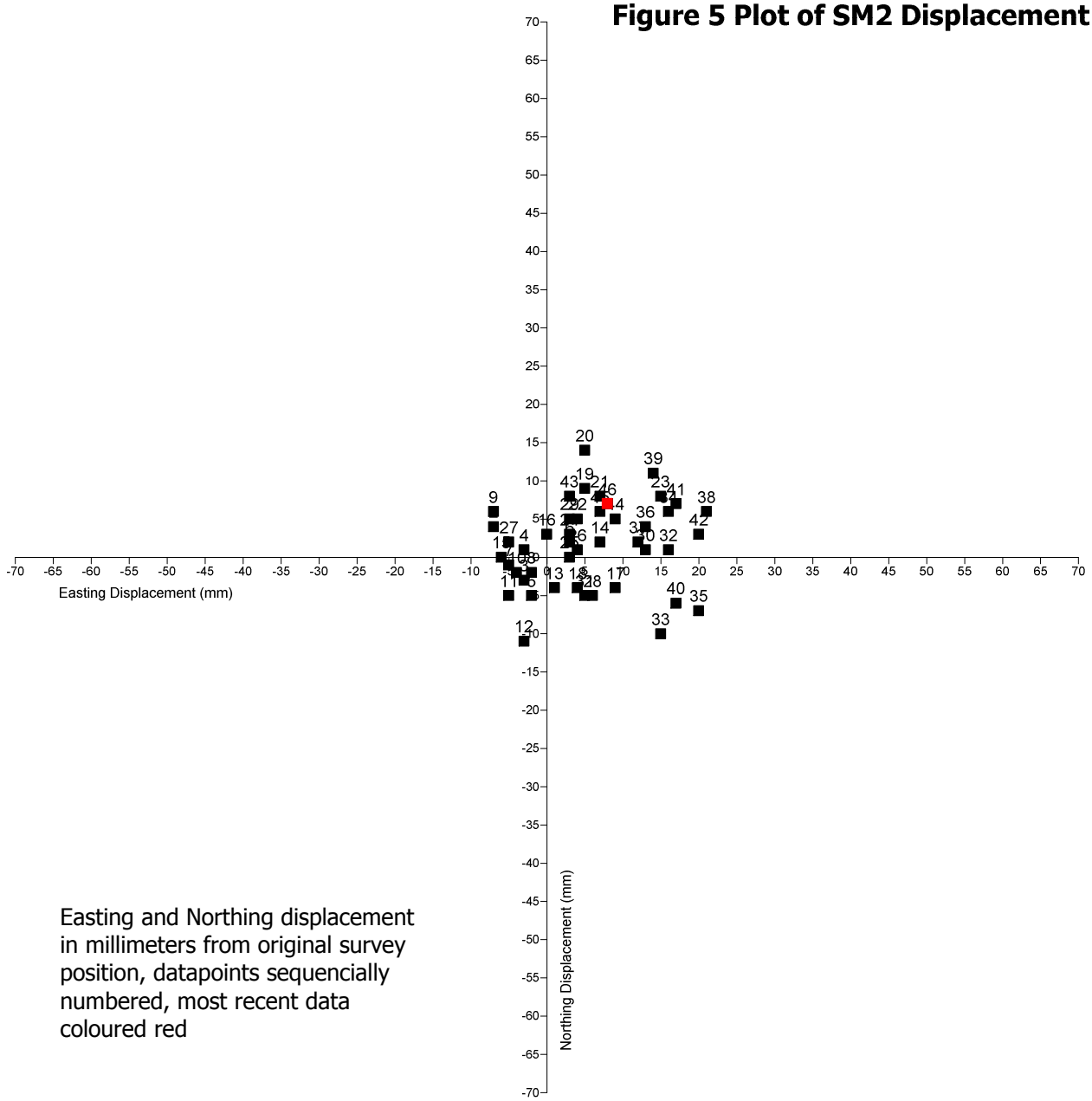


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

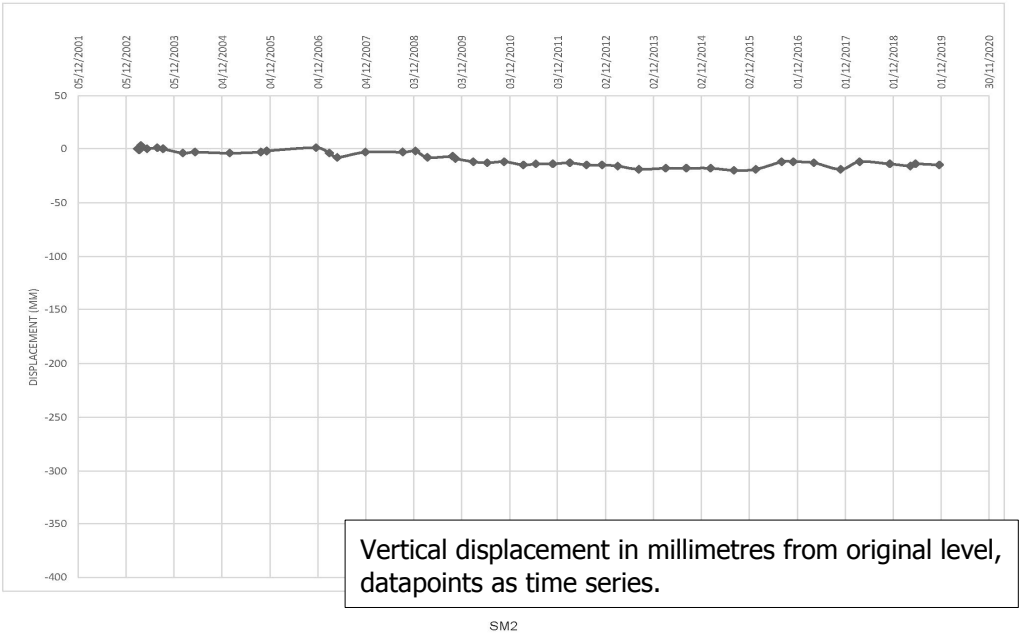


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 5 Plot of SM2 Displacement

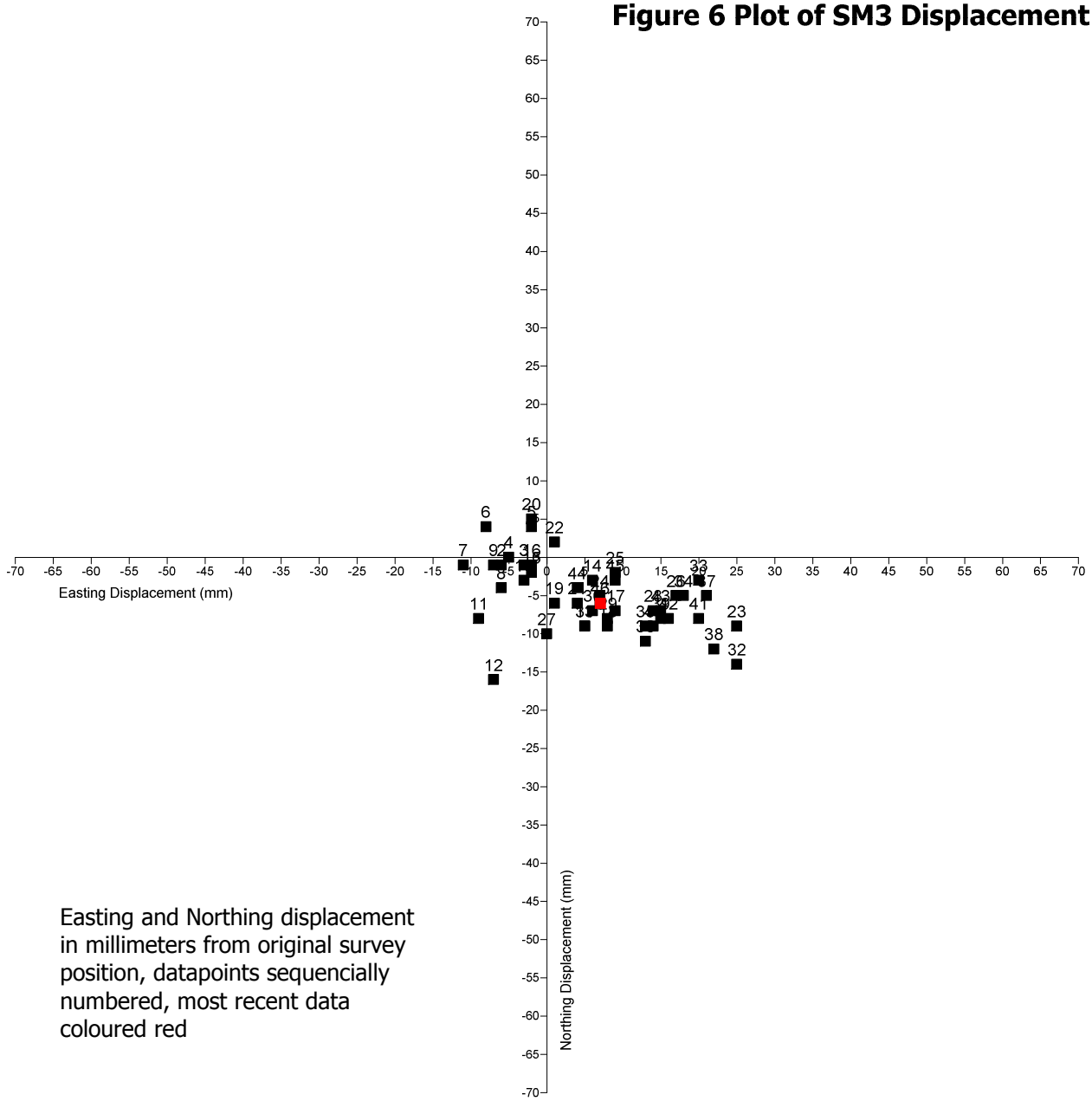


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

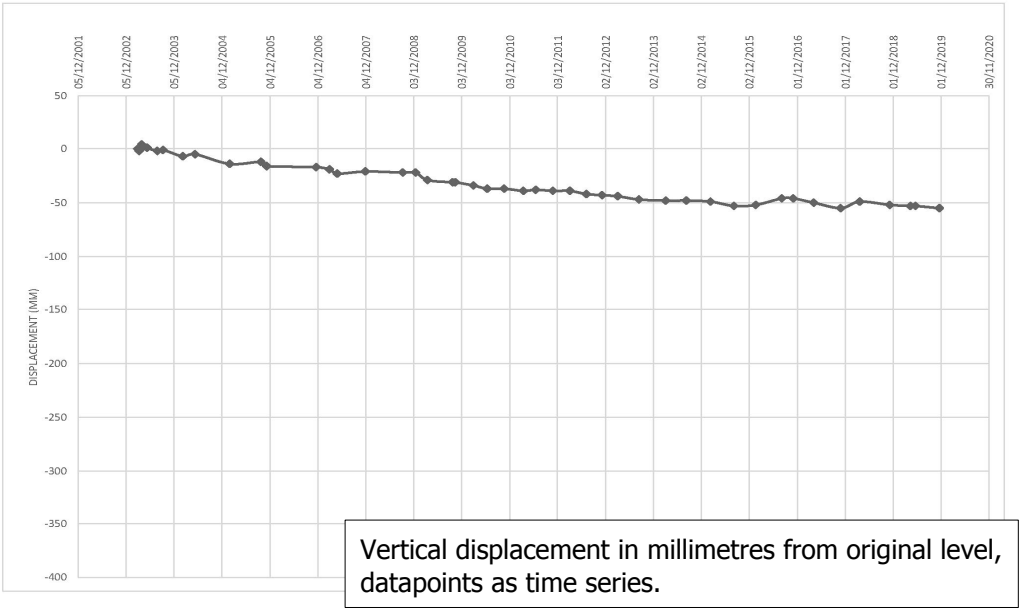


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 6 Plot of SM3 Displacement

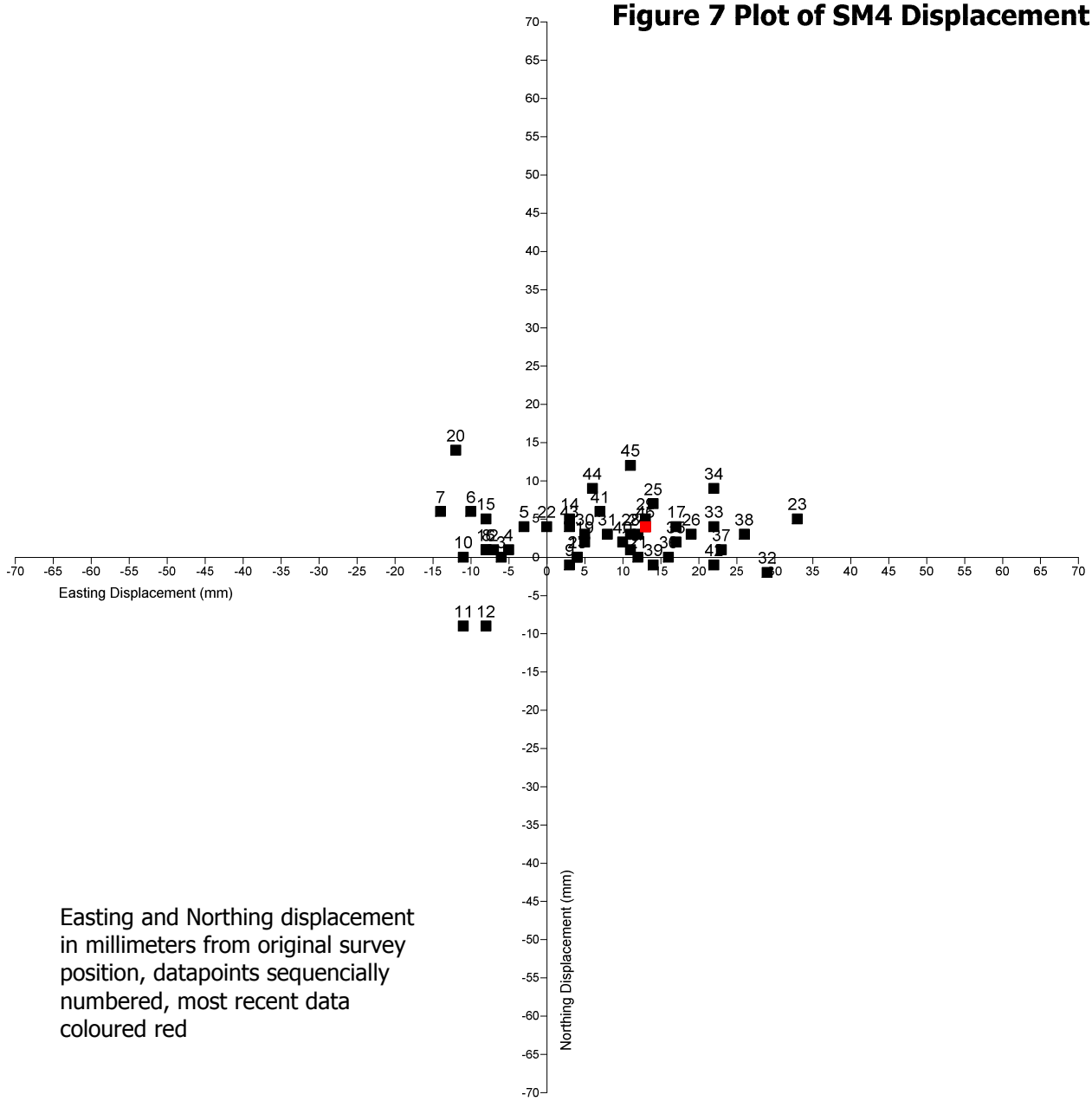


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

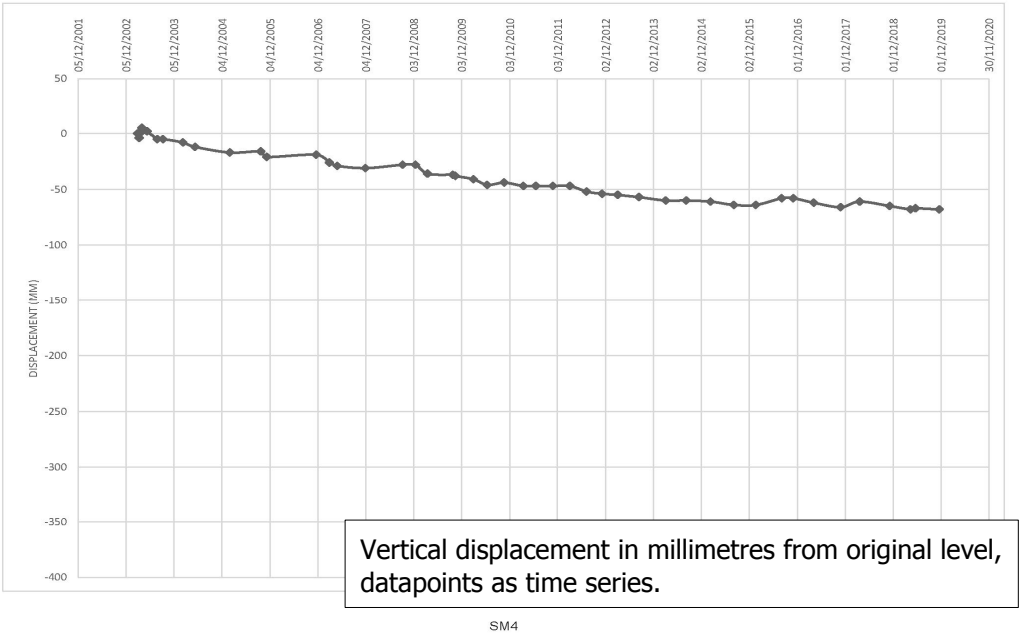


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 7 Plot of SM4 Displacement

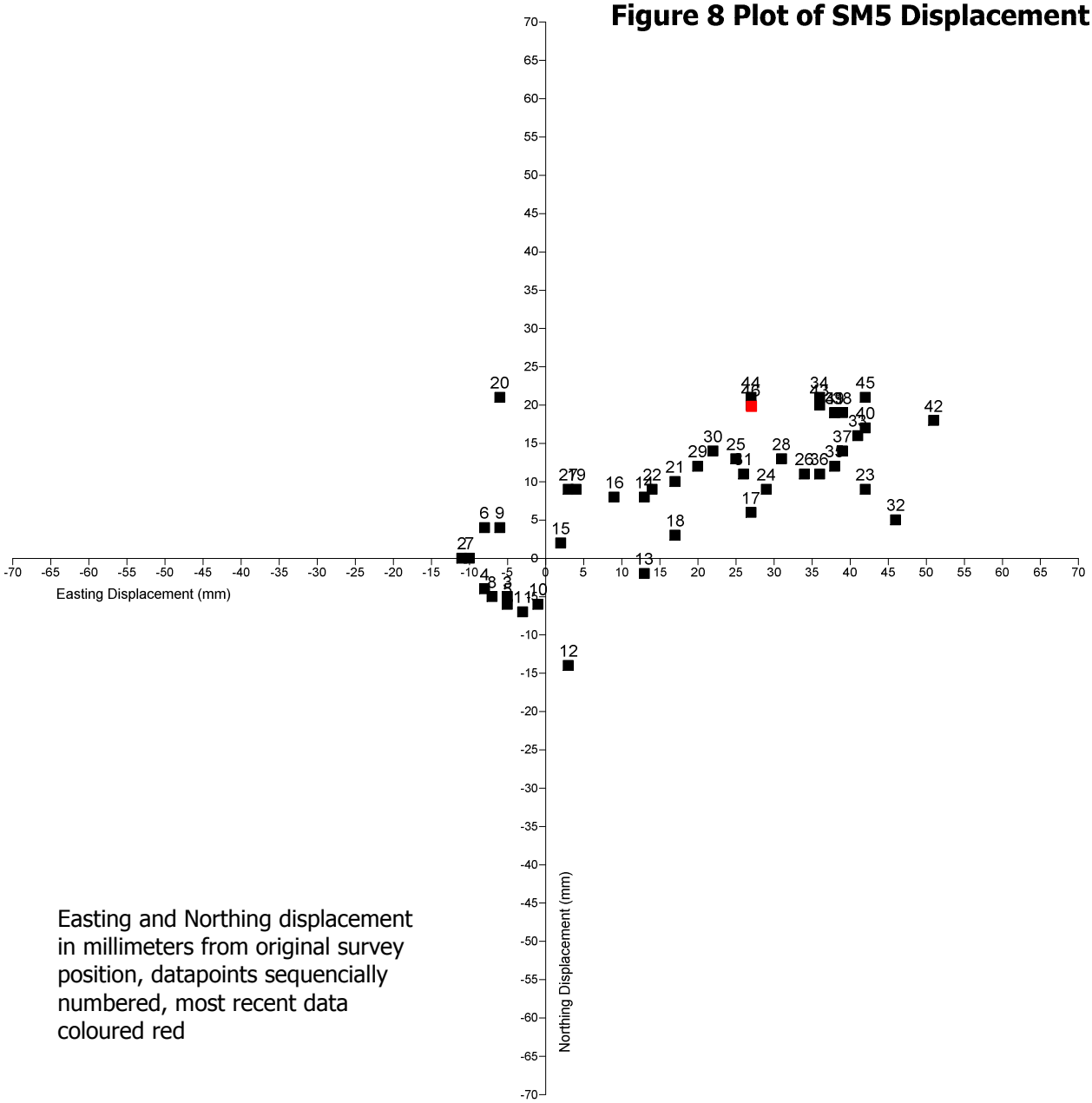


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

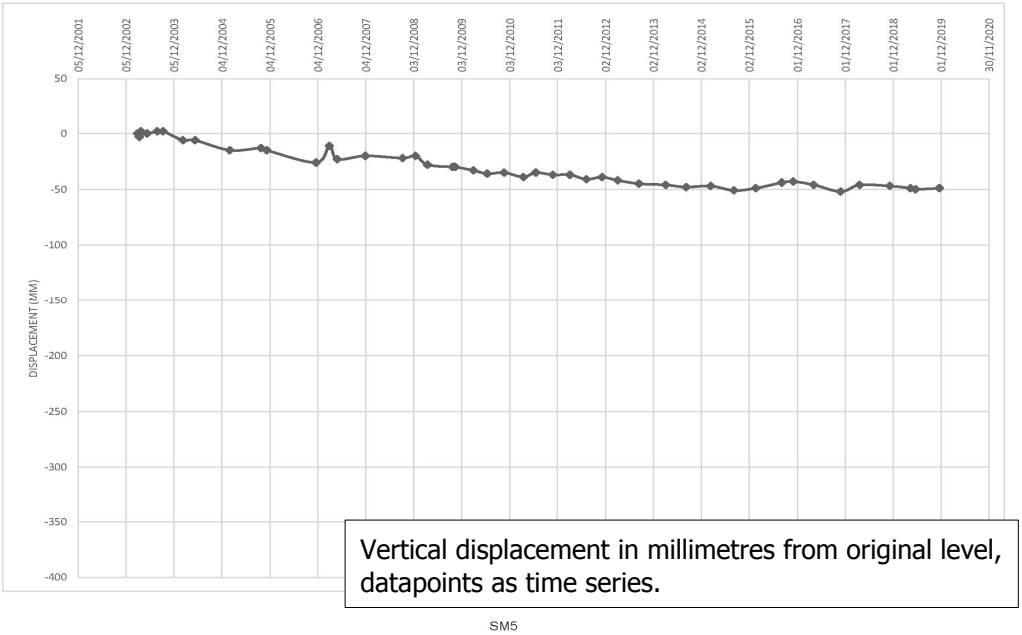


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 8 Plot of SM5 Displacement

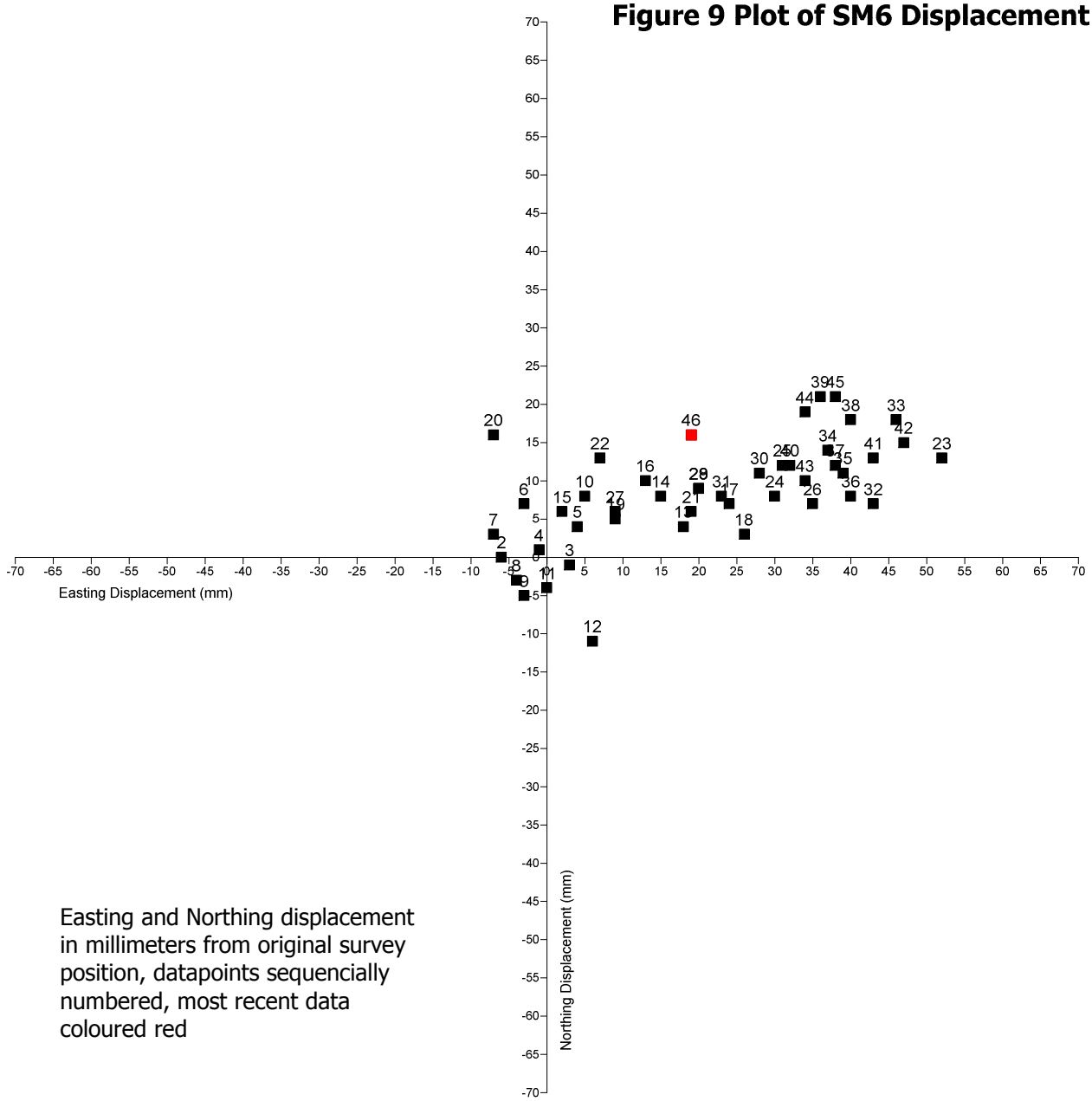


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

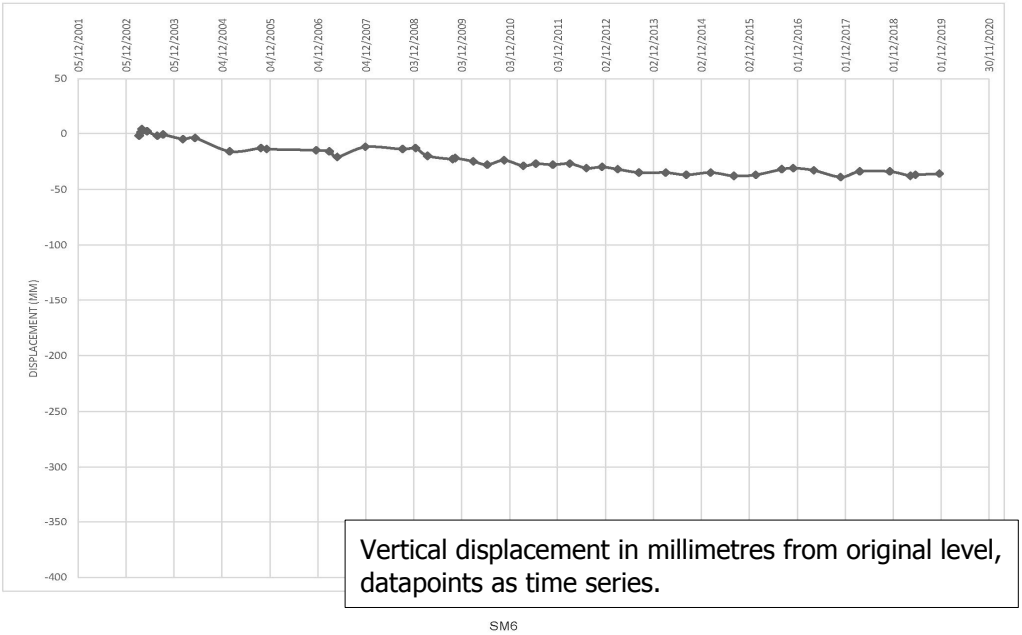


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 9 Plot of SM6 Displacement

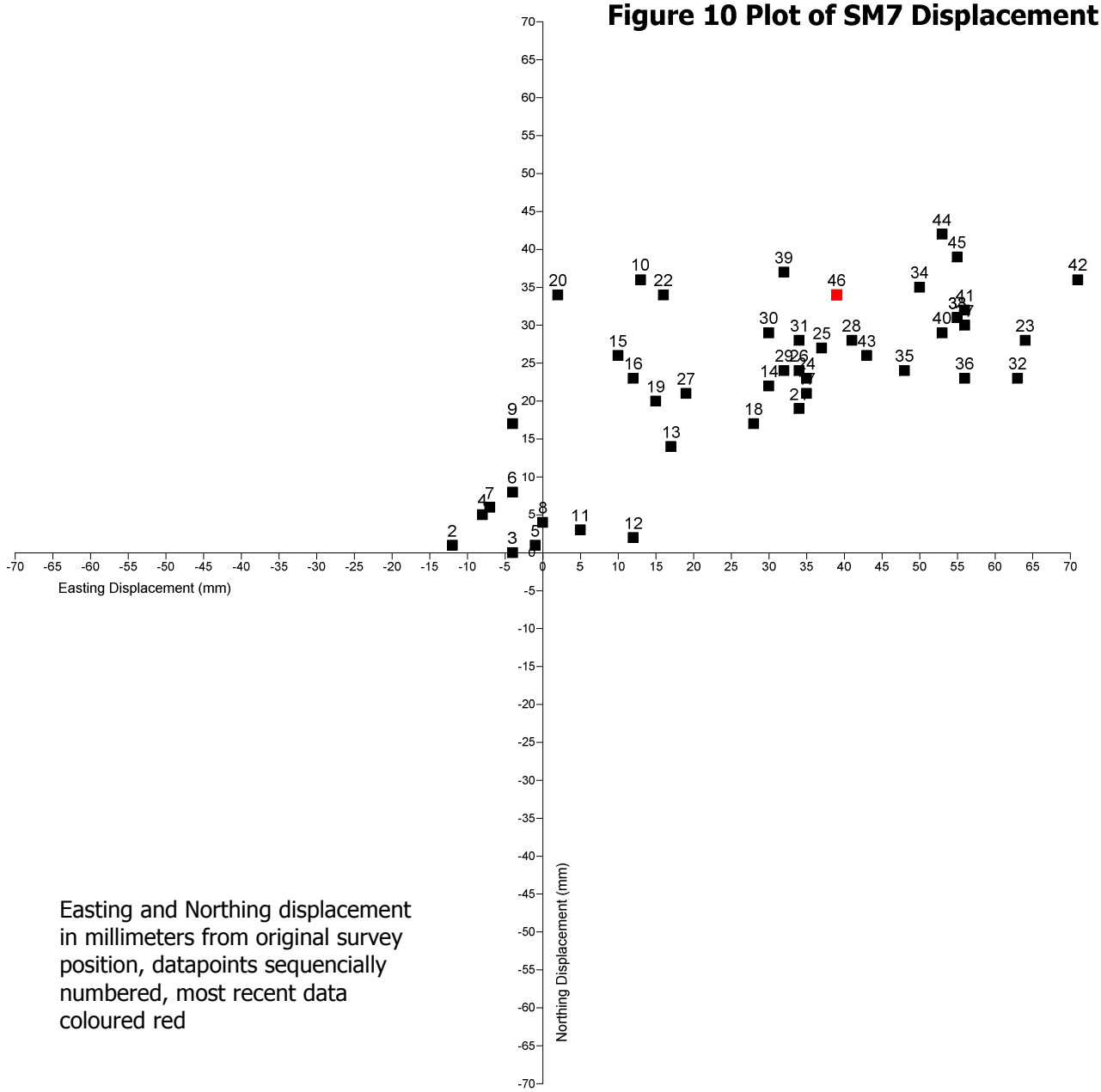


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

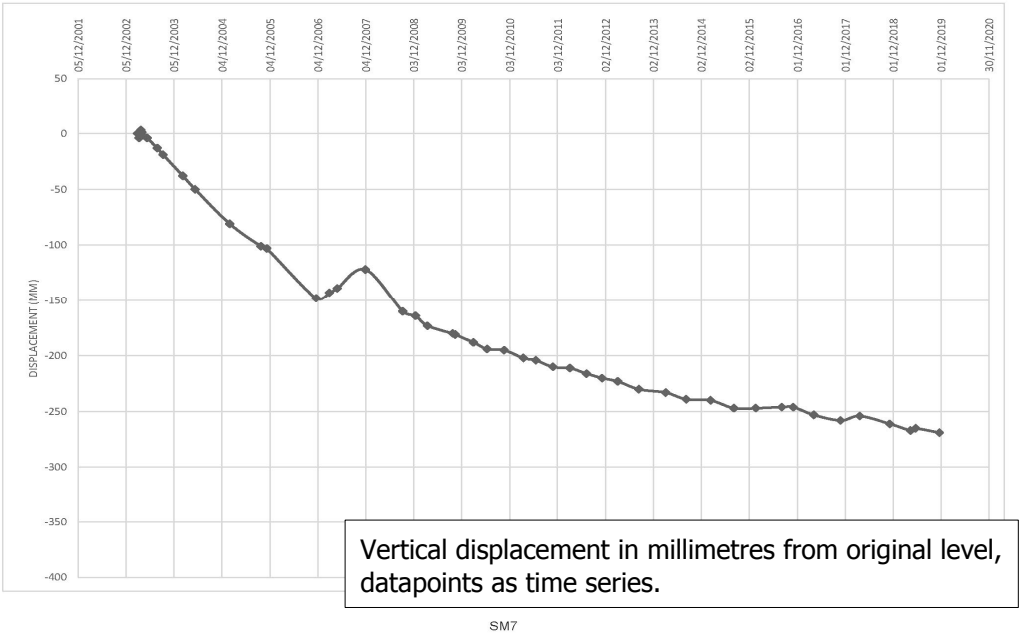


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 10 Plot of SM7 Displacement

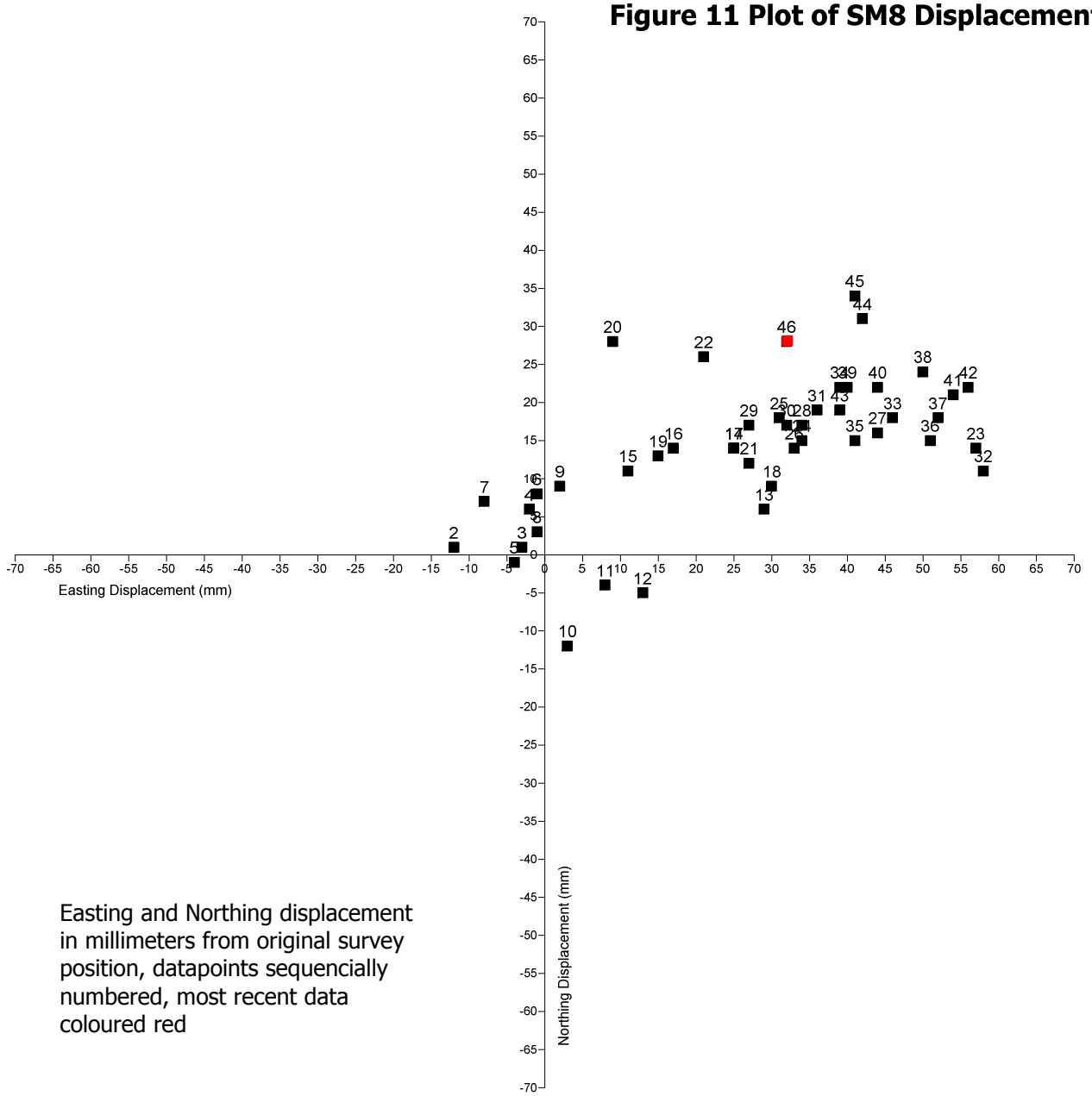


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

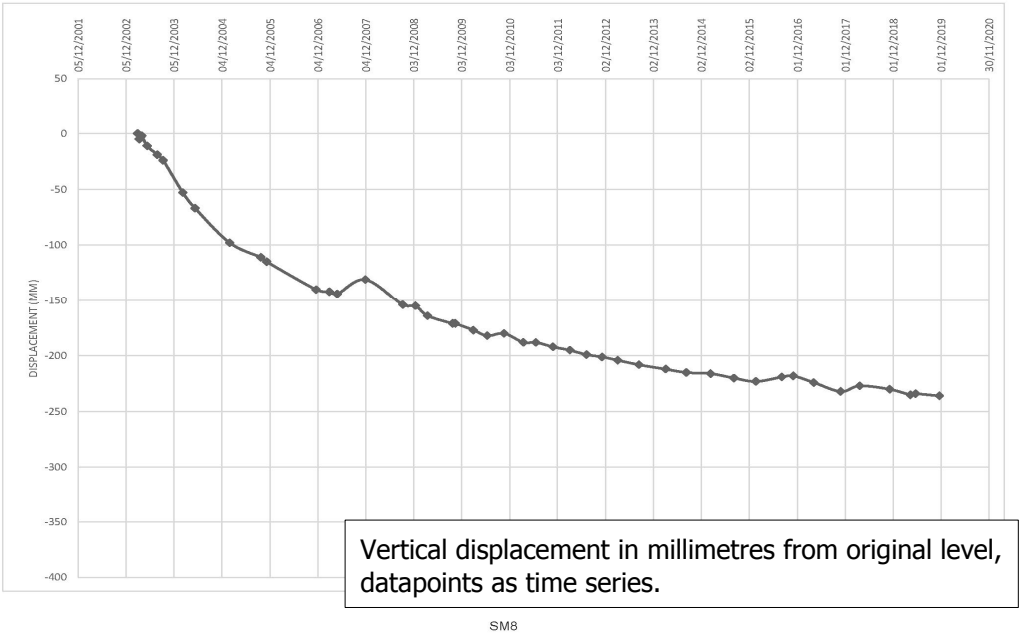


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 11 Plot of SM8 Displacement

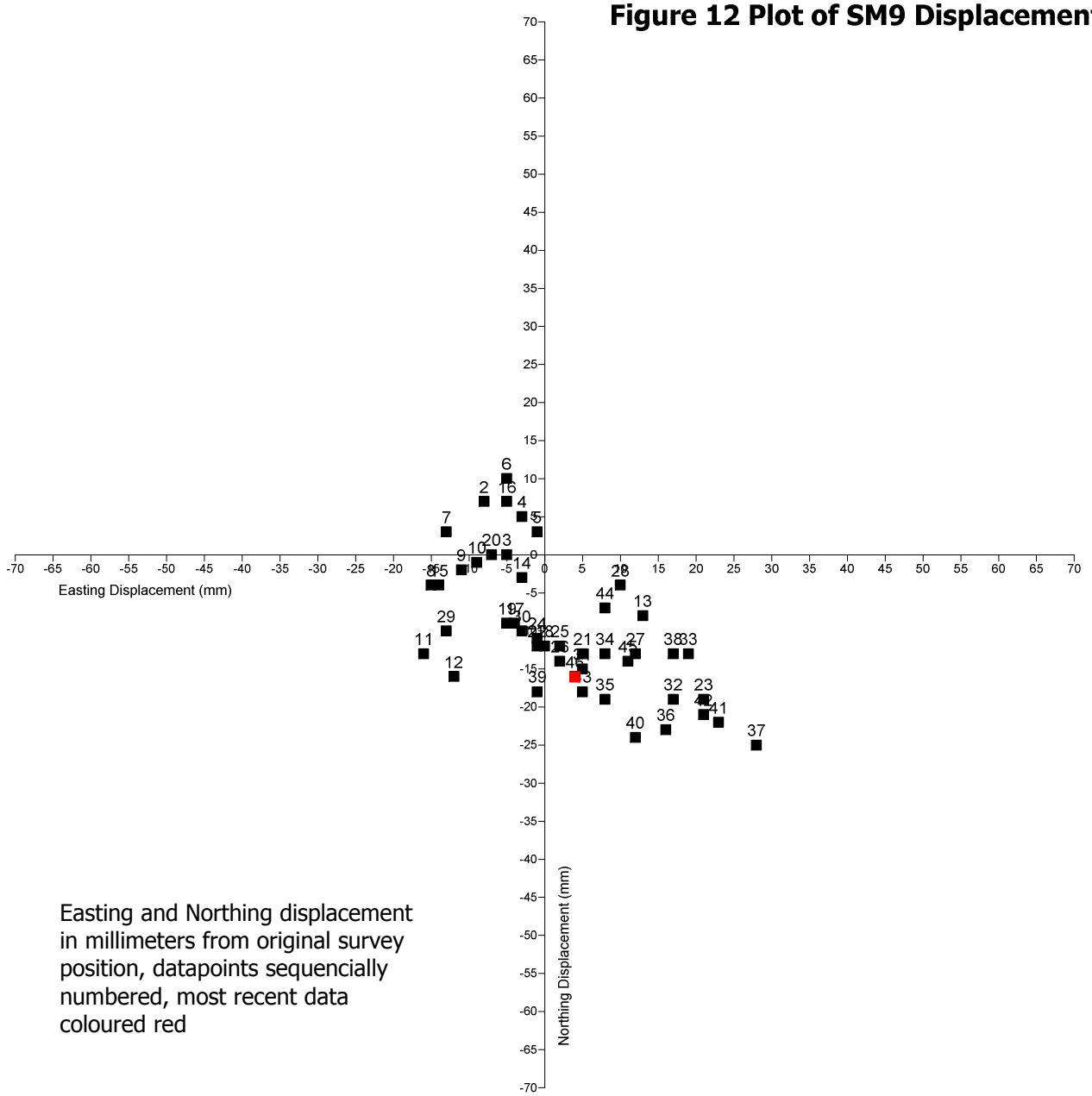


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

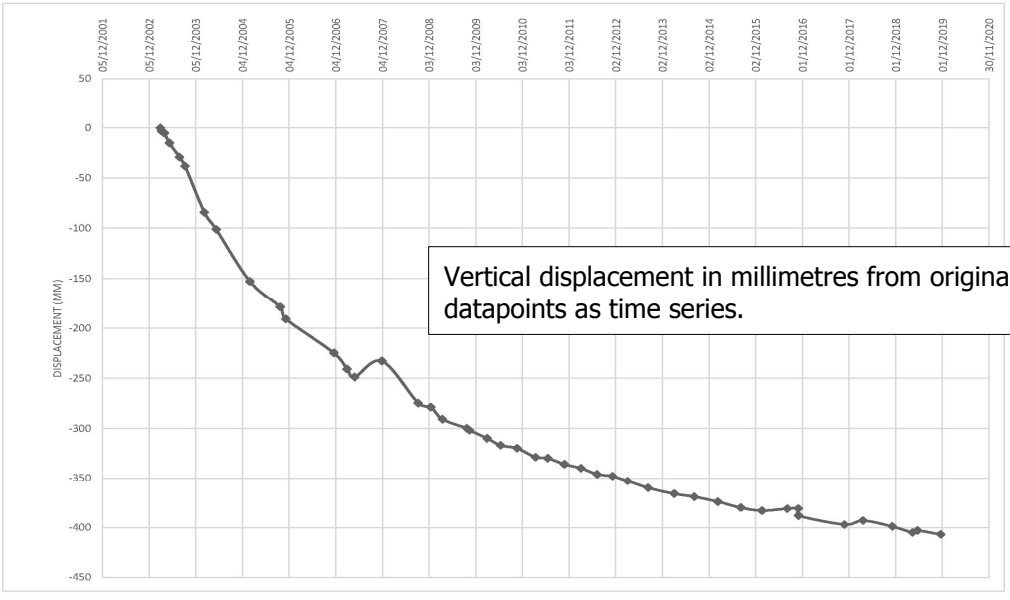


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 12 Plot of SM9 Displacement

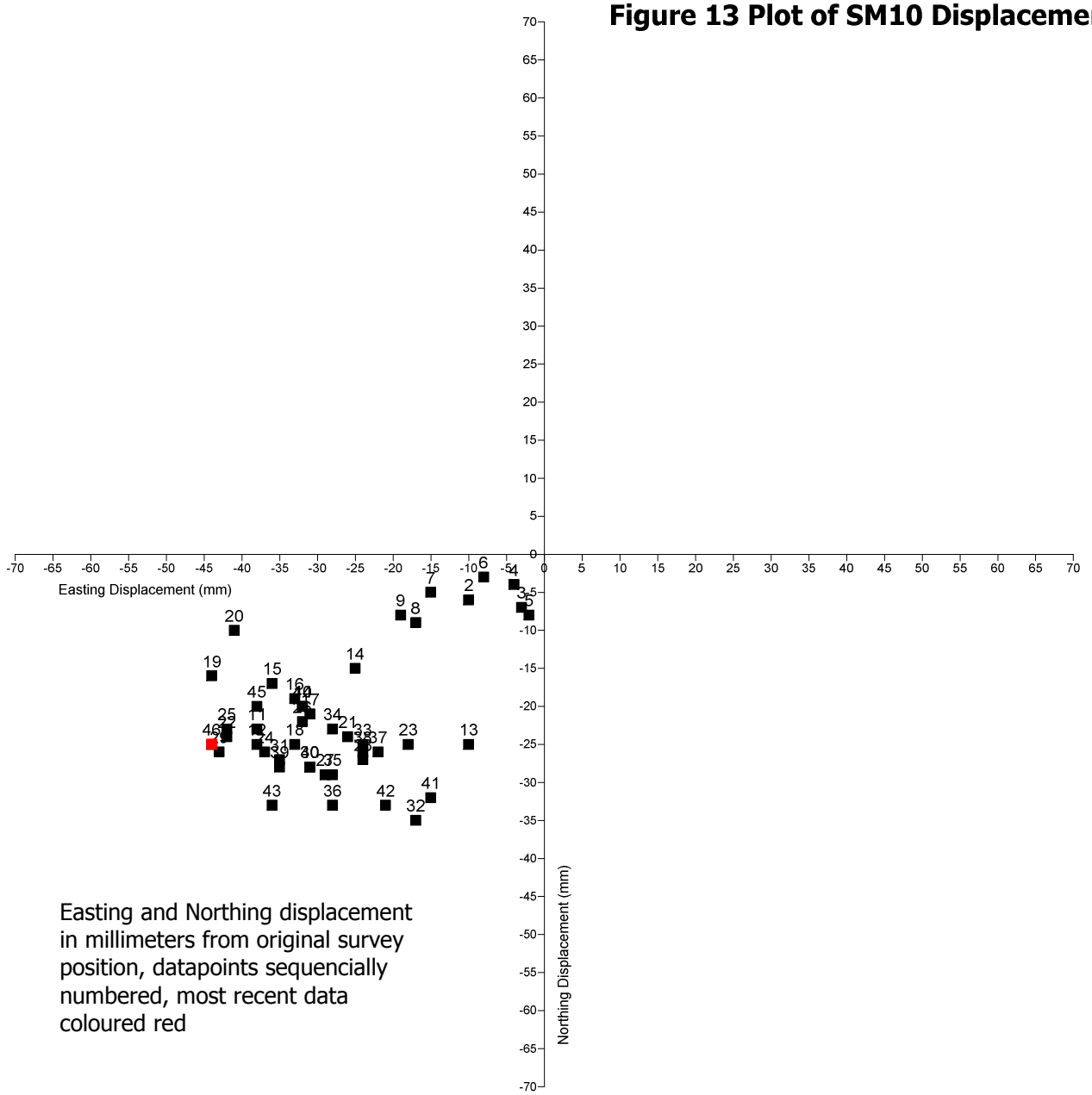


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

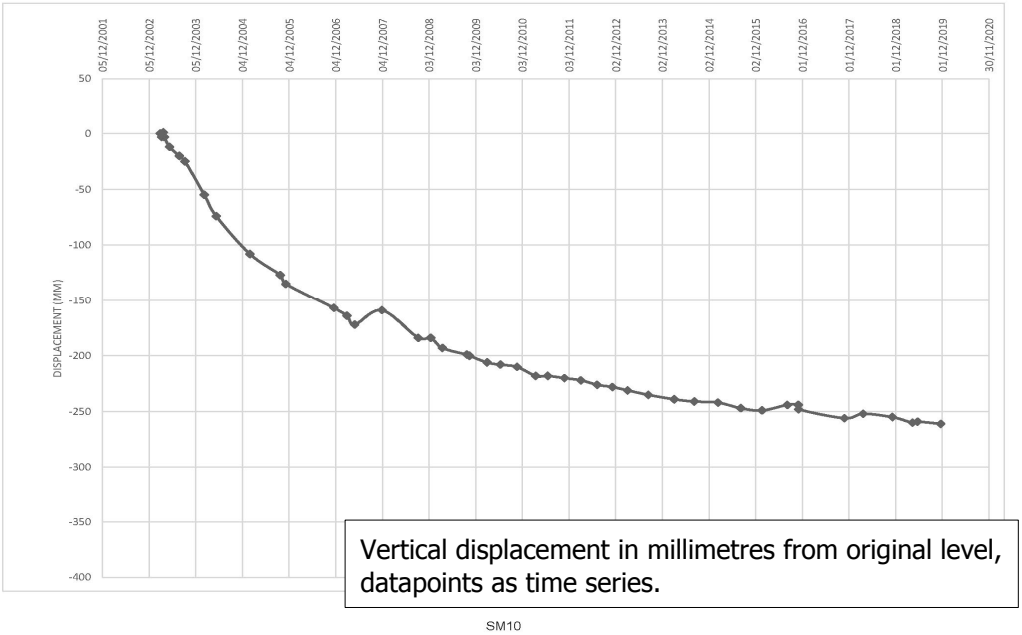


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 13 Plot of SM10 Displacement

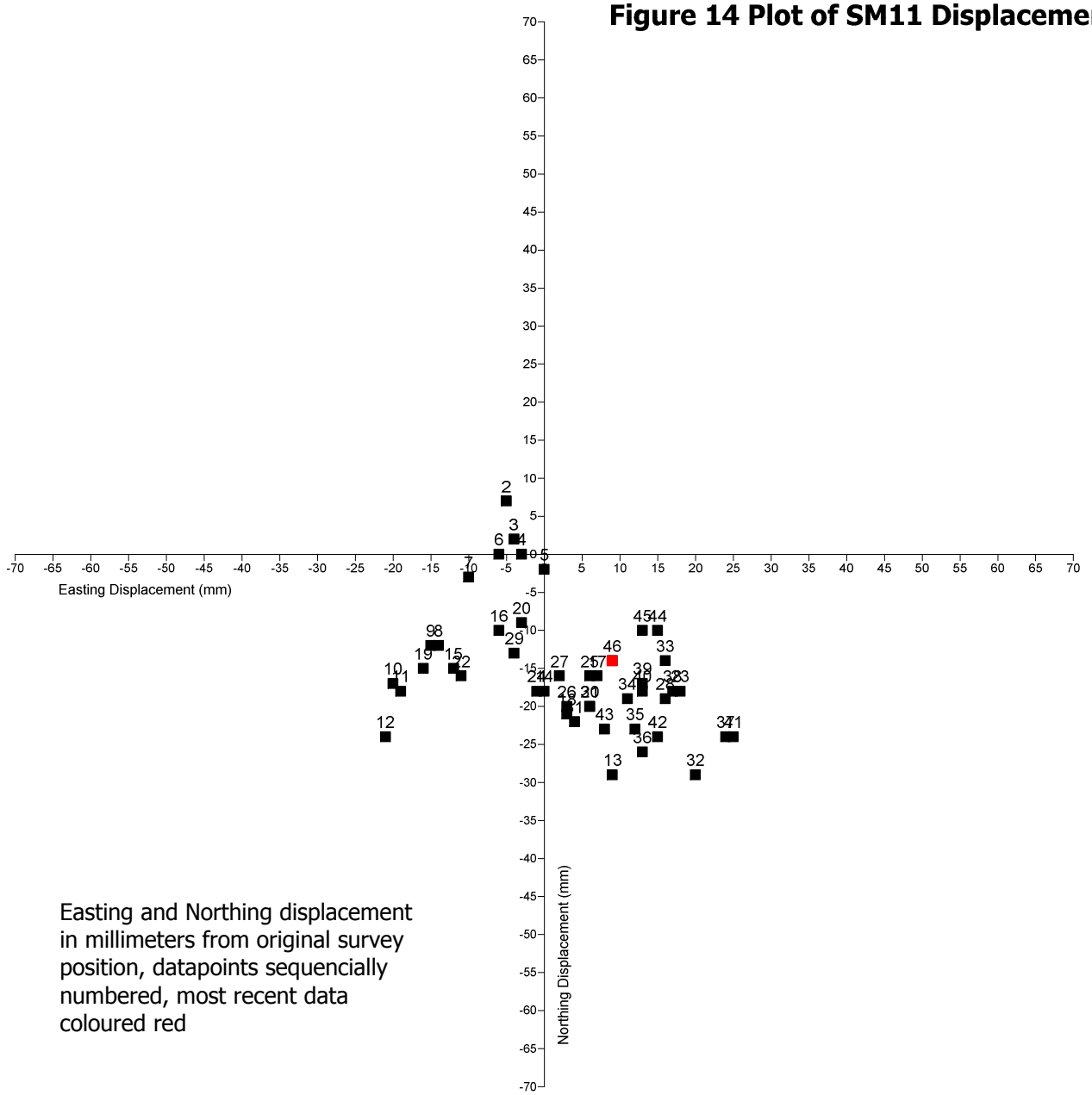


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

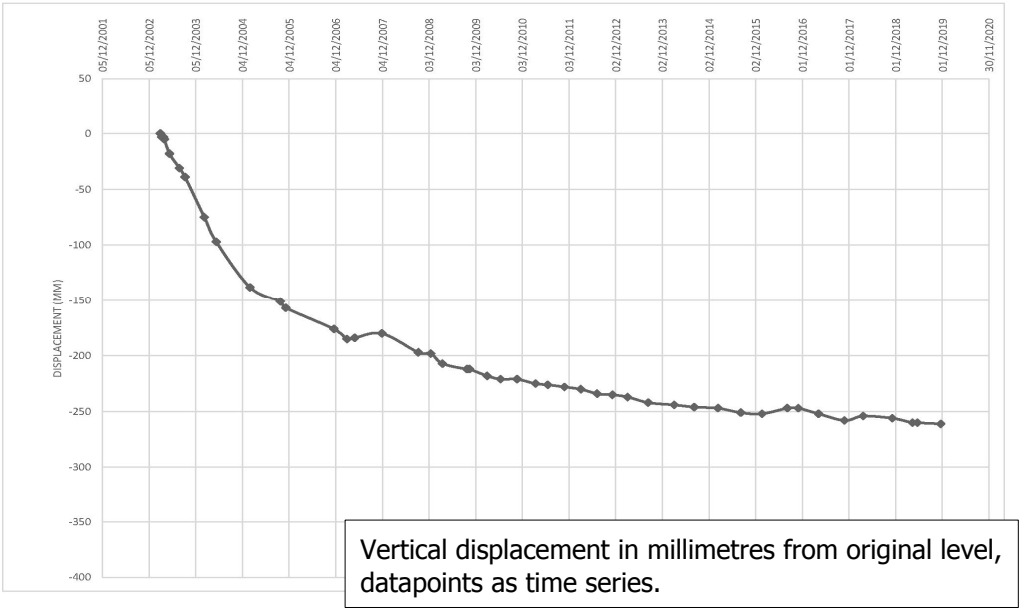


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 14 Plot of SM11 Displacement

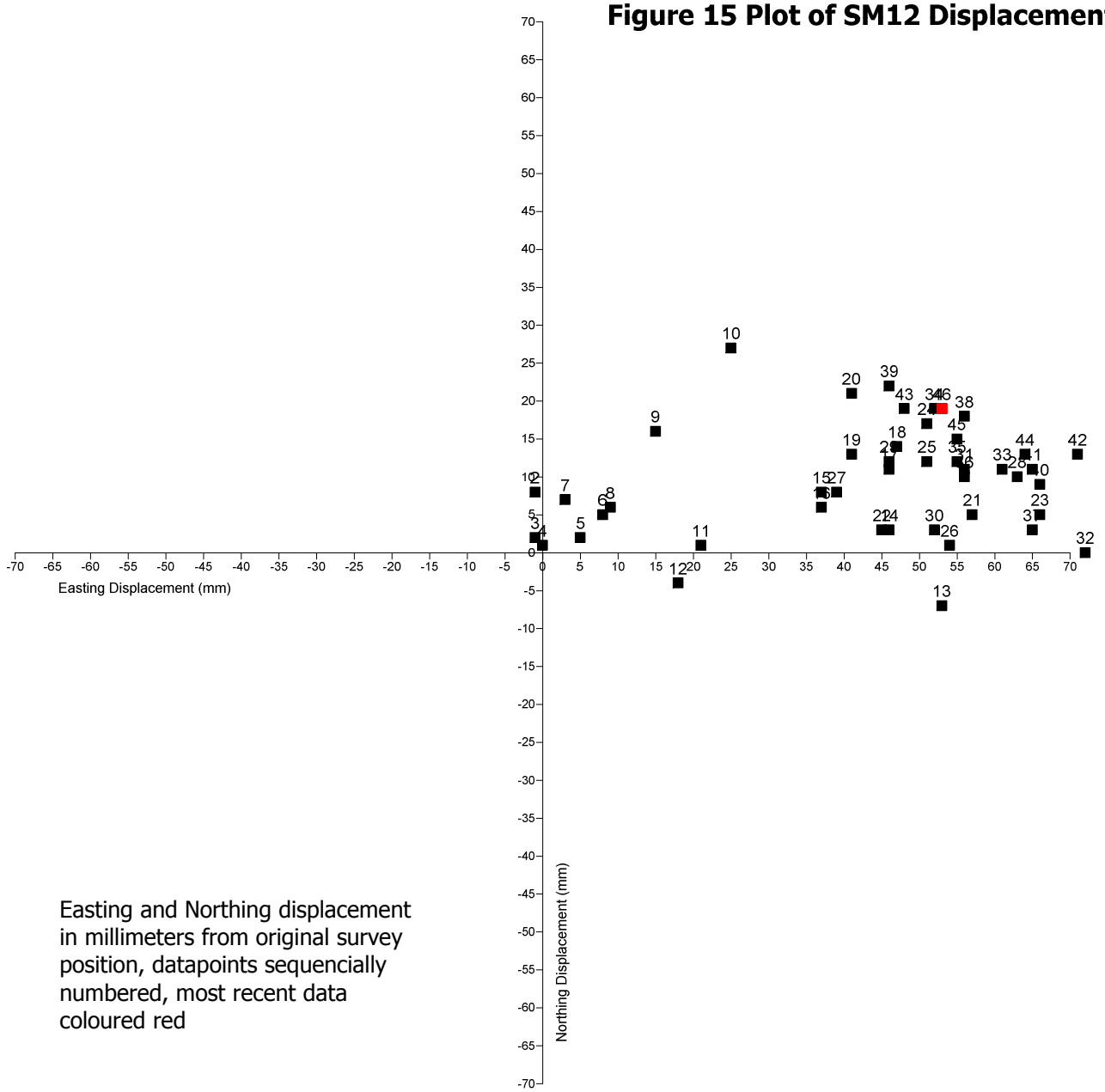


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

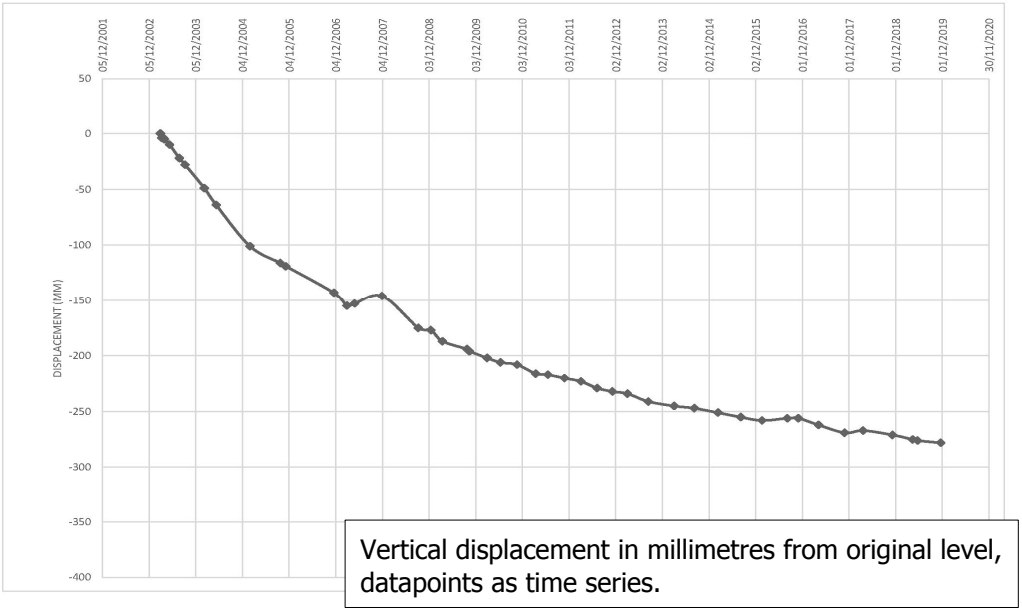


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 15 Plot of SM12 Displacement

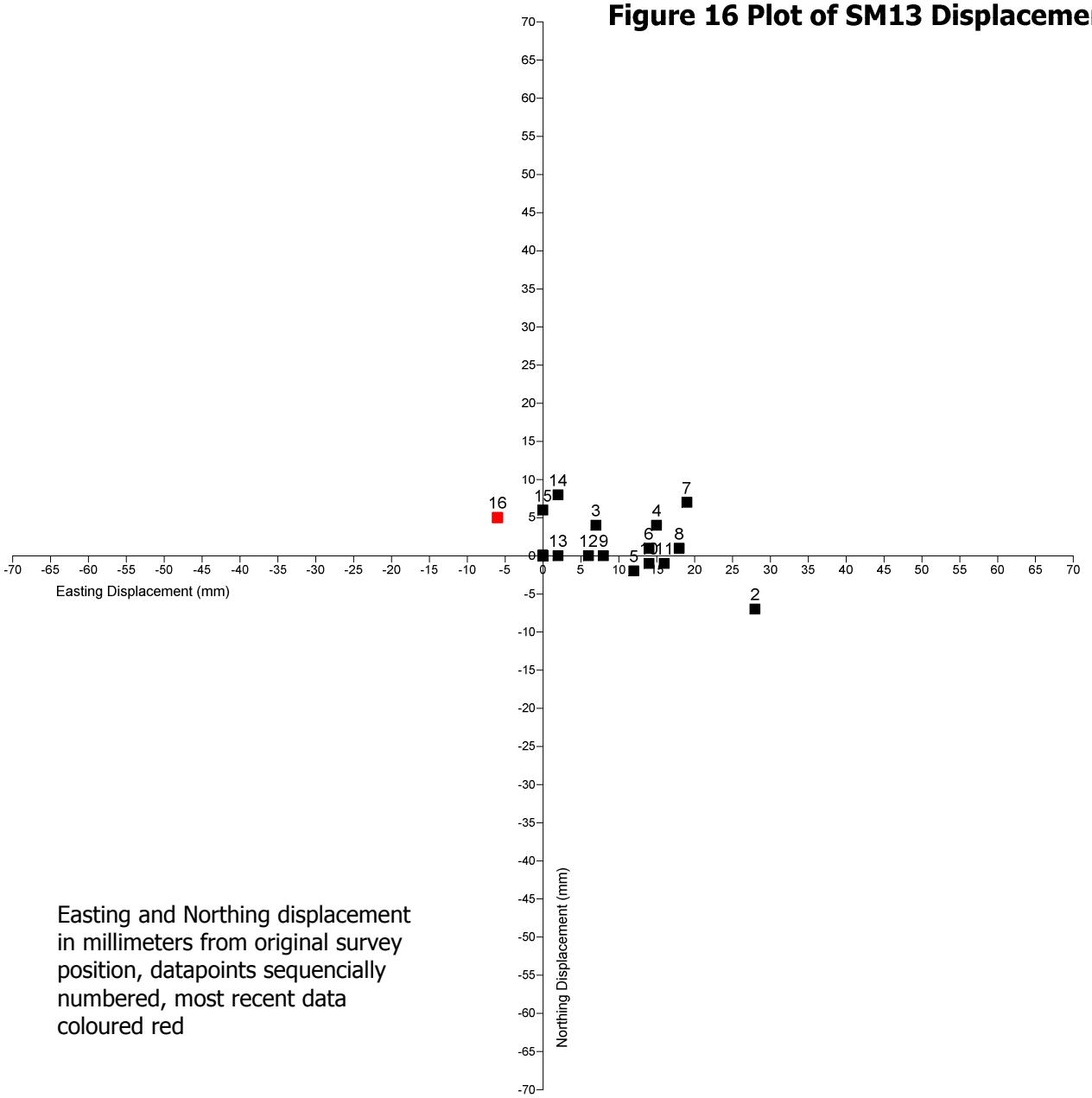


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

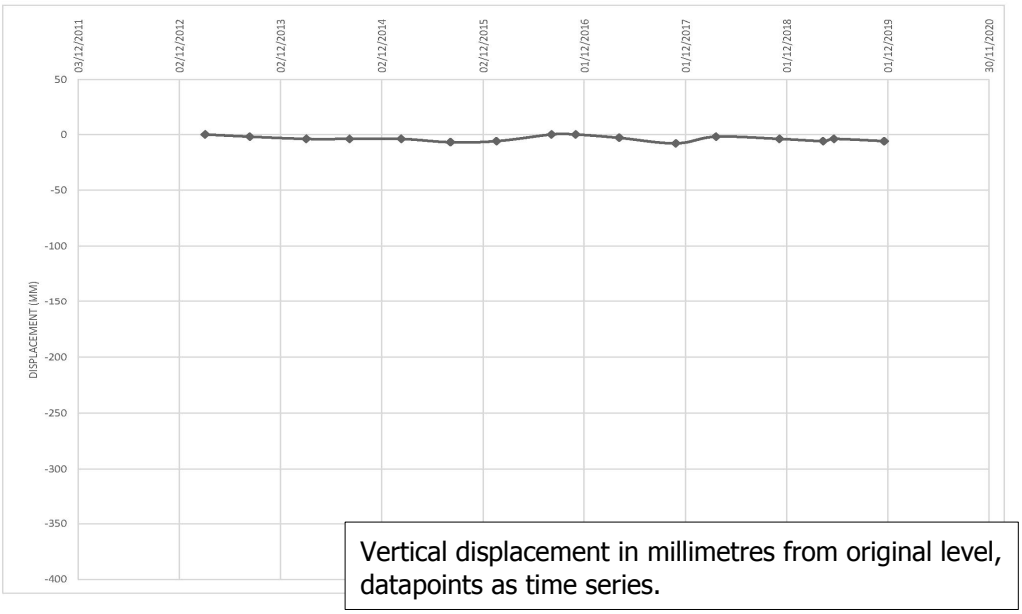


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 16 Plot of SM13 Displacement

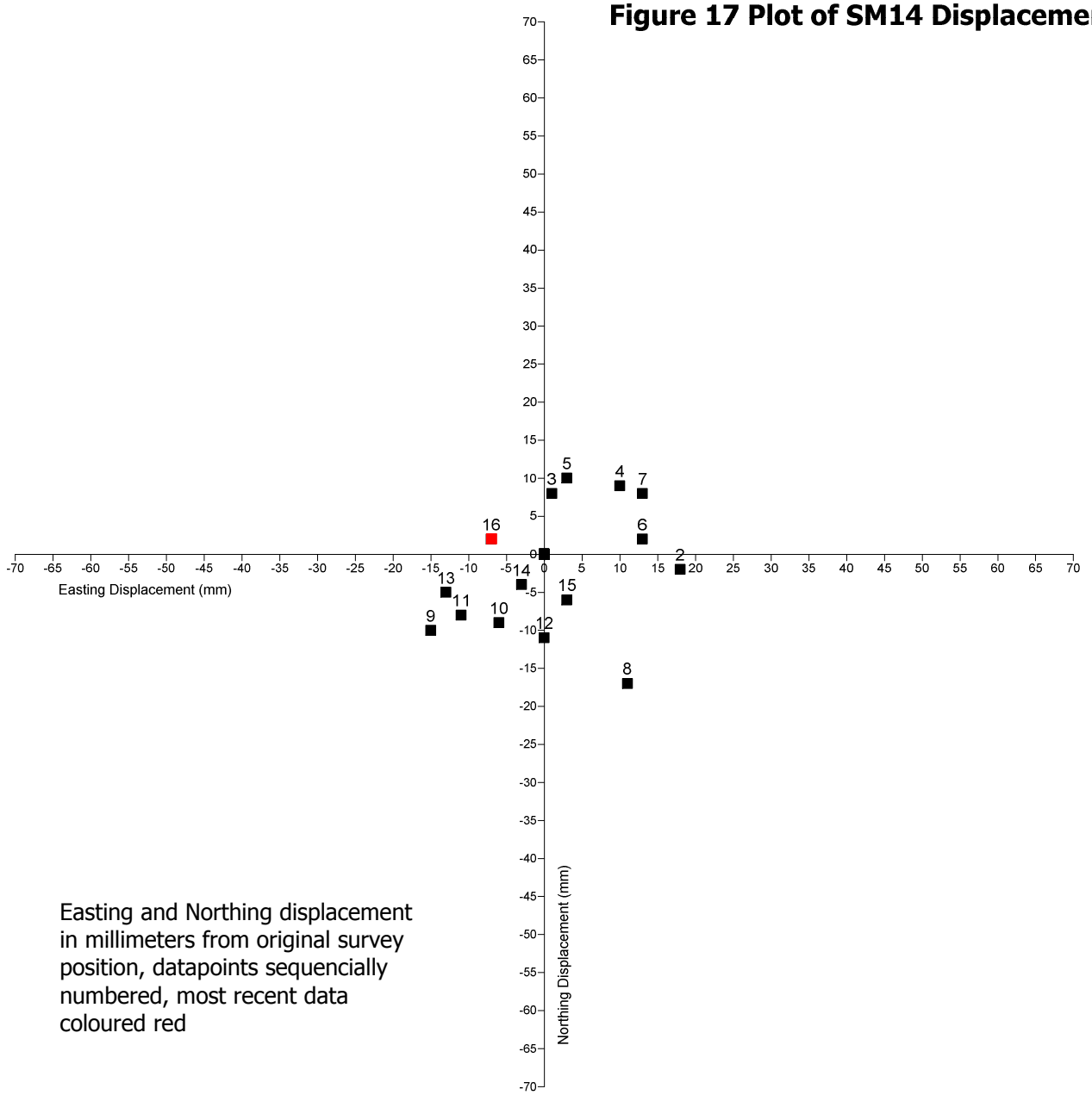


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

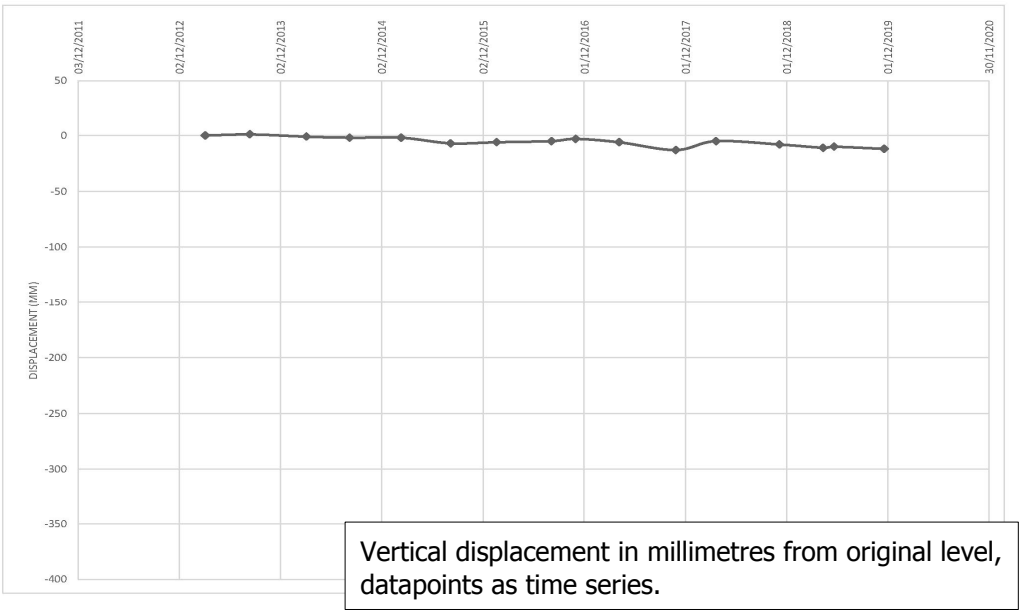


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 17 Plot of SM14 Displacement

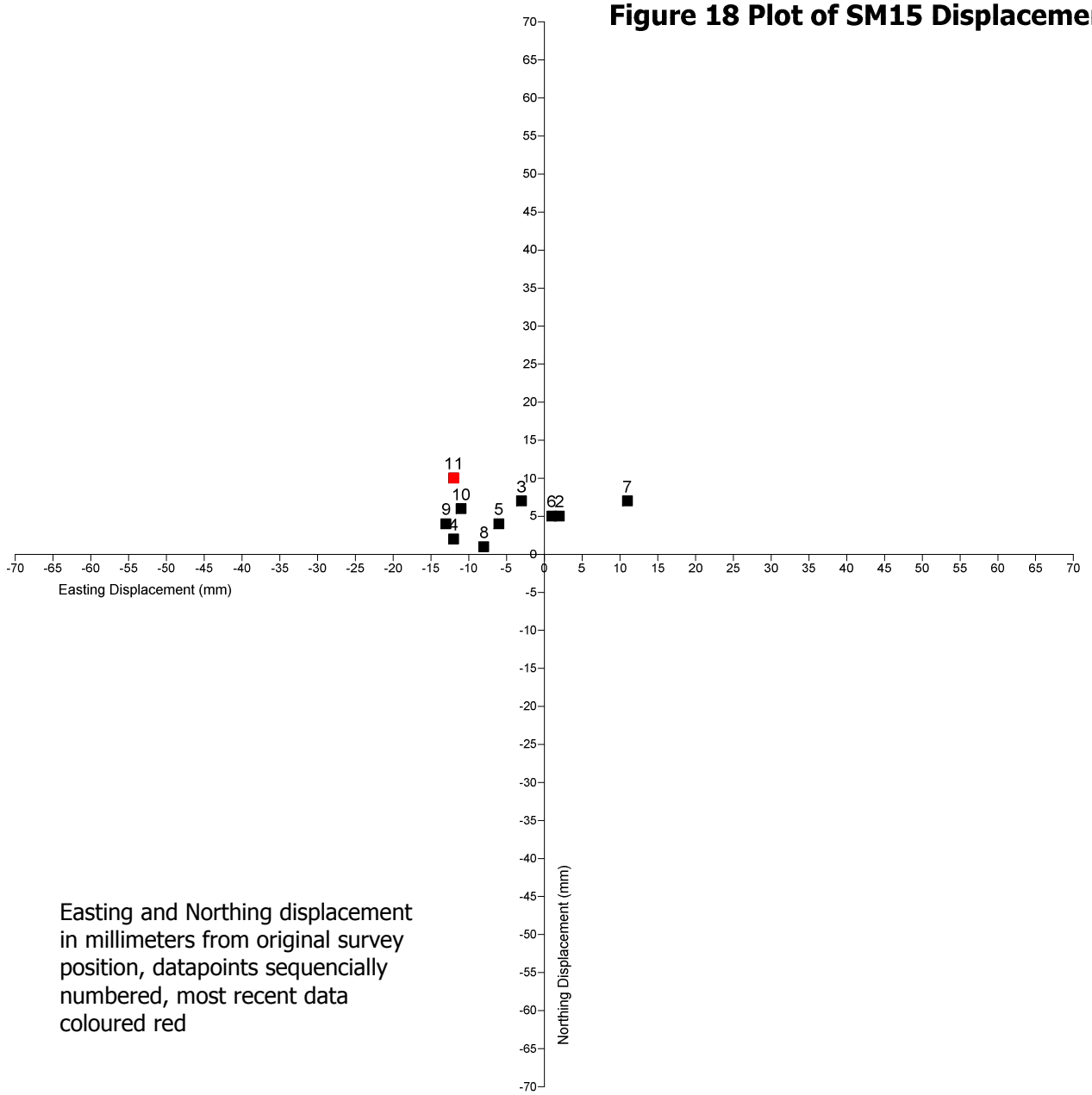


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

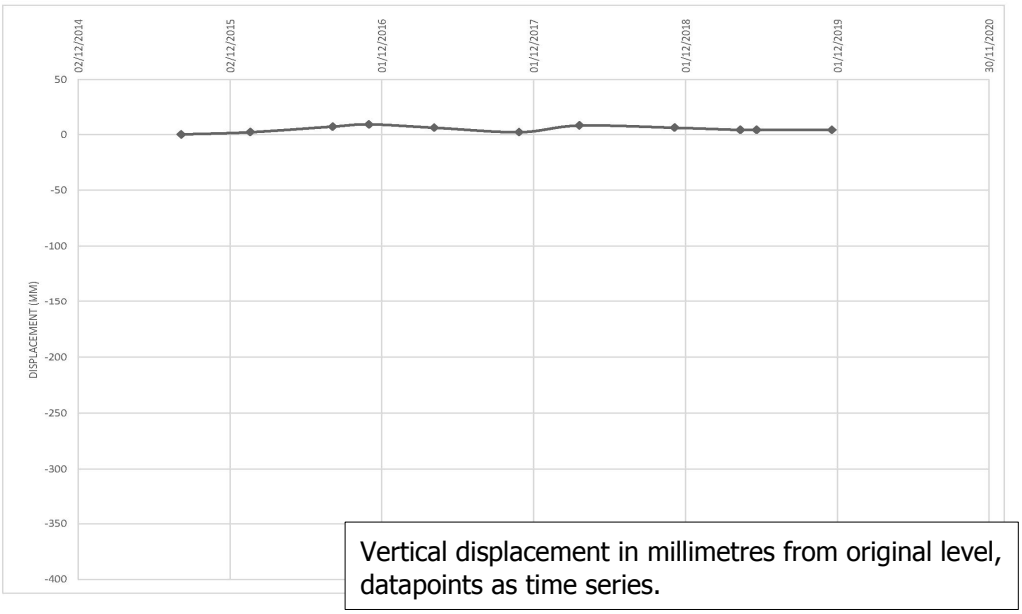


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 18 Plot of SM15 Displacement

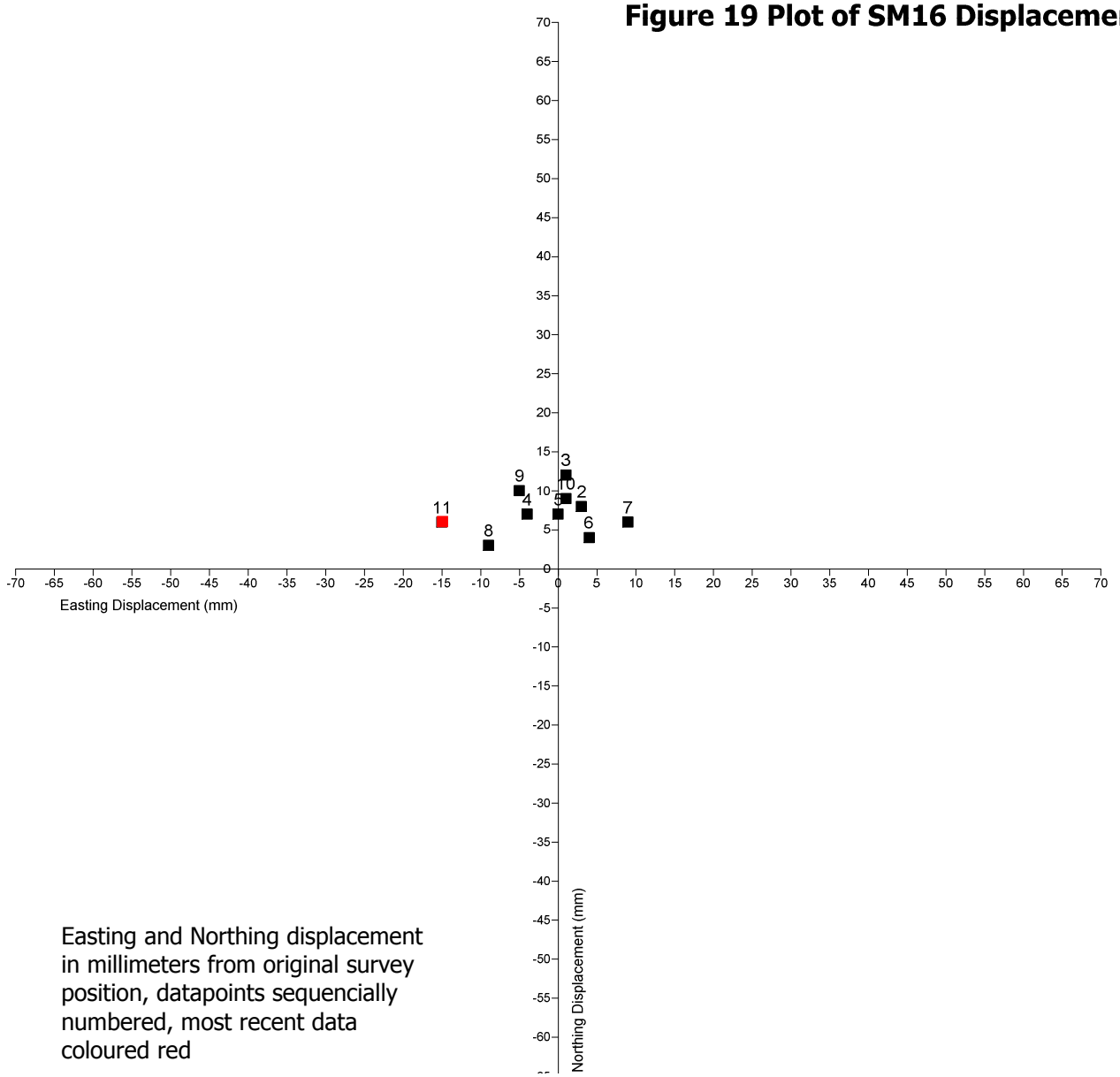


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

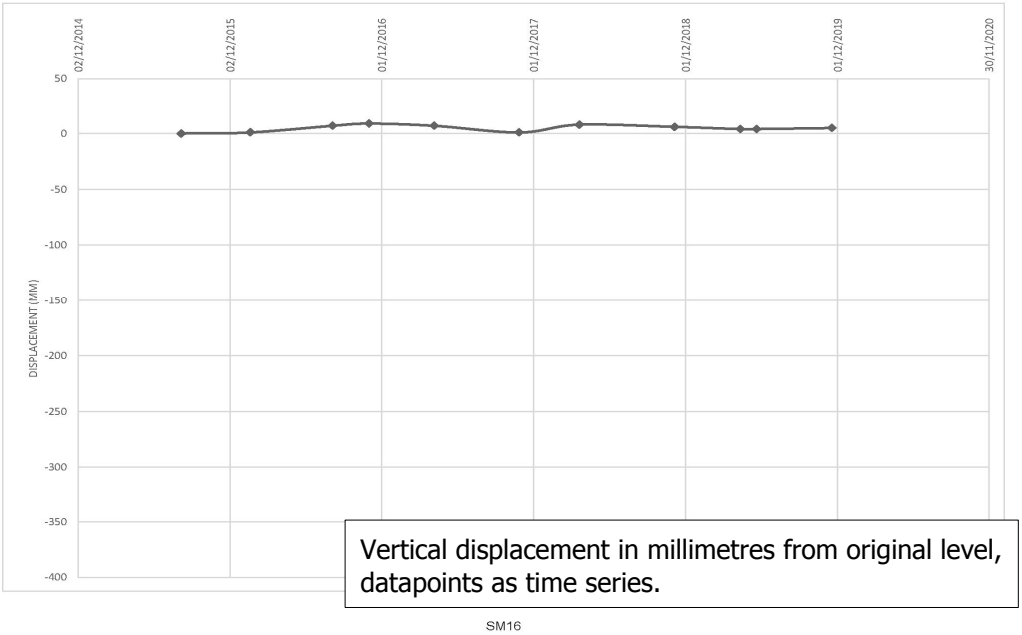


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 19 Plot of SM16 Displacement

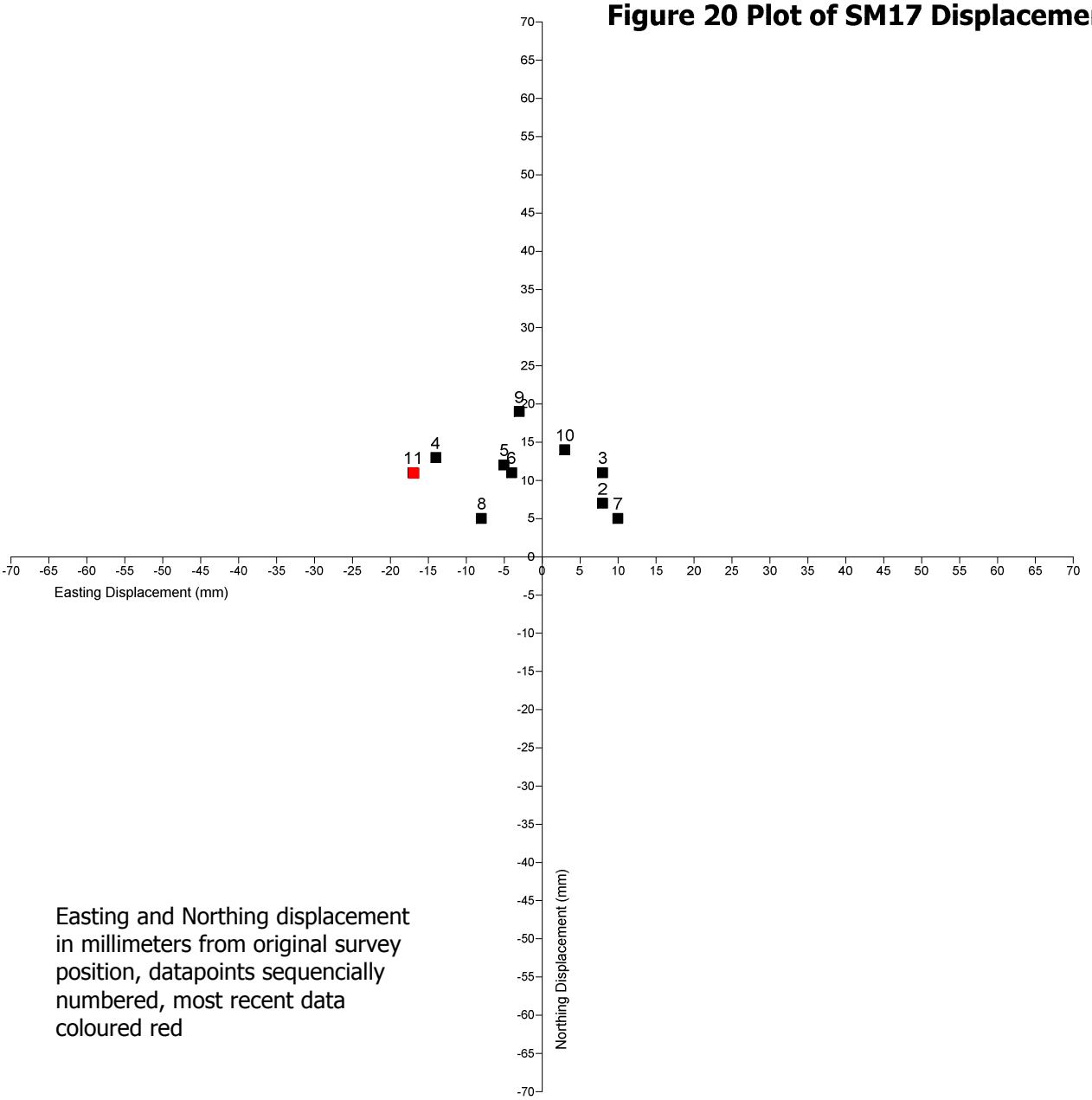


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

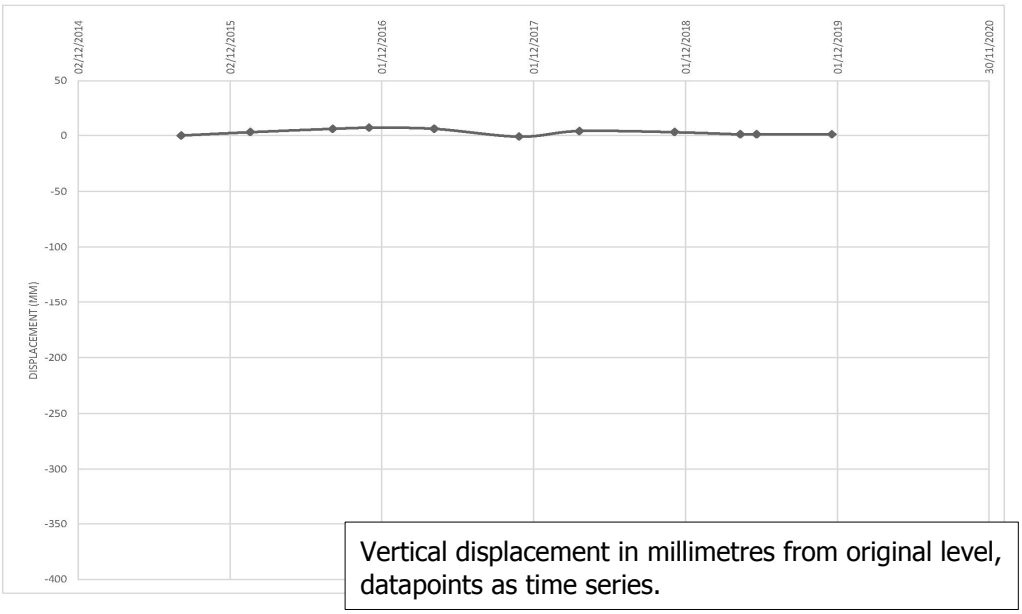


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 20 Plot of SM17 Displacement

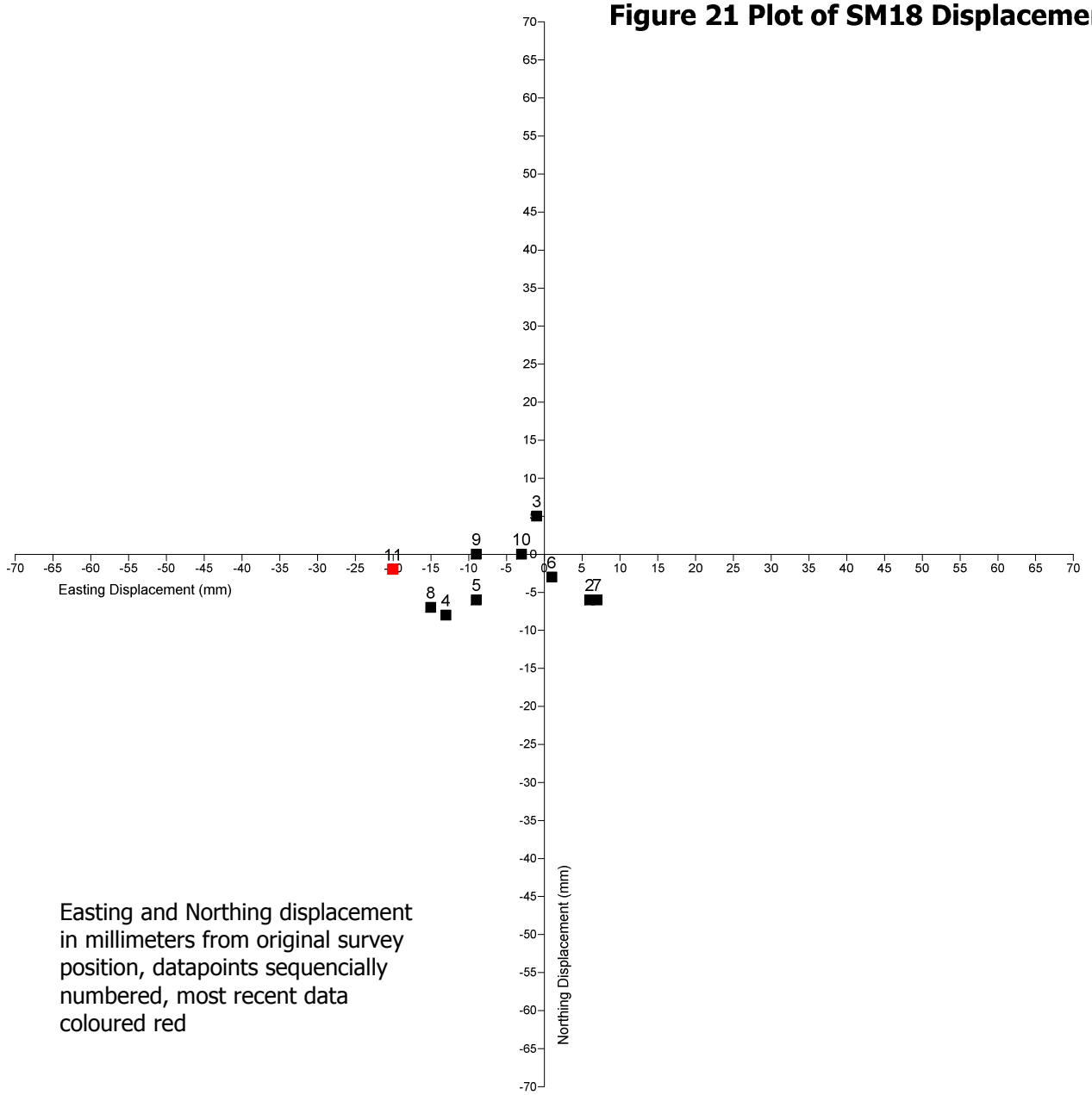


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

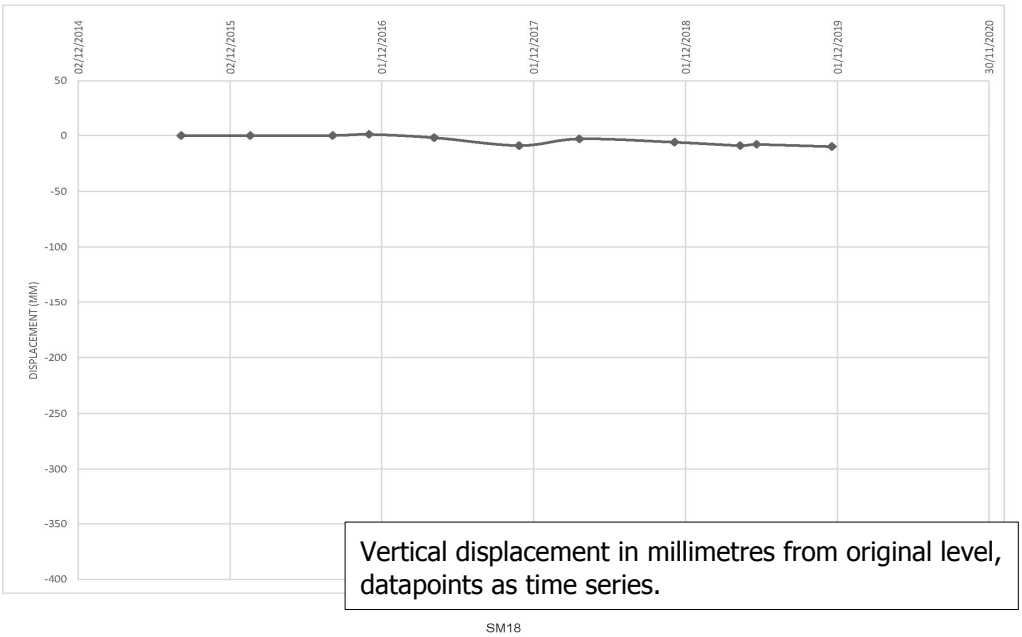


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 21 Plot of SM18 Displacement

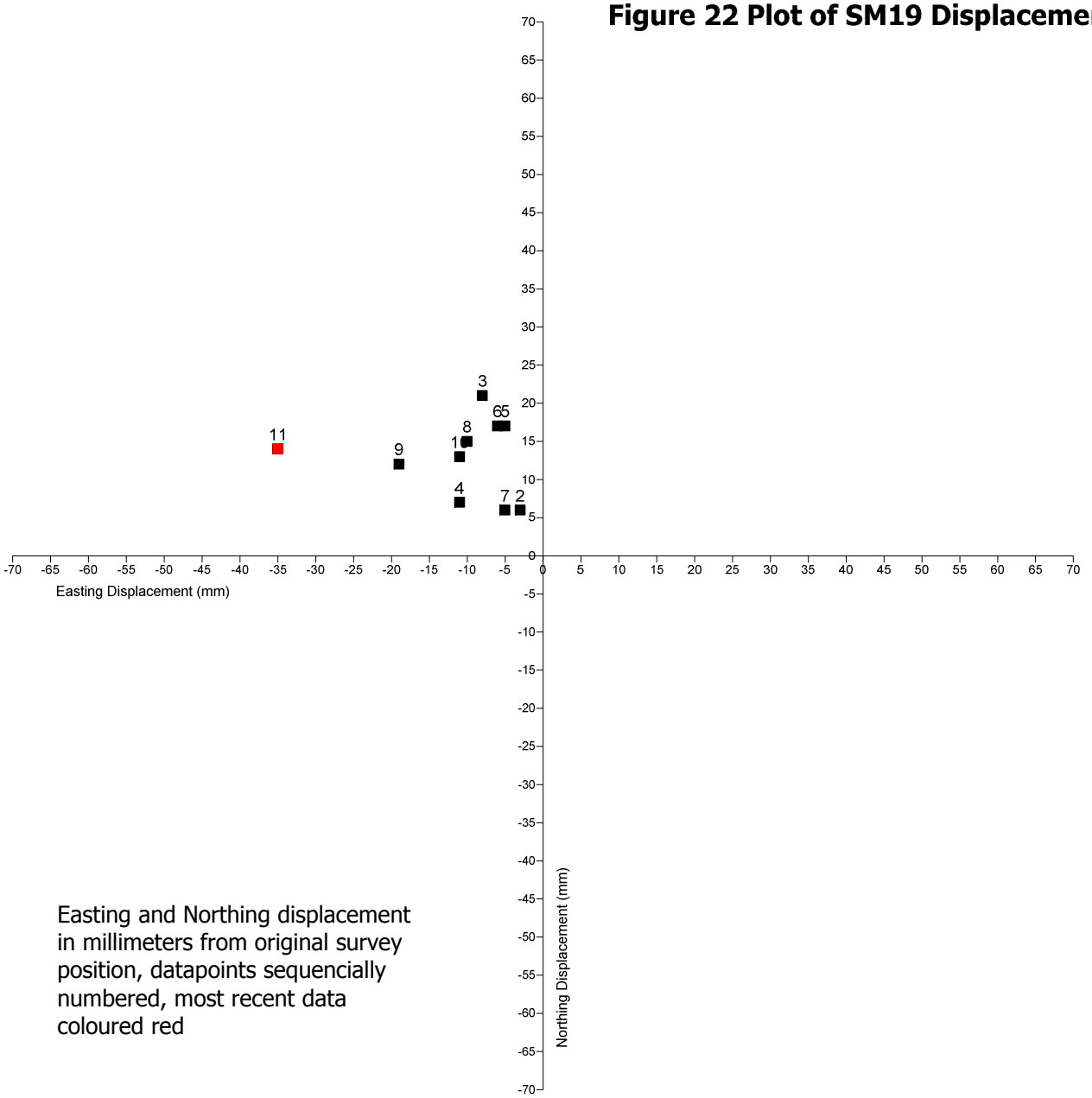


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

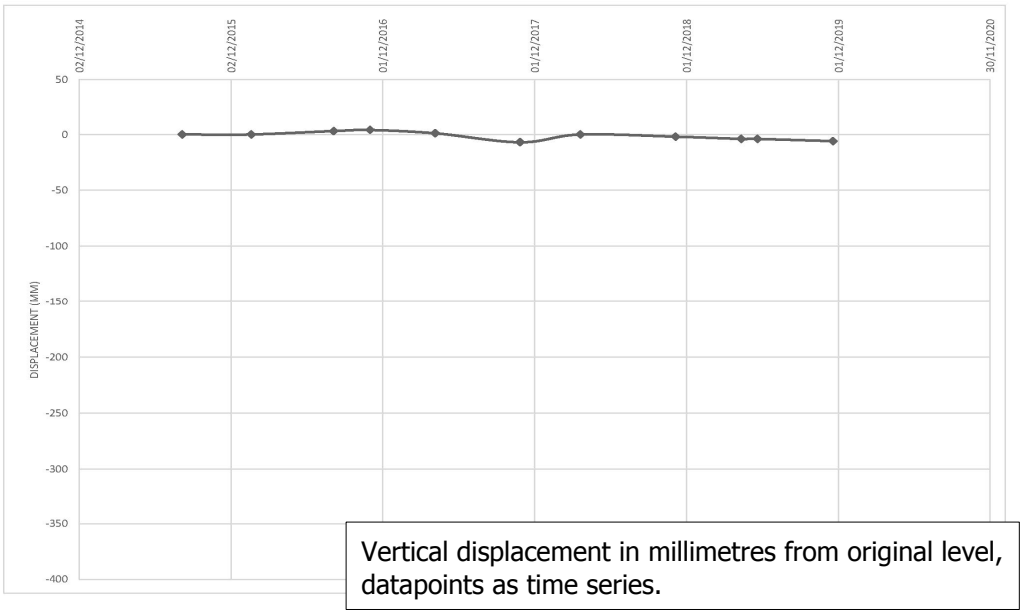


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 22 Plot of SM19 Displacement

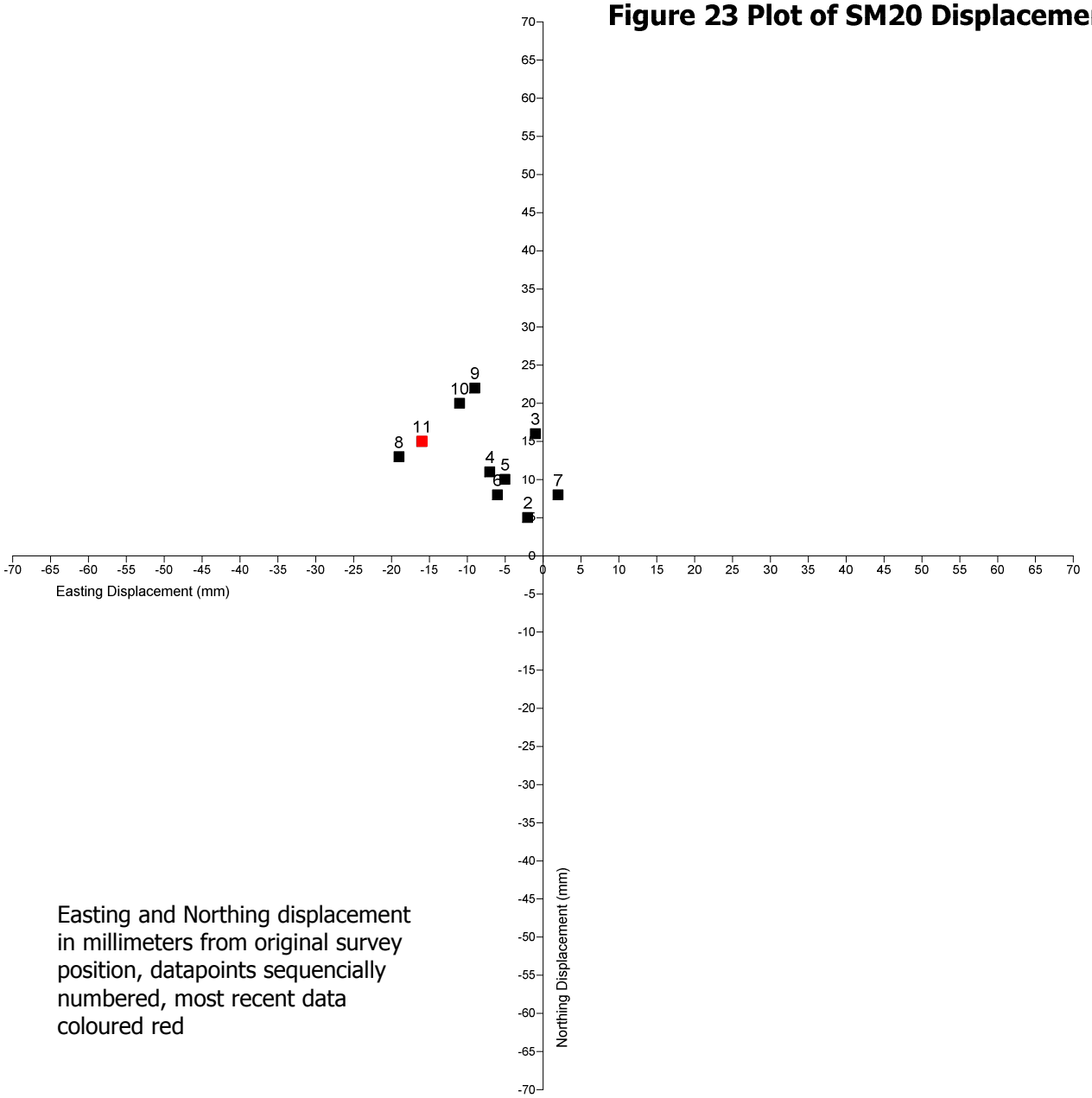


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red

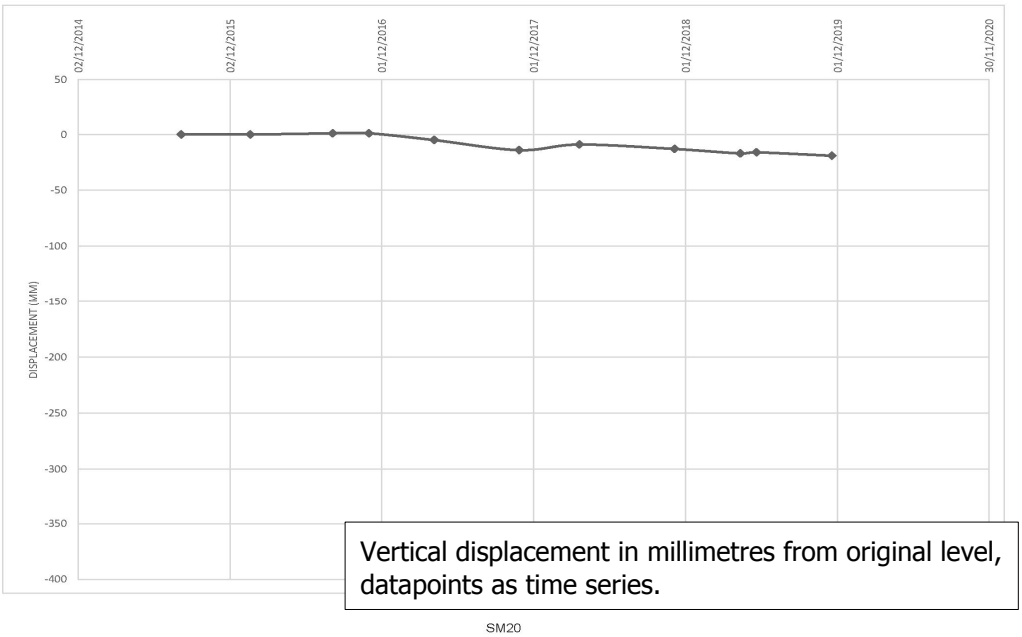


Vertical displacement in millimetres from original level, datapoints as time series.

Figure 23 Plot of SM20 Displacement

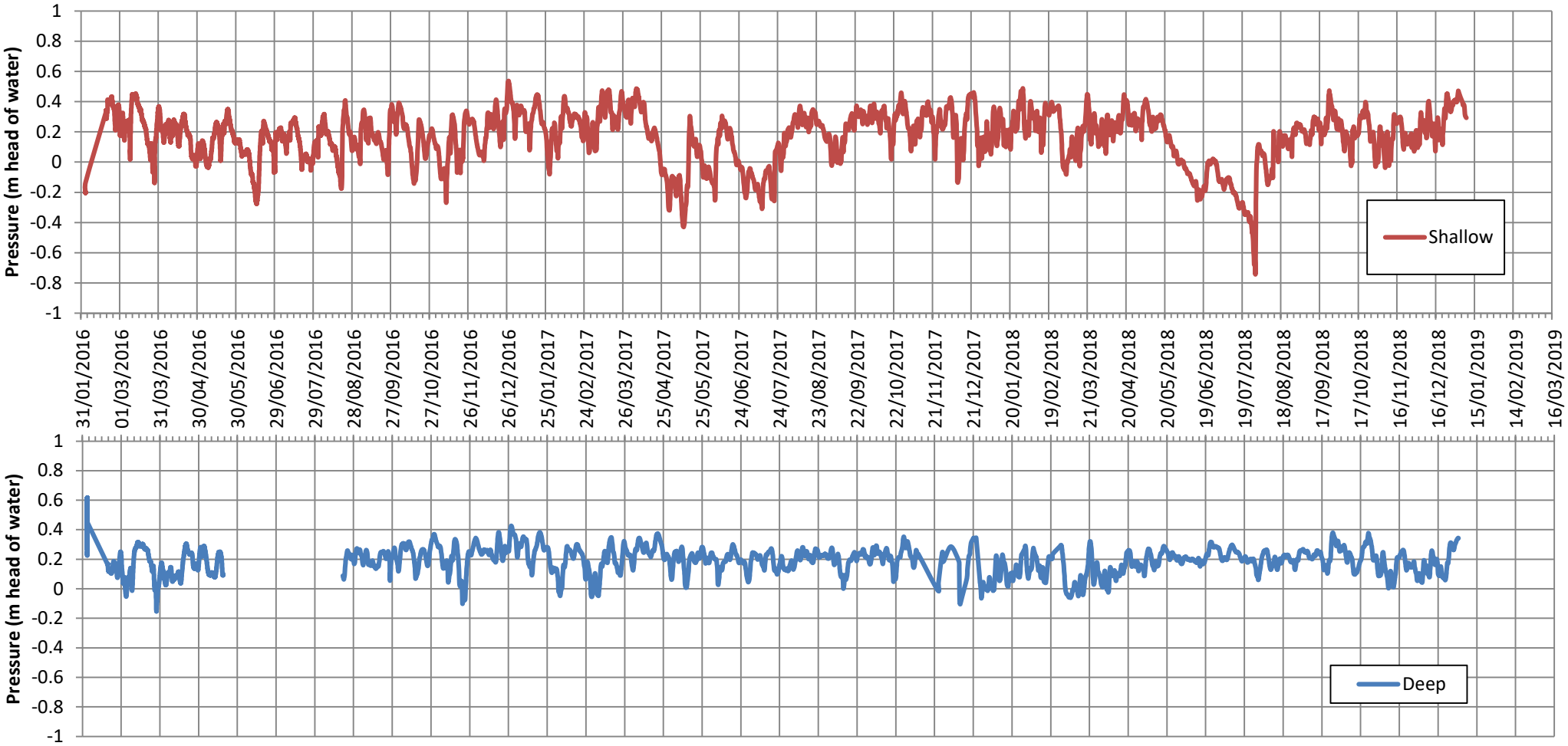


Easting and Northing displacement in millimeters from original survey position, datapoints sequencially numbered, most recent data coloured red



Vertical displacement in millimetres from original level, datapoints as time series.

Figure 24 Inert Bund Pressure Transducer Graphs



Revision 0 **1983r1v1d0320 Figure 24** **Scale: As Shown**

Figure 25 Inclinometer Profile Graph

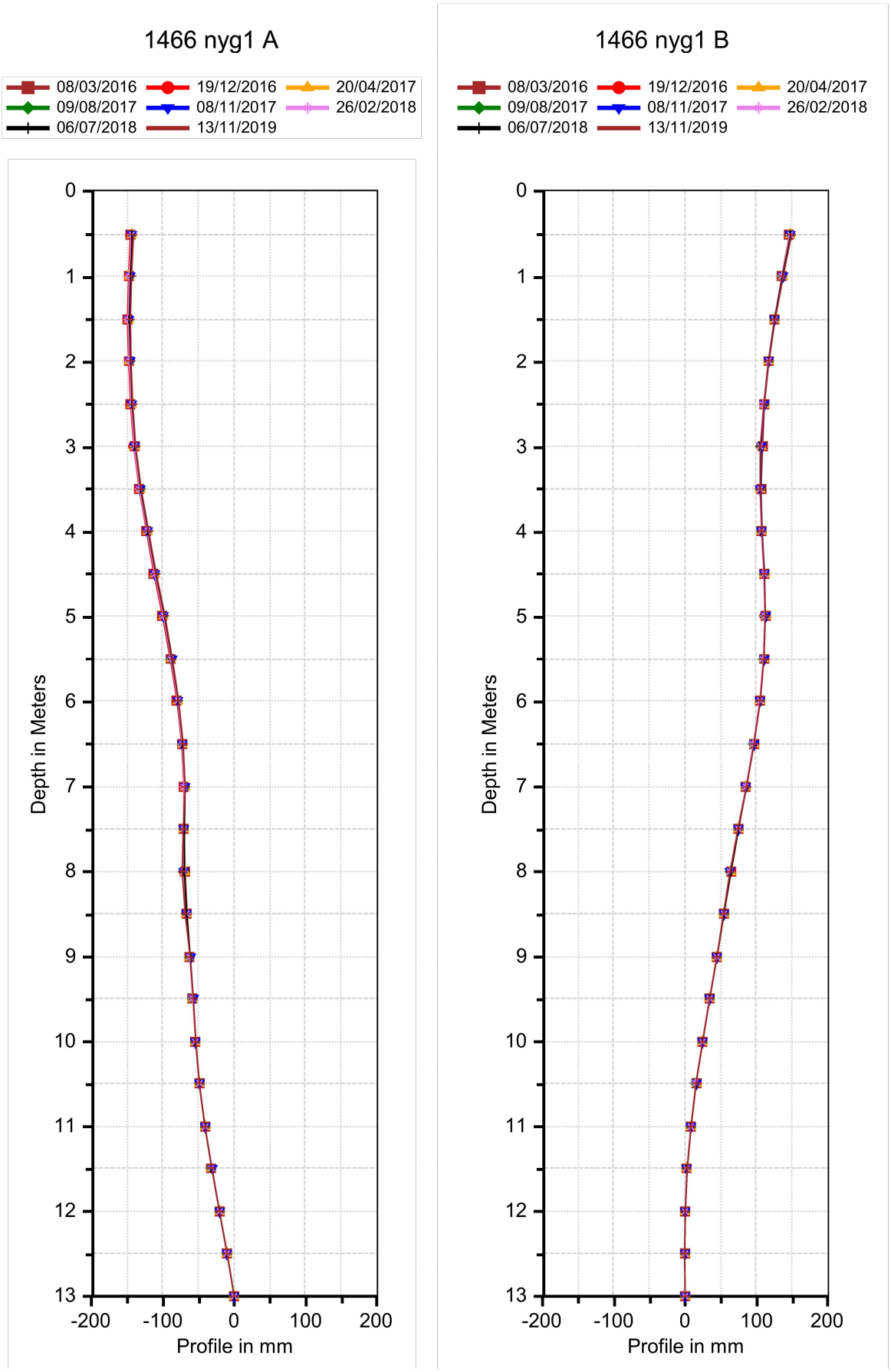
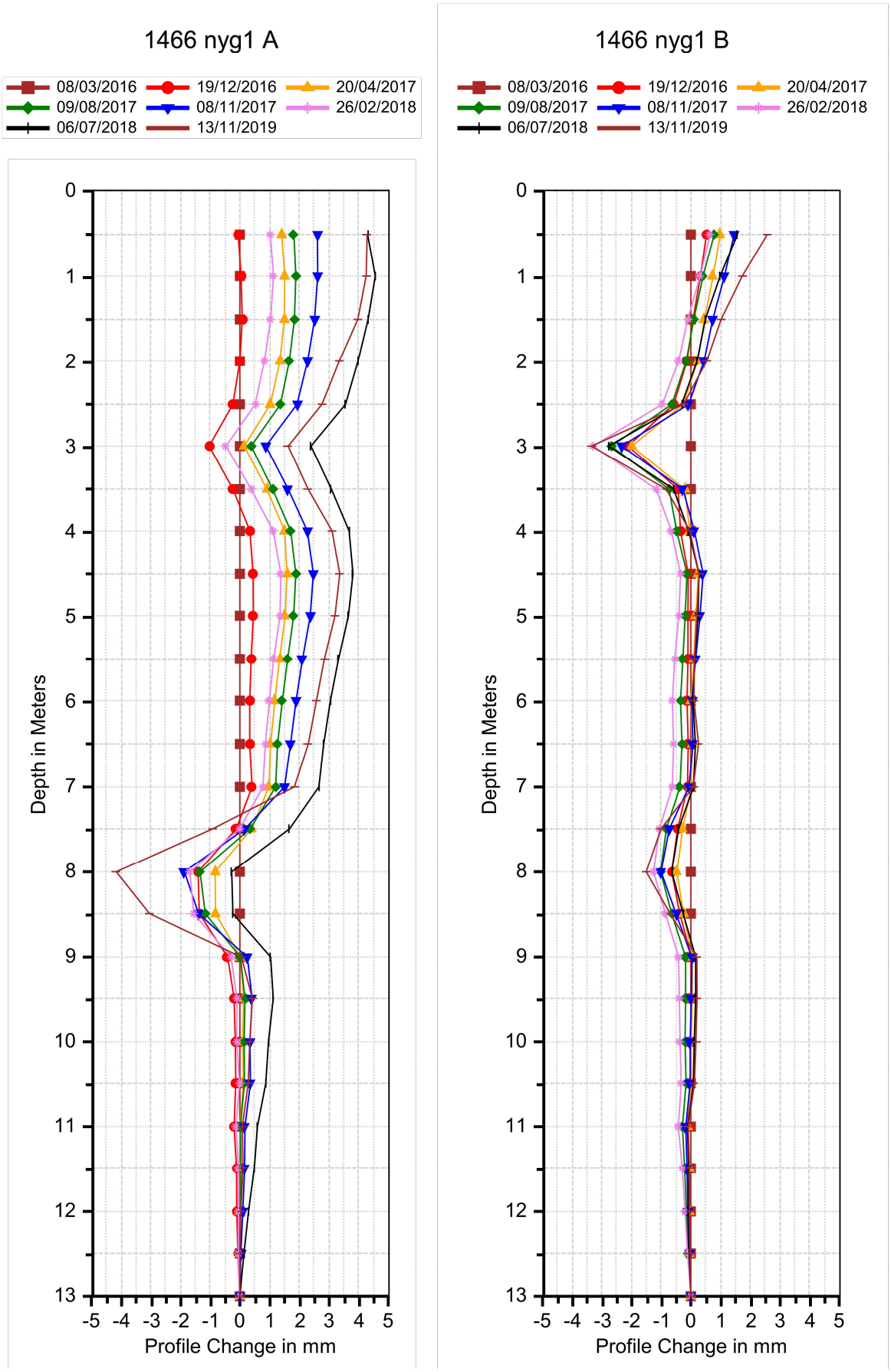
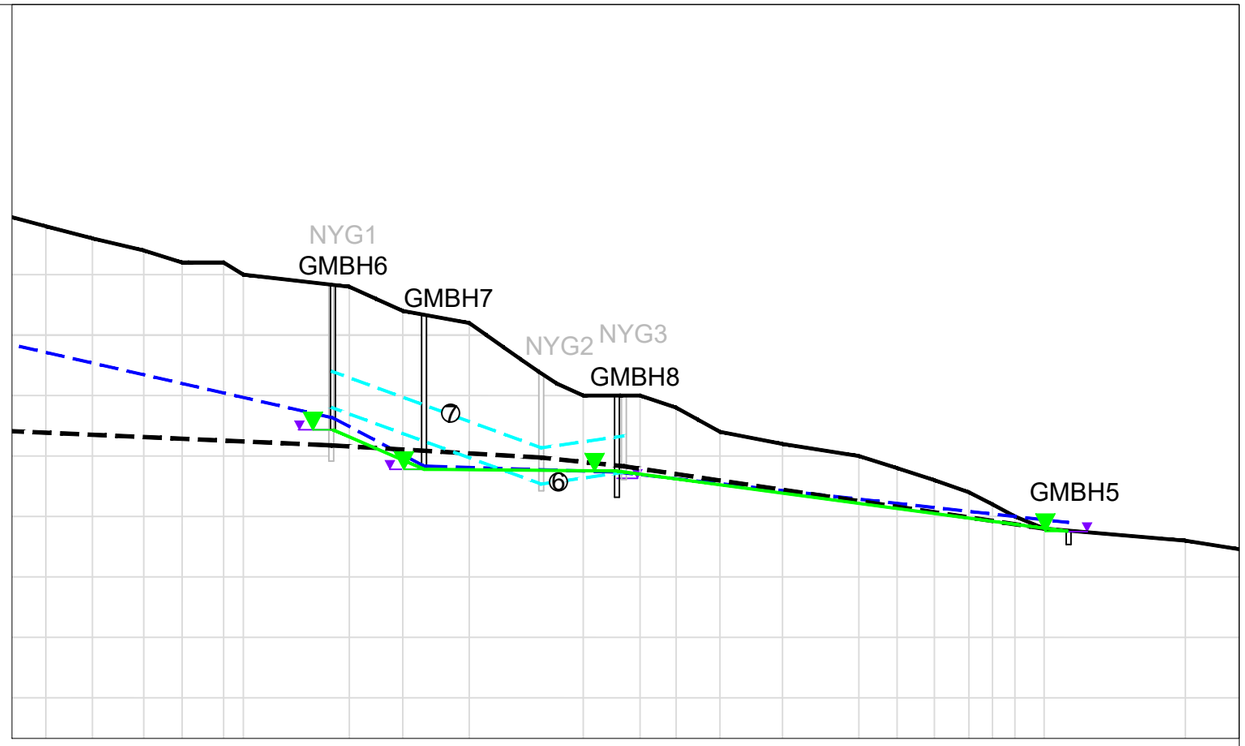
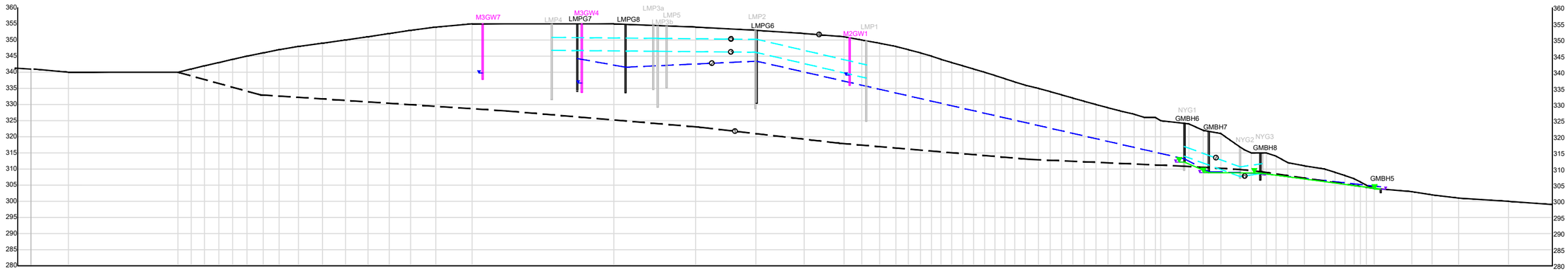


Figure 26 Inclinometer Profile Change Graph





Inert Bund Inset



LEGEND

① Original Ground Level
② Maximum Water Level 2003-2011
③ Arup Analysis WT1 Water Table
④ Arup Analysis WT2 Water Table (fullly saturated waste mass)
⑤ Arup Inerpolated Upper Limit to Maintain an Adequate Margin of Stability
⑥ Halcrow Analysis WT1 Water Table
⑦ Halcrow Analysis WT2 Water Table
⑧ 2014 leachate level
⑨ 2016 - 2017 Maximum water levels
⑩ 2018 - 2019 Maximum water levels

PROJECT
Nantygwyddon - 2019 Inert Bund Stability Assessment

TITLE
Cross section through waste mass and inert bund

DRAWING NUMBER
1983/27

SCALE AT A3	DATE	DRAWN
As Shown	**03.20**	**KJT**

NOTE

GEO TECHNOLOGY

NANT-Y-GWYDDON LANDFILL SITE RHONDDA CYNON TAF

2019 Inert Bund Stability Assessment

Appendix 1 Groundwater and Leachate Level Monitoring Data 2014-2017

Report Number 1983r1v1d0320

Amgen Rhondda Ltd. - Nant-y-Gwyddon Landfill Site
Monthly Sub-surface Landfill Gas Monitoring 2018

Gas Monitoring borehole No. 5

2018

Determinand	Jan 19.01.18	Feb 22.02.18	March 13.03.18	April 18.04.18	May 23.05.18	June 18.06.18	July 20.07.18	August 29.08.18	Sept 24.09.18	Oct 22.10.18	Nov 14.11.18	Dec 03.12.18	COUNT	MAX	MIN	AVGE
Depth (m)	2.40	2.45	2.45	2.30	2.40			2.40	2.30	2.40	2.40					
Depth to WT (m)	1.61	1.60	1.44	1.57	DRY			1.70	DRY	DRY	DRY		9	1.1	DRY	0.45
Level	0.79	0.85	1.01	0.73				0.70								

2019

Determinand	Jan 17.01.19	Feb 18.02.19	March 22.03.19	April 23.04.19	May 21.05.19	June 24.06.19	July 16.07.19	August 20.08.19	Sept 18.09.19	Oct 16.10.19	Nov 18.11.19	Dec	COUNT	MAX	MIN	AVGE
Depth (m)			2.50		2.30		2.40	2.50	2.50	2.40	2.50	2.55				
Depth to WT (m)			1.64		DRY		2.25	1.65	1.77	1.42	1.60	1.47	7	1.08	DRY	0.79
Level			0.86				0.15	0.85	0.73	0.98	0.90	1.08				

Amgen Rhondda Ltd. - Nant-y-Gwyddon Landfill Site
Monthly Sub-surface Landfill Gas Monitoring 2018

Gas Monitoring borehole No. 6

2018

Determinand	Jan 19.01.18	Feb 22.02/.18	March 13.03.18	April 18.04.18	May 23.05.18	June 18.06.18	July 20.07.18	Aug 29.08.18	Sept 24.09.18	Oct 22.10.18	Nov 14.11.18	Dec 03.12.18	COUNT	MAX	MIN	AVGE
Depth (m)	8.63	8.67	8.67	8.59	8.60			8.6	8.60	8.6	8.60					
Depth to WT (m)	DRY	DRY	DRY	DRY	DRY			DRY	DRY	DRY	DRY		9	DRY	DRY	DRY
Level																

2019

Determinand	Jan 17.01.19	Feb 18.02.19	March 22.03.19	April 23.04.19	May 21.05.19	June 24.06.19	July 16.07.19	Aug 20.08.19	Sept 18.09.19	Oct 16.10.19	Nov 18.11.19	Dec	COUNT	MAX	MIN	AVGE
Depth (m)			8.68		8.65		8.65	8.7	8.60	8.5	8.60	8.6				
Depth to WT (m)			DRY		DRY		DRY	DRY	DRY	DRY	Dry	DRY	7	DRY	DRY	DRY
Level																

Amgen Rhondda Ltd. - Nant-y-Gwyddon Landfill Site
Monthly Sub-surface Landfill Gas Monitoring 2018

Gas Monitoring borehole No. 7

2018

Determinand	Jan 19.01.18	Feb 22.02.18	Mar 13.03.18	Apr 18.04.18	May 23.05.18	Jun 18.06.18	Jul 20.07.18	Aug 29.08.18	Sep 24.09.18	Oct 22.10.18	Nov 14.11.18	Dec 03.12.18	COUNT	MAX	MIN	AVGE
Depth (m)	13.15	13.32	13.30	13.20	13.3				13.20	13.20	13.20					
Depth to WT (m)	DRY	DRY	DRY	DRY	DRY				DRY	DRY	DRY		9	DRY	DRY	DRY
Level																

2019

Determinand	Jan 17.01.19	Feb 18.02.19	Mar 22.03.19	Apr 23.04.19	May 21.05.19	Jun 24.06.19	Jul 16.07.19	Aug 20.08.19	Sep 18.09.19	Oct 16.10.2019	Nov 18.11.19	Dec	COUNT	MAX	MIN	AVGE
Depth (m)			13.20		13.2		13.20	13.20	13.10	13.20	13.25	13.2				
Depth to WT (m)			DRY		DRY		DRY	DRY	DRY	DRY	Dry	DRY	7	DRY	DRY	DRY
Level																

Amgen Rhondda Ltd. - Nant-y-Gwyddon Landfill Site
Monthly Sub-surface Landfill Gas Monitoring 2018

Gas Monitoring borehole No. 8

2018

Determinand	Jan 19.01.18	Feb 22.02.18	Mar 13.03.18	April 18.04.18	May 23.05.18	June 18.06.18	July 20.07.18	Aug 29.08.18	Sept 24.09.18	Oct 22.10.18	Nov 14.11.18	Dec 03.12.18	COUNT	MAX	MIN	AVGE
Depth (m)	8.30	8.15	8.15	8.25	8.10			8.15	8.15	8.15	8.30					
Depth to WT (m)	DRY	DRY	DRY	DRY	6.5			DRY	6.50	6.70	7.00		9	1.65	DRY	0.67
Level					1.60				1.65	1.45	1.30					

2019

Determinand	Jan 17.01.19	Feb 18.02.19	Mar 22.03.19	April 23.04.19	May 21.05.19	June 24.06.19	July 16.07.19	Aug 20.08.19	Sept 18.09.19	Oct 16.10.19	Nov 18.11.19	Dec	COUNT	MAX	MIN	AVGE
Depth (m)			8.22		8.05		8.20	8.25	8.20	8.15	8.75	8.20				
Depth to WT (m)			6.63		6.00		6.80	6.65	6.69	6.55	6.50	6.63	7	2.25	DRY	1.94
Level			1.59		2.05		1.40	1.60	1.51	1.60	2.25	1.57				

NANT-Y-GWYDDON LANDFILL SITE RHONDDA CYNON TAF

2019 Inert Bund Stability Assessment

Appendix 2 Displacement Monitoring Survey Data 2014-2017

Report Number 1983r1v1d0320

NYG - INERT BUND MONITORING.

Inert Bund

Waste Mass

Point :	SM1							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
03/03/2003	8002.981	4142.024	327.251	0	0	0		0
14/03/2003	8002.981	4142.027	327.248	0	0.003	-0.003		-3
27/03/2003	8002.981	4142.027	327.252	0	0.003	0.001		1
03/04/2003	8002.982	4142.029	327.251	0.001	0.005	0		0
14/05/2003	8002.981	4142.025	327.248	0	0.001	-0.003		-3
30/07/2003	8002.986	4142.032	327.248	0.005	0.008	-0.003		-3
12/09/2003	8002.976	4142.029	327.251	-0.005	0.005	0		0
10/02/2004	8002.978	4142.025	327.246	-0.003	0.001	-0.005		-5
13/05/2004	8002.981	4142.036	327.242	0	0.012	-0.009		-9
01/02/2005	8002.976	4142.022	327.239	-0.005	-0.002	-0.012		-12
26/09/2005	8002.976	4142.021	327.239	-0.005	-0.003	-0.012		-12
09/11/2005	8002.975	4142.018	327.236	-0.006	-0.006	-0.015		-15
20/11/2006	8002.983	4142.021	327.235	0.002	-0.003	-0.016		-16
02/03/2007	8002.986	4142.018	327.229	0.005	-0.006	-0.022		-22
01/05/2007	8002.981	4142.024	327.229	0	0	-0.022		-22
01/12/2007	8002.991	4142.018	327.23	0.01	-0.006	-0.021		-21
10/09/2008	8002.983	4142.028	327.233	0.002	0.004	-0.018		-18
16/12/2008	8002.98	4142.021	327.233	-0.001	-0.003	-0.018		-18
18/03/2009	8002.985	4142.031	327.226	0.004	0.007	-0.025		-25
25/09/2009	8002.986	4142.041	327.226	0.005	0.017	-0.025		-25
15/10/2009	8002.995	4142.027	327.225	0.014	0.003	-0.026		-26
02/03/2010	8002.99	4142.026	327.221	0.009	0.002	-0.03		-30
15/06/2010	8002.979	4142.021	327.222	-0.002	-0.003	-0.029		-29
22/10/2010	8002.976	4142.037	327.222	-0.005	0.013	-0.029		-29
17/03/2011	8002.979	4142.031	327.218	-0.002	0.007	-0.033		-33
20/06/2011	8002.984	4142.028	327.219	0.003	0.004	-0.032		-32
28/10/2011	8002.964	4142.037	327.219	-0.017	0.013	-0.032		-32
05/03/2012	8002.98	4142.03	327.219	-0.001	0.006	-0.032		-32
10/07/2012								
06/11/2012	8002.993	4142.023	327.216	0.012	-0.001	-0.035		-35
05/03/2013	8002.985	4142.027	327.213	0.004	0.003	-0.038		-38
13/08/2013	8002.992	4142.02	327.211	0.011	-0.004	-0.04		-40
05/03/2014	8002.984	4142.016	327.21	0.003	-0.008	-0.041		-41
08/08/2014	8002.98	4142.02	327.211	-0.001	-0.004	-0.04		-40
10/02/2015	8002.981	4142.019	327.21	0	-0.005	-0.041		-41
07/08/2015	8002.977	4142.018	327.208	-0.004	-0.006	-0.043		-43
20/01/2016	8002.991	4142.018	327.208	0.01	-0.006	-0.043		-43
05/08/2016	8002.98	4142.028	327.215	-0.001	0.004	-0.036		-36
31/10/2016	8002.973	4142.026	327.215	-0.008	0.002	-0.036		-36
06/04/2017	8002.981	4142.021	327.213	0	-0.003	-0.038		-38
27/10/2017	8002.99	4142.014	327.207	0.009	-0.01	-0.044		-44
21/03/2018	8002.984	4142.014	327.213	0.003	-0.01	-0.038		-38
05/11/2018	8002.973	4142.021	327.212	-0.008	-0.003	-0.039		-39
12/04/2019	8002.989	4142.017	327.21	0.008	-0.007	-0.041		-41
21/05/2019	8002.985	4142.02	327.21	0.004	-0.004	-0.041		-41
18/11/2019	8002.977	4142.028	327.21	-0.004	0.004	-0.041		-41

Point :	SM2							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
03/03/2003	8037.469	4135.702	322.249	0	0	0		0
14/03/2003	8037.462	4135.706	322.248	-0.007	0.004	-0.001		-1
27/03/2003	8037.466	4135.699	322.252	-0.003	-0.003	0.003		3
03/04/2003	8037.466	4135.703	322.25	-0.003	0.001	0.001		1
14/05/2003	8037.467	4135.697	322.249	-0.002	-0.005	0		0
30/07/2003	8037.472	4135.704	322.25	0.003	0.002	0.001		1
12/09/2003	8037.464	4135.701	322.249	-0.005	-0.001	0		0
10/02/2004	8037.467	4135.7	322.245	-0.002	-0.002	-0.004		-4
13/05/2004	8037.462	4135.708	322.246	-0.007	0.006	-0.003		-3
01/02/2005	8037.465	4135.7	322.245	-0.004	-0.002	-0.004		-4
26/09/2005	8037.464	4135.697	322.246	-0.005	-0.005	-0.003		-3
09/11/2005	8037.466	4135.691	322.247	-0.003	-0.011	-0.002		-2
20/11/2006	8037.47	4135.698	322.25	0.001	-0.004	0.001		1
02/03/2007	8037.463	4135.702	322.245	-0.006	0	-0.004		-4
01/05/2007	8037.469	4135.705	322.241	0	0.003	-0.008		-8
01/12/2007	8037.476	4135.704	322.246	0.007	0.002	-0.003		-3
10/09/2008	8037.478	4135.698	322.246	0.009	-0.004	-0.003		-3
16/12/2008	8037.473	4135.698	322.247	0.004	-0.004	-0.002		-2
18/03/2009	8037.474	4135.711	322.241	0.005	0.009	-0.008		-8
25/09/2009	8037.474	4135.716	322.242	0.005	0.014	-0.007		-7
15/10/2009	8037.476	4135.71	322.24	0.007	0.008	-0.009		-9
02/03/2010	8037.473	4135.707	322.237	0.004	0.005	-0.012		-12
15/06/2010	8037.484	4135.71	322.236	0.015	0.008	-0.013		-13
22/10/2010	8037.472	4135.705	322.237	0.003	0.003	-0.012		-12
17/03/2011	8037.472	4135.702	322.234	0.003	0	-0.015		-15
20/06/2011	8037.473	4135.703	322.235	0.004	0.001	-0.014		-14
28/10/2011	8037.464	4135.704	322.235	-0.005	0.002	-0.014		-14
05/03/2012	8037.475	4135.697	322.236	0.006	-0.005	-0.013		-13
10/07/2012	8037.472	4135.707	322.234	0.003	0.005	-0.015		-15
06/11/2012	8037.482	4135.703	322.234	0.013	0.001	-0.015		-15
05/03/2013	8037.474	4135.697	322.233	0.005	-0.005	-0.016		-16
13/08/2013	8037.485	4135.703	322.23	0.016	0.001	-0.019		-19
05/03/2014	8037.484	4135.692	322.231	0.015	-0.01	-0.018		-18
08/08/2014	8037.485	4135.708	322.231	0.016	0.006	-0.018		-18
10/02/2015	8037.489	4135.695	322.231	0.02	-0.007	-0.018		-18
07/08/2015	8037.482	4135.706	322.229	0.013	0.004	-0.02		-20
20/01/2016	8037.481	4135.704	322.23	0.012	0.002	-0.019		-19
05/08/2016	8037.49	4135.708	322.237	0.021	0.006	-0.012		-12
31/10/2016	8037.483	4135.713	322.237	0.014	0.011	-0.012		-12
06/04/2017	8037.486	4135.696	322.236	0.017	-0.006	-0.013		-13
27/10/2017	8037.486	4135.709	322.23	0.017	0.007	-0.019		-19
21/03/2018	8037.489	4135.705	322.237	0.02	0.003	-0.012		-12
05/11/2018	8037.472	4135.71	322.235	0.003	0.008	-0.014		-14
12/04/2019	8037.478	4135.707	322.233	0.009	0.005	-0.016		-16
21/05/2019	8037.476	4135.708	322.235	0.007	0.006	-0.014		-14
18/11/2019	8037.477	4135.709	322.234	0.008	0.007	-0.015		-15

Point :	SM3							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
03/03/2003	8052.209	4110.075	323.655	0	0	0		0
14/03/2003	8052.203	4110.074	323.653	-0.006	-0.001	-0.002		-2
27/03/2003	8052.206	4110.074	323.655	-0.003	-0.001	0		0
03/04/2003	8052.204	4110.075	323.659	-0.005	0	0.004		4
14/05/2003	8052.207	4110.079	323.656	-0.002	0.004	0.001		1
30/07/2003	8052.201	4110.079	323.653	-0.008	0.004	-0.002		-2
12/09/2003	8052.198	4110.074	323.654	-0.011	-0.001	-0.001		-1
10/02/2004	8052.203	4110.071	323.648	-0.006	-0.004	-0.007		-7
13/05/2004	8052.202	4110.074	323.65	-0.007	-0.001	-0.005		-5
01/02/2005	8052.206	4110.072	323.641	-0.003	-0.003	-0.014		-14
26/09/2005	8052.2	4110.067	323.643	-0.009	-0.008	-0.012		-12
09/11/2005	8052.202	4110.059	323.639	-0.007	-0.016	-0.016		-16
20/11/2006	8052.214	4110.066	323.638	0.005	-0.009	-0.017		-17
02/03/2007	8052.207	4110.073	323.636	-0.002	-0.002	-0.019		-19
01/05/2007	8052.207	4110.074	323.632	-0.002	-0.001	-0.023		-23
01/12/2007	8052.215	4110.072	323.634	0.006	-0.003	-0.021		-21
10/09/2008	8052.218	4110.068	323.633	0.009	-0.007	-0.022		-22
16/12/2008	8052.217	4110.066	323.633	0.008	-0.009	-0.022		-22
18/03/2009	8052.21	4110.069	323.626	0.001	-0.006	-0.029		-29
25/09/2009	8052.207	4110.08	323.624	-0.002	0.005	-0.031		-31
15/10/2009	8052.213	4110.069	323.624	0.004	-0.006	-0.031		-31
02/03/2010	8052.21	4110.077	323.621	0.001	0.002	-0.034		-34
15/06/2010	8052.234	4110.066	323.618	0.025	-0.009	-0.037		-37
22/10/2010	8052.216	4110.07	323.618	0.007	-0.005	-0.037		-37
17/03/2011	8052.218	4110.073	323.616	0.009	-0.002	-0.039		-39
20/06/2011	8052.226	4110.07	323.617	0.017	-0.005	-0.038		-38
28/10/2011	8052.209	4110.065	323.616	0	-0.01	-0.039		-39
05/03/2012	8052.223	4110.068	323.616	0.014	-0.007	-0.039		-39
10/07/2012	8052.217	4110.067	323.613	0.008	-0.008	-0.042		-42
06/11/2012	8052.215	4110.068	323.612	0.006	-0.007	-0.043		-43
05/03/2013	8052.214	4110.066	323.611	0.005	-0.009	-0.044		-44
13/08/2013	8052.234	4110.061	323.608	0.025	-0.014	-0.047		-47
05/03/2014	8052.229	4110.072	323.607	0.02	-0.003	-0.048		-48
08/08/2014	8052.227	4110.07	323.607	0.018	-0.005	-0.048		-48
10/02/2015	8052.222	4110.066	323.606	0.013	-0.009	-0.049		-49
07/08/2015	8052.222	4110.064	323.602	0.013	-0.011	-0.053		-53
20/01/2016	8052.23	4110.07	323.603	0.021	-0.005	-0.052		-52
05/08/2016	8052.231	4110.063	323.609	0.022	-0.012	-0.046		-46
31/10/2016	8052.224	4110.067	323.609	0.015	-0.008	-0.046		-46
06/04/2017	8052.223	4110.066	323.605	0.014	-0.009	-0.05		-50
27/10/2017	8052.229	4110.067	323.6	0.02	-0.008	-0.055		-55
21/03/2018	8052.225	4110.067	323.606	0.016	-0.008	-0.049		-49
05/11/2018	8052.224	4110.068	323.603	0.015	-0.007	-0.052		-52
12/04/2019	8052.213	4110.071	323.602	0.004	-0.004	-0.053		-53
21/05/2019	8052.218	4110.072	323.602	0.009	-0.003	-0.053		-53
18/11/2019	8052.216	4110.069	323.6	0.007	-0.006	-0.055		-55

Point :	SM4							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
03/03/2003	8067.863	4078.468	324.601	0	0	0		0
14/03/2003	8067.856	4078.469	324.597	-0.007	0.001	-0.004		-4
27/03/2003	8067.857	4078.468	324.602	-0.006	0	0.001		1
03/04/2003	8067.858	4078.469	324.606	-0.005	0.001	0.005		5
14/05/2003	8067.86	4078.472	324.603	-0.003	0.004	0.002		2
30/07/2003	8067.853	4078.474	324.596	-0.01	0.006	-0.005		-5
12/09/2003	8067.849	4078.474	324.596	-0.014	0.006	-0.005		-5
10/02/2004	8067.855	4078.469	324.593	-0.008	0.001	-0.008		-8
13/05/2004	8067.866	4078.467	324.589	0.003	-0.001	-0.012		-12
01/02/2005	8067.852	4078.468	324.584	-0.011	0	-0.017		-17
26/09/2005	8067.852	4078.459	324.585	-0.011	-0.009	-0.016		-16
09/11/2005	8067.855	4078.459	324.58	-0.008	-0.009	-0.021		-21
20/11/2006	8067.867	4078.468	324.582	0.004	0	-0.019		-19
02/03/2007	8067.855	4078.473	324.575	-0.008	0.005	-0.026		-26
01/05/2007	8067.855	4078.469	324.572	-0.008	0.001	-0.029		-29
01/12/2007	8067.866	4078.473	324.57	0.003	0.005	-0.031		-31
10/09/2008	8067.88	4078.472	324.573	0.017	0.004	-0.028		-28
16/12/2008	8067.874	4078.469	324.573	0.011	0.001	-0.028		-28
18/03/2009	8067.868	4078.47	324.565	0.005	0.002	-0.036		-36
25/09/2009	8067.851	4078.482	324.564	-0.012	0.014	-0.037		-37
15/10/2009	8067.875	4078.468	324.563	0.012	0	-0.038		-38
02/03/2010	8067.863	4078.472	324.56	0	0.004	-0.041		-41
15/06/2010	8067.896	4078.473	324.555	0.033	0.005	-0.046		-46
22/10/2010	8067.875	4078.471	324.557	0.012	0.003	-0.044		-44
17/03/2011	8067.877	4078.475	324.554	0.014	0.007	-0.047		-47
20/06/2011	8067.882	4078.471	324.554	0.019	0.003	-0.047		-47
28/10/2011	8067.867	4078.468	324.554	0.004	0	-0.047		-47
05/03/2012	8067.874	4078.471	324.554	0.011	0.003	-0.047		-47
10/07/2012	8067.876	4078.473	324.549	0.013	0.005	-0.052		-52
06/11/2012	8067.868	4078.471	324.547	0.005	0.003	-0.054		-54
05/03/2013	8067.871	4078.471	324.546	0.008	0.003	-0.055		-55
13/08/2013	8067.892	4078.466	324.544	0.029	-0.002	-0.057		-57
05/03/2014	8067.885	4078.472	324.541	0.022	0.004	-0.06		-60
08/08/2014	8067.885	4078.477	324.541	0.022	0.009	-0.06		-60
10/02/2015	8067.88	4078.47	324.54	0.017	0.002	-0.061		-61
07/08/2015	8067.879	4078.468	324.537	0.016	0	-0.064		-64
20/01/2016	8067.886	4078.469	324.537	0.023	0.001	-0.064		-64
05/08/2016	8067.889	4078.471	324.543	0.026	0.003	-0.058		-58
31/10/2016	8067.877	4078.467	324.543	0.014	-0.001	-0.058		-58
06/04/2017	8067.873	4078.47	324.539	0.01	0.002	-0.062		-62
27/10/2017	8067.87	4078.474	324.535	0.007	0.006	-0.066		-66
21/03/2018	8067.885	4078.467	324.54	0.022	-0.001	-0.061		-61
05/11/2018	8067.866	4078.472	324.536	0.003	0.004	-0.065		-65
12/04/2019	8067.869	4078.477	324.533	0.006	0.009	-0.068		-68
21/05/2019	8067.874	4078.48	324.534	0.011	0.012	-0.067		-67
18/11/2019	8067.876	4078.472	324.533	0.013	0.004	-0.068		-68

Point :	SM5							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
03/03/2003	8081.955	4051.305	326.232	0	0	0		0
14/03/2003	8081.944	4051.305	326.229	-0.011	0	-0.003		-3
27/03/2003	8081.95	4051.3	326.234	-0.005	-0.005	0.002		2
03/04/2003	8081.947	4051.301	326.233	-0.008	-0.004	0.001		1
14/05/2003	8081.95	4051.299	326.232	-0.005	-0.006	0		0
30/07/2003	8081.947	4051.309	326.234	-0.008	0.004	0.002		2
12/09/2003	8081.945	4051.305	326.234	-0.01	0	0.002		2
10/02/2004	8081.948	4051.3	326.226	-0.007	-0.005	-0.006		-6
13/05/2004	8081.949	4051.309	326.226	-0.006	0.004	-0.006		-6
01/02/2005	8081.954	4051.299	326.217	-0.001	-0.006	-0.015		-15
26/09/2005	8081.952	4051.298	326.219	-0.003	-0.007	-0.013		-13
09/11/2005	8081.958	4051.291	326.217	0.003	-0.014	-0.015		-15
20/11/2006	8081.968	4051.303	326.206	0.013	-0.002	-0.026		-26
02/03/2007	8081.957	4051.307	326.221	0.002	0.002	-0.011		-11
01/05/2007	8081.964	4051.313	326.209	0.009	0.008	-0.023		-23
01/12/2007	8081.968	4051.313	326.212	0.013	0.008	-0.02		-20
10/09/2008	8081.982	4051.311	326.21	0.027	0.006	-0.022		-22
16/12/2008	8081.972	4051.308	326.212	0.017	0.003	-0.02		-20
18/03/2009	8081.959	4051.314	326.204	0.004	0.009	-0.028		-28
25/09/2009	8081.949	4051.326	326.202	-0.006	0.021	-0.03		-30
15/10/2009	8081.972	4051.315	326.202	0.017	0.01	-0.03		-30
02/03/2010	8081.969	4051.314	326.199	0.014	0.009	-0.033		-33
15/06/2010	8081.997	4051.314	326.196	0.042	0.009	-0.036		-36
22/10/2010	8081.984	4051.314	326.197	0.029	0.009	-0.035		-35
17/03/2011	8081.98	4051.318	326.193	0.025	0.013	-0.039		-39
20/06/2011	8081.989	4051.316	326.197	0.034	0.011	-0.035		-35
28/10/2011	8081.958	4051.314	326.195	0.003	0.009	-0.037		-37
05/03/2012	8081.986	4051.318	326.195	0.031	0.013	-0.037		-37
10/07/2012	8081.975	4051.317	326.191	0.02	0.012	-0.041		-41
06/11/2012	8081.977	4051.319	326.193	0.022	0.014	-0.039		-39
05/03/2013	8081.981	4051.316	326.19	0.026	0.011	-0.042		-42
13/08/2013	8082.001	4051.31	326.187	0.046	0.005	-0.045		-45
05/03/2014	8081.996	4051.321	326.186	0.041	0.016	-0.046		-46
08/08/2014	8081.991	4051.326	326.184	0.036	0.021	-0.048		-48
10/02/2015	8081.993	4051.317	326.185	0.038	0.012	-0.047		-47
07/08/2015	8081.991	4051.316	326.181	0.036	0.011	-0.051		-51
20/01/2016	8081.994	4051.319	326.183	0.039	0.014	-0.049		-49
05/08/2016	8081.994	4051.324	326.188	0.039	0.019	-0.044		-44
31/10/2016	8081.993	4051.324	326.189	0.038	0.019	-0.043		-43
06/04/2017	8081.997	4051.322	326.186	0.042	0.017	-0.046		-46
27/10/2017	8081.993	4051.324	326.18	0.038	0.019	-0.052		-52
21/03/2018	8082.006	4051.323	326.186	0.051	0.018	-0.046		-46
05/11/2018	8081.991	4051.325	326.185	0.036	0.02	-0.047		-47
12/04/2019	8081.982	4051.326	326.183	0.027	0.021	-0.049		-49
21/05/2019	8081.997	4051.326	326.182	0.042	0.021	-0.05		-50
18/11/2019	8081.982	4051.325	326.183	0.027	0.02	-0.049		-49

Point :	SM6							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
03/03/2003	8099.41	4018.254	327.617	0	0	0		0
14/03/2003	8099.404	4018.254	327.615	-0.006	0	-0.002		-2
27/03/2003	8099.413	4018.253	327.618	0.003	-0.001	0.001		1
03/04/2003	8099.409	4018.255	327.621	-0.001	0.001	0.004		4
14/05/2003	8099.414	4018.258	327.619	0.004	0.004	0.002		2
30/07/2003	8099.407	4018.261	327.615	-0.003	0.007	-0.002		-2
12/09/2003	8099.403	4018.257	327.616	-0.007	0.003	-0.001		-1
10/02/2004	8099.406	4018.251	327.612	-0.004	-0.003	-0.005		-5
13/05/2004	8099.407	4018.249	327.613	-0.003	-0.005	-0.004		-4
01/02/2005	8099.415	4018.262	327.601	0.005	0.008	-0.016		-16
26/09/2005	8099.41	4018.25	327.604	0	-0.004	-0.013		-13
09/11/2005	8099.416	4018.243	327.603	0.006	-0.011	-0.014		-14
20/11/2006	8099.428	4018.258	327.602	0.018	0.004	-0.015		-15
02/03/2007	8099.412	4018.26	327.601	0.002	0.006	-0.016		-16
01/05/2007	8099.423	4018.264	327.596	0.013	0.01	-0.021		-21
01/12/2007	8099.425	4018.262	327.605	0.015	0.008	-0.012		-12
10/09/2008	8099.434	4018.261	327.603	0.024	0.007	-0.014		-14
16/12/2008	8099.436	4018.257	327.604	0.026	0.003	-0.013		-13
18/03/2009	8099.419	4018.259	327.597	0.009	0.005	-0.02		-20
25/09/2009	8099.403	4018.27	327.594	-0.007	0.016	-0.023		-23
15/10/2009	8099.429	4018.26	327.595	0.019	0.006	-0.022		-22
02/03/2010	8099.417	4018.267	327.592	0.007	0.013	-0.025		-25
15/06/2010	8099.462	4018.267	327.589	0.052	0.013	-0.028		-28
22/10/2010	8099.44	4018.262	327.593	0.03	0.008	-0.024		-24
17/03/2011	8099.441	4018.266	327.588	0.031	0.012	-0.029		-29
20/06/2011	8099.445	4018.261	327.59	0.035	0.007	-0.027		-27
28/10/2011	8099.419	4018.26	327.589	0.009	0.006	-0.028		-28
05/03/2012	8099.43	4018.263	327.59	0.02	0.009	-0.027		-27
10/07/2012	8099.43	4018.263	327.586	0.02	0.009	-0.031		-31
06/11/2012	8099.438	4018.265	327.587	0.028	0.011	-0.03		-30
05/03/2013	8099.433	4018.262	327.585	0.023	0.008	-0.032		-32
13/08/2013	8099.453	4018.261	327.582	0.043	0.007	-0.035		-35
05/03/2014	8099.456	4018.272	327.582	0.046	0.018	-0.035		-35
08/08/2014	8099.447	4018.268	327.58	0.037	0.014	-0.037		-37
10/02/2015	8099.449	4018.265	327.582	0.039	0.011	-0.035		-35
07/08/2015	8099.45	4018.262	327.579	0.04	0.008	-0.038		-38
20/01/2016	8099.448	4018.266	327.58	0.038	0.012	-0.037		-37
05/08/2016	8099.45	4018.272	327.585	0.04	0.018	-0.032		-32
31/10/2016	8099.446	4018.275	327.586	0.036	0.021	-0.031		-31
06/04/2017	8099.442	4018.266	327.584	0.032	0.012	-0.033		-33
27/10/2017	8099.453	4018.267	327.578	0.043	0.013	-0.039		-39
21/03/2018	8099.457	4018.269	327.583	0.047	0.015	-0.034		-34
05/11/2018	8099.444	4018.264	327.583	0.034	0.01	-0.034		-34
12/04/2019	8099.444	4018.273	327.579	0.034	0.019	-0.038		-38
21/05/2019	8099.448	4018.275	327.58	0.038	0.021	-0.037		-37
18/11/2019	8099.429	4018.27	327.581	0.019	0.016	-0.036		-36

Point :	SM7							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
03/03/2003	8078.372	4010.557	333.221	0	0	0		0
14/03/2003	8078.36	4010.558	333.217	-0.012	0.001	-0.004		-4
27/03/2003	8078.368	4010.557	333.224	-0.004	0	0.003		3
03/04/2003	8078.364	4010.562	333.222	-0.008	0.005	0.001		1
14/05/2003	8078.371	4010.558	333.217	-0.001	0.001	-0.004		-4
30/07/2003	8078.368	4010.565	333.208	-0.004	0.008	-0.013		-13
12/09/2003	8078.365	4010.563	333.202	-0.007	0.006	-0.019		-19
10/02/2004	8078.372	4010.561	333.183	0	0.004	-0.038		-38
13/05/2004	8078.368	4010.574	333.171	-0.004	0.017	-0.05		-50
01/02/2005	8078.385	4010.593	333.14	0.013	0.036	-0.081		-81
26/09/2005	8078.377	4010.56	333.12	0.005	0.003	-0.101		-101
09/11/2005	8078.384	4010.559	333.118	0.012	0.002	-0.103		-103
20/11/2006	8078.389	4010.571	333.073	0.017	0.014	-0.148		-148
02/03/2007	8078.382	4010.583	333.078	0.01	0.026	-0.143		-143
01/05/2007	8078.384	4010.58	333.082	0.012	0.023	-0.139		-139
01/12/2007	8078.402	4010.579	333.099	0.03	0.022	-0.122		-122
10/09/2008	8078.407	4010.578	333.061	0.035	0.021	-0.16		-160
16/12/2008	8078.4	4010.574	333.057	0.028	0.017	-0.164		-164
18/03/2009	8078.387	4010.577	333.048	0.015	0.02	-0.173		-173
25/09/2009	8078.374	4010.591	333.041	0.002	0.034	-0.18		-180
15/10/2009	8078.406	4010.576	333.04	0.034	0.019	-0.181		-181
02/03/2010	8078.388	4010.591	333.033	0.016	0.034	-0.188		-188
15/06/2010	8078.436	4010.585	333.027	0.064	0.028	-0.194		-194
22/10/2010	8078.407	4010.58	333.026	0.035	0.023	-0.195		-195
17/03/2011	8078.409	4010.584	333.019	0.037	0.027	-0.202		-202
20/06/2011	8078.406	4010.581	333.017	0.034	0.024	-0.204		-204
28/10/2011	8078.391	4010.578	333.011	0.019	0.021	-0.21		-210
05/03/2012	8078.413	4010.585	333.01	0.041	0.028	-0.211		-211
10/07/2012	8078.404	4010.581	333.005	0.032	0.024	-0.216		-216
06/11/2012	8078.402	4010.586	333.001	0.03	0.029	-0.22		-220
05/03/2013	8078.406	4010.585	332.998	0.034	0.028	-0.223		-223
13/08/2013	8078.435	4010.58	332.991	0.063	0.023	-0.23		-230
05/03/2014	8078.427	4010.588	332.988	0.055	0.031	-0.233		-233
08/08/2014	8078.422	4010.592	332.982	0.05	0.035	-0.239		-239
10/02/2015	8078.42	4010.581	332.981	0.048	0.024	-0.24		-240
07/08/2015	8078.428	4010.58	332.974	0.056	0.023	-0.247		-247
20/01/2016	8078.428	4010.587	332.974	0.056	0.03	-0.247		-247
05/08/2016	8078.427	4010.588	332.975	0.055	0.031	-0.246		-246
31/10/2016	8078.404	4010.594	332.975	0.032	0.037	-0.246		-246
06/04/2017	8078.425	4010.586	332.968	0.053	0.029	-0.253		-253
27/10/2017	8078.428	4010.589	332.963	0.056	0.032	-0.258		-258
21/03/2018	8078.443	4010.593	332.967	0.071	0.036	-0.254		-254
05/11/2018	8078.415	4010.583	332.96	0.043	0.026	-0.261		-261
12/04/2019	8078.425	4010.599	332.954	0.053	0.042	-0.267		-267
21/05/2019	8078.427	4010.596	332.956	0.055	0.039	-0.265		-265
18/11/2019	8078.411	4010.591	332.952	0.039	0.034	-0.269		-269

Point :	SM8							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
03/03/2003	8063.992	4036.165	332.122	0	0	0		0
14/03/2003	8063.98	4036.166	332.117	-0.012	0.001	-0.005		-5
27/03/2003	8063.989	4036.166	332.119	-0.003	0.001	-0.003		-3
03/04/2003	8063.99	4036.171	332.12	-0.002	0.006	-0.002		-2
14/05/2003	8063.988	4036.164	332.111	-0.004	-0.001	-0.011		-11
30/07/2003	8063.991	4036.173	332.103	-0.001	0.008	-0.019		-19
12/09/2003	8063.984	4036.172	332.098	-0.008	0.007	-0.024		-24
10/02/2004	8063.991	4036.168	332.069	-0.001	0.003	-0.053		-53
13/05/2004	8063.994	4036.174	332.055	0.002	0.009	-0.067		-67
01/02/2005	8063.995	4036.153	332.024	0.003	-0.012	-0.098		-98
26/09/2005	8064	4036.161	332.011	0.008	-0.004	-0.111		-111
09/11/2005	8064.005	4036.16	332.007	0.013	-0.005	-0.115		-115
20/11/2006	8064.021	4036.171	331.982	0.029	0.006	-0.14		-140
02/03/2007	8064.003	4036.176	331.98	0.011	0.011	-0.142		-142
01/05/2007	8064.009	4036.179	331.978	0.017	0.014	-0.144		-144
01/12/2007	8064.017	4036.179	331.991	0.025	0.014	-0.131		-131
10/09/2008	8064.017	4036.179	331.968	0.025	0.014	-0.154		-154
16/12/2008	8064.022	4036.174	331.967	0.03	0.009	-0.155		-155
18/03/2009	8064.007	4036.178	331.958	0.015	0.013	-0.164		-164
25/09/2009	8064.001	4036.193	331.951	0.009	0.028	-0.171		-171
15/10/2009	8064.019	4036.177	331.951	0.027	0.012	-0.171		-171
02/03/2010	8064.013	4036.191	331.945	0.021	0.026	-0.177		-177
15/06/2010	8064.049	4036.179	331.94	0.057	0.014	-0.182		-182
22/10/2010	8064.026	4036.18	331.942	0.034	0.015	-0.18		-180
17/03/2011	8064.023	4036.183	331.934	0.031	0.018	-0.188		-188
20/06/2011	8064.025	4036.179	331.934	0.033	0.014	-0.188		-188
28/10/2011	8064.036	4036.181	331.93	0.044	0.016	-0.192		-192
05/03/2012	8064.026	4036.182	331.927	0.034	0.017	-0.195		-195
10/07/2012	8064.019	4036.182	331.923	0.027	0.017	-0.199		-199
06/11/2012	8064.024	4036.182	331.921	0.032	0.017	-0.201		-201
05/03/2013	8064.028	4036.184	331.918	0.036	0.019	-0.204		-204
13/08/2013	8064.05	4036.176	331.914	0.058	0.011	-0.208		-208
05/03/2014	8064.038	4036.183	331.91	0.046	0.018	-0.212		-212
08/08/2014	8064.031	4036.187	331.907	0.039	0.022	-0.215		-215
10/02/2015	8064.033	4036.18	331.906	0.041	0.015	-0.216		-216
07/08/2015	8064.043	4036.18	331.902	0.051	0.015	-0.22		-220
20/01/2016	8064.044	4036.183	331.899	0.052	0.018	-0.223		-223
05/08/2016	8064.042	4036.189	331.903	0.05	0.024	-0.219		-219
31/10/2016	8064.032	4036.187	331.904	0.04	0.022	-0.218		-218
06/04/2017	8064.036	4036.187	331.898	0.044	0.022	-0.224		-224
27/10/2017	8064.046	4036.186	331.89	0.054	0.021	-0.232		-232
21/03/2018	8064.048	4036.187	331.895	0.056	0.022	-0.227		-227
05/11/2018	8064.031	4036.184	331.892	0.039	0.019	-0.23		-230
12/04/2019	8064.034	4036.196	331.887	0.042	0.031	-0.235		-235
21/05/2019	8064.033	4036.199	331.888	0.041	0.034	-0.234		-234
18/11/2019	8064.024	4036.193	331.886	0.032	0.028	-0.236		-236

Point :	SM9							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
03/03/2003	8048.209	4061.376	331.668	0	0	0.000		0.000
14/03/2003	8048.201	4061.383	331.665	-0.008	0.007	-0.003		-3.000
27/03/2003	8048.204	4061.376	331.664	-0.005	0	-0.004		-4.000
03/04/2003	8048.206	4061.381	331.663	-0.003	0.005	-0.005		-5.000
14/05/2003	8048.208	4061.379	331.653	-0.001	0.003	-0.015		-15.000
30/07/2003	8048.204	4061.386	331.639	-0.005	0.01	-0.029		-29.000
12/09/2003	8048.196	4061.379	331.63	-0.013	0.003	-0.038		-38.000
10/02/2004	8048.194	4061.372	331.584	-0.015	-0.004	-0.084		-84.000
13/05/2004	8048.198	4061.374	331.567	-0.011	-0.002	-0.101		-101.000
01/02/2005	8048.2	4061.375	331.515	-0.009	-0.001	-0.153		-153.000
26/09/2005	8048.193	4061.363	331.489	-0.016	-0.013	-0.179		-179.000
09/11/2005	8048.197	4061.36	331.477	-0.012	-0.016	-0.191		-191.000
20/11/2006	8048.222	4061.368	331.443	0.013	-0.008	-0.225		-225.000
02/03/2007	8048.195	4061.372	331.427	-0.014	-0.004	-0.241		-241.000
01/05/2007	8048.204	4061.383	331.419	-0.005	0.007	-0.249		-249.000
01/12/2007	8048.206	4061.373	331.435	-0.003	-0.003	-0.233		-233.000
10/09/2008	8048.205	4061.367	331.393	-0.004	-0.009	-0.275		-275.000
16/12/2008	8048.209	4061.364	331.389	0	-0.012	-0.279		-279.000
18/03/2009	8048.204	4061.367	331.377	-0.005	-0.009	-0.291		-291.000
25/09/2009	8048.202	4061.376	331.368	-0.007	0	-0.300		-300.000
15/10/2009	8048.214	4061.363	331.366	0.005	-0.013	-0.302		-302.000
02/03/2010	8048.208	4061.364	331.358	-0.001	-0.012	-0.310		-310.000
15/06/2010	8048.23	4061.357	331.351	0.021	-0.019	-0.317		-317.000
22/10/2010	8048.208	4061.365	331.348	-0.001	-0.011	-0.320		-320.000
17/03/2011	8048.211	4061.364	331.339	0.002	-0.012	-0.329		-329.000
20/06/2011	8048.211	4061.362	331.338	0.002	-0.014	-0.330		-330.000
28/10/2011	8048.221	4061.363	331.332	0.012	-0.013	-0.336		-336.000
05/03/2012	8048.219	4061.372	331.328	0.01	-0.004	-0.340		-340.000
10/07/2012	8048.196	4061.366	331.322	-0.013	-0.01	-0.346		-346.000
06/11/2012	8048.206	4061.366	331.32	-0.003	-0.01	-0.348		-348.000
05/03/2013	8048.214	4061.361	331.315	0.005	-0.015	-0.353		-353.000
13/08/2013	8048.226	4061.357	331.308	0.017	-0.019	-0.360		-360.000
05/03/2014	8048.228	4061.363	331.302	0.019	-0.013	-0.366		-366.000
08/08/2014	8048.217	4061.363	331.299	0.008	-0.013	-0.369		-369.000
10/02/2015	8048.217	4061.357	331.294	0.008	-0.019	-0.374		-374.000
07/08/2015	8048.225	4061.353	331.288	0.016	-0.023	-0.380		-380.000
20/01/2016	8048.237	4061.351	331.285	0.028	-0.025	-0.383		-383.000
05/08/2016	8048.226	4061.363	331.287	0.017	-0.013	-0.381		-381.000
31/10/2016	8048.208	4061.358	331.287	-0.001	-0.018	-0.381		-381.000
01/11/2016	8048.221	4061.352	331.28	0.012	-0.024	-0.388		-388.000
27/10/2017	8048	4061.354	331.271	-0.209	-0.022	-0.397		-397.000
21/03/2018	8048.23	4061.355	331.275	0.021	-0.021	-0.393		-393.000
05/11/2018	8048.214	4061.358	331.269	0.005	-0.018	-0.399		-399.000
12/04/2019	8048.217	4061.369	331.263	0.008	-0.007	-0.405		-405.000
21/05/2019	8048.22	4061.362	331.265	0.011	-0.014	-0.403		-403.000
18/11/2019	8048.213	4061.36	331.261	0.004	-0.016	-0.407		-407.000

Point :	SM10							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
03/03/2003	8039.657	4086.21	329.98	0	0	0.000		0.000
14/03/2003	8039.647	4086.204	329.977	-0.01	-0.006	-0.003		-3.000
27/03/2003	8039.654	4086.203	329.981	-0.003	-0.007	0.001		1.000
03/04/2003	8039.653	4086.206	329.977	-0.004	-0.004	-0.003		-3.000
14/05/2003	8039.655	4086.202	329.968	-0.002	-0.008	-0.012		-12.000
30/07/2003	8039.649	4086.207	329.96	-0.008	-0.003	-0.020		-20.000
12/09/2003	8039.642	4086.205	329.955	-0.015	-0.005	-0.025		-25.000
10/02/2004	8039.64	4086.201	329.925	-0.017	-0.009	-0.055		-55.000
13/05/2004	8039.638	4086.202	329.906	-0.019	-0.008	-0.074		-74.000
01/02/2005	8039.625	4086.19	329.872	-0.032	-0.02	-0.108		-108.000
26/09/2005	8039.619	4086.187	329.853	-0.038	-0.023	-0.127		-127.000
09/11/2005	8039.619	4086.185	329.845	-0.038	-0.025	-0.135		-135.000
20/11/2006	8039.647	4086.185	329.823	-0.01	-0.025	-0.157		-157.000
02/03/2007	8039.621	4086.193	329.816	-0.036	-0.017	-0.164		-164.000
01/05/2007	8039.624	4086.191	329.808	-0.033	-0.019	-0.172		-172.000
01/12/2007	8039.632	4086.195	329.821	-0.025	-0.015	-0.159		-159.000
10/09/2008	8039.626	4086.189	329.796	-0.031	-0.021	-0.184		-184.000
16/12/2008	8039.624	4086.185	329.796	-0.033	-0.025	-0.184		-184.000
18/03/2009	8039.613	4086.194	329.787	-0.044	-0.016	-0.193		-193.000
25/09/2009	8039.616	4086.2	329.781	-0.041	-0.01	-0.199		-199.000
15/10/2009	8039.631	4086.186	329.78	-0.026	-0.024	-0.200		-200.000
02/03/2010	8039.615	4086.186	329.774	-0.042	-0.024	-0.206		-206.000
15/06/2010	8039.639	4086.185	329.772	-0.018	-0.025	-0.208		-208.000
22/10/2010	8039.62	4086.184	329.77	-0.037	-0.026	-0.210		-210.000
17/03/2011	8039.615	4086.187	329.762	-0.042	-0.023	-0.218		-218.000
20/06/2011	8039.625	4086.188	329.762	-0.032	-0.022	-0.218		-218.000
28/10/2011	8039.628	4086.181	329.76	-0.029	-0.029	-0.220		-220.000
05/03/2012	8039.633	4086.183	329.758	-0.024	-0.027	-0.222		-222.000
10/07/2012	8039.614	4086.184	329.754	-0.043	-0.026	-0.226		-226.000
06/11/2012	8039.626	4086.182	329.752	-0.031	-0.028	-0.228		-228.000
05/03/2013	8039.622	4086.183	329.749	-0.035	-0.027	-0.231		-231.000
13/08/2013	8039.64	4086.175	329.745	-0.017	-0.035	-0.235		-235.000
05/03/2014	8039.633	4086.185	329.741	-0.024	-0.025	-0.239		-239.000
08/08/2014	8039.629	4086.187	329.739	-0.028	-0.023	-0.241		-241.000
10/02/2015	8039.629	4086.181	329.738	-0.028	-0.029	-0.242		-242.000
07/08/2015	8039.629	4086.177	329.733	-0.028	-0.033	-0.247		-247.000
20/01/2016	8039.635	4086.184	329.731	-0.022	-0.026	-0.249		-249.000
05/08/2016	8039.633	4086.184	329.736	-0.024	-0.026	-0.244		-244.000
31/10/2016	8039.622	4086.182	329.736	-0.035	-0.028	-0.244		-244.000
01/11/2016	8039.626	4086.182	329.732	-0.031	-0.028	-0.248		-248.000
27/10/2017	8039.642	4086.178	329.724	-0.015	-0.032	-0.256		-256.000
21/03/2018	8039.636	4086.177	329.728	-0.021	-0.033	-0.252		-252.000
05/11/2018	8039.621	4086.177	329.725	-0.036	-0.033	-0.255		-255.000
12/04/2019	8039.625	4086.19	329.72	-0.032	-0.02	-0.260		-260.000
21/05/2019	8039.619	4086.19	329.721	-0.038	-0.02	-0.259		-259.000
18/11/2019	8039.613	4086.185	329.719	-0.044	-0.025	-0.261		-261.000

Point :	SM11							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
03/03/2003	8022.002	4108.892	330.337	0	0	0.000		0.000
14/03/2003	8021.997	4108.899	330.334	-0.005	0.007	-0.003		-3.000
27/03/2003	8021.998	4108.894	330.334	-0.004	0.002	-0.003		-3.000
03/04/2003	8021.999	4108.892	330.332	-0.003	0	-0.005		-5.000
14/05/2003	8022.002	4108.89	330.319	0	-0.002	-0.018		-18.000
30/07/2003	8021.996	4108.892	330.306	-0.006	0	-0.031		-31.000
12/09/2003	8021.992	4108.889	330.298	-0.01	-0.003	-0.039		-39.000
10/02/2004	8021.988	4108.88	330.262	-0.014	-0.012	-0.075		-75.000
13/05/2004	8021.987	4108.88	330.24	-0.015	-0.012	-0.097		-97.000
01/02/2005	8021.982	4108.875	330.199	-0.02	-0.017	-0.138		-138.000
26/09/2005	8021.983	4108.874	330.186	-0.019	-0.018	-0.151		-151.000
09/11/2005	8021.981	4108.868	330.18	-0.021	-0.024	-0.157		-157.000
20/11/2006	8022.011	4108.863	330.161	0.009	-0.029	-0.176		-176.000
02/03/2007	8021.99	4108.877	330.152	-0.012	-0.015	-0.185		-185.000
01/05/2007	8021.996	4108.882	330.153	-0.006	-0.01	-0.184		-184.000
01/12/2007	8022.002	4108.874	330.157	0	-0.018	-0.18		-180.000
10/09/2008	8022.009	4108.876	330.14	0.007	-0.016	-0.197		-197.000
16/12/2008	8022.005	4108.871	330.139	0.003	-0.021	-0.198		-198.000
18/03/2009	8021.986	4108.877	330.13	-0.016	-0.015	-0.207		-207.000
25/09/2009	8021.999	4108.883	330.125	-0.003	-0.009	-0.212		-212.000
15/10/2009	8022.008	4108.872	330.125	0.006	-0.02	-0.212		-212.000
02/03/2010	8021.991	4108.876	330.119	-0.011	-0.016	-0.218		-218.000
15/06/2010	8022.02	4108.874	330.116	0.018	-0.018	-0.221		-221.000
22/10/2010	8022.001	4108.874	330.116	-0.001	-0.018	-0.221		-221.000
17/03/2011	8022.008	4108.876	330.112	0.006	-0.016	-0.225		-225.000
20/06/2011	8022.005	4108.872	330.111	0.003	-0.02	-0.226		-226.000
28/10/2011	8022.004	4108.876	330.109	0.002	-0.016	-0.228		-228.000
05/03/2012	8022.018	4108.873	330.107	0.016	-0.019	-0.23		-230.000
10/07/2012	8021.998	4108.879	330.103	-0.004	-0.013	-0.234		-234.000
06/11/2012	8022.008	4108.872	330.102	0.006	-0.02	-0.235		-235.000
05/03/2013	8022.006	4108.87	330.1	0.004	-0.022	-0.237		-237.000
13/08/2013	8022.022	4108.863	330.095	0.02	-0.029	-0.242		-242.000
05/03/2014	8022.018	4108.878	330.093	0.016	-0.014	-0.244		-244.000
08/08/2014	8022.013	4108.873	330.091	0.011	-0.019	-0.246		-246.000
10/02/2015	8022.014	4108.869	330.09	0.012	-0.023	-0.247		-247.000
07/08/2015	8022.015	4108.866	330.086	0.013	-0.026	-0.251		-251.000
20/01/2016	8022.026	4108.868	330.085	0.024	-0.024	-0.252		-252.000
05/08/2016	8022.019	4108.874	330.09	0.017	-0.018	-0.247		-247.000
31/10/2016	8022.015	4108.875	330.09	0.013	-0.017	-0.247		-247.000
06/04/2017	8022.015	4108.874	330.085	0.013	-0.018	-0.252		-252.000
27/10/2017	8022.027	4108.868	330.079	0.025	-0.024	-0.258		-258.000
21/03/2018	8022.017	4108.868	330.083	0.015	-0.024	-0.254		-254.000
05/11/2018	8022.01	4108.869	330.081	0.008	-0.023	-0.256		-256.000
12/04/2019	8022.017	4108.882	330.077	0.015	-0.01	-0.26		-260.000
21/05/2019	8022.015	4108.882	330.077	0.013	-0.01	-0.26		-260.000
18/11/2019	8022.011	4108.878	330.076	0.009	-0.014	-0.261		-261.000

Point :	SM12							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
03/03/2003	7994.817	4117.21	332.262	0	0	0.000		0.000
14/03/2003	7994.816	4117.218	332.258	-0.001	0.008	-0.004		-4.000
27/03/2003	7994.816	4117.212	332.258	-0.001	0.002	-0.004		-4.000
03/04/2003	7994.817	4117.211	332.257	0	0.001	-0.005		-5.000
14/05/2003	7994.822	4117.212	332.252	0.005	0.002	-0.01		-10.000
30/07/2003	7994.825	4117.215	332.24	0.008	0.005	-0.022		-22.000
12/09/2003	7994.82	4117.217	332.234	0.003	0.007	-0.028		-28.000
10/02/2004	7994.826	4117.216	332.213	0.009	0.006	-0.049		-49.000
13/05/2004	7994.832	4117.226	332.198	0.015	0.016	-0.064		-64.000
01/02/2005	7994.842	4117.237	332.161	0.025	0.027	-0.101		-101.000
26/09/2005	7994.838	4117.211	332.146	0.021	0.001	-0.116		-116.000
09/11/2005	7994.835	4117.206	332.143	0.018	-0.004	-0.119		-119.000
20/11/2006	7994.87	4117.203	332.119	0.053	-0.007	-0.143		-143.000
02/03/2007	7994.854	4117.218	332.107	0.037	0.008	-0.155		-155.000
01/05/2007	7994.854	4117.216	332.109	0.037	0.006	-0.153		-153.000
01/12/2007	7994.863	4117.213	332.116	0.046	0.003	-0.146		-146.000
10/09/2008	7994.863	4117.221	332.087	0.046	0.011	-0.175		-175.000
16/12/2008	7994.864	4117.224	332.085	0.047	0.014	-0.177		-177.000
18/03/2009	7994.858	4117.223	332.075	0.041	0.013	-0.187		-187.000
25/09/2009	7994.858	4117.231	332.068	0.041	0.021	-0.194		-194.000
15/10/2009	7994.874	4117.215	332.066	0.057	0.005	-0.196		-196.000
02/03/2010	7994.862	4117.213	332.06	0.045	0.003	-0.202		-202.000
15/06/2010	7994.883	4117.215	332.056	0.066	0.005	-0.206		-206.000
22/10/2010	7994.868	4117.227	332.054	0.051	0.017	-0.208		-208.000
17/03/2011	7994.868	4117.222	332.046	0.051	0.012	-0.216		-216.000
20/06/2011	7994.871	4117.211	332.045	0.054	0.001	-0.217		-217.000
28/10/2011	7994.856	4117.218	332.042	0.039	0.008	-0.22		-220.000
05/03/2012	7994.88	4117.22	332.039	0.063	0.01	-0.223		-223.000
10/07/2012	7994.863	4117.222	332.033	0.046	0.012	-0.229		-229.000
06/11/2012	7994.869	4117.213	332.03	0.052	0.003	-0.232		-232.000
05/03/2013	7994.873	4117.221	332.028	0.056	0.011	-0.234		-234.000
13/08/2013	7994.889	4117.21	332.021	0.072	0	-0.241		-241.000
05/03/2014	7994.878	4117.221	332.017	0.061	0.011	-0.245		-245.000
08/08/2014	7994.869	4117.229	332.015	0.052	0.019	-0.247		-247.000
10/02/2015	7994.872	4117.222	332.011	0.055	0.012	-0.251		-251.000
07/08/2015	7994.873	4117.22	332.007	0.056	0.01	-0.255		-255.000
20/01/2016	7994.882	4117.213	332.004	0.065	0.003	-0.258		-258.000
05/08/2016	7994.873	4117.228	332.006	0.056	0.018	-0.256		-256.000
31/10/2016	7994.863	4117.232	332.006	0.046	0.022	-0.256		-256.000
06/04/2017	7994.883	4117.219	332	0.066	0.009	-0.262		-262.000
27/10/2017	7994.882	4117.221	331.993	0.065	0.011	-0.269		-269.000
21/03/2018	7994.888	4117.223	331.995	0.071	0.013	-0.267		-267.000
05/11/2018	7994.865	4117.229	331.991	0.048	0.019	-0.271		-271.000
12/04/2019	7994.881	4117.223	331.987	0.064	0.013	-0.275		-275.000
21/05/2019	7994.872	4117.225	331.986	0.055	0.015	-0.276		-276.000
18/11/2019	7994.87	4117.229	331.984	0.053	0.019	-0.278		-278.000

Point :	SM13							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
05/03/2013	8056.063	4104.239	323.781	0	0	0		0
13/08/2013	8056.091	4104.232	323.779	0.028	-0.007	-0.002		-2
05/03/2014	8056.07	4104.243	323.777	0.007	0.004	-0.004		-4
08/08/2014	8056.078	4104.243	323.777	0.015	0.004	-0.004		-4
10/02/2015	8056.075	4104.237	323.777	0.012	-0.002	-0.004		-4
07/08/2015	8056.077	4104.24	323.774	0.014	0.001	-0.007		-7
20/01/2016	8056.082	4104.246	323.775	0.019	0.007	-0.006		-6
05/08/2016	8056.081	4104.24	323.781	0.018	0.001	0		0
31/10/2016	8056.071	4104.239	323.781	0.008	0	0		0
06/04/2017	8056.077	4104.238	323.778	0.014	-0.001	-0.003		-3
27/10/2017	8056.079	4104.238	323.773	0.016	-0.001	-0.008		-8
21/03/2018	8056.069	4104.239	323.779	0.006	0	-0.002		-2
05/11/2018	8056.065	4104.239	323.777	0.002	0	-0.004		-4
12/04/2019	8056.065	4104.247	323.775	0.002	0.008	-0.006		-6
21/05/2019	8056.063	4104.245	323.777	0	0.006	-0.004		-4
18/11/2019	8056.057	4104.244	323.775	-0.006	0.005	-0.006		-6

Point :	SM14							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
05/03/2013	8072.374	4072.909	324.584	0	0	0		0
13/08/2013	8072.392	4072.907	324.585	0.018	-0.002	0.001		1
05/03/2014	8072.375	4072.917	324.583	0.001	0.008	-0.001		-1
08/08/2014	8072.384	4072.918	324.582	0.01	0.009	-0.002		-2
10/02/2015	8072.377	4072.919	324.582	0.003	0.01	-0.002		-2
07/08/2015	8072.387	4072.911	324.577	0.013	0.002	-0.007		-7
20/01/2016	8072.387	4072.917	324.578	0.013	0.008	-0.006		-6
05/08/2016	8072.385	4072.892	324.579	0.011	-0.017	-0.005		-5
31/10/2016	8072.359	4072.899	324.581	-0.015	-0.01	-0.003		-3
06/04/2017	8072.368	4072.9	324.578	-0.006	-0.009	-0.006		-6
27/10/2017	8072.363	4072.901	324.571	-0.011	-0.008	-0.013		-13
21/03/2018	8072.374	4072.898	324.579	0	-0.011	-0.005		-5
05/11/2018	8072.361	4072.904	324.576	-0.013	-0.005	-0.008		-8
12/04/2019	8072.371	4072.905	324.573	-0.003	-0.004	-0.011		-11
21/05/2019	8072.377	4072.903	324.574	0.003	-0.006	-0.01		-10
18/11/2019	8072.367	4072.911	324.572	-0.007	0.002	-0.012		-12

Point :	SM15							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
07/08/2015	8112.411	4044.164	318.124	0	0	0		0
20/01/2016	8112.413	4044.169	318.126	0.002	0.005	0.002		2
05/08/2016	8112.408	4044.171	318.131	-0.003	0.007	0.007		7
31/10/2016	8112.399	4044.166	318.133	-0.012	0.002	0.009		9
06/04/2017	8112.405	4044.168	318.13	-0.006	0.004	0.006		6
27/10/2017	8112.412	4044.169	318.126	0.001	0.005	0.002		2
21/03/2018	8112.422	4044.171	318.132	0.011	0.007	0.008		8
05/11/2018	8112.403	4044.165	318.13	-0.008	0.001	0.006		6
12/04/2019	8112.398	4044.168	318.128	-0.013	0.004	0.004		4
21/05/2019	8112.4	4044.17	318.128	-0.011	0.006	0.004		4
18/11/2019	8112.399	4044.174	318.128	-0.012	0.01	0.004		4

Point :	SM16							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
07/08/2015	8106.379	4041.197	320.145	0	0	0		0
20/01/2016	8106.382	4041.205	320.146	0.003	0.008	0.001		1
05/08/2016	8106.38	4041.209	320.152	0.001	0.012	0.007		7
31/10/2016	8106.375	4041.204	320.154	-0.004	0.007	0.009		9
06/04/2017	8106.379	4041.204	320.152	0	0.007	0.007		7
27/10/2017	8106.383	4041.201	320.146	0.004	0.004	0.001		1
21/03/2018	8106.388	4041.203	320.153	0.009	0.006	0.008		8
05/11/2018	8106.37	4041.2	320.151	-0.009	0.003	0.006		6
12/04/2019	8106.374	4041.207	320.149	-0.005	0.01	0.004		4
21/05/2019	8106.38	4041.206	320.149	0.001	0.009	0.004		4
18/11/2019	8106.364	4041.203	320.15	-0.015	0.006	0.005		5

Point :	SM17							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
07/08/2015	8097.827	4037.517	324.627	0	0	0		0
20/01/2016	8097.835	4037.524	324.63	0.008	0.007	0.003		3
05/08/2016	8097.835	4037.528	324.633	0.008	0.011	0.006		6
31/10/2016	8097.813	4037.53	324.634	-0.014	0.013	0.007		7
06/04/2017	8097.822	4037.529	324.633	-0.005	0.012	0.006		6
27/10/2017	8097.823	4037.528	324.626	-0.004	0.011	-0.001		-1
21/03/2018	8097.837	4037.522	324.631	0.01	0.005	0.004		4
05/11/2018	8097.819	4037.522	324.63	-0.008	0.005	0.003		3
12/04/2019	8097.824	4037.536	324.628	-0.003	0.019	0.001		1
21/05/2019	8097.83	4037.531	324.628	0.003	0.014	0.001		1
18/11/2019	8097.81	4037.528	324.628	-0.017	0.011	0.001		1

Point :	SM18							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
07/08/2015	8093.094	4035.688	326.503	0	0	0		0
20/01/2016	8093.1	4035.682	326.503	0.006	-0.006	0		0
05/08/2016	8093.093	4035.693	326.503	-0.001	0.005	0		0
31/10/2016	8093.081	4035.68	326.504	-0.013	-0.008	0.001		1
06/04/2017	8093.085	4035.682	326.501	-0.009	-0.006	-0.002		-2
27/10/2017	8093.095	4035.685	326.494	0.001	-0.003	-0.009		-9
21/03/2018	8093.101	4035.682	326.5	0.007	-0.006	-0.003		-3
05/11/2018	8093.079	4035.681	326.497	-0.015	-0.007	-0.006		-6
12/04/2019	8093.085	4035.688	326.494	-0.009	0	-0.009		-9
21/05/2019	8093.091	4035.688	326.495	-0.003	0	-0.008		-8
18/11/2019	8093.074	4035.686	326.493	-0.02	-0.002	-0.01		-10

Point :	SM19							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
07/08/2015	8087.313	4033.063	328.391	0	0	0		0
20/01/2016	8087.31	4033.069	328.391	-0.003	0.006	0		0
05/08/2016	8087.305	4033.084	328.394	-0.008	0.021	0.003		3
31/10/2016	8087.302	4033.07	328.395	-0.011	0.007	0.004		4
06/04/2017	8087.308	4033.08	328.392	-0.005	0.017	0.001		1
27/10/2017	8087.307	4033.08	328.384	-0.006	0.017	-0.007		-7
21/03/2018	8087.308	4033.069	328.391	-0.005	0.006	0		0
05/11/2018	8087.303	4033.078	328.389	-0.01	0.015	-0.002		-2
12/04/2019	8087.294	4033.075	328.387	-0.019	0.012	-0.004		-4
21/05/2019	8087.302	4033.076	328.387	-0.011	0.013	-0.004		-4
18/11/2019	8087.278	4033.077	328.385	-0.035	0.014	-0.006		-6

Point :	SM20							
	Observed			Diff. / Period				
Date	Easting	Northing	Level	Easting	Northing	Level		Level Diff
07/08/2015	8067.902	4018.381	334.375	0	0	0		0
20/01/2016	8067.9	4018.386	334.375	-0.002	0.005	0		0
05/08/2016	8067.901	4018.397	334.376	-0.001	0.016	0.001		1
31/10/2016	8067.895	4018.392	334.376	-0.007	0.011	0.001		1
06/04/2017	8067.897	4018.391	334.37	-0.005	0.01	-0.005		-5
27/10/2017	8067.896	4018.389	334.361	-0.006	0.008	-0.014		-14
21/03/2018	8067.904	4018.389	334.366	0.002	0.008	-0.009		-9
05/11/2018	8067.883	4018.394	334.362	-0.019	0.013	-0.013		-13
12/04/2019	8067.893	4018.403	334.358	-0.009	0.022	-0.017		-17
21/05/2019	8067.891	4018.401	334.359	-0.011	0.02	-0.016		-16
18/11/2019	8067.886	4018.396	334.356	-0.016	0.015	-0.019		-19

NANT-Y-GWYDDON LANDFILL SITE RHONDDA CYNON TAF

2019 Inert Bund Stability Assessment

Appendix 3 Piezometer and Inclinometer Installation Details

Report Number 1983r1v1d0320

Ty Coed
Cefn-Yr-Allt
Aberdulais
Neath
SA10 8HE

Borehole Log

Borehole No.
GEO 1
Sheet 1 of 2

Project Name:	Nantygwyddon Inclinometer and Piezometer Installation	Project No. 1466	Co-ords: 298094.25 - 194032.62	Hole Type RO
Location:	Nantygwyddon Landfill, Gelli, Rhondda Cynon Taff		Level: 326.80	Scale 1:50
Client:	Amgen Rhondda Ltd		Dates: 03/02/2016 - 03/02/2016	Logged By KJT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Dark grey/brown sandy silty GRAVEL. Gravel fine to medium, sub-angular to angular, comprising brick, concrete, limestone, sandstone, and occasional ceramic. MADE GROUND

Continued on next sheet

Remarks
1. No samples taken
2. No in-situ testing
3. No water strikes

Ty Coed Cefn-Yr-Allt Aberdulais Neath SA10 8HE	# Borehole Log		Borehole No. **GEO 1** Sheet 2 of 2
Project Name: Nantygwyddon Inclinometer and Piezometer Installation	Project No. 1466	Co-ords: 298094.25 - 194032.62	Hole Type RO
Location: Nantygwyddon Landfill, Gelli, Rhondda Cynon Taff		Level: 326.80	Scale 1:50
Client: Amgen Rhondda Ltd		Dates: 03/02/2016 - 03/02/2016	Logged By KJT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					11.10	315.70		Grey very clayey GRAVEL. (Wet) WEATHERED BEDROCK
					12.00	314.80		SANDSTONE. Retrieved as fine grey powder, with occasional fine angular gravel. Occasional darker bands, probably mudstone / siltstone. (Dry) RHONDDA MEMBER SANDSTONE
					15.00	311.80		End of borehole at 15.00 m

Remarks
1. No samples taken
2. No in-situ testing
3. No water strikes

AGS

Ty Coed Cefn-Yr-Allt Aberdulais Neath SA10 8HE	# Borehole Log		Borehole No. **GEO 2** Sheet 1 of 2

Project Name:	Nantygwyddon Inclinometer and Piezometer Installation	Project No. 1466	Co-ords: 298090.73 - 194038.14	Hole Type RO
Location:	Nantygwyddon Landfill, Gelli, Rhondda Cynon Taff		Level: 326.41	Scale 1:50
Client:	Amgen Rhondda Ltd		Dates: 04/02/2016 - 04/02/2016	Logged By KJT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Black gravelly SAND speckled with white. Gravel fraction containing brick, limestone, sandstone and occasional ceramic. MADE GROUND
					2.00	324.41		Red sandy angular GRAVEL primarily comprising brick. MADE GROUND
					2.50	323.91		Dark grey/black sandy GRAVEL comprising brick, limestone, sandstone and occasional ceramic. MADE GROUND
	▼				9.20	317.21		Dark green/grey sandy gravelly CLAY becoming orange with depth. (Wet) WEATHERED BEDROCK
								Continued on next sheet

Remarks
1. No samples taken
2. No in-situ testing

AGS

Ty Coed Cefn-Yr-Allt Aberdulais Neath SA10 8HE	# Borehole Log		Borehole No. **GEO 2** Sheet 2 of 2
Project Name: Nantygwyddon Inclinometer and Piezometer Installation	Project No. 1466	Co-ords: 298090.73 - 194038.14	Hole Type RO
Location: Nantygwyddon Landfill, Gelli, Rhondda Cynon Taff		Level: 326.41	Scale 1:50
Client: Amgen Rhondda Ltd		Dates: 04/02/2016 - 04/02/2016	Logged By KJT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					10.50	315.91		Orange/brown gravelly SAND. Gravel fraction fine to medium, angular. (Dry) WEATHERED BEDROCK
					11.00	315.41		SANDSTONE. Retrieved as fine grey powder, with occasional fine angular gravel. Occasional darker bands, probably mudstone / siltstone. (Dry) RHONDDA MEMBER SANDSTONE
					13.00	313.41		End of borehole at 13.00 m

Remarks
1. No samples taken
2. No in-situ testing

AGS

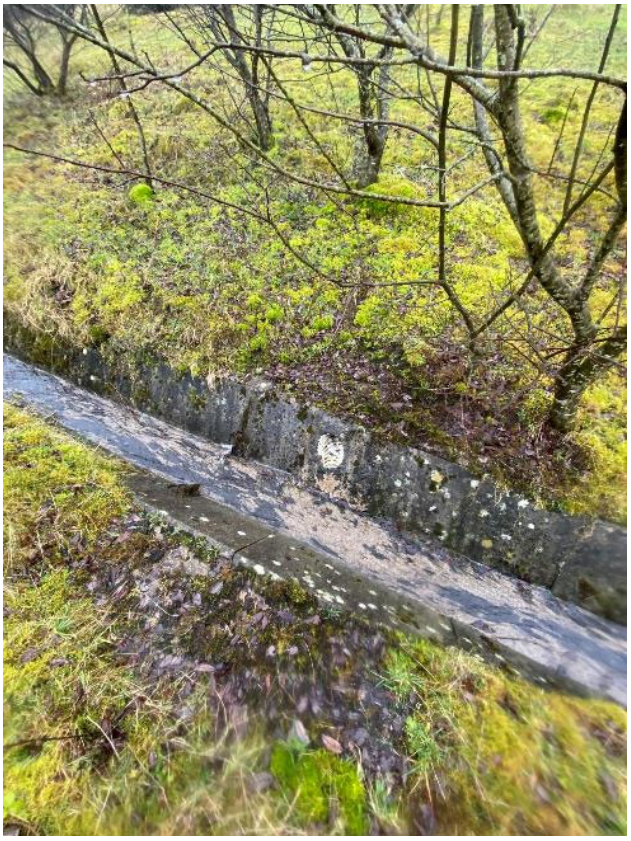
NANT-Y-GWYDDON LANDFILL SITE RHONDDA CYNON TAF

2019 Inert Bund Stability Assessment

Appendix 4
Site Photographs

Report Number 1983r1v1d0320

Concrete drainage channel



Cracks in drainage channel

GEO TECHNOLOGY	**Project:** Nantygwyddon	**Job Number:** 1983
	Client: Amgen	
	Date: February 2020	

Concrete drainage channel

Concrete drainage channel

GEO TECHNOLOGY	**Project:** Nantygwyddon	**Job Number:** 1983
	Client: Amgen	
	Date: February 2020	

Primary drainage culvert

Project:	**Nantygwyddon**	**Job Number: 1983**
Client:	**Amgen**	
Date:	**February 2020**	

Cracks in concrete drainage channel

Cracks in concrete drainage channel

Project:	**Nantygwyddon**	**Job Number: 1983**
Client:	**Amgen**	
Date:	**13 November 2019**	

Concrete drainage channel

Vegetation on Bund

Project:	**Nantygwyddon**	**Job Number: 1983**
Client:	**Amgen**	
Date:	**13 November 2019**	

Vegetation on Bund

Vegetation on Bund

Project:	**Nantygwyddon**	**Job Number: 1983**
Client:	**Amgen**	
Date:	**13 November 2019**	

Geotechnical &
Environmental Services

Ty Coed
Cefn-yr-Allt
Aberdulais
Neath SA10 8HE

T 01639 775293
F 01639 779173

enquiries@geotechnology.net
www.geotechnology.net