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Faro Mine Complex

2015 Annual Geotechnical Review

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March 30, 2016

Yukon Government
Faro Mine Remediation Project
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Karen Furlong, EIT
Project Manager

Dear Ms. Furlong:

Faro Mine Complex
2015 Annual Geotechnical Review

We are pleased to submit the report on Faro Mine Complex - 2015 Annual Geotechnical Review., including Appendix I on 2015 select site photos, Appendix II on reviewed site monitoring data, and Appendix III on instrumentation status and monitoring schedule. The current review covers the geotechnical and hydrotechnical aspects of the water management and waste storage facilities at the Faro Mine Complex. The review is based on site observations by Mr. David Willms and Ms. Kate Patterson on June 9 to June 11, 2015 and September 8 to September 10, 2015 and ongoing review of monitoring data collected by Tlicho Engineering and Environmental Services.

Yours truly,

KLOHN CRIPPEN BERGER LTD.

David Willms, P.Eng. (YT)
Project Manager

DW/KP:dl

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CLARIFICATIONS REGARDING THIS REPORT

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1 INTRODUCTION

1.1 Project Background

The Faro Mine Complex is located about 200 km north-northeast of Whitehorse, Yukon, as shown on Figure 1.1. This site consists of two mines: the Faro Mine and the Vangorda Plateau Mine. Faro Mine was in operation from 1969 to 1992. Vangorda Plateau Mine was in production between 1986 and 1998. The Faro Mine Complex was managed by court-appointed interim receiver Deloitte & Touche from 1998 to 2008. Since 2009 the site has been managed by the Yukon Government (YG). Denison Environmental Services (DES) carried out ongoing care, maintenance, and environmental protection activities between 2009 and 2011. These activities were focussed on a seasonal pumping and water treatment program for the Faro and Vangorda open pits, and inspection and maintenance of water and waste retention and water diversion structures. The role of DES was undertaken by Tlicho Engineering and Environmental Services (TEES) in 2012.

There are three main waste and water retention dams (Intermediate Dam, Cross Valley Dam and Little Creek Dam) in the Faro Mine Complex covered by the Operations, Maintenance and Surveillance (OMS) Manual (KCB 2014b). In addition to these three dams, three water diversion structures, (Faro Creek Diversion Channel, Rose Creek Diversion Channel, and Vangorda Creek Diversion Flume), are covered in the Emergency Response Plan (ERP) (KCB 2014c). The Intermediate Dam and Cross Valley Dams are located in the Rose Creek Valley and were constructed between 1981 and 1991 to form the Down Valley tailings area (Golder 1980, 1981, 1982, 1983, 1990a, 1990b and 1992). The Little Creek Dam, constructed in 1991 with a spillway added in 1998, is located adjacent to Vangorda Creek to capture water discharging from the Vangorda Waste Rock Dump (SRK 1990 and 1998).

The annual geotechnical review reports for the mine contain a summary of the site observations, provide the instrumentation monitoring data, and note recommendations for operation and maintenance for the coming year. These reports have been prepared by Golder Associates Ltd. (Golder 1996 to 1999, 2010, 2011), BGC Engineering (BGC 2000 to 2009), and SRK Consulting Engineers (SRK 1996 to 2011). Geo-Engineering (MST 1999) conducted an independent review for government agencies. The annual reviews for 2011-2014 were completed by Klohn Crippen Berger (KCB 2012-2013 and 2014d).

In September 2014 Worley Parsons conducted a dam safety review (DSR) for the Intermediate Dam, Cross Valley Dam and Little Creek Dam with a site visit on September 25 and 26, 2014 (Worley Parsons 2015). Worley Parsons concluded that all three dams should be classified as “high” consequence. In response, YG, TEES, and KCB updated the Emergency Response Plan (ERP) in draft (KCB 2015b), and plan to issue the update of both the ERP and OMS Manual in 2016. The updated ERP document also included three diversion channels: Faro Creek Diversion Channel, Rose Creek Diversion Channel, and Vangorda Creek Diversion Flume.

A list of design references for the dams and a summary of the designs are given in the OMS Manual.

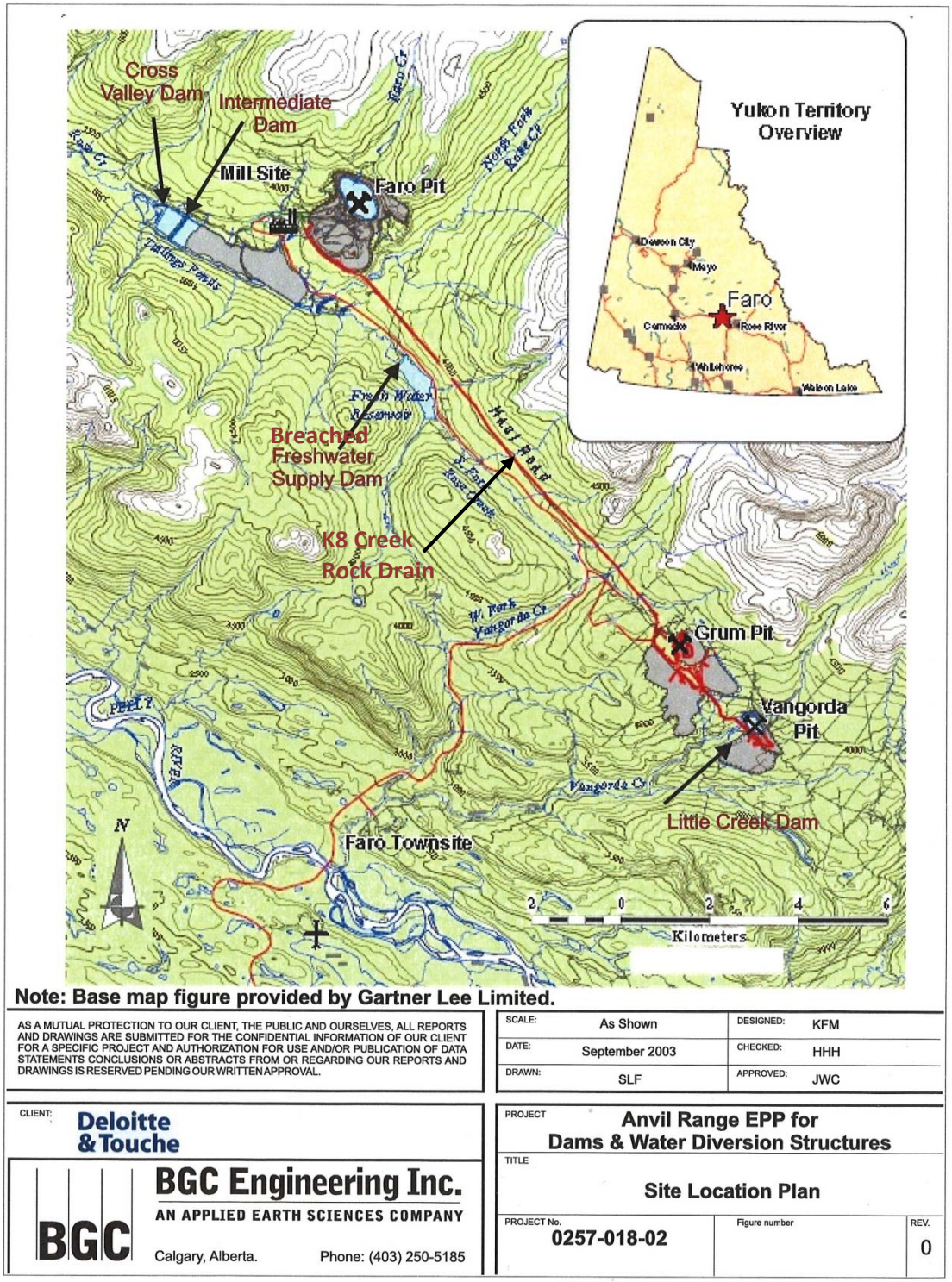


Figure 1.1 Site Location Plan of Faro Mine Complex (BGC 2009)

1.2 Project Scope

This report documents the 2015 annual review of the geotechnical performance of waste and water management facilities at the Faro Mine Complex.

Faro Site (see Figures 1 and 2):

- Faro Pit and Faro Creek Diversion Channel
- North Valley Wall Interceptor Ditch
- Rose Creek Diversion Channel
- North Fork Rock Drain
- K8 Creek Rock Drain
- Secondary Tailings Impoundment
- Intermediate Dam
- Cross Valley Dam

Vangorda Plateau Site (see Figures 3 to 5):

- Grum Pit
- Vangorda Pit
- Grum Overburden Dump
- Vangorda Waste Rock Dump
- Grum Interceptor Ditch
- Vangorda Northeast Interceptor Ditch
- Vangorda Creek Diversion Flume
- Little Creek Dam
- Sheep Pad Sediment Ponds
- Grum Settling Pond
- V-15 Seepage Ditch and Moose Pond
- Sludge Pond Embankment at Vangorda Water Treatment Plant

Representative photos are provided in Appendix I.

Monitoring data are summarized in Appendix II.

The monitoring program recommended for 2016 is given in Appendix III.

The review is based on our site observations in 2015 and ongoing review of monitoring data collected by Tlicho Engineering and Environmental Services (TEES).

2 FARO SITE FACILITIES

2.1 Faro Pit and Faro Creek Diversion Channel

The Faro Pit (Figure 2) is an inactive, inundated open pit, roughly elliptical in shape with the major axis oriented to the northwest/southeast. The east wall is roughly 375 m high and has two main instability zones (North and South) which are separated by a more stable calc-silica rich rock slope.

The Faro Creek Diversion Channel (FCDC) diverts flow from the headwaters north of the Faro Pit around the east side of the Faro mine site and discharges into the North Fork of Rose Creek. The minimum distance between the Faro Pit east wall and the diversion channel are 18.5 m and 93 m, respectively, in the North and South instability zones.

2.1.1 Observations

Faro Pit

The 2015 observations of the Faro Pit are as follows:

- Pit wall condition is similar to that observed in 2014 fall, except with a higher lake level.
- Faro pit is currently used to store water pumped back from Intermediate Pond and other Seepage Interception Systems (SIS).
- As treatment of water stored in the Faro Pit was suspended in 2013 and most of 2014, pit-lake level has risen above the maximum recommended level, and is within the range of the waste rock/bedrock contact elevation.
- A waste rock embankment has been constructed upstream of Faro Pit (The Faro Valley Rock Dumps). We understand that this is intended to temporarily attenuate flows from a potential breach of the Faro Creek Diversion Channel. Under flood conditions this dump may behave as a dam. We are not aware of any assessment of the expected performance of these rock dumps under a flood scenario. There is a small pond upstream of the Rock Dumps.

Faro Creek Diversion Channel

Our 2015 observations of the Faro Creek Diversion Channel are as follows:

- Moderate flow in channel at time of inspection.
- Some cracking, likely related to annual freeze-thaw condition, was noticed near the top of the channel hillside slope occurring sporadically between FCD 1 and FCD 3 during spring 2014 and 2015 visit. This cracking was not evident in fall of 2014.
- Minor vegetation growth along channel.
- Overhead wires were installed across the channel by TEES in 2014 at staff gauges FCD-1, FCD-2 and FCD-4 for measurements of high flows for calibration of the gauges. There was no overhead wire at FCD-3. The overhead wires don't appear to be high enough for high flows and posts are sloping in, making the wires ineffective. Karen Furlong advised us on March 22,

2016 that repair work has been done on the overhead guidance wires for the StreamPro flow measurement system (no wire is used at FCD-3), and that the flow stations are ready for the 2016 spring freshet.

- Staff Gauge FCD 2 was not measured and needs to be repaired/replaced.
- Slumps and erosion on the channel hillside slope for about 100 m downstream of FCD-3 have not been repaired in recent years due to access issues. We understand there is a plan to re-align the diversions back behind the zone of projected pit regression which would eliminate this concern.
- Minor sloughing of side slopes between FCDC-3 and FCDC-4.

2.1.2 Instrumentation

Faro Pit

Instrumentation at the Faro Pit includes one pond level indicator at the Faro Pit, nine reference bars to monitor pit wall regression and nine prisms to monitor pit wall movements (Golder 2009b and 2014). However, the pit wall movement measurements have been discontinued since 2014 due to unsafe access of these instruments (reference bars and prisms). Monitoring data is presented in Appendix II.

The Faro Pit lake surveyed elevation is about 7.3 m above the maximum recommended elevation (established by Others). A key concern is that this reduces the available storage in the pit and subsequently the time the mine has to respond in the event that the FCDC flows into the pit due to a pit wall failure or overtopping or failure of the FCDC. This has potential environmental and dam safety consequences downstream of Faro Pit. YG is working to draw down the pit lake but is limited by the requirement to treat the water and the achievable treatment rate. The pit lake elevation has been reduced from a high of about El. 1153.1 m in April 2014 to about El. 1151.6 m in December 2015. This is similar to historical seasonal fluctuations so it is not clear if the current efforts are resulting in a net decrease in pit lake volume. The effects of the current efforts should become more apparent as a trend in pit lake elevation forms over the next year and subsequent years.

Faro Creek Diversion Channel

Instrumentation at the Faro Creek Diversion Channel includes four staff gauges (FCD-1 to FCD-4) used for flow measurements.

- Staff gauge flow measurements (see Appendix II-B) - Historical and 2015 flows in the Faro Creek Diversion Channel are shown in Table 2.1.
- Discharge rating curves for the staff gauges are shown in Section II-B1 of Appendix II. Two rating curves are shown for FCD-1, FCD-3 and FCD-4, one for the period 2008 to 2010; and the other for the period 2011 to 2015. Different staff gauge calibration equipment was used during these two periods, and it is believed that the equipment used after 2010 is more accurate. FCD 2 was reported “needs repair” and did not record readings during 2015.

Plots of channel discharges estimated from the rating curves shown in Section II-B1 are presented in Section II-B2 (Appendix II). Since the discharges shown are based on spot measurements, they might not show the lowest or the highest flows the channel experienced during the reporting period. Furthermore, the high flows shown in the plots are based on the extrapolation of the rating curves beyond their calibrated range therefore they are likely not reliable. These flows should be recalculated when the rating curves are re-calibrated with high flow measured with the StreamPro.

Table 2.1 Faro Pit Lake Level and Faro Creek Diversion Channel Flow

Structure	Monitor Location	Historical		2015	
		Max	Min	Max	Min
Faro Pit - Pond El.	FP	1153.2 m	1140.7 m	1153.2 m	1151.3 m
Faro Creek Diversion Channel - Flow	FCD-1	2213 L/s	69 L/s	820 L/s	70 L/s
	FCD-2	6178 L/s	7 L/s	Not functioning. Needs Repair.	
	FCD-3	1366 L/s	47 L/s	320 L/s	120 L/s
	FCD-4	6018 L/s	47 L/s	1760 L/s	140 L/s

Notes:

1. Values shown in the table are based on spot measurements; therefore, they might not show the lowest or the highest flows experienced during the reporting period.

2.1.3 Recommendations

- The pit lake exceeds maximum recommended elevation (established by Others). Continue trigger level procedures described in our technical memo dated February 10 2015 titled Faro Pit East Rim Slope Stability Monitoring during Elevated Lake Level. Draw down pit lake as soon as practical.
- Repair slumps on the hillside slope of the channel under safe conditions or re-align the diversion.
- Take flow measurements for the FCDC during spring freshet or other high flow conditions to improve the stage/discharge rating curves at high flows.
- Observe the overhead wires during freshet to confirm they are functional at high flows.
- Repair staff gauge FCD-2 and take new calibration measurements.
- The Faro Valley Rock Dumps should be assessed for expected performance under flood conditions and a failure of the FCDC and the results of the assessment included in the Emergency Plan.

2.2 North Valley Wall Interceptor Ditch

The North Valley Wall Interceptor Ditch (NVWID) (also referred to as the North Wall Interceptor Ditch) (Figures 1 and 2) diverts creek flow from the north valley wall around the tailings impoundment area. It is approximately 3 km long and includes constructed and natural stream channel reaches. The ditch has relatively flat channel gradients along the constructed reaches and steep gradients along the natural stream reaches. The constructed channel reaches include:

- 920 m long upper reach;
- 430 m long middle reach; and
- 500 m long lower reach.

2.2.1 Observations

Our 2015 observations of the North Valley Wall Interceptor Ditch are as follows:

- The channel and side slopes appeared to be stable.
- Culverts were re-installed in 2015 and are performing satisfactorily.
- There was moderate to heavy vegetation growth in the upper and middle constructed channel reaches. Vegetation clearance started from the upstream end of the upper reach in the fall of 2012 and 2013 and should be continued.
- In July 2015, TEES installed a weir in the ditch near the beginning of the upper constructed reach (See Photo 7).
- The weir was flowing at about 40 L/s during the fall site visit.
- The weir appears to be too small to contain freshet flows.

2.2.2 Instrumentation

Instrumentation at the North Valley Wall Interceptor Ditch includes one flow monitoring location, NWID, within the diversion channel. A weir was installed at this station in July 2015. Flow data for the NWID is shown in Section II-C1 of Appendix II. Historical and 2015 flow data for this ditch is shown in Table 2.2. Readings prior to July 2015 were made either by visual estimation or Global Water Flow Meter. Readings after July 2015 used the newly installed weir to measure the flow.

Table 2.2 North Valley Wall Interceptor Ditch - Flow

Structure	Monitoring Location	Historical[1]		2015	
		Max (L/s)	Min (L/s)	Max (L/s)	Min (L/s)
North Valley Wall Interceptor Ditch	NWID	554	0.1	56	0.5

Notes:
1. Historical data was taken from 2014 Annual Geotechnical Review (KCB 2015c).
2. Values shown in the table are based on spot measurements; therefore, they might not show the lowest or the highest flows experienced during the reporting period.

2.2.3 Recommendations

- Continue vegetation clearance along the upper and middle constructed channel reaches. Clearing should also include the access road and berm along the channel to facilitate future inspection.
- Observe weir during the spring freshet to confirm that it is large enough to record the flow i.e. the freshet flow is contained within the v-notch and does not overtop the sides.

2.3 Rose Creek Diversion Channel and Canal Dyke

The Rose Creek Diversion Channel (RCDC) (Figures 1 and 2) diverts Rose Creek flow around the south side of the tailings impoundment. It is approximately 3.8 km long with, typically flat to moderate channel gradients along the upper reaches and steep gradients along the lower reaches. The upper reach of the diversion channel has three areas that are of geotechnical significance:

- Canal Dyke (CD): The dyke flanks the north side of the channel along the upper reach of the diversion channel and separates the channel from the tailings deposit, the Intermediate Pond, Intermediate Dam, Polishing Pond and Cross Valley Dam, see Figures 1 and 2.
- Spoil Piles (SP): The spoil piles are wastes generated by the construction of the Canal Dyke. They are downslope of the Canal Dyke and located at various spots along the southern periphery of the tailings impoundment.
- Back Slope (BS): The Back Slope is the hillside slope of the Diversion Channel excavation.

2.3.1 Observations

Our 2015 observations of the Rose Creek Diversion Channel and Canal Dyke are as follows:

- Moderate flow in channel at time of inspections. Approximately 8 m^3/s in the spring and 3 m^3/s in the fall.
- The channel and side slopes appeared to be in general stable condition with satisfactory rock armour protection.
- The deformed segments of the hillside channel slope of the Rose Creek Diversion Channel (also called Back Slope) were examined by KCB in our spring and fall site visits in 2015 (on the Back Slope as well as from the Canal Dyke crest). Slumping has progressed slightly from 2014. See Figure 7 for locations.
- Moderate vegetation growth in lower channel reaches.
- Minor seepage from the RCDC at base of spoil piles into the Polishing Pond was reported previously, but was not observed during the 2015 inspections.
- Overhead wires were installed across the channel by TEES in 2014 at existing staff gauges for measurement of high flows for calibration of the gauges. Not all overhead wire locations (for use with the StreamPro) have a corresponding staff gauge.
- StreamPro readings were not captured during high freshet flows in 2015.
- Seepage was not observed from the RCDC into the tailings impoundment at the time of inspections, however; we understand that there is seepage visible at several locations as advised by Dustin Rainey of YG.
- Several of the instruments appear to be abandoned or overgrown (limited access).

2.3.2 Instrumentation

Rose Creek Diversion Channel

Instrumentation in the diversion channel consists of one in-stream flow monitoring location (RCDC4). There are two flow monitoring locations along the North Fork of Rose Creek, upstream of the RCDC: NFRD-23, and X2. There are two monitoring locations in Rose Creek downstream of the RCDC: X10 and X14.

- Historical and 2015 data of maximum and minimum flows for the stream flow stations are shown in Table 2.3.
- NFRD-23 has a datalogger and a staff gauge that is regularly monitored. The datalogger does not correlate well with the staff gauge. This may be due to turbulent water at the measurement location.
- Discharge rating curves for the staff gauges NFRD-23 and RCDC-4 are shown in Section II-D1 of Appendix II-D.
- Plots of channel discharges estimated from the rating curves shown in Section II-D1 (Appendix II) are presented in Section II-D2.

Table 2.3 Flow in North Fork Rose Creek and Rose Creek Diversion Channel

Location	Name	Historical[1]		2015	
		Max (L/s)	Min (L/s)	Max (L/s)	Min (L/s)
North Fork Rose Creek	NFRD-23	8000	0	1560	1340
	X2[3]	1538	207	-	-
Rose Creek Diversion Channel	RCSG4/ RCDC4[2]	38,000	< 500[5]	17400	< 500[6]
Rose Creek	X14[3]	99,000[3]	210	-	-

Notes:
1. Historical data was taken from 2014 Annual Geotechnical Review (KCB 2015c).
2. RCDC4 is a replacement of RCSG4 in 2012.
3. No data was provided for X14 or X2. High flow value is unreliable since they are below the calibrated range of staff gauge readings.
4. Values shown in the table are based on spot measurements; therefore, they might not show the lowest or the highest flows experienced during the reporting period.
5. Low flow value is unreliable since they are below the calibrated range of staff gauge readings.

Canal Dyke, Spoil Piles, and Back Slope

A summary of existing instrumentation on the Canal Dyke, Spoil Piles and Back Slope of the diversion channel is shown in Table 2.4. Plots and recorded data, provided by TEES, for these instruments are given in Appendix II: Section II-E (Piezometers in Section II-E1, Thermistors in Section II-E2 and Inclinometers in Section II-E3).

- Some inclinometer readings taken in 2015 appear to be erroneous and have been omitted from the plots. Inclinometer plots are presented in Section II-E3 for six inclinometers with some erroneous data removed.

- Inclinometers CD15, BH-91-CD-1, BH-94-CD-1, BGC-05-05, BGC-05-08, SP-2, SP-5 were not measured as they were blocked or damaged. The cause of the damage was not determined and should be investigated, particularly if the damage is due to deformation of the slopes.
- Inclinometers CD19, CD-21, BS-5, BS-10 showed significant deflection which appears to be erroneous.
- Some thermistor beads are not functioning:
  - CD-15: 4 out of 12 beads functioning.
  - CD-26: 8 out 10 beads functioning.
  - BGC-05-04: 2 out of 10 beads functioning.
  - BGC-05-07: Not functioning.
  - BS-9: 2 out of 10 beads functioning.
  - BS-10: 8 m bead is suspect.
  - BS-12: 9 out of 10 beads functioning.
- We reviewed the Back Slope instrumentation and could not determine conclusively the cause of the slumping; however, we believe the slumping is due to the melting of the underlying permafrost as shown in the general warming trend of BS-5 and BS-10 which correspond to the areas of slumping. Other possible causes include infiltration of surface water from upslope, and/or freeze-thaw action on the loose sand and gravel cover. We believe that this can be managed through a program of monitoring and maintenance.
- No instability of the Canal Dyke or Spoil Piles was observed in 2015.

Table 2.4 Instrumentation for Canal Dyke, Spoil Piles and Diversion Channel Back Slope

Structure	Instrumentation
Canal Dyke[1,2,3]	5 paired pneumatic piezometers[2] with tips at deep and shallow depths (BGC05-02, BGC05-03, BGC05-06, CD-13, CD-15, and CD-26) and one pneumatic piezometer[2] (CD-21 shallow)
	4 Thermistors (BGC05-04, CD-15, CD-21 and CD-26)
	8 Inclinometers - (BGC05-05, BGC05-08, CD-10, CD-15, CD-19, CD-21, BH91-CD-1 and BH94-CD-1)
Spoil Piles[3]	2 Thermistors - (SP-3 and SP-5) – SP3 not read in 2015
	2 Inclinometers - (SP-2 and SP-5)
Back Slope of Rose Creek Diversion Channel	2 single pneumatic piezometers - (BS-5 and BS-9)
	4 Thermistors[4] - (BS-5, BS-9, BS-10 and BS-12)
	3 Inclinometers - (BS-5, BS-9 and BS-10)

Notes:
1. 3 single pneumatic Piezometers: CD-7, CD-9 and CD-10 are removed from the table, as no data is given for them.
2. 3 paired pneumatic Piezometers: BH88-7, BH88-11 and CD-19, and CD-21 deep pneumatic piezometer are removed from the table, as they were destroyed.
3. 2 thermistors: CD-10 and SP-2 are removed from the table, as no data is given for them.
4. Some of the thermistor beads were not functioning in 2015 and need repair.

2.3.3 Recommendations

- Take calibration flow measurements at the staff gauges in 2016 during high flows, using the overhead StreamPro guidance wires. Extend staff gauges, if required, such that they can be read during high flows.
- Rehabilitate or replace malfunctioning thermistors installed along the Back Slope. We suggest that a thermistor supplier such as RST be engaged to carry out the assessment.
- Monitor the condition of longitudinal cracks and slope slump scarps on the Back Slope from standardized photograph locations to be established in spring 2016, and continue instrumentation monitoring along the Back Slope.
- Explore permit requirements regarding investigation and repair of the above slope slumps. RCDC is the main diversion channel at the Faro site; prevention of a major slump and blockage is a high priority.
- Improve access trail/road condition for personnel and vehicle/equipment from landing sites to the slope slump areas on the Back Slope. There is an existing access track on the Back Slope but it is overgrown with trees. It is also time consuming and difficult to cross the RCDC. Explore the use of Argo or equivalent vehicle to cross the channel at an existing ford under existing permit.
- Clear vegetation along lower channel reaches.
- Assess the cause of the damaged inclinometers (CD15, BH-91-CD-1, BH-94-CD-1, BGC-05-05, BGC-05-08, SP-2, SP-5) and if can be repaired.
- Re-read Inclinometers CD19, CD-21, BS-5, BS-10 to confirm deflection.
- Confirm the offset between the staff gauge at NFRD23 and the datalogger so that flows can be determined more reliably or relocate the flow station to a section of the stream where more consistent measurements can be achieved. A staff gauge and flow measurements should be added at the new location. Potential locations should be identified during the spring site visit.
- Take flow measurements to develop a rating curve for staff gauge X2.
- Several inclinometer readings taken in 2015 were erroneous. The field personnel need to check the instrument manual for proper procedures, and to perform “checksum” (see the inclinometer manual) during monitoring in the field to confirm correct readings have been taken.
- Locate the missing annual review reports by Golder (1983 to 1999) and BGC (2000, 2001, and 2003), when repair works in the Back Slope area were conducted. Past successful repair experiences could provide guidance for current and future care and maintenance activities in the Back Slope area.
- As part of routine monitoring on site, note any seepage that is observed from the RCDC into the tailings impoundment area.

2.4 North Fork Rock Drain

The North Fork Rock Drain (NFRD) (Figure 1) is a mine haul road stream crossing constructed of coarse waste rock fill. It functions as a conduit for the North Fork of Rose Creek flow to cross the haul road, see Figures 1 and 2. The haul road at stream crossing is approximately 55 m high with a 25 m crest width. Downstream of the haul road, the North Fork of Rose Creek crosses the Main Access Road to the mine via a culvert which is supplemented by an auxiliary culvert at a slightly higher elevation.

Construction of a new seepage interception system downstream of the NFRD was carried out from October 8, 2014 to January 30, 2015 (BGC 2015). The system pumps some of the seepage (approximately 5 L/s) from the NFRD to the Faro Pit during the winter months.

2.4.1 Observations

- Water level in the upstream pond is similar to previous years.
- The mine haul road crest and side slope are generally stable.
- 2013 erosion washouts of the upstream and downstream road shoulder and embankment slope have been remediated and a road berm has been constructed.
- Remediation of the drainage point on the haul road is performing well.

2.4.2 Instrumentation

Instrumentation at the North Fork Rock Drain consists of water level readings surveyed periodically throughout the year to record the upstream pond (NF1) and downstream discharge (NF2) elevations. A summary of the historical maximum and minimum values including the most current data (2015) is shown in Table 2.5. Recorded water level plots provided by TEES, are given in Section II-F1 of Appendix II. It may be possible to develop a correlation of pond elevation to downstream flows by using a datalogger at NF-1 and another for the downstream flows. The NF-2 elevation is not very meaningful since it measures a turbulent stream elevation rather than a stable pond.

Table 2.5 North Fork Rock Drain - Water Level

Name	Historical[1]		2015		Comments
	Max (m)	Min (m)	Max (m)	Min (m)	
NF-1	1094.35	1088.83	1091.7	1089.6	Upstream of haul road
NF-2	1089.11	1085.02	1088.0	1085.9	Downstream of haul road

Notes:
1. Historical data was taken from 2014 Annual Geotechnical Review (KCB, 2015c).
2. Values shown in the table are based on spot measurements; therefore, they might not show the lowest or the highest water levels experienced during the reporting period.

2.4.3 Recommendations

- Install an additional data logger upstream of the NFRD to develop a correlation between storage and discharge through the rock drain. The data logger should be placed at a fixed elevation below the normal minimum pond level. A location for the data logger can be identified during the 2016 spring site visit.
- Discontinue reading NF-2.

2.5 K8 Creek Rock Drain

The K8 Creek Rock Drain (K8CRD) (Figure 1.1) is a mine haul road stream crossing constructed of coarse waste rock fill. It functions as a conduit for the K8 Creek to cross the main mine haul road. The haul road at the creek crossing is approximately 40 m high on the downstream side with a 25 m crest width. There is currently no instrumentation or monitoring program at this creek crossing.

2.5.1 Observations

- Generally stable crest and side slopes of mine haul road.
- Drainage condition is acceptable downstream of rock drain.
- Road surface runoff drains through a cut in the haul road berm. There appears to be recent placement of riprap to control erosion. It appears to be performing well.

2.5.2 Recommendations

- None.

2.6 Secondary Tailings Impoundment

The Secondary Tailings Impoundment (STI) (Figures 1 and 2) is located on the east side of the Down Valley project area. The Secondary Tailings Dam is a perimeter tailings dam that retains tailings, supernatant, and run-off water, and encloses the original tailings impoundment. The dam crest is approximately 2300 m long, 6 m wide, with the crest level varying from El. 1060.2 m to El. 1063.3 m. The overall dam height is about 28 m. The STI was not reviewed as part of the 2014 DSR by Worley Parsons since they considered it as an “embankment” rather than a dam. This dam should be included with the next DSR.

2.6.1 Observations

- Stable crest, upstream and downstream slopes and no evidence of seepage along the downstream toe. Lower downstream-berm road conditions are satisfactory.
- No visible seepage along the downstream slope above the Intermediate Impoundment.
- Dustin Rainy of YG advised that there is evidence of seepage out of the toe of the dam near the Rose Creek Diversion water level along the upper approximately 800 m of the RCD, and into the fuse plug. This is evidenced by iron-rich precipitates. The amount of the orange precipitates suggest that this seepage has been occurring for several years or more.

- The condition of the Lower Road, which also serves as the Rose Creek Canal Dyke, was satisfactory.
- Some small trees on downstream slope.
- The annual appearance of longitudinal cracks along the downstream berm road surface in the spring and their subsequent disappearance seemed to be related to seasonal freezing and thawing effect.
- A ditch was constructed upstream of the crest of the dam. The ditch drains into the lower impoundment via a spillway cut on the north side of the impoundment. The spillway cut appears to be field fit and has no armouring. Erosion would likely occur under an extreme flood condition; however, any materials eroded would end up in the Intermediate Impoundment.
- Minor undercutting was observed on the access road side slope along a ditch between the west abutment of the Secondary Tailings Dam and the north access road. See Photo 28 in Appendix I. A large scale failure of the road would block the spillway of the upper impoundment so the condition should be monitored.
- Surface casing of piezometer P81-6 is broken.
- Piezometers P03-01 and P03-03 are blocked and showing unreliable readings.

2.6.2 Instrumentation

Instrumentation at the Secondary Tailings Impoundment (see Figure 8) consists of 3 standpipe piezometers installed in 1981 on the dam crest and 4 standpipe piezometers installed in 2003 in the tailings pond (Piezometer P03-4 has not been monitored since September 2008). A summary of the current readings taken from these instruments along with historical maximum and minimum readings are shown in Table 2.6. Individual plots of piezometric levels at these piezometers as provided by TEES, are included in Section II-G1 of Appendix II. Piezometers P81-6 to P81-8 have been dry, while P03-1 to P03-3 show a variation less than 1 m to 2 m except when blockages have occurred. The piezometric levels monitored at these piezometers have been quite steady, about 5 m to 6 m below the ground surface when not dry.

Table 2.6 Secondary Tailings Impoundment – Pond and Piezometer Levels

Location	Piezometer	Historical[1]		2015	
		Max (m)	Min (m)	Max (m)	Min (m)
Dam Crest	P81-06	Dry	Dry	Dry	Dry
	P81-07	Dry	Dry	Dry	Dry
	P81-08	Dry	Dry	Dry	Dry
Tailings Pond	P03-01	1055.25	1054.29	1054.97	1054.73
	P03-02	1058.35[2]	1053.72	1054.41	1054.07
	P03-03	1060.27[2]	1052.28	1057.36[3]	1057.36[3]

Notes:
1. Historical data was taken from 2014 Annual Geotechnical Review (KCB, 2015c).
2. Maximum historical reading near ground level due to blockage.
3. Only one good reading taken.

2.6.3 Recommendations

- Clear trees from the downstream slope.
- Add visual monitoring of the erosion on the North Access Road. Repair road as required.
- Add protection to the piezometers to help prevent blockages.
- Repair surface casing of piezometer P81-6.
- Assess if piezometers P03-01 and P03-03 can be repaired.
- Include the Secondary Tailings Dam in the next DSR.

2.7 Intermediate Dam

The Intermediate Dam (ID) (Figures 1, 2, and 9) is located at the west end of the Intermediate Pond, just east of the Polishing Pond. It retains tailings, supernatant, and run-off water on the upstream side and polishing pond water on the downstream side. The dam is approximately 650 m long, 7 m wide at the crest and 32 m high. The dam crest elevation is at 1049.2 m, and the spillway invert elevation is at 1047.7 m. It has a downstream berm about 7 m wide, with the berm surface at approximate 1031.7 m. The Starter Dam has a vertical core, which was modified to an upstream sloping core during subsequent dam raises. The rest of dam zones consists of gravel shells and filters.

2.7.1 Observations

Our 2015 observations of the Intermediate Dam are as follows:

- Stable crest, upstream slope and spillway channel, in general.
- Downstream rill erosion was repaired. Some repaired areas are still rutted and should be smoothed out.
- There is a wet area at the toe where there are deep ruts from the repairs which impede surface drainage. Some saturated material from the repairs has been left at the toe.
- Water is being cycled from the Cross Valley Pond to the Intermediate Pond as required. We understand that this is done on a short term basis only.
- Piezometer BKS04-07 appears to be blocked or damaged and shows unreliable readings.
- Piezometer BH-96-2 has a void on the outside of the surface monument. Possibly caused by impact with heavy equipment.
- Piezometers BH91-ID 6 and BH91-ID 7 are reported damaged.
- There is a kinked HDPE pipeline at the toe of the dam. If the pipeline bursts there could be erosion of the dam toe.
- Pipelines and equipment are located in the spillway between the Intermediate Pond and the Cross Valley Pond. These reduce the capacity of the spillway. The spillway capacity is already undersized relative to the IDF (Worley Parsons 2015) and the pipelines should be removed.

2.7.2 Instrumentation

Instrumentation at the Intermediate Dam (see Figures 7 and 9) consists of a pond level measurement of the intermediate pond; 14 standpipe piezometers at 9 locations; one single pneumatic piezometer and three paired pneumatic piezometers with tips at shallow and deep depths. The piezometers are installed in the embankment zones downstream of the core above, in and below the horizontal drain at the downstream berm elevation as well as in the dam foundation. They are distributed from the northeast dam segment to the southwest abutment (see Figure 9).

A summary of current maximum and minimum pond and piezometric levels as well as corresponding historical maximum and minimum levels are shown in Table 2.7. Plots of pond and piezometric levels are included in Sections II-H1 and II-H2 of Appendix II. The upper and lower ranges of pond level in 2015 were similar to 2014. The monitored piezometric levels were in a range consistent with historical variations.

Table 2.7 Intermediate Dam - Pond and Piezometer Levels

Location	Name	Historical[1]		2015		Comments
		Max (m)	Min (m)	Max (m)	Min (m)	
Water Elevation Readings						
Int. Pond	IP	1047.58	1043.47	1046.8	1045.0	Target El. 1043 m
Standpipe Piezometers (Nested piezometers at P01-4, BH96-3 and BH96-4)						
Dam Crest	BH96-1	1031.65	1027.37	1030.1	1028.9	-Tip El. At 1027.35 m
	BH96-2	1031.94	1028.87	1047.3	1029.4	-Tip El. At 1028.87 m
	BH94-IDC-1	Dry	Dry	Dry	Dry	-
	BKS04-06	Dry	Dry	Dry	Dry	-
	BKS04-07	Dry	Dry	Dry	Dry	-
Dam Toe	P01-3	1030.63	1027.48	1030.1	1029.3	-
	P01-4A	1032.24	1029.27	1031.9	1030.7	Shallow
	P01-4B	1032.17	1029.06	1031.3	1030.9	Deep
	BH96-3A	1031.38	1026.62	1030.0	1029.1	Shallow
	BH96-3B	1031.45	1027.48	1030.0	1029.1	Deep
	BH96-4A[3]	1032.04	1027.61	1030.1	1029.2	
	BH96-4B[3]	1032.28	1028.39	1029.2	1028.4	
	BH96-4C[3]	1031.64	1026.9	1030.1	1026.9	
	BH96-4D[3]	1031.75	1027.62	1029.7	1026.6	
Pneumatic Piezometers (BH91-ID3 to ID6 are nested piezometers with one tip deep and one shallow)						
South Abutment	BH91-ID3	1039.23	1036.33	1044.5	1036.8	Shallow
		1038.04	1029.95	1033.0	1028.9	Deep
Dam Toe	BH91-ID4	1035.91	1028.28	1038.0	1024.3	Shallow (Reported Damaged
		1031.85	1026.74	1029.3	1028.8	Deep
	BH91-ID6	1030.95	1026.62	-	-	- Reported Damaged in 2015
		1034.96	1020.82	-	-	
	BH91-ID7[2]	1035.2	1028.82	-	-	Destroyed in winter of 2011/2012

Notes:
1. Historical data taken from 2014 Annual Geotechnical Review (KCB, 2015c).
2. BH91-ID7 was destroyed in winter of 2011/2012.
3. BH96-4: 4 nested piezometers with -4A being the shallowest, and -4D being the deepest.
4. BH91-ID5: No data since 2011.

2.7.3 Recommendations

- Repair the ruts on the downstream slope and the toe area.
- Upgrade spillway to meet CDA dam safety criteria for Inflow Design Flood (IDF) for the high consequence classification dam.
- Assess if piezometer BKS04-07 can be repaired.
- Fill the void outside the surface casing of piezometer BH-96-2.
- Assess if piezometers BH91-ID 4, 6, and 7 can be repaired.
- Fix or remove the damaged HDPE pipeline at the toe of the dam.
- Remove pipelines and operational equipment from the spillway.

2.8 Cross Valley Dam

The Cross Valley Dam (CVD) (Figures 1, 2, 7, and 10) impounds the Polishing Pond (also known as the Cross Valley Pond) at the downstream limit of the Rose Creek Tailings Facility. The Polishing Pond receives seepage from the tailings storage facility, the Rose Creek Diversion Channel, and discharge from the Faro Water Treatment Plant. The Cross Valley Dam is 500 m long, 7 m wide at the crest and 17 m high. The dam crest elevation is at 1033.1 m, while the spillway channel invert is at El. 1030.7 m. The dam has a central silty till core with gravel shells and filters, an upstream impervious blanket and a downstream drainage blanket.

2.8.1 Observations

- The crest, upstream and downstream slopes and spillway channel appeared to be stable.
- The annual appearance of longitudinal cracks along the dam crest in the spring and their subsequent disappearance seem to be related to freezing and spring thawing effect. This phenomenon was repeated in 2015 with only barely visible signs of spring cracks in the fall.
- Minor rill erosion on downstream slopes.
- Total Suspended Solids (TSS) levels in the Cross Valley pond appear to be sensitive to thermal changes, mine water inputs, and wind. The pond can “turn over” quickly making the water unsuitable for discharge due to the high TSS and turbidity. This means that the pond must sometimes store more water while the TSS and turbidity reduce to acceptable levels. This increases the risk to the dam from increased phreatic surface and less available storage for a flood event.
- Downstream Weir No. 3 was repaired and appears to be functional.
- Siphon pipelines are located in the spillway from the Cross Valley Pond to the downstream environment. The pipelines reduce the capacity of the spillway which is already undersized for the current IDF (Worley Parson 2015) and should be relocated such that they do not block the spillway.
- There is vegetation (tree) growth on the upstream and downstream slopes of the dam as well as within the spillway channel.

- The washout along the north access road close to the Cross Valley Dam has been repaired in 2015.
- We are not aware of any operational water balance for the Polishing Pond or other ponds on site.

2.8.2 Instrumentation

Instrumentation at the Cross Valley Dam (see Figures 7 and 10) consists of a pond level measurement, 12 standpipe piezometers, four pneumatic piezometers and two thermistors. Except for one piezometer installed in the embankment zone downstream of the core, all other piezometers are installed in the dam foundation at and beyond the downstream toe and beneath the dam crest. In addition, four weirs are installed downstream of the dam, Weir X11, X12, X13, and Weir 3.

One functional shallow thermistor string (BH88-4) is installed in the dam fill zone upstream of the dam core, and one deep thermistor string is installed in the dam foundation underneath the upstream dam crest shoulder (CVDC-6). Permafrost condition no longer exists at these locations and thermistor data is not required.

Plots of Polishing Pond and piezometric levels, ground temperature profiles, and downstream weir flows are included, respectively, in Sections II-I1 to II-I.4 of Appendix II. A summary of historical and current pond and piezometer levels are shown in Table 2.8. A summary of historical and current maximum and minimum flow weir readings are shown in Table 2.9.

Table 2.8 Cross Valley Dam – Pond and Piezometer Levels

Structure	Name	Historical[1]		2015		Comments
		Max (m)	Min (m)	Max (m)	Min (m)	
Water Elevation Readings						
Polishing Pond	PP	1030.33	1026.31	1029.9	1028.3	Target El. 1027 m
Standpipe Piezometers						
Dam Toe	CVDT-1	1018.57	1017.13	1018.1	1017.9	-
	CVDT-2	1019.5	1015.40	1015.8	1015.6	-
	P01-02[2]	1018.3	1017.42	-	-	Shallow
		1019.73	1017.86	-	-	Deep
	P01-11	1017.83	1016.17	1016.9	1016.7	-
Dam Crest	CVDC-4	1019.05	1016.72	1019.0	1017.9	Deep
	CVDC-7	1017.74	1015.14	1015.5	1015.4	Shallow
		1019.21	1015.27	1018.0	1017.7	Deep
	94CVDC-1	1024.58	1022.71	1023.9	1023.5	-
	CVDC-9	1024.74	1019.91	1021.1	1020.6	Shallow
		1025.61	1021.18	1024.4	1023.5	Deep
Pneumatic Piezometers						
Dam Toe	CVDP-1	1019.83	1016.82	1018.4	1018.2	-
	CVDP-3	1017.65	1016.11	-	-	-
	CVDP-5	1022.05	Dry	1020.7	Dry	-
	CVDP-6	1019.55	1014.86	1017.6	1017.4	-

Notes:
1. Historical data was taken from 2014 Annual Geotechnical Review (KCB 2015c).
2. No readings for Piezometers P01-02 were given.

Table 2.9 Cross Valley Dam - Weir Flows

Weir Number	Historical[1]		2015	
	Maximum (L/s)	Minimum (L/s)	Maximum (L/s)	Minimum (L/s)
X11 (North)	23.78[2]	2.56	23.78[2]	6.11
W3 (Central)	7.1	0.03[3]	Note 3	
X12 (South)	2.03	0.02	0.55	0.04
X13 (Combined)	123[4]	7.45	123[4]	17.67

Notes:
1. Historical data was taken from 2014 Annual Geotechnical Review (KCB 2015c).
2. X11: Maximum flow increased from 22.01 L/s to 23.78 L/s on June 11, 2015.
3. Weir plate was corroded through the v-notch after September 11, 2014 and no measurements have been taken since then. However the weir has now been repaired.
4. X13: Maximum flow increased from 59.63 L/s to 123 L/s on June 25, 2015.
5. Values shown in the table are based on spot measurements; therefore, they might not show the lowest or the highest flows experienced during the reporting period.

2.8.3 Recommendations

- Start monitoring the Weir 3 as the corroded weir plates are now replaced.
- Stop thermistor readings at the dam. Protect the thermistor for potential future use. (The data show that the ground at depth is essentially thawed.
- Repair rill erosions in local areas of the downstream slope near the dam crest.
- Monitor longitudinal tension cracks on dam crest using quantitative measures (pins for length and width), and seal these cracks by grading to minimize water ingress to the embankment dam.
- Remove trees from the dam and in the spillway channel.
- Remove siphon pipeline from the spillway.
- Upgrade spillway to handle the design flood.
- As a general recommendation; the site wide hydrology monitoring program should be used along with pumping records and climate data to develop an operational water balance for all the dam impoundments.

3 VANGORDA PLATEAU SITE FACILITIES

3.1 Grum Pit

The Grum Pit (GP) (Figures 3 to 5) is the northernmost major structure at the Vangorda Plateau Site, which is approximately 12 km southeast of the Faro Pit. Grum Pit is an inundated, inactive open pit with a roughly elliptical shape, extending 850 m in the north/south direction and 600 m in the east/west direction. The highwall of the pit is the east pit wall which is 160 m high. Instability of the east wall appears to be still evolving (Golder 2009a, 2013, and 2014), and ongoing monitoring of potential pit-wall rim movement started in the summer of 2010. Since August 2013, a pump barge has been used in the summer and fall to transfer water from Grum to Vangorda Pit for treatment.

3.1.1 Observations

- East wall instability appears to be progressing.
- Inspections of the Survey Rods were not performed in spring and fall 2015 due to safety concerns. Monitoring of these pins has been discontinued.
- Several nearby power poles tilt towards the pit. We understand that this line of poles no longer carries live wires. However, there are live power lines on another set of poles that are further back from the pit but that we understand are within the possible future pit rim regression zone.
- Pit lake level is above the maximum recommended level but the seasonal low elevation has dropped about 1.2 metres in 2015 compared to 2013 and 2014.
- Access road on the north pit rim was partially flooded. We understand that TEES plans to deactivate this road for safety reasons.
- Ponding of surface water above the north pit rim across the road from West Pond has been observed in the spring of 2014 and 2015 and the fall of 2015.

3.1.2 Instrumentation

Instrumentation at the Grum pit (see Figure 11) involves reference rods which are no longer read due to safety concerns, a pit lake-level measurement point, and two piezometers installed in the Grum Pit cut slot.

Following Golder's recommendation, CH2MHILL (2013a) established 14 locations of survey prisms for ongoing monitoring of Grum Pit wall and rim movement. YES (2013b) installed and surveyed the initial 4 prisms, MP005 to MP008, in September 2013 and provided installation details for additional prisms for TEES to complete the installation work in 2014 (see Figure 11). Due to potential risk to the safety of site personnel in installing these prisms, YG is working with Golder to find a safe alternative method for ongoing survey.

Plots showing the readings of pond elevation and the slot cut piezometers (SRK09-GSA and SRK09-GSB) are included in Appendix II-J. The seasonal fluctuation of the piezometers may be due to freezing.

3.1.3 Recommendations

- Prepare a power supply contingency plan in case progressive failure of the pit wall endangers the remaining two rows of power poles carrying live wires.
- Pump the water in the West Pond and the smaller pond on the Grum Pit side of the road into the Grum Interceptor Ditch.
- Draw down the Grum Pit Lake as soon as practical.

3.2 Vangorda Pit

The Vangorda Pit (VP) (Figures 3 to 5) is approximately 1.8 km southeast of the Grum Pit, just to the north of the Vangorda Waste Dump. It is an inactive, inundated open pit with an approximate elliptical shape, with the long axis oriented in the northwest to southeast direction. Water pumped from Grum Pit flows into Vangorda Pit via a pipeline located on the northwest pit wall. Water in Vangorda pit is pumped to the Vangorda Water Treatment plant. Sludge from the Water Treatment plant was previously pumped to Vangorda Pit but has been re-directed to Grum Pit since 2014.

3.2.1 Observations

- Pit lake level appears to be trending lower than in 2014.
- A sinkhole in fill material on the pit rim was observed on the south side of the pit. The hole is approximately 1 m in diameter and appears to be visible to 3 m depth. No released material was evident on the pit wall.

3.2.2 Instrumentation

- There is currently only a pit lake level measurement point at the Vangorda Pit. Pit lake level plot provided by TEES is included in Section II-K1 of Appendix II. The maximum pit lake level in 2015 was at El. 1088.1 m on June 15 about 3.7 m below the recommended maximum elevation of 1091.8 m.

3.2.3 Recommendations

- Repair the sinkhole. Karen Furlong and Eric Domingue advised that this work has been completed.

3.3 Vangorda Waste Rock Dump

The Vangorda Waste Rock Dump (VWRD), located to the south of the Vangorda Pit and Little Creek Dam, has six transverse base drains installed beneath the glacial till starter dyke to collect dump seepage into a seepage collection ditch. The collected seepage, in turn, drains into the Little Creek Pond retained by the Little Creek Dam, see Figures 3 to 5 (SRK-Robinson 1994).

3.3.1 Observations

- Some repairs have been completed on the drain weirs.
- Drain 1 (V28) – no weir and no sign of seepage at time of site visits.
- Drain 2 (V29) – weir is in satisfactory condition, no flow at time of fall site visit.
- Drain 3 (V30) – weir is in satisfactory condition, minor flow at time of fall site visit.
- Drain 4 (V31) – accumulation of debris behind weir, should be removed, low flow at time of fall site visit.
- Drain 5 (V32) – accumulation of debris behind weir, should be removed, no flow at time of fall site visit.
- Drain 6 (V33) – accumulation of debris behind weir, should be removed, low flow at time of fall site visit.

3.3.2 Instrumentation

Instrumentation at the Vangorda Waste Dump (see Figures 4, 5, and 12) consists of five V-notch weirs, V29 to V33, at transverse base drains 2, 3, 5 and 6 for flow measurement, 14 piezometers and 4 groundwater monitoring wells in the dump area. Detailed data on base drain flows and piezometric levels provided by TEES are included in Section II-L of Appendix II. The weir flow data in 2015 are summarized in Table 3.1. The maximum piezometric level in 2014, and the corresponding dates as well as trigger level as provided by SRK (2011b), are shown in Table 3.2.

Recent readings for piezometers V39/V40, and V44/V45 appear to be reversed. This has been fixed on the plots.

Piezometer PW-10-01A exceeded trigger levels in May; however it appears that this is due to a data entry error. This has been removed on the plot.

Table 3.1 Vangorda Waste Dump - 2015 Drain Flow

Drain[1]/Weir No.	Maximum Flow		Minimum Flow	
	Flow (L/s)	Date Measured	Flow (L/s)	Date Measured
Drain No. 1 (V28)	No flow	During monitoring visits	No flow	During monitoring visits
Drain No. 2 (V29)	0.026	June 24	No flow	July, Aug, Sep, Oct
Drain No. 3 (V30)	0.5	May 20	0.03	August 20
Drain No. 4 (V31)	0.06	August 20	No flow	July 08
Drain No. 5 (V32)	0.008	July 22	No flow	September 23
Drain No. 6 (V33)	0.21	May 20	No flow	September 23

Note:
1. Drain number has been confirmed by TEES.
2. Values shown in the table are based on spot measurements; therefore, they might not show the lowest or the highest flows experienced during the reporting period.

Table 3.2 Vangorda Waste Dump - 2015 Piezometer Levels

Groundwater Monitoring Well/ Piezometer		Date of Max. Piez. Level in 2015[2]	Max. Piez. El. (m)	Trigger Level[1] El. (m)	Above Trigger Level?
V34	GW-94-01	May 27 (only one measurement in 2015)	1111.61	1115	No
V35	GW-94-02	May 21 (only one measurement in 2015)	1108.70	1115	No
V36	GW-94-03	September 23	1109.77	1113	No
V37	GW-94-04	September 23	1107.78	1109	No
V39	P-94-01A	September 23	1126.6	1131	No
V40	P-94-01B	May 20	1131.52	1133	No
V41	P-94-02A	September 23	1130.88	1133	No
V42	P-94-02B	May 20	1132.54	1134	No
V43	P-94-02C	September 23	1121.73	1125	No
V44	P-94-03A	September 29	1124.59	1126	No
V45	P-94-03B	September 29	1121.56	1126	No
V47	P-94-04B	September 29	1125.55	1126	No
DH1	PW-10-01	September 23	1127.57	1135	No
DH2	PW-10-02	May 20	1128.99	1131	No
DH3	PW-10-03	September 23	1123.49	1130	No
DH4	PW-10-04	September 23	1132.59	1133[3]	No
DH5	PW-10-05	September 23	1138.22	1139	No

Notes:
1. Trigger levels were taken from SRK (2011b).
2. Trigger level at Piezometer PW-10-04 in Hole DH4 was increased from 1132 to 1133 m by SRK (2011b).

3.3.3 Recommendations

- Remove buildup of sediment and debris from behind weirs V31, V32 and V33.
- Confirm readings for piezometers V39/V40, and V44/V45 on monitoring spreadsheets. Already fixed on the plot in Appendix II.
- Fix data entry error in monitoring spreadsheets for piezometer PW-10-04 for May 2015. Already fixed on the plot in Appendix II.

3.4 Grum Pit Interceptor Ditch

The Grum Interceptor Ditch diverts water around the Grum Pit and Grum Overburden Dump. It consists of the following three reaches:

- 900 m long ditch upslope of the Grum Pit to divert clean water away from the pit;
- 900 m long ditch along the northeast toe of the Grum Overburden Dump; and
- 650 m long ditch to convey flow downhill to Tributary B of the Vangorda Creek.

3.4.1 Observations

- Minimal flow in the upper ditch; Low to moderate flow in the middle ditch, most flow is coming from Vangorda Water Treatment Facility Sludge Pond.

- Stable channel side slopes, minor sloughing in areas.
- Light to heavy vegetation growth, particularly along the uppermost and lowest reaches of the ditch.
- Rill erosion on Till Overburden Dump slope. Silt fences for surface runoff sediment control on the Till Overburden Dump slope, have fallen over in sections.
- No change in condition of culverts since 2013.
- Water in ditch has low turbidity, as opposed to the moderate turbidity that was observed in the lower reach of the channel during the 2015 spring site visit. It is possible that the moderate turbidity observed during the spring site visit was due to surface water runoff following freshet but this cannot be confirmed.
- Top of the culvert under the road to Fresh Water Pond (site coordinates 6 905 250N, 592 790E) is deformed approximately 300 mm to 600 mm, and there is sediment deposit in the culvert.
- Top of culvert at site coordinates 6 905 107N, 592 890E is deformed approximately 200 mm to 300 mm.
- The road to the Water Treatment Plant has three culverts: one CSP at the ditch invert; and two HDPE pipes at higher level. The top of the CSP is deformed by approximately 100 mm and its inlet is partially blocked with riprap. Both HDPE pipes are deformed by approximately 20% to 30%.

3.4.2 Recommendations

- Clear vegetation from ditch.
- Replace the following culverts and replace them if the calculated capacity is less than design flow. Alternatively, remove the culverts if the road crossings are no longer required.
  - The culvert under the road to the Fresh Water Pond.
  - The culvert at the road to the Water Treatment plant.
  - The culvert at the crossing south of the Fresh Water Pond at site coordinates 6 905 107N, 592 890E.

3.5 North East Interceptor Ditch

North East Interceptor Ditch (NEID)

The North East Interceptor Ditch (Figures 4 and 5) diverts surface runoff away from the Vangorda Pit. There is currently no instrumentation in place to monitor the ditch flow.

3.5.1 Observations

- No flow along the upper (50%) reach of the ditch; increased flow along the reach downstream of the tributary confluence.

- Multiple side-slope slumps were observed along the lower reach: one at the road embankment slope was partially repaired in 2013 with large boulders, and remaining slumps are to be repaired as required before spring freshet including two on the bank slope on the opposite side from the road. Additional slumping in multiple areas has been observed in both 2015 site trips. Previous repairs do not appear to be filter compatible with base soils.
- At the main bend in road, slumping failures have occurred on both sides of the ditch, causing water to back-up. In ponded area upstream of the slumping, substantial algae growth has occurred.
- Cracking along the access road has progressed since 2014.
- Moderate vegetation growth in channel.

3.5.2 Recommendations

- Repair slumps in side slopes with riprap and place filter materials between existing slope and newly added riprap materials. The maintenance activity should focus on maintaining adequate flow capacity of the Interceptor Ditch during the next spring freshet. Side slope repairs could use a simple design with coarse rock placed over filter cloth such that the side slopes and the channel capacity are maintained.

3.6 Vangorda Creek Diversion Flume

The Vangorda Creek Diversion Flume diverts flow from Vangorda Creek around the Vangorda Pit via a Corrugated Steel Pipe (CSP) half-pipe, or flume. The headworks for the flume include: a main culvert under the road at the upstream end of the flume and a trashrack at the culvert inlet, and two emergency spillway culverts with a trash rack at a higher level under the road. At the end of the diversion, the flume discharges to a plunge pool, west of the Vangorda Pit, and the flow is carried across the haul road via a CSP culvert and drop box to the Vangorda Creek. There is no instrumentation related to the diversion flume.

A flash flood occurred in June 2012, and the flume overflowed. The flood flow was barely contained by the ditch bank slopes above the flume without spilling into the Vangorda Pit. During repair after the flood, the road surface adjacent to the flume ditch was raised in the area to help contain the flood flow. This flood and its impact were similar to what occurred in June 2004 (SRK 2004). No flash flood occurred in 2014 at the Vangorda Creek Diversion Flume.

3.6.1 Observations

- At the upstream end of the flume main culvert, large boulders were added as riprap but no filter materials appeared to be present between the riprap and road embankment fill. A small steel trashrack, tied to a few boulders by ropes, has been installed to prevent unravelling of the boulders over the culvert entrance.
- One broken bar on the large trash rack at the entrance of the flume culvert
- Some sediments were observed at the bottom of twin emergency culverts; channel invert downstream of the culverts appeared to be slightly too high.

- Galvanized flume braces appeared to be undersized and buckled. The buckling may be due to lateral pressure from riprap around the flume or it may be caused during maintenance and repairs. Flume was deformed in places as the result of the buckled braces.
- CSP segments are not always connected, making containment inefficient.
- Water flows both over and under the CSP.
- Old truck beds were placed over the CSP to prevent the CSP from being lifted by high flows.
- Woody debris has built up at the trash rack at the outlet of the Flume Plunge Pool; this has increased since spring 2015, causing the plunge pool to fill.

3.6.2 Recommendations

- Clear the entrance of the twin emergency spillway culverts and lower the spillway channel invert at the discharge end of the culverts.
- Replace the flume with a new structure as early as practical.
- Remove debris from trash racks.

3.7 Little Creek Dam

The Little Creek Dam (LCD) (Figures 3 to 5, and 14) was completed in 1991. It is located just northwest of the Vangorda Waste Dump, and currently collects contact water from the Vangorda Waste Dump in the form of seepage and surface runoff. Water collected here is pumped to the Vangorda Pit for treatment at the Vangorda Water Treatment Plant, see Figures 3 to 5.

The Little Creek Dam is a homogeneous embankment dam constructed of local glacial till. It has a cutoff trench and a granular base drains downstream under the downstream slope. The crest is about 10 m above natural ground, ranging in elevation from 1114.5 m to 1120 m. Side slopes are 2H:1V on the downstream side and 2.5H:1V on the upstream side. A zone of permafrost encountered at the south abutment was excavated prior to till placement. A 900 mm diameter, Corrugated Steel Pipe (CSP) emergency spillway located at the south abutment was added in 1998 to route through the 1 in 200-year flood. The emergency spillway appears to be undersized for the design flood (Worley Parsons 2015).

3.7.1 Observations

- Stable dam slopes with rill erosion developed on the downstream and upstream crest shoulders and slopes as well as downstream berm slopes. It appears some maintenance has been conducted on the upstream slope.
- Significant erosion on downstream slope.
- Small 5cks in the ground at the downstream end of the spillway outfall channel at the top of bank slope above Vangorda Creek.
- Wet, soggy ground at the toe of the dam. Possible seepage.

3.7.2 Instrumentation

Instrumentation at the Little Creek Dam (see Figures 13 and 14) consists of a pond level measuring point; three pared pneumatic piezometers (P94-LCD-1 to P94-LCD-3) with tips at both shallow and deep depths; and seven piezometers (P09-LCD-1 to P09-LCD-7) installed in 2010 along the downstream toe for monitoring groundwater quality (SRK 2011b). Detailed data of the pond and piezometric levels as provided by TEES, are included in Section II-M of Appendix II. The pond level and maximum piezometric level and corresponding date in 2015 for these piezometers are summarized in Table 3.3. We have limited information on the installation details of the P09- series piezometers. This information would be useful in interpreting the readings.

Three thermistor strings were installed in 1994 on the dam crest (94LCD-4T to 94LCD-6T) to a depth ranging from 13 m to 17 m. As permafrost condition no longer exists at these locations, thermistor data is not required.

Table 3.3 Little Creek Dam - Pond and Piezometer Levels

Location	Name	Historical[1]		2015		Comments
		Max. El. (m)	Min. El. (m)	Max. El. (m)	Min. El. (m)	
Water Elevation Readings						
Pond Level	LCD	1111.70	1106.48	1110.7	1108.6	Licence Limit = 1111.80
Standpipe Piezometers						
Downstream Toe	P09-LCD-1	1094.23[2]	1093.45	1093.85	1093.82	
	P09-LCD-2	1095.40[3]	1093.26	1093.49	1093.41	
	P09-LCD-3	1092.10	1091.83	1092.06	1091.99	
	P09-LCD-4	1091.98	1082.00	1091.70	1086.76	
	P09-LCD-6[8]	1090.91	1087.47	1090.51	1087.47	
	P09-LCD-7	1097.50[4]	1096.93	1097.50	1097.09	
Pneumatic Piezometers (BH94-LCD1 to LCD3 are nested piezometers with one tip deep and one shallow)						
Dam Crest	BH94-LCD1[6]	1105.77	1104.02[5]	1105.21[7]	-	Shallow
		1105.82	1103.79	1105.26[7]	-	Deep
	BH94-LCD2[6]	1101.76	1100.50	1101.41[7]	-	Shallow
		1102.39	1098.54	1099.45[7]	-	Deep
	BH94-LCD3[6]	1106.76	Dry	1106.41[7]	-	Shallow
		1108.69	1102.89	1104.21[7]	-	Deep

Notes:
1. Historical data taken from 2014 Annual Geotechnical Review (KCB 2015c).
2. P09-LCD-1: Maximum level increased by 0.39 m from 1093.84 m to 1094.23 m on September 25, 2014.
3. P09-LCD-2: Maximum level increased by 1.89 m from 1093.51 m to 1095.40 m on September 25, 2014.
4. P09-LCD-7: Maximum level increased by 0.09 m from 1097.41 m to 1097.5 m on September 25, 2014.
5. BH94-LCD1 shallow piezometer: Minimum level decreased by 0.14 m from 1104.16 m to 1104.02 m on September 22, 2014.
6. The September 22, 2014 readings for all three deep piezometers in BH94-series appeared to be in error, and should be checked and removed.
7. Only one reading measured on October 19th, 2015.
8. P09-LCD-6: Minimum level decreased by 1.99 m from El. 1089.46 m to El. 1087.47 m on September 29, 2015.

3.7.3 Recommendations

- Repair erosion on the downstream dam slope.
- Grade the downstream toe to promote drainage and prevent the toe area becoming saturated after snowmelt and/or heavy rain.
- Carry out a hydrological assessment to confirm the design flood, and if it can be stored and/or whether the spillway should be resized.
- Clear trees from dam slope.
- Check water quality of seeps to determine if it originates from Little Creek Pond.
- Retrieve the installation details for the P09- series of piezometers for better interpretation of monitored data obtained from these piezometers.
- Stop thermistor reading at the dam. Protect the thermistor for potential future use. (The data show that the ground at depth is essentially thawed.

3.8 Sheep Pad Sediment Ponds

The Sheep Pad Sediment Ponds (Figures 3 to 5) are located between the Grum and Vangorda Pits along the main haul road. The facility consists of two ponds which collect surface runoff from upslope areas, including the Grum Overburden Dump. The upstream pond discharges to the downstream pond via a CSP half-round pipe. The lower pond discharges towards the plunge pool for the Vangorda Creek Flume via a riprap lined spillway channel. We have not reviewed construction documents for the Sheep Pad Sediment Ponds; however, the ponds appear to be retained behind small man-made embankments rather than a natural depression and as such, may be classified as a dam as per the Canadian Dam Association (defined as capable of retaining 30,000 m^3 of water and being at least 2.5 m high). This is more likely to apply to the lower pond; but both ponds should be checked.

3.8.1 Observations

- Freeze-and-thaw longitudinal cracks were observed along the dyke crest and upstream slope during the spring 2015 site visit, these were not evident in fall 2015.
- Upper pond has high water level with only about 0.3 m of freeboard. Inflows and outflows to upper pond are moderate to high.
- A silt fence has been added to the inlet of the upper pond.
- Large boulders that are weighing down the half-round CSP between the Upper and Lower Ponds near the entrance restrict flow. There are no stiffening braces across the top of the half-round CSP and the CSP sections are not tied together. The entrance CSP section appeared to have shifted.
- There is exposed geofabric at the Lower Pond Spillway.
- Weir upstream of the plunge pool has staff gauge in the flow, affecting the readings. There has been maintenance to the weir foundation - flow is no longer by-passing the weir.
- Survey pin was added to monitor dyke slope at Lower Pond spillway channel.

3.8.2 Recommendations

- Reduce the size of the large boulders weighing down the half-round CSP between the Upper and Lower Ponds. Add stiffening braces to the top of the CSP to prevent further pipe deformation due to lateral pressure from riprap materials around the pipe.
- Consider options for lowering the invert elevation of CSP half round between upper and lower Sheep Pond. This should help to maintain more freeboard in the upper pond.
- Cover exposed geofabric, as required, with riprap materials, on the berm separating the Lower and Upper Pond spillway.
- Move staff gauge at V25BSP away from the V-Notch so that it does not restrict flow.
- Confirm storage capacity and height of impoundment to determine if the pond should be classified as a dam.
- Include annual surveys of the survey pin installed near the lower pond spillway channel in the geotechnical monitoring program.

3.9 Fresh Water Pond

The Fresh Water Pond (FWP), located just northwest of the Grum Pit (Figure 4 and Figure 5), is used to clarify water for the use in Vangorda Water Treatment Plant. Water from the pond spillway discharges to the Grum Interceptor Ditch via a riprap lined spillway channel. There is no instrumentation related to the Fresh Water Pond. We have not reviewed any construction documents for the FWP; however, the pond appears to be retained behind a small man made embankment rather than a natural depression and as such, may be classified as a dam as per the Canadian Dam Association (defined as capable of retaining 30,000 m^3 of water and being at least 2.5 m high).

3.9.1 Observations

- Spillway channel appeared to be in good condition, other than considerable vegetation growth.
- Vegetation growth (small trees) on the dyke crest and downstream slope.

3.9.2 Recommendations

- Clear trees from embankment slopes and spillway channel.
- Confirm storage capacity and height of impoundment to determine if the pond should be classified as a dam.

3.10 V-15 Seep Ditch and Moose Pond

Both structures are located between the Grum Dump and the Vangorda Waste Dump (see Figures 3 to 5).The V-15 Seep Ditch is a bentomat lined ditch that collects Grum Dump seepage water from the V-15 Pond. Most of this seepage water is pumped to Vangorda Pit with a small amount of seepage

flowing to Moose Pond. Moose Pond is a natural pond that retains water due to a natural geomorphic depression in coarse-grained glaciofluvial surficial deposits. The water is retained by a narrow natural landform. Water flows out of Moose Pond via seepage through the landform at Moose Seep. Moose pond acts as a natural exfiltration structure which is beneficial for the downstream water quality. The landform that contains the pond has a steep downstream slope and has been eroding and ravelling in recent years.

Excess inflow and sediments entered Moose Pond during 2011 and 2013 spring freshets due to release of surface runoff from the Grum Waste Rock Dump. We believe this resulted in slower exfiltration and higher pond levels due to the lower permeability of the sediments. This has likely resulted in sealing off the pond bottom by silt deposits, raising pond level and increased the regression of the downstream slope of the landform that retains the pond.

In 2014 and 2015, YG modified the V-15 pumping procedure to pump most of the V-15 seepage to Vangorda to reduce the water in Moose Pond and the corresponding risk of instability in the landform that contains the pond (which is visually monitored on a regular basis).

3.10.1 Observations

Our 2015 observations of the Moose Pond are as:

- The steep reach of the V-15 Ditch above the Moose Pond appeared to be in good shape.
- A pumping station has been installed in the upper reach of V-15 ditch in the spring of 2014 to control the flow to the Moose Pond. Sand bags limiting flow to Moose Pond and storing water to pump to Vangorda Pit have been removed and a small amount of flow is still directed to Moose Pond.
- Pond level dropped significantly in the summer of 2013 and 2014 due to the blockage of V-15 Ditch to facilitate pumping the ditch flow to Vangorda Pit.
- Shallow surficial slides continued on the downstream slope of the esker. Slope erosion is likely to continue and the eventual failure of the esker and release of pond water to the environment is possible. Since seepage from V-15 to Moose pond is now reduced, the pond water quality is expected to improve and the pond water volume is expected to reduce. This will reduce both the potential for failure and the environmental consequences of a failure.

3.10.2 Recommendations

- Minimize the seepage and surface water runoff that reports to Moose Pond.

3.11 Sludge Pond Embankment at Vangorda Water Treatment

The Sludge Pond Embankment (Figures 3 to 5), located just east of the Grum Pit, is a rectangular shaped pond retained by an embankment dyke. There appears to be no instrumentation at this pond and its periphery dyke. We have not reviewed construction documents for the Sludge Pond; however, the pond is retained behind an embankment and as such, may be classified as a dam as per the

Canadian Dam Association (defined as capable of retaining 30,000 m^3 of water and being at least 2.5 m high).

3.11.1 Observations

- Freeze-and-thaw longitudinal cracks observed on the dyke crest in the spring of 2013 and 2014 were less obvious in the fall of 2015.
- Decommissioned lamp posts are sloping.
- There are small trees on the downstream slope.

3.11.2 Recommendations

- Clear trees from embankment slopes.
- Confirm storage capacity and height of impoundment to determine if the pond should be classified as a dam.

4 SUMMARY OF RECOMMENDATIONS

Table 4.1 summarizes the recommendations in this report and relevant recommendations from our previous reports. The recommendations are prioritized into subjective categories of High, Medium, and Low which are described as follows:

- High – Should be completed as soon as possible. Critical infrastructure or instrumentation. Current environmental, H&S, or dam safety risk.
- Medium – Should be completed within a year. Important infrastructure or instrumentation. Could lead to environmental, H&S, or dam safety risk.
- Low – Should be completed within 2 years. Useful infrastructure or instrumentation. Affects quality of long term performance or monitoring.

The priorities and timelines for the recommendations should be developed further in consultation with YG in 2016.

Table 4.1 Summary of Recommendations

Structure	Recommendation	Number	Priority
Monitoring Schedule	See Appendix III for the 2016 recommended monitoring schedule.	KCB-2015-1	M
Hydrology Monitoring	As a general recommendation; the site wide hydrology monitoring program should be used along with pumping records and climate data to develop an operational water balance for all the dam impoundments.	KCB-2015-2	L
	Develop a comprehensive and systematic approach for maintaining the rating curves at flow measurement stations.	KCB-2015-3	M
Faro Pit	The pit lake exceeds maximum recommended elevation established by Golder 2009. Continue trigger level procedures described in our technical memo dated February 10, 2015 titled “Faro Pit East Rim Slope Stability Monitoring During Elevated Lake Level”. Draw down pit lake as soon as practical.	KCB-2014-11	H
Faro Creek Diversion Channel	Repair slumps on the hillside slope of the channel under safe conditions or re-align the diversion.	KCB-2015-4	M
	Take flow measurements for the FCDC during spring freshet or other high flow conditions to improve the stage/discharge rating curves at high flows.	KCB-2015-5	L
	Observe the overhead wires during freshet to confirm they are functional at high flows.	KCB-2015-6	L
	Repair staff gauge FCD-2 and take new calibration measurements.	KCB-2015-7	L
	The Faro Valley Rock Dumps should be assessed for expected performance under flood conditions and a failure of the FCDC and the results of the assessment included in the Emergency Plan.	KCB-2015-8	M
North Valley Wall Interceptor Ditch	Continue vegetation clearance along the upper and middle constructed channel reaches. Clearing should also include the access road and berm along the channel to facilitate future inspection.	KCB-2014-2	L
	Observe weir during the spring freshet to confirm that it is large enough to record the flow i.e. the freshet flow is contained within the v-notch and does not overtop the sides.	KCB-2015-9	L
Rose Creek Diversion Channel	Take calibration flow measurements at the staff gauges in 2016 during high flows, using the overhead StreamPro guidance wires . Extend staff gauges, if required, such that they can be read during high flows.	KCB-2015-10	M
	Rehabilitate or replace malfunctioning thermistors installed along the Back Slope. We suggest that a thermistor supplier such as RST be engaged to carry out the assessment.	KCB-2014-11	L
	Monitor the condition of longitudinal cracks and slope slump scarps on the Back Slope from standardized photograph locations to be established in spring 2016, and continue instrumentation monitoring along the Back Slope.	KCB-2015-12	M
	Explore permit requirements regarding investigation and repair of the above slope slumps. RCDC is the main diversion channel at the Faro site; prevention of a major slump and blockage is a high priority.	KCB-2014-3	M
	Improve access trail/road condition for personnel and vehicle/equipment from landing sites to the slope slump areas on the Back Slope. There is an existing access track on the Back Slope but it is overgrown with trees. It is also time consuming and difficult to cross the RCDC. Explore the use of Argo or equivalent vehicle to cross the channel at an existing ford under existing permit.	KCB-2014-3	M
	Clear vegetation along lower channel reaches.	KCB-2014-4	M
	As part of routine monitoring on site, note any seepage that is observed from the RCDC into the tailings impoundment area.	KCB-2014-5	L
	Assess the cause of the damaged inclinometers (CD15, BH-91-CD-1, BH-94-CD-1, BGC-05-05, BGC-05-08, SP-2, SP-5) and if can be repaired.	KCB-2015-13	M
	Re-read Inclinometers CD19, CD-21, BS-5, BS-10 to confirm deflection.	KCB-2015-14	L
	Confirm the offset between the staff gauge at NFRD23 and the datalogger so that flows can be determined more reliably or relocate the flow station to a section of the stream where more consistent measurements can be achieved. A staff gauge and flow measurements should be added at the new location. Potential locations should be identified during the spring site visit.	KCB-2015-15	L
	Take flow measurements to develop a rating curve for staff gauge X2.	KCB-2015-16	L
	Several inclinometer readings taken in 2015 were erroneous. The field personnel need to check the instrument manual for proper procedures, and to perform “checksum” (see the inclinometer manual) during monitoring in the field to confirm correct readings have been taken.	KCB-2015-17	L
	Locate the missing annual review reports by Golder (1983 to 1999) and BGC (2000, 2001, and 2003), when repair works in the Back Slope area were conducted. Past successful repair experiences could provide guidance for current and future care and maintenance activities in the Back Slope area.	KCB-2014-6	L
North Fork Rock Drain	Install an additional data logger upstream of the NFRD to develop a correlation between storage and discharge through the rock drain. The data logger should be placed at a fixed elevation below the normal minimum pond level. A location for the data logger can be identified during the 2016 spring site visit.	KCB-2015-18	L
	Discontinue reading NF-2.	KCB-2015-19	L
K8 Creek Rock Drain	None		N/A
Secondary Tailings Impoundment	Clear trees from the downstream slope.	KCB-2015-20	M
	Add visual monitoring of the erosion on the North Access Road. Repair road as required.	KCB-2015-21	L
	Add protection to the piezometers to help prevent blockages.	KCB-2015-22	M
	Repair surface casing of piezometer P81-6.	KCB-2015-23	L
	Assess if piezometers P03-01 and P03-03 can be repaired.	KCB-2015-24	M
	Include the Secondary Tailings Dam in the next DSR	KCB-2015-25	H
Intermediate Dam	Repair the ruts on the downstream slope and the toe area.	KCB-2015-26	H
	Upgrade spillway to meet CDA dam safety criteria for Inflow Design Flood (IDF) for the high consequence classification dam.	KCB-2015-27 / WSR-2014	H
	Assess if piezometer BKS04-07 can be repaired.	KCB-2015-28	H
	Assess if piezometers BH91-ID 4, 6, and 7 can be repaired.	KCB-2015-29	M
	Fill the void outside the surface casing of piezometer BH-96-2.	KCB-2015-30	M
	Fix or remove the damaged HDPE pipeline at the toe of the dam.	KCB-2015-31	H
	Remove pipelines and operational equipment from the spillway.	KCB 2015-32 / WSR-2014	H
	Remove trees from dam slope.	KCB-2015-33	M

Structure	Recommendation	Number	Priority
Cross Valley Dam	Start monitoring the Weir 3 as the corroded weir plates are now replaced.	KCB-2015-34	L
	Stop thermistor readings at the dam. Protect the thermistor for potential future use. (The data show that the ground at depth is essentially thawed.	KCB-2015-35	L
	Repair rill erosions in local areas of the downstream slope near the dam crest.	KCB-2015-36	M
	Monitor longitudinal tension cracks on dam crest using quantitative measures (pins for length and width), and seal these cracks by grading to minimize water ingress to the embankment dam.	KCB-2015-37	M
	Remove trees from the dam and in the spillway channel.	KCB-2014-8	M
	Remove siphon pipeline from the spillway.	KCB-2015-38 / WSR-2014	H
	Upgrade spillway to handle the design flood.	KCB 2015 / WSR-2014	H
	Assess if piezometer CVDP-3 can be repaired.	KCB-2015-36	M
Grum Pit	Prepare a power supply contingency plan in case progressive failure of the pit wall endangers the remaining two rows of power poles carrying live wires.	KCB-2014-11	M
	Pump the water in the West Pond and the smaller pond on the Grum Pit side of the road into the Grum Interceptor Ditch.	KCB-2014-12	M
	Draw down the Grum Pit Lake as soon as practical.	KCB-2014-13	H
Vangorda Pit	Repair the sinkhole. Karen Furlong and Eric Domingue advised that this work has been completed.		Complete
Vangorda Waste Rock Dump	Remove buildup of sediment and debris from behind weirs V31, V32 and V33.	KCB-2015-37	L
	Confirm readings for piezometers V39/V40, and V44/V45 on monitoring spreadsheets. Already fixed on the plot in Appendix II.	KCB-2015-38 / WSR-2014	M
	Fix data entry error in monitoring spreadsheets for piezometer PW-10-04 for May 2015. Already fixed on the plot in Appendix II.	KCB-2015-39	L
Grump Pit Interceptor Ditch	Clear vegetation from ditch.	KCB-2012-1	L
	Check capacity replace the following culverts and replace them if the calculated capacity is less than design discharge. Alternatively, remove the culverts if the road crossings are no longer required. The design flows, if not known, could be estimated from the climate data and the catchment areas. 1) The culvert under the road to the Fresh Water Pond 2) The culvert at the road to the Water Treatment plant 3) The culvert at the crossing south of the Fresh Water Pond at site coordinates 6 905 107N, 592 890E	KCB-2012-2	L
North East Interceptor Ditch	Repair slumps in side slopes with riprap and place filter materials between existing slope and newly added riprap materials. The maintenance activity should focus on maintaining adequate flow capacity of the Interceptor Ditch during the next spring freshet. Side slope repairs could use a simple design with coarse rock placed over filter cloth such that the side slopes and the channel capacity are maintained.	KCB-2015-40	L
Vangorda Creek Diversion Flume	Clear the entrance of the twin emergency spillway culverts and lower the spillway channel invert at the discharge end of the culverts.	KCB-2015-41	L
	Replace the flume with a new structure as early as practical.	KCB-2014-14	M
	Remove debris from trash racks.	KCB-2014-15	H
Little Creek Dam	Repair erosion on the downstream dam slope.	KCB-2015-42	H
	Grade the downstream toe to promote drainage and prevent the toe area becoming saturated after snowmelt and/or heavy rain.	KCB-2015-43	M
	Carry out a hydrological assessment to confirm the design flood, and if it can be stored and/or whether the spillway should be resized.	KCB-2015-44	H
	Clear trees from dam slope.	KCB-2015-45	M
	Check water quality of seeps to determine if it originates from Little Creek Pond.	KCB-2015-46	L
	Stop thermistor reading at the dam. Protect the thermistor for potential future use. (The data show that the ground at depth is essentially thawed.	KCB-2015-47	L
Sheep Pad Sediment Ponds	Reduce the size of the large boulders weighing down the half-round CSP between the Upper and Lower Ponds. Add stiffening braces to the top of the CSP to prevent further pipe deformation due to lateral pressure from riprap materials around the pipe.	KCB-2015-48	H
	Consider options for lowering the invert elevation of CSP half round between upper and lower Sheep Pond. This should help to maintain more freeboard in the upper pond.	KCB-2015-49	M
	Cover exposed geofabric, as required, with riprap materials, on the berm separating the Lower and Upper Pond spillway.	KCB-2015-50	L
	Move staff gauge at V25BSP away from the V-Notch so that it does not restrict flow.	KCB-2015-51	L
	Confirm storage capacity and height of impoundment to determine if the pond should be classified as a dam.	KCB-2015-52	M
	Include annual surveys of the survey pin installed near the lower pond spillway channel in the geotechnical monitoring program.	KCB-2015-53	L
Fresh Water Pond	Clear trees from embankment slopes and spillway channel.	KCB-2015-54	M
	Confirm storage capacity and height of impoundment to determine if the pond should be classified as a dam.	KCB-2015-55	M
V-15 Seep Ditch and Moose Pond	Minimize the seepage and surface water runoff that reports to Moose Pond.	KCB-2015-56	M
Sludge Pond Embankment	Clear trees from embankment slopes.	KCB-2015-57	M
	Confirm storage capacity and height of impoundment to determine if the pond should be classified as a dam.	KCB-2015-58	M

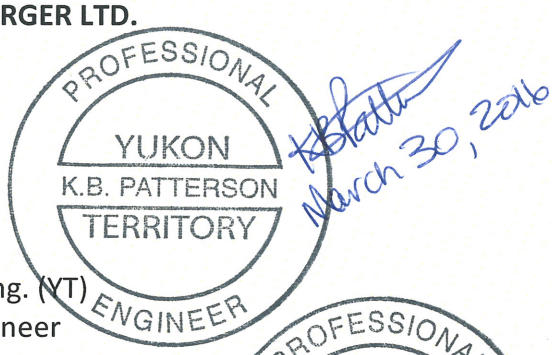
H - High Priority
M - Medium Priority
L - Low Priority

5 CLOSING

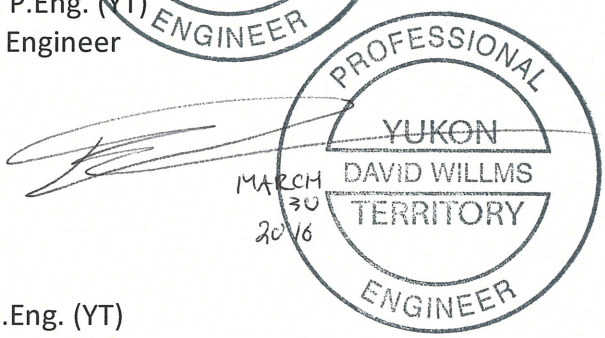
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We appreciate the opportunity to work on this interesting and environmentally important project.

KLOHN CRIPPEN BERGER LTD.



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Hydrotechnical Engineer



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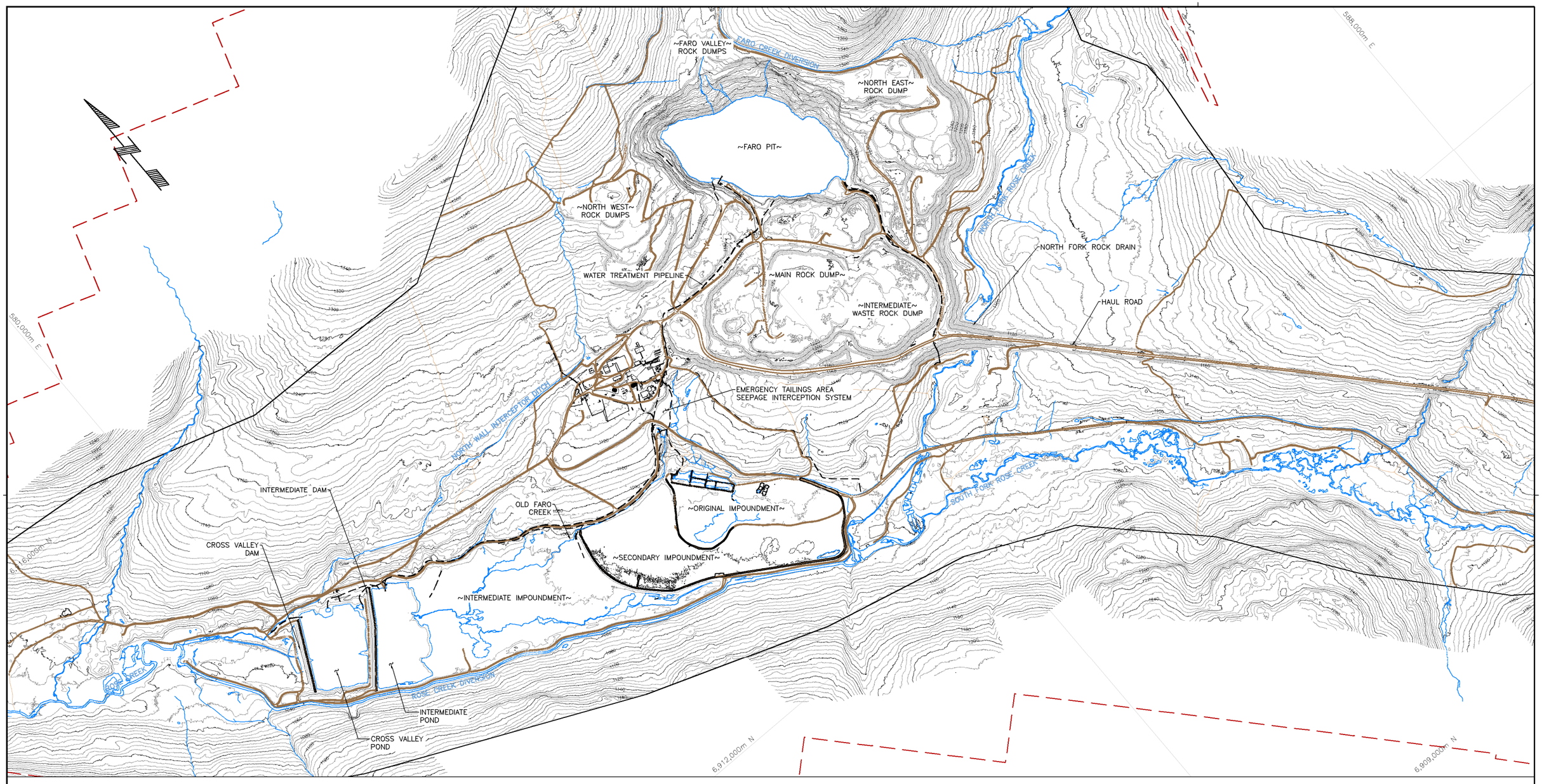
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FIGURES

Figure 1 Faro Site – General Layout
Figure 2 Faro Site – Air Photo
Figure 3 Vangorda Plateau Mine – Site Overview
Figure 4 Vangorda Plateau Site – General Arrangement Plan
Figure 5 Vangorda Plateau Site – Air Photo
Figure 6 Faro Pit Brim – Reference Bars and Survey Prisms
Figure 7 Down Valley Tailings Containment Instrument Location – 1 of 2
Figure 8 Down Valley Tailings Containment Instrument Location – 2 of 2
Figure 9 Section View of Intermediate Dam
Figure 10 Section View of Cross Valley Dam
Figure 11 Grum Pit Brim – Reference Rods and Survey Prisms
Figure 12 General Arrangement Plan – Vangorda Waste Rock Dump
Figure 13 Little Creek Dam – General Arrangement Plan
Figure 14 Little Creek Dam – Section B-B



LEGEND

- IMPACTED AREA BOUNDARY
- ACESS ROADS
- STREAMS

NOT FOR CONSTRUCTION

To be read with Klohn Crippen Berger report dated

SCALE 0 1000m

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CLIENT: YUKON GOVERNMENT

Klohn Crippen Berger

PROJECT: FARO MINE COMPLEX
2012 ANNUAL GEOTECHNICAL REVIEW

TITLE: FARO SITE GENERAL LAYOUT

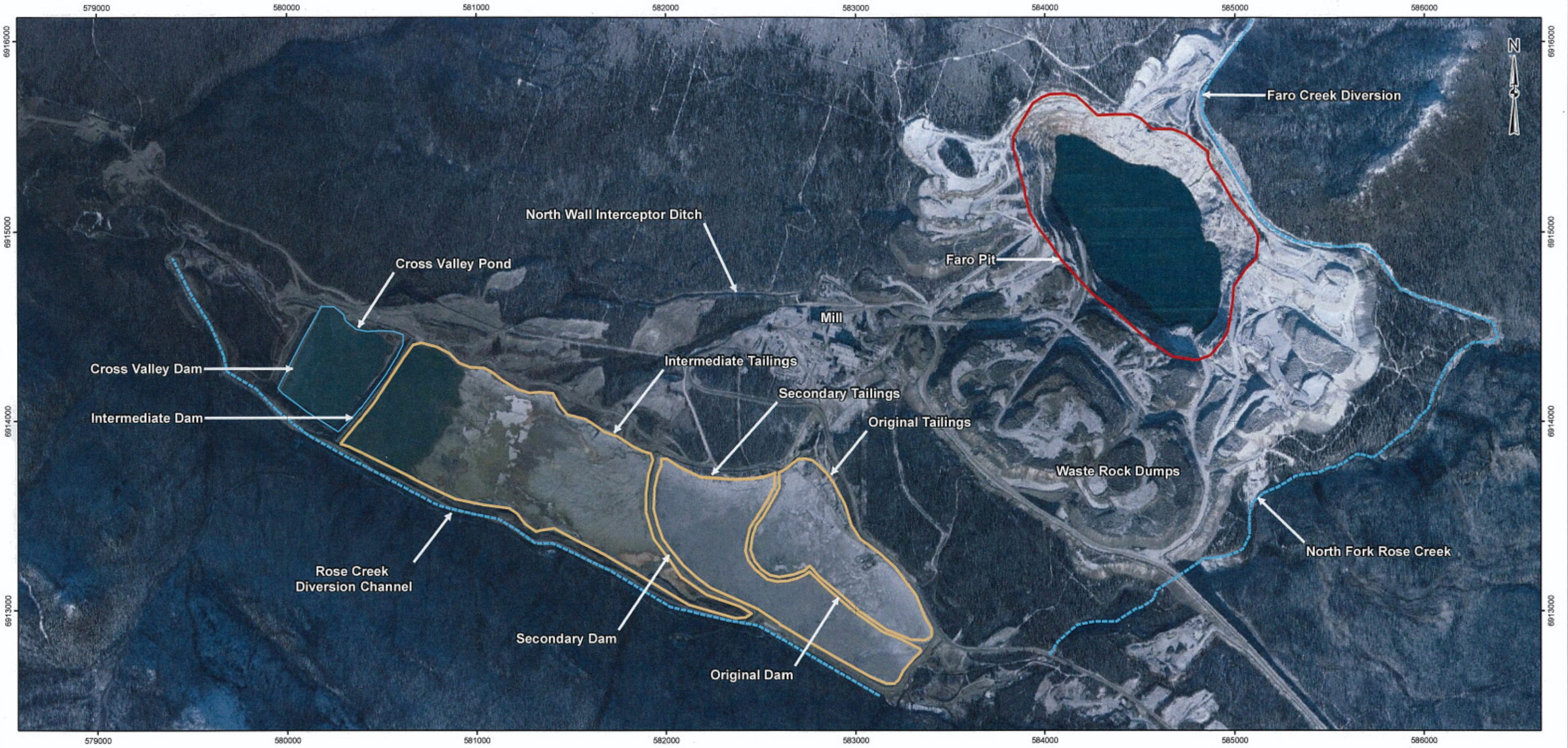
PROJECT No. M09770A02 02

FIG. No. FIGURE 1

KCB-R-MLD

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Xref File(s): bm-faro-130221; for insert-by others-faro site plan-130221
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LEGEND

- Pit
- Tailings
- Pond
- Diversion

NOTE

Refer to Figures 3-1 and 3-2 for Down Valley Tailings Containment instrument location details.

REFERENCE

Ortho-image obtained from Google © 2007 Data SIO, NOAA, U.S. Navy, NGA, GEBCO Image © 2011 DigitalGlobe.
Projection: UTM Zone 8 Datum: NAD 83

500 0 500
SCALE 1:20,000 METRES

Fig. 2 Original Source: Figure 2-1 General Arrangement Plan Golder 2011. 2010 Annual Geotechnical Dam Inspection, Faro Mine Complex, Faro, Yukon

FIGURE 2

PROJECT
DENISON ENVIRONMENTAL SERVICES
FARO MINE COMPLEX
YUKON

TITLE
FARO SITE AIR PHOTO

Golder Associates
Greater Vancouver Office, B.C.

PROJECT No. 10-1427-0032			PHASE No. 2000	
DESIGN	WJP	08FEB11	SCALE AS SHOWN	REV. 0
GIS	AL	08FEB11		
CHECK	WJP	28FEB11	FIGURE 2-1	
REVIEW	JAH	28FEB11		

\\int.klohn.com\ProjData\M\VCR\M09770A01 - Gov't Yukon-FaroSiteGeotech\300 Design\Figures\GIMP_edited_files\Figure3_Vangorda_Plateau_Mine_Site_Overview.xcf (afischer)

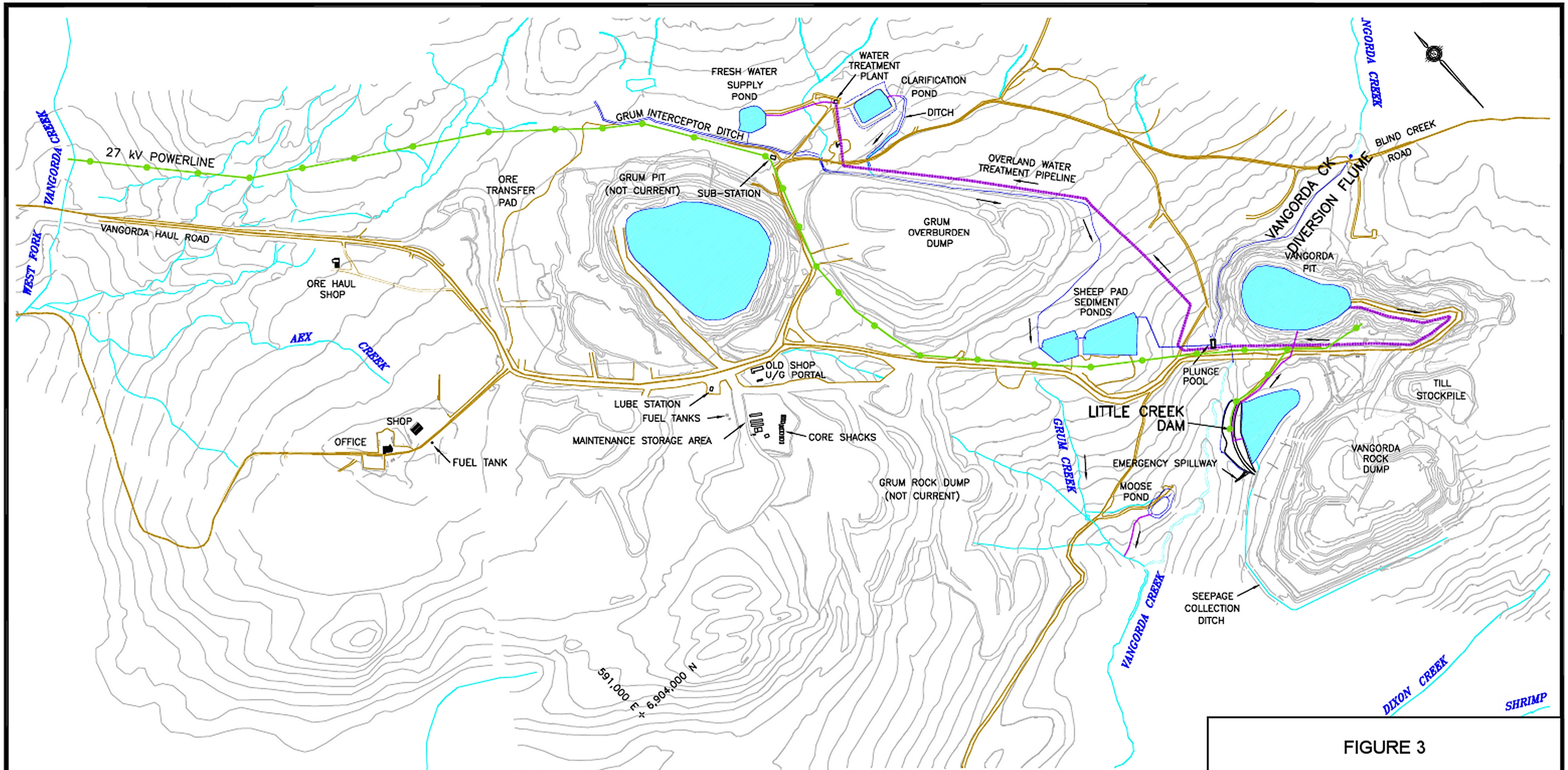


Fig. 3 Original Source: Figure 3 Vangorda Plateau Mine Site – Overview BGC 2003. Report on Emergency Preparedness Plan for Selected Dams and Water Diversion Structures

CLIENT: **Deloitte & Touche**

NOTE: BASE MAP FIGURE PROVIDED BY GARTNER LEE LTD.

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LEGEND:
- ROADS
- EXISTING SURFACE DRAINAGE
- PRE-MINE DRAINAGE
- EFFLUENT PIPELINE
- PIPELINE
- POWERLINE
- WATER TREATMENT PIPELINE
- SURFACE WATER

REV.	DATE	REVISION NOTES	DRAWN	CHECKED	APPROVED

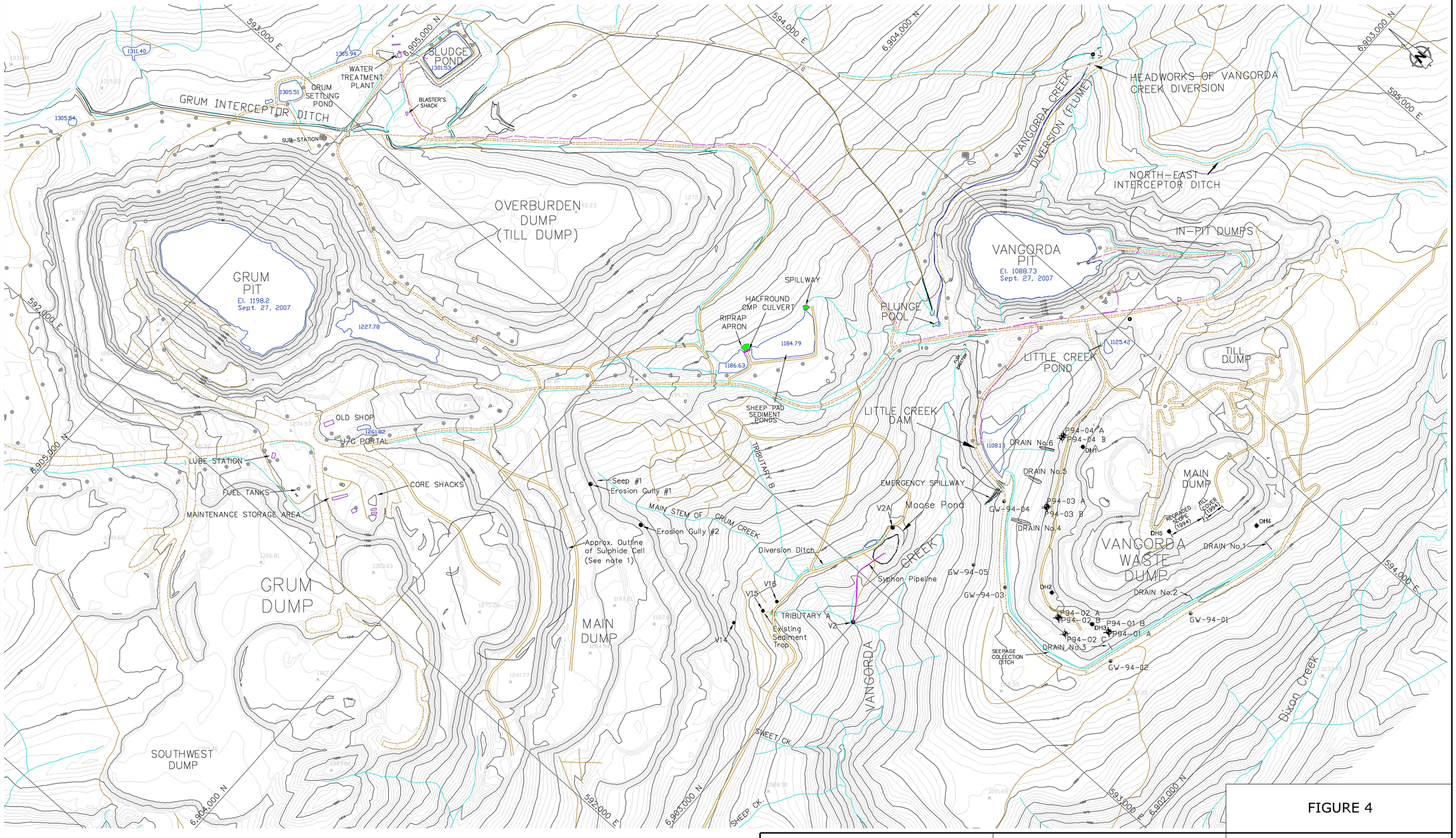
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DATE:	OCTOBER 2003
DRAWN:	GEJ
DESIGNED:	KM
CHECKED:	HHH/JWC
APPROVED:	JWC

FIGURE 3

PROJECT	ANVIL RANGE EPP FOR DAMS & WATER DIVERSION STRUCTURES
TITLE	VANGORDA PLATEAU MINE SITE OVERVIEW

PROJECT No.	FIGURE No.	REV.
0257-018-02	3	0

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY
Calgary, AB Phone: (403) 250 5185



Map Scale: 1:2500
Contour Interval: 2m
Date of Photography: 03/07/25
Scale of Photography: 1:20000
Survey control derived from existing 1:20000 photography
Survey control based on: UTM Projection, NAD27
Compiled by The ORTHOSHOP, Calgary, September 2003
WO 8856

0 100 200 300 400 500
Scale 1:10,000

Fig 4. Original Source: Figure 2 2011 Geotechnical Inspection. Waste and Water Management Facilities Vangorda/Grum

SRK Consulting
Engineers and Scientists
Vancouver

SRK JOB NO.: 1CD009.003
FILE NAME: site_plan.dwg

Denison Environmental Services

FARO MINE COMPLEX

FIGURE 4

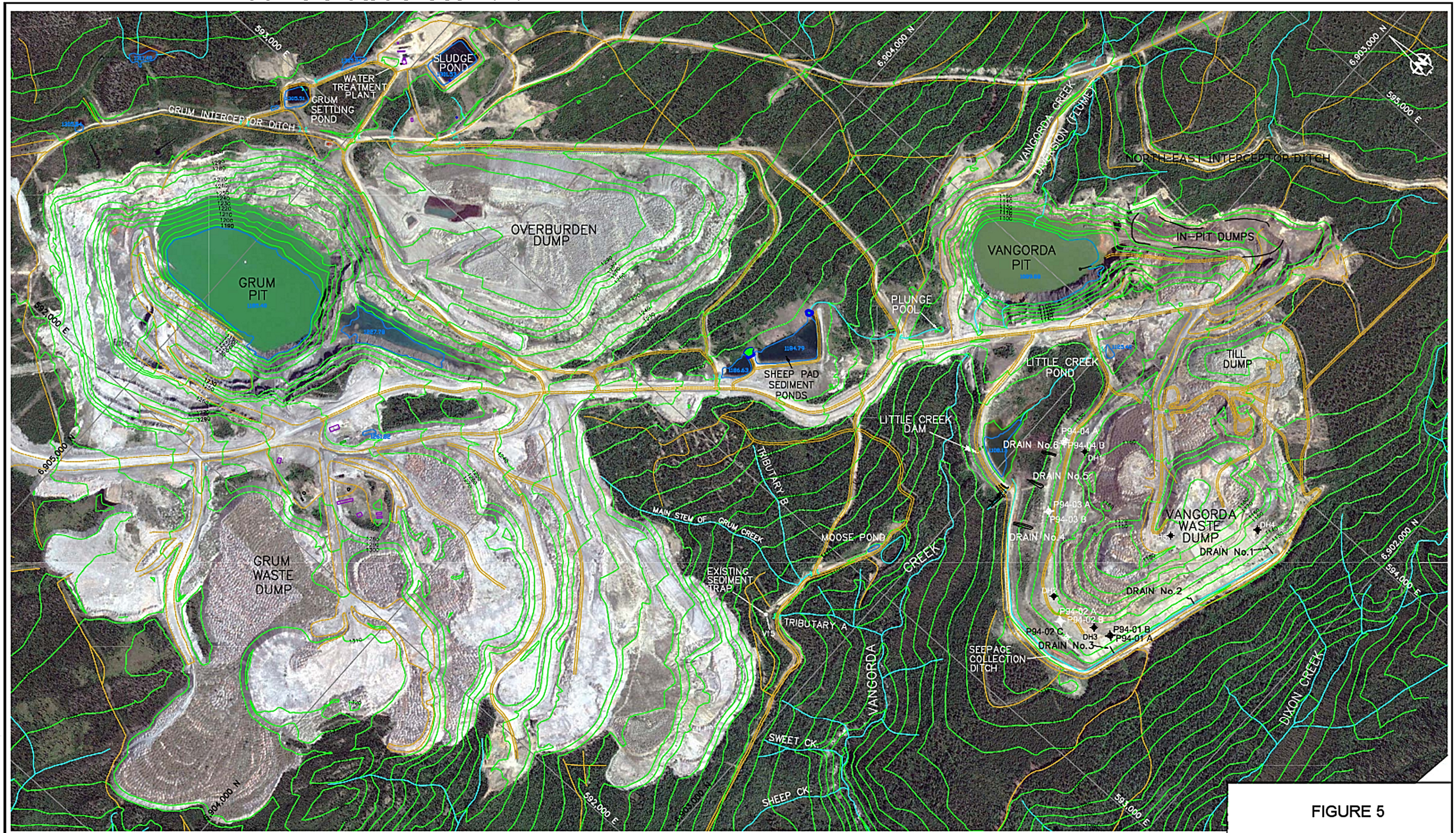
2010 Vangorda Annual Inspection

General Arrangement Plan

DATE:	APPROVED:	FIGURE:
Feb. 2011		2

J:\01_SITES\FARO\1107_1CD009.003_2010 Geot_Insp\040_AutoCAD\site_plan.dwg

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Map Scale: 1:2500
Contour Interval: 2m
Date of Photography: 18/09/09
Survey control derived from existing 1:20000 photography
Survey control based on: UTM Projection, NAD27

0 100 200 300 400 500
Scale 1:10,000

Fig. 5 Original Source: Figure 3 Photo-Rectified Mosaic, with Contours, of Vangorda Plateau Area SRK 2011. 2010 Annual Inspection – Waste and Water Management Facilities – Vangorda/Grum

srk consulting

SRK JOB NO.: 1CD009.005
FILE NAME: site_plan_photo.dwg

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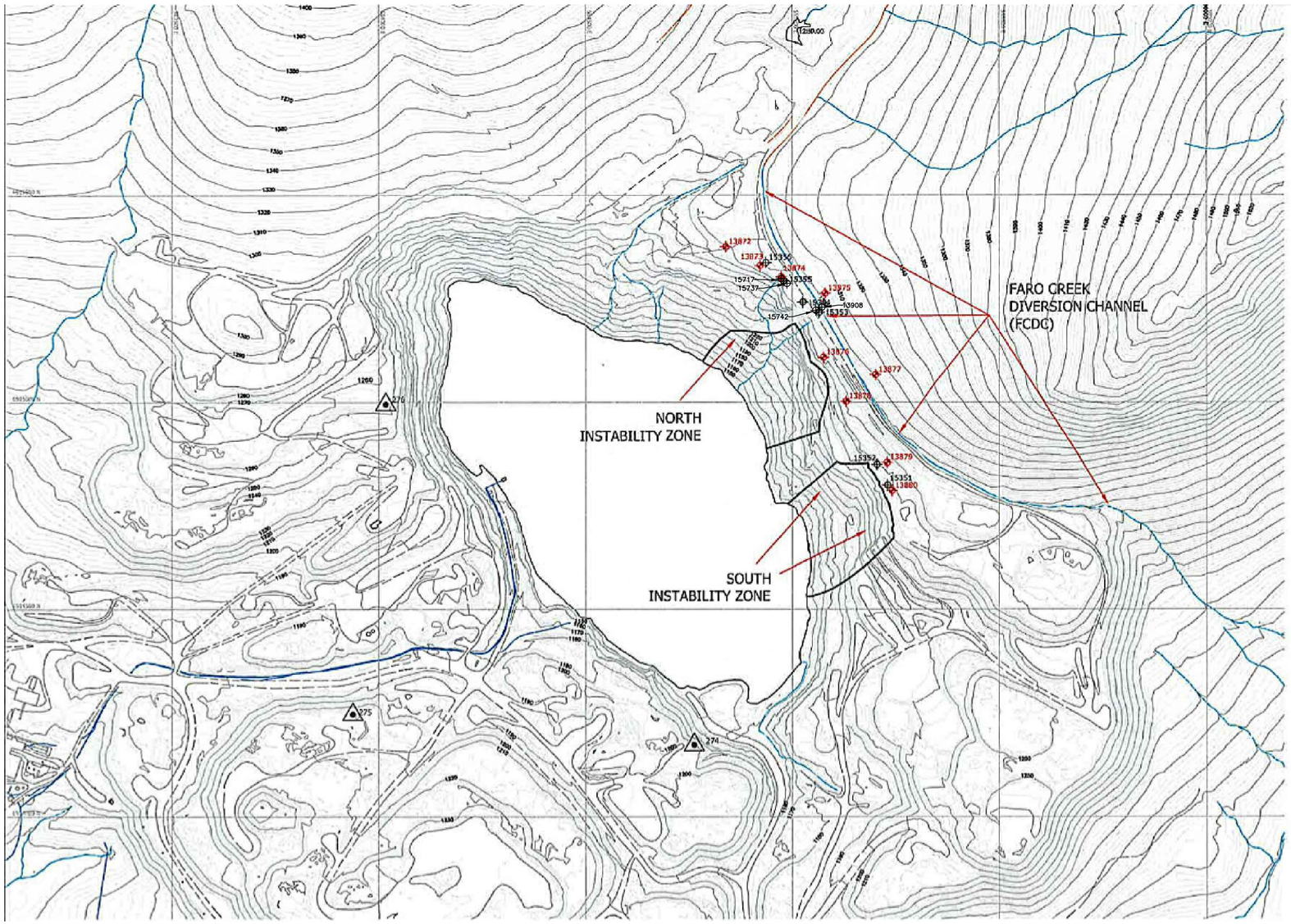
FARO MINE COMPLEX

FIGURE 5

2011 Vangorda Geotechnical Inspection

VANGORDA PLATEAU SITE AIR PHOTO

DATE:	APPROVED:	FIGURE:
July 2011	PMH	3



NOTES:

1) ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.

LEGEND:

13878 — MONITORING SURVEY PRISMS

13912 — SLOPE MOVEMENT OBSERVATIONS - REFERENCE BARS

274 — OBSERVATION POINTS FIXED LOCATION

NOTES:
1. ORIGINAL FIGURE PROVIDED BY GOLDER ASSOCIATES.
2. SLOPE MOVEMENT OBSERVATIONS 15717, 15737, 15742 AND 13908 APPROXIMATELY LOCATED.

To be read with Klohn Crippen Berger report dated

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CLIENT: Yukon Government

Klohn Crippen Berger

PROJECT: FARO MINE COMPLEX
ANNUAL REVIEW

TITLE: FARO PIT BRIM
REFERENCE BARS AND SURVEY PRISMS

PROJECT No.: M09770A03 01

FIGURE 6

KCB-R-MLD

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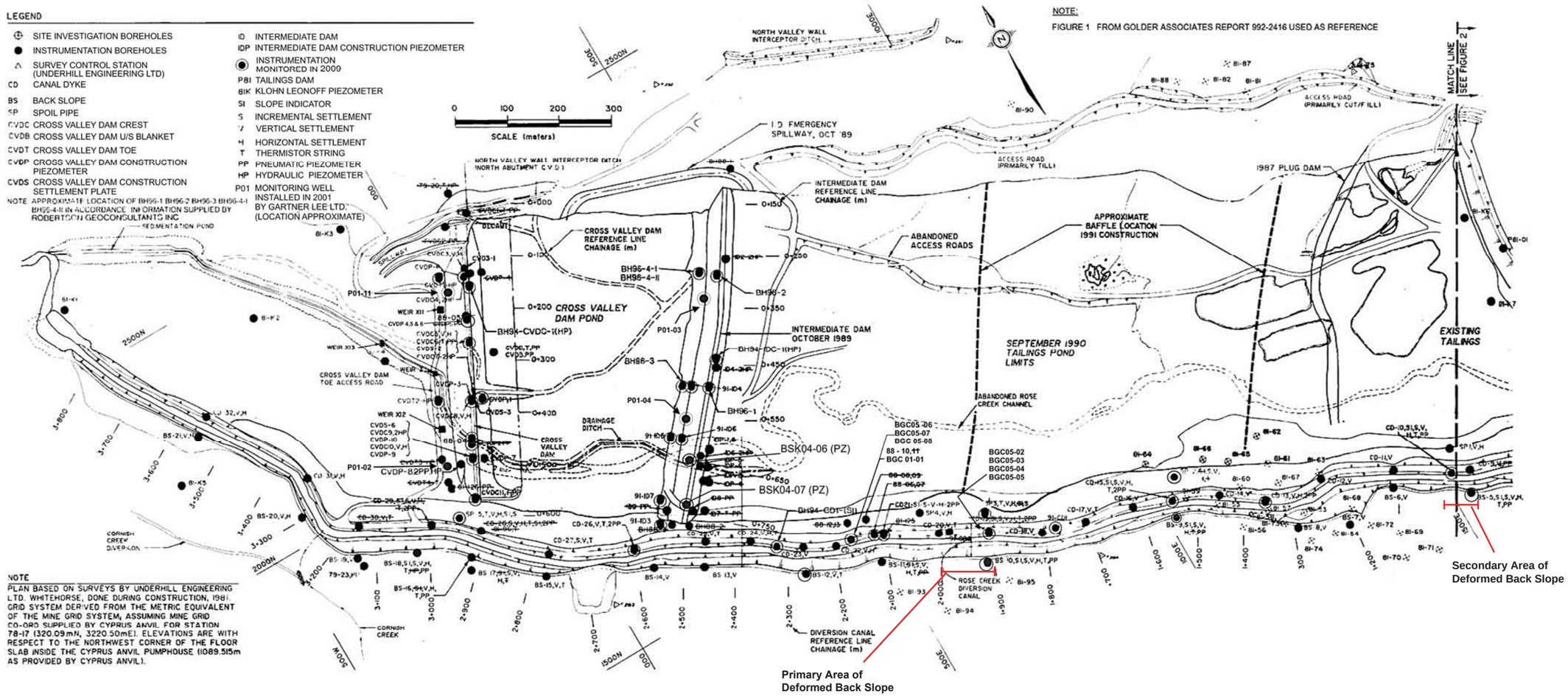


Fig. 7 Original Source: Figure 2 - 2009 Geotechnical Evaluation and Instrumentation Review, Volume 1

FIGURE 7

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CHECKED:	HHH
APPROVED:	GWF

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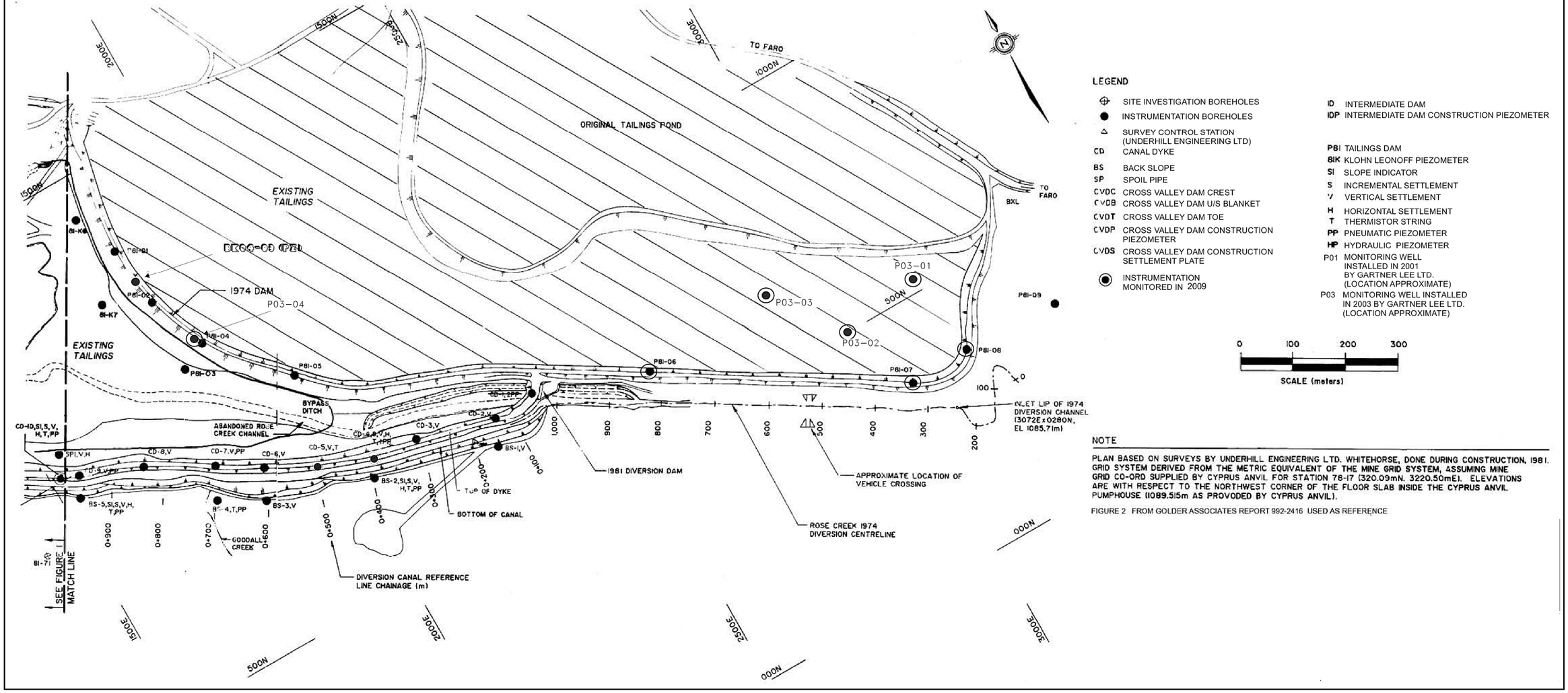
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CLIENT: Denison Environmental Services

PROJECT: 2009 ANNUAL GEOTECHNICAL EVALUATION AND INSTRUMENTATION REVIEW

TITLE: DOWN VALLEY TAILINGS CONTAINMENT INSTRUMENT LOCATION 1 OF 2

PROJECT No.:	FIGURE No.:	REV.:
0762-002-05	2	0



LEGEND

- ⊕ SITE INVESTIGATION BOREHOLES
- ● INSTRUMENTATION BOREHOLES
- △ SURVEY CONTROL STATION (UNDERHILL ENGINEERING LTD)
- CD CANAL DYKE
- BS BACK SLOPE
- SP SPOIL PIPE
- CVDC CROSS VALLEY DAM CREST
- CVDB CROSS VALLEY DAM U/S BLANKET
- CVDT CROSS VALLEY DAM TOE
- CVDP CROSS VALLEY DAM CONSTRUCTION PIEZOMETER
- CVDS CROSS VALLEY DAM CONSTRUCTION SETTLEMENT PLATE
- ◉ INSTRUMENTATION MONITORED IN 2009
- ID INTERMEDIATE DAM
- IDP INTERMEDIATE DAM CONSTRUCTION PIEZOMETER
- P8I TAILINGS DAM
- 8IK KLOHN LEONOFF PIEZOMETER
- SI SLOPE INDICATOR
- S INCREMENTAL SETTLEMENT
- V VERTICAL SETTLEMENT
- H HORIZONTAL SETTLEMENT
- T THERMISTOR STRING
- PP PNEUMATIC PIEZOMETER
- HP HYDRAULIC PIEZOMETER
- P01 MONITORING WELL INSTALLED IN 2001 BY GARTNER LEE LTD. (LOCATION APPROXIMATE)
- P03 MONITORING WELL INSTALLED IN 2003 BY GARTNER LEE LTD. (LOCATION APPROXIMATE)

0 100 200 300
SCALE (meters)

NOTE

PLAN BASED ON SURVEYS BY UNDERHILL ENGINEERING LTD. WHITEHORSE, DONE DURING CONSTRUCTION, 1981. GRID SYSTEM DERIVED FROM THE METRIC EQUIVALENT OF THE MINE GRID SYSTEM, ASSUMING MINE GRID CO-ORD SUPPLIED BY CYPRUS ANVIL FOR STATION 78-17 (320.09mN, 3220.50mE). ELEVATIONS ARE WITH RESPECT TO THE NORTHWEST CORNER OF THE FLOOR SLAB INSIDE THE CYPRUS ANVIL PUMPHOUSE (1089.515m AS PROVODED BY CYPRUS ANVIL).

FIGURE 2 FROM GOLDER ASSOCIATES REPORT 992-2416 USED AS REFERENCE

Fig. 8 Original Source: Figure 3 - 2009 Annual Geotechnical Evaluation and Instrumentation Review, Volume 1

FIGURE 8

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CHECKED:	HHH
APPROVED:	GWF

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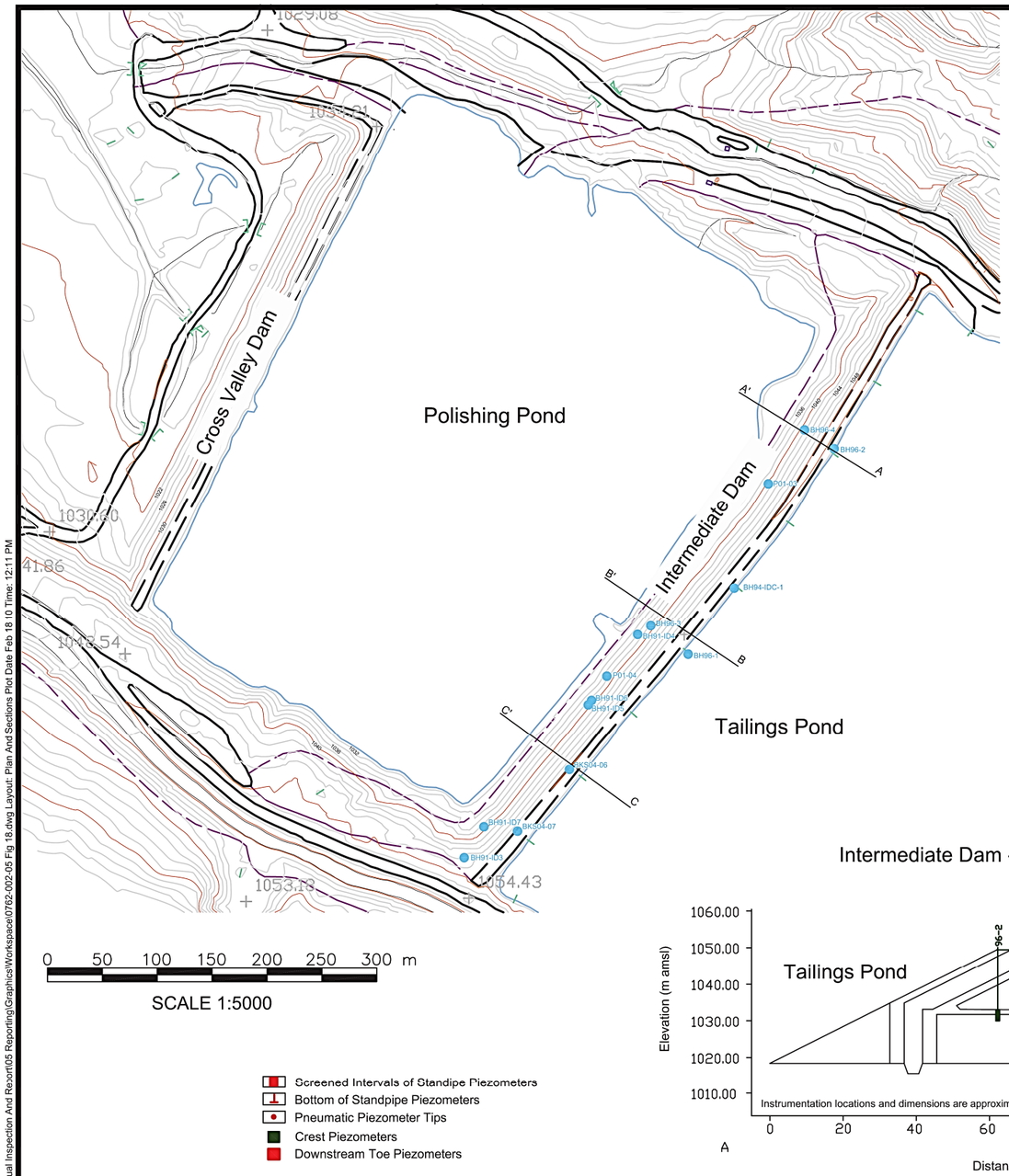
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AN APPLIED EARTH SCIENCES COMPANY

CLIENT: Denison Environmental Services

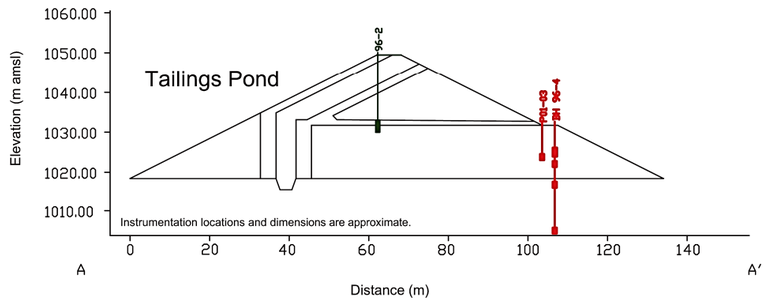
PROJECT: 2009 ANNUAL GEOTECHNICAL EVALUATION AND INSTRUMENTATION REVIEW

TITLE: DOWN VALLEY TAILINGS CONTAINMENT INSTRUMENT LOCATION 2 OF 2

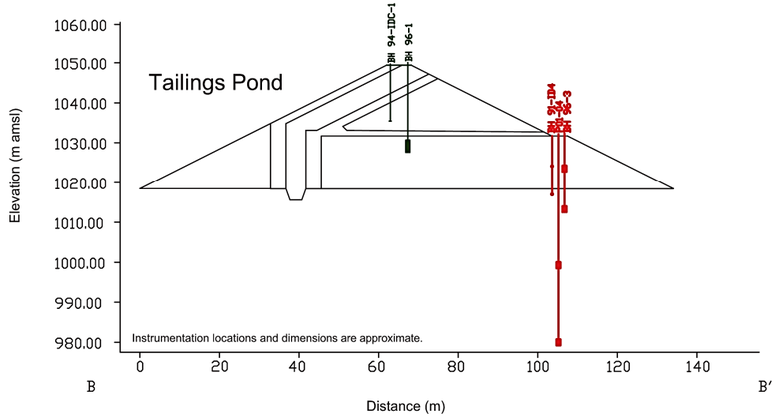
PROJECT No.:	FIGURE No.:	REV.:
0762-002-05	3	0



Intermediate Dam - Cross-Section A - A'



Intermediate Dam - Cross-Section B - B'



Intermediate Dam - Cross-Section C - C'

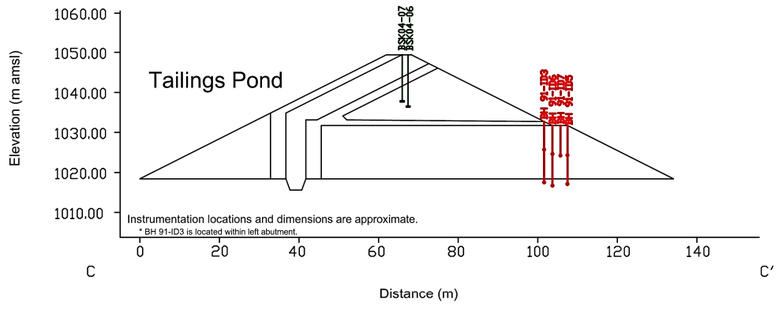


Fig. 9 Original Source: Figure 18 - 2009 Annual Geotechnical Evaluation and Instrumentation Review, Volume 1

FIGURE 9

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REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	AS SHOWN
DATE:	FEB 2010
DRAWN:	JL
DESIGNED:	TMW
CHECKED:	HHH
APPROVED:	GWF

PROFESSIONAL SEAL:

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: Denison Environmental Services

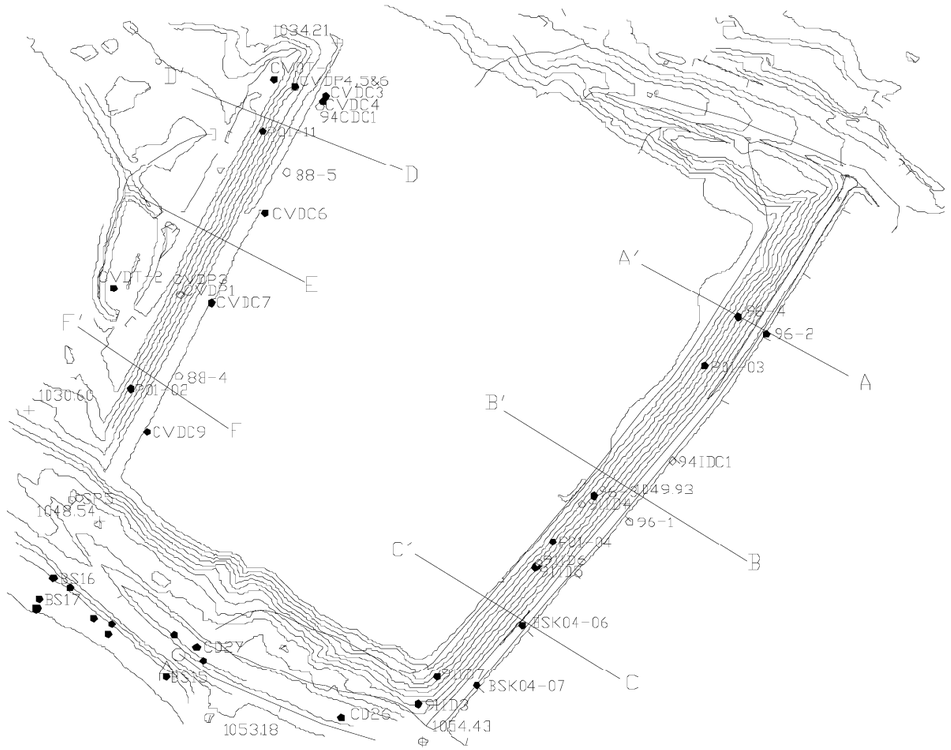
PROJECT: 2009 ANNUAL GEOTECHNICAL EVALUATION AND INSTRUMENTATION REVIEW

TITLE: SECTION VIEW OF INTERMEDIATE DAM

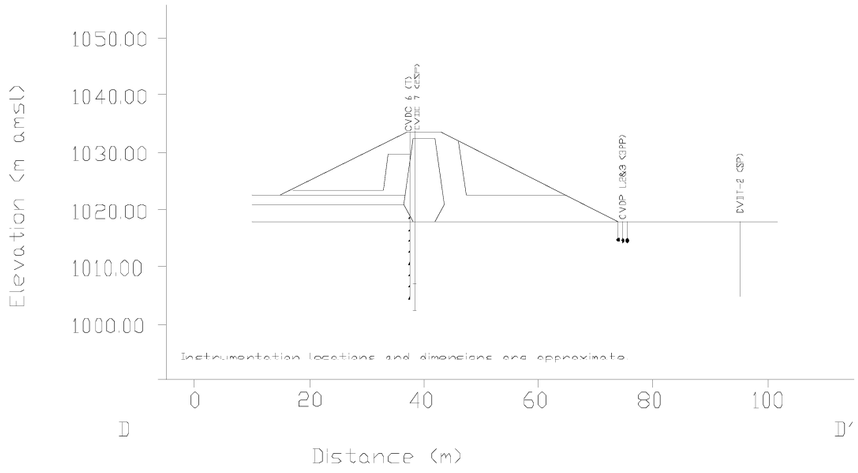
PROJECT No.:	FIGURE No.:	REV.:
0762-002-05	18	0

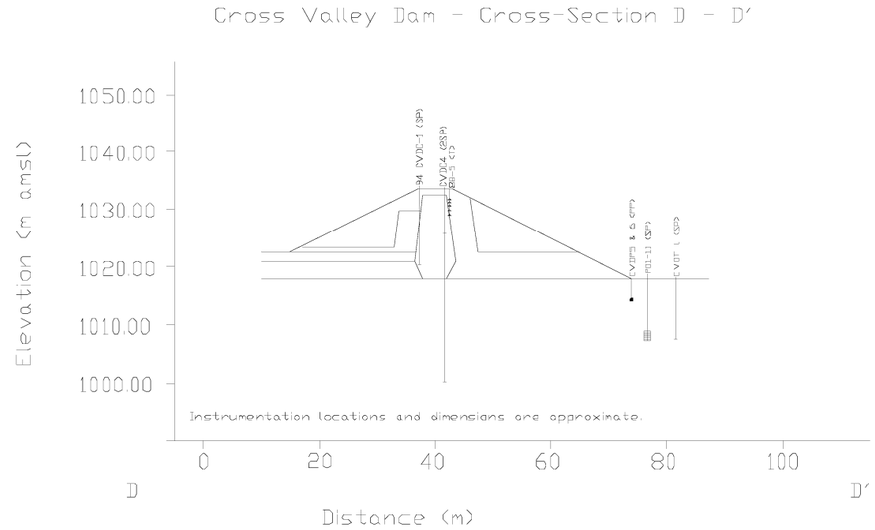
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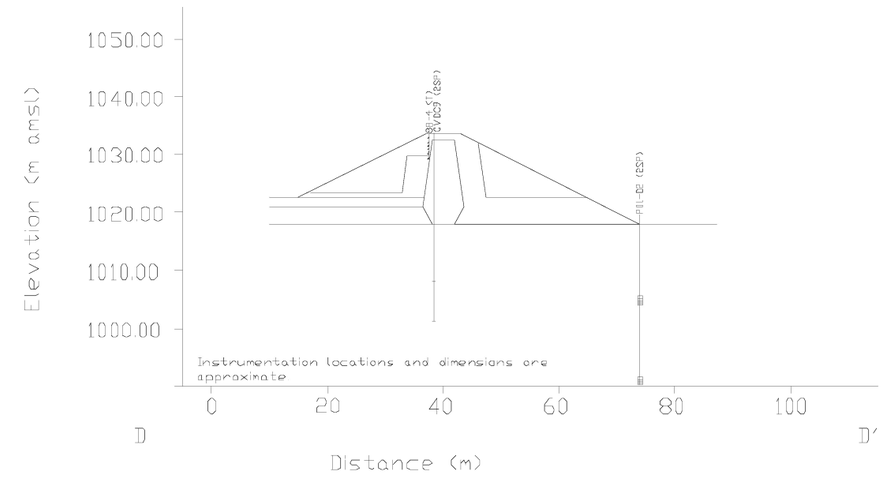
DWG TO BE READ WITH BGC REPORT TITLED " 2009 ANNUAL GEOTECHNICAL EVALUATION AND INSTRUMENT REVIEW" DATED FEB 2010



Cross Valley Dam - Cross-Section E - E′







SP Standpipe Piezometers
PP Pneumatic Piezometers
T Thermistor Cables
Screened Intervals of Standpipe Piezometers
Bottom of Standpipe Piezometers
Pneumatic Piezometer Tips
Thermistor Nodes

Fig. 10 Original Source: Figure 24 - 2009 Geotechnical Evaluation and Instrumentation Review, Volume 1

FIGURE 10

AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC, AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT. AUTHORIZATION FOR ANY USE AND/OR PUBLICATION OF THIS REPORT OR ANY DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS, THROUGH ANY FORM OF PRINT OR ELECTRONIC MEDIA, INCLUDING WITHOUT LIMITATION, POSTING OR REPRODUCTION OF SAME ON ANY WEBSITE, IS RESERVED PENDING BGC'S WRITTEN APPROVAL. IF THIS REPORT IS ISSUED IN AN ELECTRONIC FORMAT, AN ORIGINAL PAPER COPY IS ON FILE AT BGC ENGINEERING INC. AND THAT COPY IS THE PRIMARY REFERENCE WITH PRECEDENCE OVER ANY ELECTRONIC COPY OF THE DOCUMENT, OR ANY EXTRACTS FROM OUR DOCUMENTS PUBLISHED BY OTHERS.

REV.	DATE	REVISION NOTES	DRAWN	CHECK	APPR.

SCALE:	N/A
DATE:	FEB 2010
DRAWN:	TMW
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CHECKED:	HHH
APPROVED:	GWF

PROFESSIONAL SEAL:

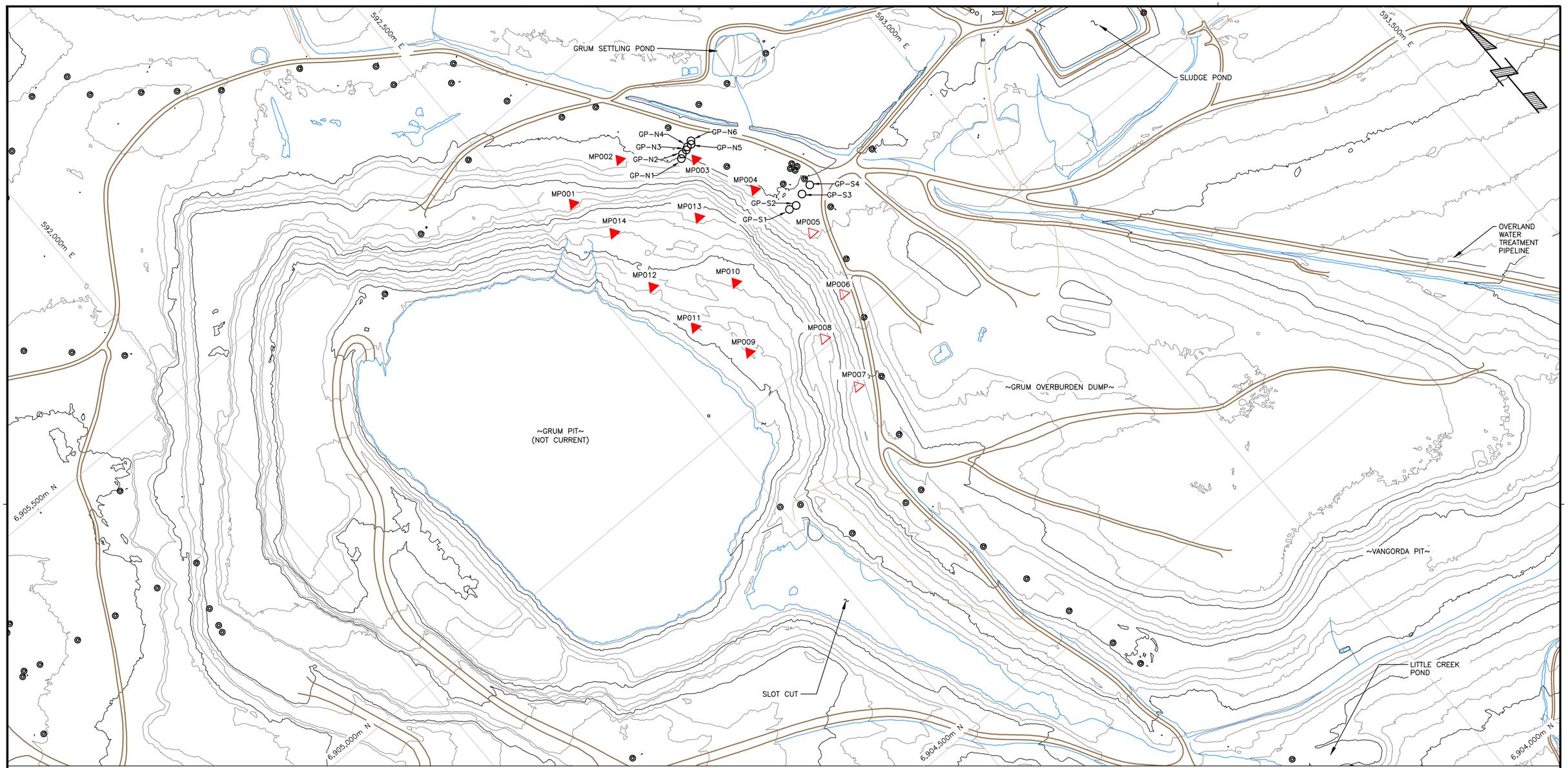
BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: Dominion Environmental Services

PROJECT: 2009 ANNUAL GEOTECHNICAL EVALUATION AND INSTRUMENTATION REVIEW

TITLE: SECTION VIEW OF CROSS VALLEY DAM

PROJECT No.:	FIGURE No.:	REV.:
0762-002-05	24	0



LEGEND

- ACESS ROADS
- STREAMS
- POWER POLE
- MP014 — 2014 SURVEY PRISM
- MP005 — 2013 SURVEY PRISM
- GP-N1 — REFERENCE ROD

To be read with Klohn Crippen Berger report dated

SCALE 0 750m

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CLIENT: Yukon Government

Klohn Crippen Berger

PROJECT: FARO MINE COMPLEX ANNUAL REVIEW

TITLE: GRUM PIT BRIM REFERENCE RODS AND SURVEY PRISMS

PROJECT No. M09770A03 01

FIGURE 11

KCB-F-MD

Date: 1/29/2013 Time: 13:25:10 Scale: 1:2,585
Filename: \\NT.KLOHN.COM\PROJDATA\M\VCR\M09770A03-GOVTYUKON-2013 FARO\400 DRAWINGS\ANNUALREVIEW\FIG_11.DWG



LEGEND

- Piezometer Location
- Monitoring Well Location (1994)
- Monitoring Well Location (2010)
- Monitoring Well Location (2009)

Contour Interval: 2m
Survey control based on: UTM Projection, NAD83
Based on The ORTHOSHOP, Calgary, September 2003

0 50 100 150 200 250
Scale in Metres

Fig. 12 Original Source: Figure 4 - 2011 Geotechnical Inspection Waste and Water Management Facilities Vangorda/Grum

srk consulting

SRK JOB NO.: 1CD009.005
FILE NAME: site_plan nad 83.dwg

Denison Environmental Services

FARO MINE COMPLEX

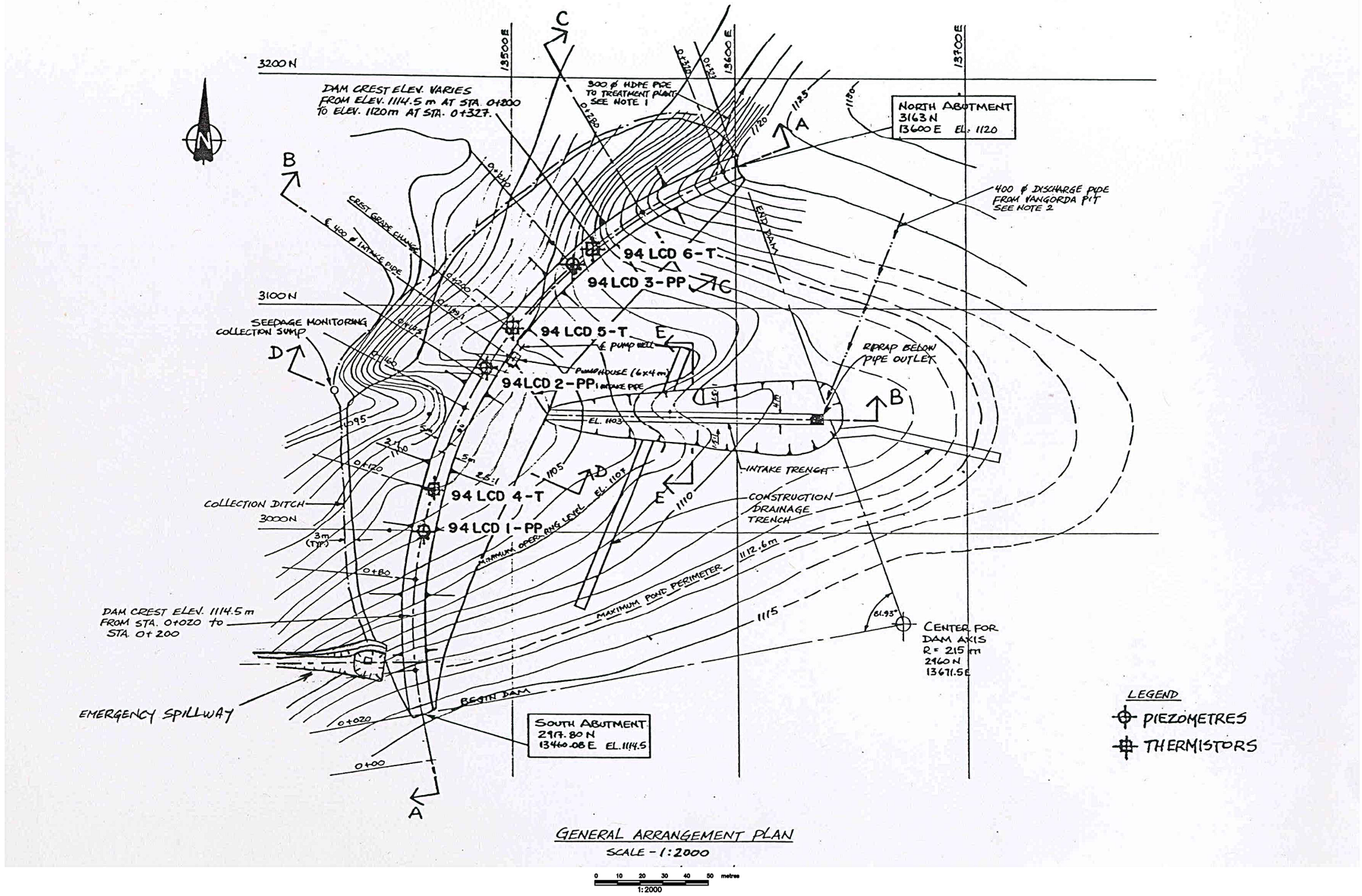
FIGURE 12

2011 Vangorda Geotechnical Inspection

General Arrangement Plan
Vangorda Waste Rock Dump

DATE:	APPROVED:	FIGURE:
July 2011	JK	4

J:\01_SITES\FARO\22I0_1CD009.005 _Vangorda 2011 Geotech Inspection\C40_AutoCad\site_plan nad 83.dwg



GENERAL ARRANGEMENT PLAN
SCALE - 1:2000

Fig. 13 Original Source: Figure 10 - 2011 Geotechnical Inspection Waste and Water Management Facilities Vangorda/Grum

FIGURE 13

srk consulting

Denison Environmental Services

2011 Vangorda Geotechnical Inspection

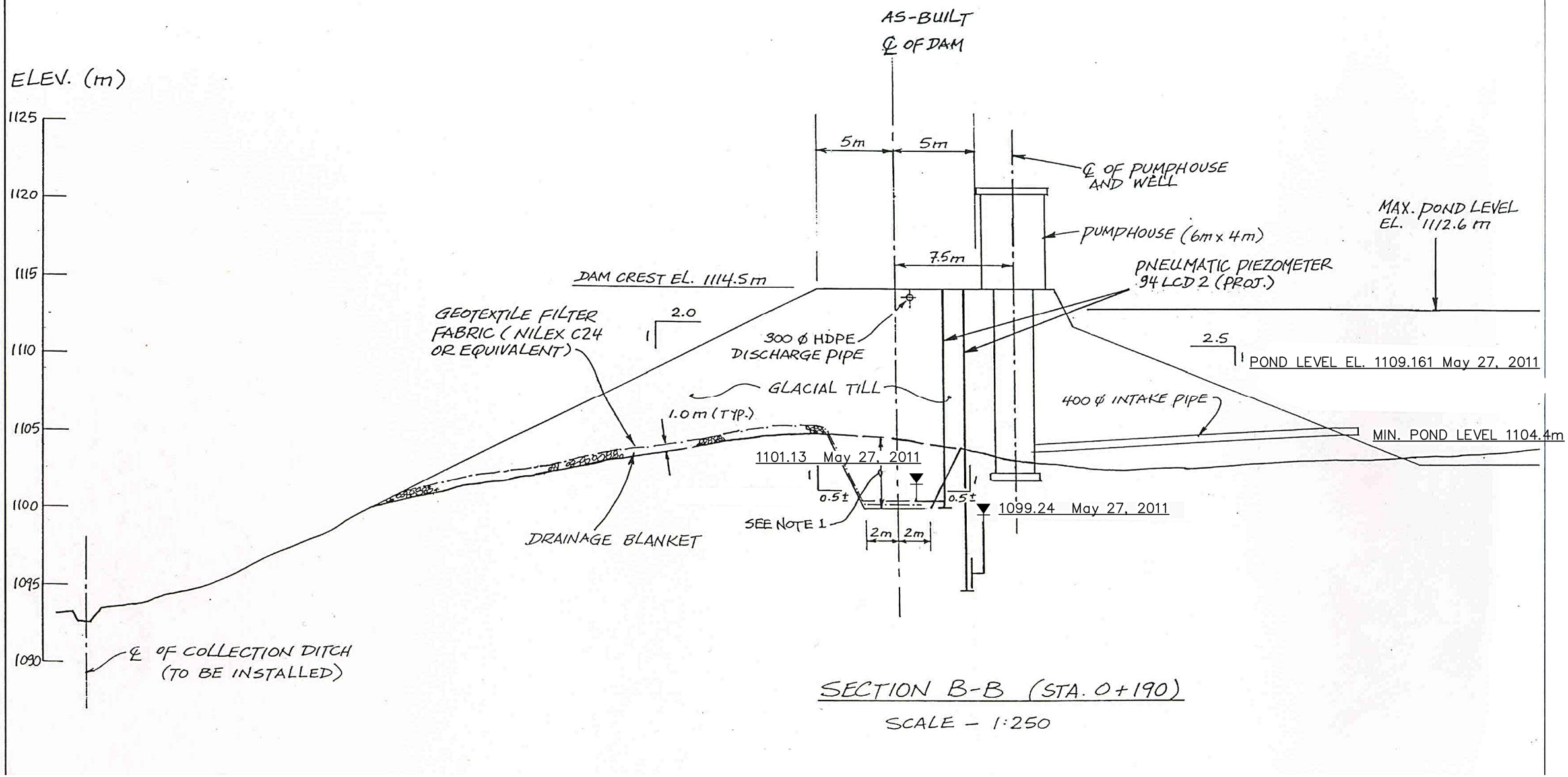
LITTLE CREEK DAM
GENERAL ARRANGEMENT PLAN

SRK JOB NO.: 1CD009.005

FILE NAME: FIG-10.dwg

FARO MINE COMPLEX

DATE:	APPROVED:	FIGURE:
July 2011	PMH	10



SECTION B-B (STA. 0+190)

SCALE – 1:250

0 2 4 6 8 10 METRES
1:250

Fig. 14 Original Source: Figure 11 - 2011 Geotechnical Inspection Waste and Water Management Facilities Vangorda/Grum

srk consulting	Denison Environmental Services	FIGURE 14
SRK JOB NO.: 1CD009.005	FARO MINE COMPLEX	2011 Vangorda Geotechnical Inspection
FILE NAME: FIG-11.dwg		LITTLE CREEK DAM SECTION B-B
		DATE: July 2011 / APPROVED: PMH / FIGURE: 11

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APPENDIX I

2015 Select Site Photographs

Faro Pit



Photo 1 Faro Pit north segment of east wall as seen from "eye-in-the-sky"



Photo 2 Faro Pit south segment of east wall as seen from "eye-in-the-sky"

Faro Pit



Photo 3 **Faro Pit north segment of east wall note drilling program underway**



Photo 4 **Faro Pit south segment of east wall (looking northwest) note tension cracks and slope regression. The Faro Creek Diversion channel is uphill to the right of the photographer.**

Faro Creek Diversion Channel



Photo 5 **Segment between Road and Faro Pit – note water accumulation (TEES November 4, 2015)**



Photo 6 **Close-up of water accumulation in Photo 5 (TEES November 4, 2015)**

Faro Creek Diversion Channel



Photo 7 **Faro Creek Diversion Channel erosion on hillside bank**



Photo 8 **Faro Creek Diversion Channel Staff Gauge FCD 4 – note newly installed channel-crossing overhead wire for flow calibration during high flow**

North Valley Wall Interceptor Ditch



Photo 9 New weir installed in upper man-made reach



Photo 10 Interceptor Ditch upper man-made reach

North Valley Wall Interceptor Ditch



Photo 11 Interceptor Ditch upstream of road crossing



Photo 12 Interceptor Ditch upstream of road crossing

North Valley Wall Interceptor Ditch



Photo 13 Interceptor Ditch downstream of road crossing



Photo 14 Middle reach of man-made ditch – overgrown vegetation along ditch and dyke

Rose Creek Diversion Channel

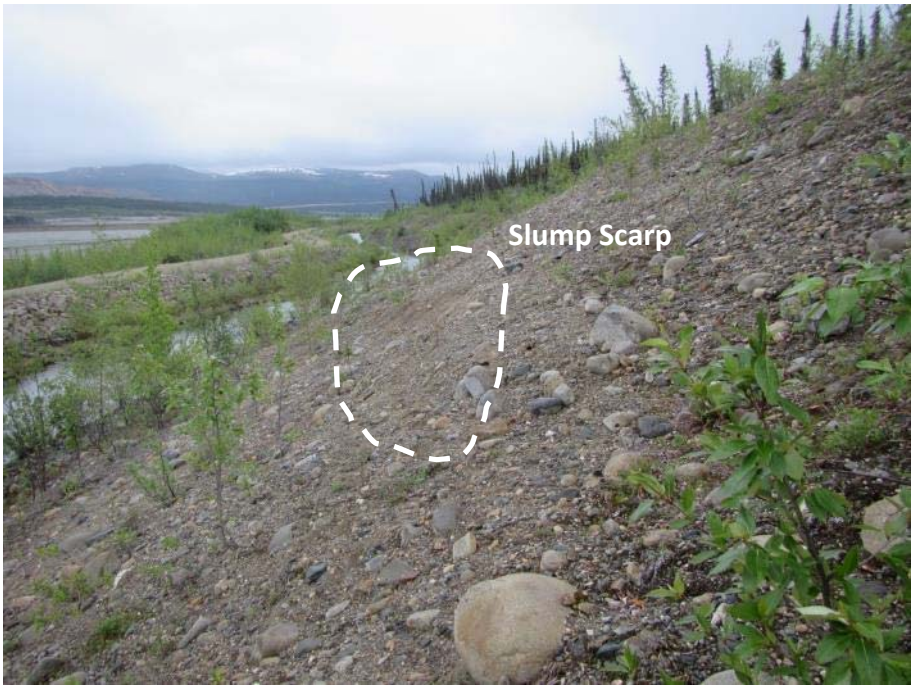


Photo 15 Back Slope slump scarps

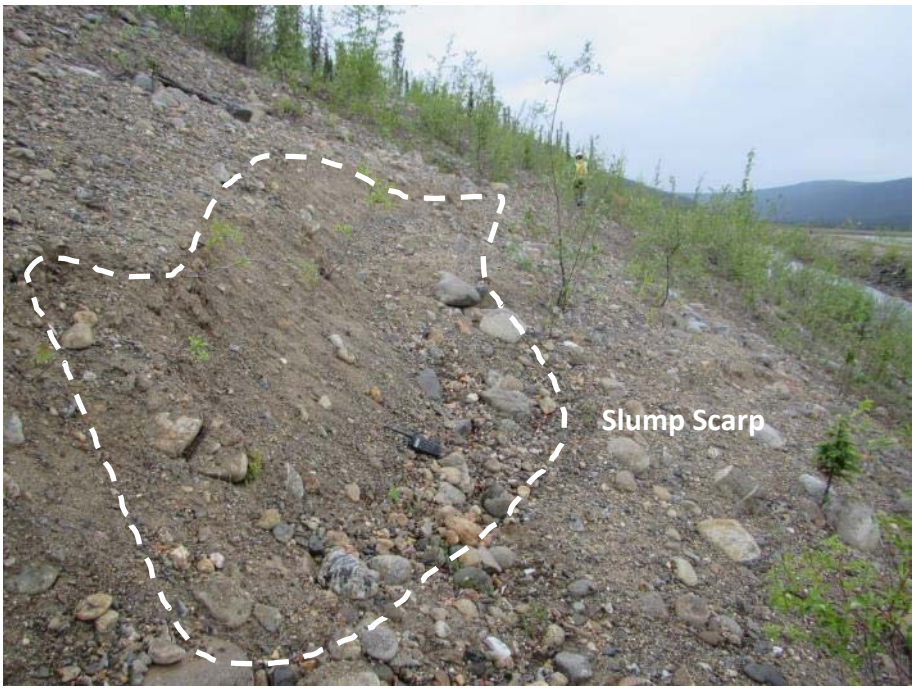


Photo 16 Back Slope slump scarps

Rose Creek Diversion Channel



Photo 17 Back Slope with minor slumping



Photo 18 Rose Creek Diversion Channel near Cross Valley Dam

Rose Creek Diversion Channel



Photo 19 Downstream end of Rose Creek Diversion Channel – looking upstream

North Fork and K8 Rock Drains



Photo 20 **North Fork Rock Drain upstream pool at access road (TEES, June 17, 2015)**



Photo 21 **Channel downstream of North Fork Rock Drain (by TEES, December 16, 2015)**

North Fork and K8 Rock Drains



Photo 22 K8 Rock Drain upstream pool



Photo 23 K8 Rock Drain downstream outlet, looking down - note coarse rock inside the erosion of the road embankment.

Secondary Tailings Dam



Photo 24 **Secondary Tailings Dam and upstream tailings – looking west. Crest is in good condition.**

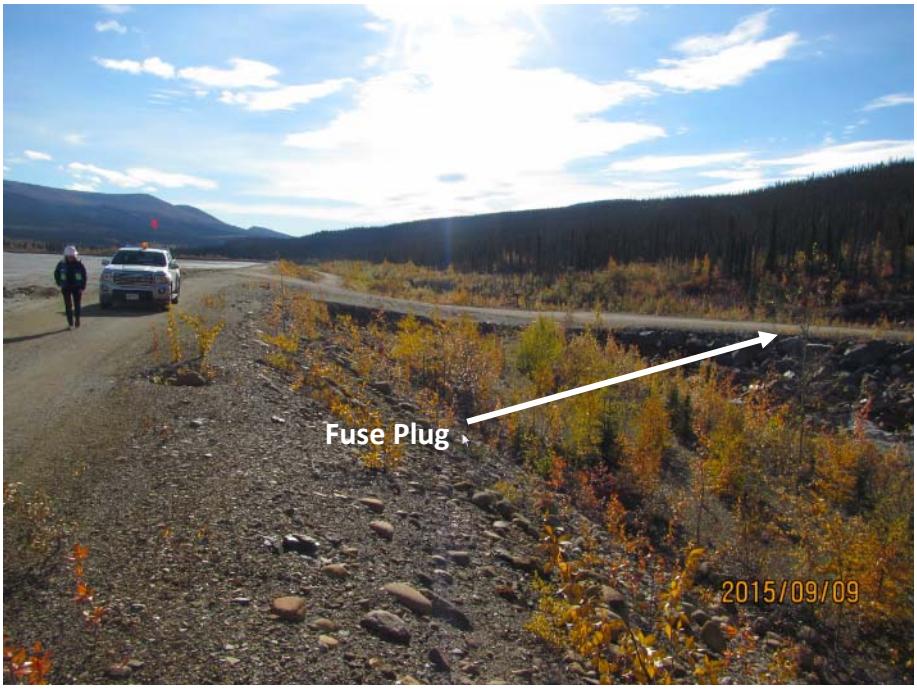


Photo 25 **Fuse plug of Canal Dyke, looking upstream**

Secondary Tailings Dam



Photo 26 Secondary Tailings Dam, looking south



Photo 27 Secondary Tailings Dam Crest, looking northwest

Secondary Tailings Dam



Photo 28 Secondary Tailings Dam Crest, north abutment below access road



Photo 29 Secondary Tailings Dam Crest, trees on downstream slope

Intermediate Dam



Photo 30 Intermediate Dam, downstream slope looking north



Photo 31 Intermediate Dam, crest looking north

Intermediate Dam



Photo 32 Intermediate Dam, crest looking north



Photo 33 Rill erosion and slumping on downstream slope – looking up slope

Intermediate Dam



Photo 34 Rill erosion along downstream slope



Photo 35 Repaired downstream slope

Intermediate Dam



Photo 36 Repairs along downstream slope



Photo 37 Repairs along downstream slope of the Intermediate Dam– wet material at toe to be removed or graded to promote drainage.

Intermediate Dam



Photo 38 **Repairs along downstream slope – ruts to be re-track-packed**



Photo 39 **Some instruments are unprotected and vulnerable to damage from weather and animals**

Intermediate Dam



Photo 40 Spillway channel adjacent to dam crest – looking upstream at the Intermediate Pond

Cross Valley Dam



Photo 41 Barely visible sign of freeze-thaw longitudinal crack along dam crest, looking south



Photo 42 Rill erosion at downstream crest shoulder near north abutment, looking down slope

Cross Valley Dam



Photo 43 **Rill erosion at downstream slope looking south (from TEES July 3, 2015)**



Photo 44 **Downstream slope rill erosion looking north**

Cross Valley Dam



Photo 45 Repaired rill erosion at downstream slope near north abutment

Cross Valley Dam

Spring 2014



Fall 2015



Photo 46 Repaired road shoulder washout along north access road near CVD

Cross Valley Dam



Photo 47 Weir No. 3 has been repaired and is functioning. Readings should be resumed.

Grum Pit



Photograph 48 Grum Pit Panorama



Photograph 49 East pit wall along instability zone

Grum Pit



Photo 50 East pit wall



Photo 51 Poor Drainage on Grum Pit east rim looking west

Grum Pit



Photo 52 North array of pit wall movement survey rods



Photo 53 Grum slot cut, looking north

Vangorda Pit



Photo 54 Northwest pit wall adjacent to Vangorda Diversion Flume



Photo 55 Vangorda pump barge and discharge line from Grum Pit Lake

Vangorda Pit



Photo 56 Sinkhole on Vangorda Pit south pit rim near power pole



Photo 57 Over-steepened slope below sinkhole (by power pole)

Vangorda Waste Dump



Photo 58 Waste dump slope and toe seepage collection ditch



Photo 59 Waste dump rill erosions and sediment deposits (from TEES June 17, 2015)

Vangorda Waste Dump



Photo 60 Drain No. 1 (V28)





Photo 61 Drain No. 2 (V29)

Vangorda Waste Dump



Photo 62 Drain No. 3 (V30)

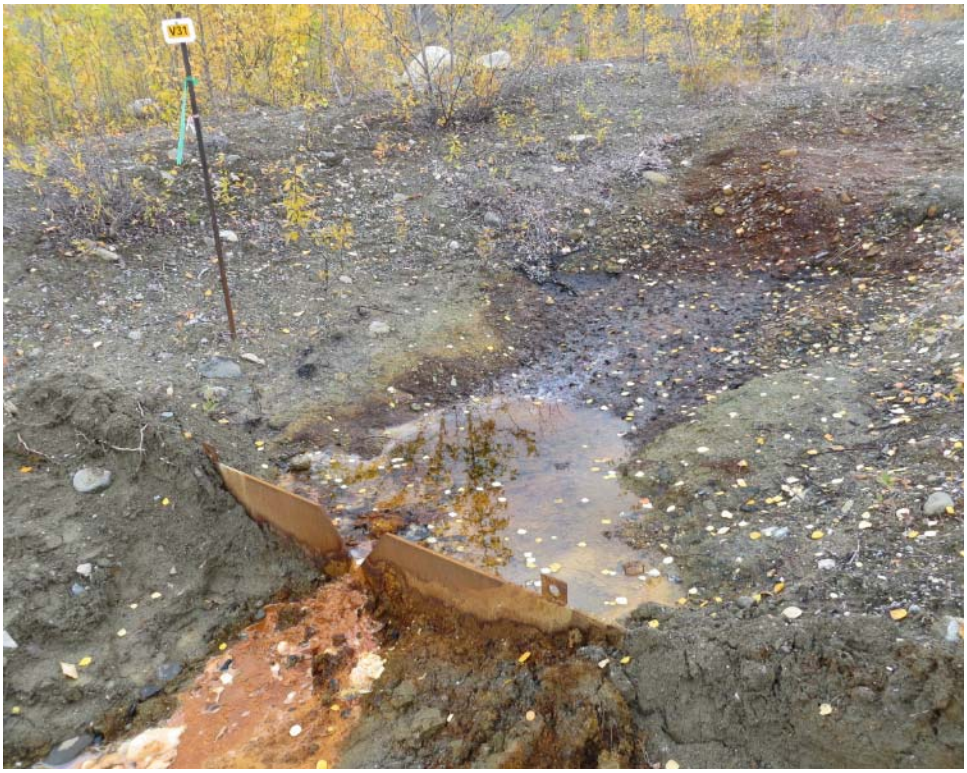


Photo 63 Drain No. 4 (V31)

Vangorda Waste Dump



Photo 64 Drain No. 5 (V32)



Photo 65 Drain No. 6 (V33)

Grum Pit Interceptor Ditch



Photo 66 **Ponded water (West Pond) pumped to upstream reach of Interceptor Ditch in Spring 2015**



Photo 67 **West Pond looking northeast in Fall 2015. (No pump operating)**

Grum Pit Interceptor Ditch



Photo 68 Road slumping in upper reach



Photo 69 Upper reach of Interceptor Ditch

Grum Pit Interceptor Ditch



Photo 70 **Vegetation on Grum Till Overburden slope above Interceptor Ditch - note rill erosion along slope**



Photo 71 **Downstream reach of Interceptor Ditch with a steep gradient**

Grum Interceptor Ditch



Photo 72 **Downstream end of Interceptor Ditch – note erosion of access road surface due to ditch overflow in Spring 2015**

Vangorda Northeast Interceptor Ditch



Photo 73 Vangorda Northeast Interceptor Ditch - 2013 repair of road-side bank slope



Photo 74 2013 repair of road-side bank slope to be completed, road continuing to erode

Vangorda Northeast Interceptor Ditch



Photo 75 Slumping of side slopes



Photo 76 Slumped bank slopes

Vangorda Northeast Interceptor Ditch



Photo 77 Portion of the channel in good condition



Photo 78 Previously placed rock to repair slumped area

Vangorda Northeast Interceptor Ditch



Photo 79 **Low flow in upper reaches with evidence of sediment inflows from previous freshet flows**

Vangorda Creek (Flume) Diversion



Photo 80 **Flume emergency spillway culverts entrance area**



Photo 81 **Vangorda Flume intake culvert upstream trash rack with a bent rod (from TEES June 17, 2015)**

Vangorda Creek (Flume) Diversion



Photo 82 Auxiliary trash rack downstream of Main Rack at Culvert Entrance



Photo 83 Flume deformed with buckled braces

Vangorda Creek (Flume) Diversion



Photo 84 Steel braces across two new flume sections



Photo 85 Outlet to Flume Plunge Pool - trash rack blocked with woody debris

Little Creek Dam



Photo 86 Little Creek Dam looking southeast



Photo 87 Upstream slope and pond

Little Creek Dam



Photo 88 Repairs on upstream slope. (Spring above, Fall Below)

Little Creek Dam



Photo 89 Dam crest and slopes. Vegetation on slopes. Crest in good condition.



Photo 90 Dam crest/upstream slope and pond (looking south)

Little Creek Dam



Photo 91 Rill erosion on the downstream slope



Photo 92 Rill erosions along downstream crest shoulder and slope

Little Creek Dam



Photo 93 Wet area at toe of dam



Photo 94 Spillway culvert and trash rack. Note low freeboard if spillway were operating.

Little Creek Dam



Photo 95 Vegetation in spillway



Photo 96 Ground slope crack across downstream spillway channel near discharge end

Sheep Pad Sediment Ponds



Photo 97 Longitudinal cracks on dyke slope of Upper Sediment Pond

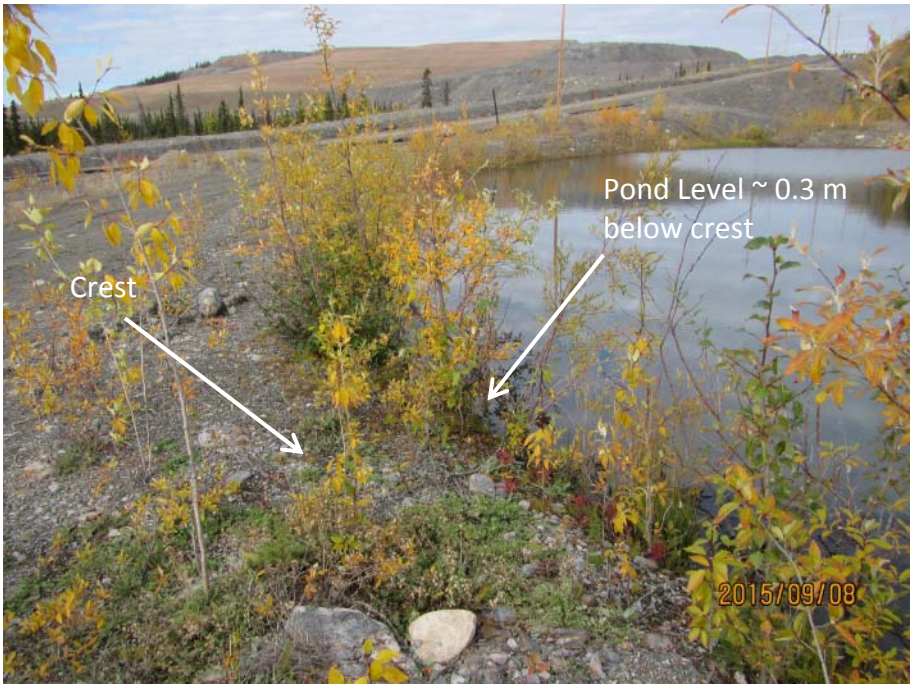


Photo 98 Small amount of freeboard in upper pond

Sheep Pad Sediment Ponds



Photo 99 **Downstream dyke slope of Lower Sediment Pond**



Photo 100 **Upstream end of flume between Upper and Lower Ponds – note slumped side slope and shifted flume section**

Sheep Pad Sediment Ponds



Photo 101 **Upstream end of flume between Upper and Lower Ponds note boulders near the upper invert that restrict flow.**



Photo 102 **Outflow of Sediment Pond upstream of Plunge Pool. Staff gauge is in the centre of the v-notch weir which restricts the flow.**

Freshwater Pond



Photo 103 Dyke crest and slopes – note overgrown vegetation



Photo 104 Pond spillway channel, looking downstream towards Grum Interceptor Ditch

V-15 Seepage Collection Ditch

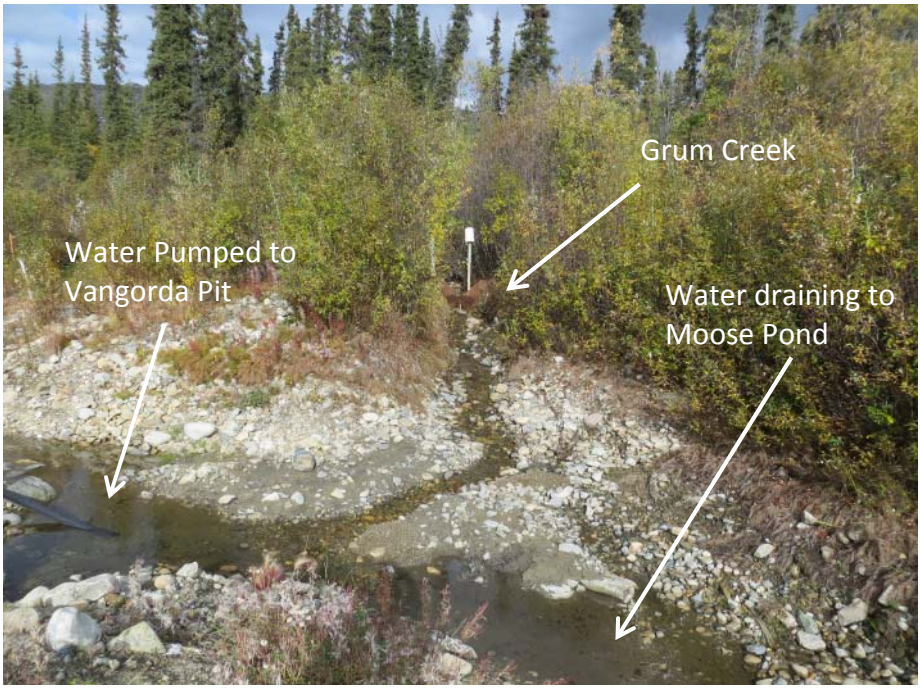


Photo 105 Ponded V-15 Ditch adjacent to pump house



Photo 106 Last reach of V-15 Ditch along access road above Moose Pond

Moose Pond



Photo 107 Moose Pond Esker downstream slope



Photo 108 Moose Pond with staff gauge for monitoring pond level

Sludge Pond Embankment Dyke - Vangorda Water Treatment Plant



Photo 109 Sludge pond, dyke crest and downstream slope



Photo 110 Sludge pond, dyke crest and upstream slope

APPENDIX II

Instrumentation Plots and Data

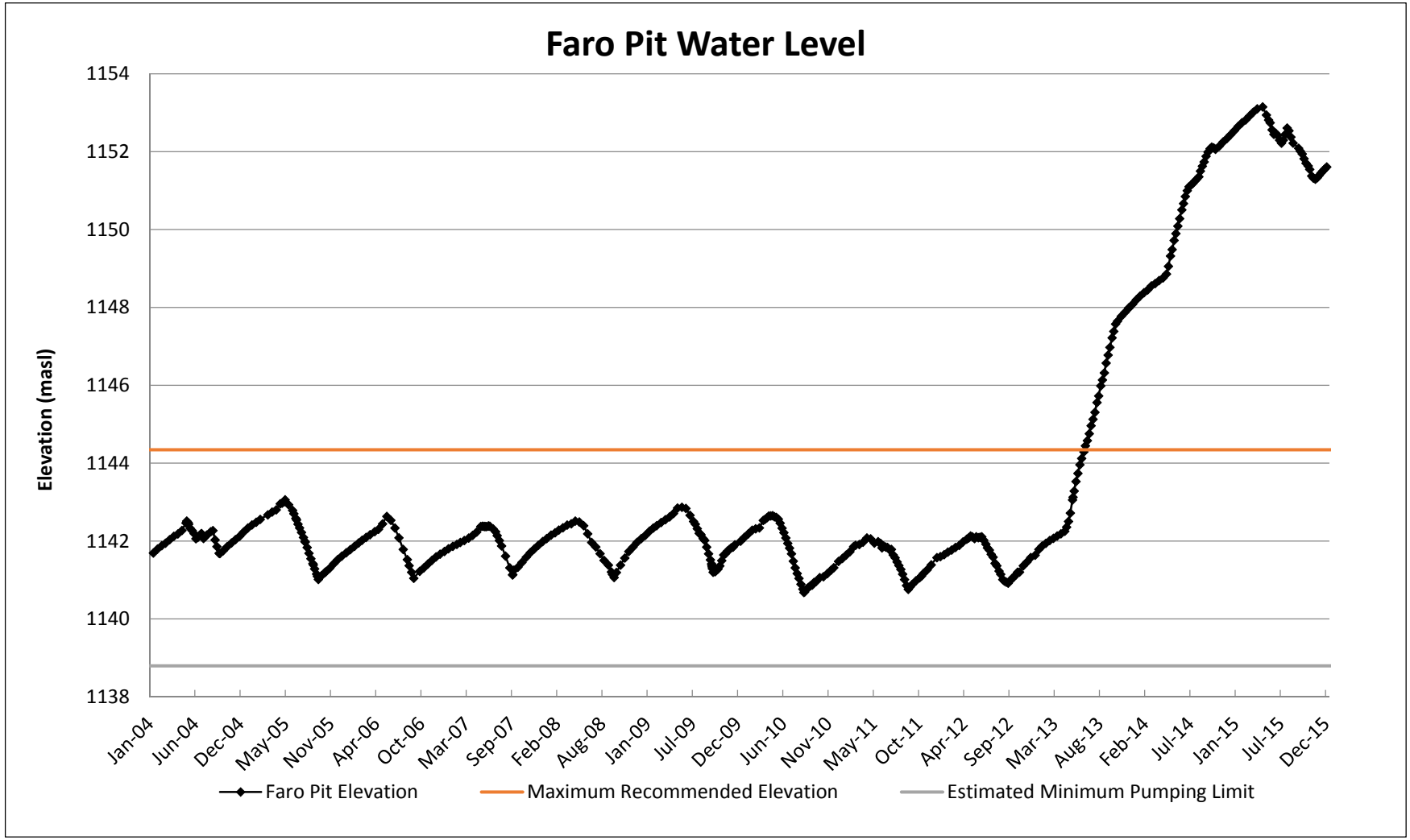
Instrumentation Plots and Data

Site	Appendix Section: Structure	Data Included Herein	Section Number
Faro	II-A: Faro Pit	Pond Level	A1
	II-B: Faro Creek Diversion Channel	Staff Gauge Calibrations	B1
		Staff Gauge Flows	B2
	II-C: North Valley Wall Interceptor Ditch	Ditch Flow	C1
	II-D: Rose Creek Diversion Channel	Staff Gauge Calibrations	D1
		Staff Gauge Flows	D2
	II-E: Canal Dyke	Piezometers	E1
		Thermistors	E2
		Inclinometers	E3
	II-F: North Fork Rock Drain	U/S and D/S Water Levels	F1
	II-G: Secondary Tailings Impoundment	Piezometers	G1
	II-H: Intermediate Dam	Pond Level (Intermediate Pond)	H1
		Piezometers	H2
	II-I: Cross Valley Dam	Pond Level (Polishing Pond)	I1
		Piezometers	I2
		Thermistors	I3
		D/S Weir Flows	I4
Vangorda Plateau	II-J: Grum Pit	Pond Level	J1
		Pit Slot Cut Piezometers	J2
	II-K: Vangorda Pit	Pond Level	K1
	II-L: Vangorda Waste Rock Dump	Weir Flows	L1
		Piezometers	L2
	II-M: Little Creek Dam	Pond Level (Little Creek Pond)	M1
		Piezometers	M2
		Thermistor	M3
	II-N: Moose Pond	Pond Level	N1
Faro Airport	II-O: Faro Airport Climate	Monthly Precipitation/Temperature	O1

APPENDIX II-A

Faro Pit

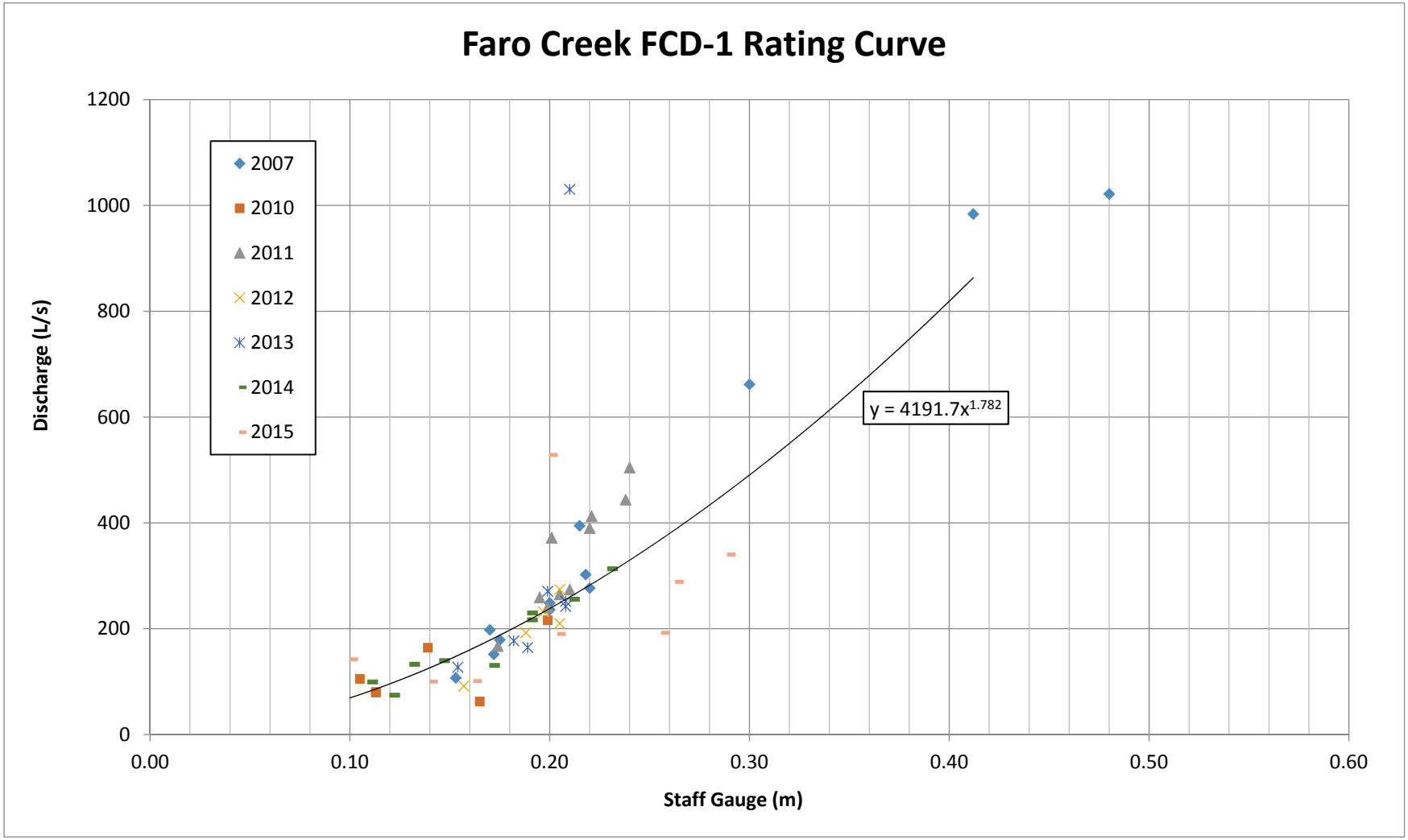
A1 - Pond Level

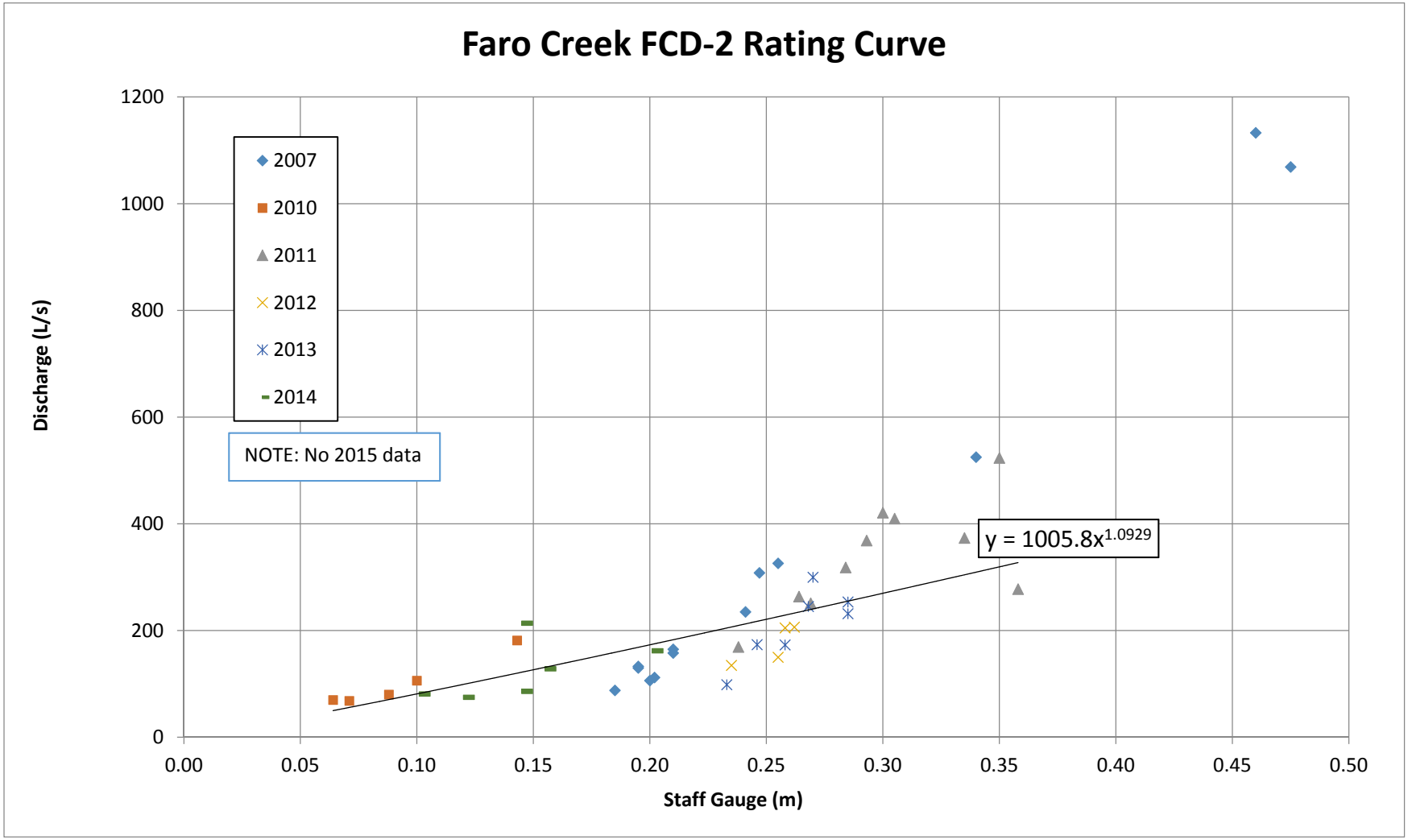

Faro Pit Water Level
Elevation (masl)
1154
1152
1150
1148
1146
1144
1142
1140
1138
Jan-04
Jun-04
Dec-04
May-05
Nov-05
Apr-06
Oct-06
Mar-07
Sep-07
Feb-08
Aug-08
Jan-09
Jul-09
Dec-09
Jun-10
Nov-10
May-11
Oct-11
Apr-12
Sep-12
Mar-13
Aug-13
Feb-14
Jul-14
Jan-15
Jul-15
Dec-15
Faro Pit Elevation
Maximum Recommended Elevation
Estimated Minimum Pumping Limit

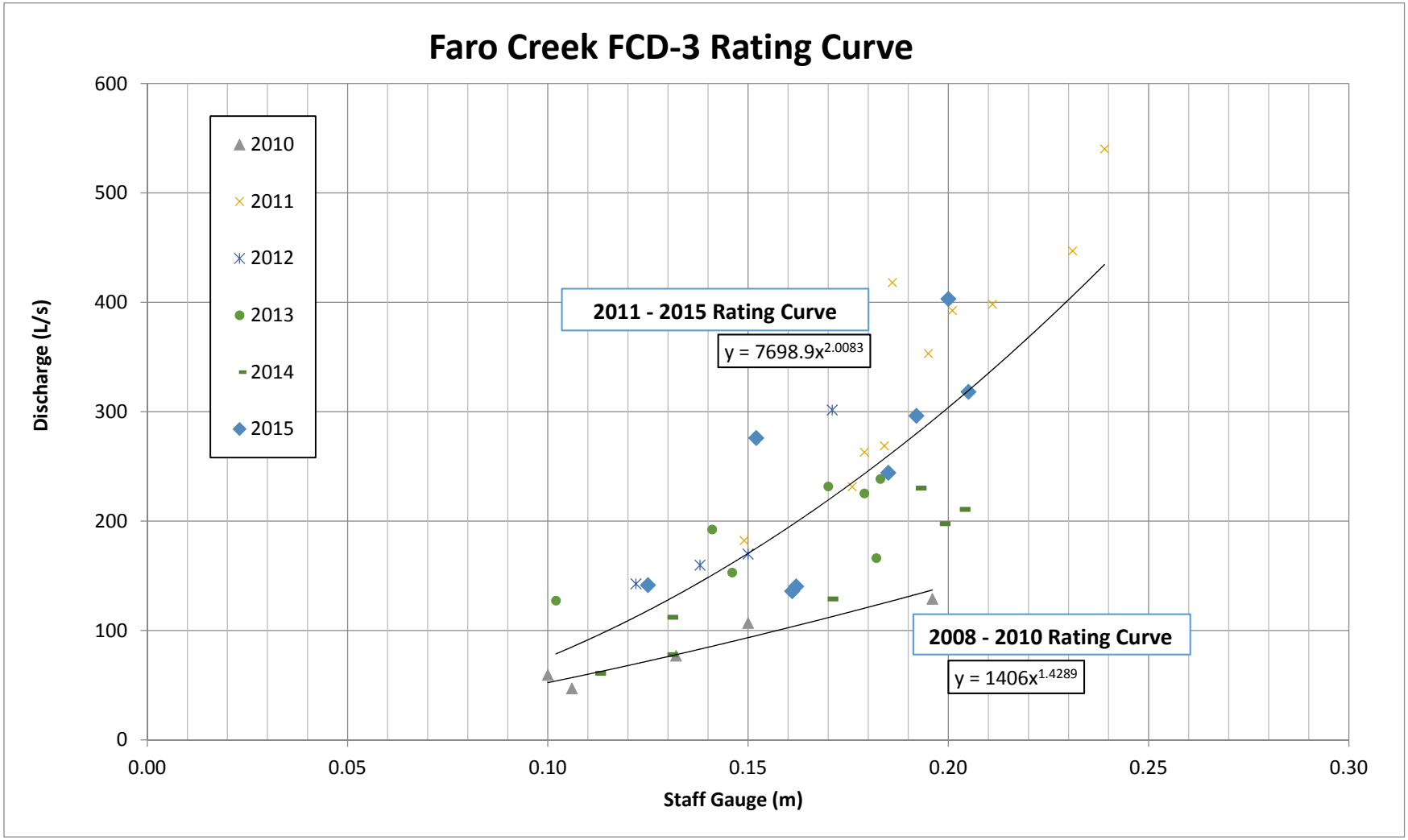
APPENDIX II-B

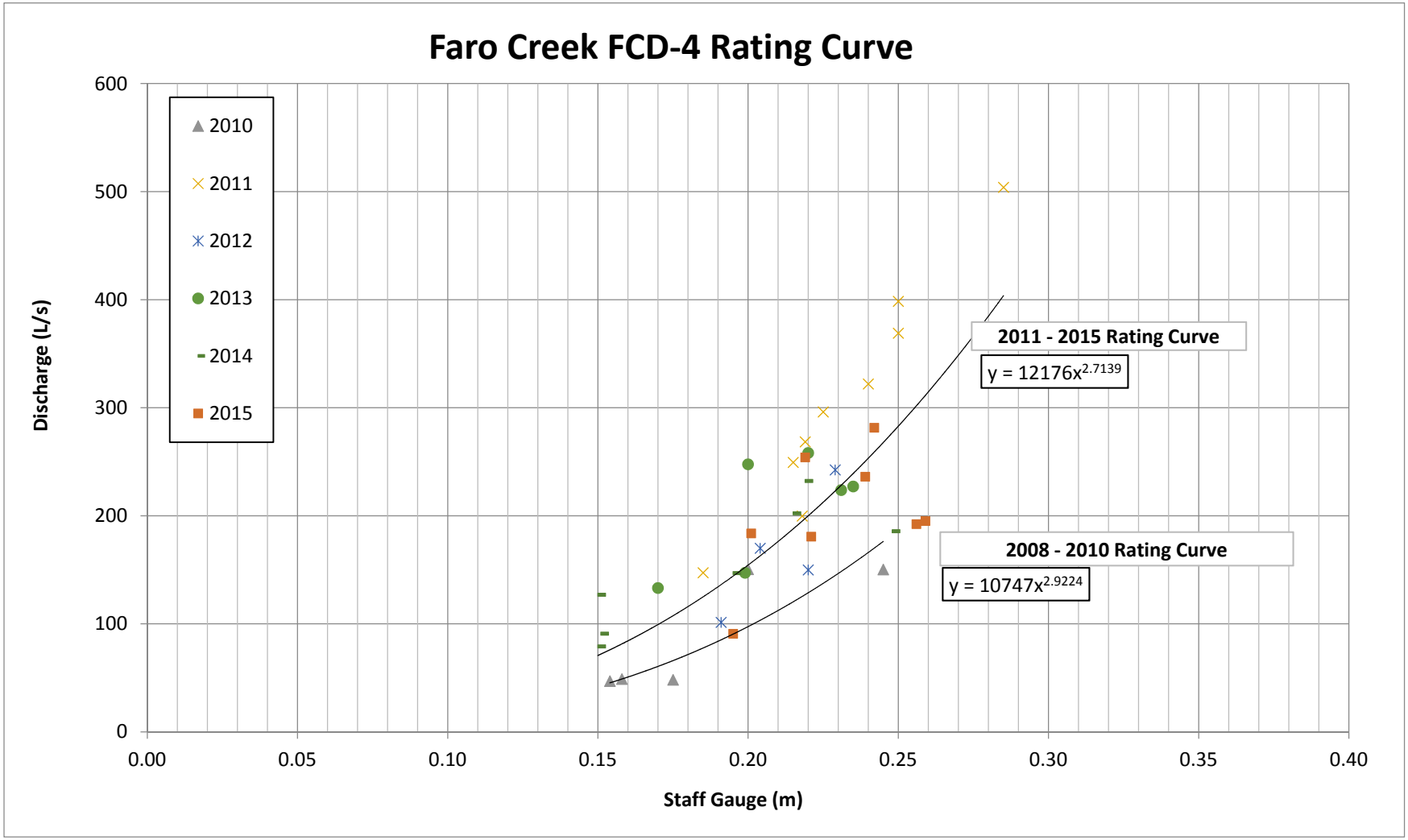
Faro Creek Diversion Channel

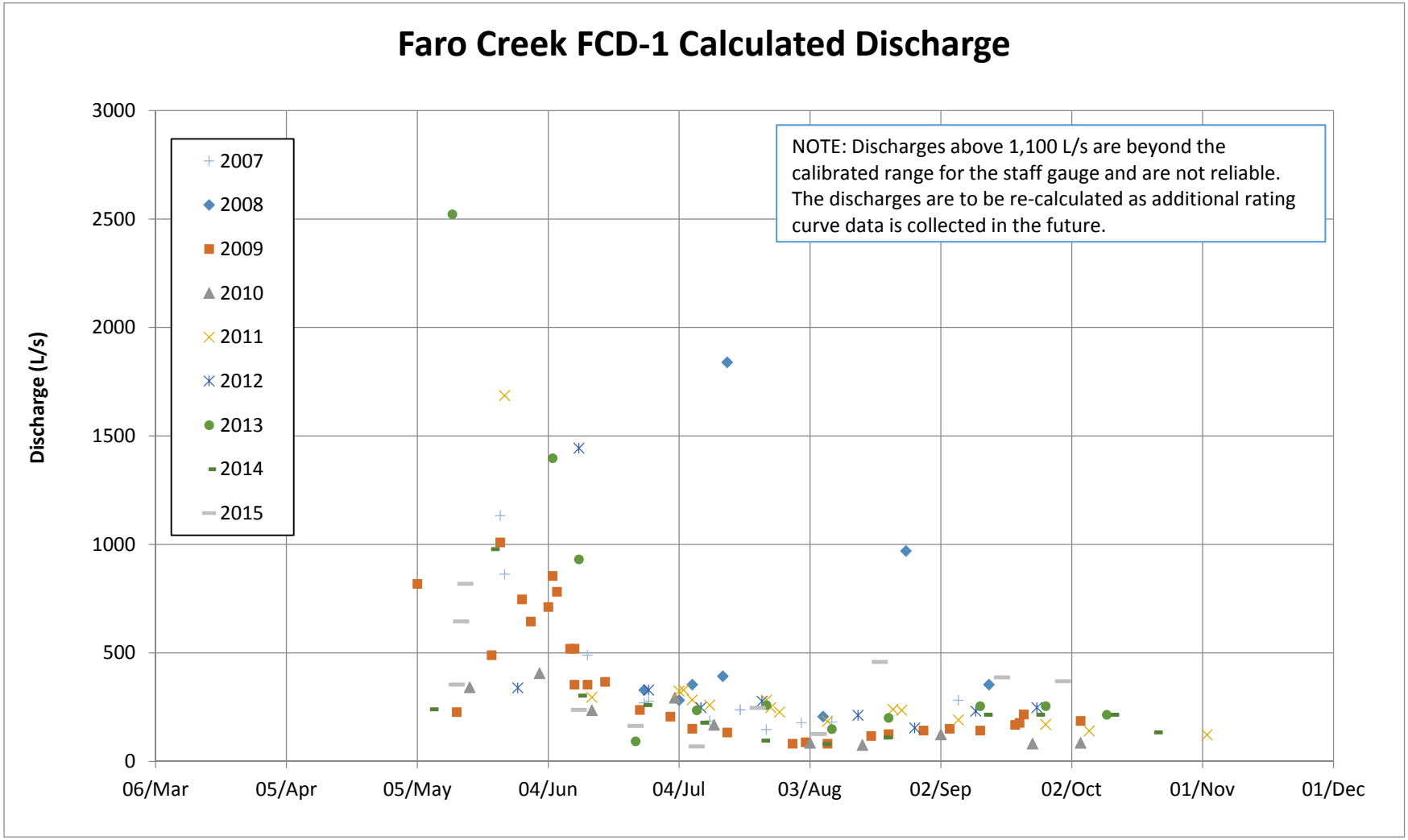
B1 – Staff Gauge Calibrations
B2 – Staff Gauge Flows

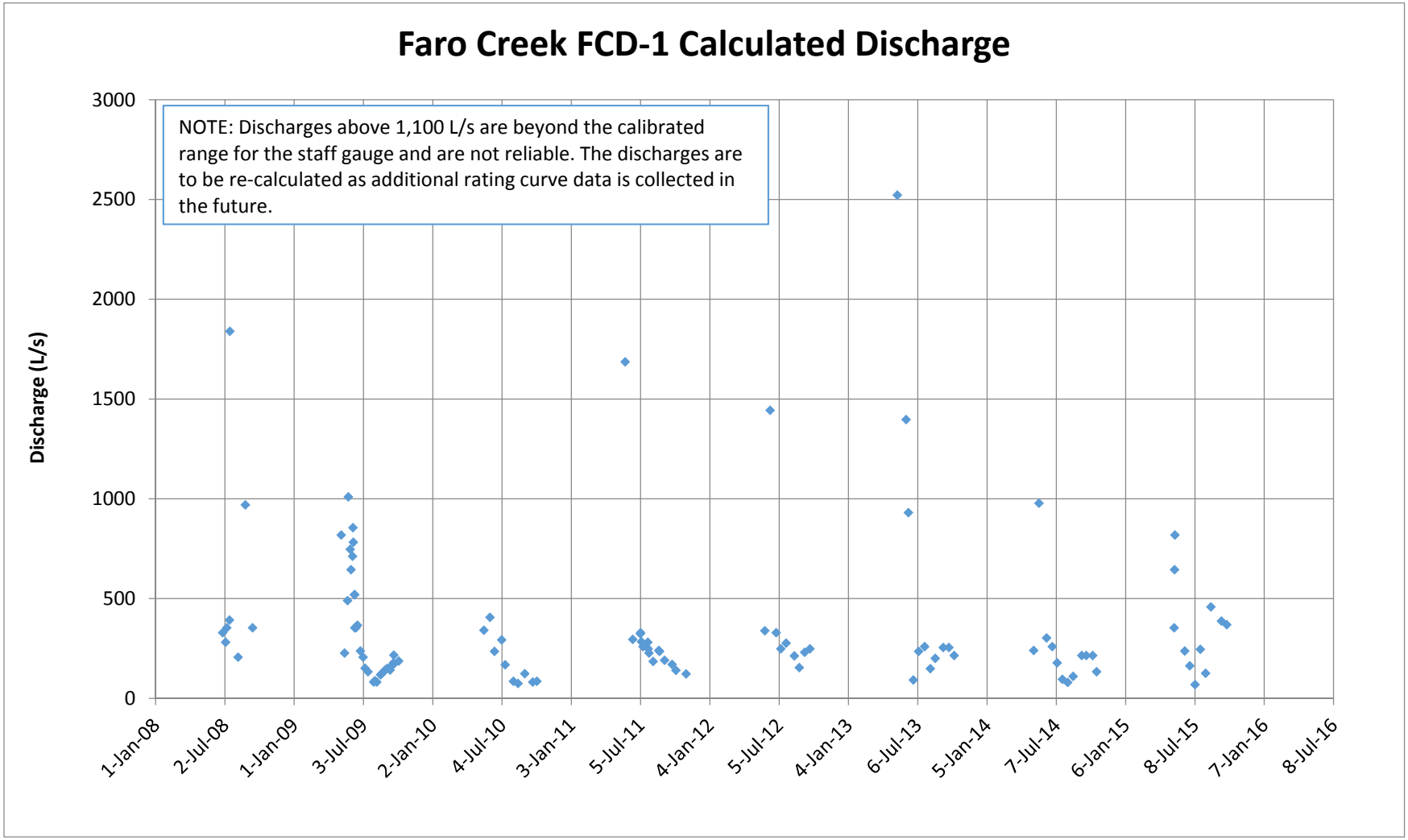

Faro Creek FCD-1 Rating Curve
Discharge (L/s)
Staff Gauge (m)
2007
2010
2011
2012
2013
2014
2015
y = 4191.7x^1.782
0
200
400
600
800
1000
1200
0.00
0.10
0.20
0.30
0.40
0.50
0.60

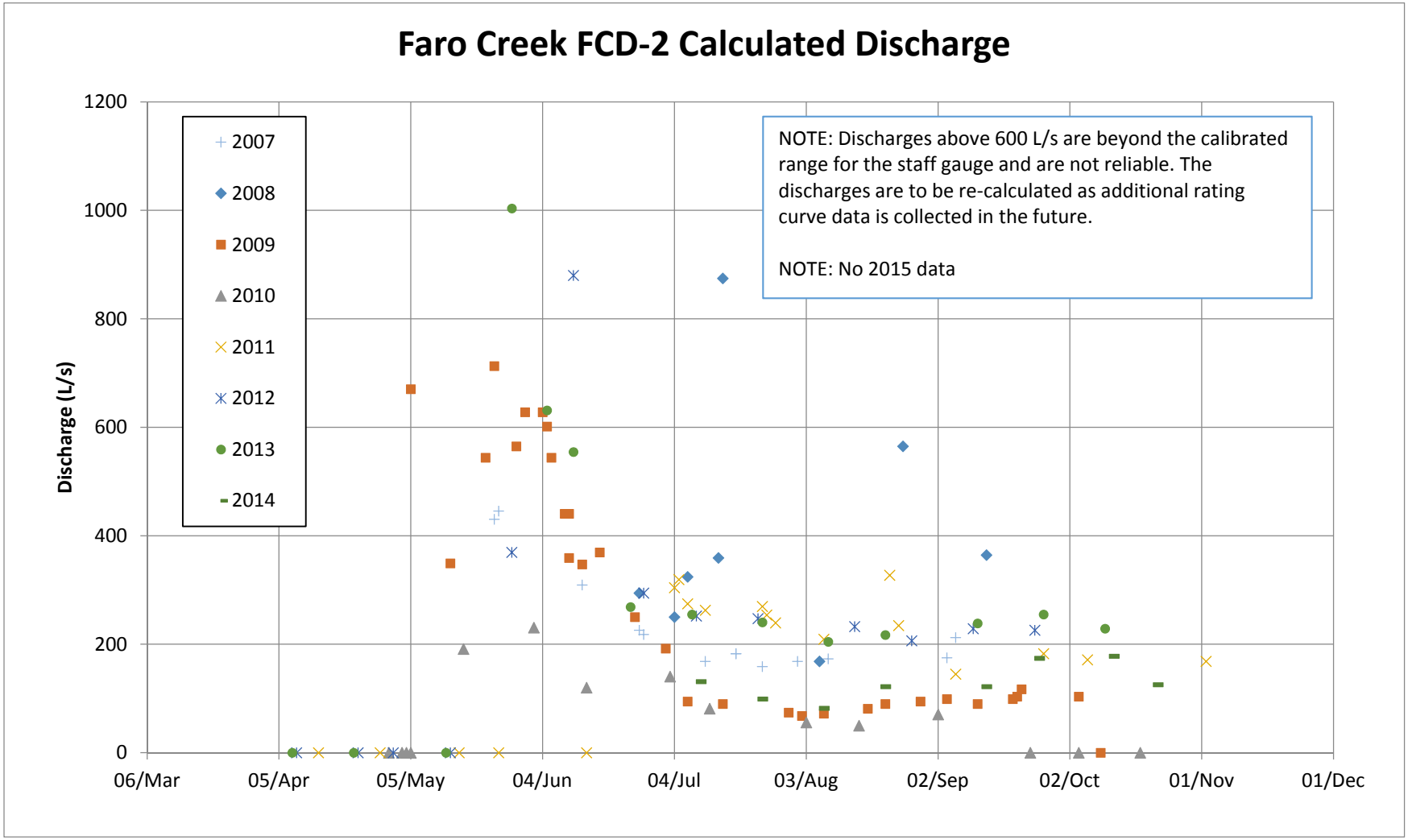

Faro Creek FCD-2 Rating Curve
Discharge (L/s)
Staff Gauge (m)
2007
2010
2011
2012
2013
2014
NOTE: No 2015 data
y = 1005.8x^1.0929
0
200
400
600
800
1000
1200
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50

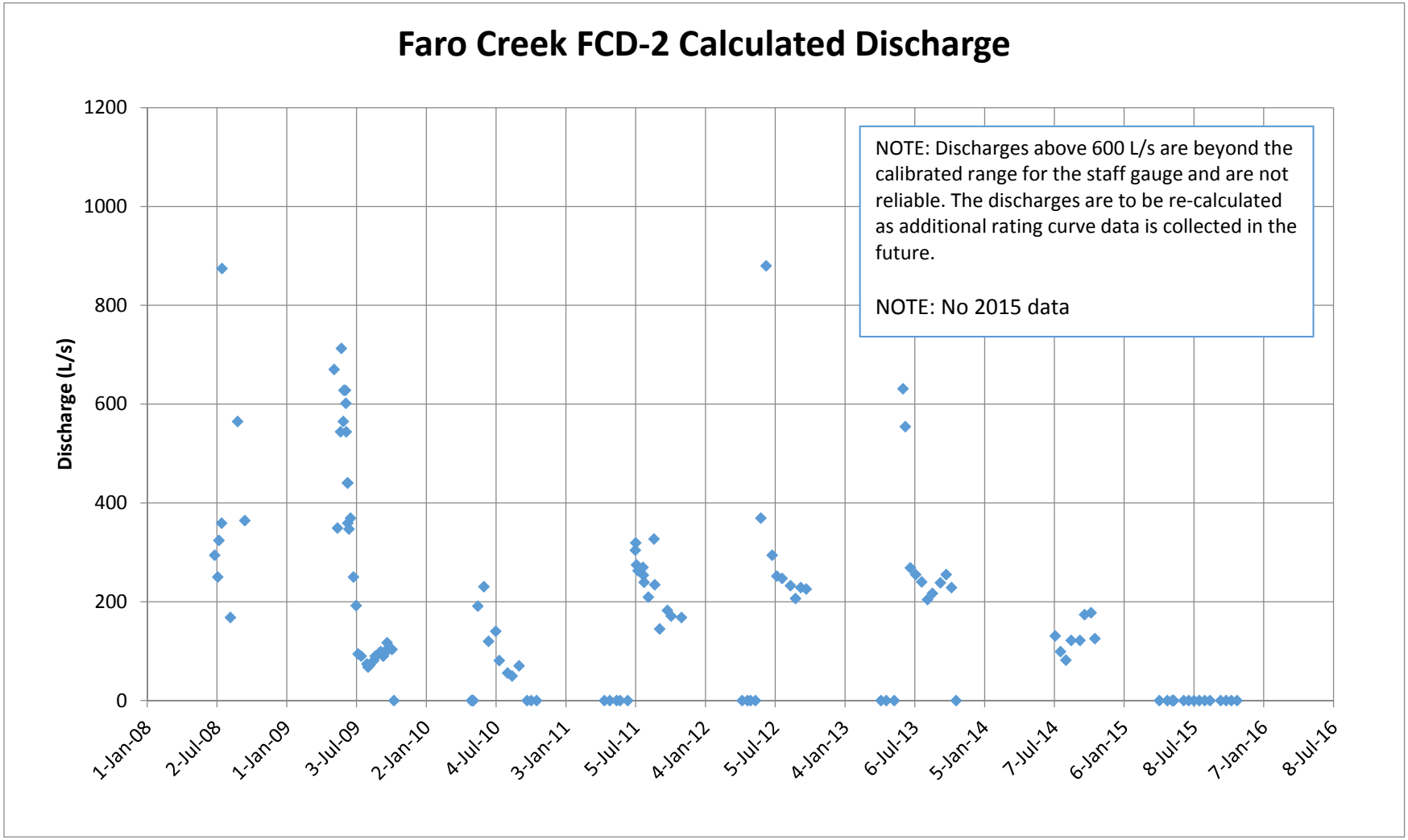

Faro Creek FCD-3 Rating Curve
Discharge (L/s)
Staff Gauge (m)
2010
2011
2012
2013
2014
2015
2011 - 2015 Rating Curve
y = 7698.9x^2.0083
2008 - 2010 Rating Curve
y = 1406x^1.4289
0
100
200
300
400
500
600
0.00
0.05
0.10
0.15
0.20
0.25
0.30

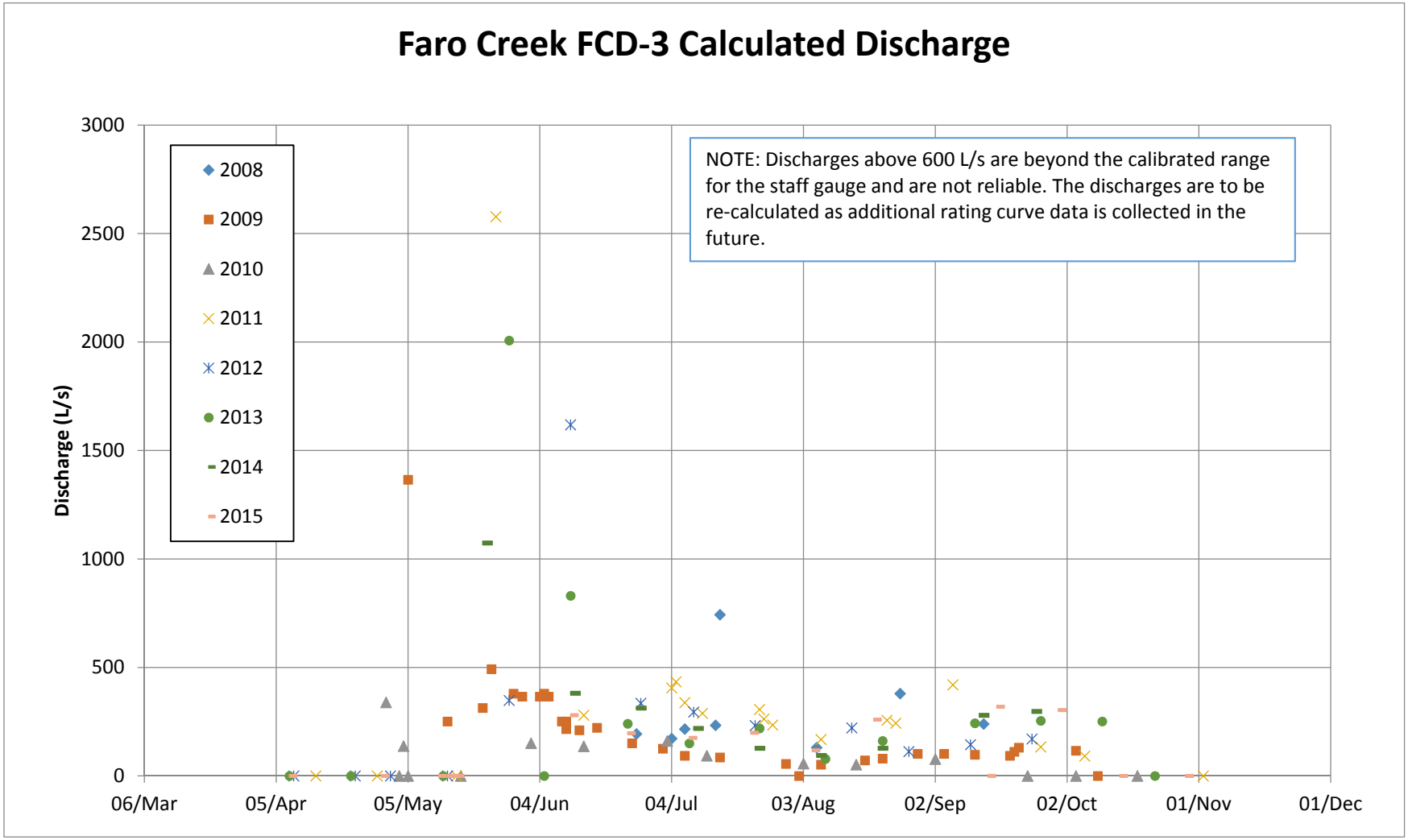

Faro Creek FCD-4 Rating Curve
Discharge (L/s)
Staff Gauge (m)
2010
2011
2012
2013
2014
2015
2011 - 2015 Rating Curve
y = 12176x^2.7139
2008 - 2010 Rating Curve
y = 10747x^2.9224
0
100
200
300
400
500
600
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40

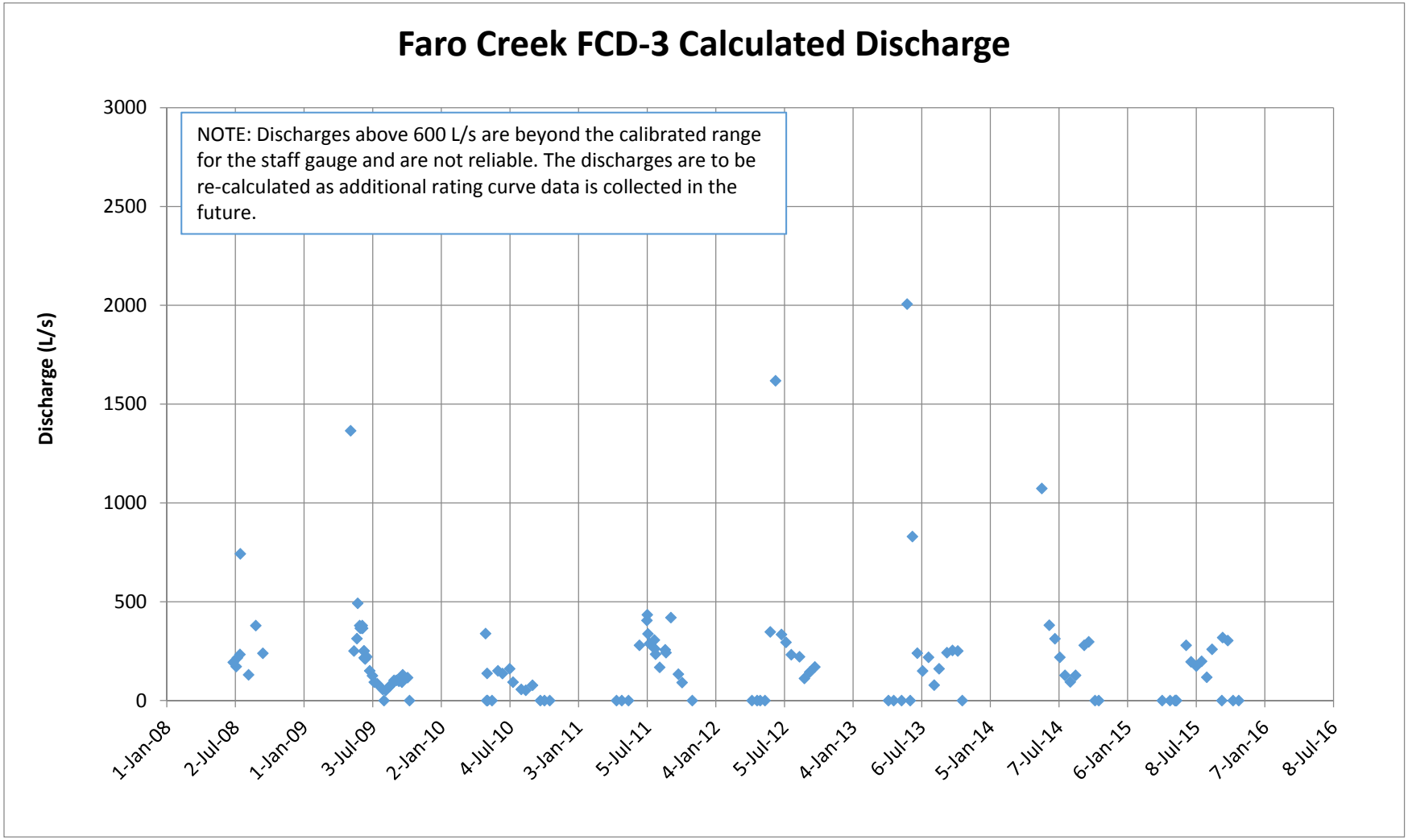

Faro Creek FCD-1 Calculated Discharge
Discharge (L/s)
3000
2500
2000
1500
1000
500
0
06/Mar
05/Apr
05/May
04/Jun
04/Jul
03/Aug
02/Sep
02/Oct
01/Nov
01/Dec
2007
2008
2009
2010
2011
2012
2013
2014
2015
NOTE: Discharges above 1,100 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.

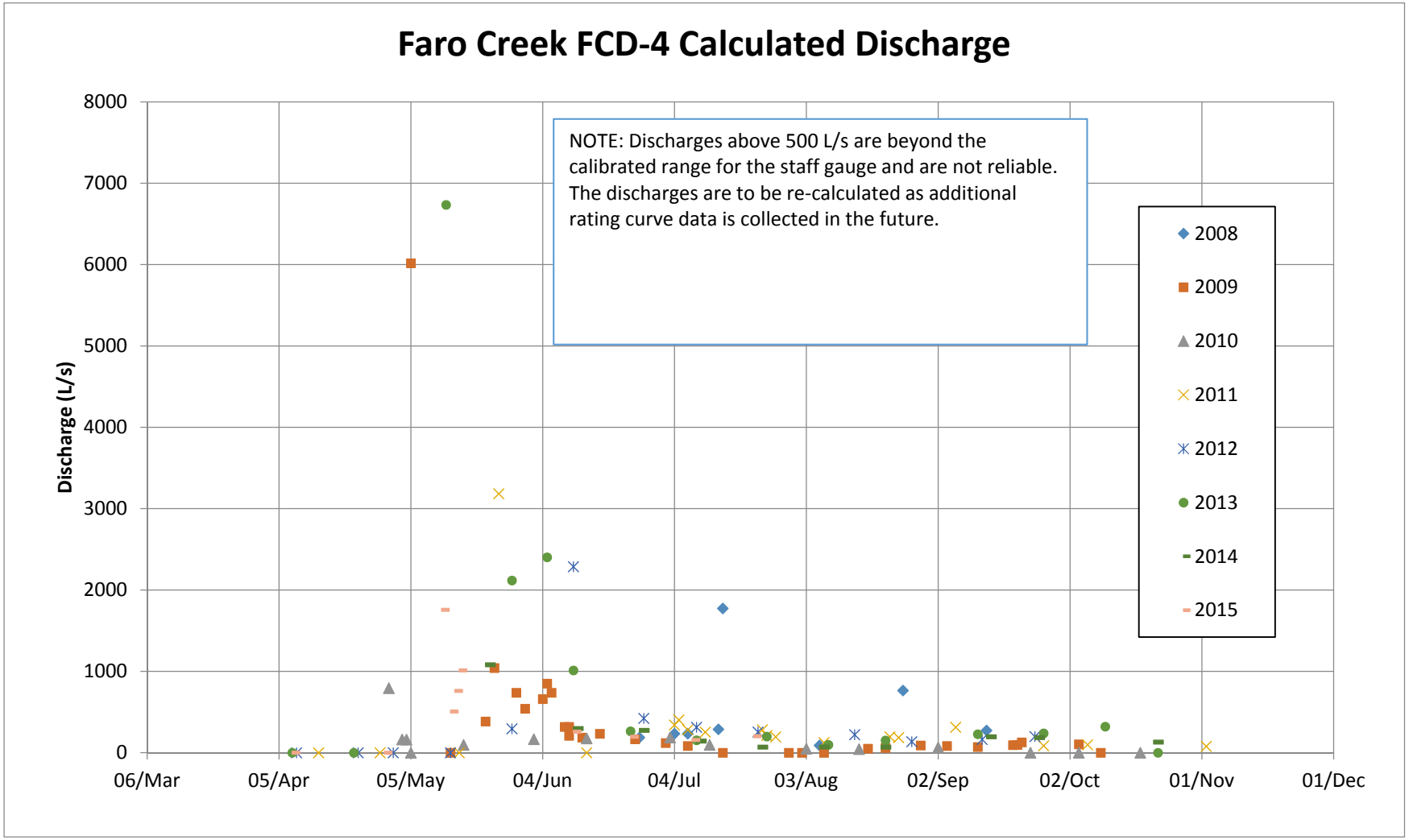

Faro Creek FCD-1 Calculated Discharge
NOTE: Discharges above 1,100 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.
Discharge (L/s)
3000
2500
2000
1500
1000
500
0
1-Jan-08
2-Jul-08
1-Jan-09
3-Jul-09
2-Jan-10
4-Jul-10
3-Jan-11
5-Jul-11
4-Jan-12
5-Jul-12
4-Jan-13
6-Jul-13
5-Jan-14
7-Jul-14
6-Jan-15
8-Jul-15
7-Jan-16
8-Jul-16

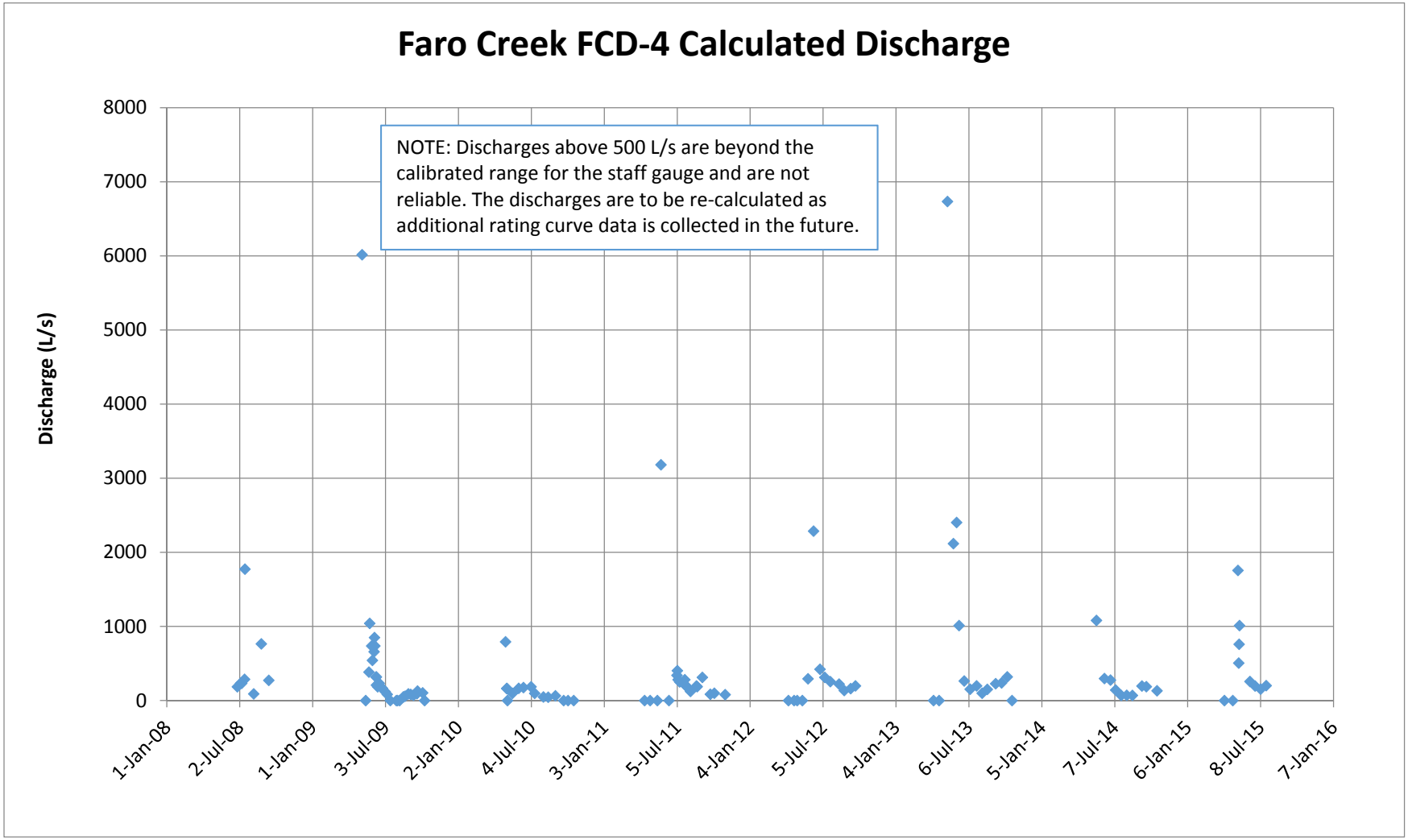

Faro Creek FCD-2 Calculated Discharge
Discharge (L/s)
1200
1000
800
600
400
200
0
06/Mar
05/Apr
05/May
04/Jun
04/Jul
03/Aug
02/Sep
02/Oct
01/Nov
01/Dec
2007
2008
2009
2010
2011
2012
2013
2014
NOTE: Discharges above 600 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.
NOTE: No 2015 data


Faro Creek FCD-2 Calculated Discharge
Discharge (L/s)
1200
1000
800
600
400
200
0
1-Jan-08
2-Jul-08
1-Jan-09
3-Jul-09
2-Jan-10
4-Jul-10
3-Jan-11
5-Jul-11
4-Jan-12
5-Jul-12
4-Jan-13
6-Jul-13
5-Jan-14
7-Jul-14
6-Jan-15
8-Jul-15
7-Jan-16
8-Jul-16
NOTE: Discharges above 600 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.
NOTE: No 2015 data


Faro Creek FCD-3 Calculated Discharge
Discharge (L/s)
3000
2500
2000
1500
1000
500
0
06/Mar
05/Apr
05/May
04/Jun
04/Jul
03/Aug
02/Sep
02/Oct
01/Nov
01/Dec
2008
2009
2010
2011
2012
2013
2014
2015
NOTE: Discharges above 600 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.


Faro Creek FCD-3 Calculated Discharge
NOTE: Discharges above 600 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.
Discharge (L/s)
3000
2500
2000
1500
1000
500
0
1-Jan-08
2-Jul-08
1-Jan-09
3-Jul-09
2-Jan-10
4-Jul-10
3-Jan-11
5-Jul-11
4-Jan-12
5-Jul-12
4-Jan-13
6-Jul-13
5-Jan-14
7-Jul-14
6-Jan-15
8-Jul-15
7-Jan-16
8-Jul-16

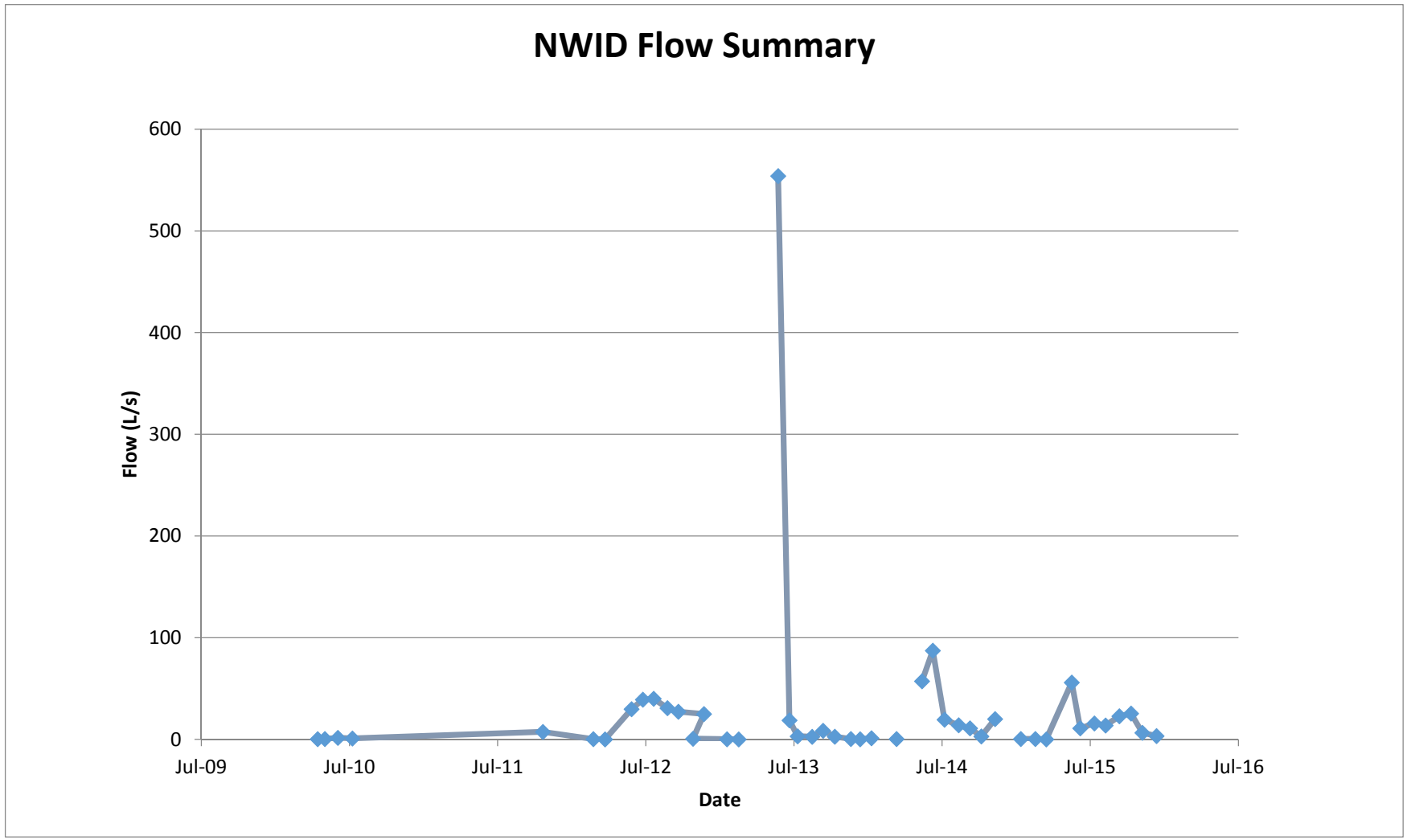

Faro Creek FCD-4 Calculated Discharge
NOTE: Discharges above 500 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.
Discharge (L/s)
8000
7000
6000
5000
4000
3000
2000
1000
0
06/Mar
05/Apr
05/May
04/Jun
04/Jul
03/Aug
02/Sep
02/Oct
01/Nov
01/Dec
2008
2009
2010
2011
2012
2013
2014
2015


Faro Creek FCD-4 Calculated Discharge
NOTE: Discharges above 500 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.
Discharge (L/s)
8000
7000
6000
5000
4000
3000
2000
1000
0
1-Jan-08
2-Jul-08
1-Jan-09
3-Jul-09
2-Jan-10
4-Jul-10
3-Jan-11
5-Jul-11
4-Jan-12
5-Jul-12
4-Jan-13
6-Jul-13
5-Jan-14
7-Jul-14
6-Jan-15
8-Jul-15
7-Jan-16

APPENDIX II-C

North Valley Wall Interceptor Ditch

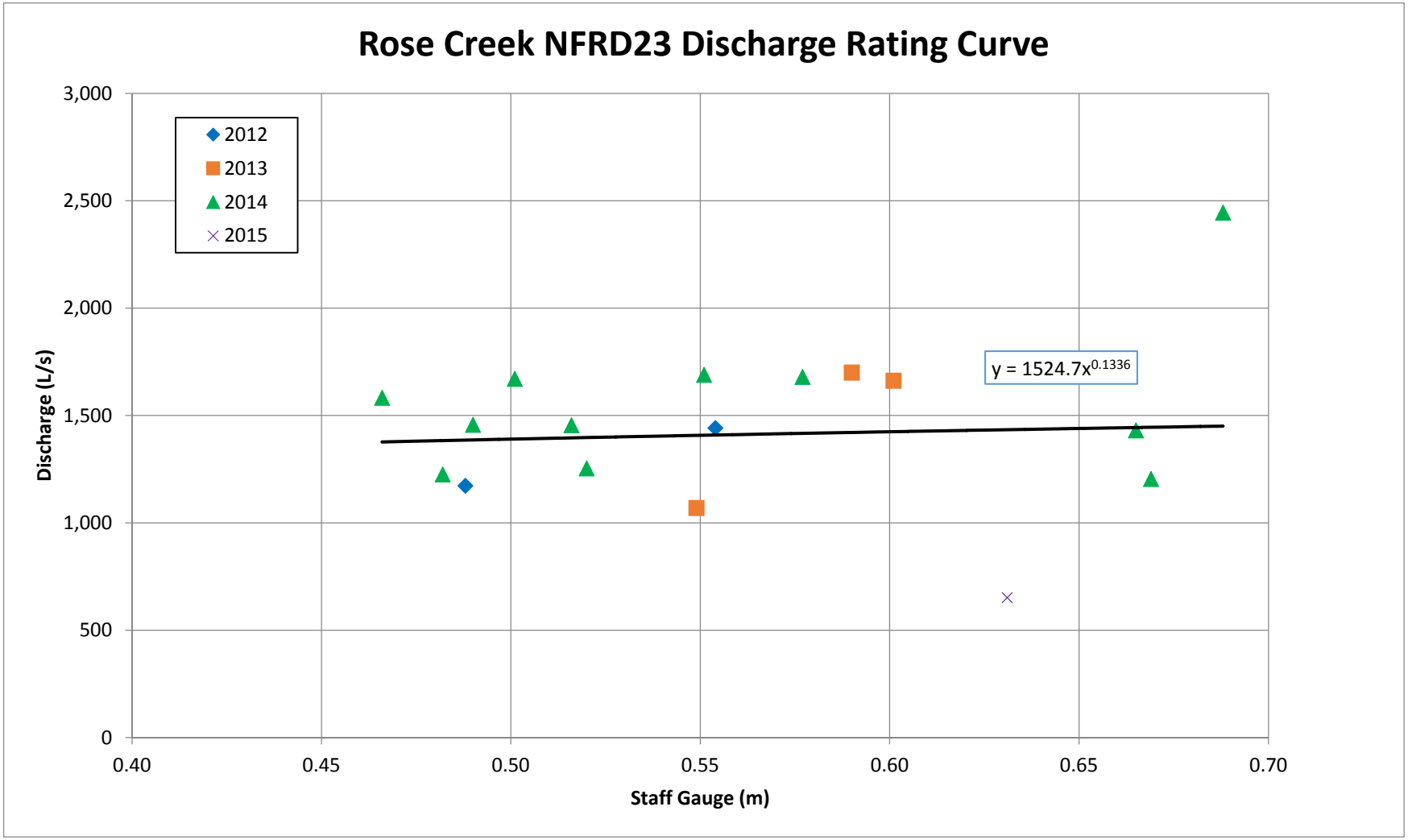
C1 – Ditch Flow

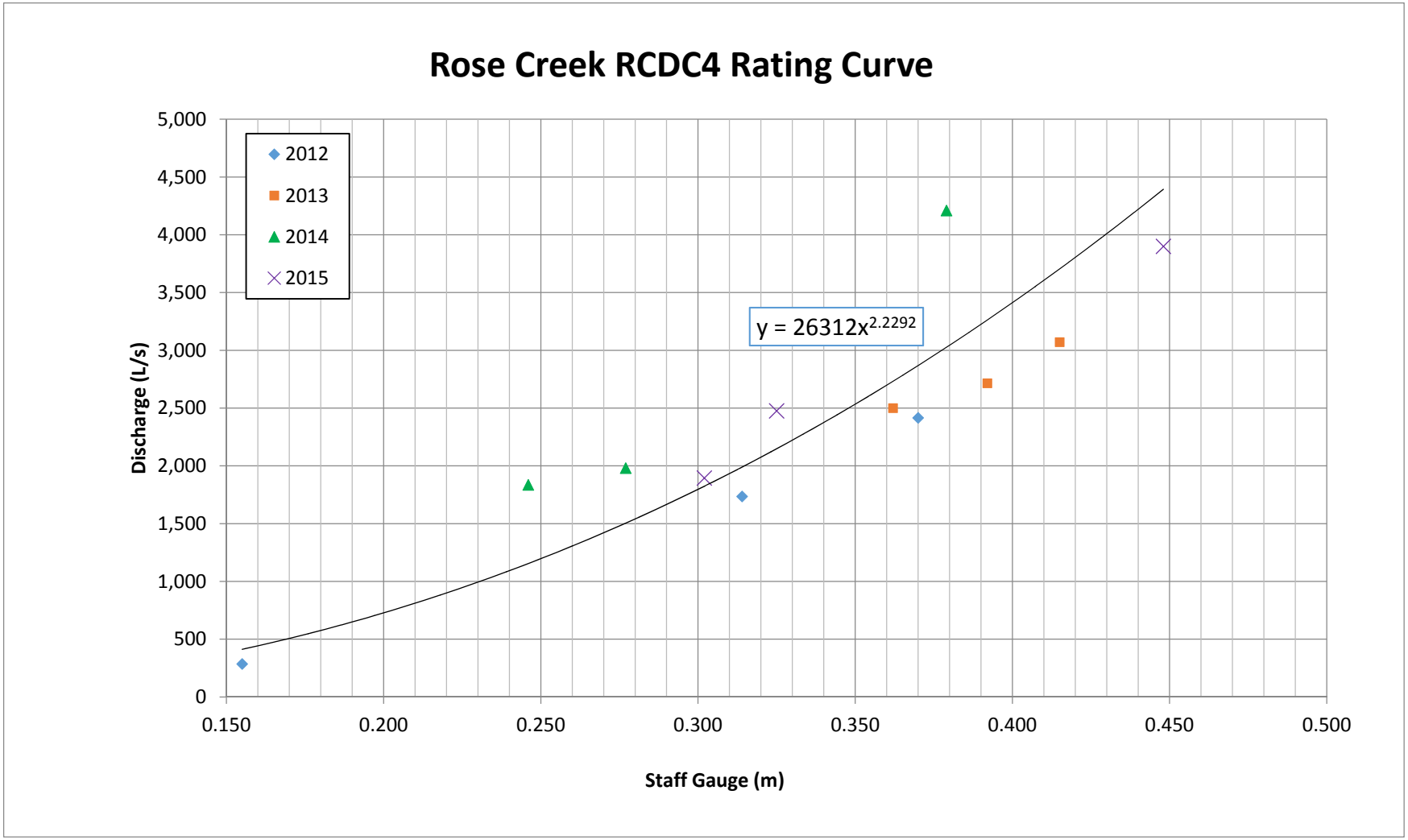

NWID Flow Summary
600
500
400
300
200
100
0
Flow (L/s)
Jul-09
Jul-10
Jul-11
Jul-12
Jul-13
Jul-14
Jul-15
Jul-16
Date

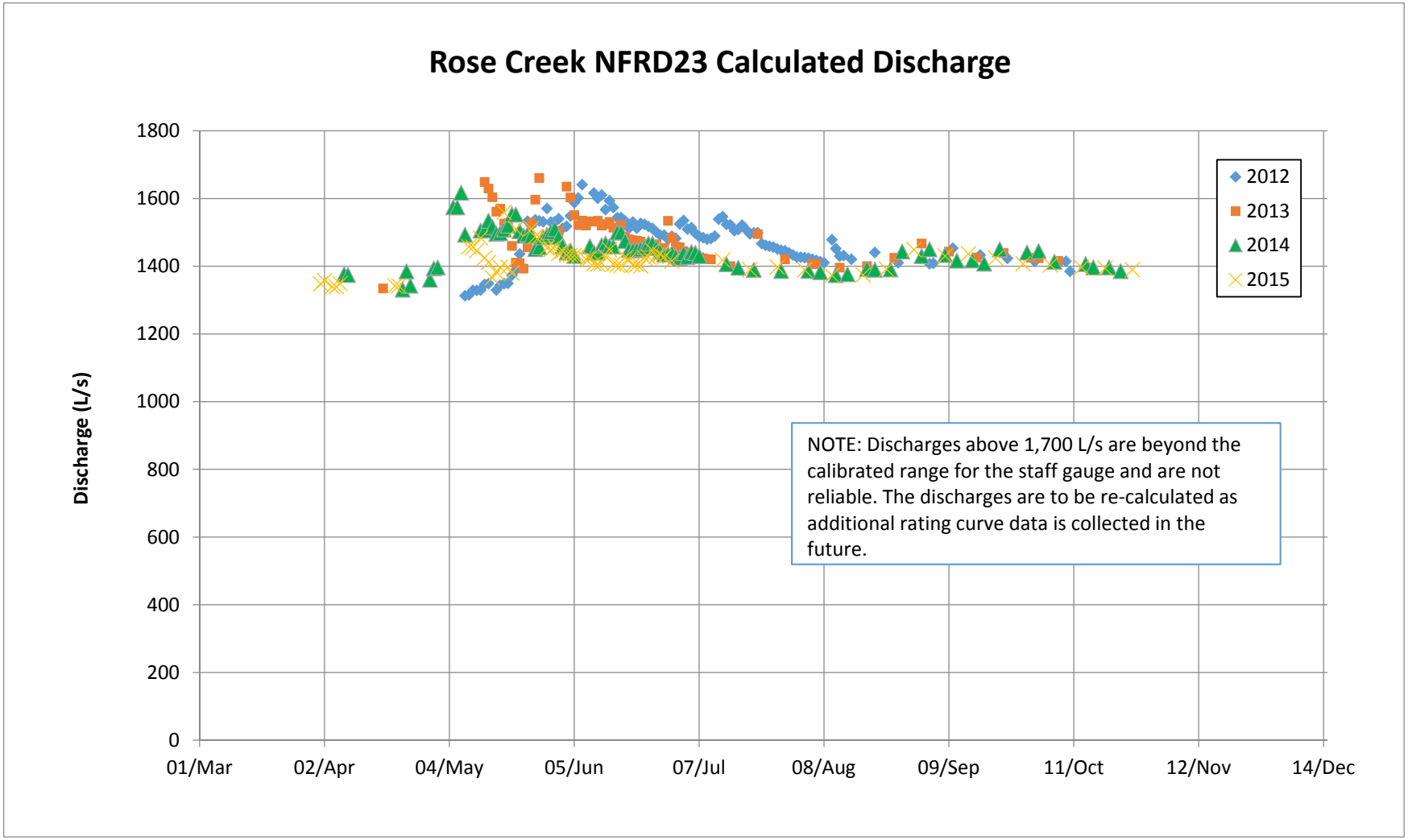
APPENDIX II-D

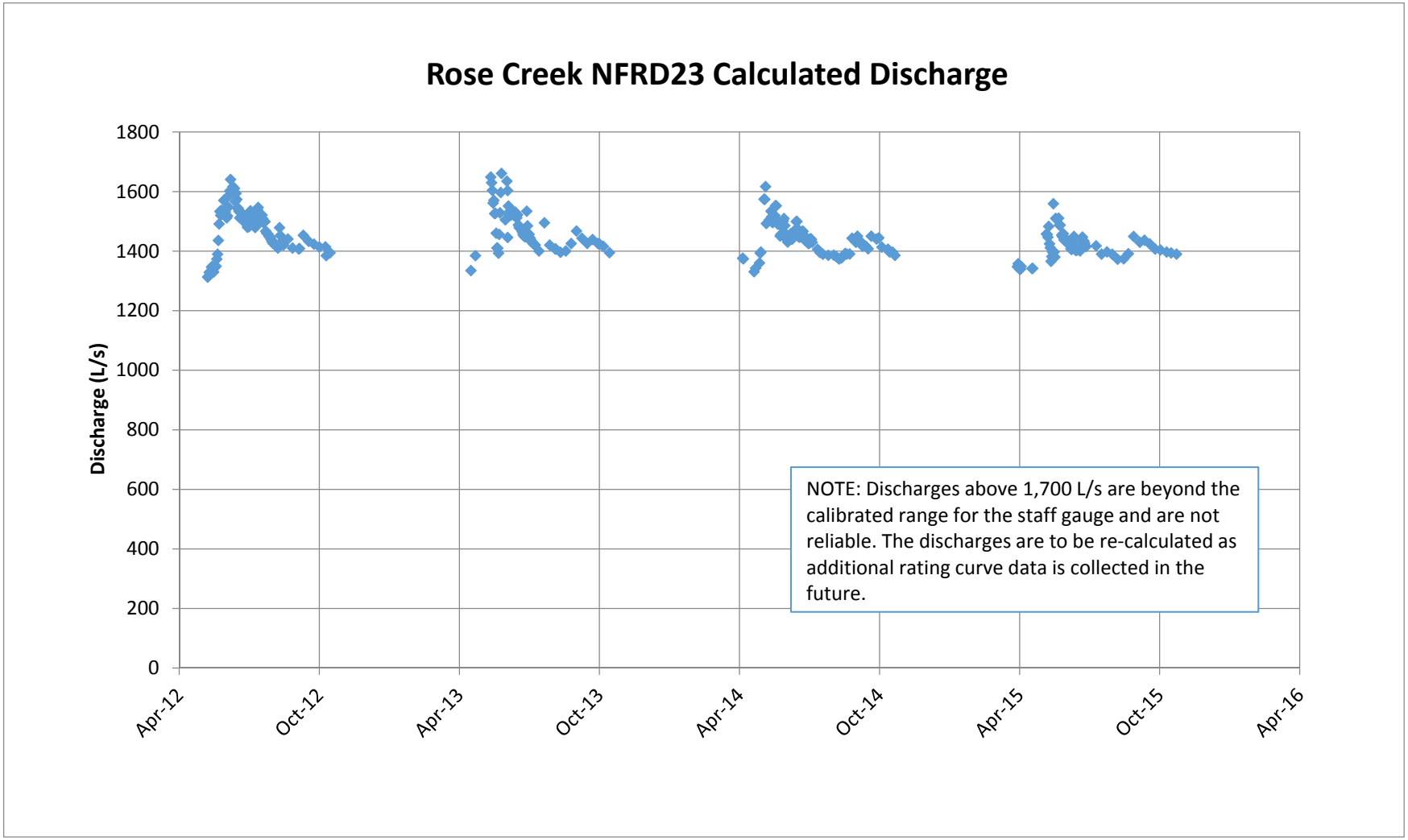
Rose Creek Diversion Channel

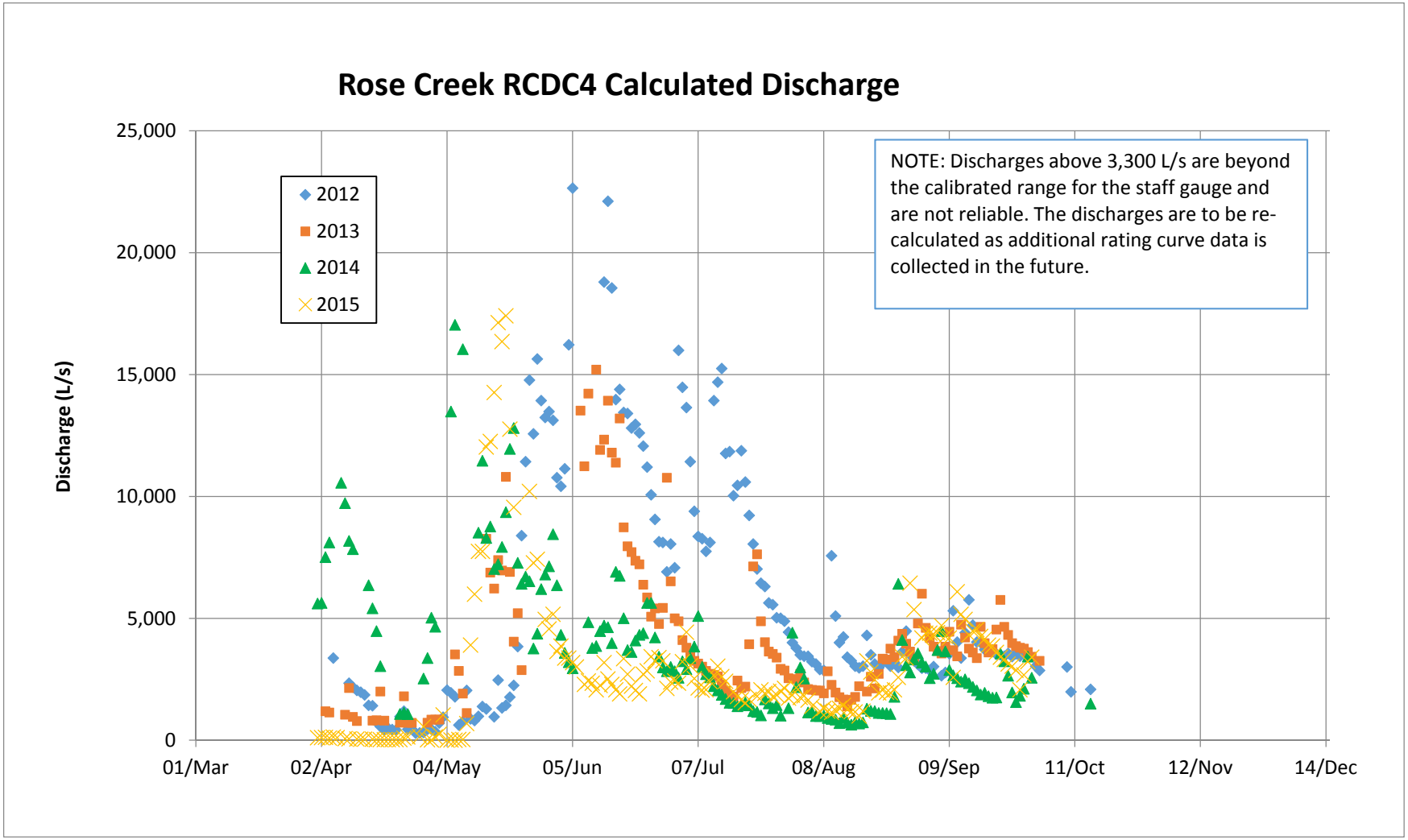
D1 – Staff Gauge Calibrations
D2 – Staff Gauge Flows

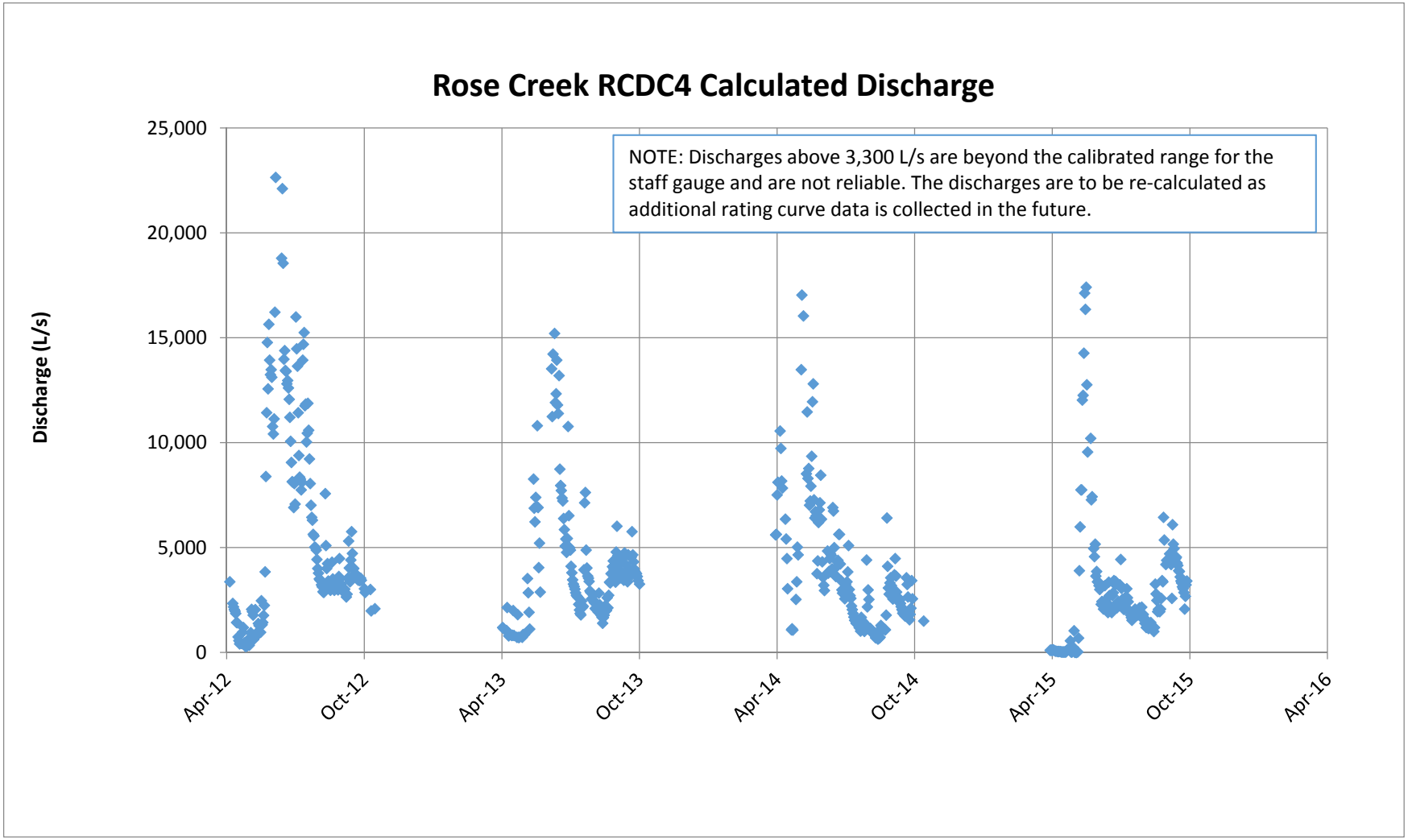

Rose Creek NFRD23 Discharge Rating Curve
3,000
2,500
2,000
1,500
1,000
500
0
Discharge (L/s)
0.40
0.45
0.50
0.55
0.60
0.65
0.70
Staff Gauge (m)
2012
2013
2014
2015
y = 1524.7x^0.1336

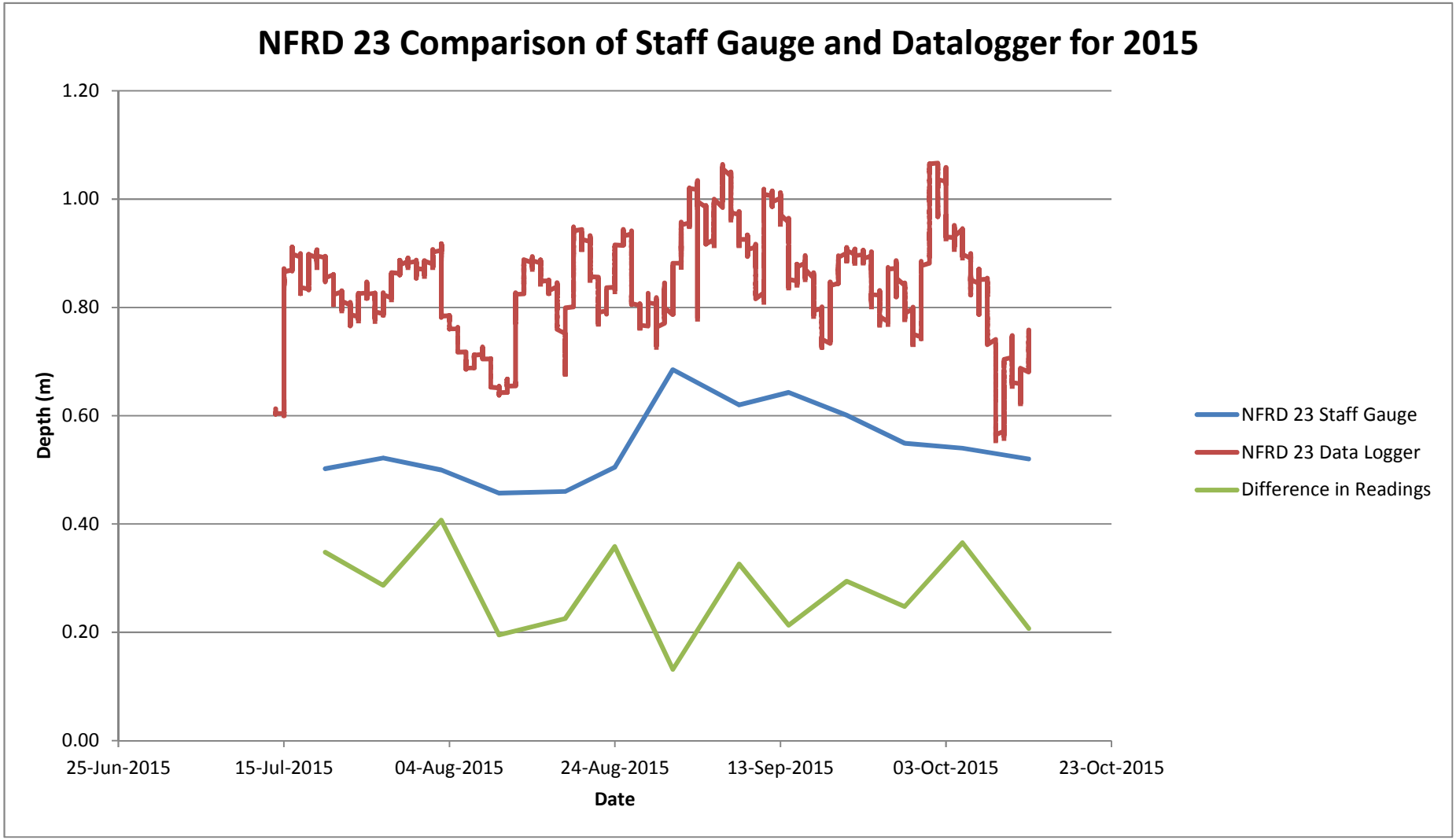

Rose Creek RCDC4 Rating Curve
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Discharge (L/s)
0.150
0.200
0.250
0.300
0.350
0.400
0.450
0.500
Staff Gauge (m)
2012
2013
2014
2015
y = 26312x2.2292


Rose Creek NFRD23 Calculated Discharge
Discharge (L/s)
1800
1600
1400
1200
1000
800
600
400
200
0
01/Mar
02/Apr
04/May
05/Jun
07/Jul
08/Aug
09/Sep
11/Oct
12/Nov
14/Dec
2012
2013
2014
2015
NOTE: Discharges above 1,700 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.


Rose Creek NFRD23 Calculated Discharge
Discharge (L/s)
1800
1600
1400
1200
1000
800
600
400
200
0
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Oct-15
Apr-16
NOTE: Discharges above 1,700 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.


Rose Creek RCDC4 Calculated Discharge
Discharge (L/s)
25,000
20,000
15,000
10,000
5,000
0
01/Mar
02/Apr
04/May
05/Jun
07/Jul
08/Aug
09/Sep
11/Oct
12/Nov
14/Dec
2012
2013
2014
2015
NOTE: Discharges above 3,300 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.


Rose Creek RCDC4 Calculated Discharge
NOTE: Discharges above 3,300 L/s are beyond the calibrated range for the staff gauge and are not reliable. The discharges are to be re-calculated as additional rating curve data is collected in the future.
Discharge (L/s)
25,000
20,000
15,000
10,000
5,000
0
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Oct-15
Apr-16

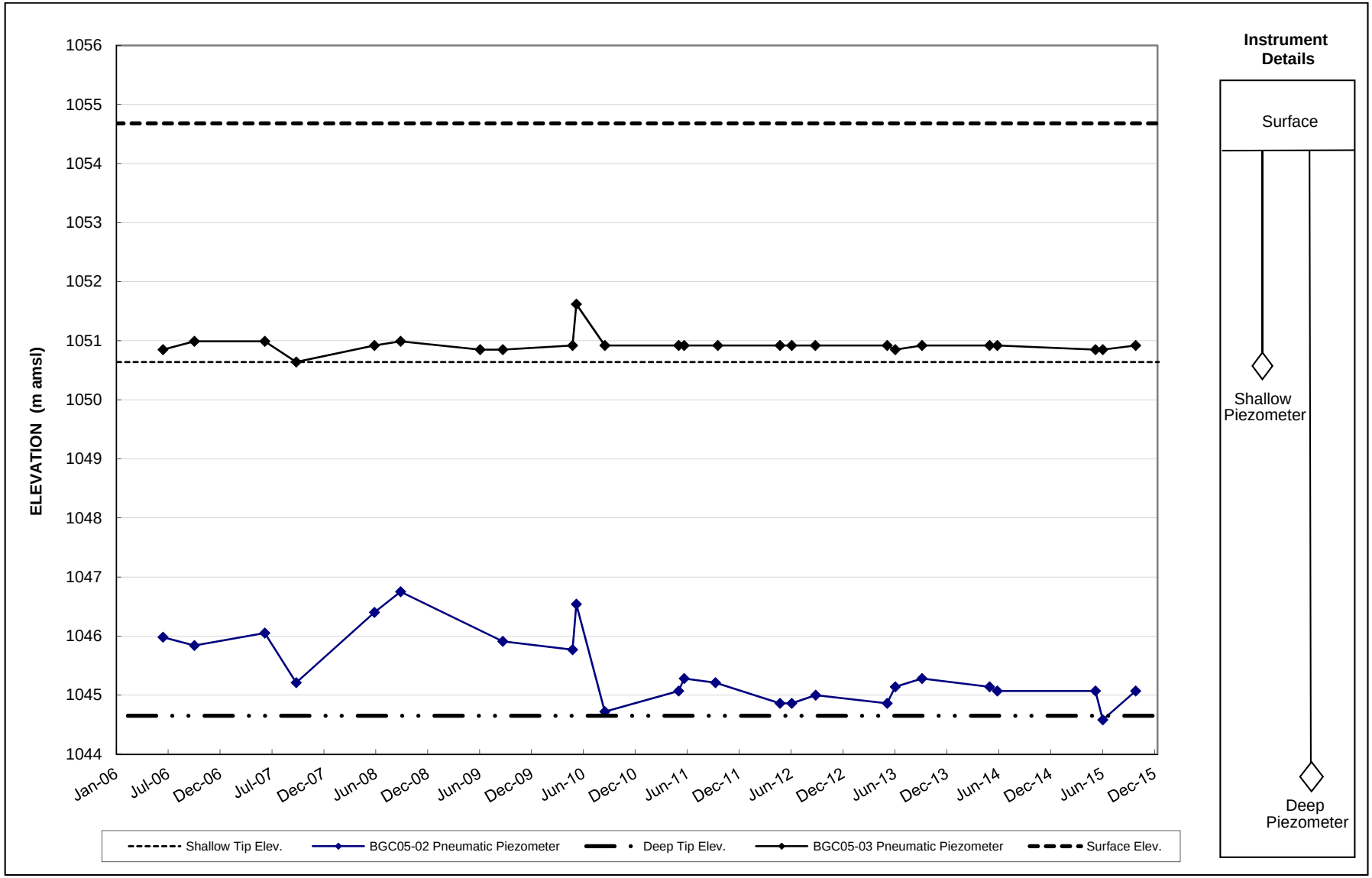

NFRD 23 Comparison of Staff Gauge and Datalogger for 2015
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Depth (m)
25-Jun-2015
15-Jul-2015
04-Aug-2015
24-Aug-2015
13-Sep-2015
03-Oct-2015
23-Oct-2015
Date
NFRD 23 Staff Gauge
NFRD 23 Data Logger
Difference in Readings

APPENDIX II-E

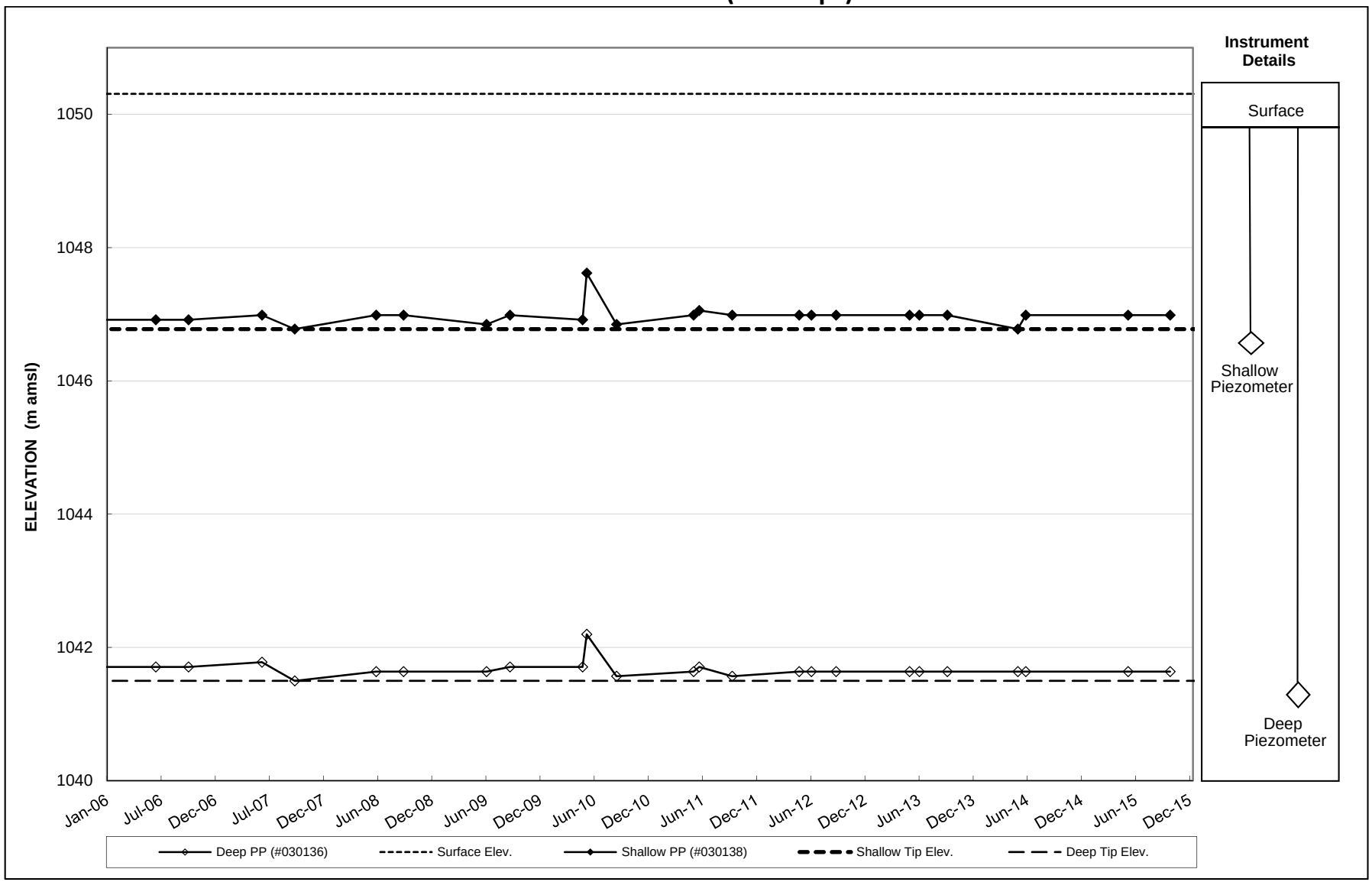
Canal Dyke

E1 – Piezometers
E2 – Thermistors (Thawed ones not included)
E3 – Inclinometers

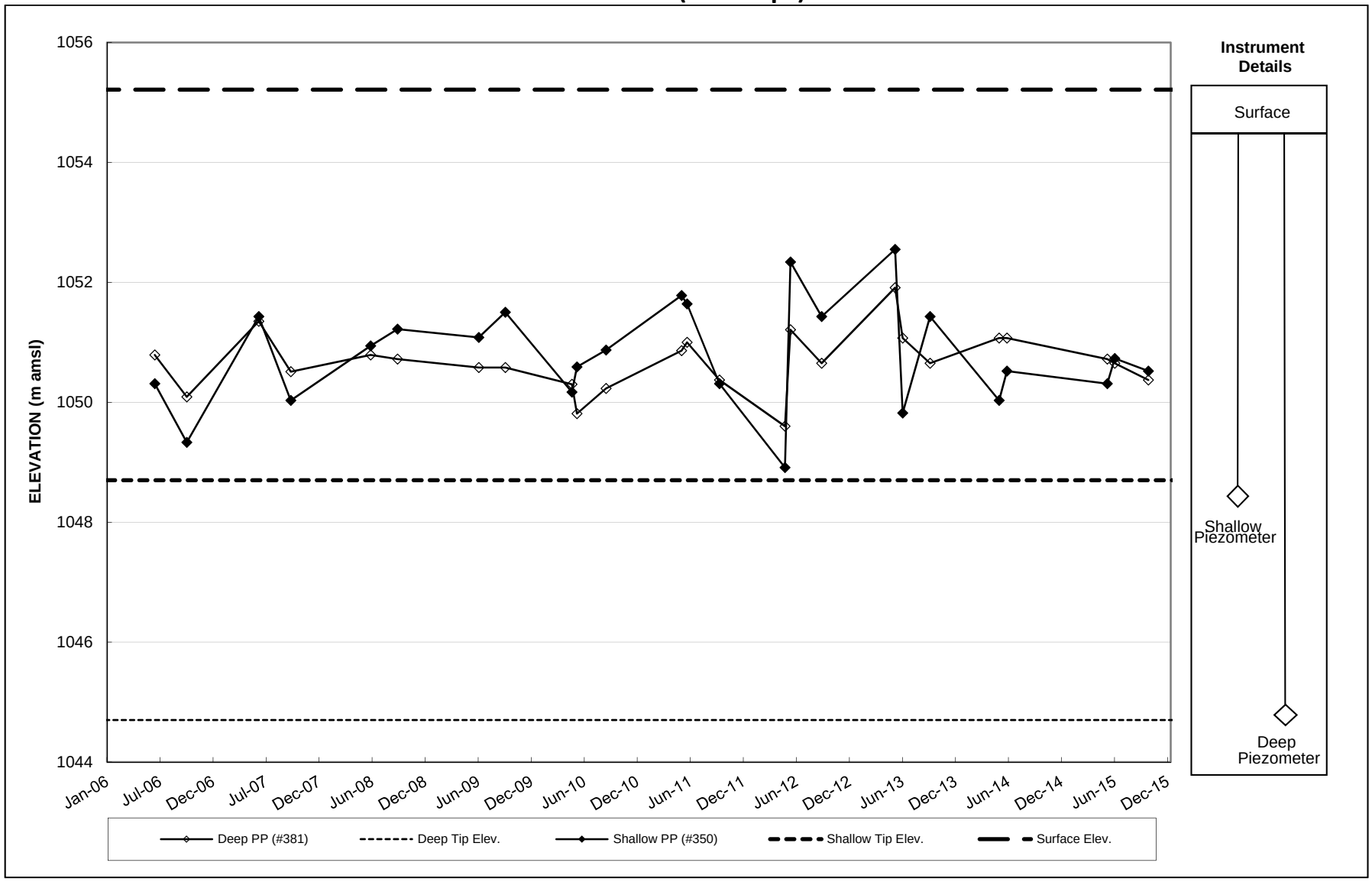
Diversion Canal (Canal Dyke) – Piezometers
BGC – 05 -02 03



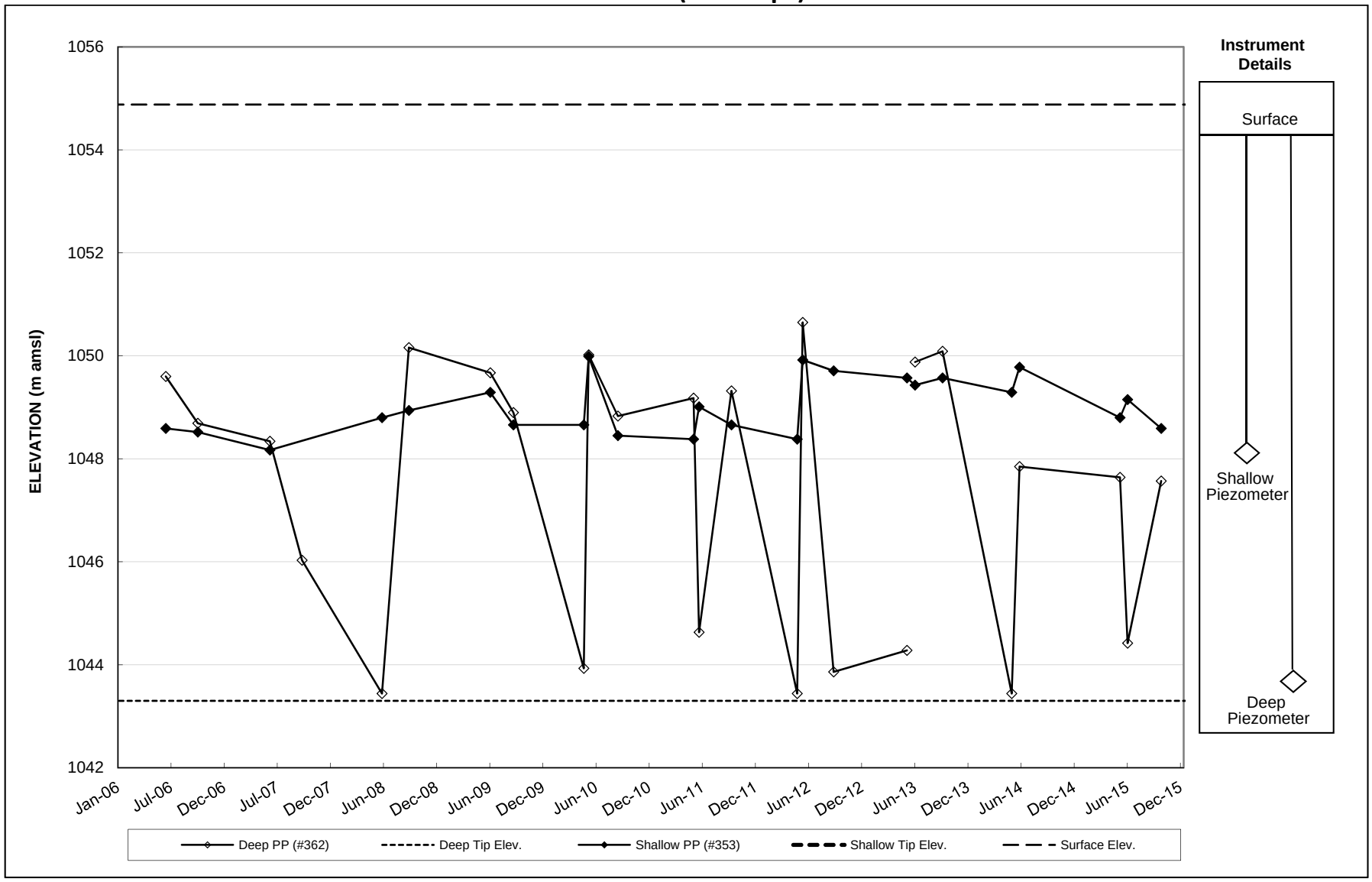
Diversion Canal (Canal Dyke) – Piezometers
BGC – 05 -05 06 (Both Tips)



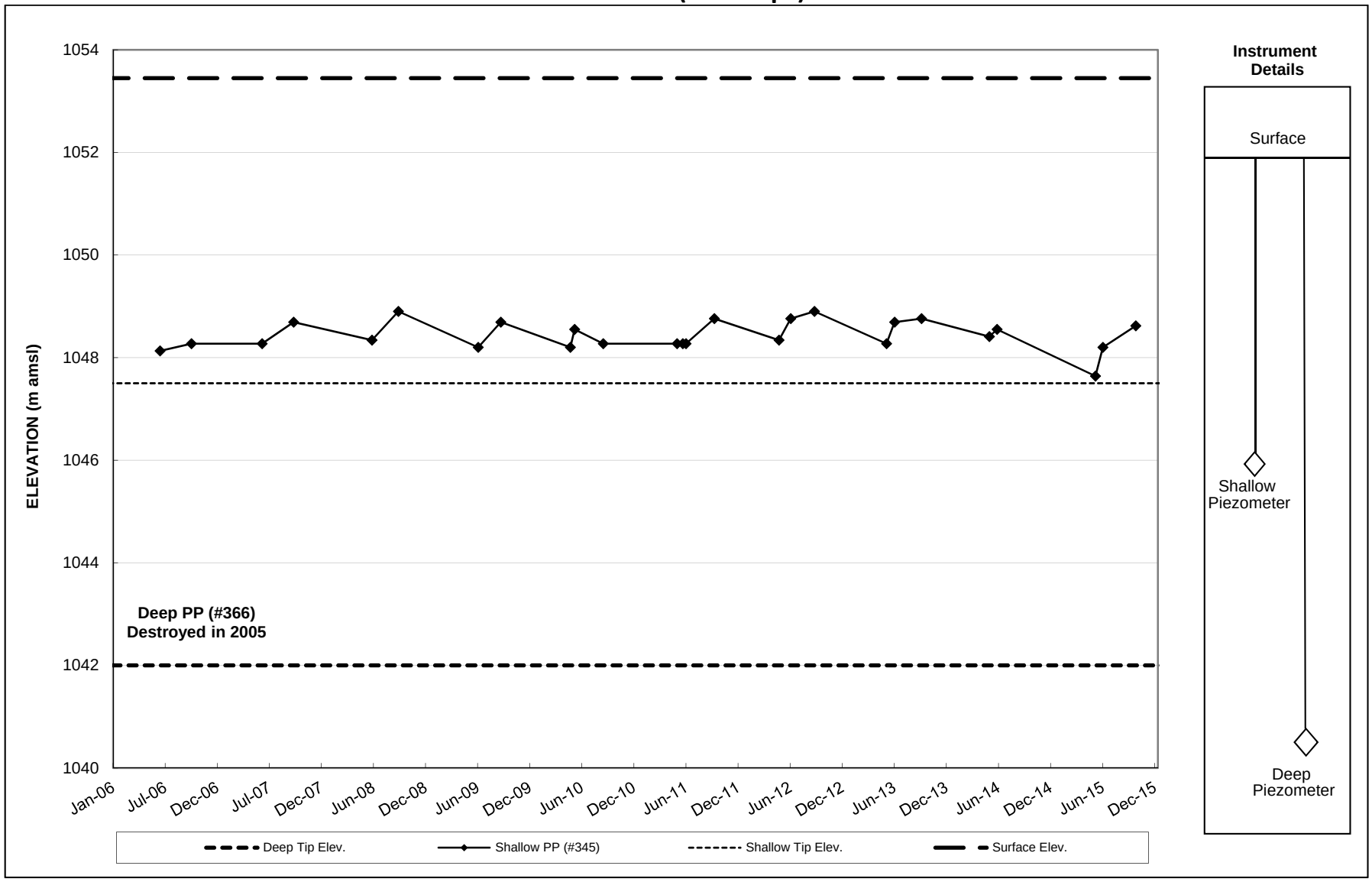
Diversion Canal (Canal Dyke) – Piezometers
CD – 13 (Both Tips)



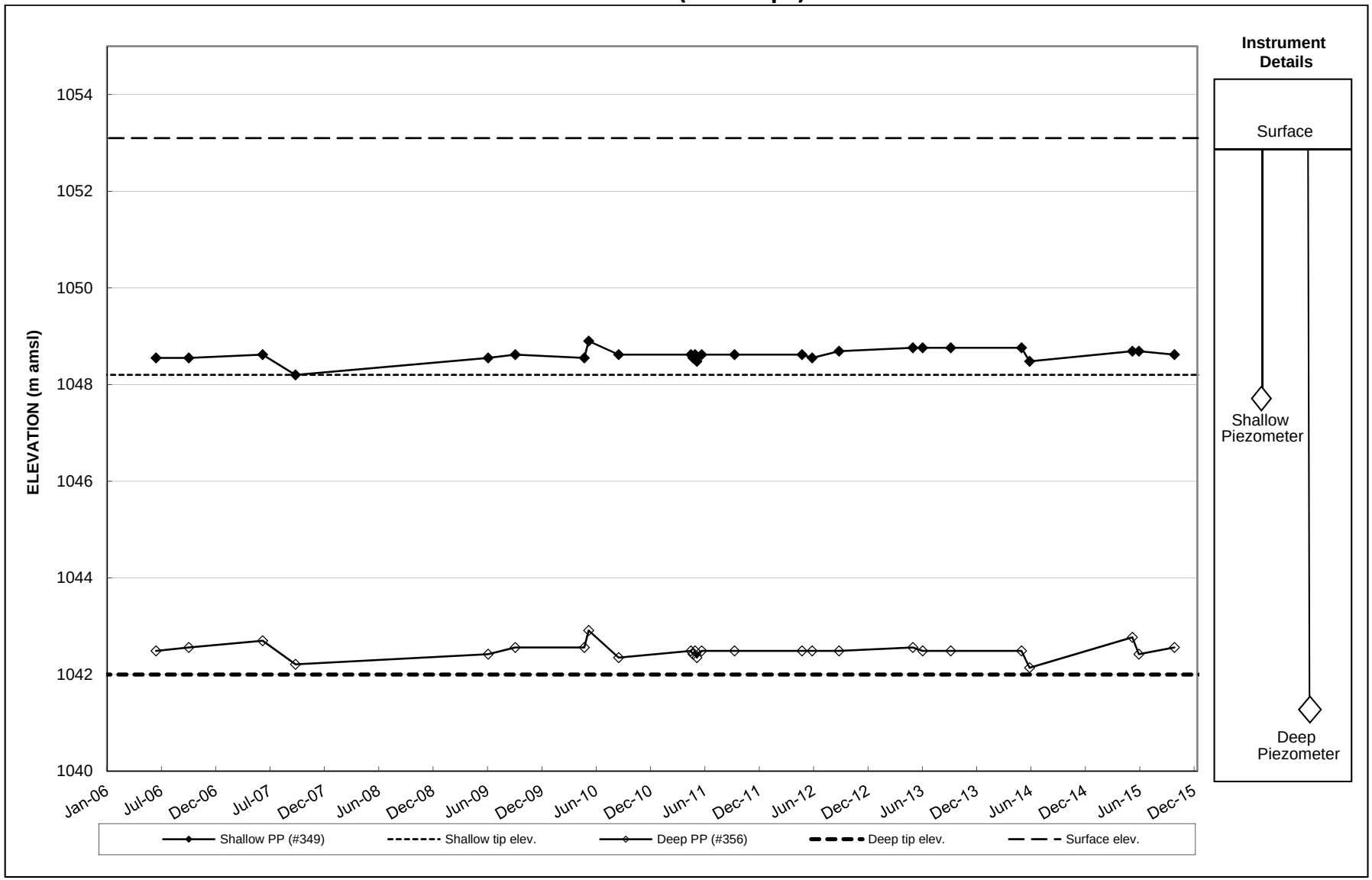
Diversion Canal (Canal Dyke) – Piezometers
CD – 15 (Both Tips)



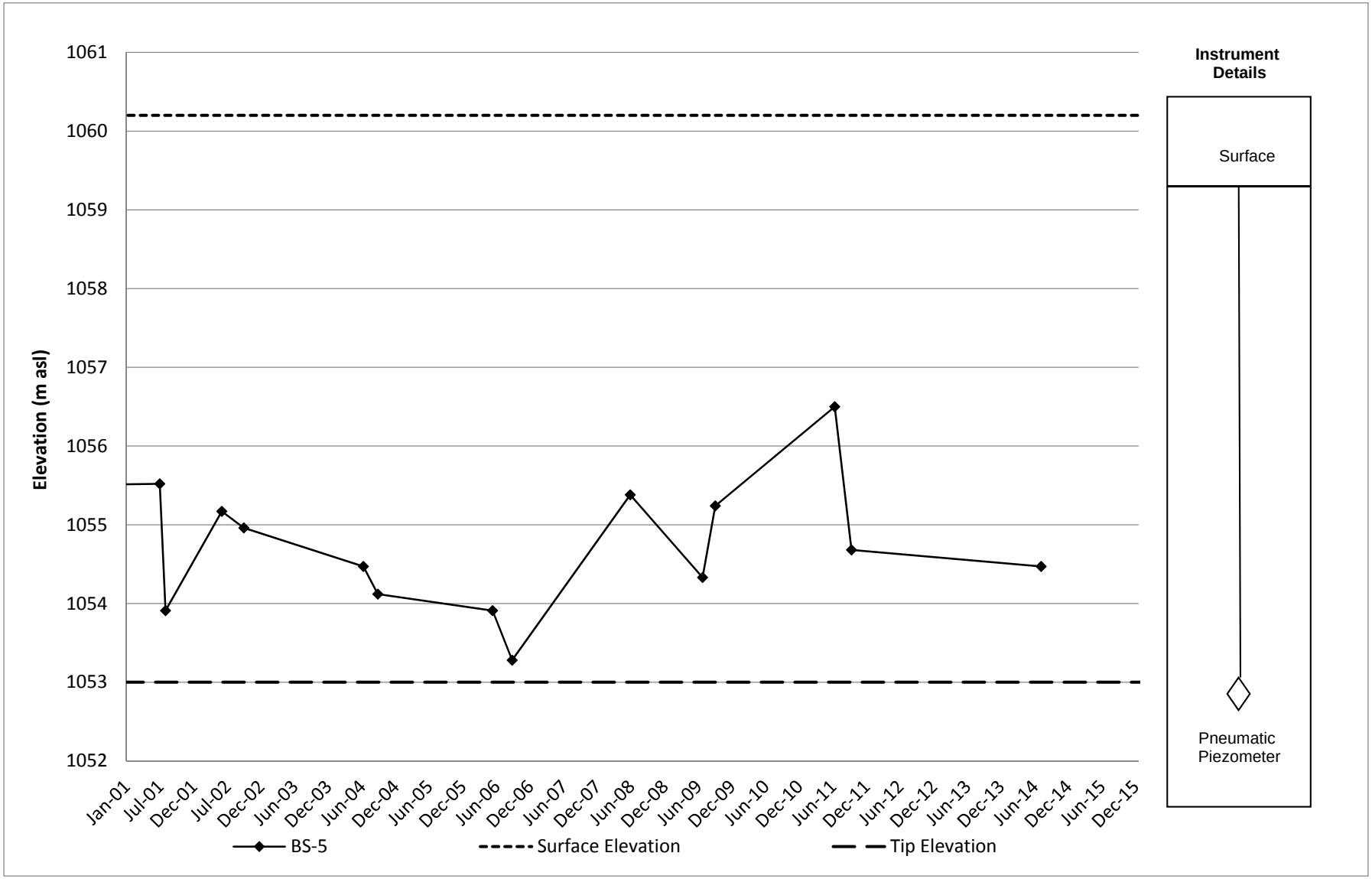
Diversion Canal (Canal Dyke) – Piezometers
CD – 21 (Both Tips)



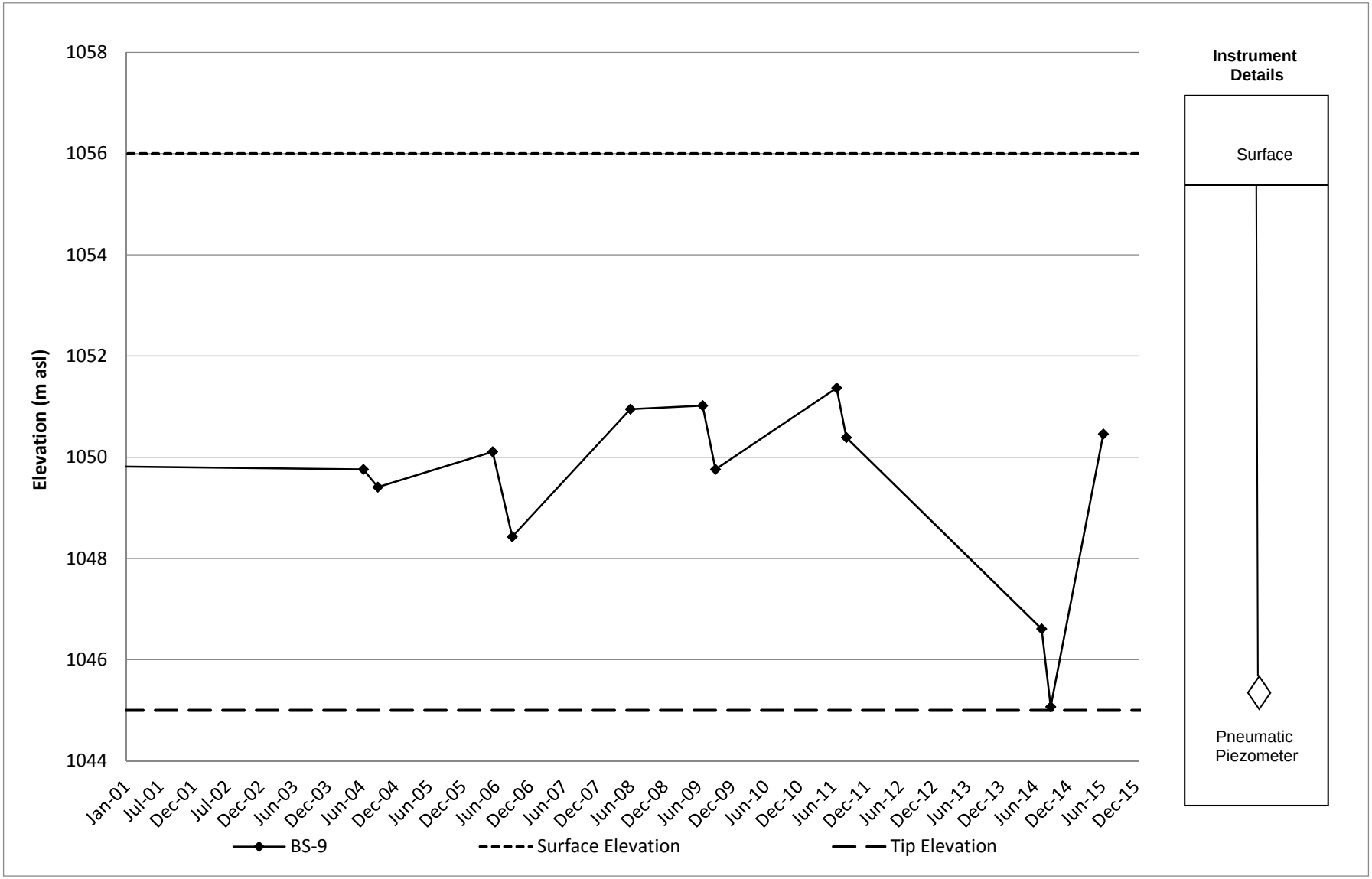
Diversion Canal (Canal Dyke) – Piezometers
CD – 26 (Both Tips)



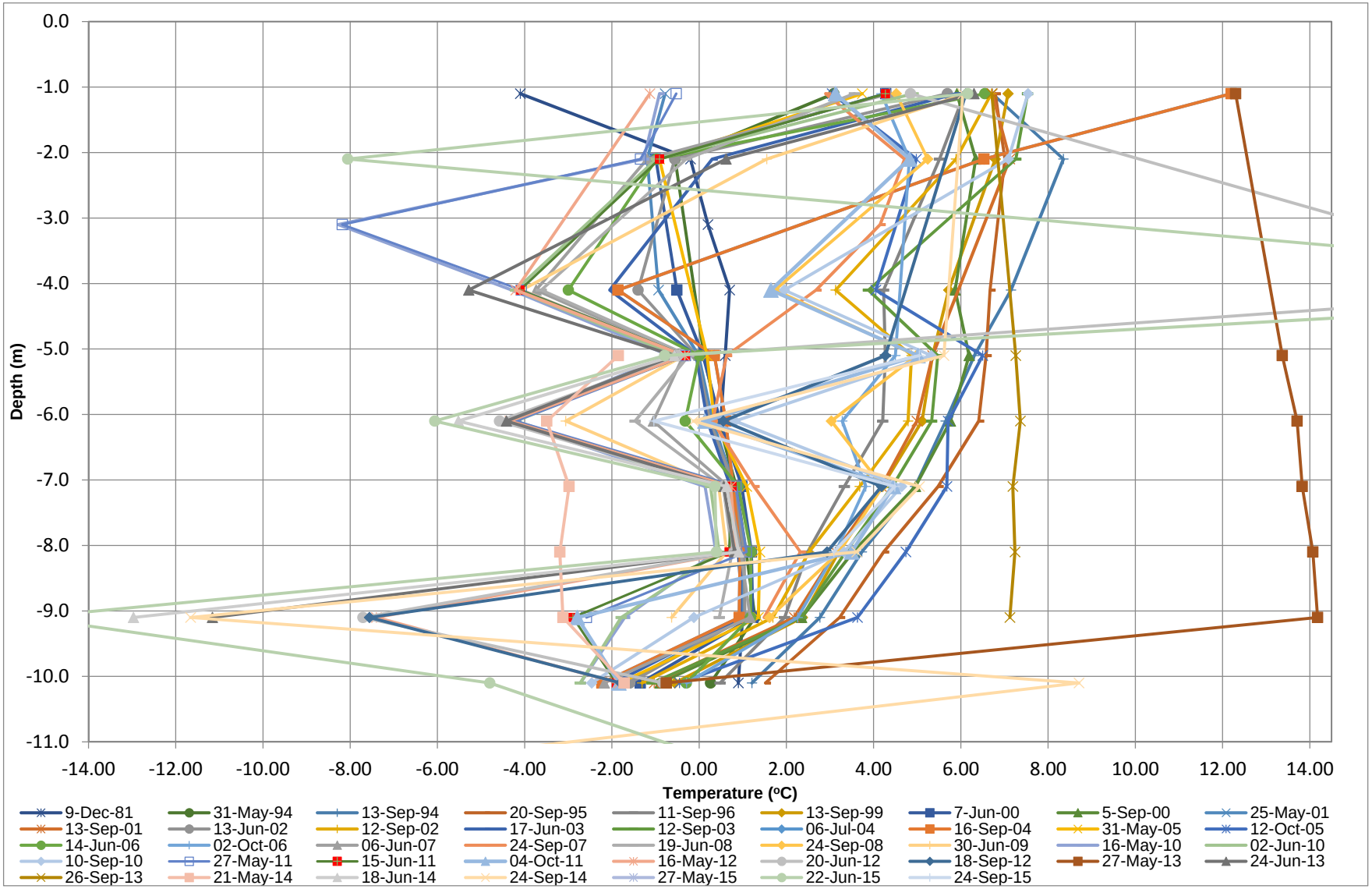
Diversion Canal (Back Slope) – Piezometers
BS-5



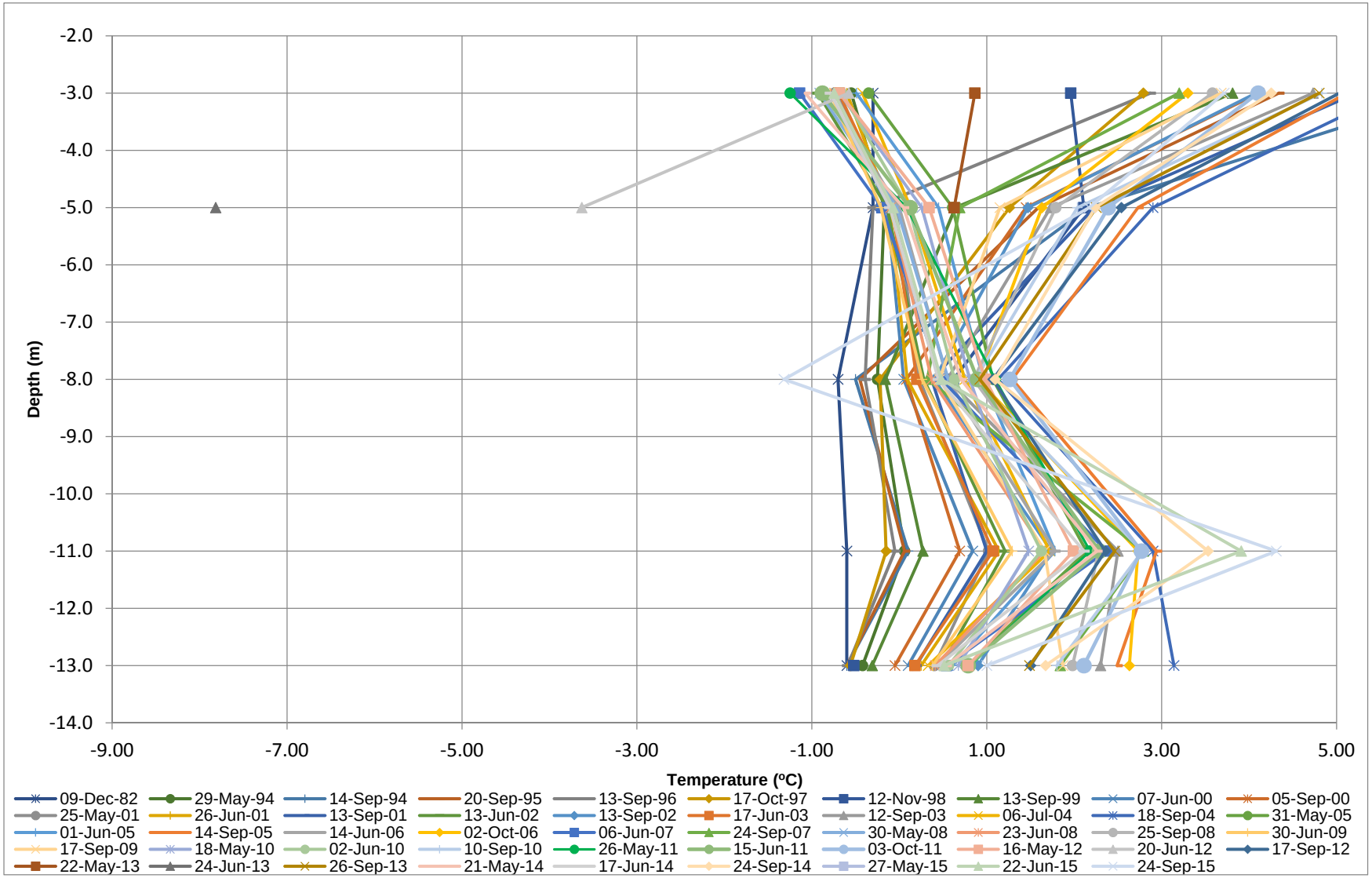
Diversion Canal (Back Slope) – Piezometers
BS-9



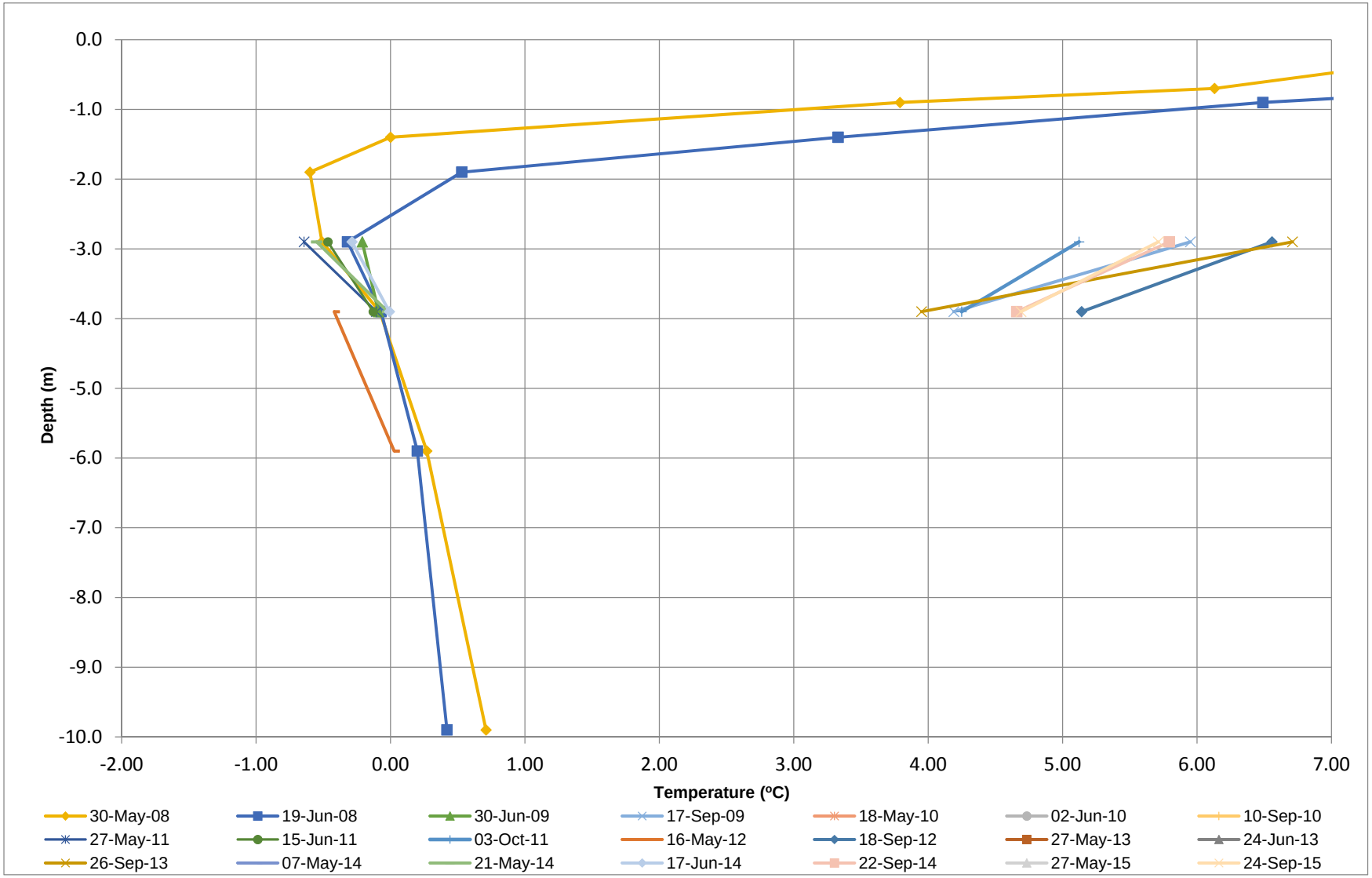
Diversion Canal (Canal Dyke)
Thermistor CD-15



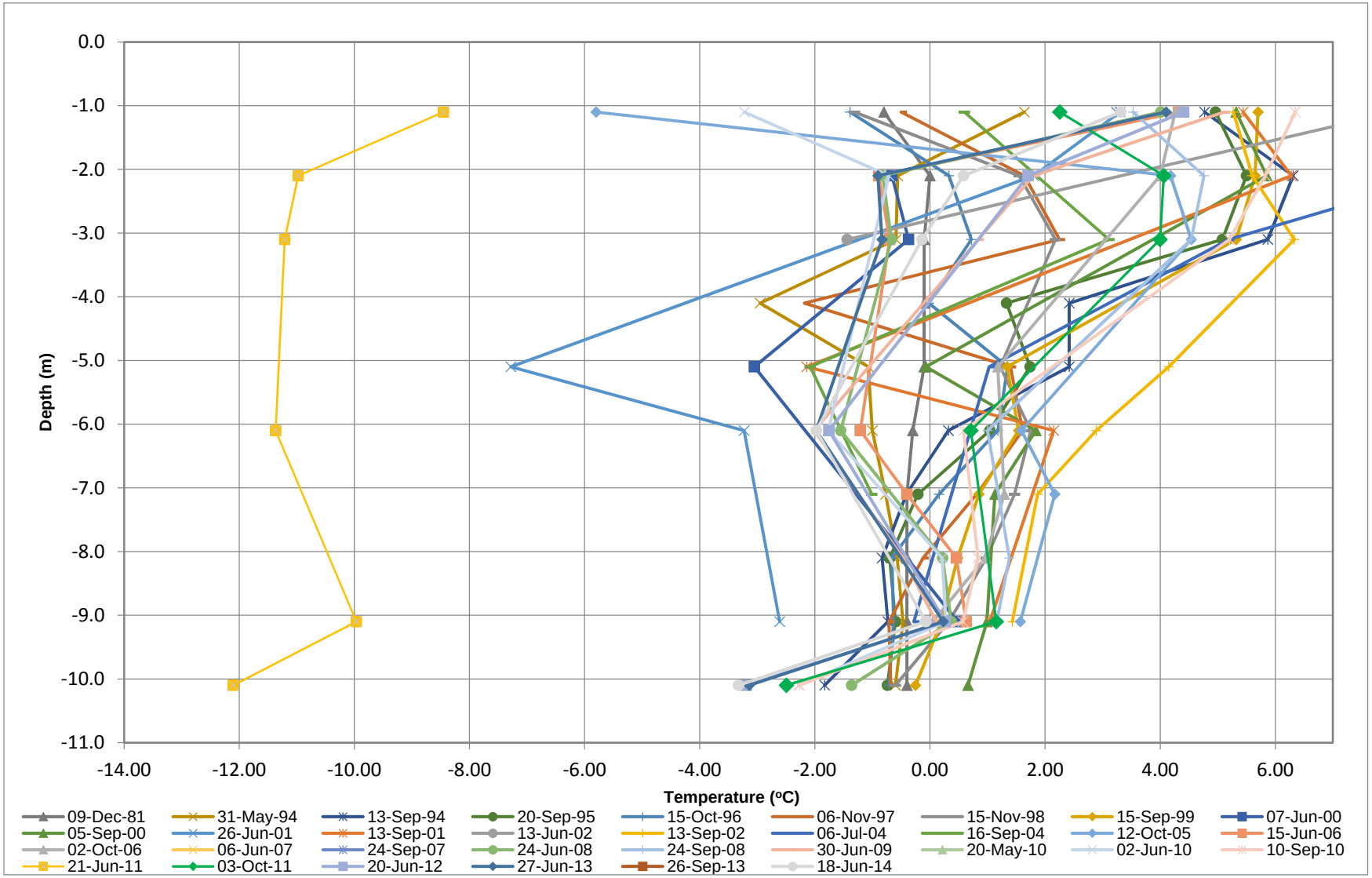
Diversion Canal (Canal Dyke)
Thermistor CD-21



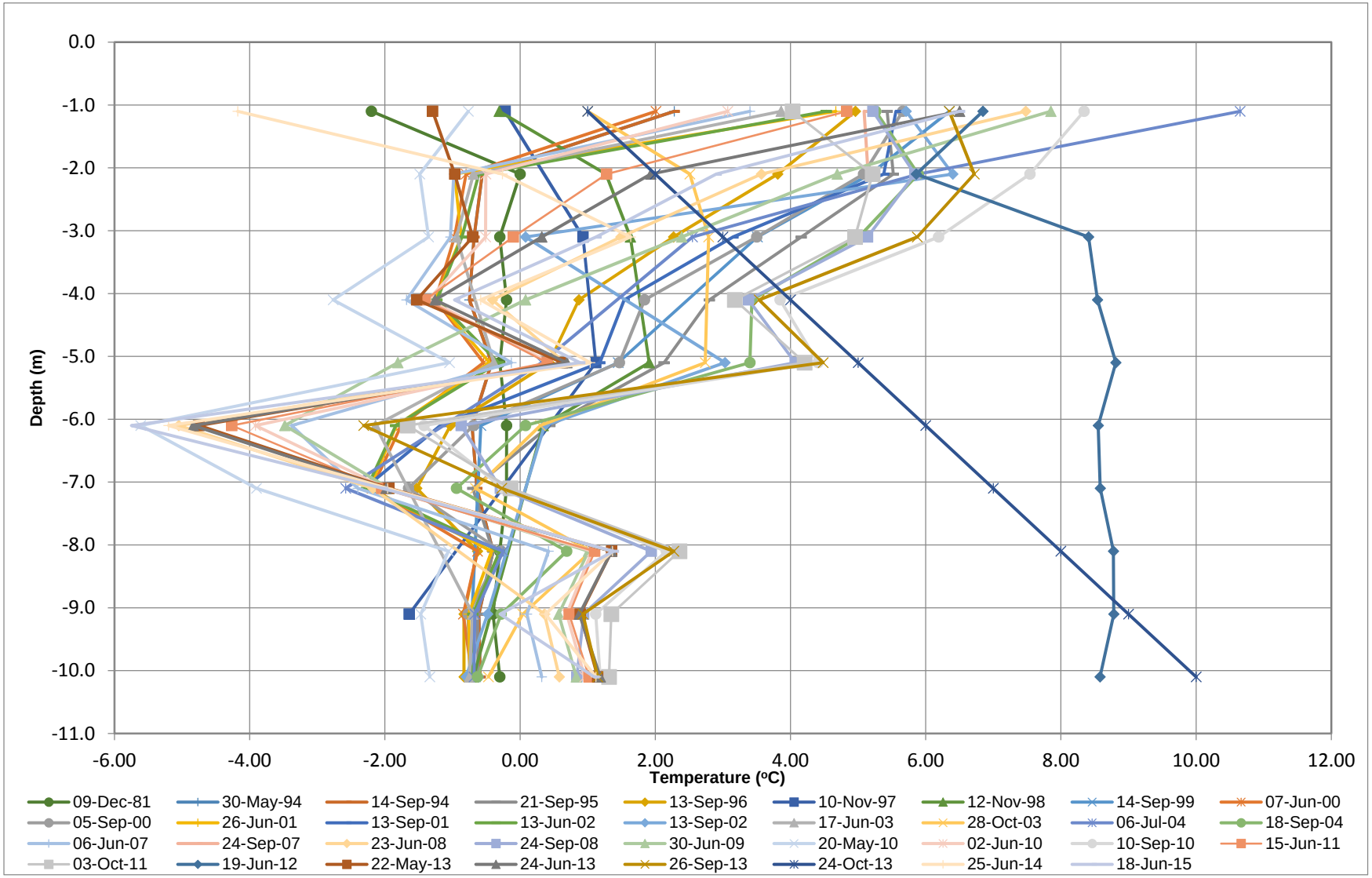
Diversion Canal (Canal Dyke)
Thermistor BGC 05-04



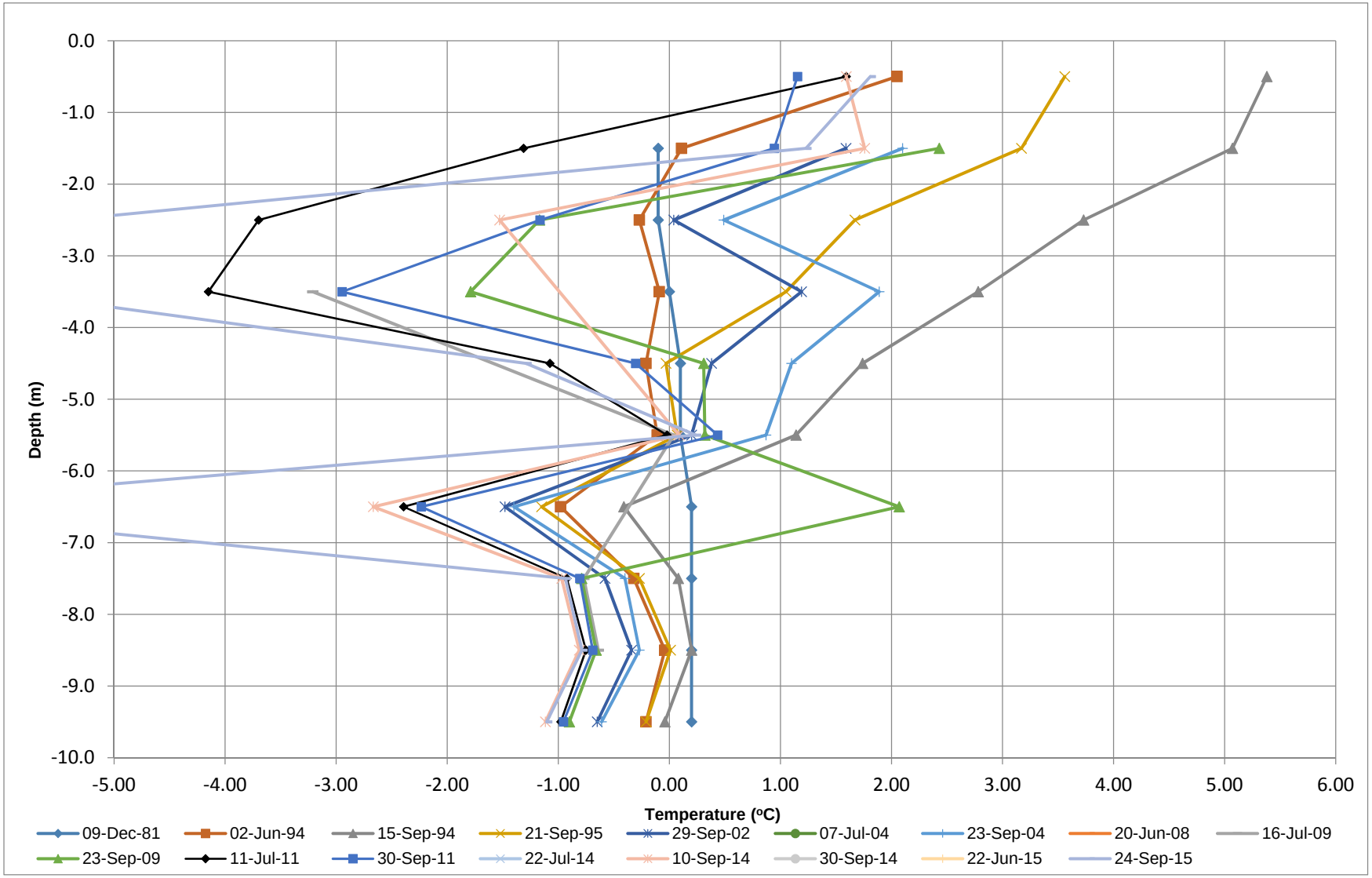
Diversion Canal (Spoil Pile)
Thermistor SP-3



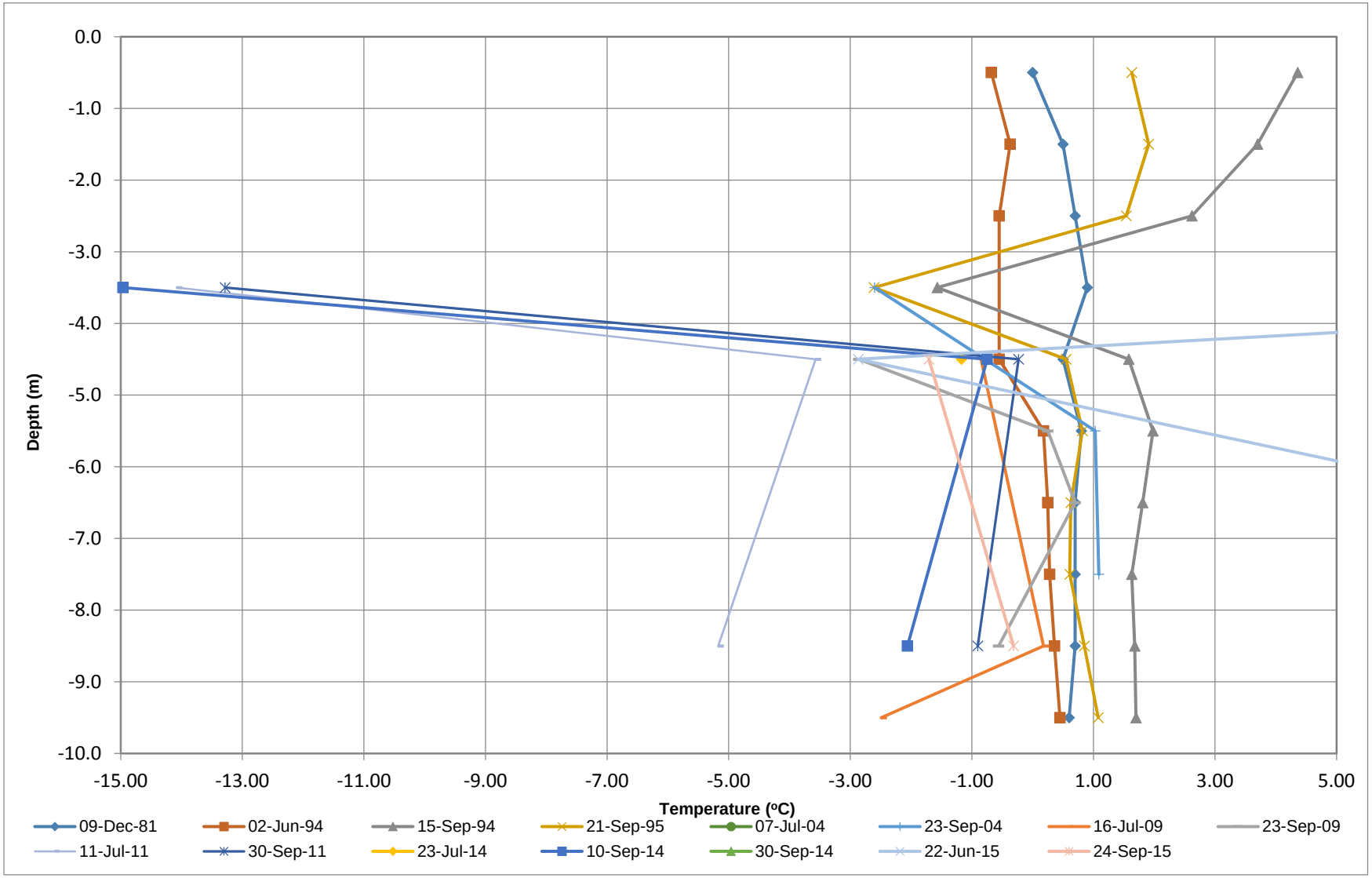
Diversion Canal (Spoil Pile)
Thermistor SP-5



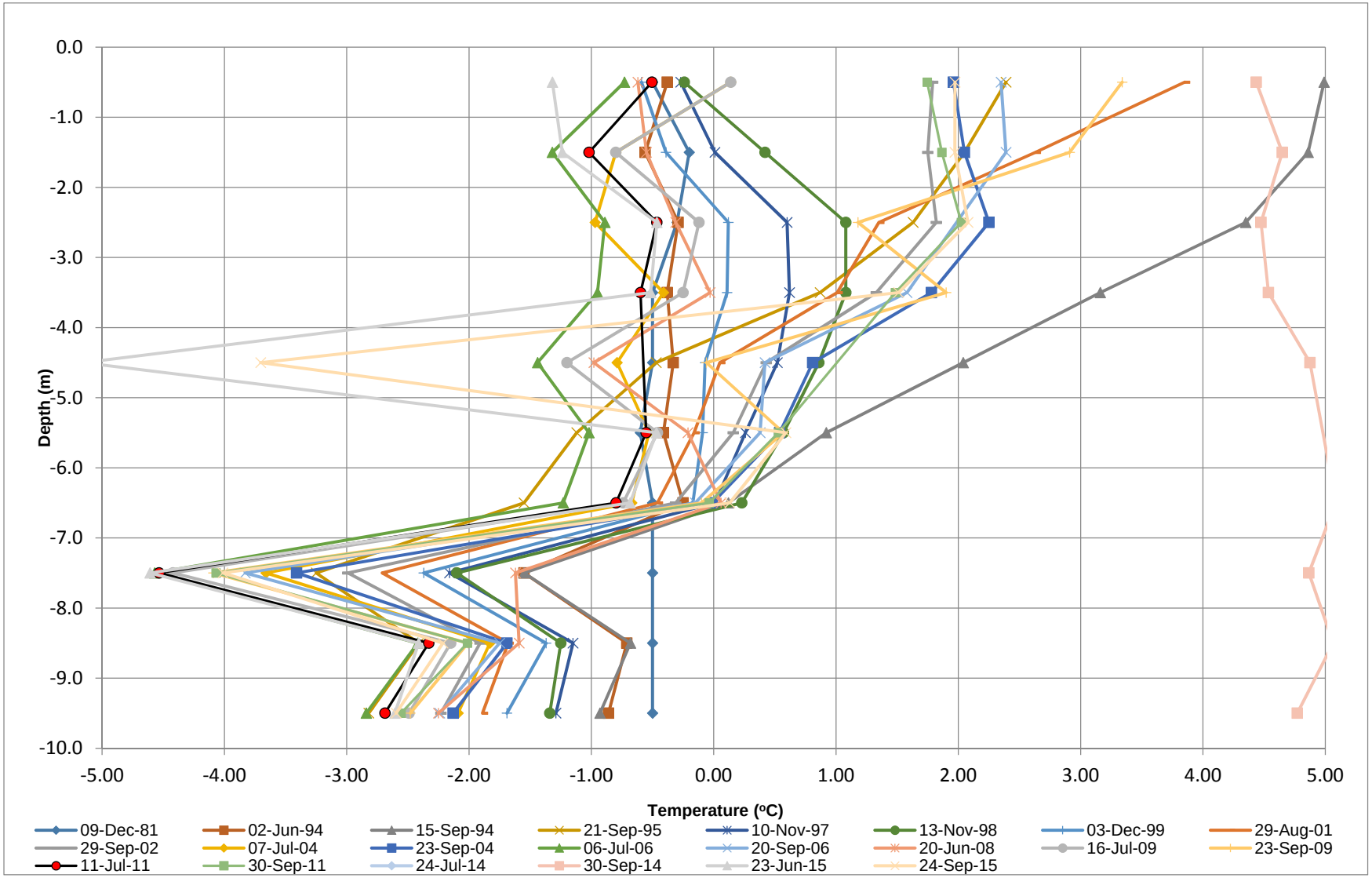
Diversion Canal (Back Slope)
Thermistor BS-5



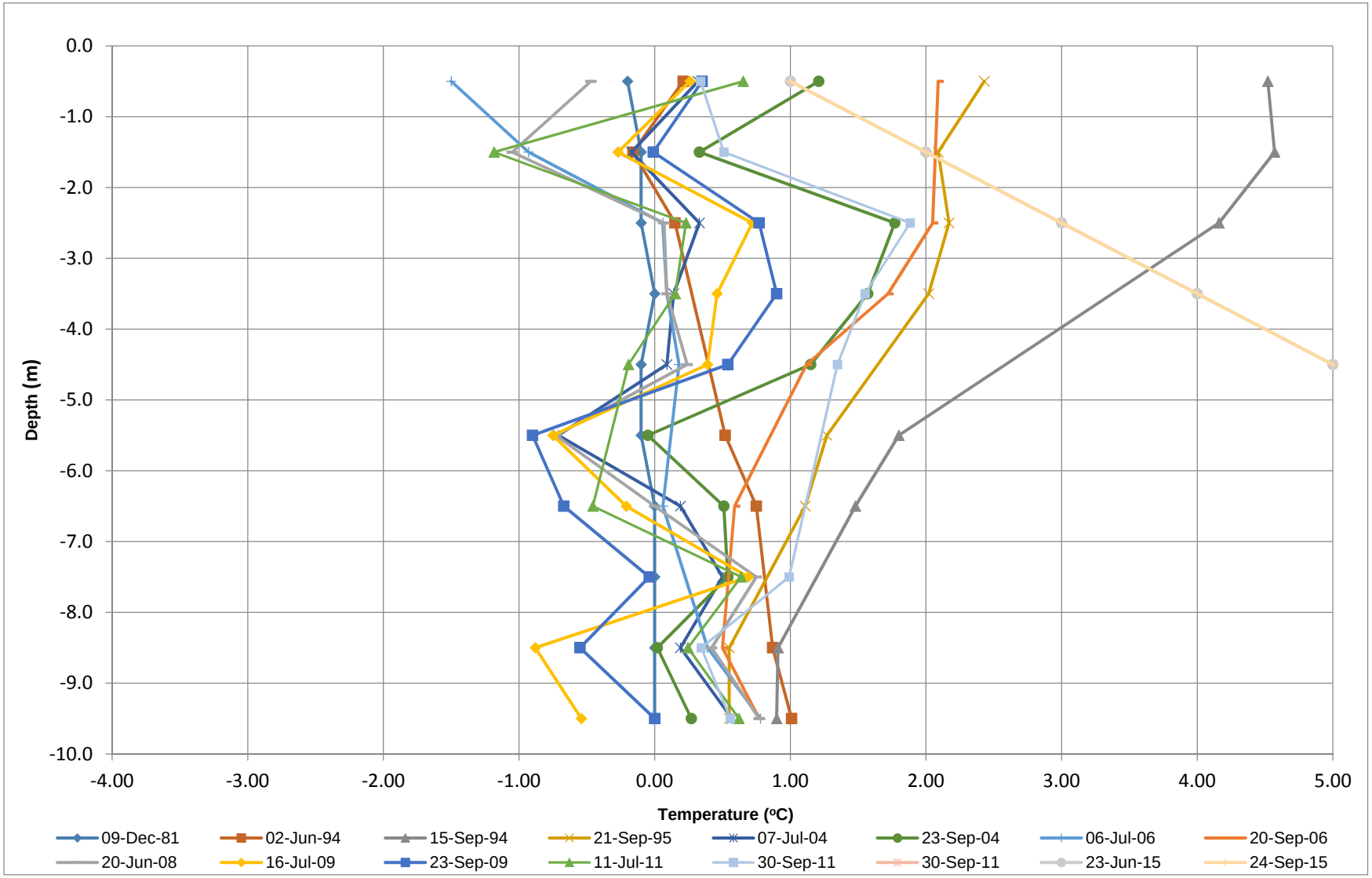
Diversion Canal (Back Slope)
Thermistor BS-9



Diversion Canal (Back Slope)
Thermistor BS-10

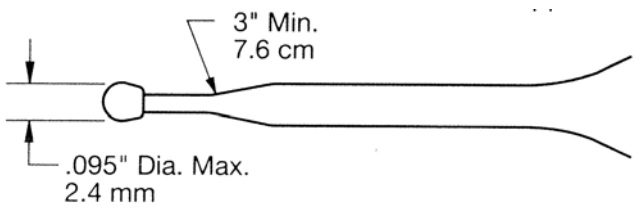


Diversion Canal (Back Slope)
Thermistor BS-12



44007RC Precision Epoxy NTC Thermistor

MECHANICAL DETAILS



RESISTANCE V TEMPERATURE TABLE

Temp °C	K-Ohms
-55	482.200
-54	447.900
-53	416.300
-52	387.100
-51	360.200
-50	335.300
-49	312.300
-48	291.000
-47	271.300
-46	253.000
-45	236.200
-44	220.500
-43	205.900
-42	192.500
-41	180.000
-40	168.300
-39	157.500
-38	147.500
-37	138.200
-36	129.500
-35	121.400
-34	113.900
-33	106.900
-32	100.300
-31	94.220
-30	88.530
-29	83.220
-28	78.260
-27	73.620
-26	69.290
-25	65.240
-24	61.450
-23	57.900
-22	54.580
-21	51.470
-20	48.560
-19	45.830
-18	43.270
-17	40.860
-16	38.610

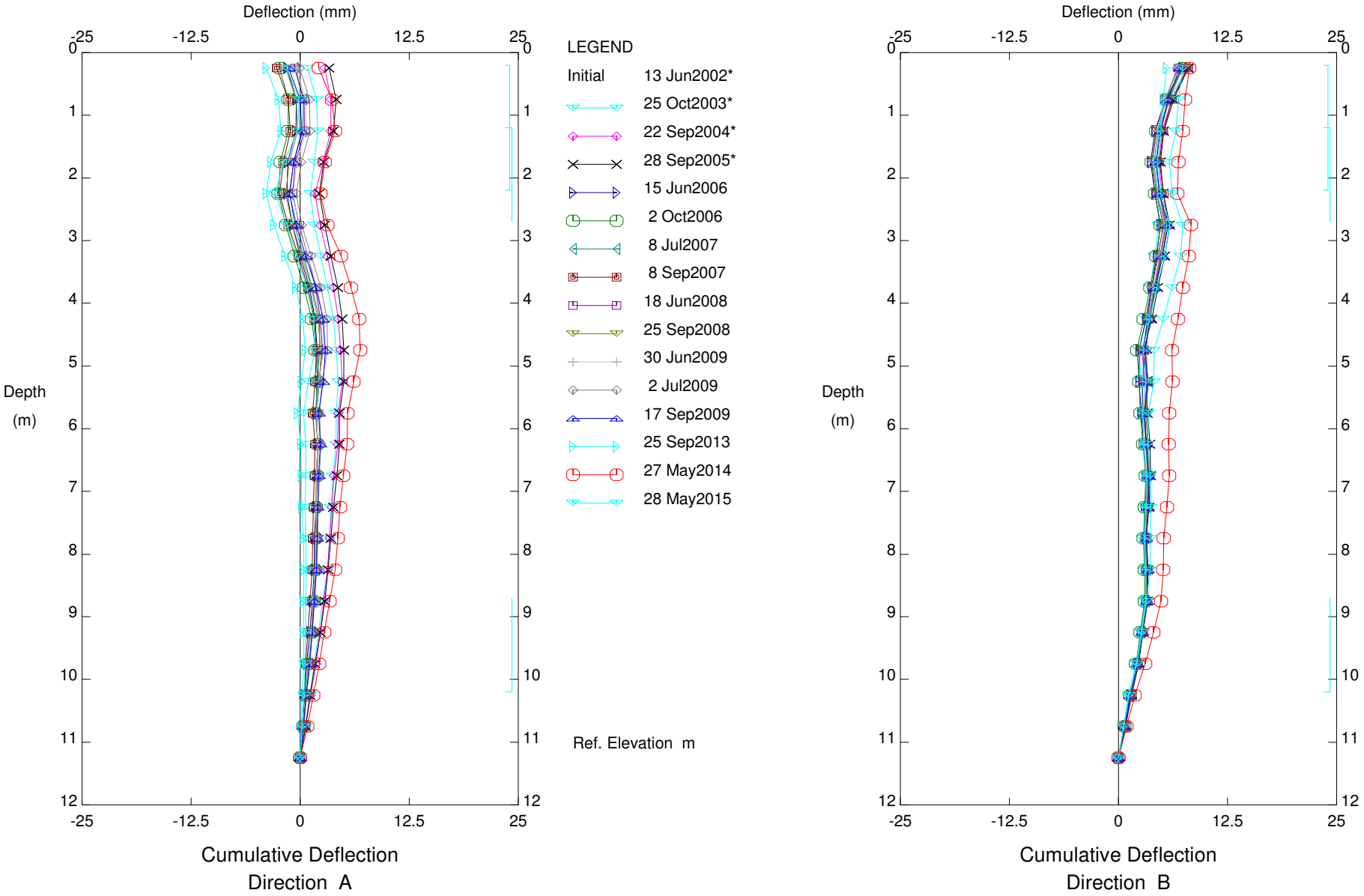
Temp °C	K-Ohms
-15	36.490
-14	34.500
-13	32.630
-12	30.880
-11	29.230
-10	27.670
-9	26.210
-8	24.830
-7	23.540
-6	22.320
-5	21.170
-4	20.080
-3	19.060
-2	18.100
-1	17.190
0	16.330
1	15.520
2	14.750
3	14.030
4	13.340
5	12.700
6	12.090
7	11.510
8	10.960
9	10.440
10	9.951
11	9.486
12	9.046
13	8.628
14	8.232
15	7.857
16	7.500
17	7.162
18	6.841
19	6.536
20	6.247
21	5.972
22	5.710
23	5.462
24	5.225

Temp °C	K-Ohms
25	5.000
26	4.787
27	4.583
28	4.389
29	4.204
30	4.029
31	3.861
32	3.702
33	3.549
34	3.404
35	3.266
36	3.134
37	3.008
38	2.888
39	2.773
40	2.663
41	2.559
42	2.459
43	2.363
44	2.272
45	2.184
46	2.101
47	2.021
48	1.944
49	1.871
50	1.801
51	1.734
52	1.670
53	1.608
54	1.549
55	1.493
56	1.439
57	1.387
58	1.337
59	1.290
60	1.244
61	1.200
62	1.158
63	1.117
64	1.079

Temp °C	K-Ohms
65	1.0410
66	1.0060
67	0.9711
68	0.9380
69	0.9063
70	0.8757
71	0.8464
72	0.8183
73	0.7912
74	0.7651
75	0.7400
76	0.7159
77	0.6927
78	0.6703
79	0.6488
80	0.6281
81	0.6082
82	0.5889
83	0.5704
84	0.5526
85	0.5354
86	0.5188
87	0.5028
88	0.4874
89	0.4726
90	0.4582
91	0.4444
92	0.4310
93	0.4182
94	0.4057
95	0.3937
96	0.3821
97	0.3709
98	0.3601
99	0.3497
100	0.3396
101	0.3298
102	0.3204
103	0.3113
104	0.3025

Temp °C	K-Ohms
105	0.2940
106	0.2857
107	0.2778
108	0.2701
109	0.2626
110	0.2554
111	0.2484
112	0.2416
113	0.2351
114	0.2287
115	0.2226
116	0.2167
117	0.2109
118	0.2053
119	0.1999
120	0.1947
121	0.1896
122	0.1847
123	0.1799
124	0.1753
125	0.1708
126	0.1664
127	0.1622
128	0.1581
129	0.1541
130	0.1503
131	0.1465
132	0.1429
133	0.1394
134	0.1360
135	0.1326
136	0.1294
137	0.1263
138	0.1232
139	0.1203
140	0.1174
141	0.1146
142	0.1119
143	0.1092
144	0.1067
145	0.1042
146	0.1018
147	0.0994
148	0.0971
149	0.0949
150	0.0927

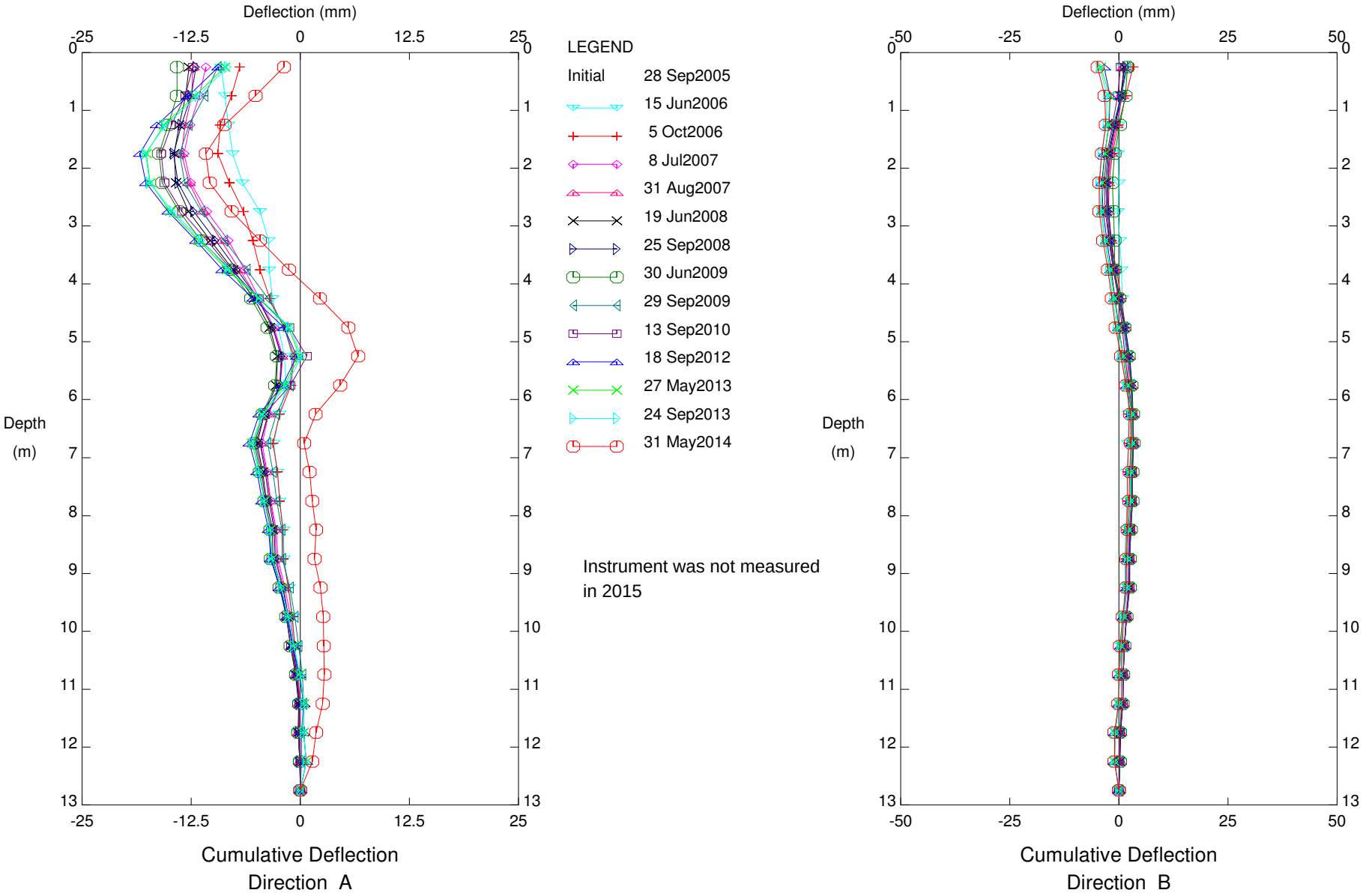
Klohn Crippen Berger Ltd. - Vancouver BC



91CD-1, Inclinometer 1+767

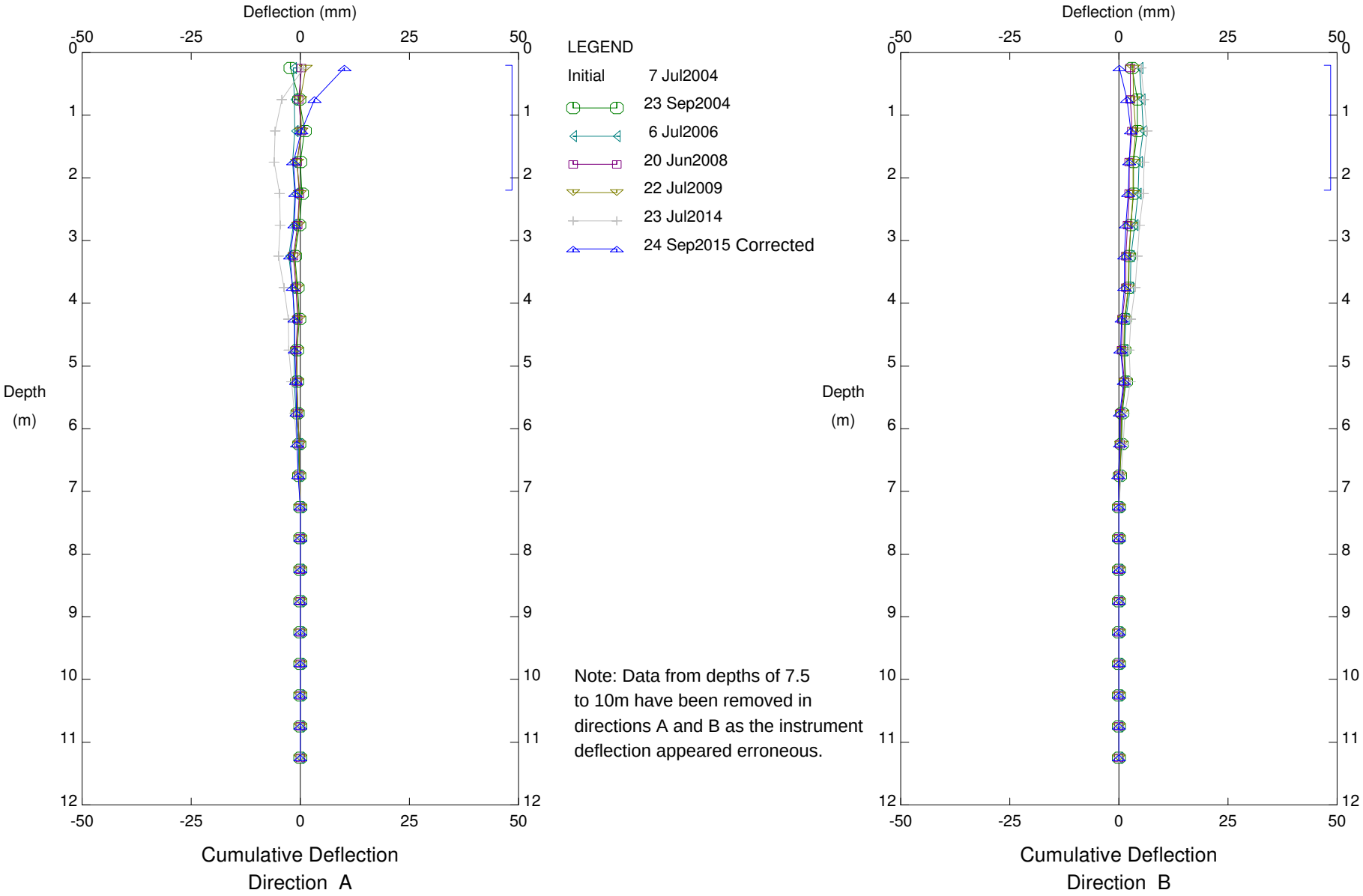
Sets marked * include zero shift and/or rotation corrections.

Klohn Crippen Berger Ltd. - Vancouver BC



Canal Dike, Inclinometer BGC05-08

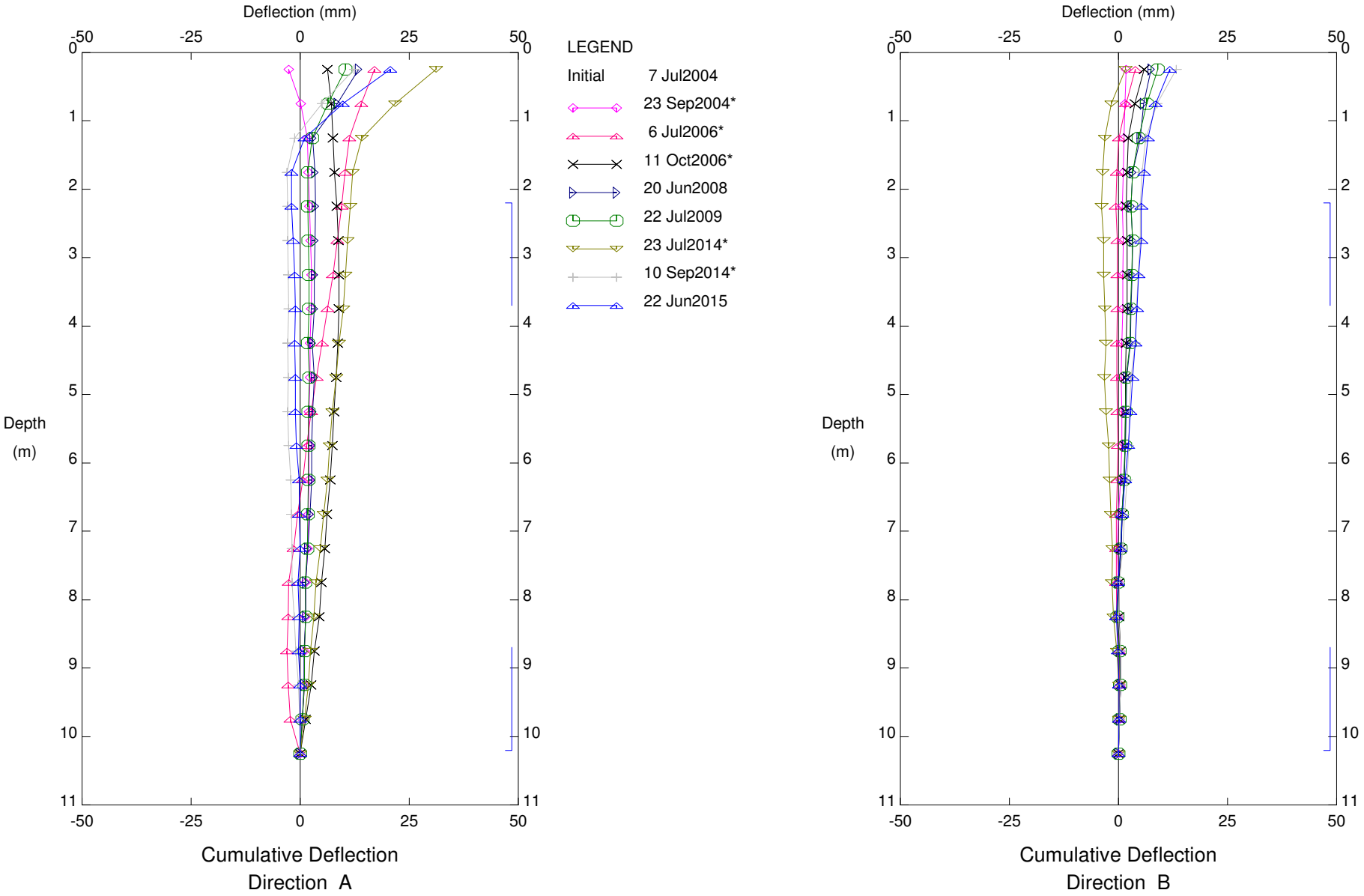
Klohn Crippen Berger Ltd. - Vancouver BC



Faro, Inclinometer BS-5

Denison Environmental Service

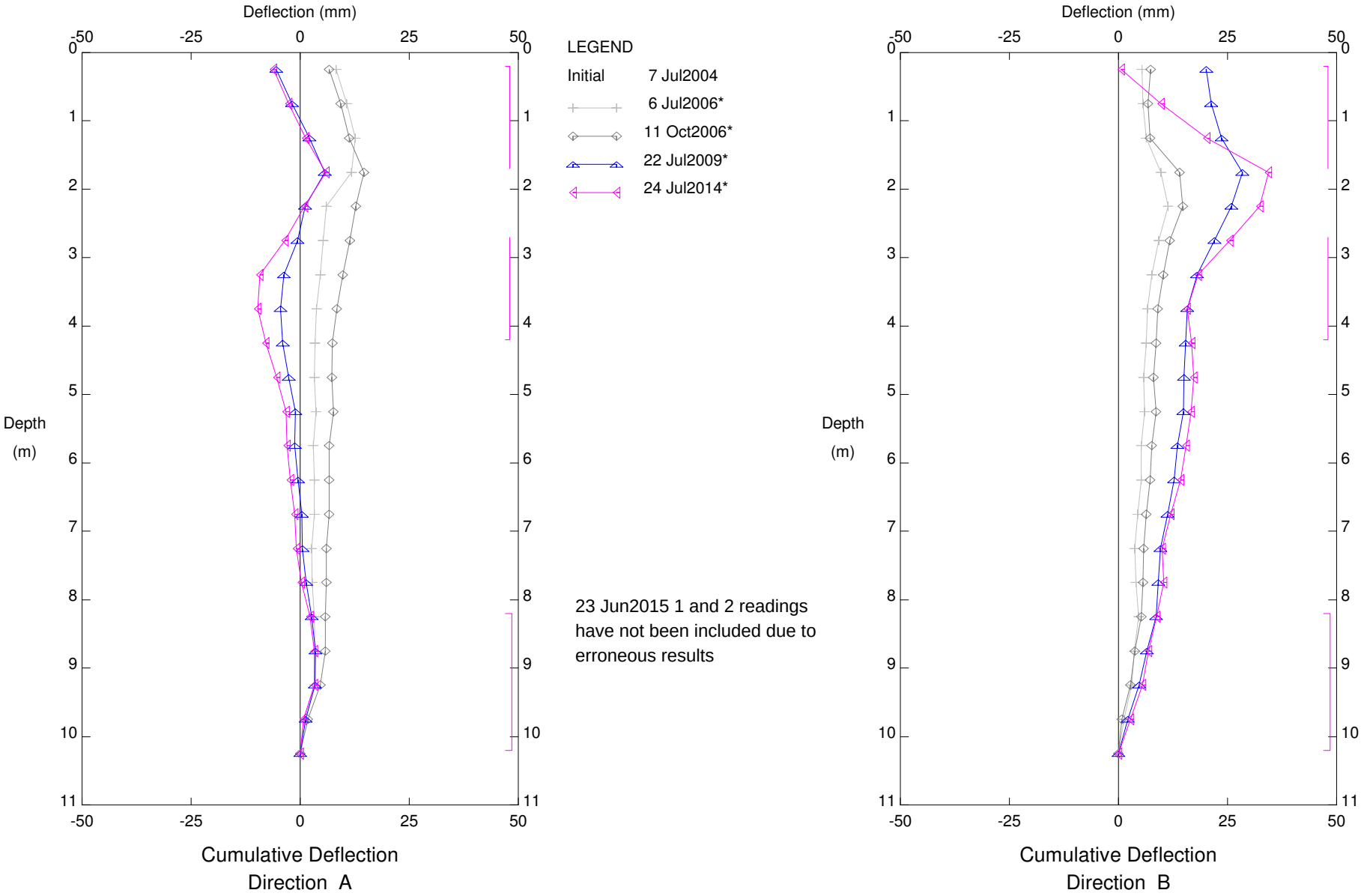
Klohn Crippen Berger Ltd. - Vancouver BC



BS-9, Inclinometer 1+530

Denison Environmental Service

Sets marked * include zero shift and/or rotation corrections.

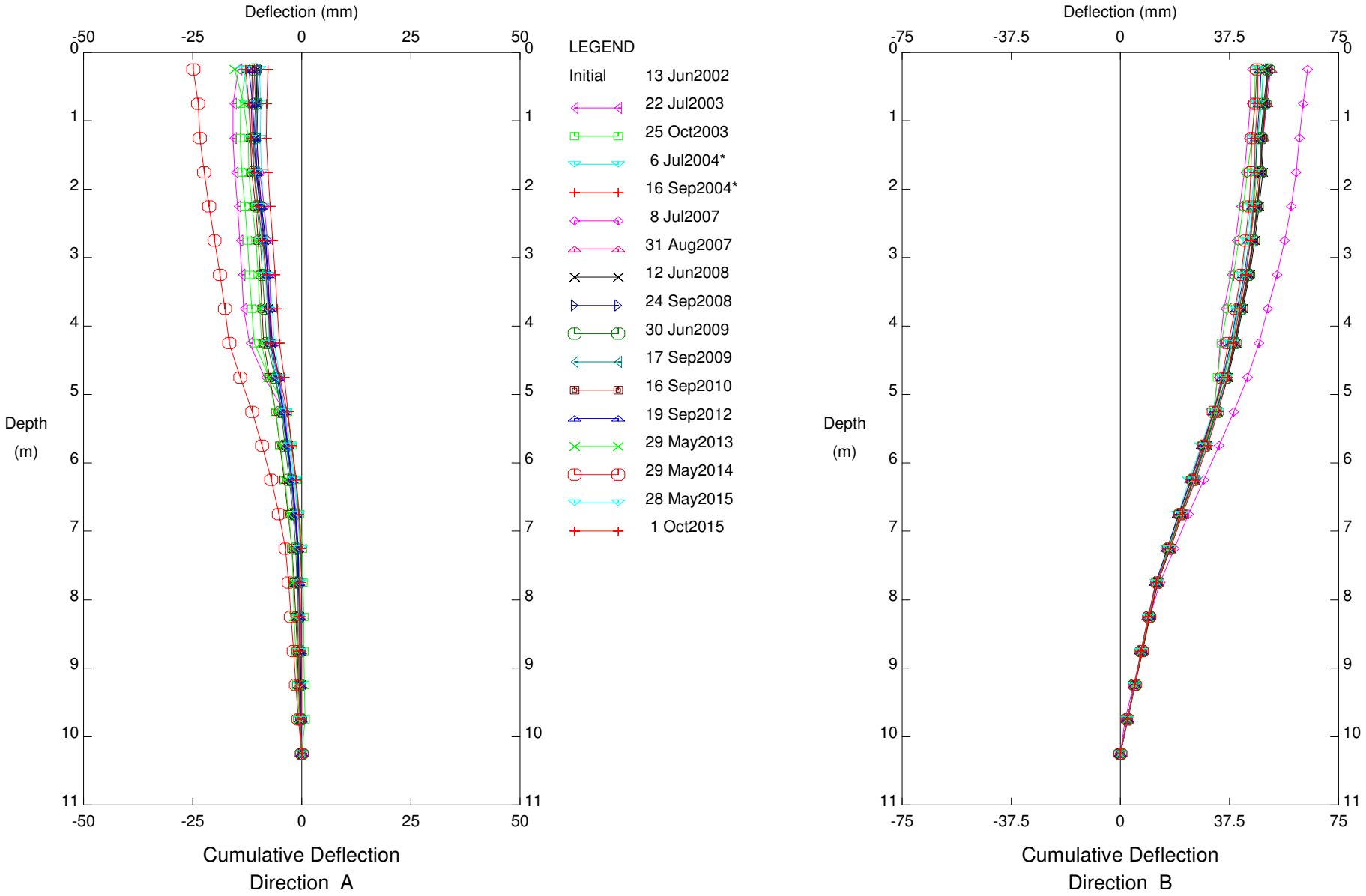


BS-10, Inclinometer 1+900

Denison Environmental Service

Sets marked * include zero shift and/or rotation corrections.

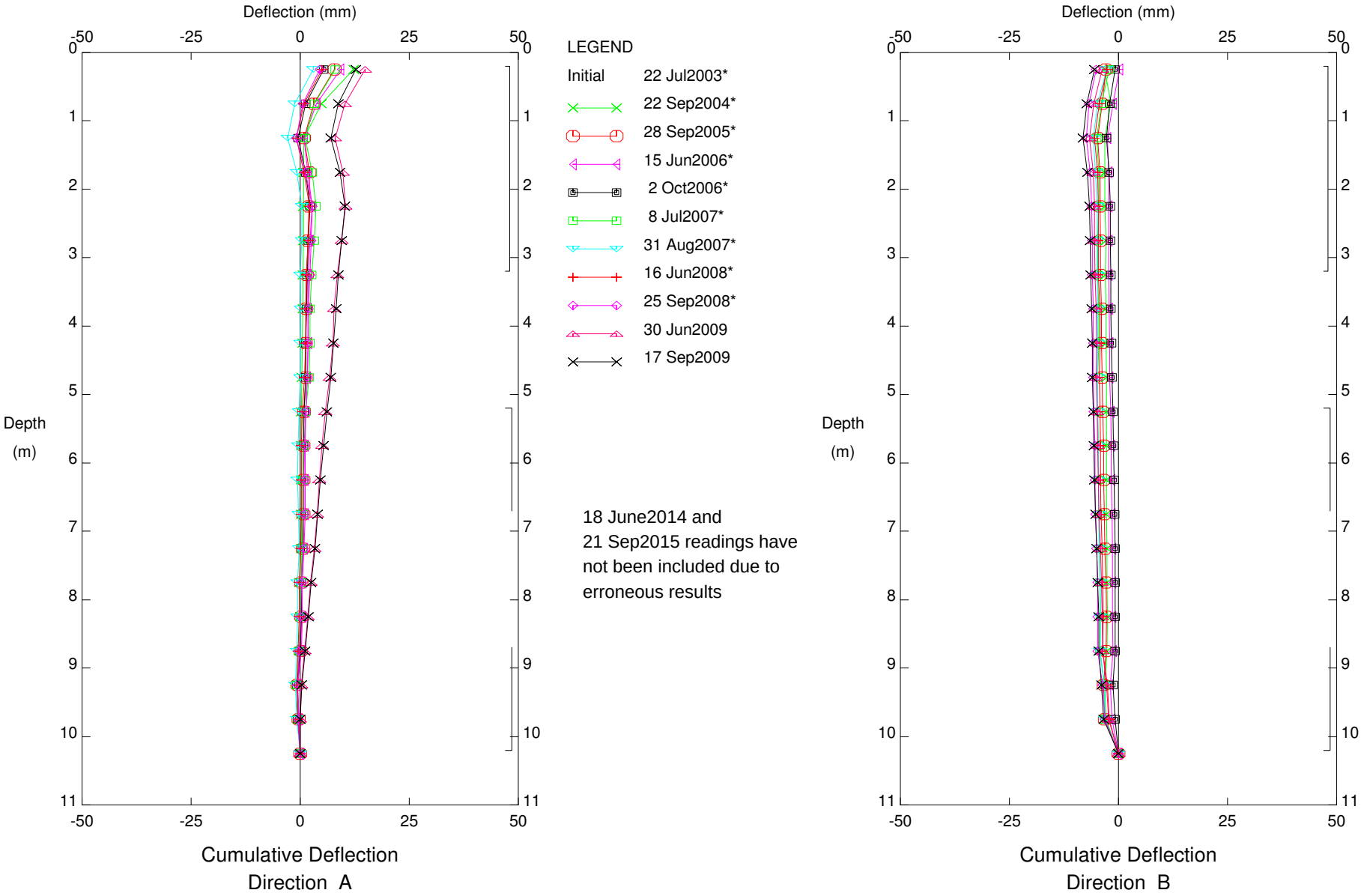
Klohn Crippen Berger Ltd. - Vancouver BC



CD-10, Inclinometer 0+990

Sets marked * include zero shift and/or rotation corrections.

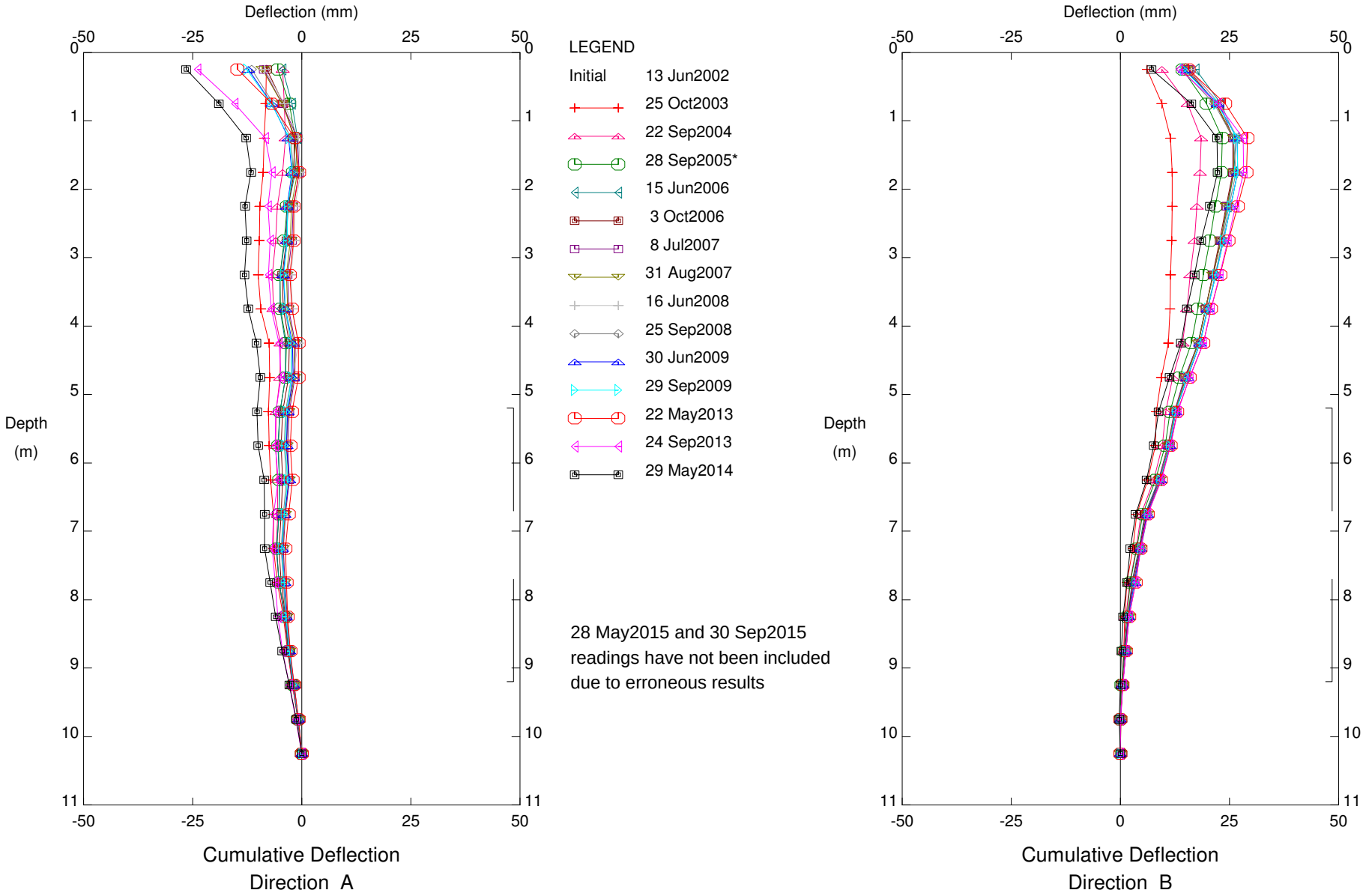
Klohn Crippen Berger Ltd. - Vancouver BC



CD-19, Inclinometer 1+900

Sets marked * include zero shift and/or rotation corrections.

Klohn Crippen Berger Ltd. - Vancouver BC



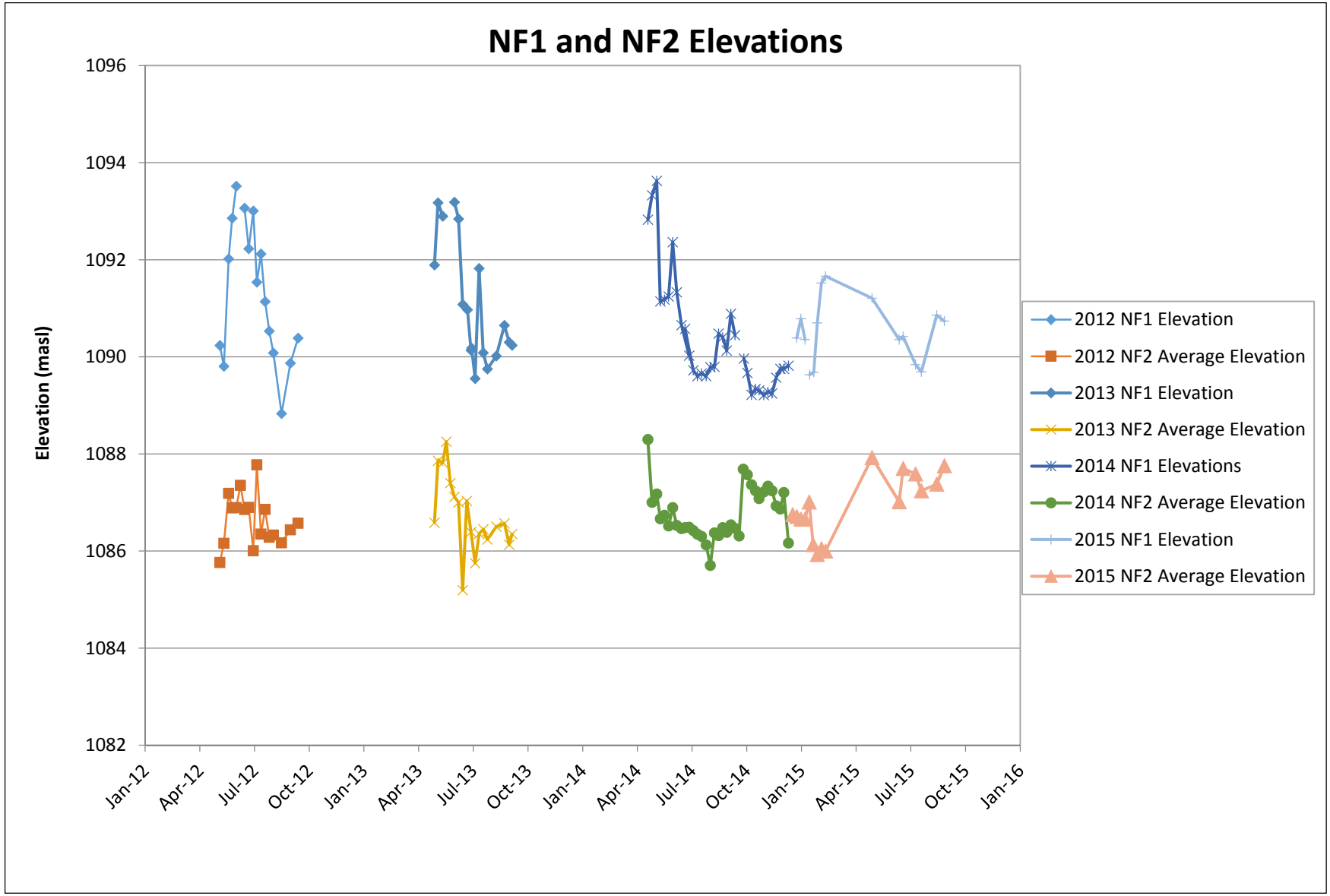
CD-21, Inclinometer 2+100

Sets marked * include zero shift and/or rotation corrections.

APPENDIX II-F

North Fork Rock Drain

F1 – U/S and D/S Water Levels

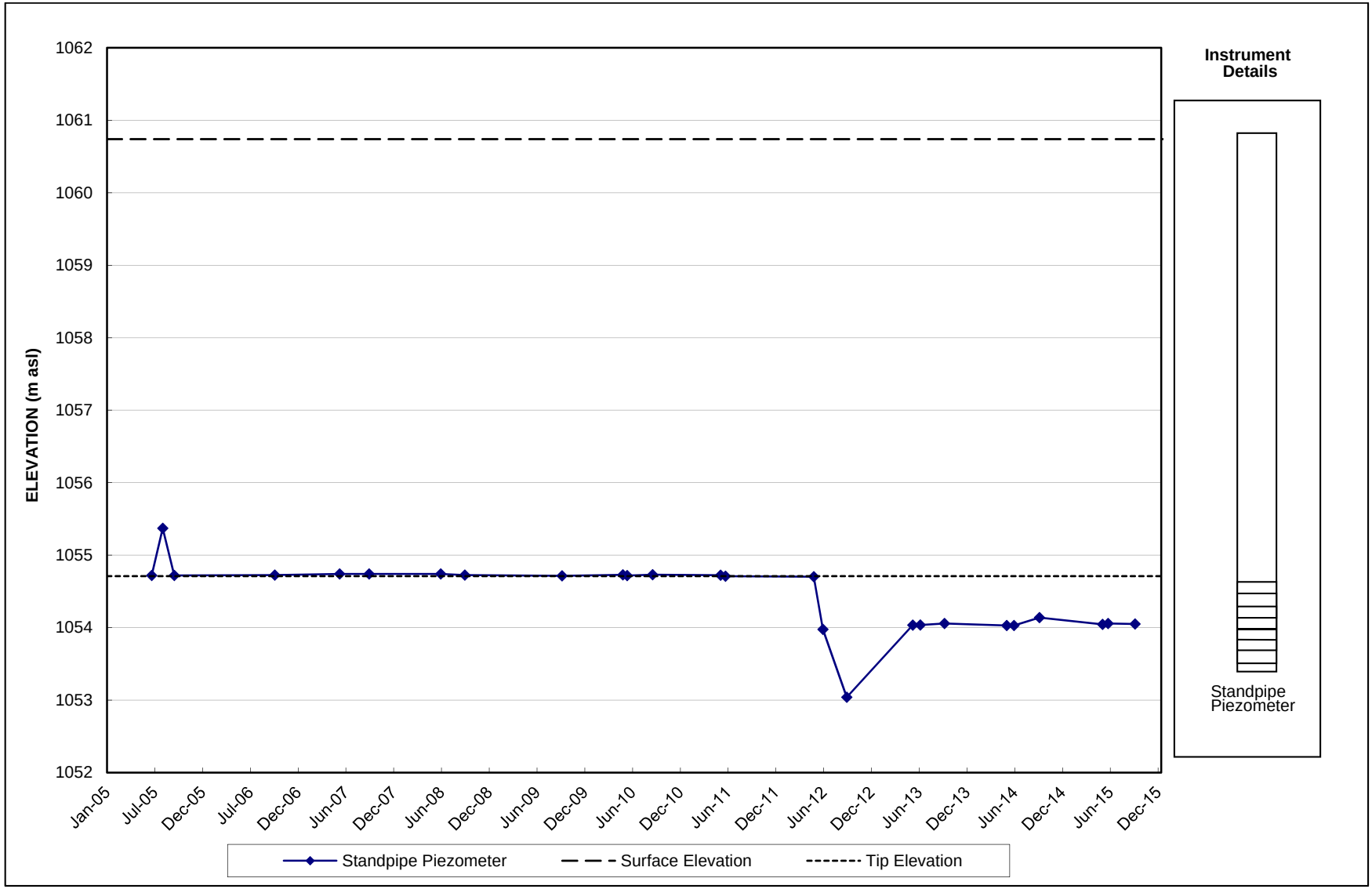

NF1 and NF2 Elevations
Elevation (masl)
1096
1094
1092
1090
1088
1086
1084
1082
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
2012 NF1 Elevation
2012 NF2 Average Elevation
2013 NF1 Elevation
2013 NF2 Average Elevation
2014 NF1 Elevations
2014 NF2 Average Elevation
2015 NF1 Elevation
2015 NF2 Average Elevation

APPENDIX II-G

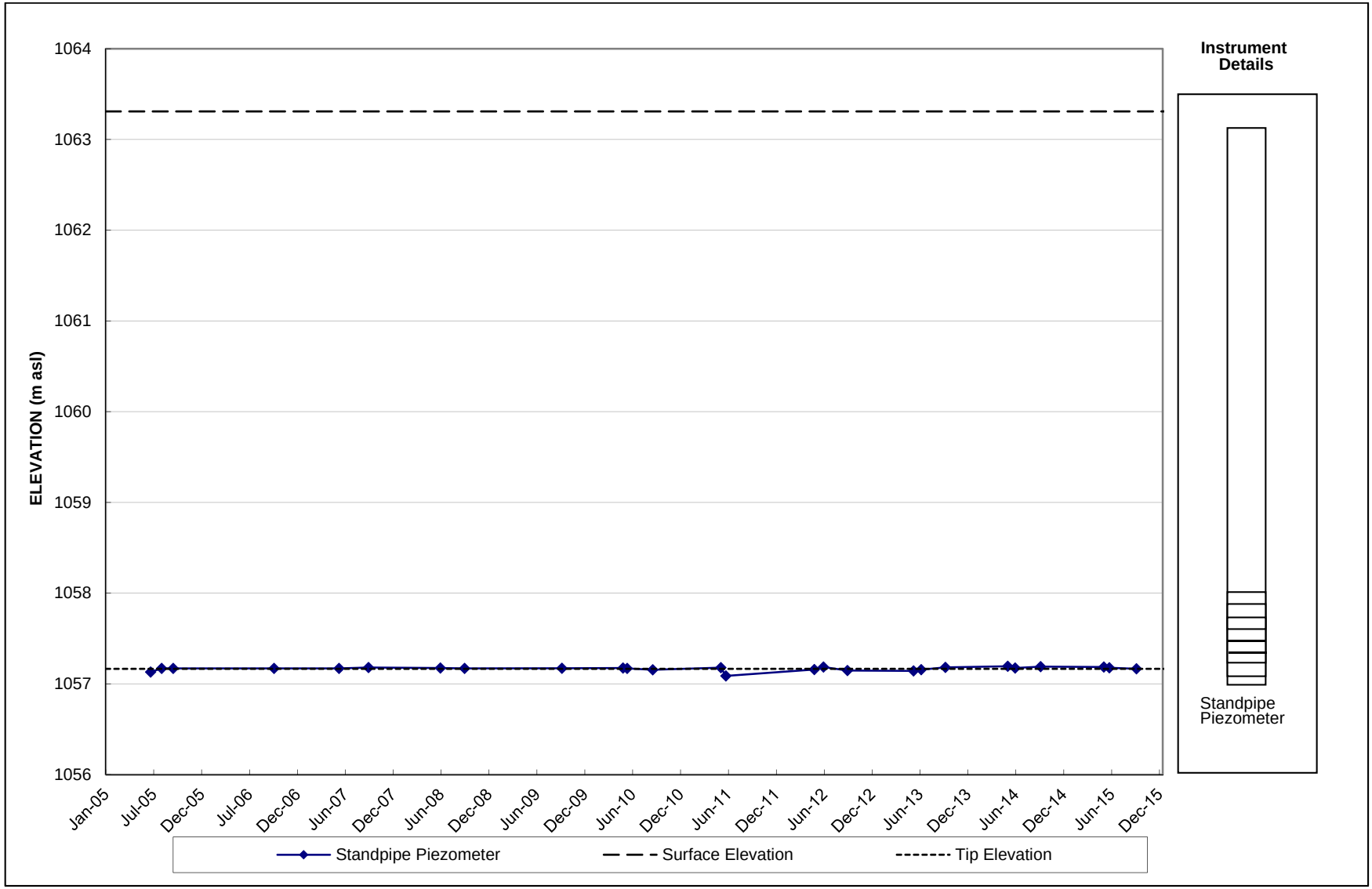
Secondary Tailings Impoundment

G1 – Piezometers

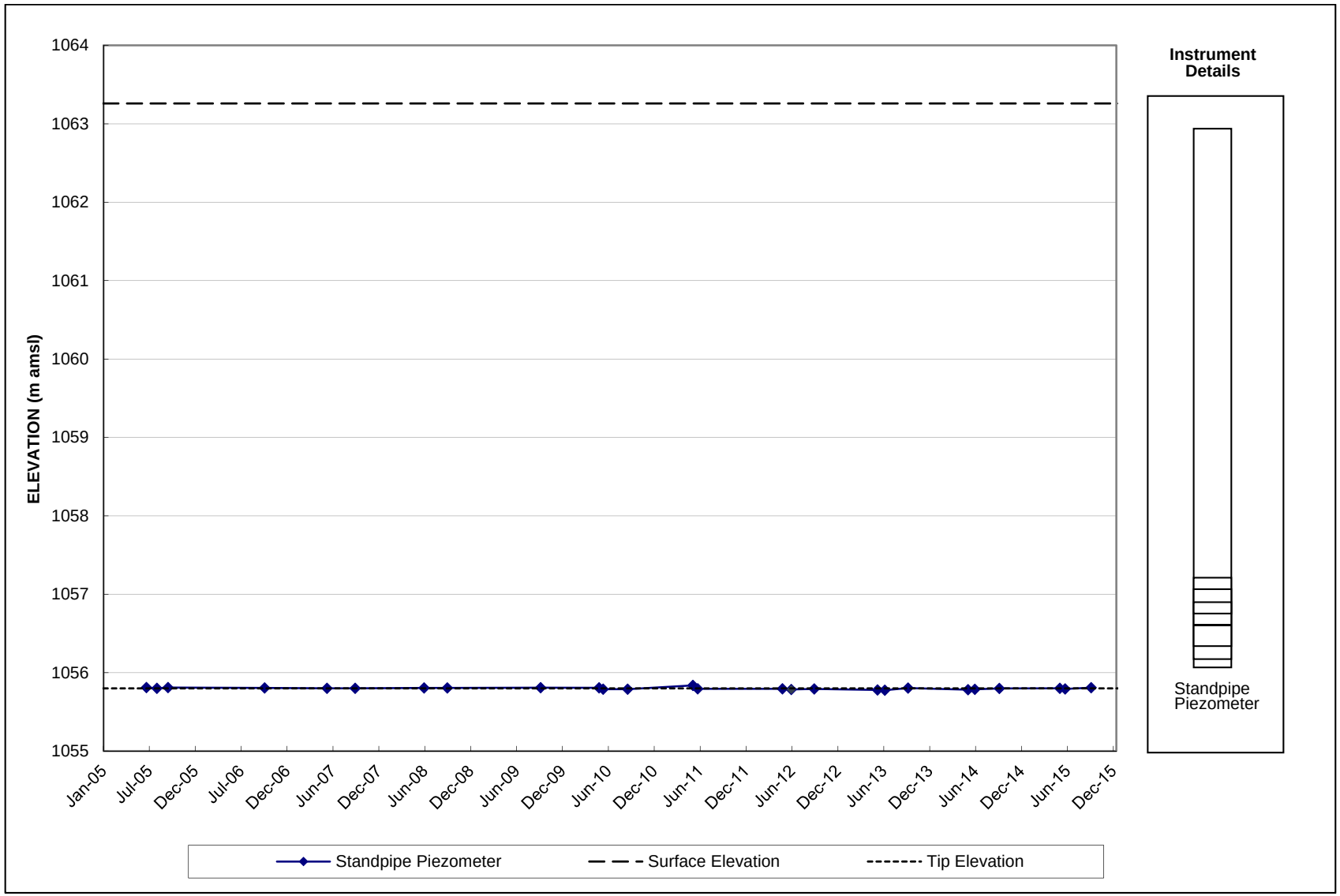
Secondary Tailings Dam
Piezometer P81-06



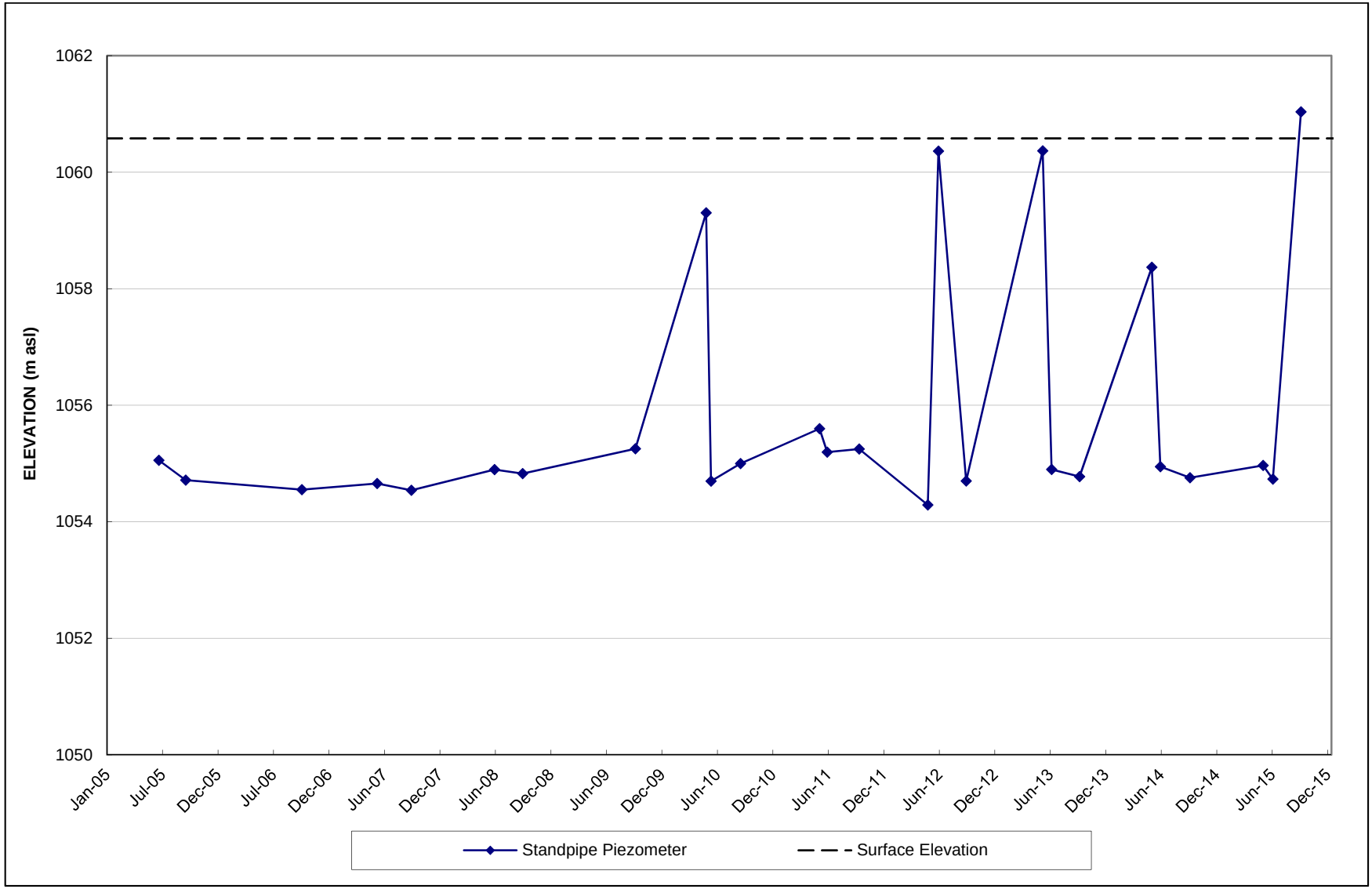
Secondary Tailings Dam
Piezometer P81-07



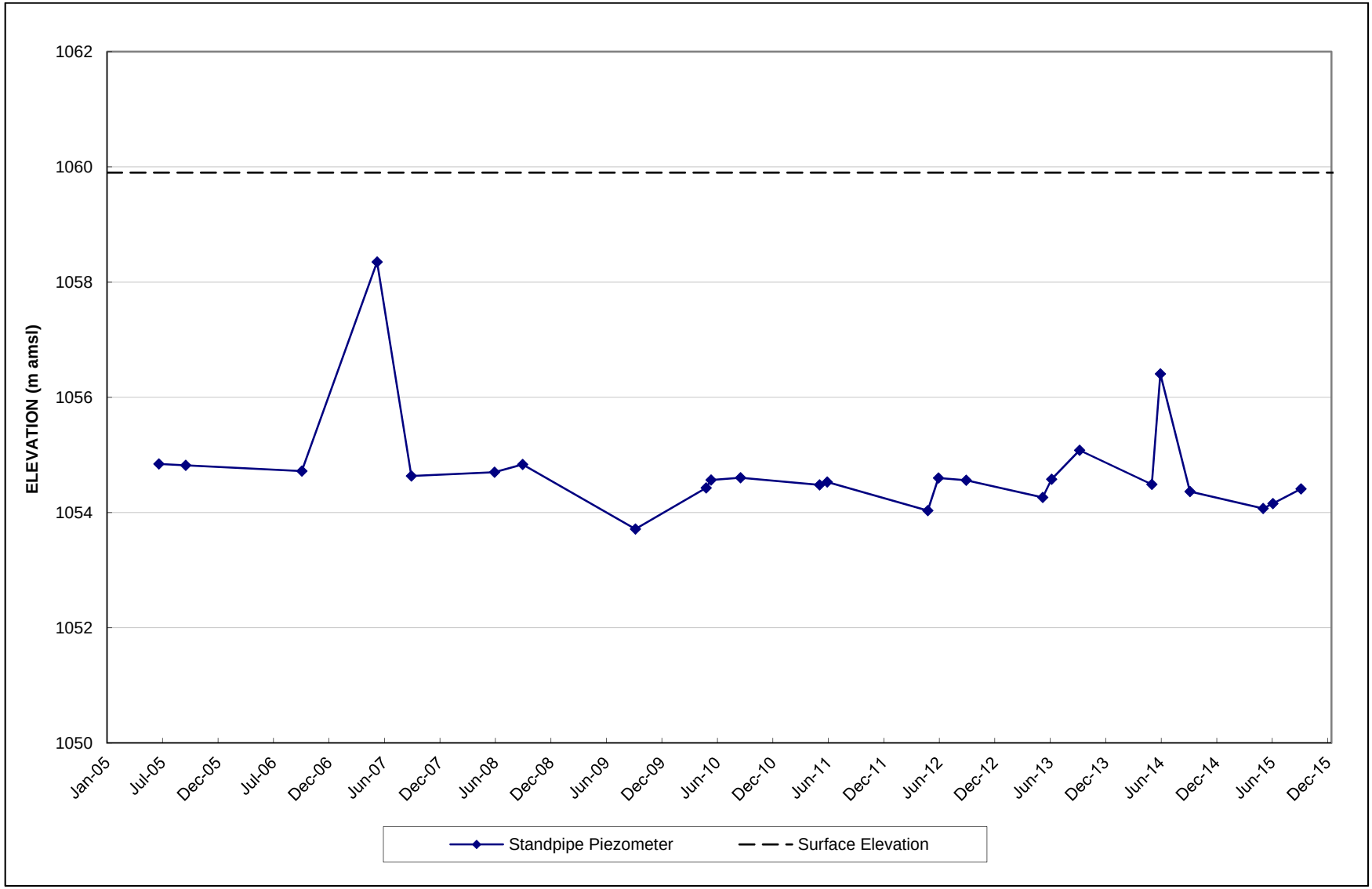
Secondary Tailings Dam
Piezometer P81-08



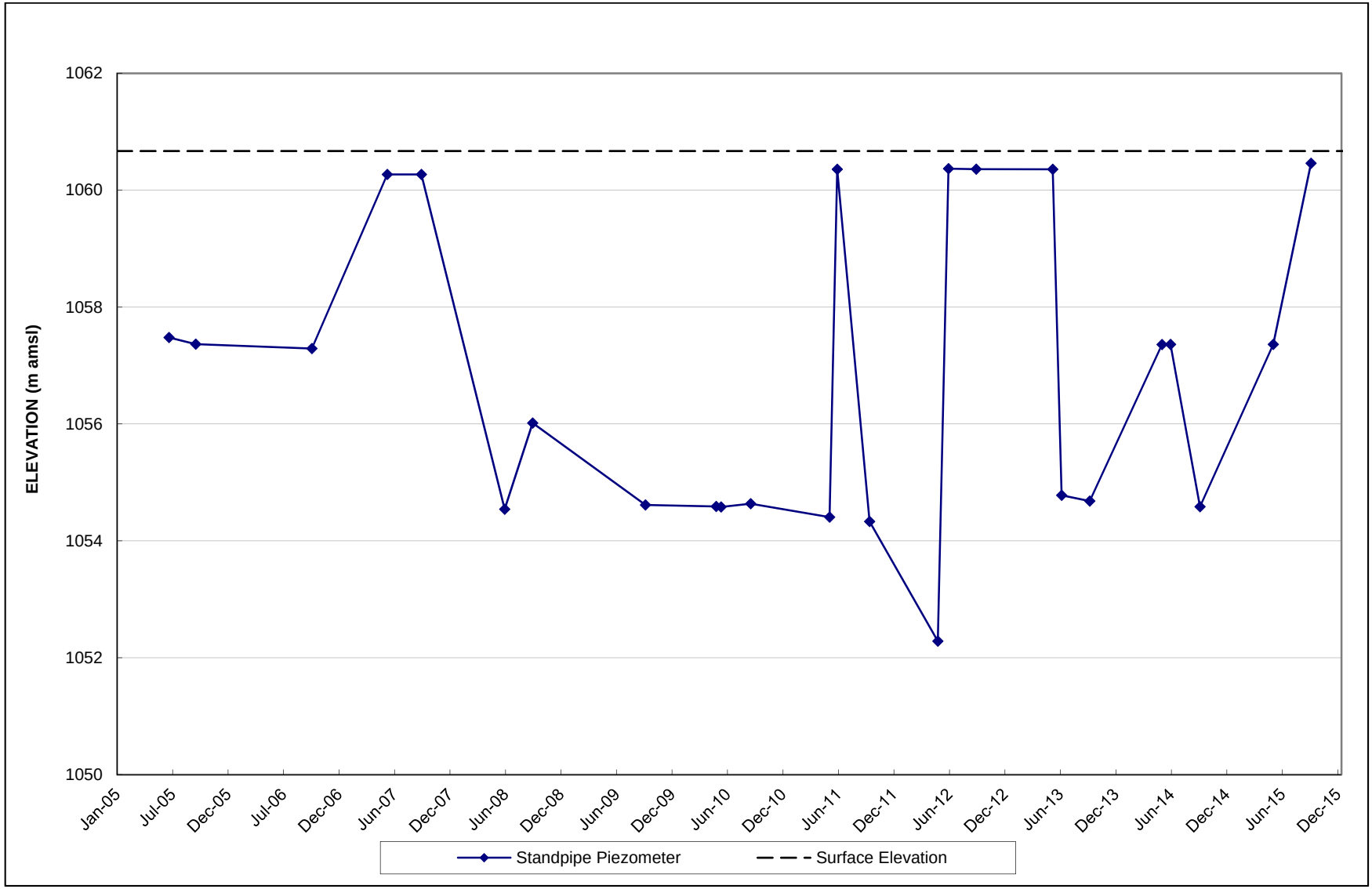
Secondary Tailings Dam
Piezometer P03-01



Secondary Tailings Dam
Piezometer P03-02



Secondary Tailings Dam
Piezometer P03-03

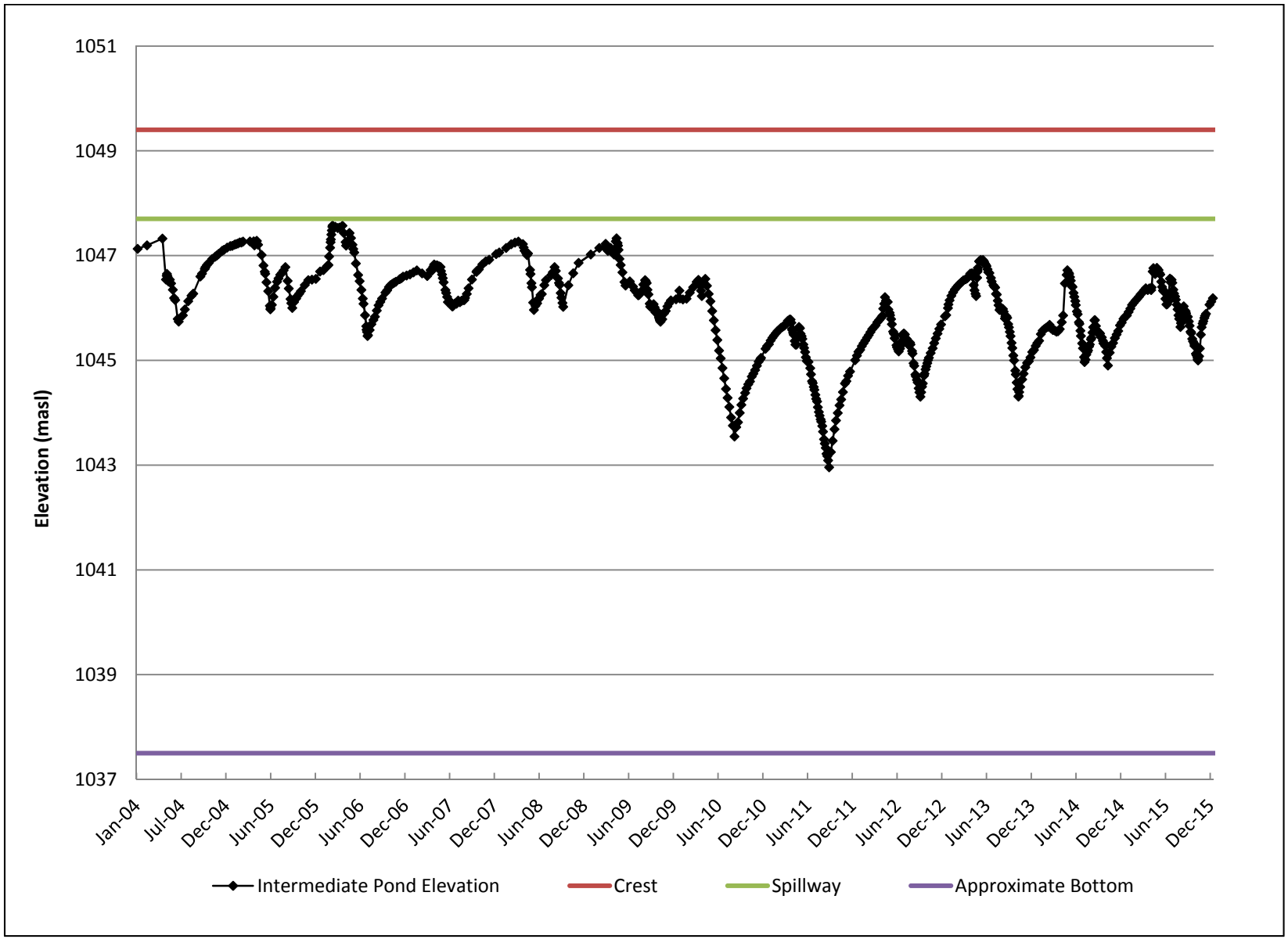


APPENDIX II-H

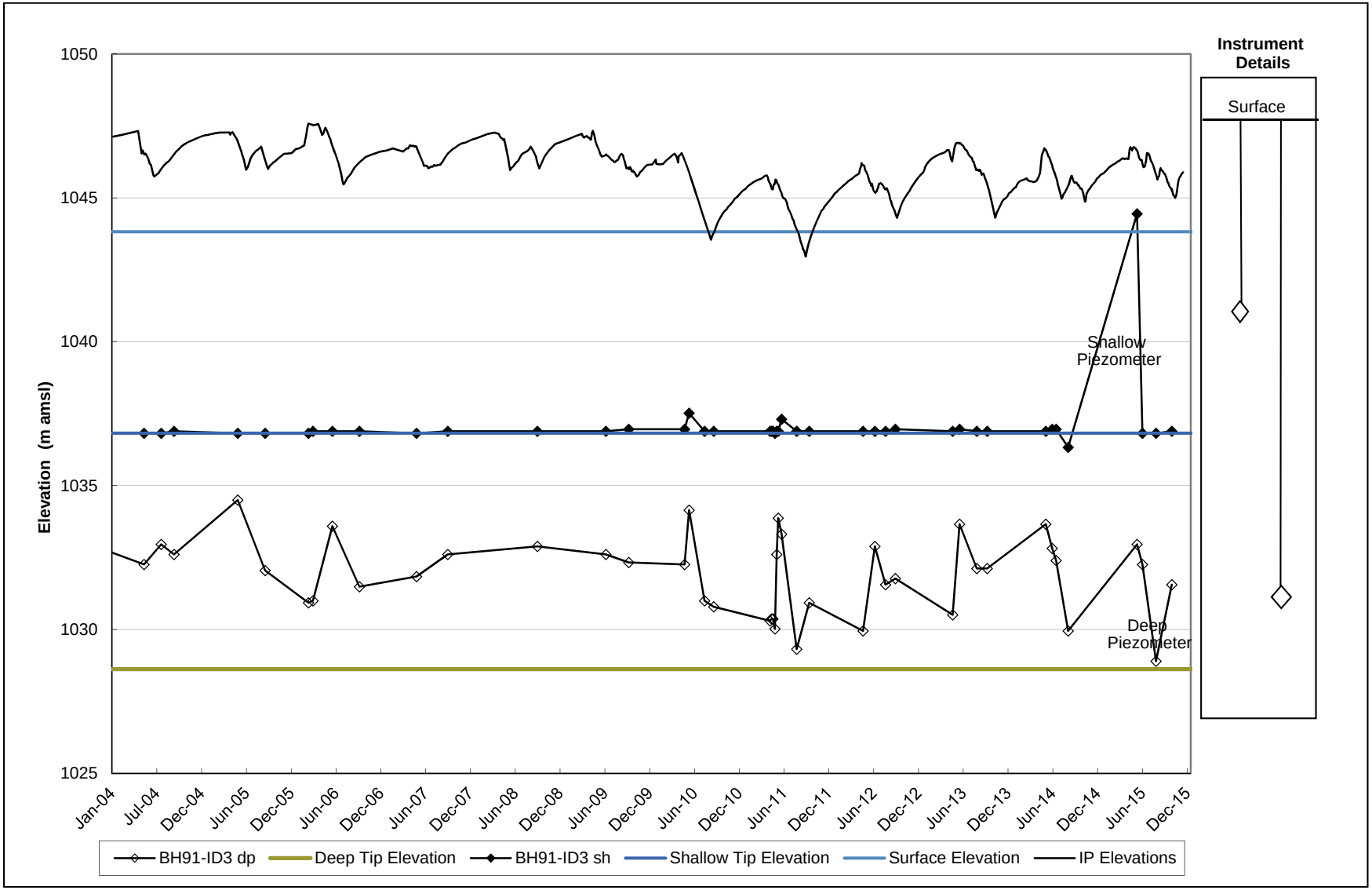
Intermediate Dam

H1 – Pond Level (Intermediate Pond)
H2 – Piezometers

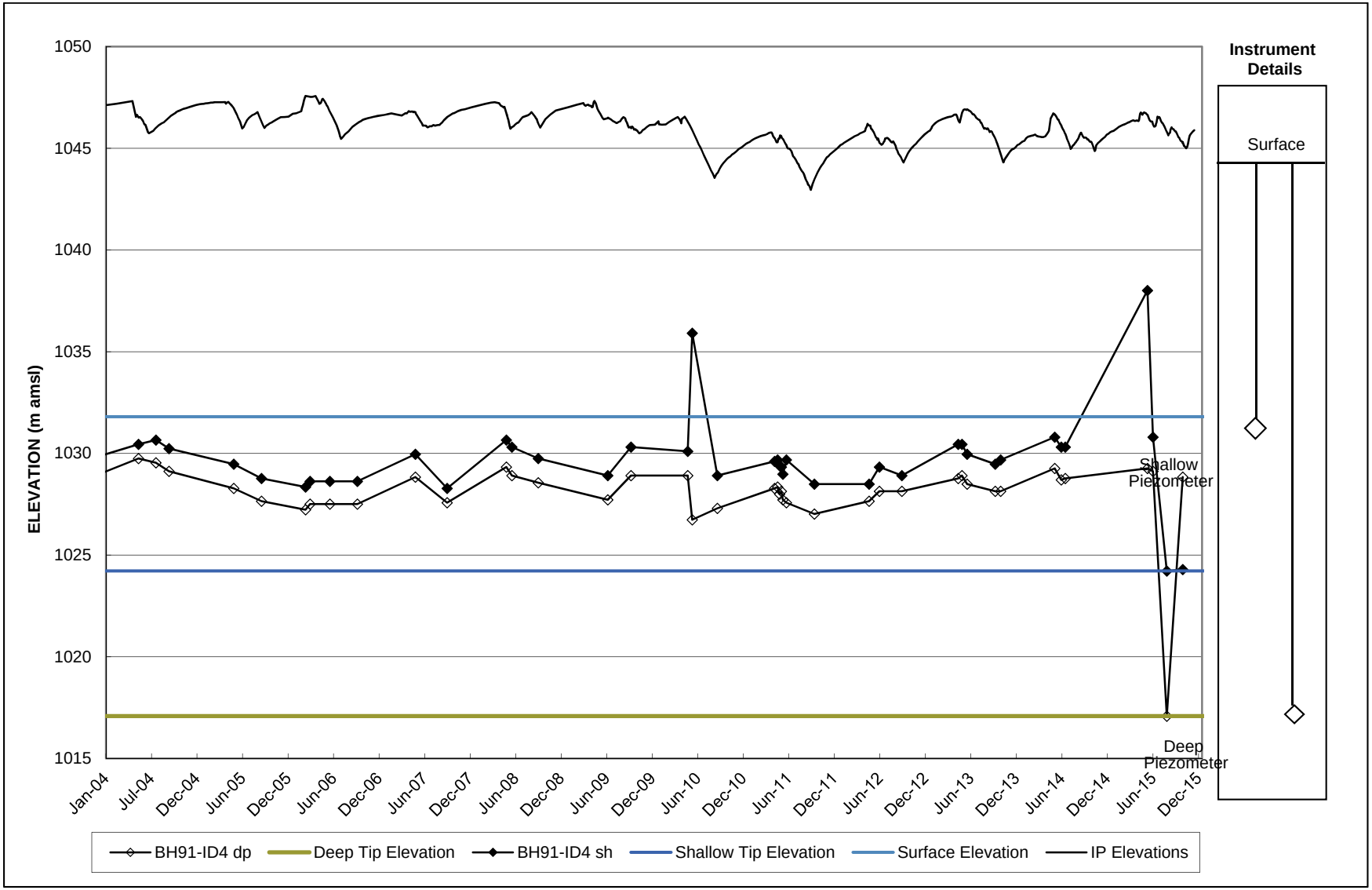
Intermediate Pond Water Level



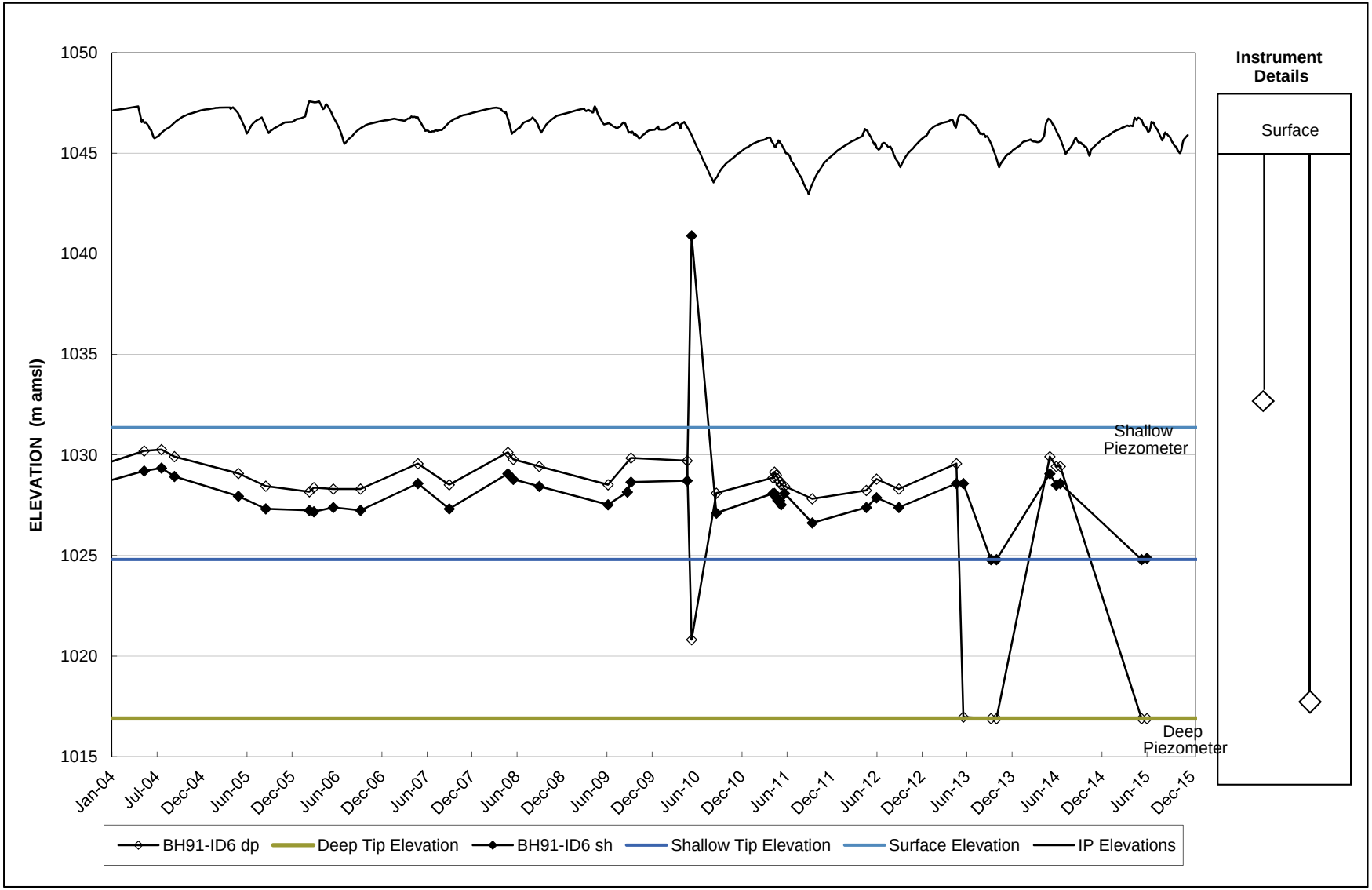
Intermediate Dam
Piezometer BH91-ID3



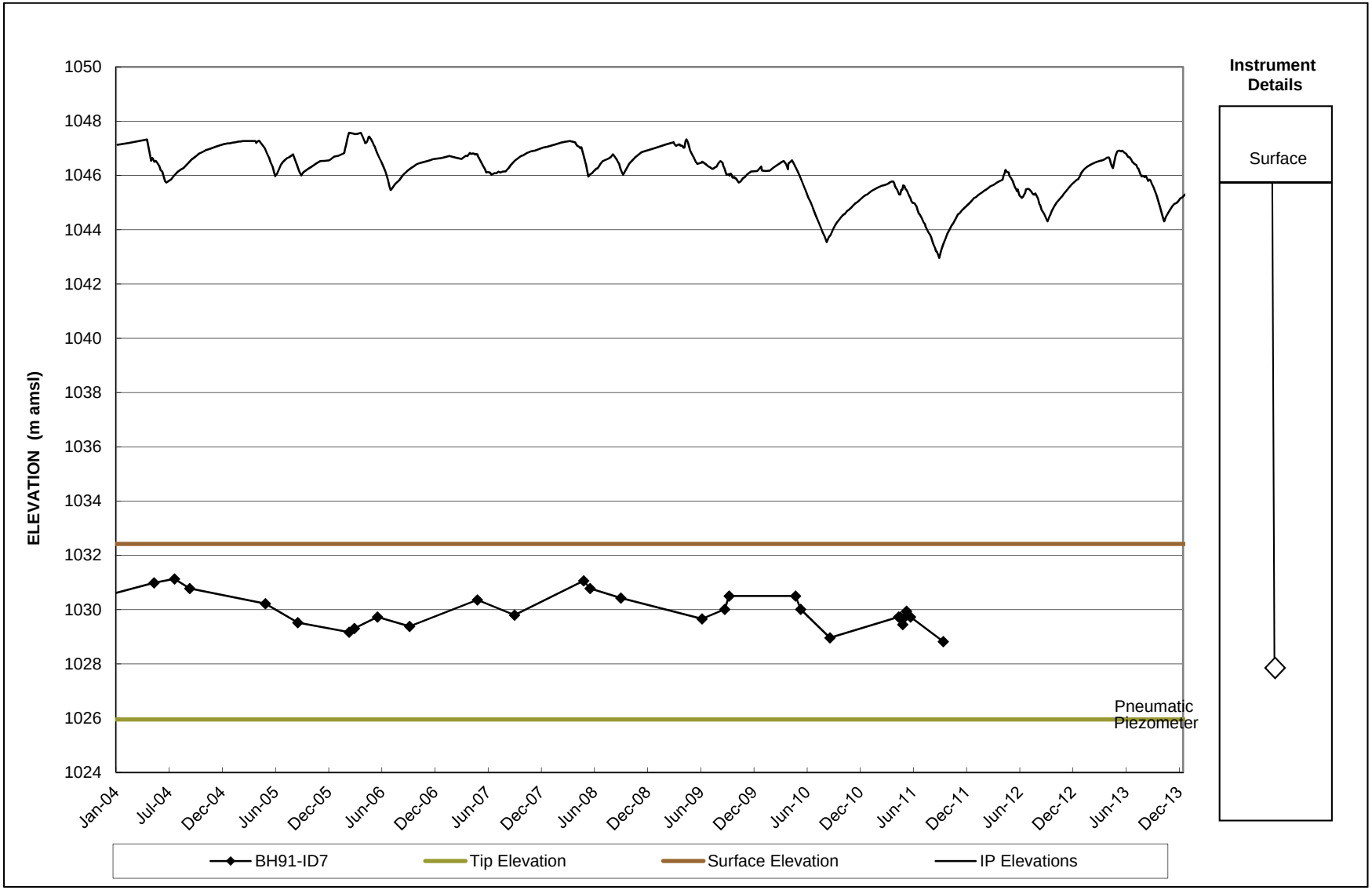
Intermediate Dam
Piezometer BH91-ID4



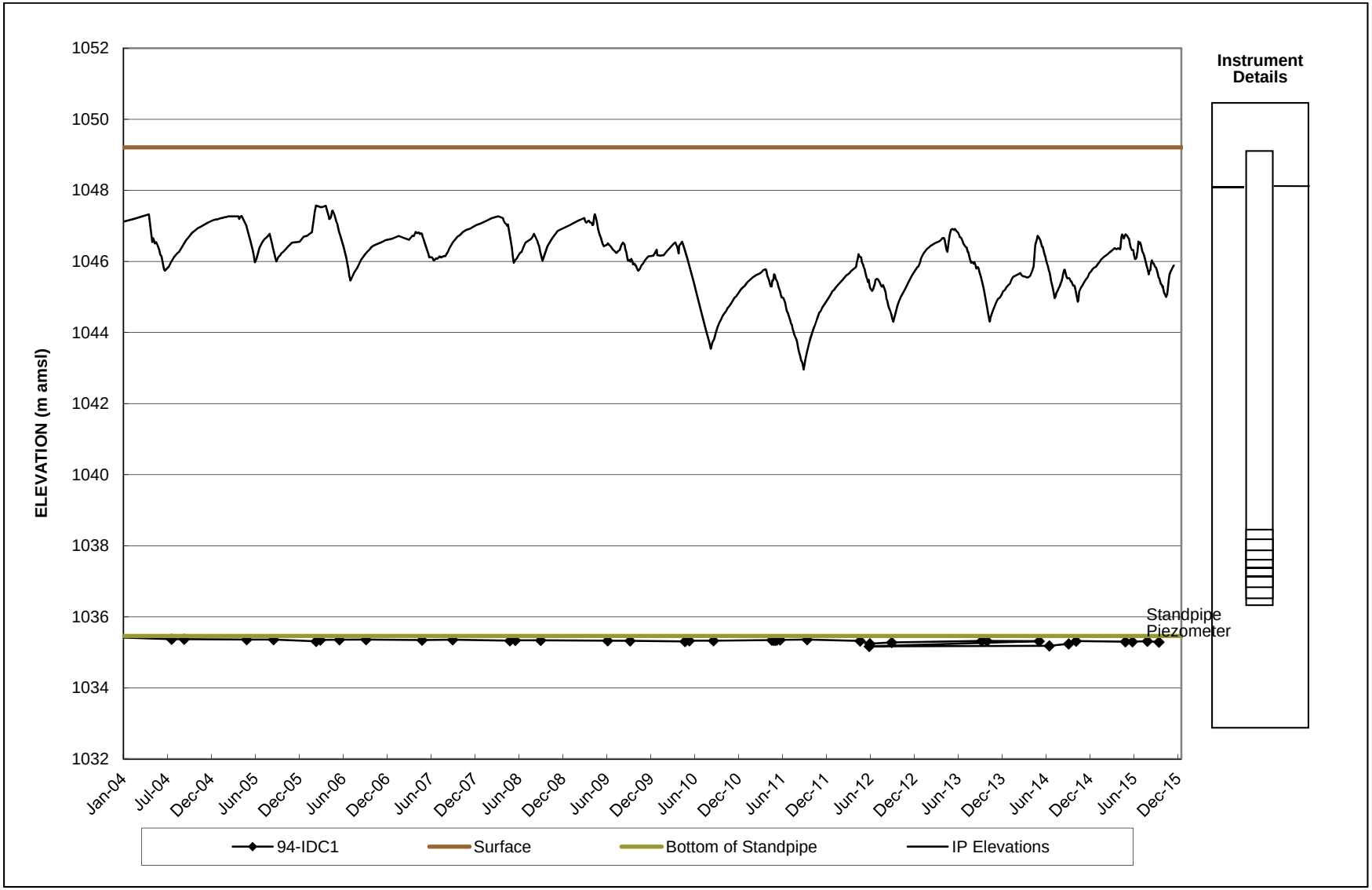
Intermediate Dam
Piezometer BH91-ID6



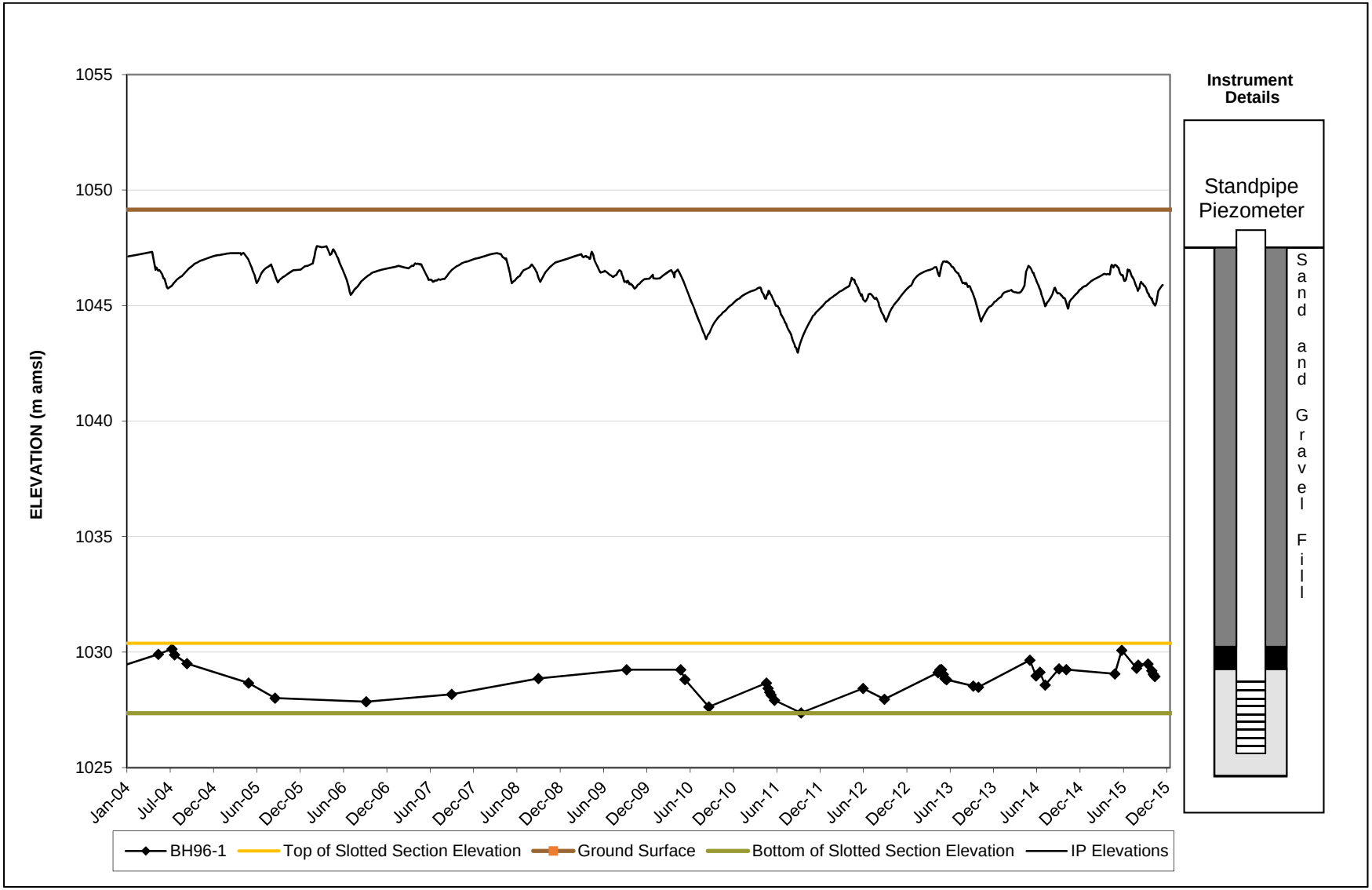
Intermediate Dam
Piezometer BH91-ID7



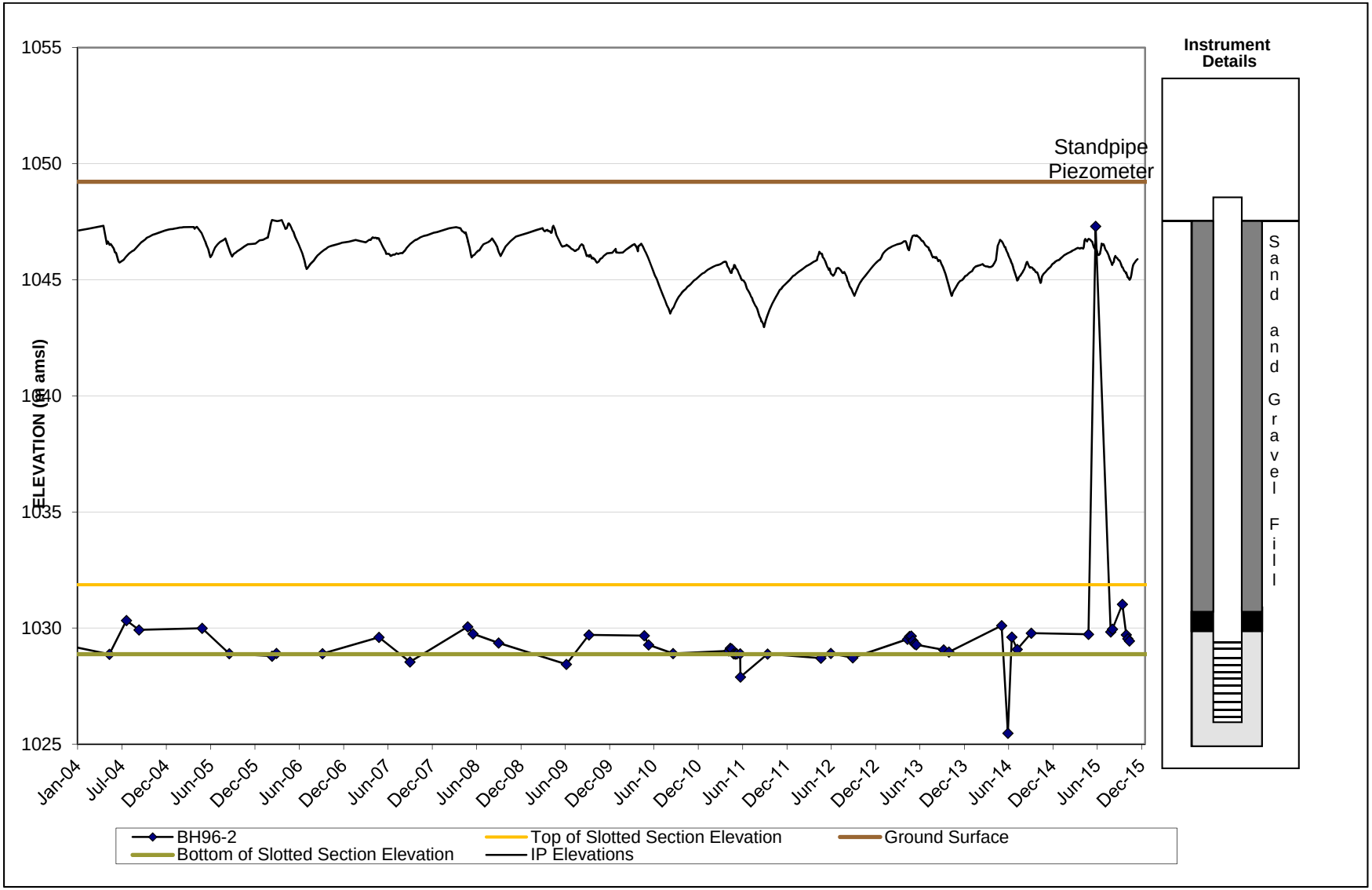
Intermediate Dam
Piezometer BH94-IDC-1



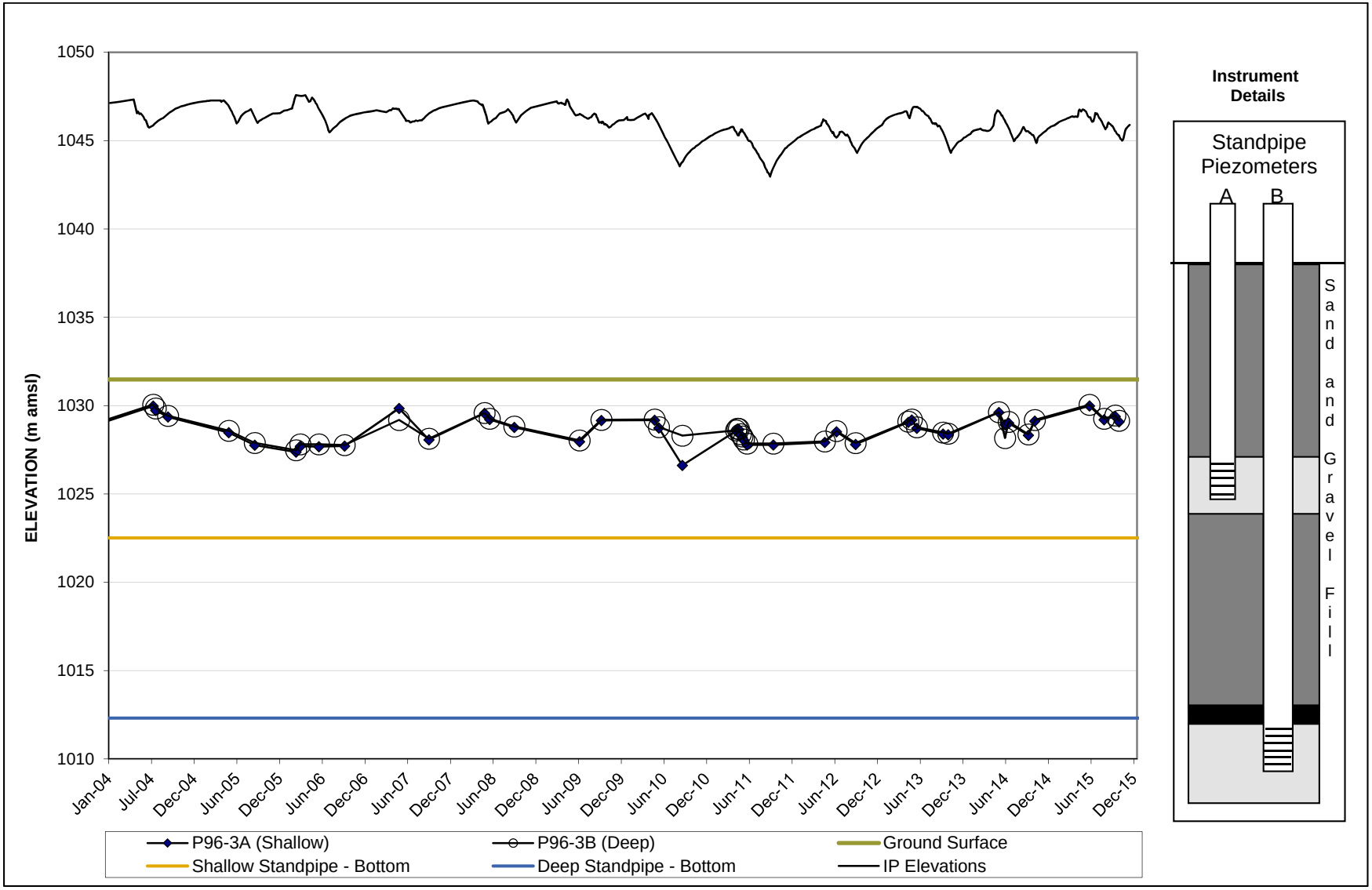
Intermediate Dam
Piezometer 96-1



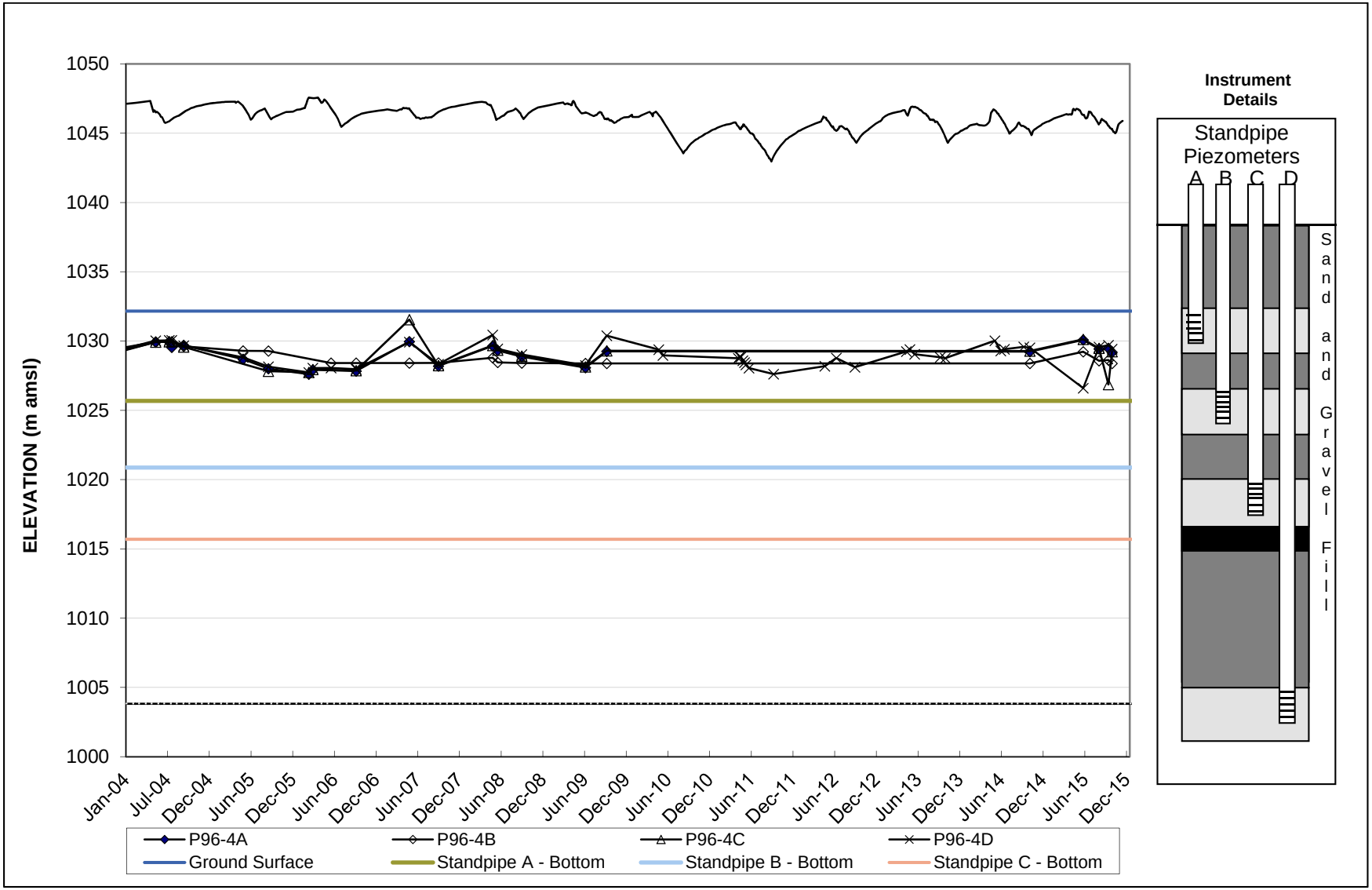
Intermediate Dam
Piezometer 96-2



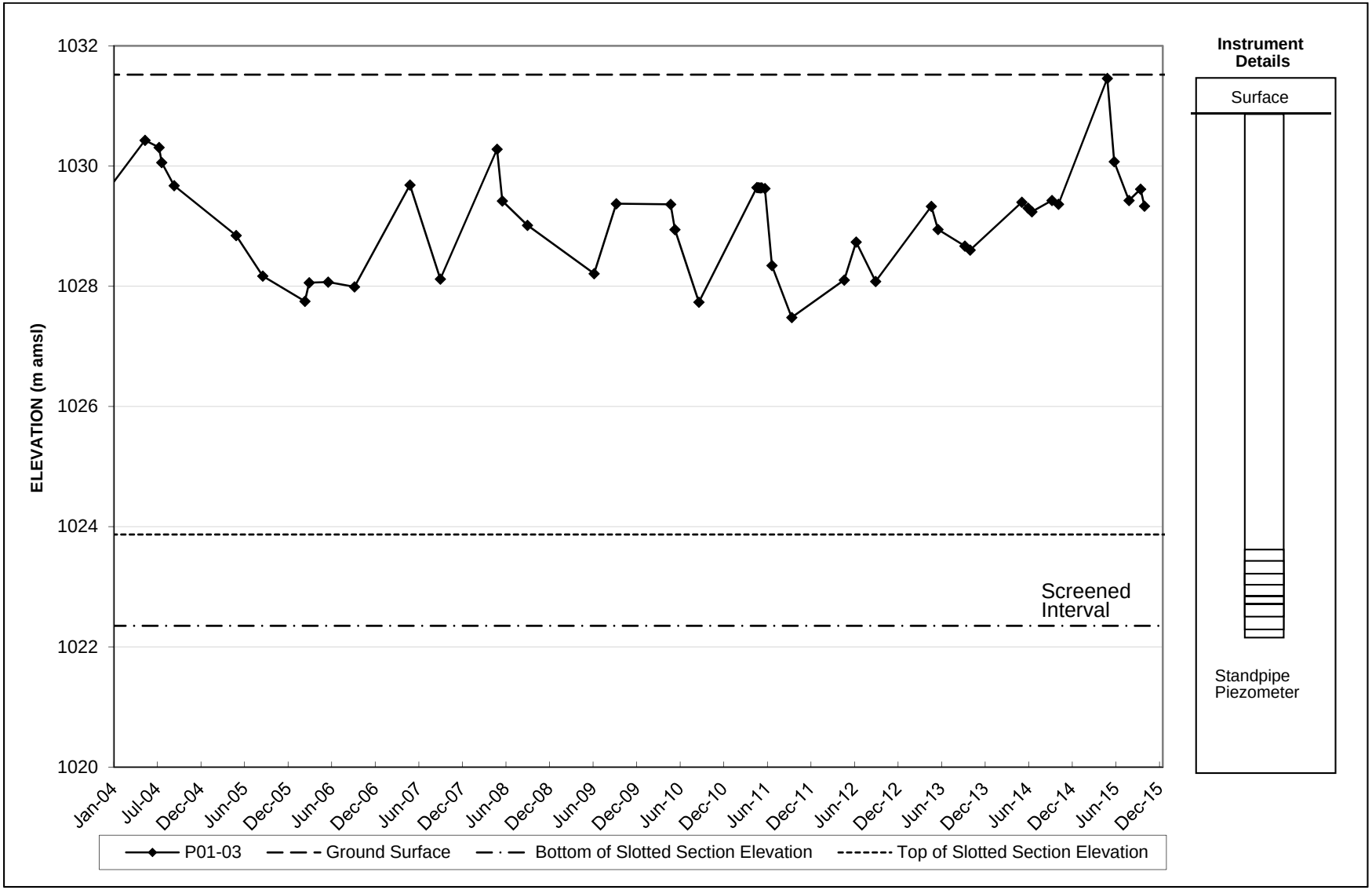
Intermediate Dam
Piezometer 96-3



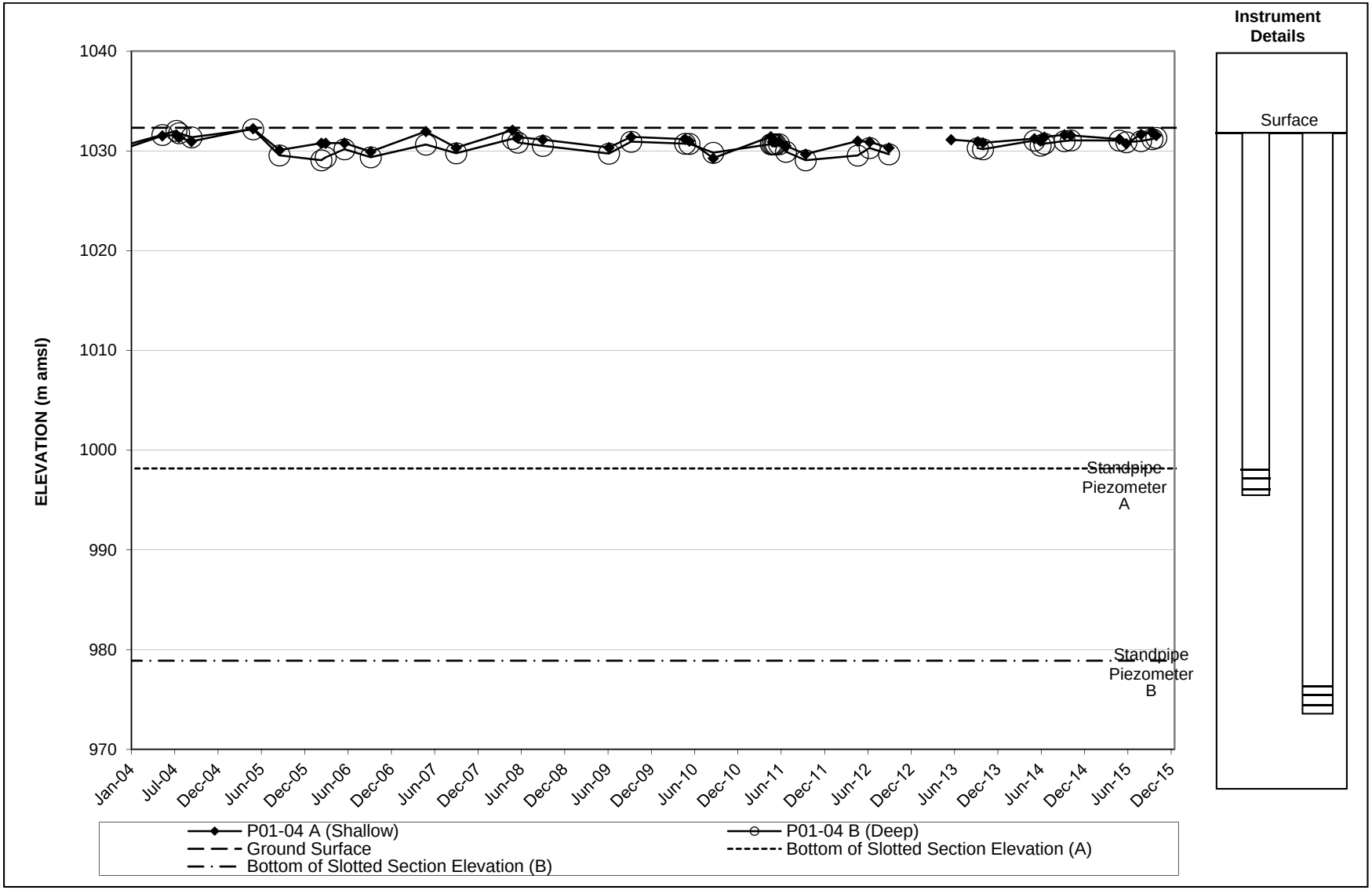
Intermediate Dam
Piezometer 96-4



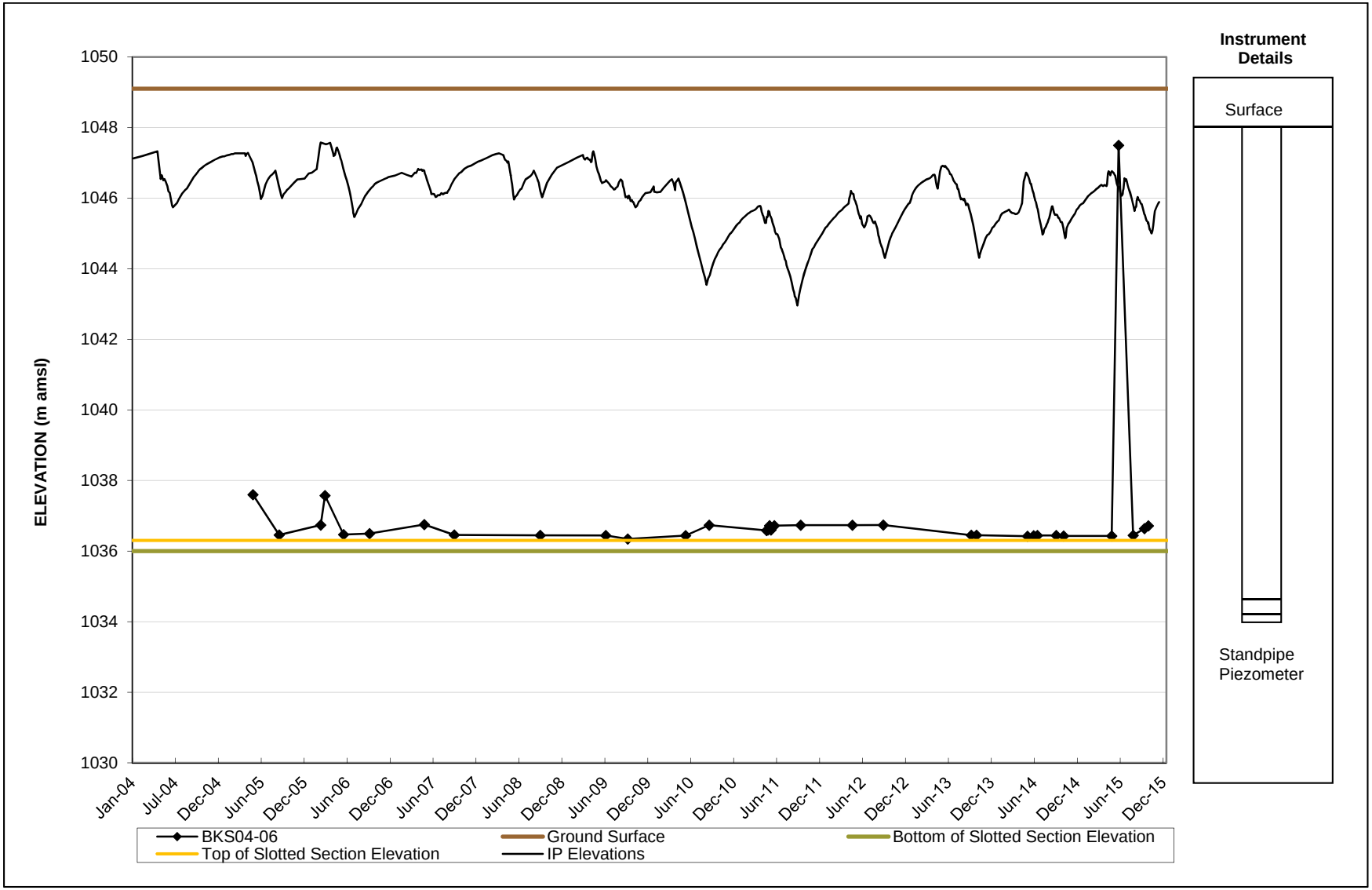
Intermediate Dam
Piezometer P01-03



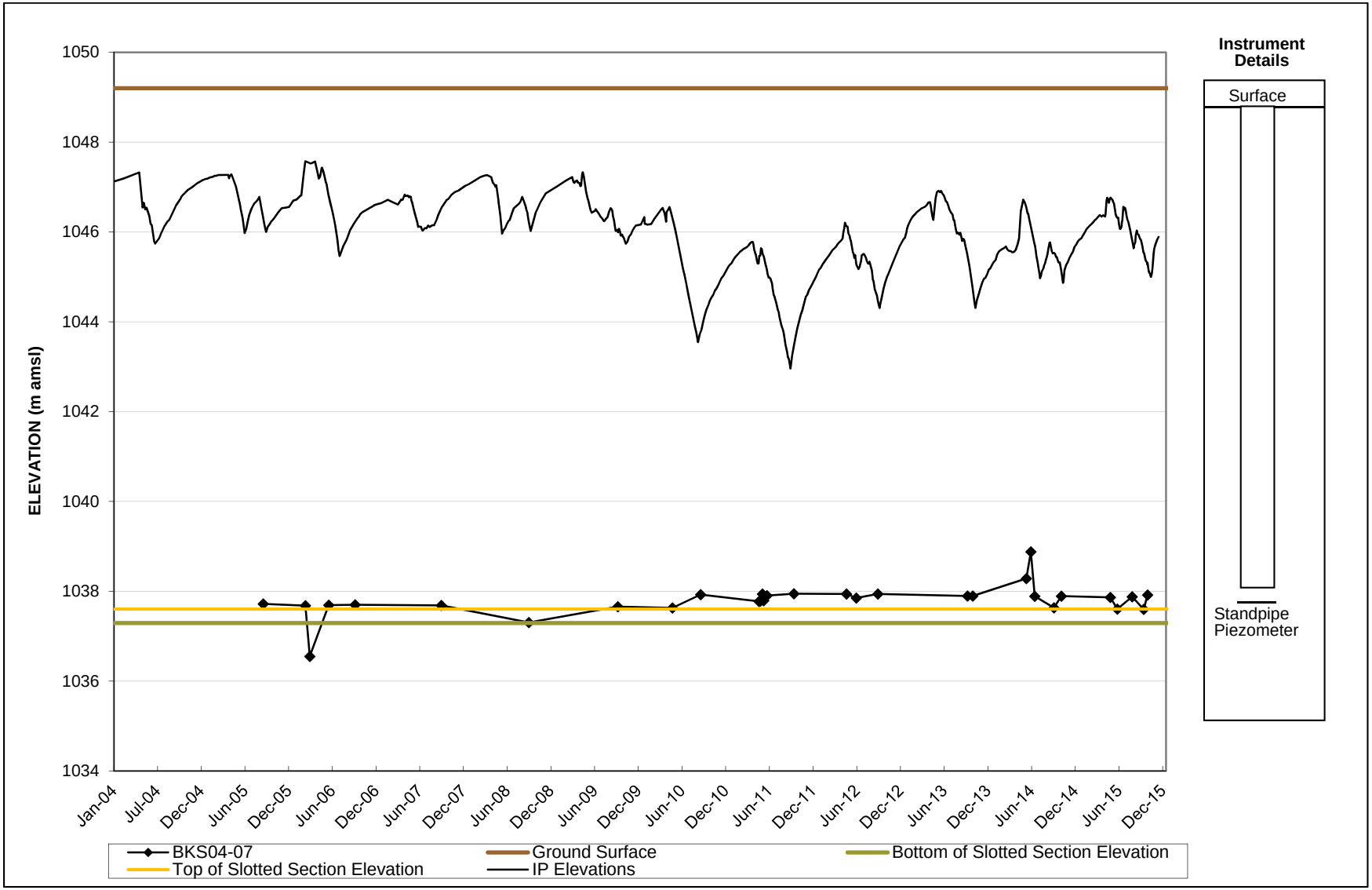
Intermediate Dam
Piezometer P01-04



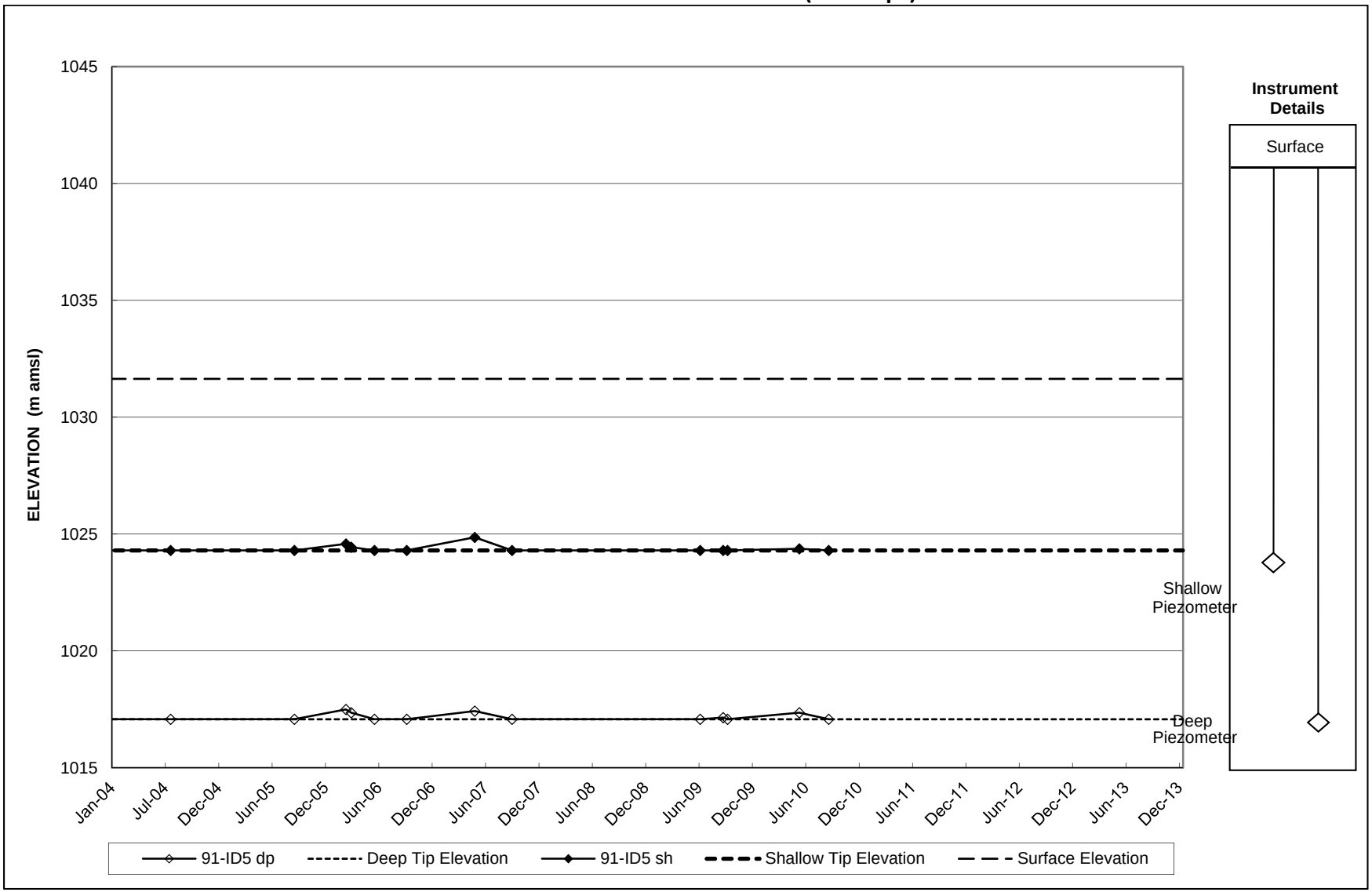
Intermediate Dam
Piezometer BSK04-06



Intermediate Dam
Piezometer BSK04-07



Piezometric Monitoring
BH91-ID5 Pneumatic Piezometer (Both Tips)

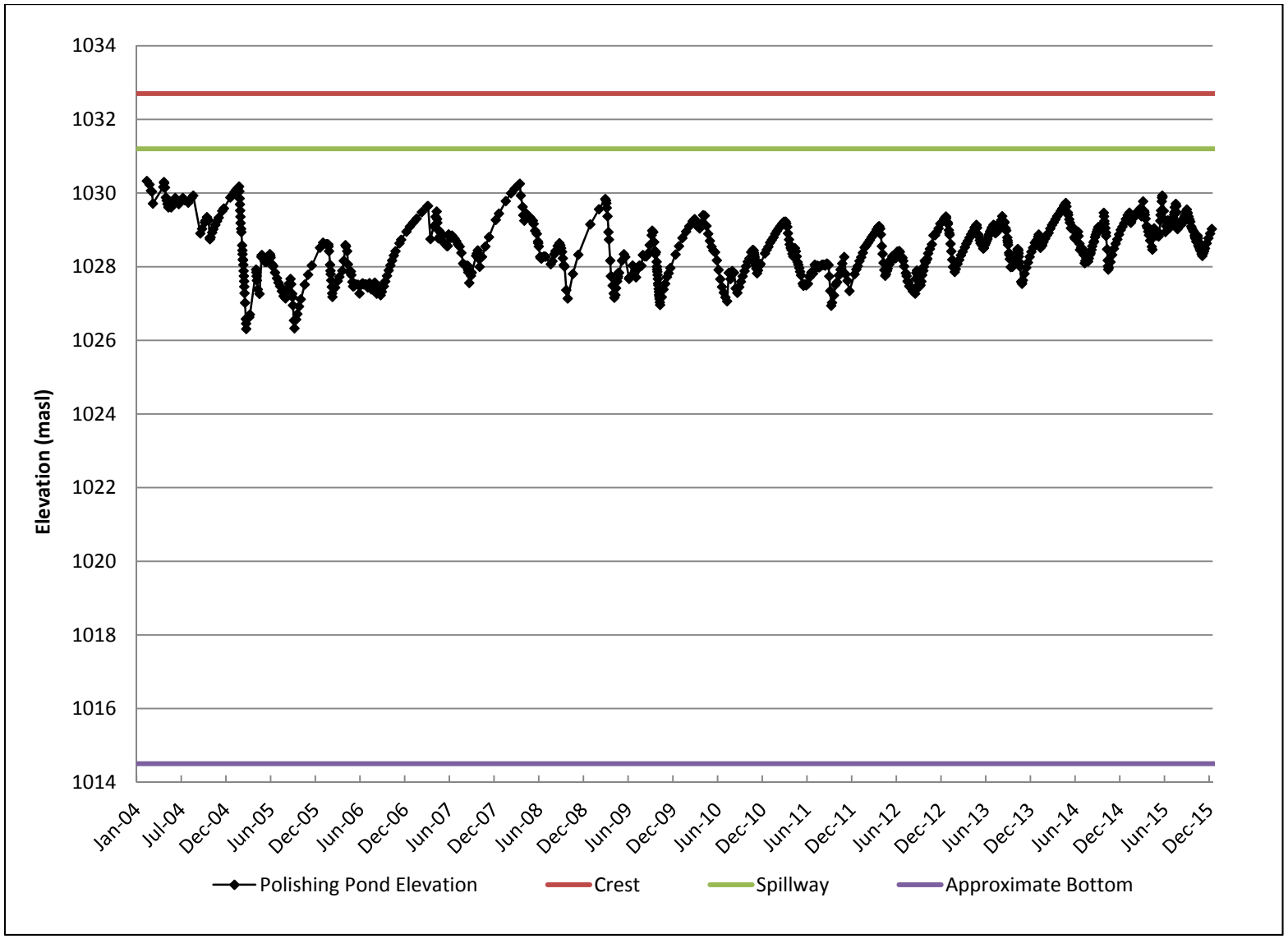


APPENDIX II-I

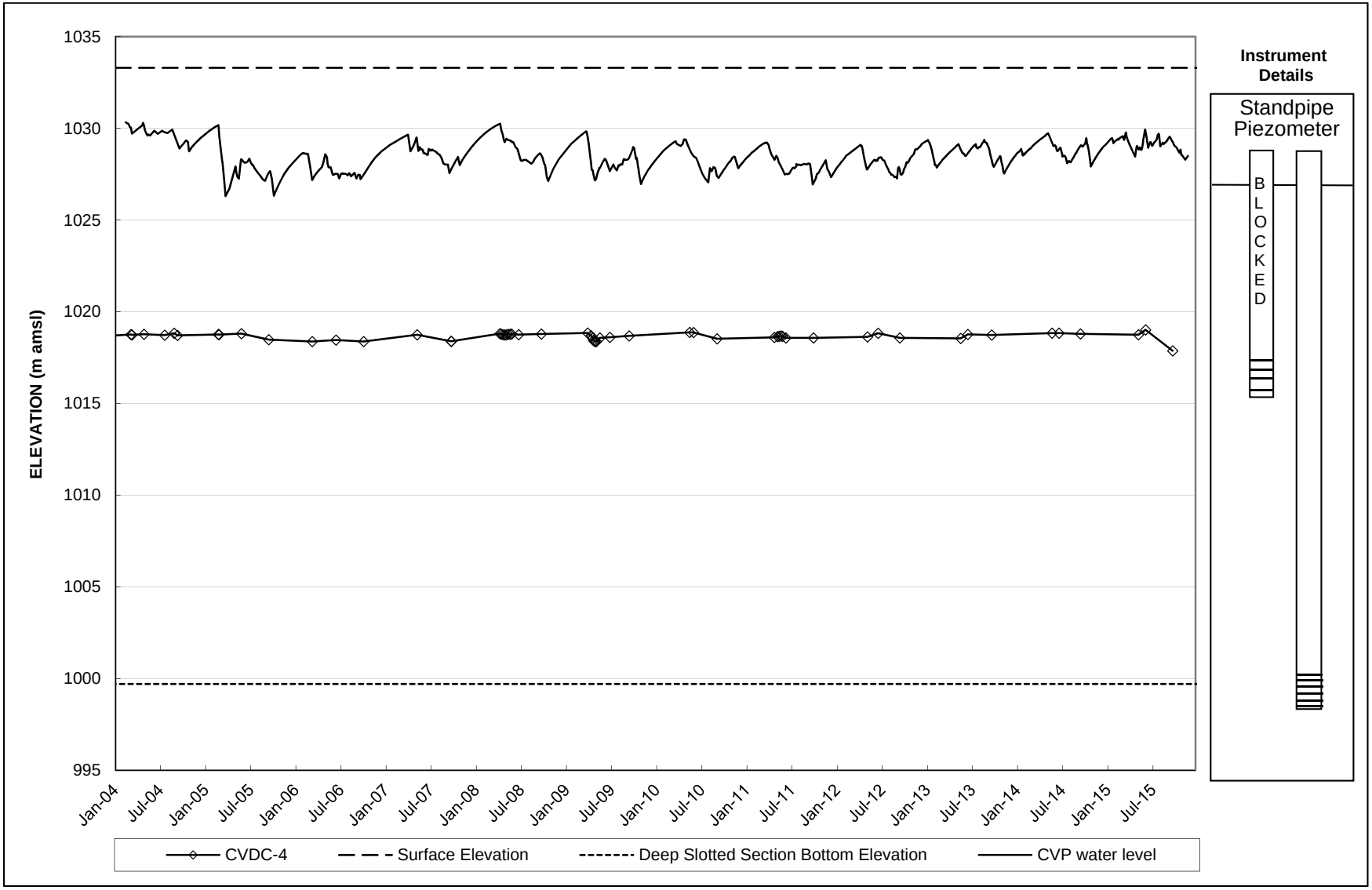
Cross Valley Dam

I1 – Pond Level (Polishing Pond)
I2 – Piezometers
I3 – Thermistors (Not included)
I4 – D/S Weir Flows

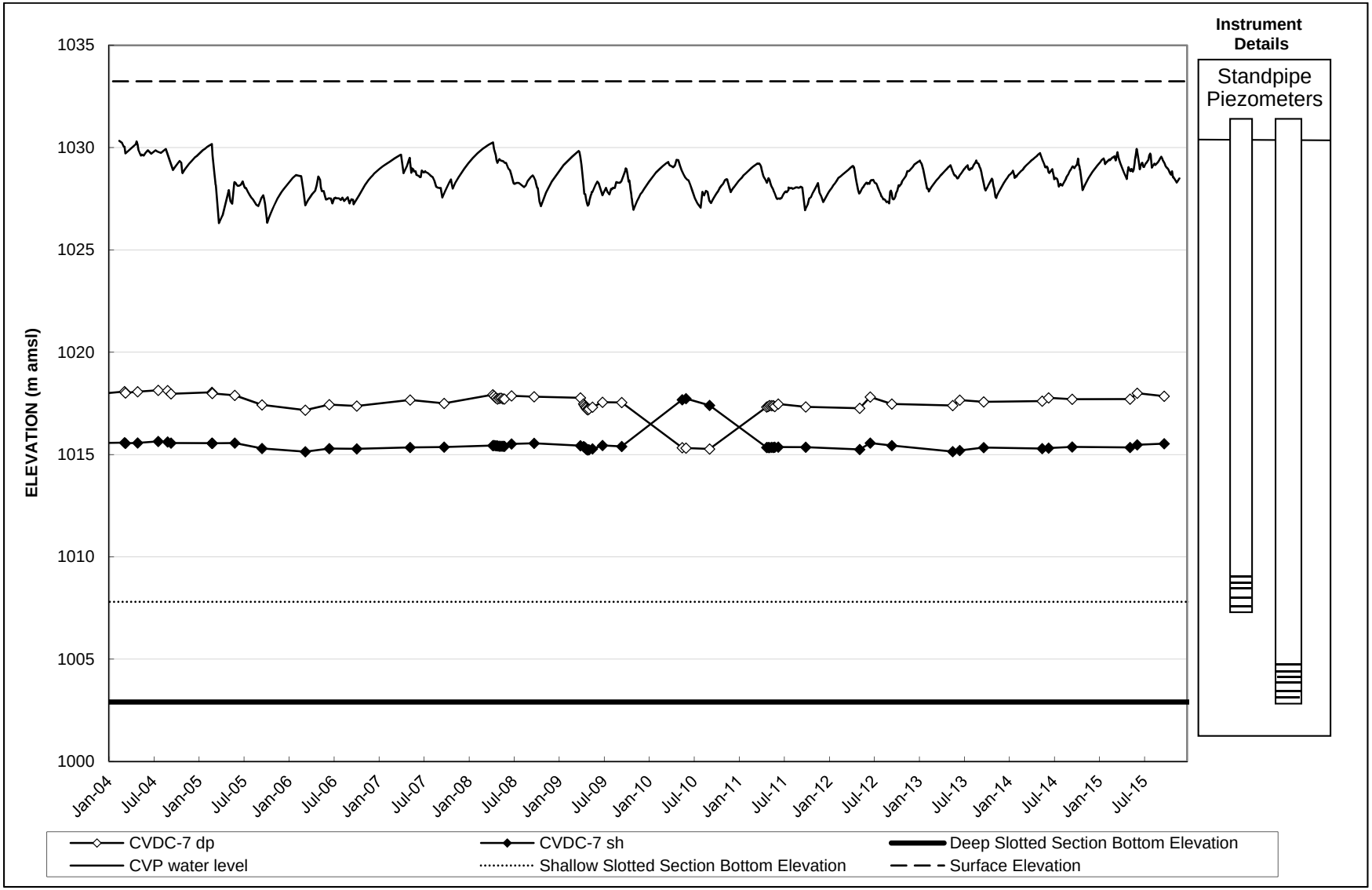
Polishing Pond Water Level



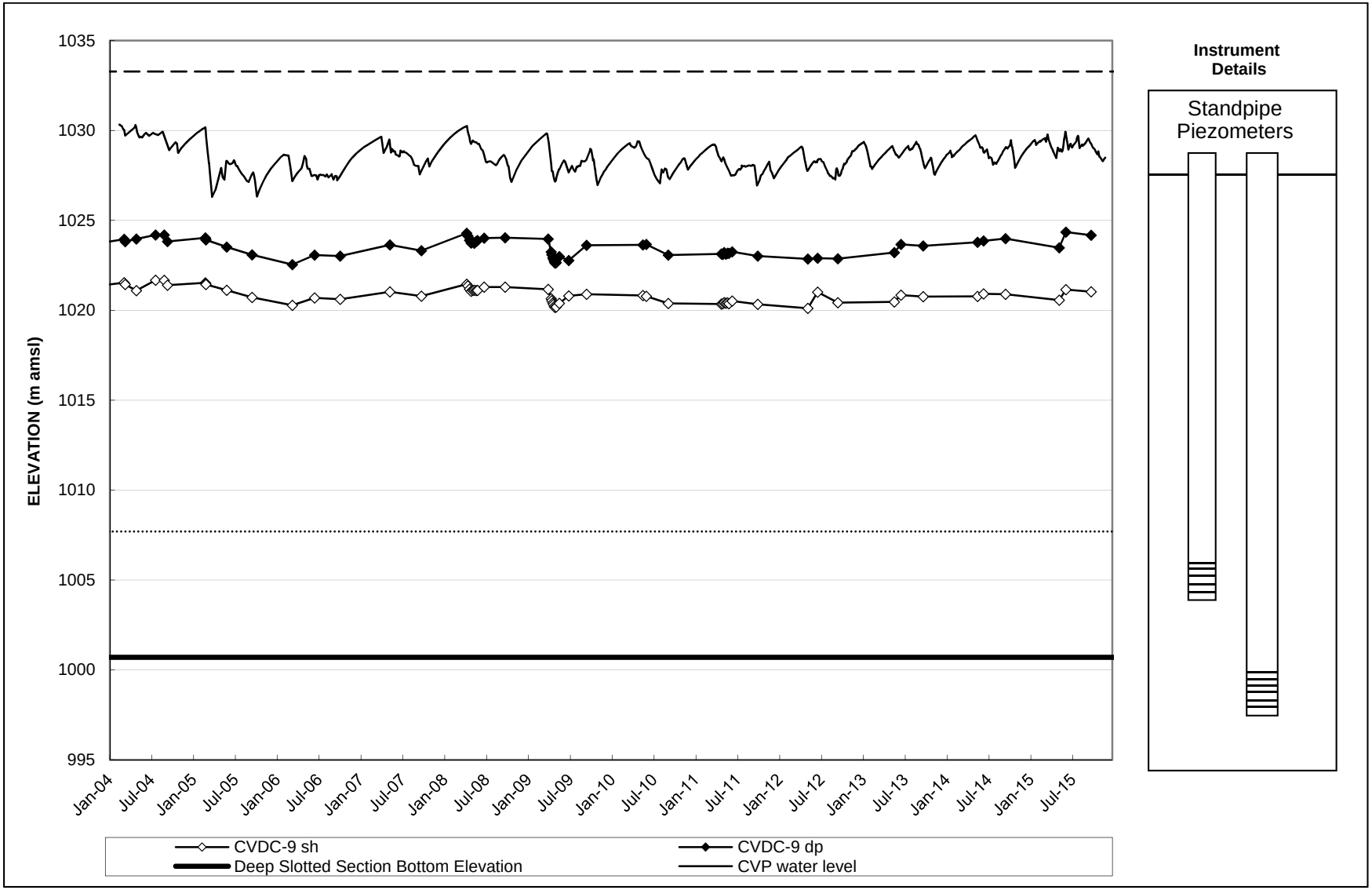
Cross Valley Dam
Piezometer CVDC-4



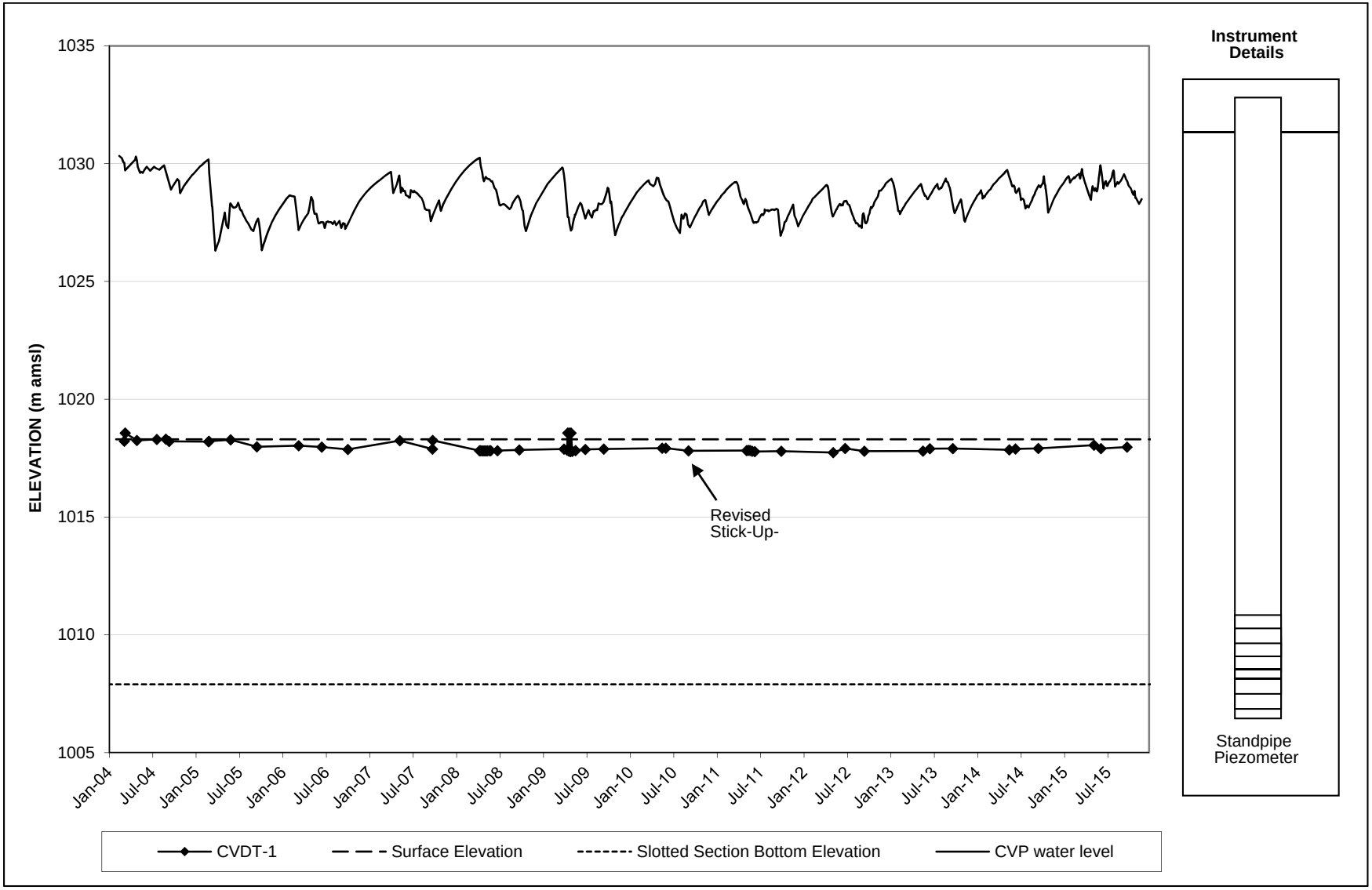
Cross Valley Dam
Piezometer CVDC-7



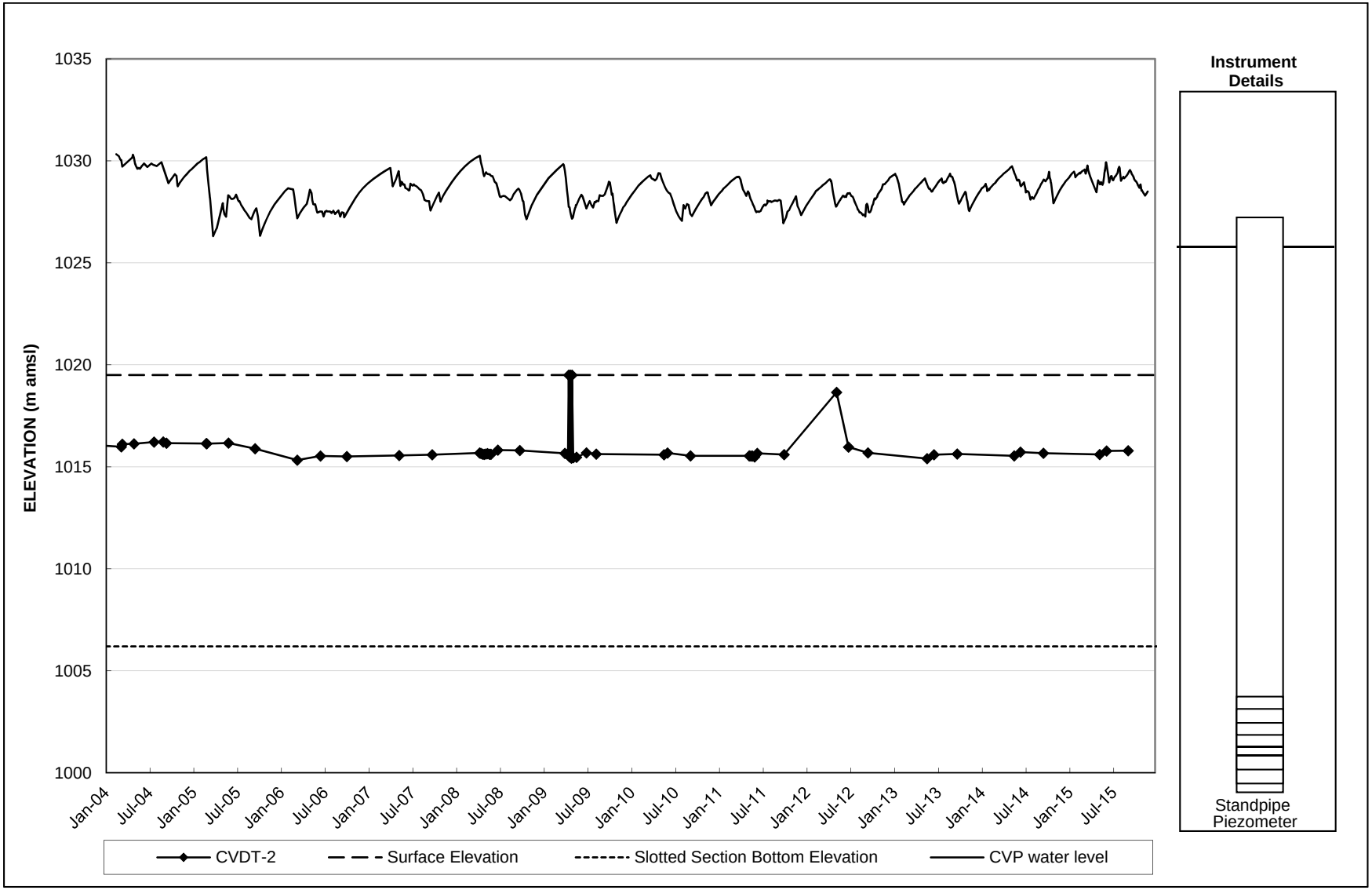
Cross Valley Dam
Piezometer CVDC-9



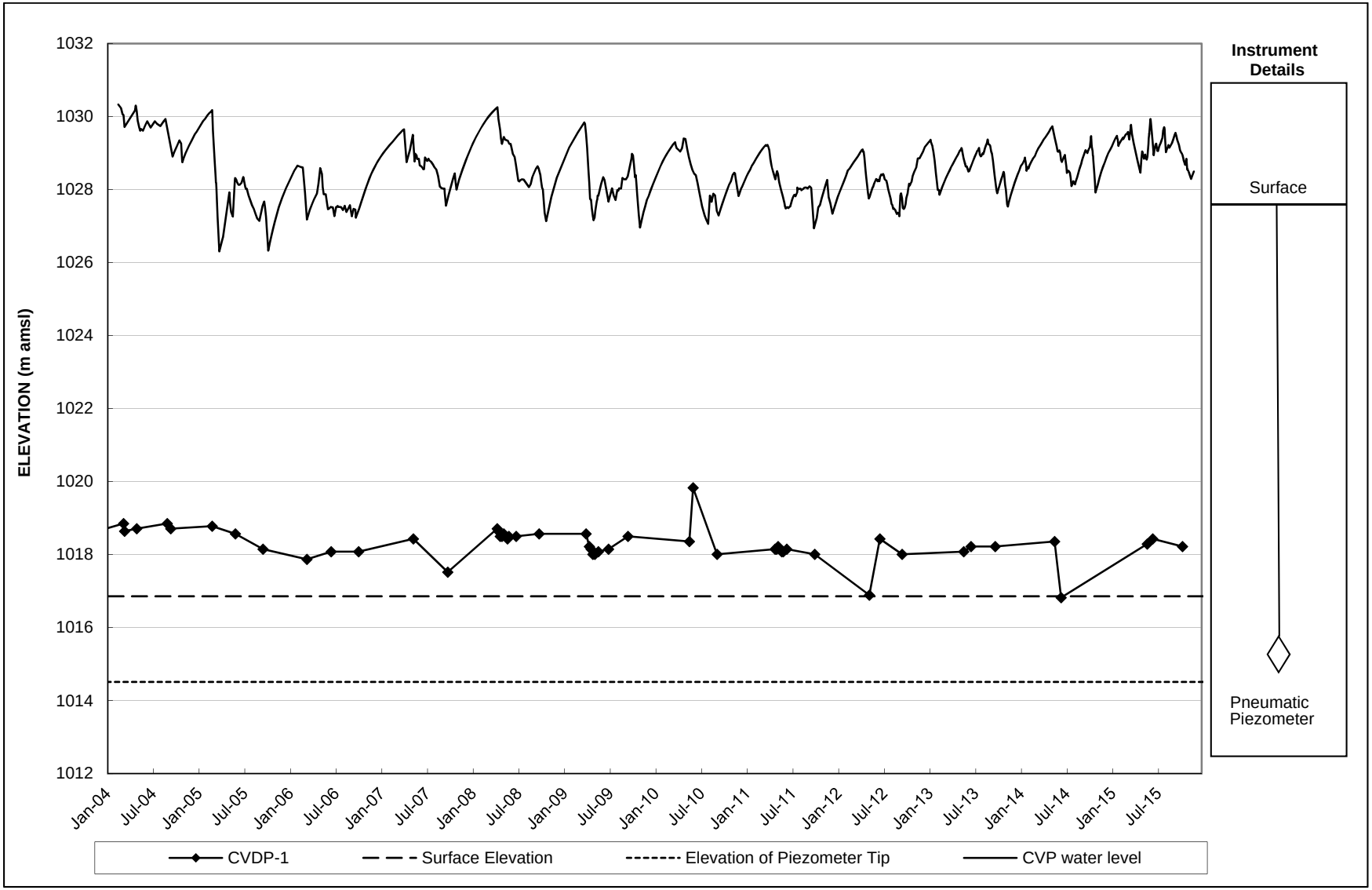
Cross Valley Dam
Piezometer CVDT-1



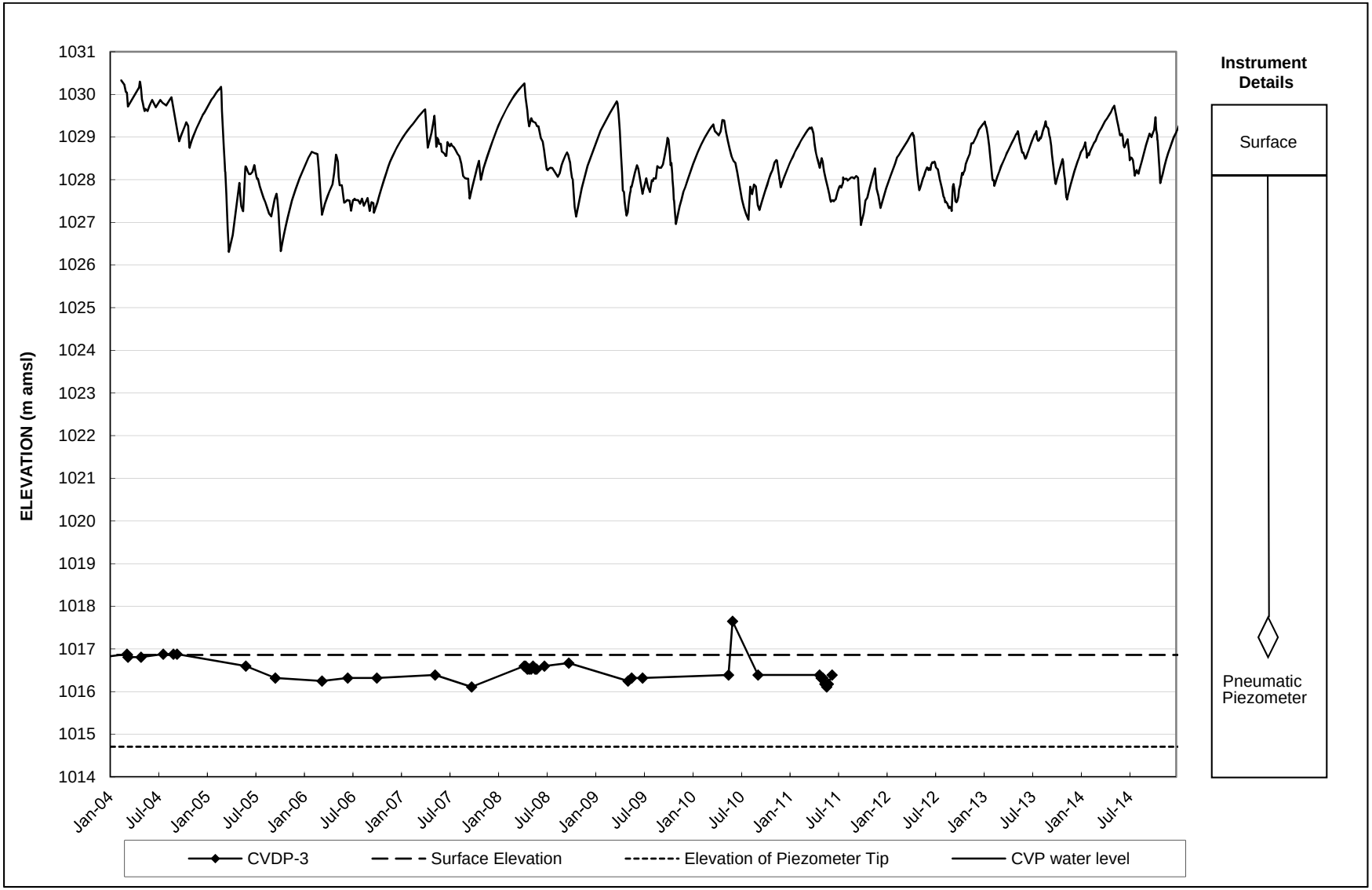
Cross Valley Dam
Piezometer CVDT-2



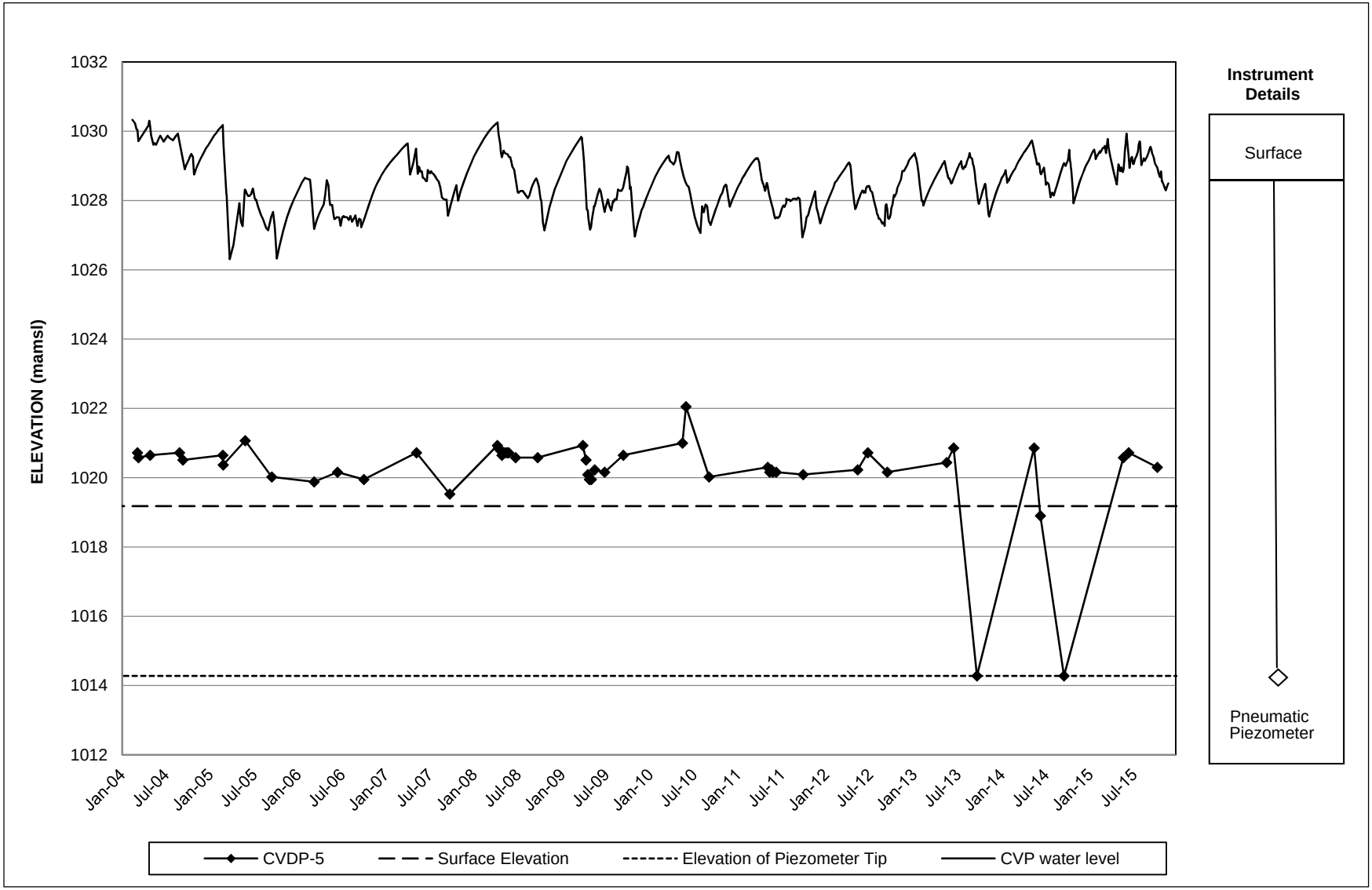
Cross Valley Dam
Piezometer CVDP-1



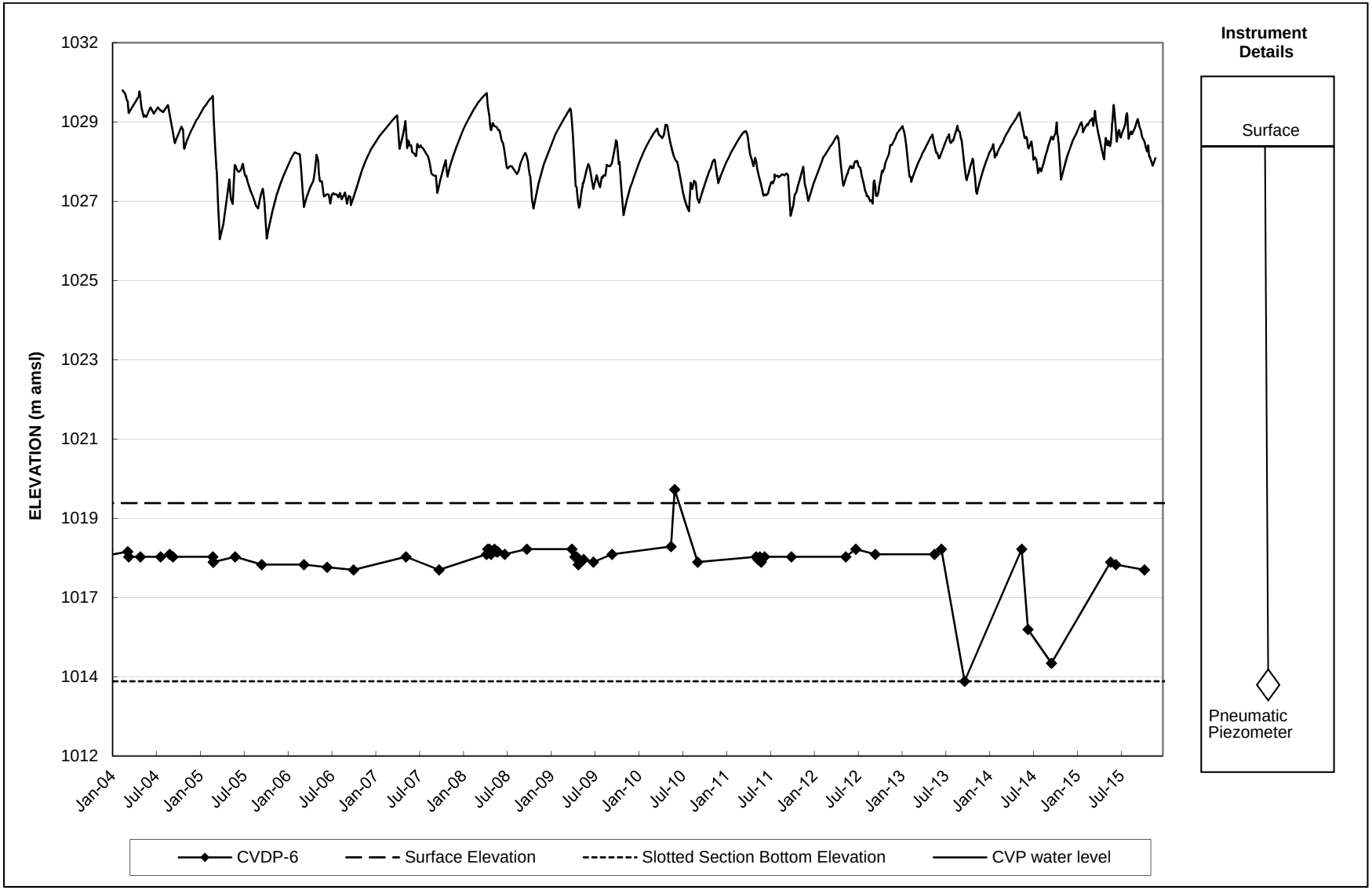
Cross Valley Dam
Piezometer CVDP-3



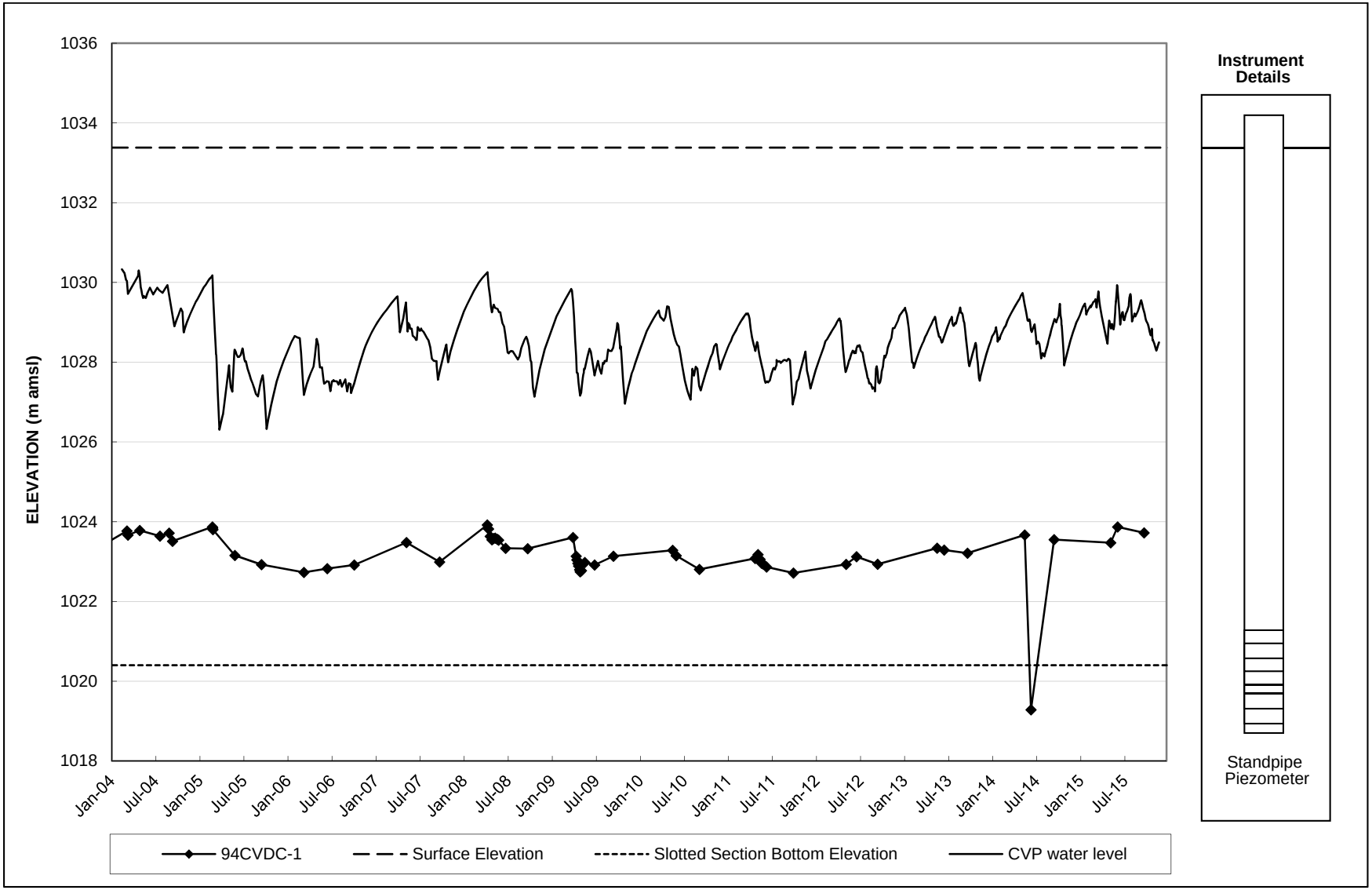
Cross Valley Dam
Piezometer CVDP-5



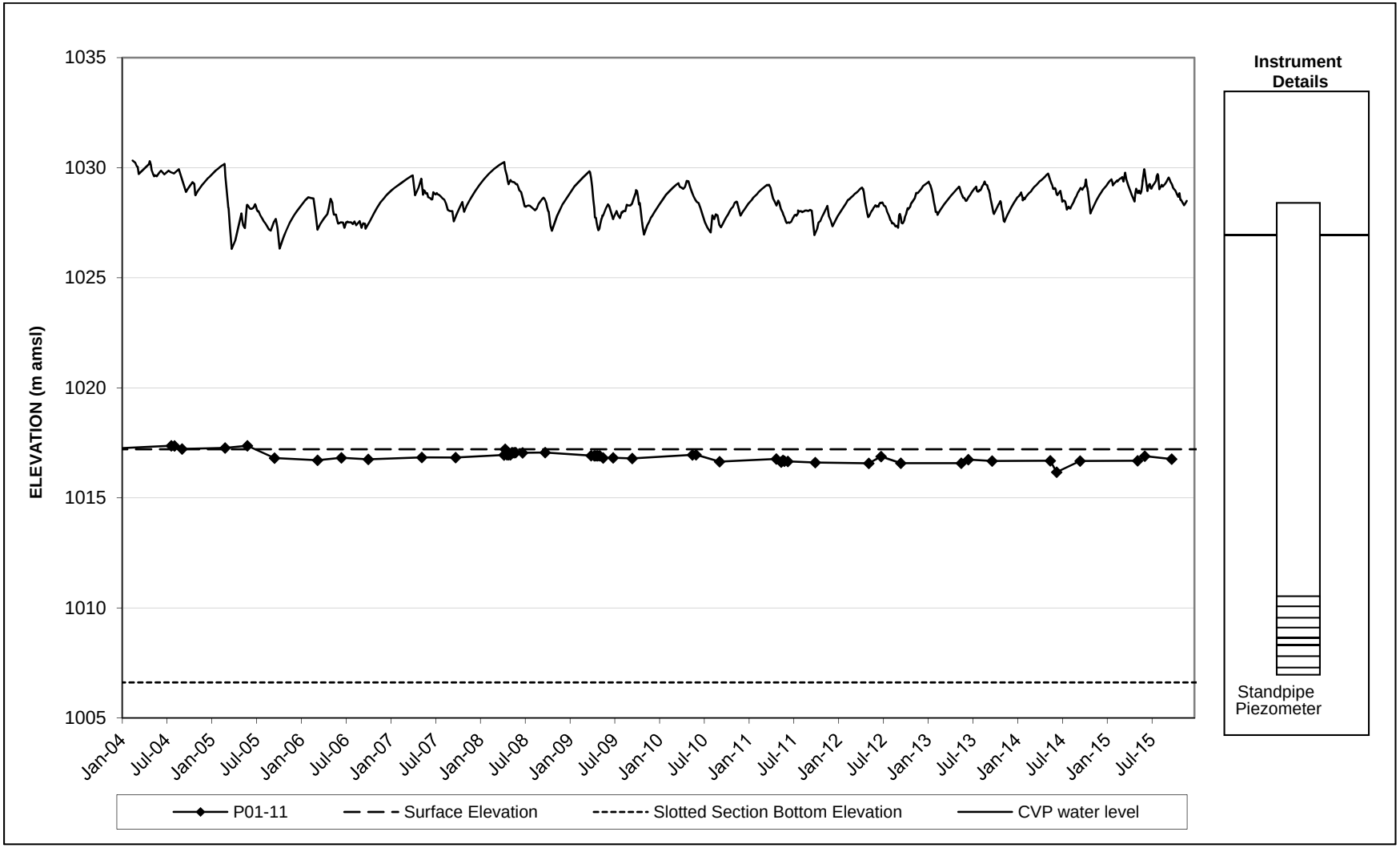
Cross Valley Dam
Piezometer CVDP-6



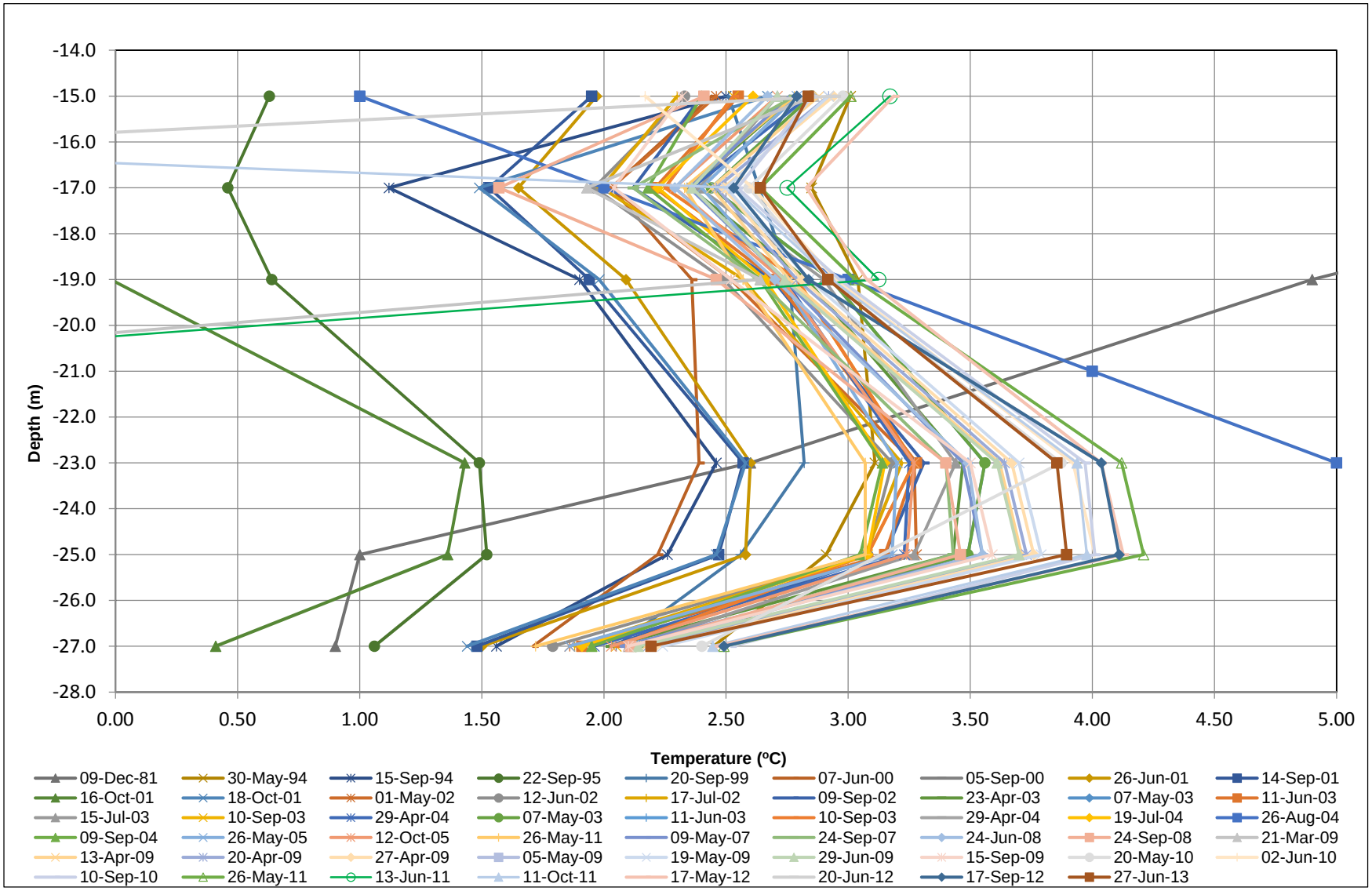
Cross Valley Dam
Piezometer CVDC-1



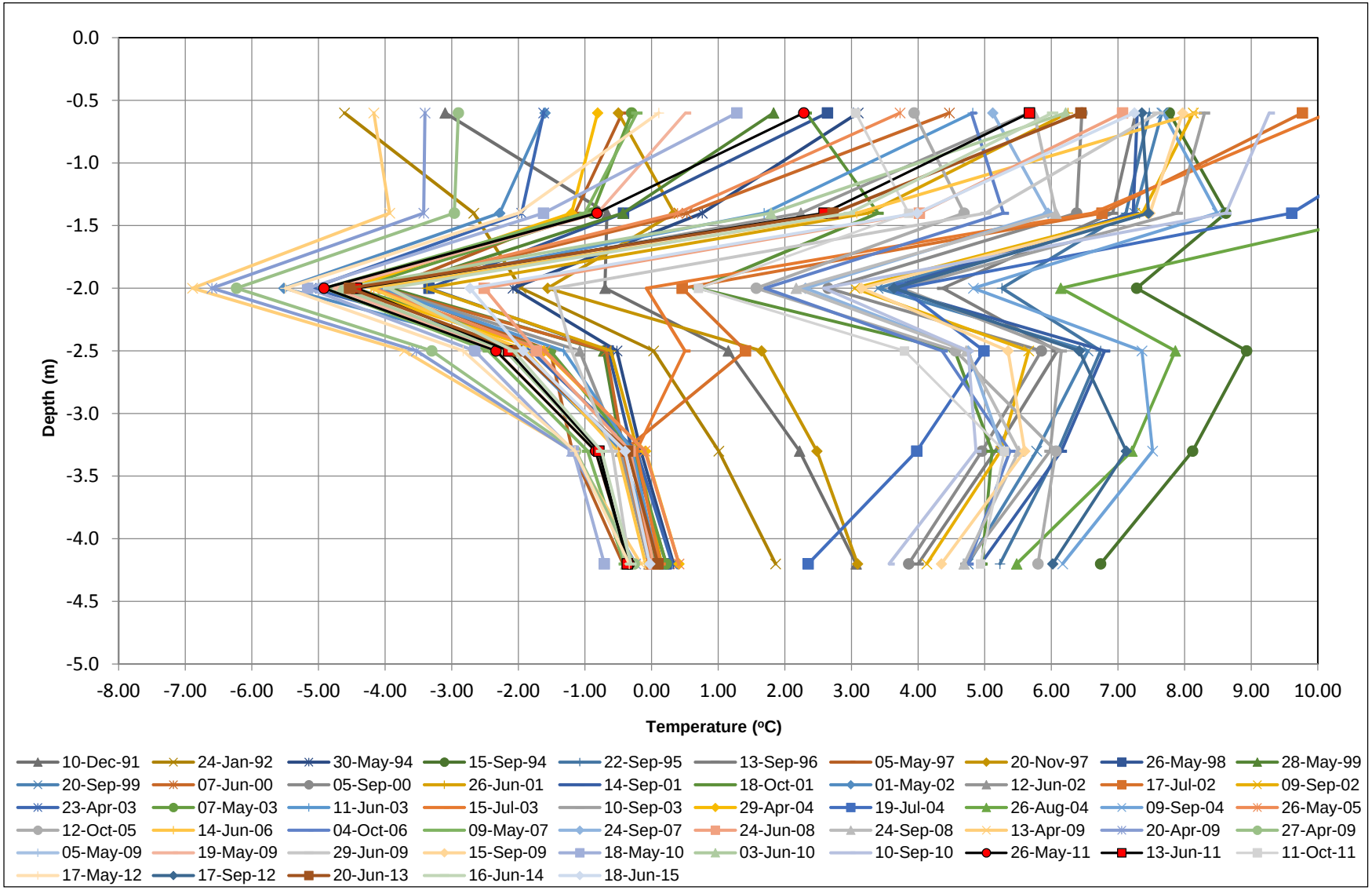
Cross Valley Dam
Piezometer P01-11

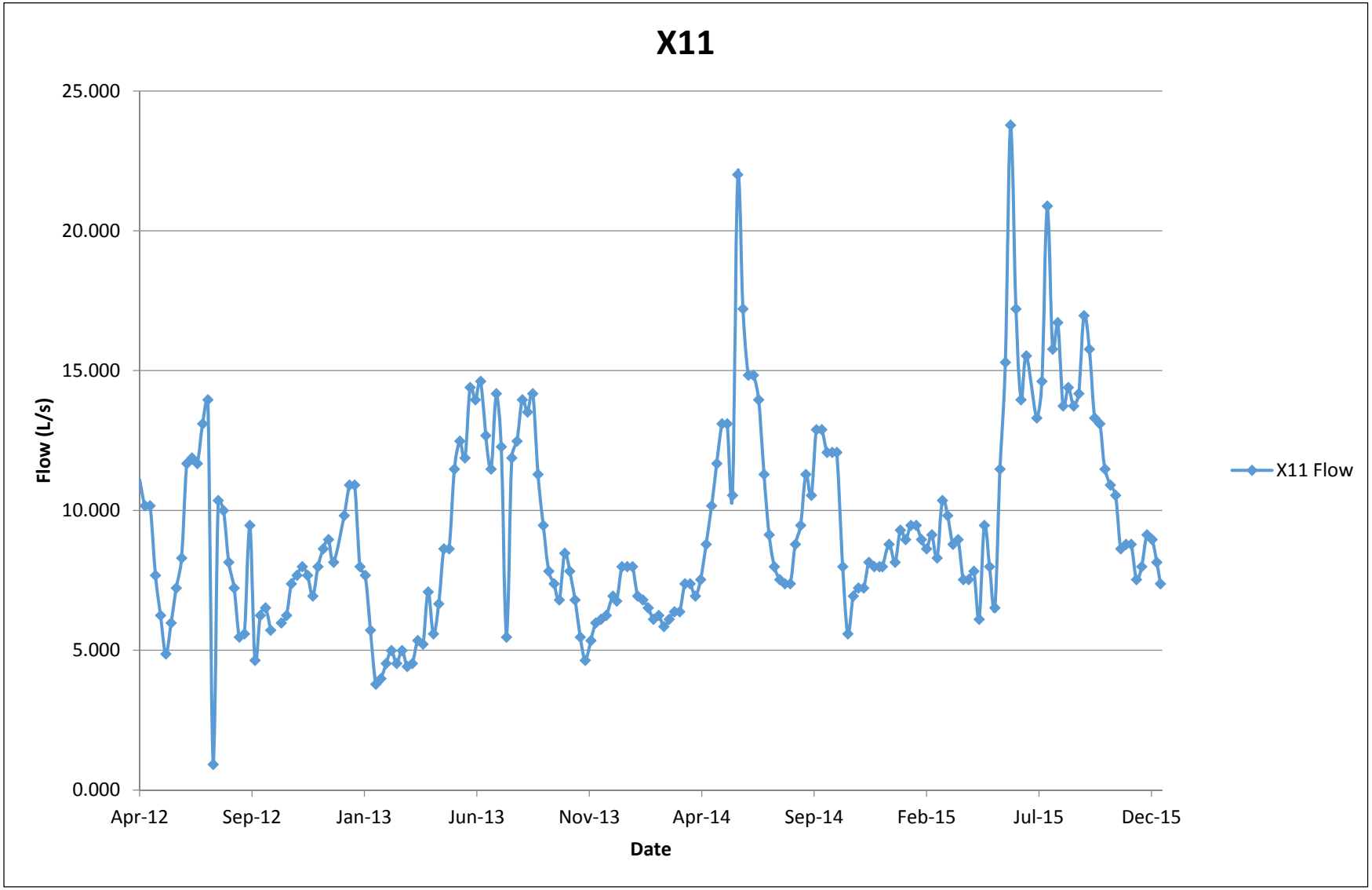


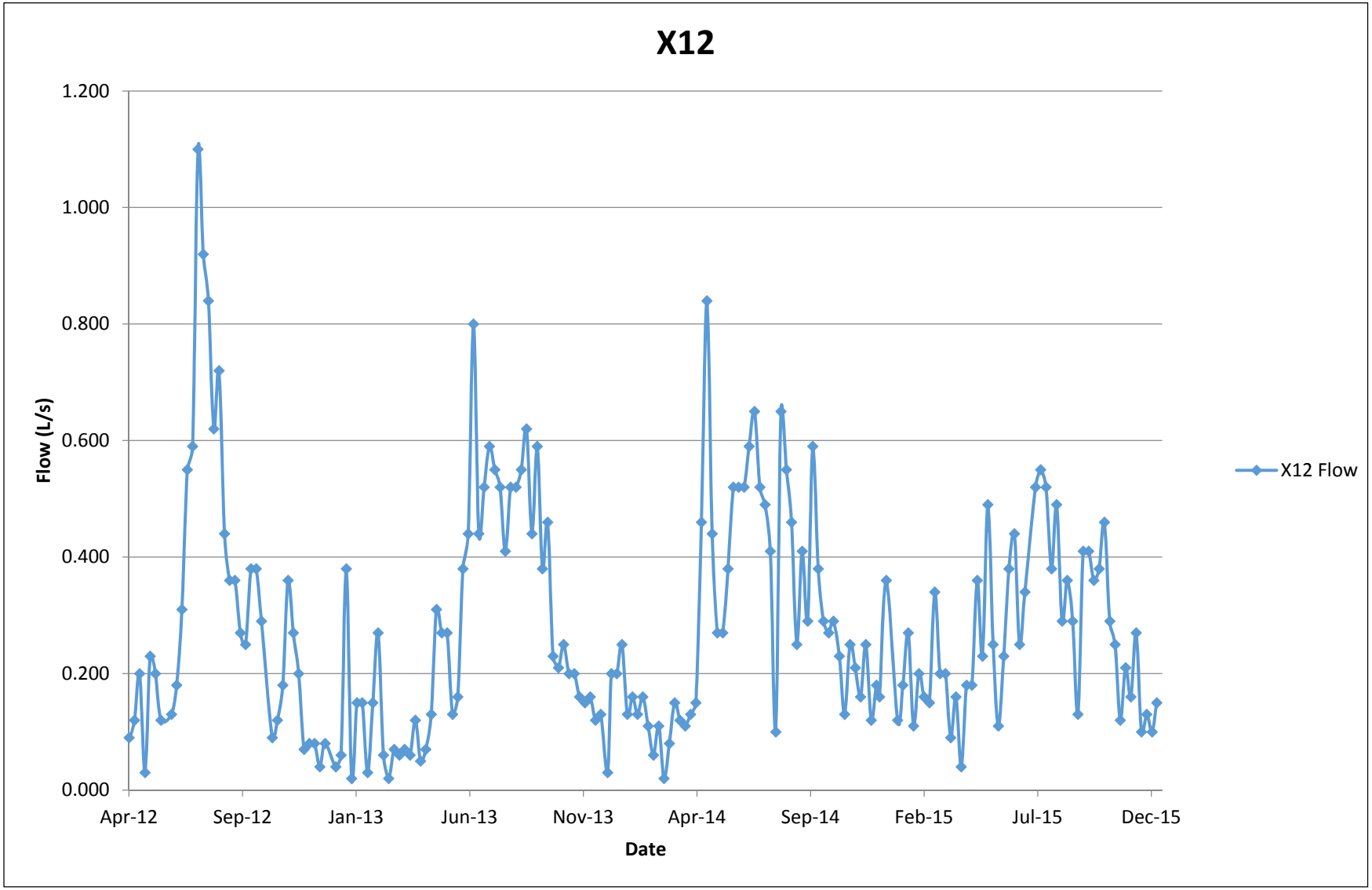
Cross Valley Dam
Thermistor CVDC-6

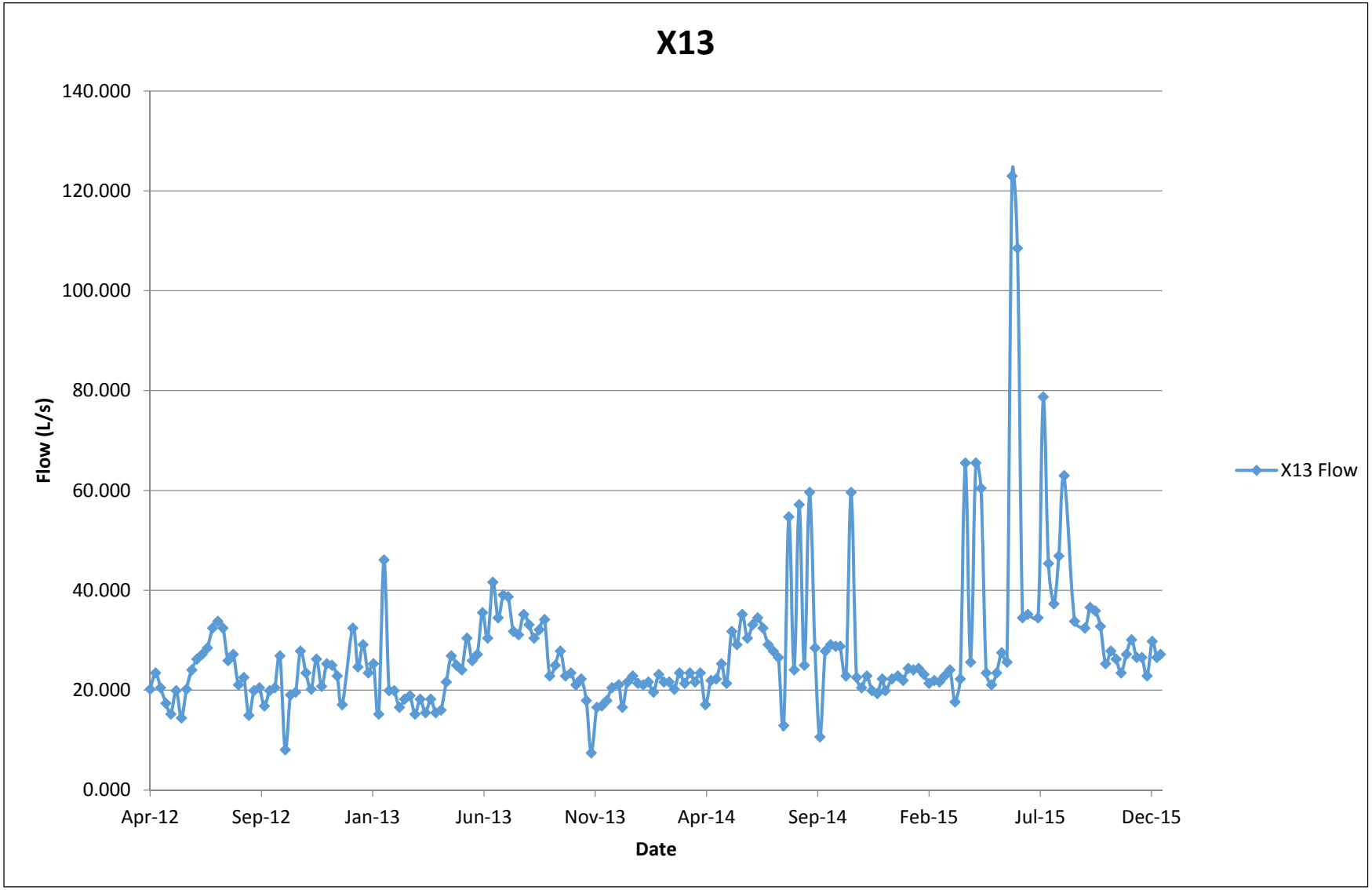


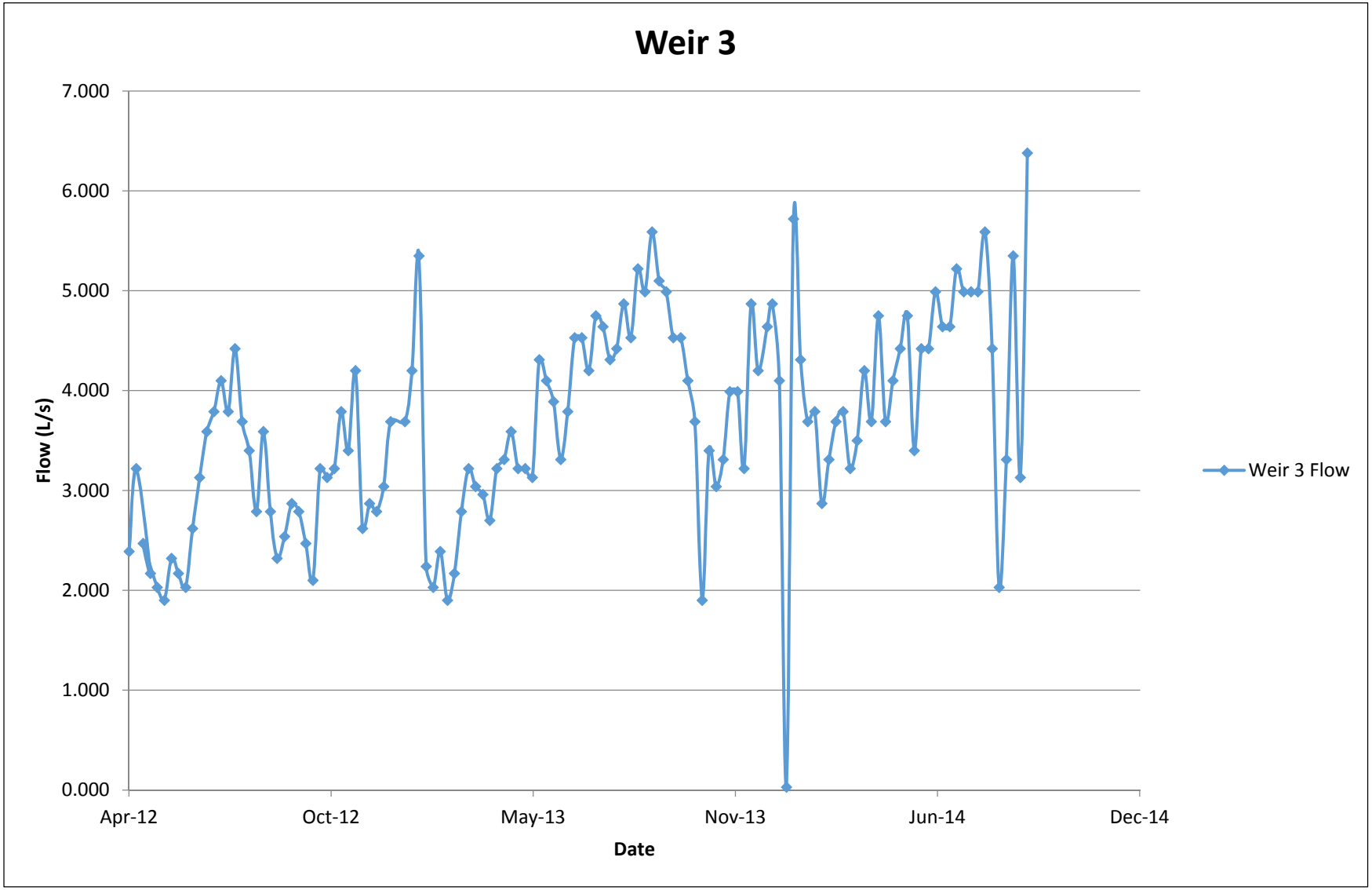
Cross Valley Dam
Thermistor BH 88-4

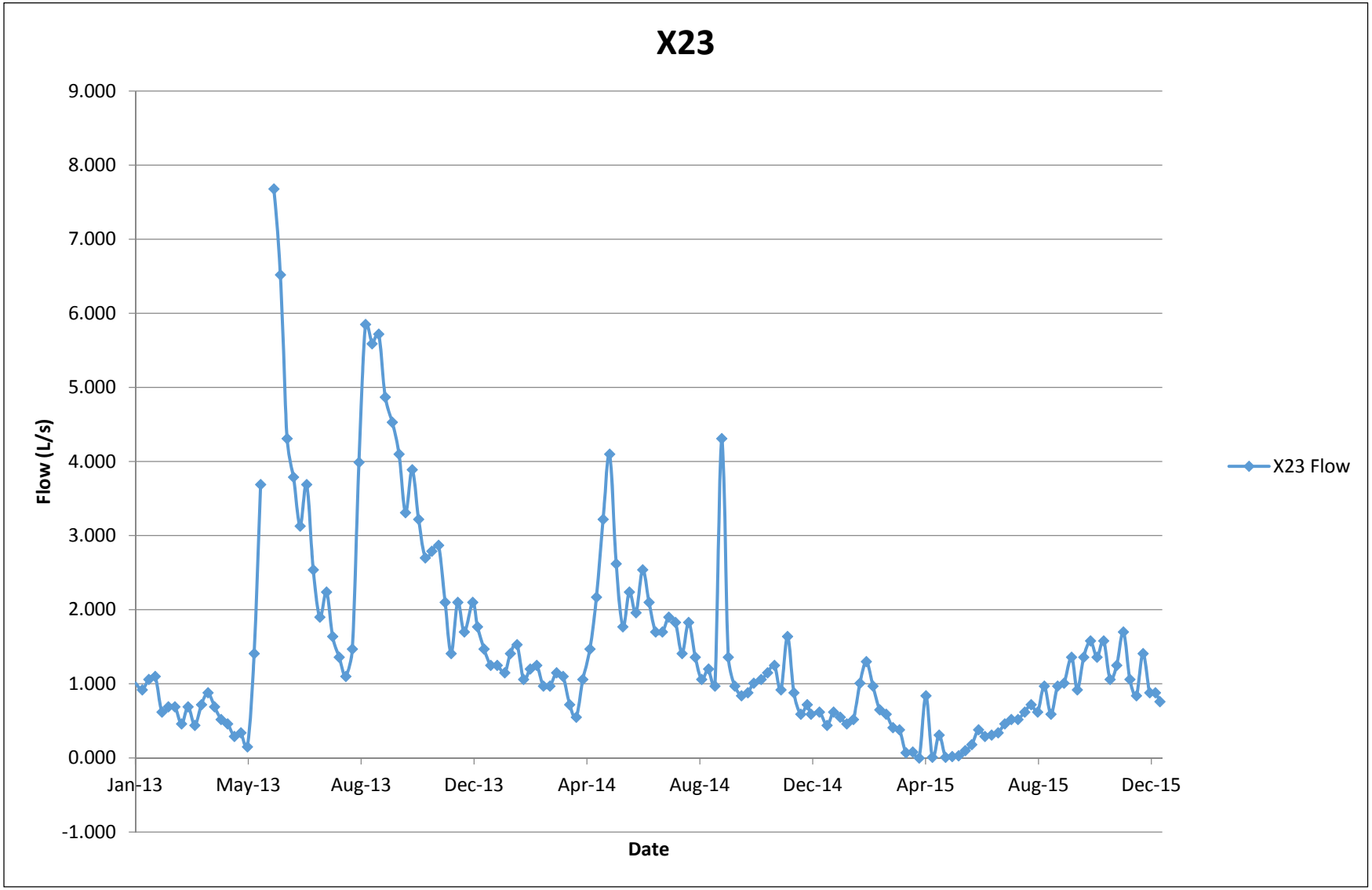



X11
25.000
20.000
15.000
10.000
5.000
0.000
Flow (L/s)
Apr-12
Sep-12
Jan-13
Jun-13
Nov-13
Apr-14
Sep-14
Feb-15
Jul-15
Dec-15
Date
X11 Flow


X12
1.200
1.000
0.800
0.600
0.400
0.200
0.000
Flow (L/s)
Apr-12
Sep-12
Jan-13
Jun-13
Nov-13
Apr-14
Sep-14
Feb-15
Jul-15
Dec-15
Date
X12 Flow


X13
140.000
120.000
100.000
80.000
60.000
40.000
20.000
0.000
Flow (L/s)
Apr-12
Sep-12
Jan-13
Jun-13
Nov-13
Apr-14
Sep-14
Feb-15
Jul-15
Dec-15
Date
X13 Flow


Weir 3
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
Flow (L/s)
Apr-12
Oct-12
May-13
Nov-13
Jun-14
Dec-14
Date
Weir 3 Flow

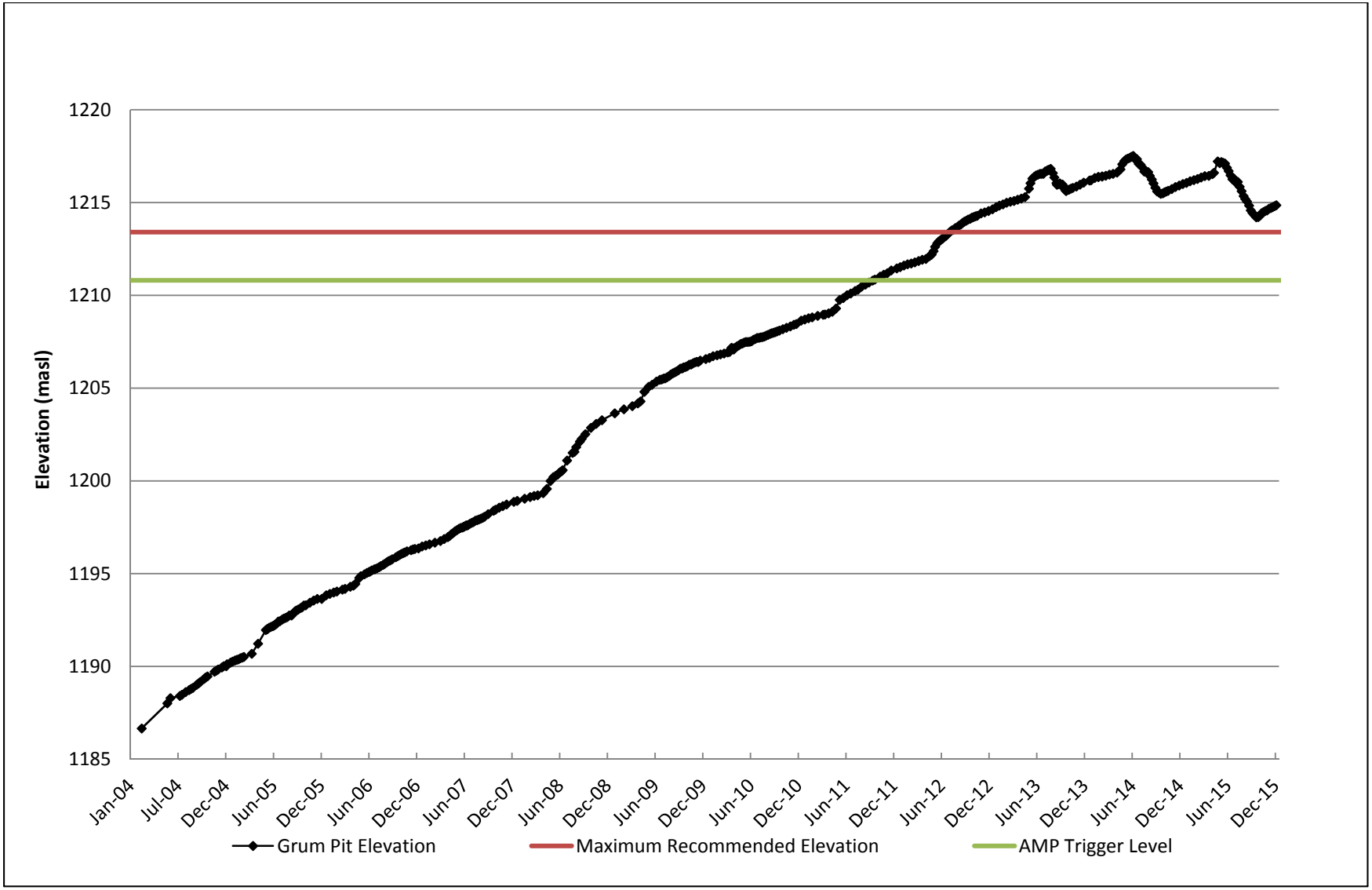

X23
9.000
8.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
-1.000
Flow (L/s)
Jan-13
May-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Date
X23 Flow

APPENDIX II-J

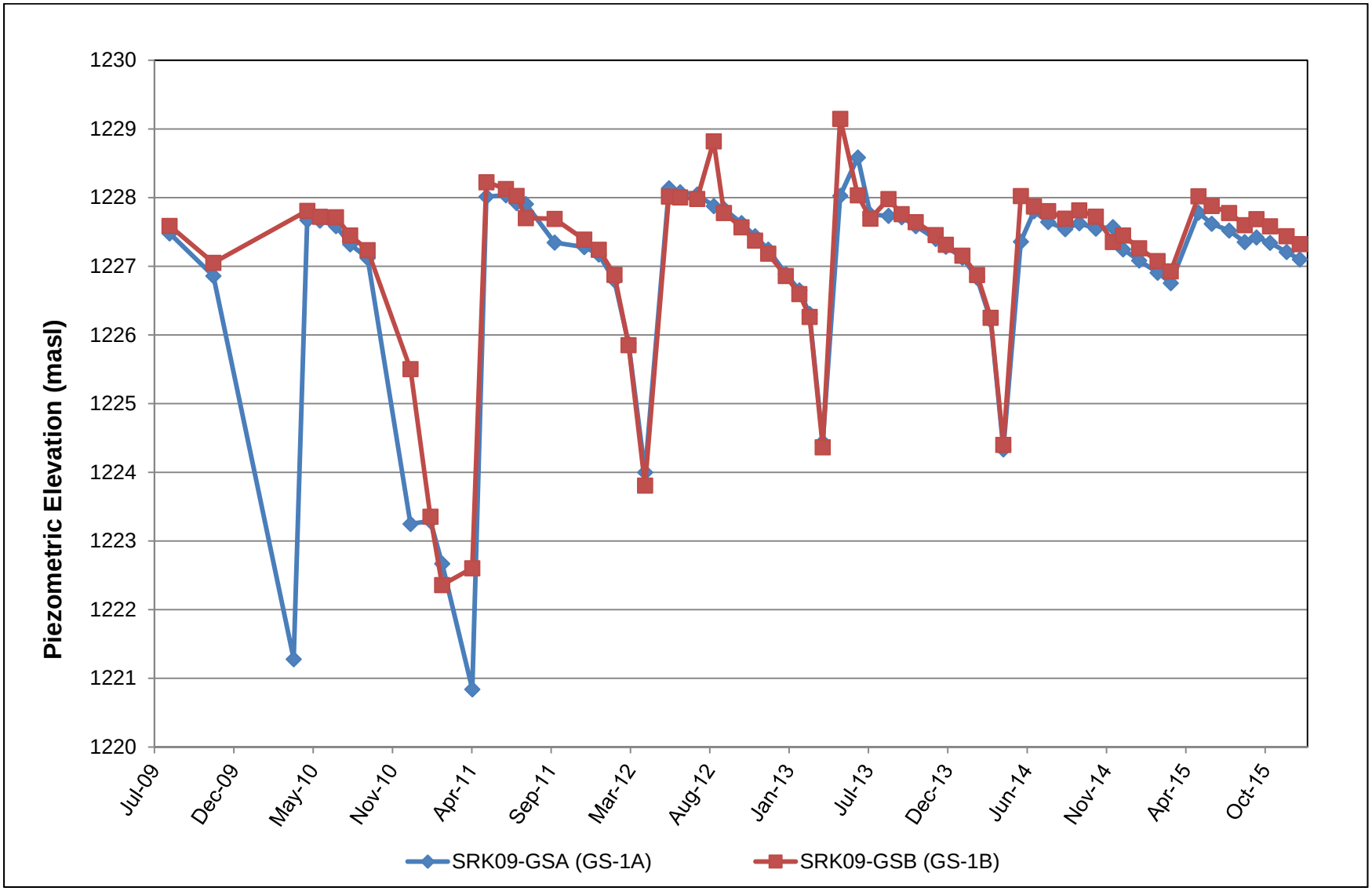
Grum Pit

J1 – Pond Level
J2 – Pit Slot Cut Piezometers

Grum Pit Water Level



Water Elevations – Grum Slot Cut Piezometers

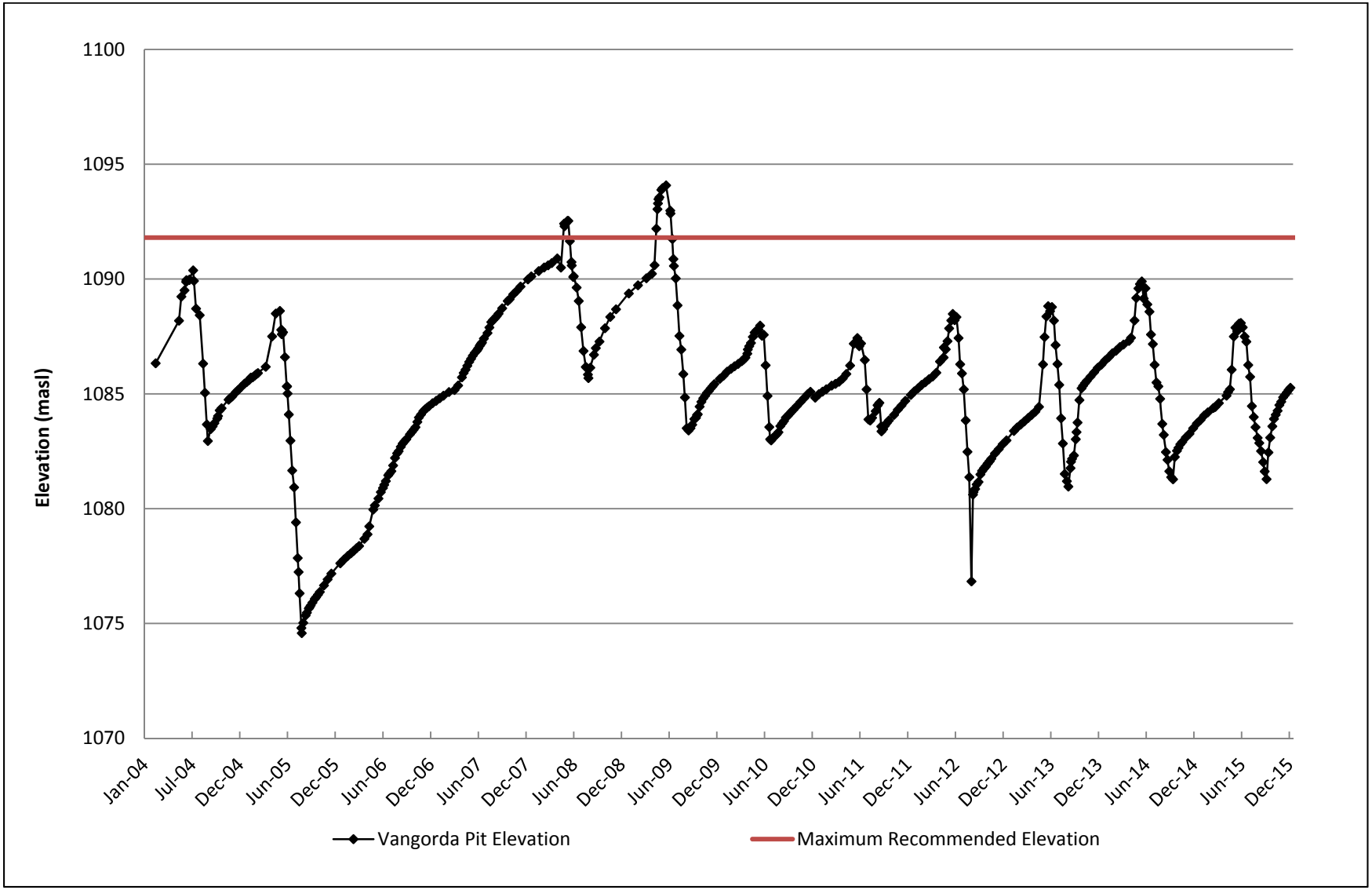


APPENDIX II-K

Vangorda Pit

K1 – Pond Level

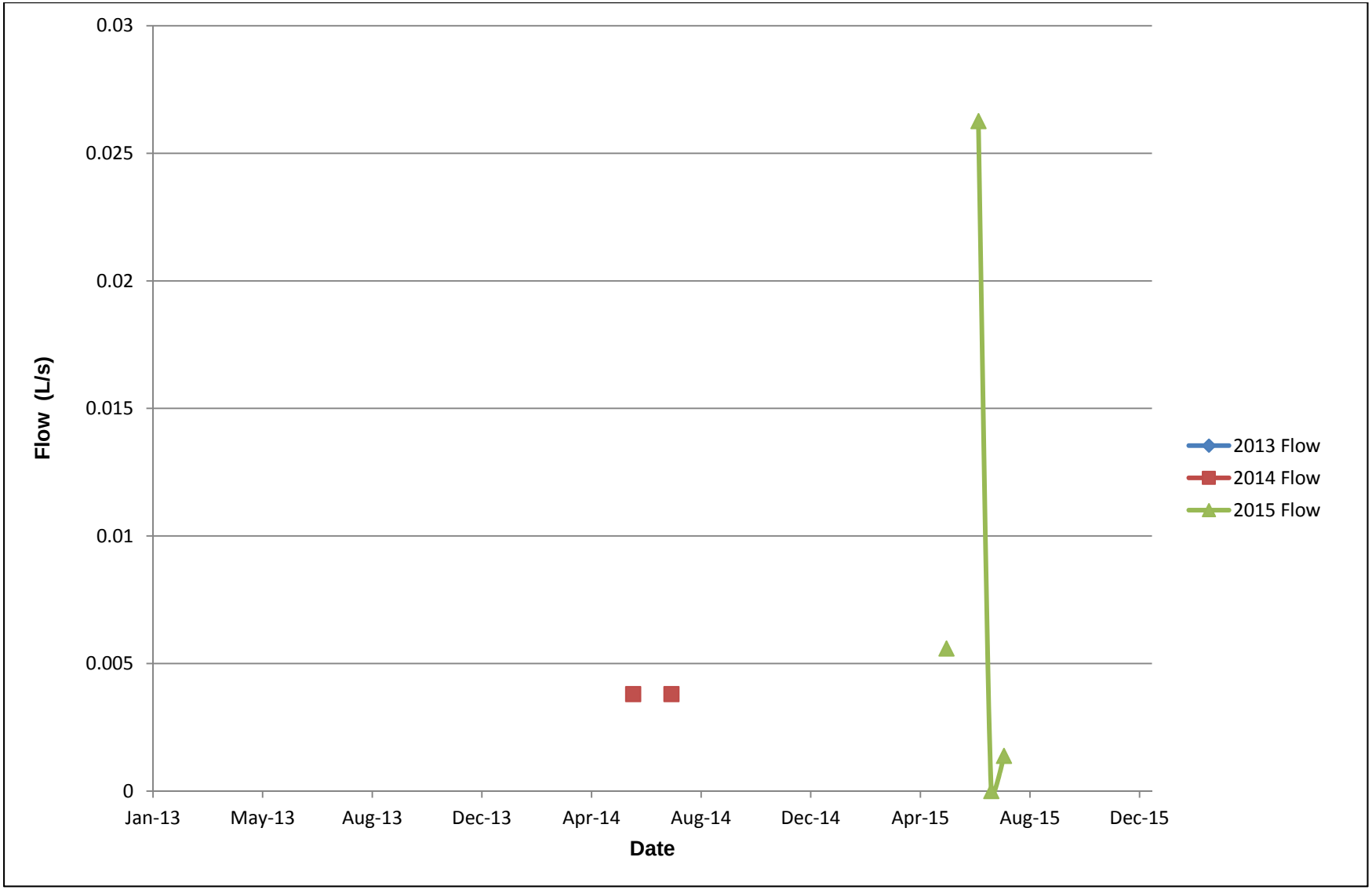
Vangorda Pit Water Level



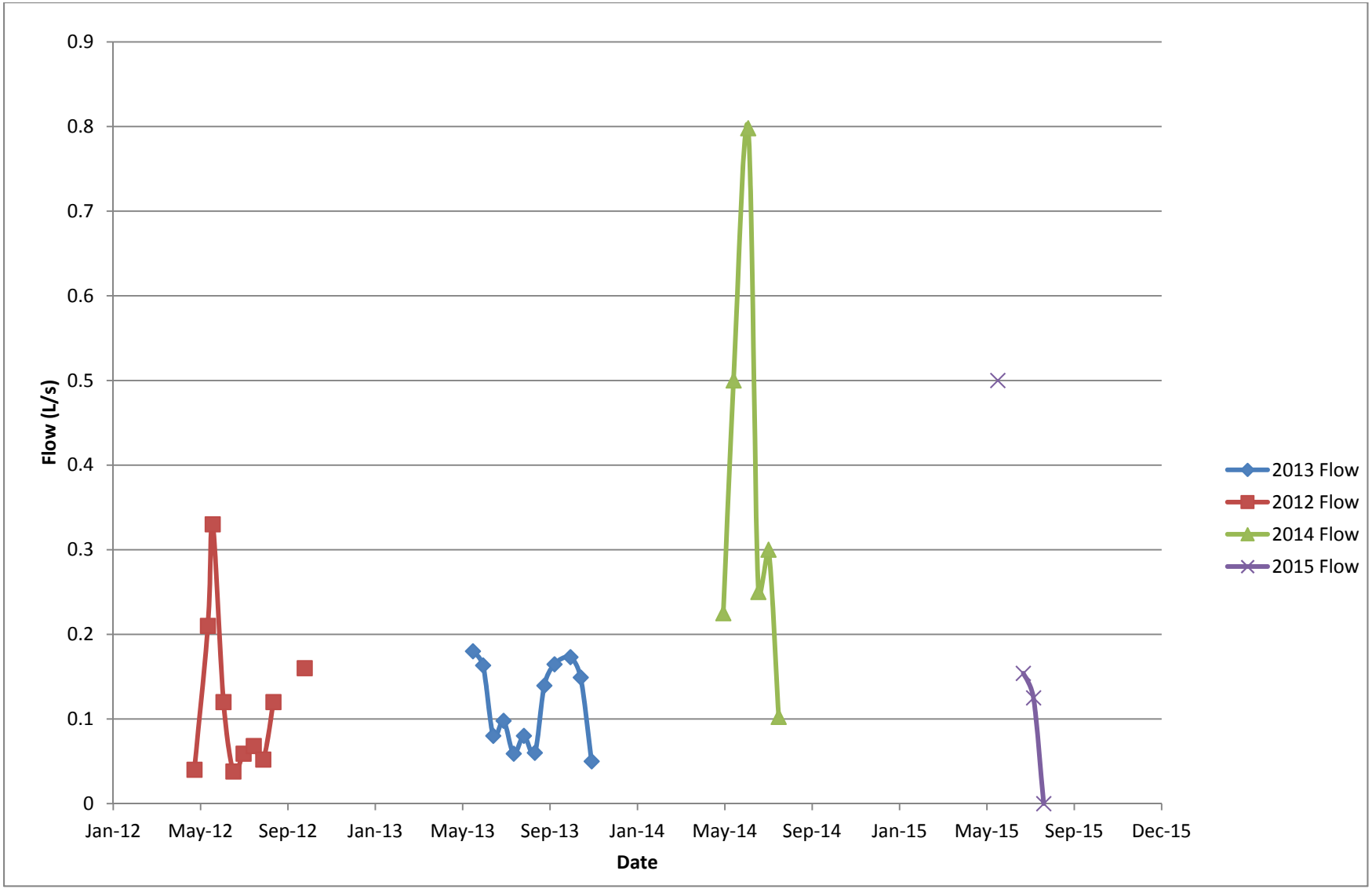
APPENDIX II-L

Vangorda Waste Rock Dump

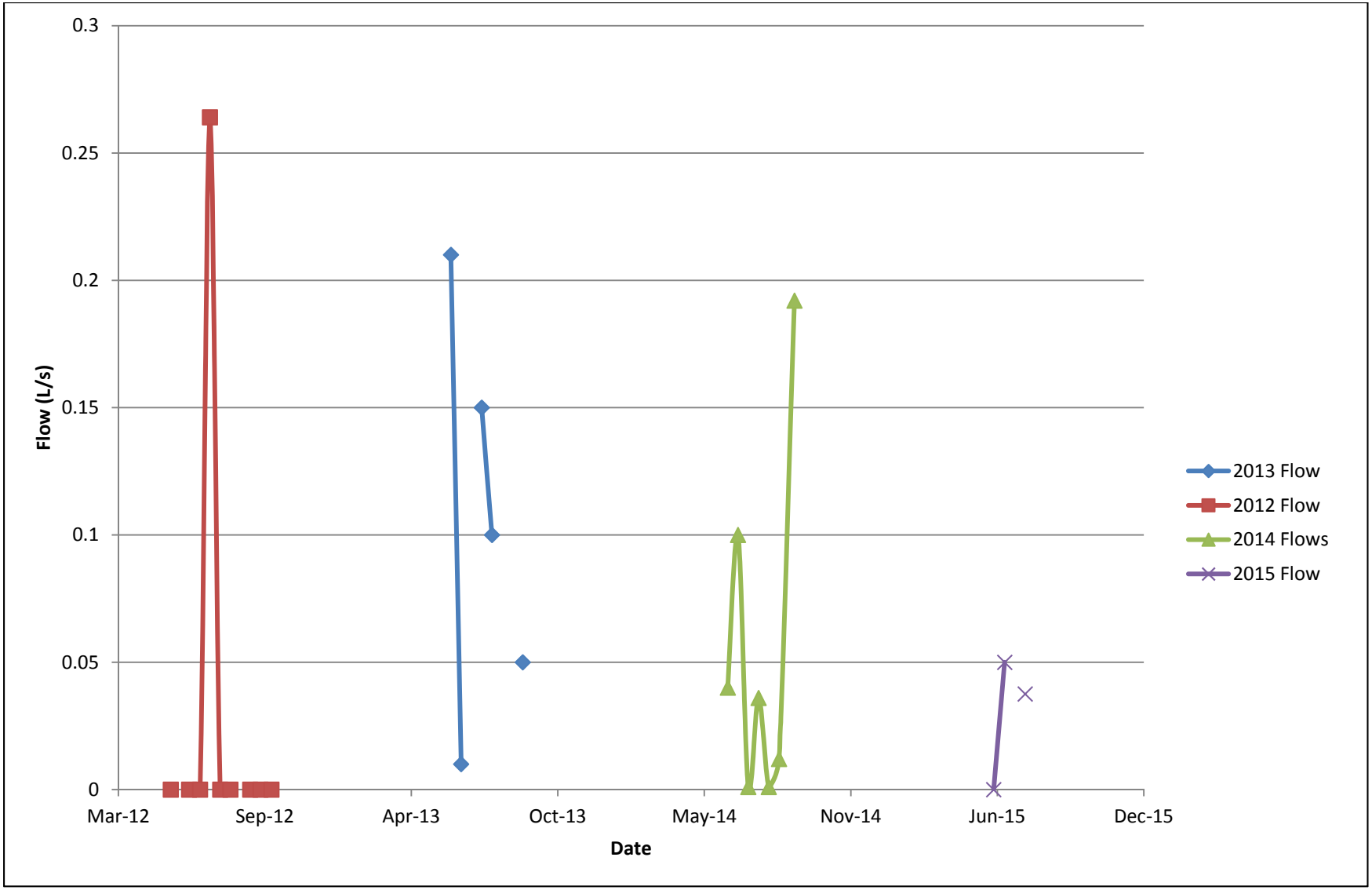
L1 – Weir Flows
L2 – Piezometers


V29 (Drain 2)
0.03
0.025
0.02
0.015
0.01
0.005
0
Flow (L/s)
Jan-13
May-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Date
2013 Flow
2014 Flow
2015 Flow

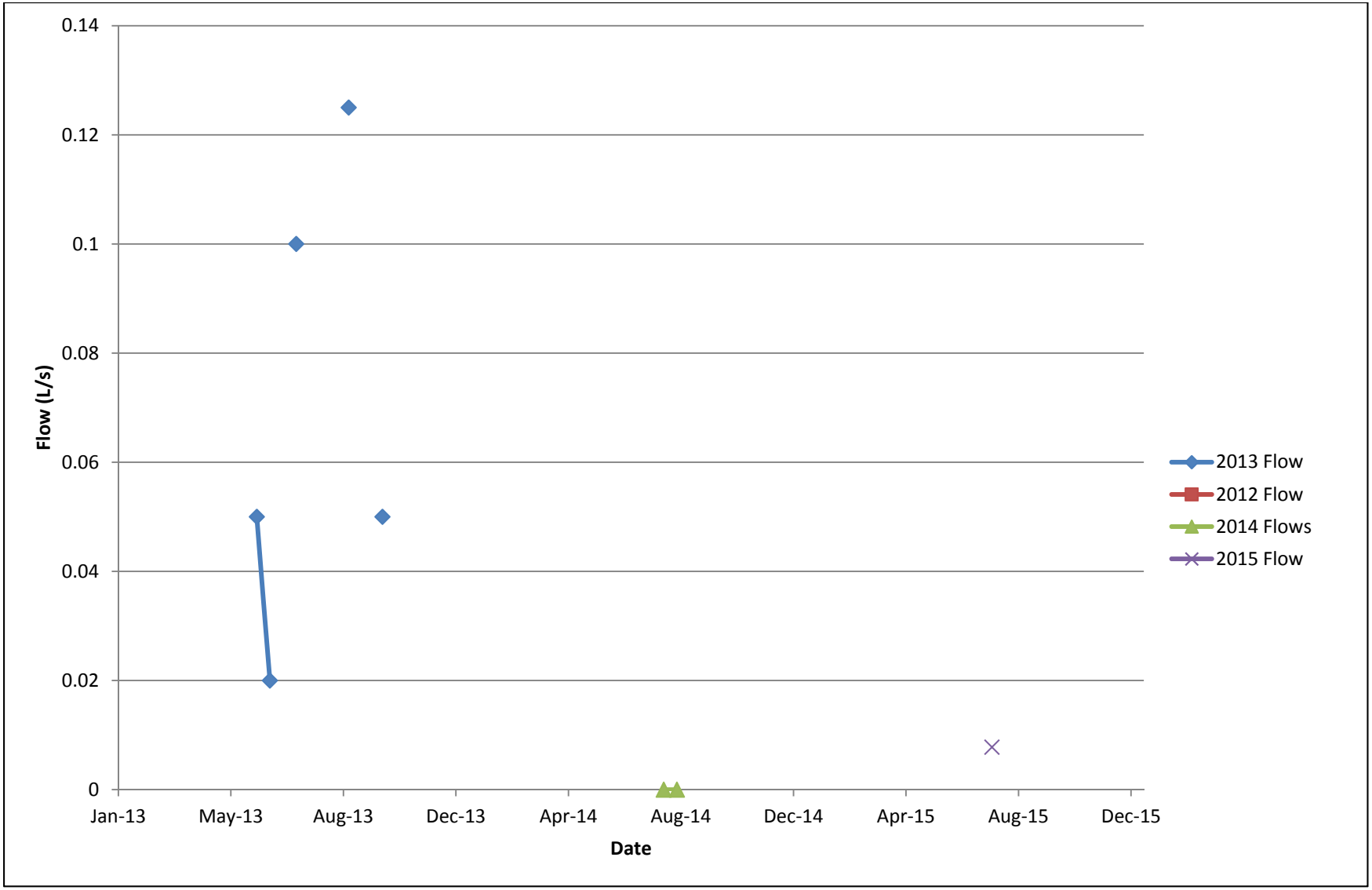
V30 (Drain 3)


0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Flow (L/s)
Jan-12
May-12
Sep-12
Jan-13
May-13
Sep-13
Jan-14
May-14
Sep-14
Jan-15
May-15
Sep-15
Dec-15
Date
2013 Flow
2012 Flow
2014 Flow
2015 Flow

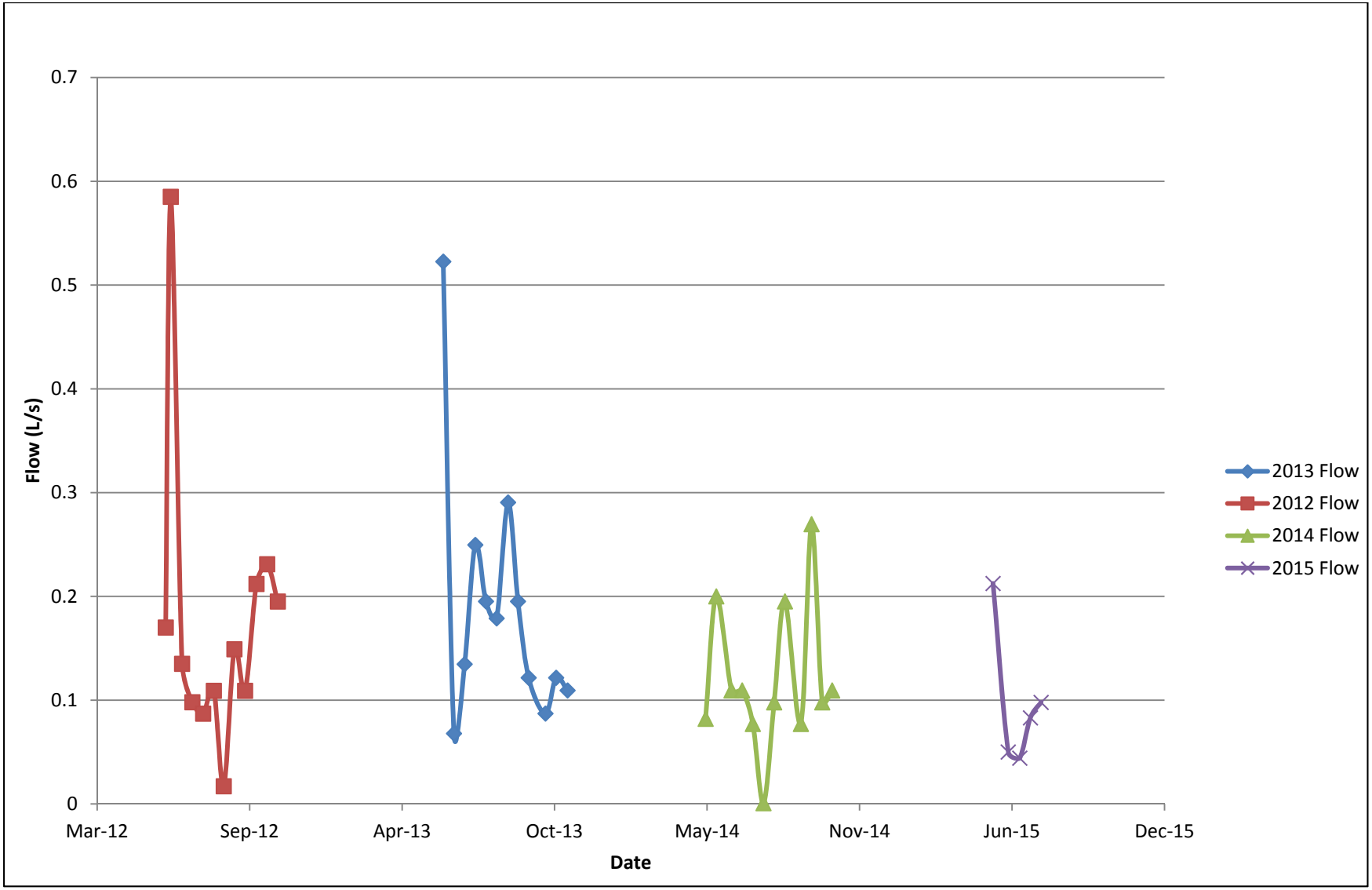
V31 (Drain 4)


0.3
0.25
0.2
0.15
0.1
0.05
0
Flow (L/s)
Mar-12
Sep-12
Apr-13
Oct-13
May-14
Nov-14
Jun-15
Dec-15
Date
2013 Flow
2012 Flow
2014 Flows
2015 Flow

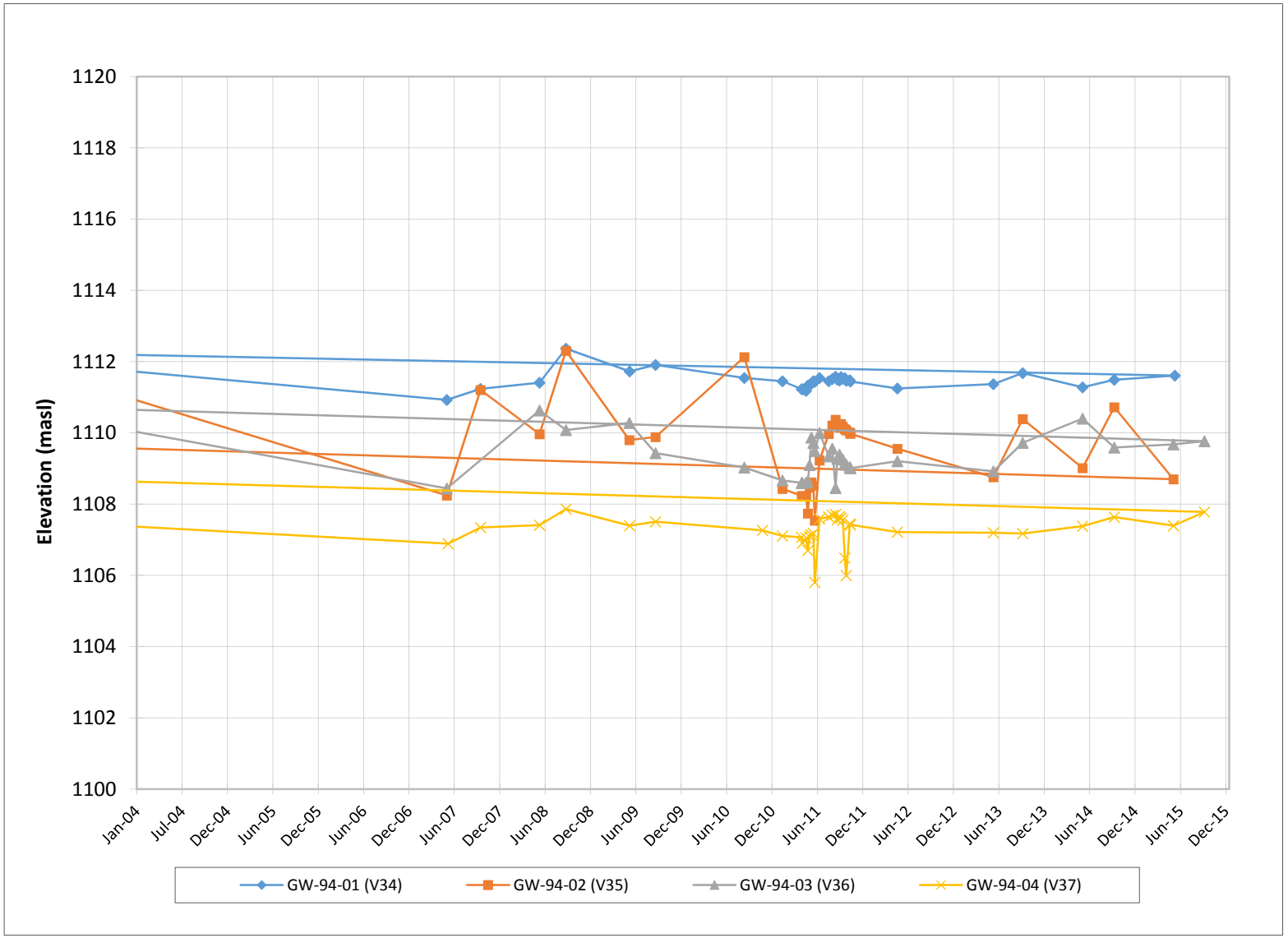
V32 (Drain 5)


0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Flow (L/s)
Jan-13
May-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Date
2013 Flow
2012 Flow
2014 Flows
2015 Flow

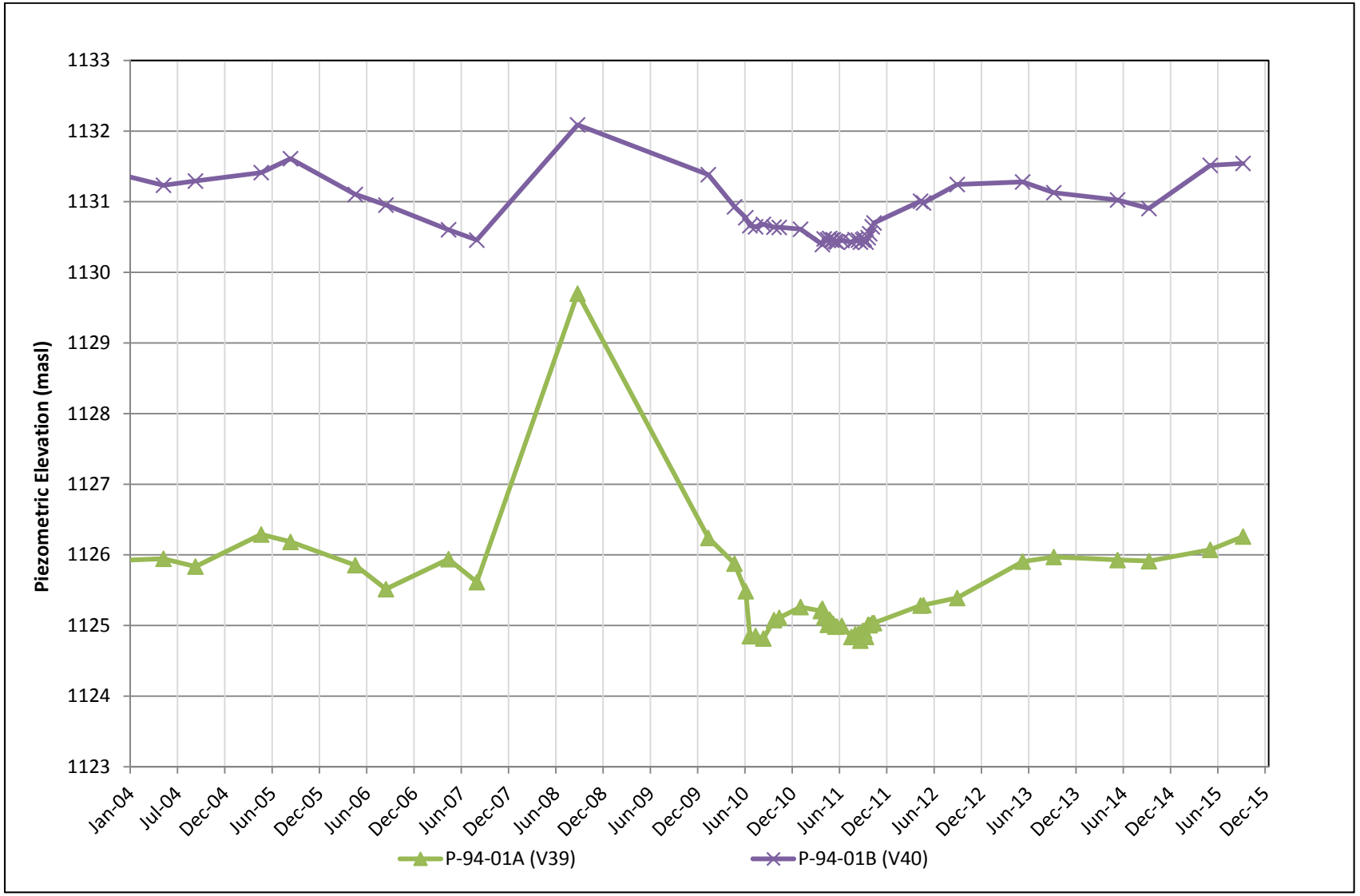
V33 (Drain 6)


0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Flow (L/s)
Mar-12
Sep-12
Apr-13
Oct-13
May-14
Nov-14
Jun-15
Dec-15
Date
2013 Flow
2012 Flow
2014 Flow
2015 Flow

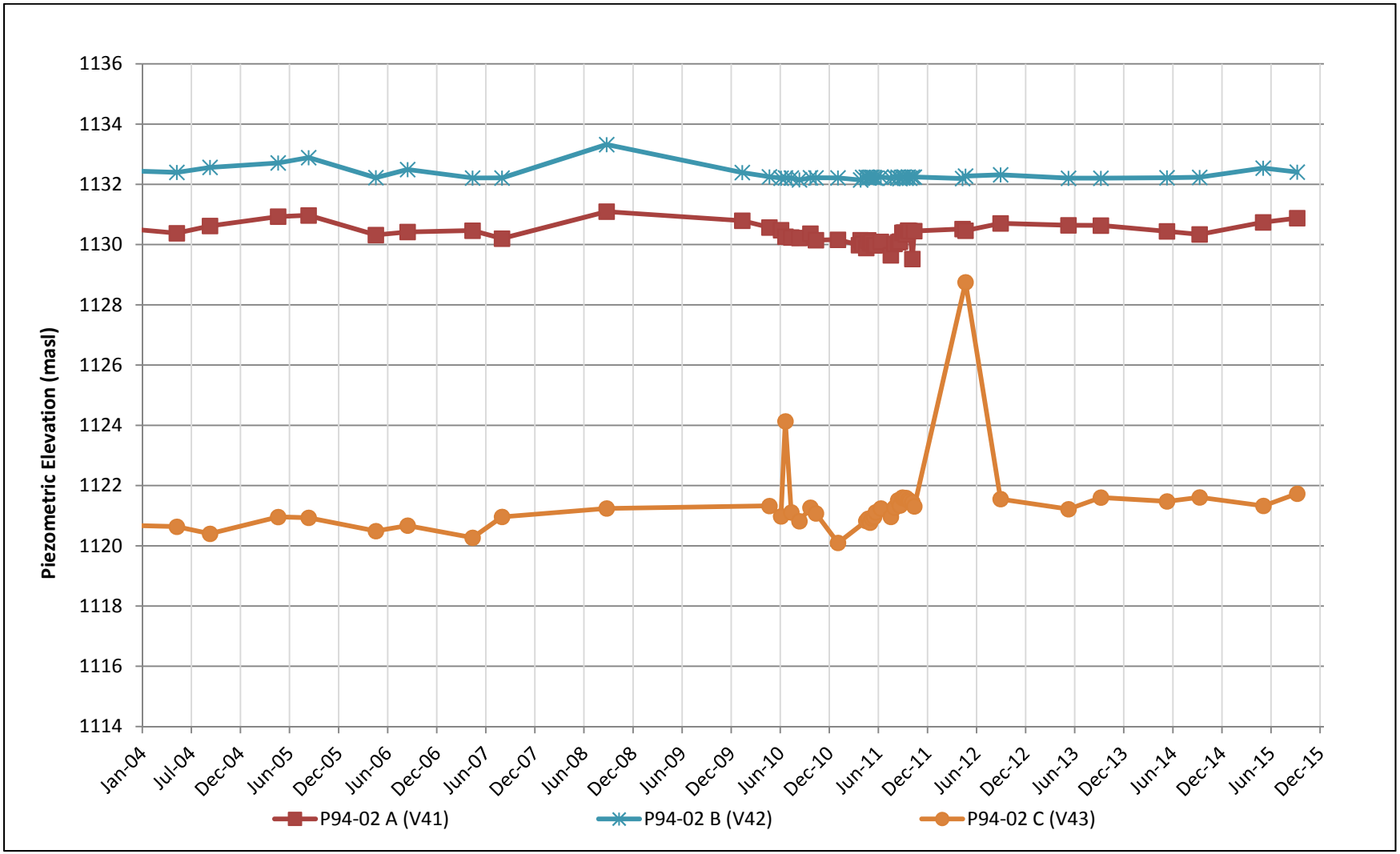
Vangorda Dump Toe Groundwater Elevations
V34, V35, V36, V37



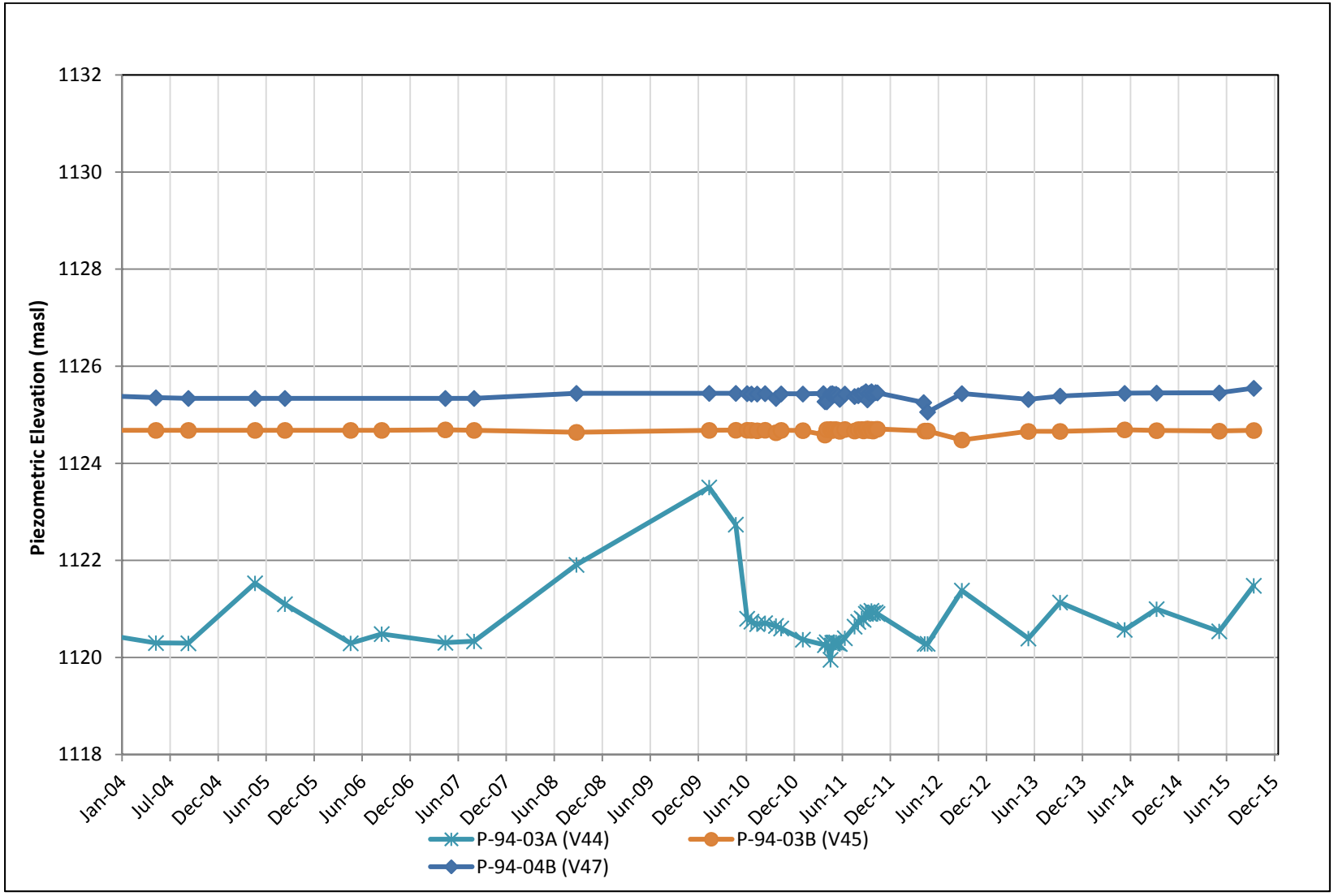
Vangorda Waste Rock Dump
Piezometric Elevations
P94-01A (V39), P94-01B (V40)



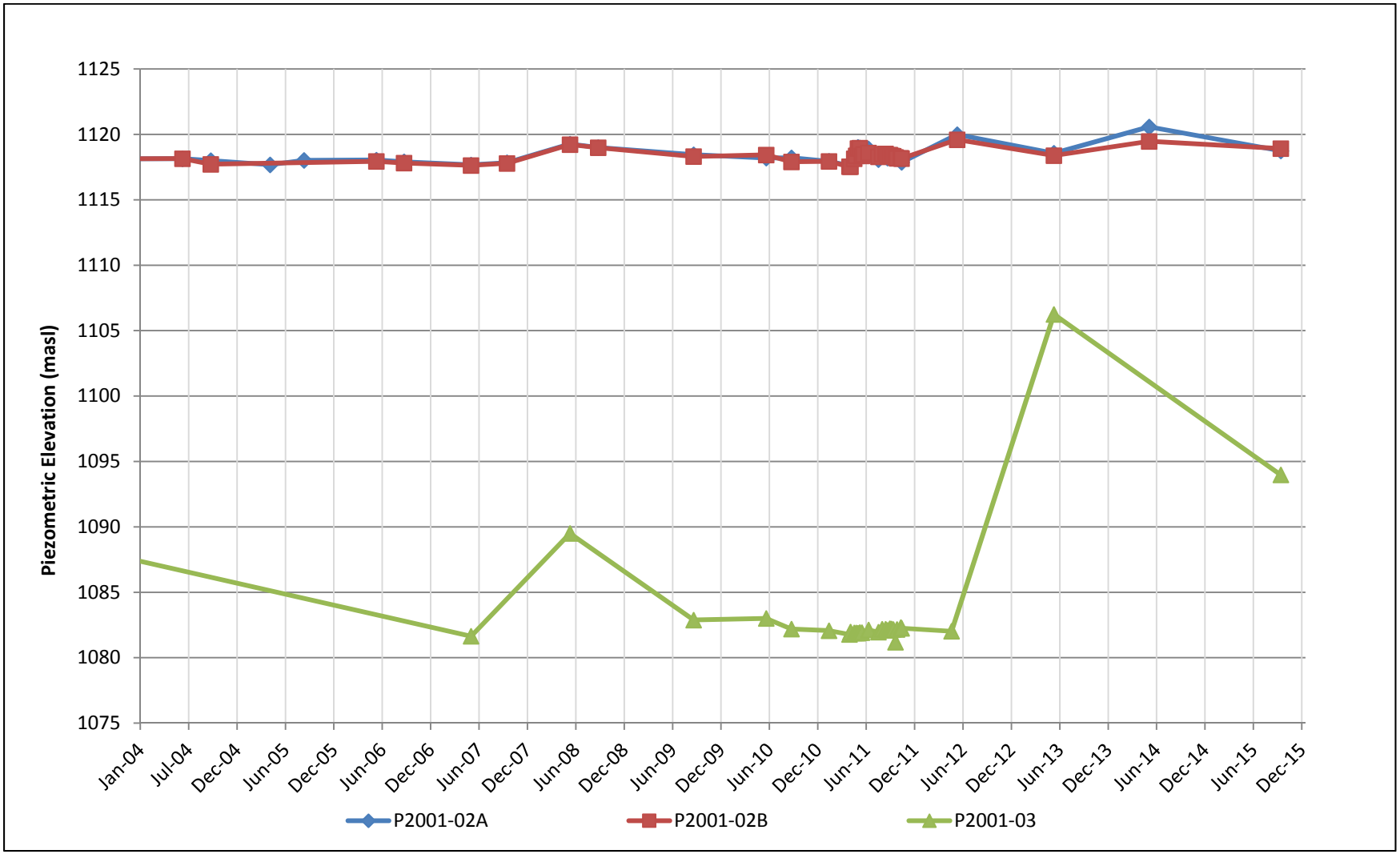
Vangorda Waste Rock Dump
Piezometric Elevations
V41, V42, V43



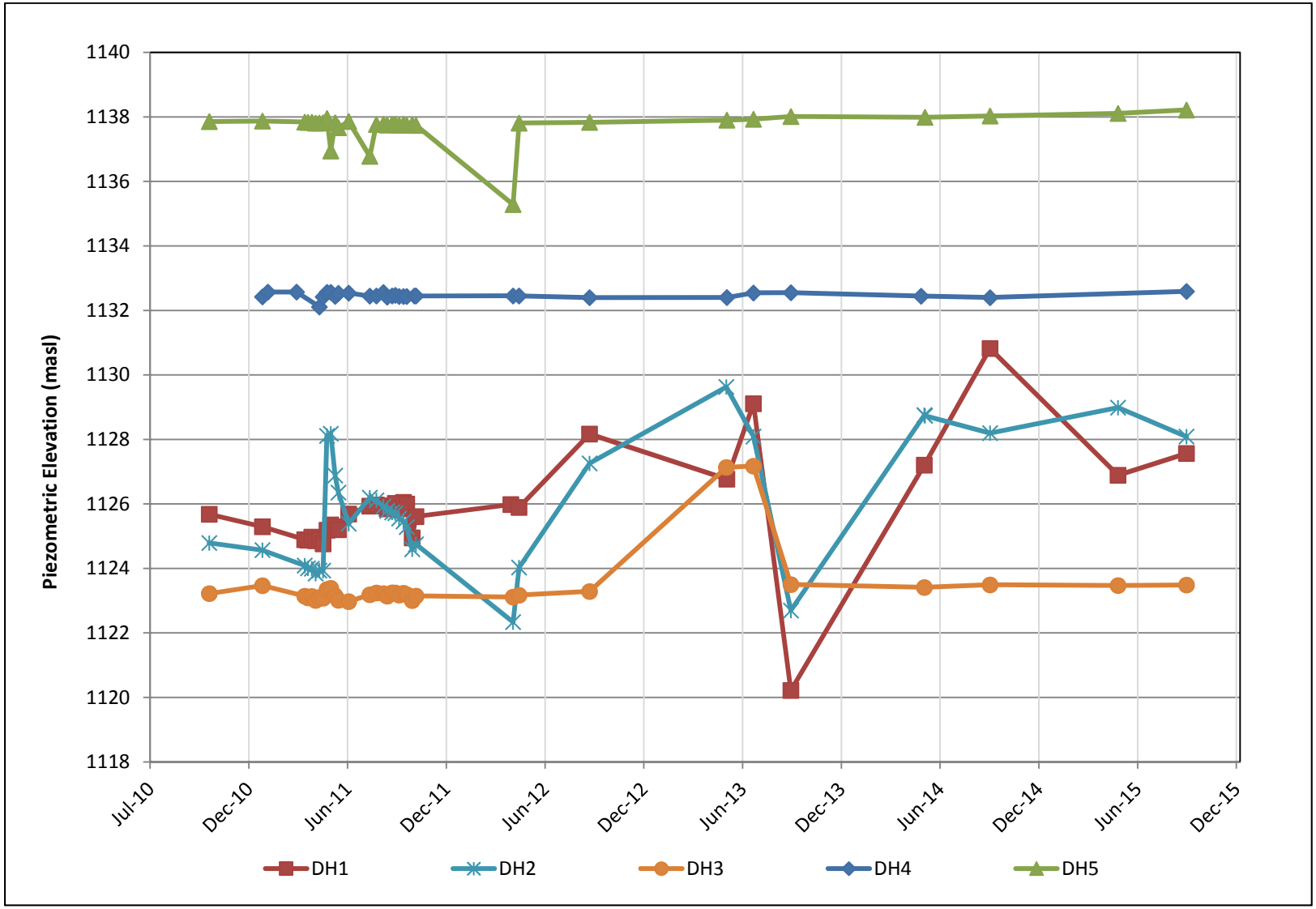
Vangorda Waste Rock Dump
Piezometric Elevations
V44, V45, V47



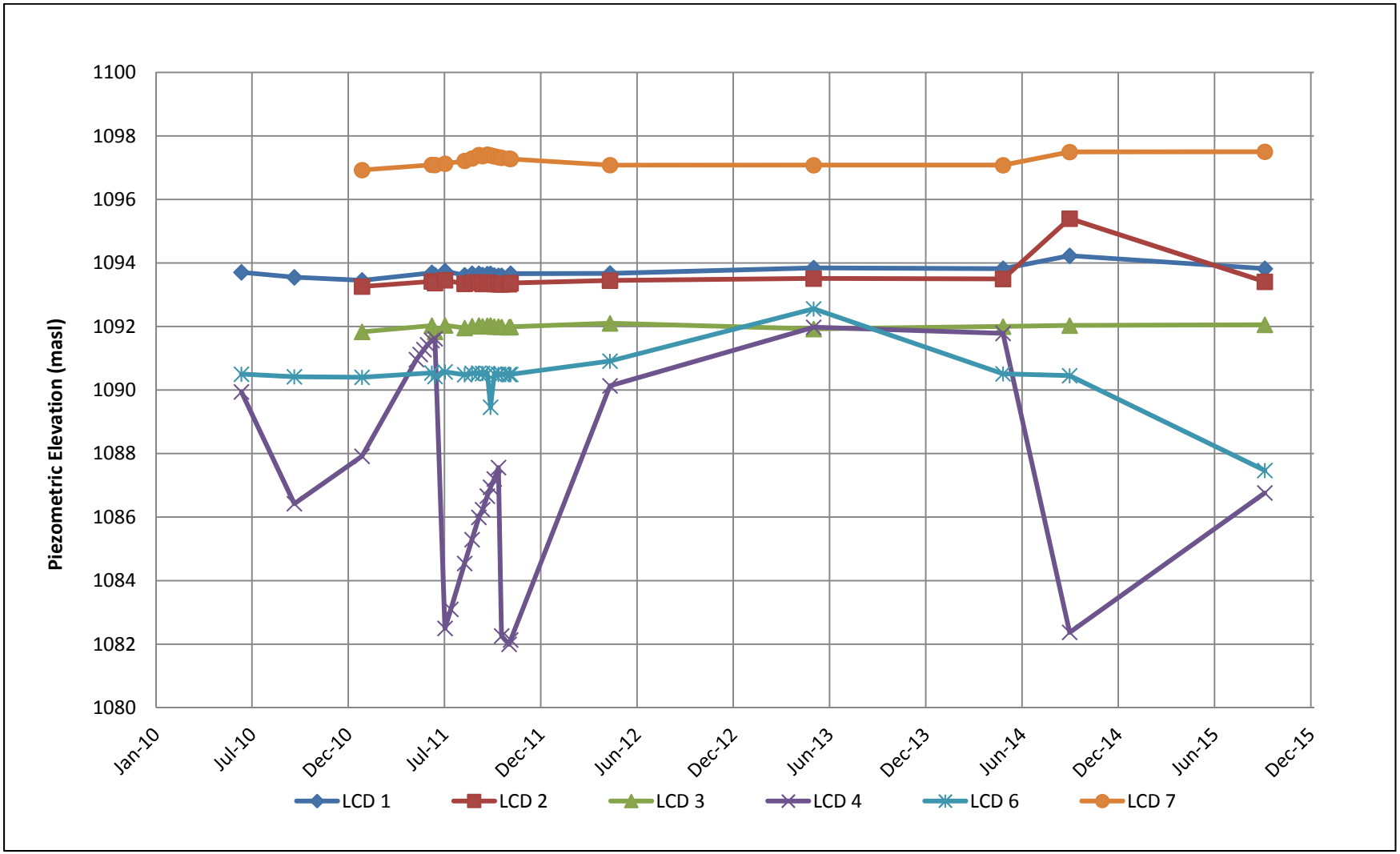
Vangorda Waste Rock Dump
Piezometric Elevations
P2001-02A, P2001-02B, P2001-03



Vangorda Waste Rock Dump
Piezometric Elevations
DH1, DH2, DH3, DH4, DH5, (PW-10-01, -02, -03, -04, -05)



Vangorda Waste Rock Dump
Piezometric Elevations
LCD 1, LCD 2, LCD 3, LCD 4, LCD 5, LCD 6, LCD 7

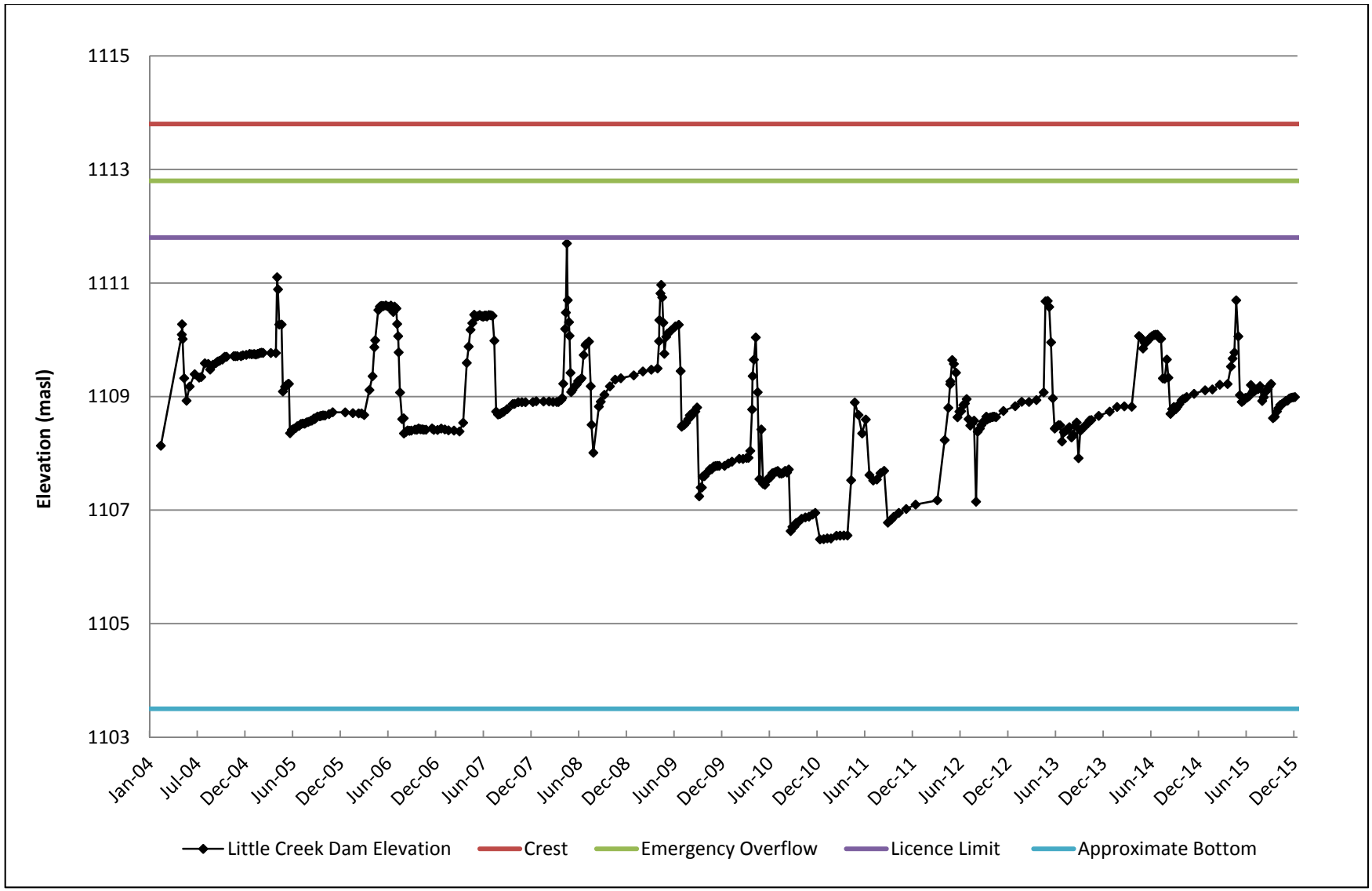


APPENDIX II-M

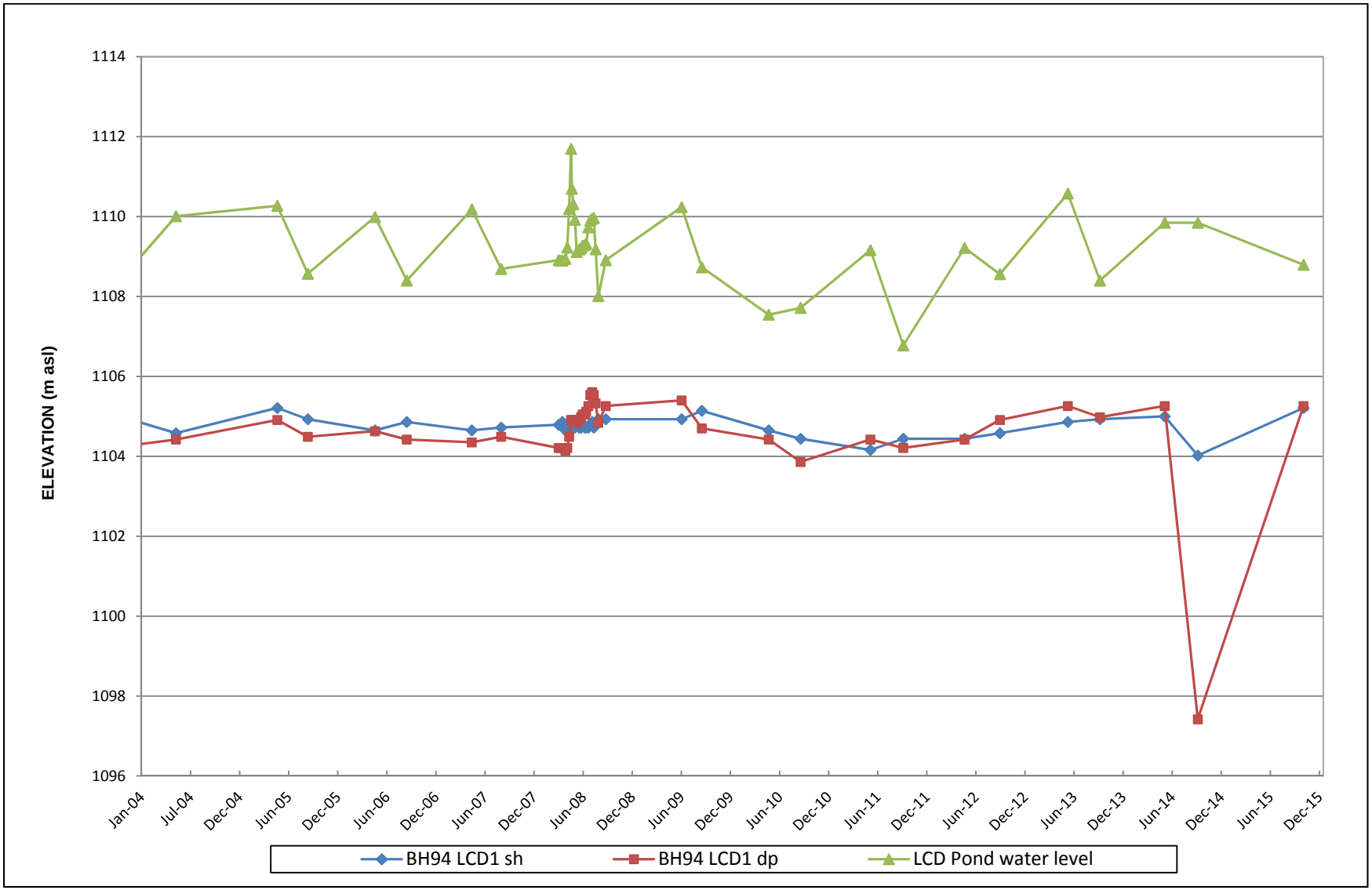
Little Creek Dam

M1 – Pond Level (Little Creek Pond)
M2 – Piezometers
M3 – Thermistors

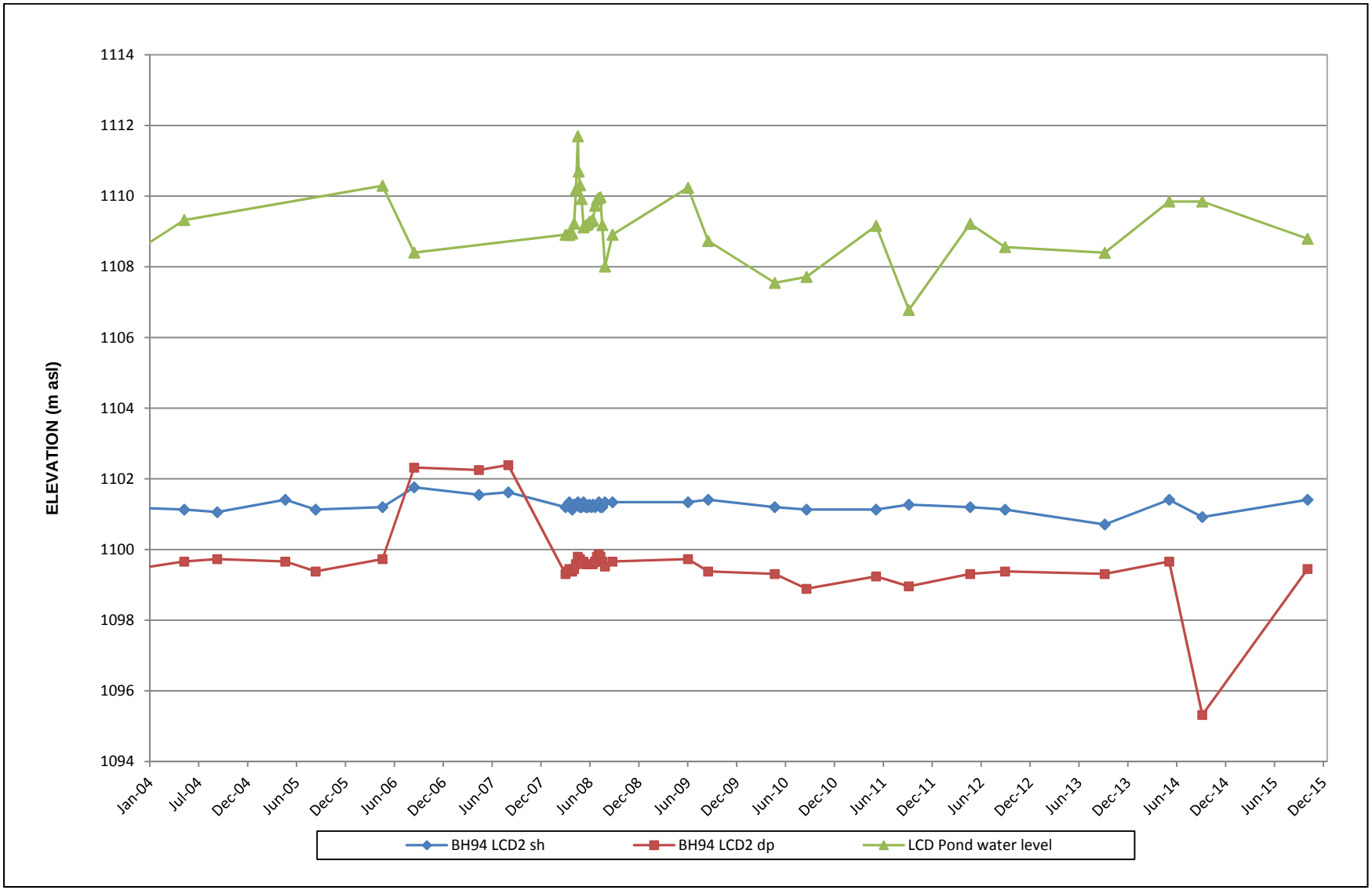
Little Creek Dam Pond Water Level



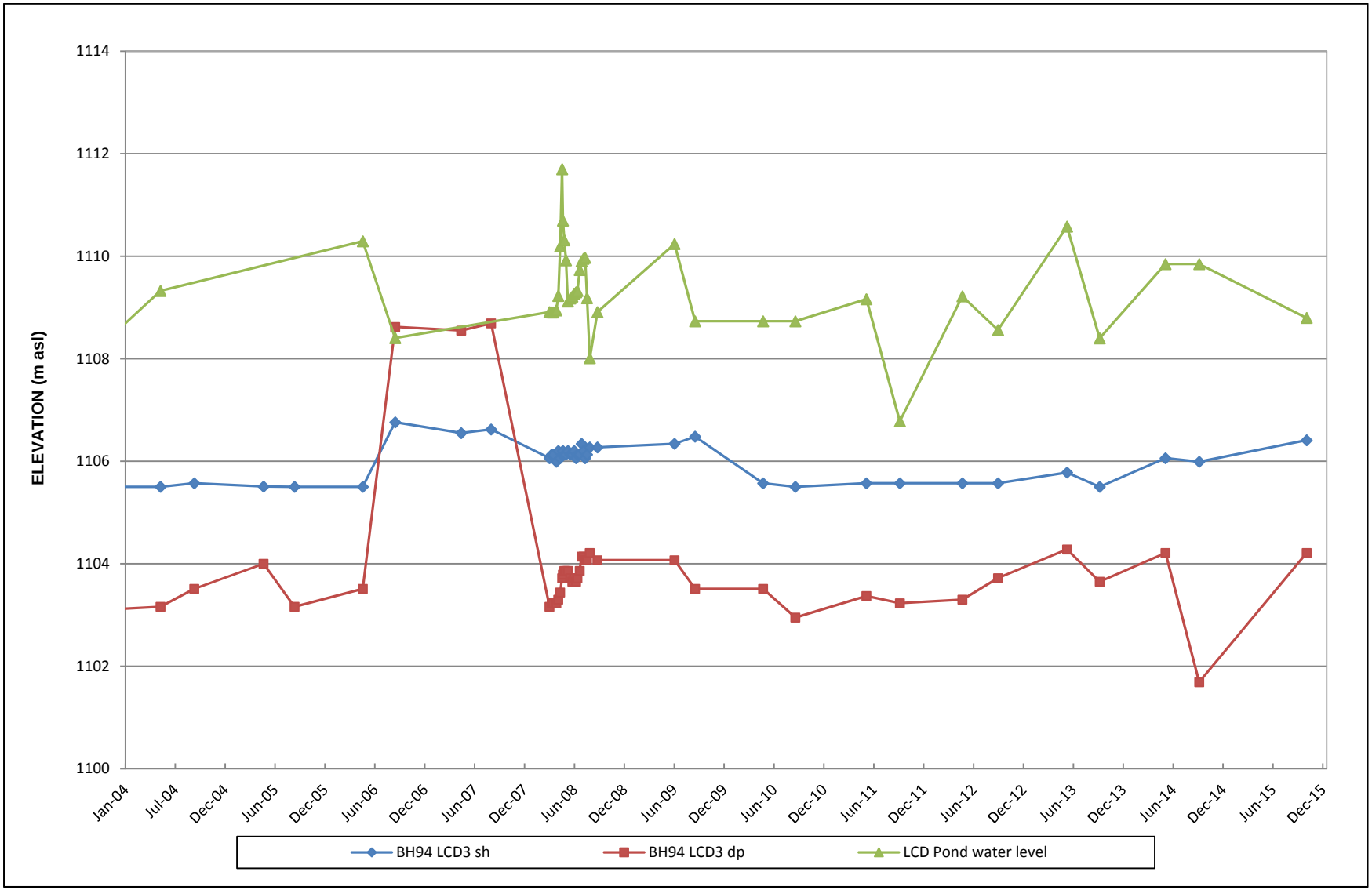
Little Creek Dam
Piezometer BH 94 LCD1



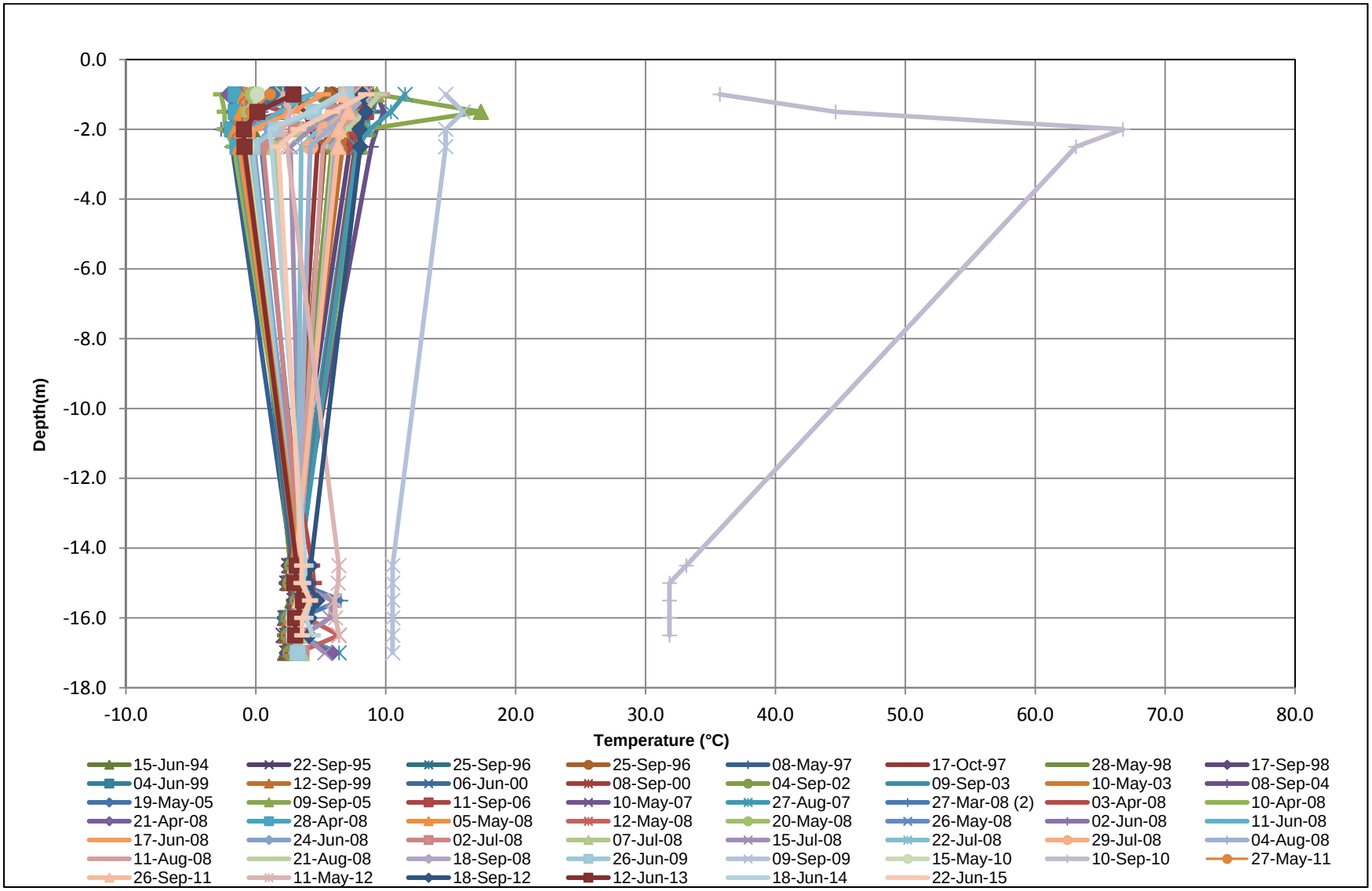
Little Creek Dam
Piezometer BH 94 LCD2



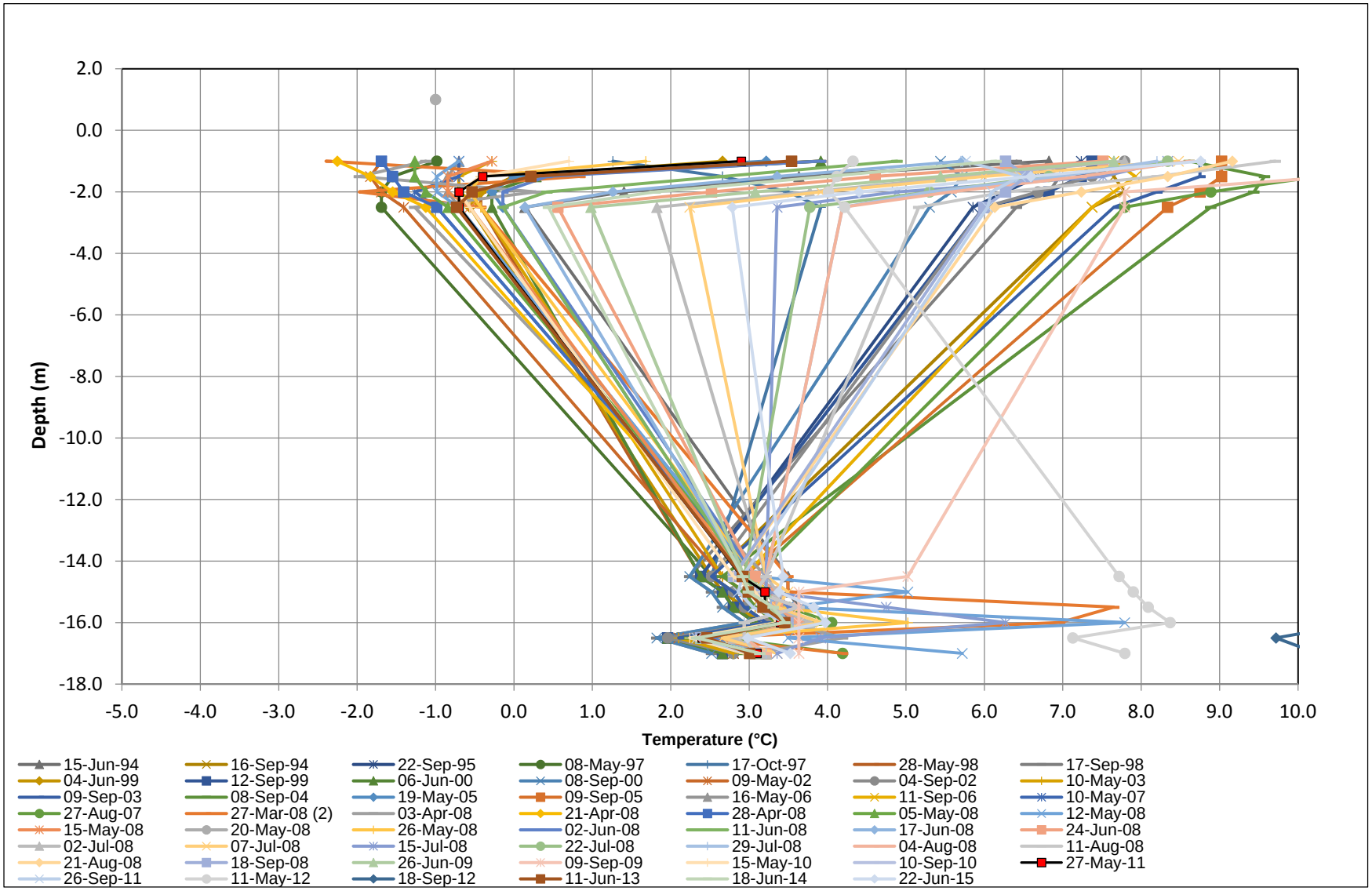
Little Creek Dam
Piezometer BH 94 LCD3



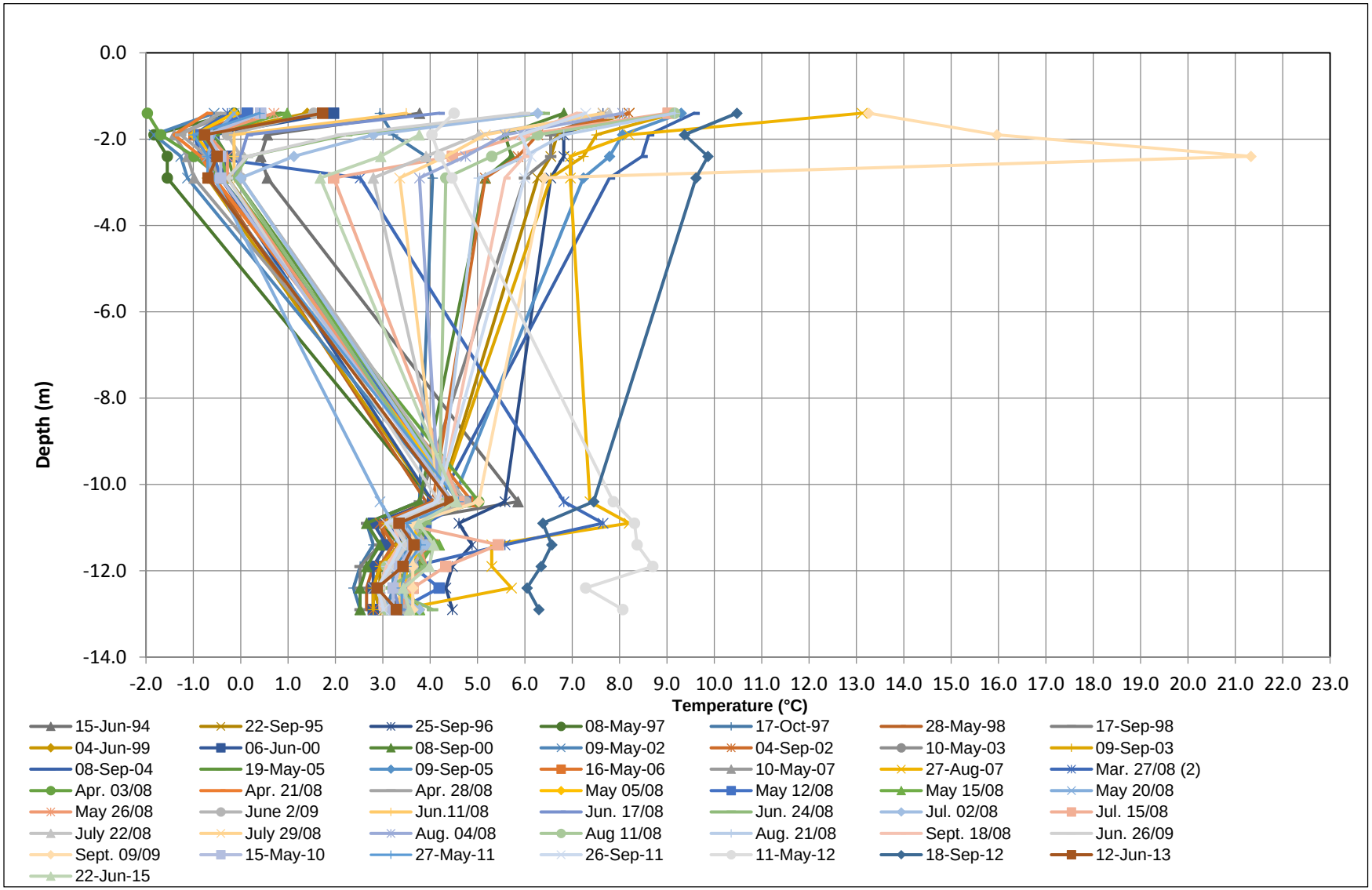
Little Creek Dam
Thermistor BH94 LCD4



Little Creek Dam
Thermistor BH94 LCD5



Little Creek Dam
Thermistor BH94 LCD6

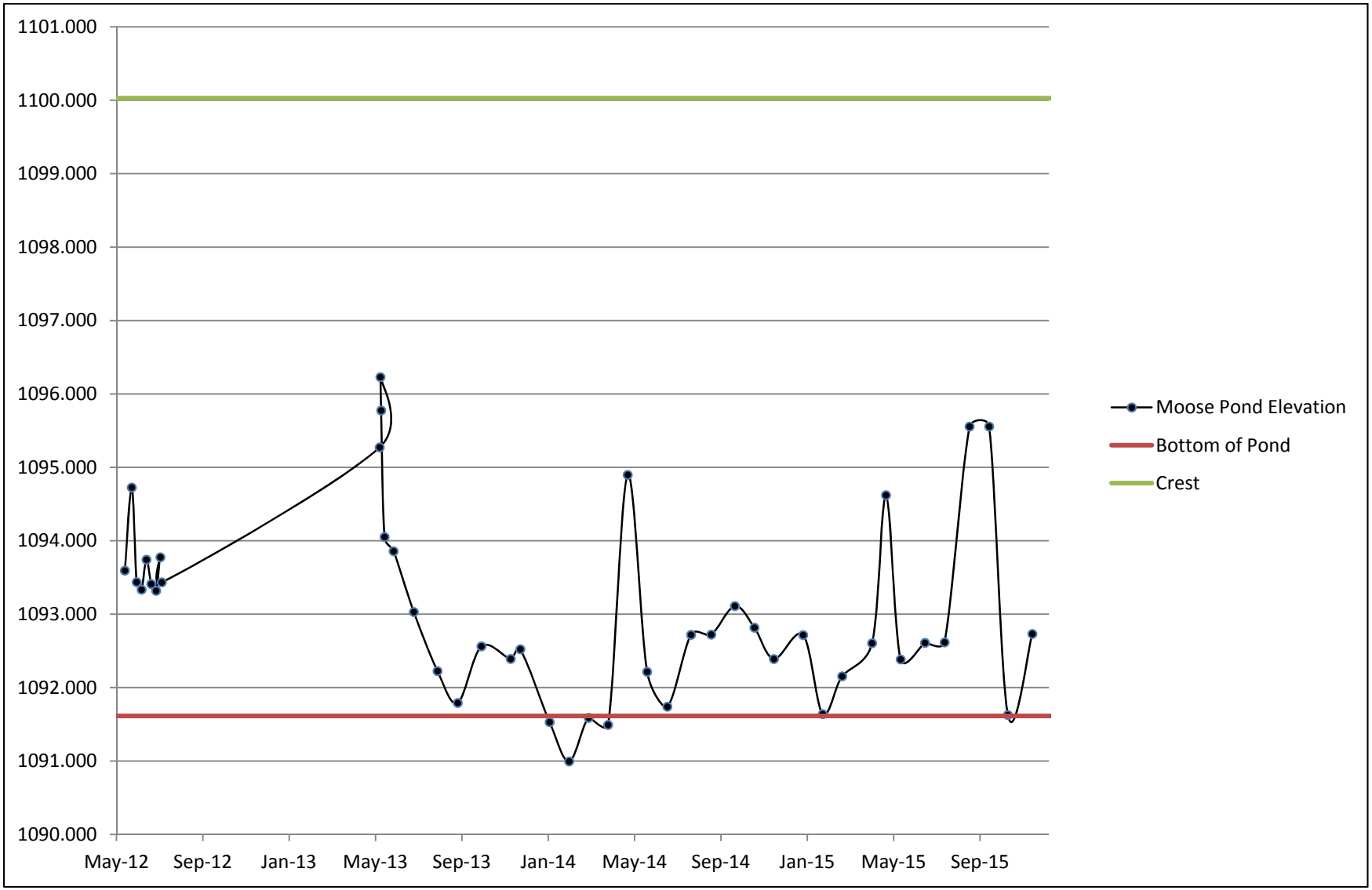


APPENDIX II-N

Moose Pond

N1 – Pond Level

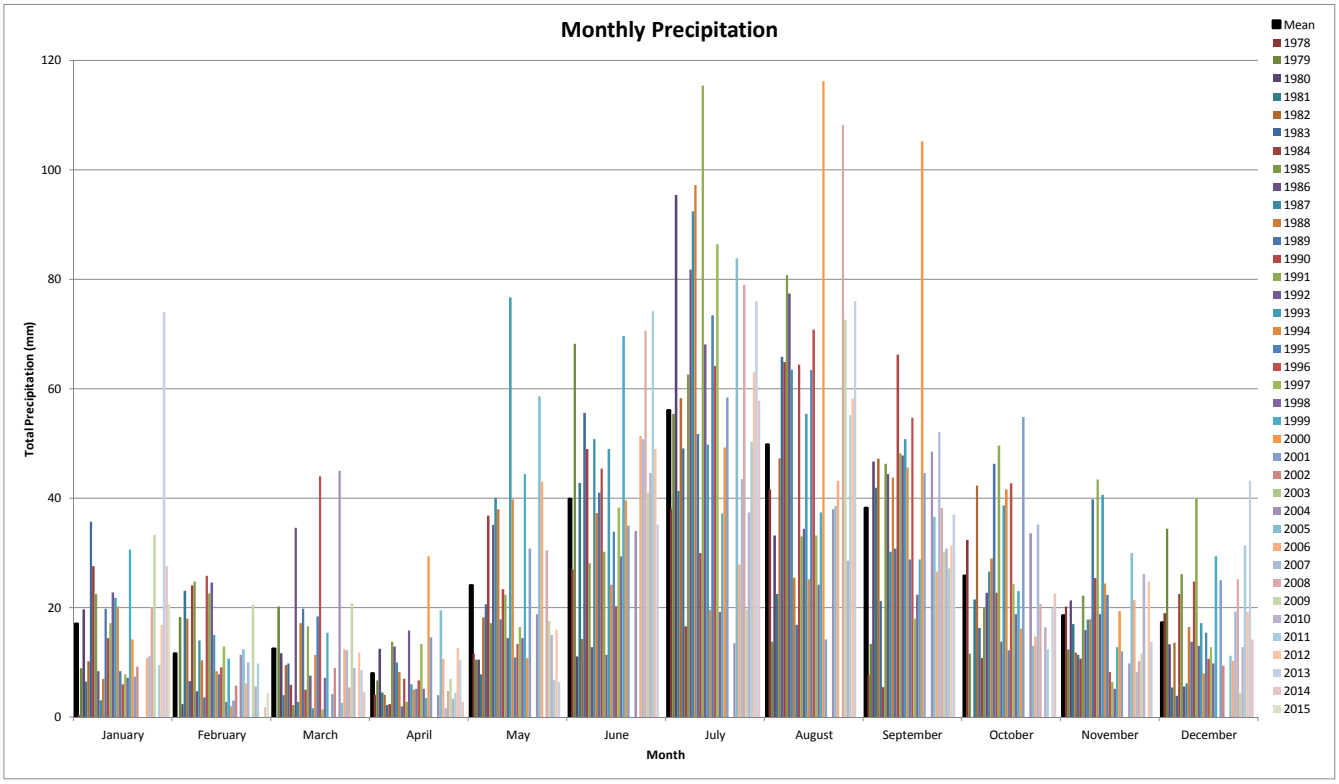
Moose Pond Elevations

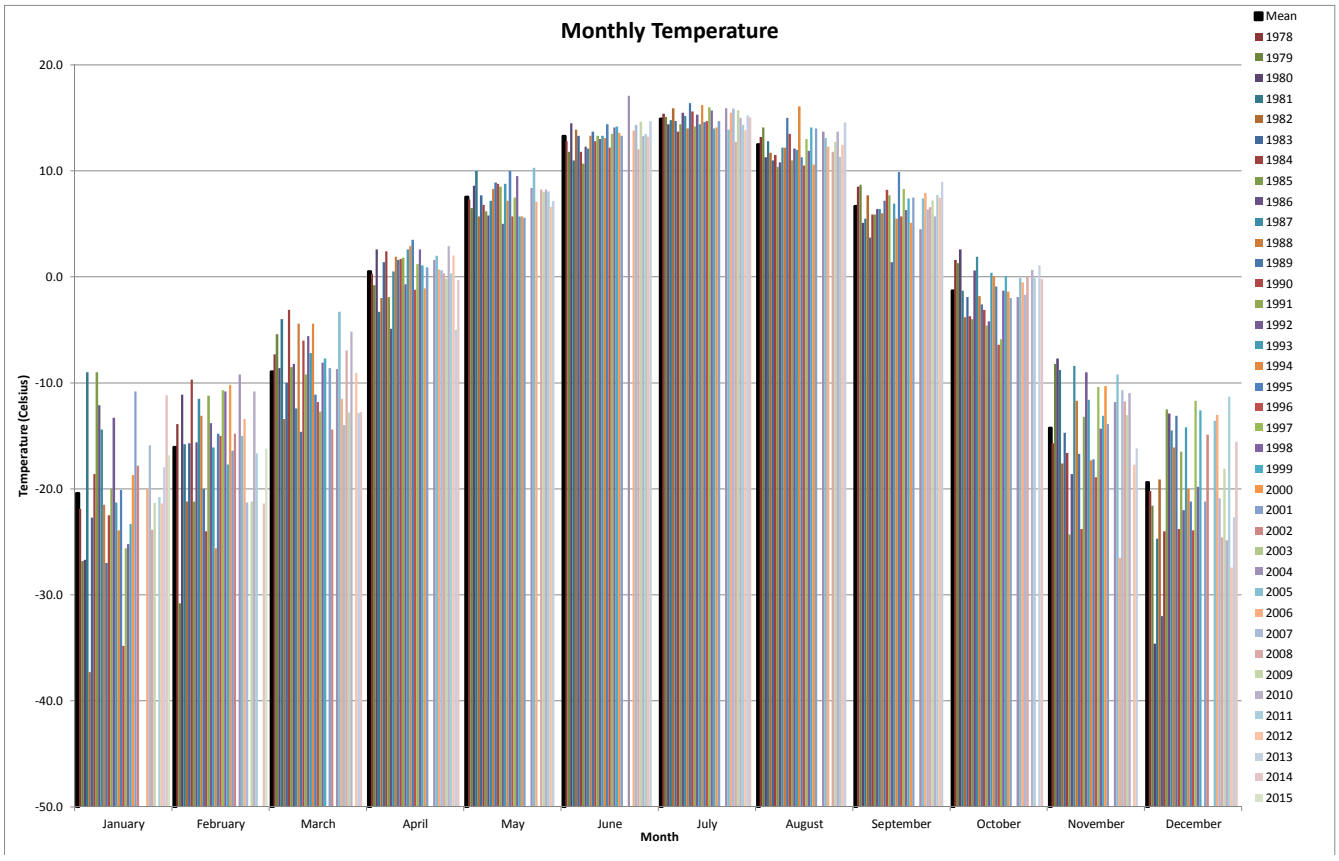


APPENDIX II-O

Faro Airport Climate

O1 – Monthly Precipitation/Temperature


Monthly Precipitation
Total Precipitation (mm)
120
100
80
60
40
20
0
January
February
March
April
May
June
July
August
September
October
November
December
Month
Mean
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015


Monthly Temperature
Temperature (Celsius)
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
January
February
March
April
May
June
July
August
September
October
November
December
Month
Mean
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015

APPENDIX III

Instrumentation Status and Monitoring Schedule

Table III.1 2016 Faro Mine Complex Geotechnical - Hydrotechnical Monitoring Program

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rose Creek Diversion Channel													
Thermistors	Canal Dyke: CD-10[2], CD-15[2], CD-21[2], BGC05-04, BGC05-07, CD-26						M						
	Spoil Pile[2]: SP-2, SP-3, SP-5						M						
	Backslope[2]: BS-5, BS-9, BS-10, BS-12						M			M			
Slope Indicators	Canal Dyke: CD-10, -15, -19, -21. BH94CD-1. BH91-CD1. BGC05-05, -08.	One successful reading for all inclinometers											
	Spoil Pile: SP-2, SP-5	One successful reading for all inclinometers											
	Backslope: BS-5, BS-9, BS-10	Two successful readings for all inclinometers: one in spring/summer, the other in fall											
Piezometers	Canal Dyke: CD-13, -15,-21. BGC05-02, -03, -06. CD-26.					M	M			M			
	Backslope: BS-5, BS-9					M	M			M			
Staff Gauges	RCDC-4				Daily	Daily	Daily	W	W	W			
Flows	RCDC-4 (Obtain one reading during high flow at freshet)				M	M	M	M	M	M	M		
Cross Valley Dam													
Thermistors	CVDC-6, BH88-4	Not required											
Piezometers	CVDC-4, -7, -9. CVDT-1, -2. CVDP-1, -3, -5, -6. 94 CVDC-1.					M	M			M			
Weir Flows	X11, X12, X13, Weir 3	W	W	W	W	W	W	W	W	W	W	W	W
Elevations	Polishing Pond	W	W	W	W	W	W	W	W	W	W	W	W
Visual Inspection	Visual Inspections of the dam and spillway as required in the water license.	W	W	W	W	W	W	W	W	W	W	W	W
Intermediate Dam													
Piezometers	91ID-3, -4, -6, -7. 94-IDC-1, 96-1, -2, -3, -4. P01-03, -04. BKS04-06, -07.					M	M			M			
Observe	Seepage observations near south abutment					M	M		M	M			
Elevations	Intermediate Pond	W	W	W	W	W	W	W	W	W	W	W	W
Visual Inspection	Visual Inspections of the dam and spillway.	W	W	W	W	W	W	W	W	W	W	W	W
Secondary Tailings Dam													
Piezometers	P81-6, P81-7, P81-8, P03-01, P03-02, P03-03					M	M			M			
North Fork Rock Drain													
Data loggers	NFRD23 (Relocate NFRD23 or establish new staff gauge downstream)				M	M	M	M	M	M	M		
Staff Gauges	NFRD23, X2 (Relocate NFRD23 or establish new staff gauge downstream)				Daily	Daily	W	W	M	M	M		
Flows	NFRD23, X2				M	M	M	M	M	M	M		
Pond Elevation	NF1, delete NF2					W	W	W	TAM	TAM			
Observe	NF1, NF2	M	M	M	M	M	M	M	M	M	M	M	M
K8 Rock Drain													
Observe						M	M	M					
Faro Creek Diversion Channel													
Staff Gauges	FCD-1, FCD-2, FCD-3, FCD-4				TAM	TAM	M	M	M	M	M		
Flows	FCD-1, FCD-2, FCD-3, FCD-4				TAM	TAM	M	M	M	M	M		
Faro Pit													
Measure	15356, 15717, 15355, 15737, 15354, 15742, 13908, 15352, 15351	Discontinued for safety reasons											
Observe	Faro Pit	M	M	M	M	M	M	M	M	M	M	M	M
Grum Pit													
Measure	GP-S1, -S2,-S3, -S4. GP-N1, -N2, -N3, -N4, -N5, -N6.	Discontinued for safety reasons											
Observe	Grum Pit Wall	M	M	M	M	M	M	M	M	M	M	M	M
Piezometers	SRK09-GSA, SRK09-GSB - reduced frequency from 2015					M	M			M			
Vangorda Pit													
Observe	Vangorda Pit Wall	M	M	M	M	M	M	M	M	M	M	M	M
Vangorda Waste Rock Dump													
Observe	Weirs: V28, V29, V30, V31, V32, V33					M	M	M	M	M	M		
Observe	Drainage Ditch						M						
Observe	Northeast Dump Crest						M						
Flows	V29, V30, V31, V32, V33					M	M	M	M	M	M		
Piezometers	V39, 40, 41, 42, 43, 44, 45, 46, 47. PW-10-01, -02, -03, -04, -05.					M				M			
Data loggers	PW-10-01, -02, -03, and -05 (DH1, DH2, DH3, DH5)					M				M			
Little Creek Dam													
Piezometers	BH94 LCD-1, BH94 LCD-2, BH94 LCD-3					M				M			
Thermistors	BH94 LCD-4, BH94 LCD-5, BH94 LCD-6	Not required											
Visual Inspection	Visual Inspections of the dam and spillway.	W	W	W	W	W	W	W	W	W	W	W	W
Vangorda Creek Diversion													
Observe	Trash Rack at Headworks				M	M	M	M	M	M			
Observe	Seepage Collection Pond				M	M	M						
Observe	Side Slopes Above Flume					M	M						
Sludge Pond Embankment													
Observe	Downstream slopes and embankment				M	M				M			
Fresh Water Pond													
Observe	Spillway from Fresh Water Pond to Grum Inteceptor Ditch					M				M			
Grum Interceptor Ditch and Sheep Pad Pond													
Observe	Outlets / Inlets to Ditch				M	M				M			
Measure	Sheep Pad Pond Survey Pin						M						
Observe	Sheep Pad Pond Dyke				M	M				M			

Notes: 1. M means monthly, W means weekly and TAM means twice a month. 2016 revisions are shown in red font.