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Burlington Quarry Extension

SURFACE WATER ASSESSMENT

Nelson Aggregate Co.

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1	April 2020	First Submission
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1 Introduction

Tatham Engineering Limited (Tatham) has been retained by Nelson Aggregate Co. (Nelson) to complete a surface water assessment of the proposed Burlington Quarry extension to identify potential impacts, if any, to the existing surface water features within the proposed licence boundary and the surrounding area and develop mitigative measures to address any potential impacts. This surface water assessment has been completed in accordance with the Terms of Reference for the Level 1 and 2 Hydrogeological and Hydrologic Impact Assessment of the Proposed Burlington Quarry Extension (February 2020). The Terms of Reference were prepared in consultation with Halton Region and Halton Conservation following the Halton Region Aggregate Resources Reference Manual, specifically Section 4.10 Water Resource Study. The following is a summary of the work undertaken in support of this surface water assessment:

- A comprehensive surface water monitoring program has been developed and implemented over the past six (6) years to establish existing baseline conditions for the surface water features on-site and in the surrounding area;
- An existing condition water balance has been generated and calibrated/verified to the existing surface water monitoring data collected to date to understand the seasonal hydrologic response of the surface water features to precipitation events and climatic conditions;
- A proposed condition water balance has been generated to predict potential seasonal impacts to the surface water features resulting from the proposed quarry extension;
- An existing condition event based hydrologic model has been created to understand the event based hydrologic response of the surface water features to precipitation events;
- A proposed condition event based hydrologic model has been created to predict potential event-based impacts to the surface water features resulting from the proposed quarry extension; and
- A surface water management strategy has been developed for the proposed quarry extension during and post extraction (during operations and after rehabilitation) to establish a protocol for monitoring the surface water features and identifying/investigating potential impacts, implementing mitigative measures, and managing surface water and intercepted groundwater on-site.

1.1 OBJECTIVES

The objective of this surface water assessment is to establish the existing form and function of the surface water features on-site and in the surrounding area and determine if the proposed quarry extension will have an adverse impact on the areas surface water regime and/or natural heritage features. If impacts are predicted, the objective is to determine if effective mitigative measures can be implemented to address the potential impacts of the proposed quarry extension during and post extraction (during operations and after rehabilitation) to protect the environment. If the potential impacts can be effectively mitigated, the objective is to establish a protocol to monitor the surface water and natural heritage features, to identify and investigate potential impacts, and for implementing the mitigative measures.

1.2 EXISTING PERMITS AND APPROVALS

Burlington Quarry currently operates under the authority of a Permit to Take Water and Environmental Compliance Approval allowing surface water and intercepted groundwater to be collected, treated and disposed of off-site at specified rates and volumes. The Quarry's existing PTTW and ECA are outlined in the following sections.

1.2.1 Permit to Take Water (PTTW)

Nelson is authorized to withdraw water in accordance with Permit to Take Water No. 96-P-3009 issued by the Ministry of Environment and Energy April 29, 1996. PTTW No. 96-P-3009 is enclosed in Appendix A for reference. Water may be taken from Quarry Sump 0100 and 0200 in accordance with Schedule "A" of the permit at rates of 4,090 L/minute (5,889,600 L/day) and 945 L/minute (1,360,800 L/day), respectively. Water taken from Quarry Sump 0100 is discharged northwest to the roadside ditch along Colling Road which drains into a tributary of Willoughby Creek north of Colling Road. Water Taken from Quarry Sump 0200 is discharged southeast across No. 2 Sideroad to the upstream end of the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek.

In addition to specifying the maximum allowable water taking rates and volumes, PTTW No. 96-P-3009 requires Nelson to:

- Measure, record and submit the quantities of water taken daily to the Ministry;
- Notify the Ministry of any complaints arising from the water taking; and
- Address any negative impacts caused by the water taking.

The water taking data measured, recorded and submitted by Nelson since 2012 is summarized in the following table.

Table 1: Water Taking Summary

YEAR	QUARRY SUMP 0100		QUARRY SUMP 0200	
	No. of Days of Taking	Total Volume Taken (L)	No. of Days of Taking	Total Volume Taken (L)
2012	137	728,518,015	44	44,369,337
2013	340	1,726,244,854	32	33,418,027
2014	315	1,740,945,251	292	234,427,013
2015	220	851,636,148	0	0
2016	363	1,571,892,181	0	0
2017	38	170,429,151	0	0
2018	337	1,941,120,000	204	264,384,000
2019	245	1,398,165,080	127	127,028,257

Following several significant rain events, a temporary amendment to the PTTW was issued by the Ministry August 13, 2014 increasing the maximum water taking from Quarry Sump 0100 to 8,200 L/minute. The PTTW amendment included a condition restricting the water taking to 4,090 L/minute (original maximum allowable water taking rate) on days when rainfall depths exceeded 10 mm. The amendment expired September 30, 2014 and the quarry has operated under the authority of PTTW No. 96-P-3009 since.

1.2.2 Environmental Compliance Approval (ECA)

Environmental Compliance Approval Number 5203-AN6NGV was issued by the Ministry of the Environment and Climate Change to Nelson June 29, 2017. ECA Number 5203-AN6NGV is enclosed in Appendix A for reference. The ECA was issued for the collection, transmission, treatment and disposal of surface water and quarry water from the Burlington Quarry. Specifically, the ECA authorizes Burlington Quarry to discharge off-site. The ECA permits Nelson to operate the sewage works constructed within the Burlington Quarry as follows:

- A settling pond, referred to as the North Pond, which collects groundwater and surface water from the existing quarry, directs the water to Quarry Sump 0100 where it is pumped off-site at specified rates to the roadside ditch along Colling Road which drains into a tributary of Willoughby Creek; and

- A settling pond, referred to as the South Pond, which collects groundwater and surface water from the existing quarry, directs the water to Quarry Sump 0200 where it is pumped off-site at specified rates across No. 2 Sideroad to the upstream end of the West Arm of the Branch of the Mount Nemo Tributary of Grindstone Creek.

As a condition of the ECA, Nelson is required to conduct an effluent monitoring program to confirm the effluent discharge from the quarry remains in compliance with the concentration limits stipulated within the ECA. The ECA requires monthly and quarterly (once every three months) effluent grab samples be collected from the two off-site discharges and analyzed for a variety of parameters to confirm compliance. In addition, quarterly field temperature monitoring is required at the various key points of interest downstream of the Quarry Sump 0100 discharge location to assess seasonal impacts.

In addition to specifying the effluent monitoring program requirements and concentration limits, ECA Number 5203-AN6NGV requires Nelson to:

- Adhere to strict sampling, analysis and recording methods and protocols;
- Operate and maintain the sewage works in accordance with an established protocol;
- Implement a spills contingency and pollution prevent plan to mitigate any potential impacts related to spills; and
- Prepare and submit an annual performance report to the Ministry summarizing the effluent monitoring completed, inspection and maintenance actions conducted, complaints received and spills that occurred the previous year.

1.3 ADDITIONAL STUDIES

In support of the of proposed Burlington Quarry extension, the following documents have been prepared which are referenced in this surface water assessment:

- *Level 1 and Level 2 Hydrogeological Assessment – Proposed Burlington Quarry Extension, Nelson Aggregates Co.* Earthfx Incorporated (April 2020);
- *Natural Environment Technical Report – Nelson Aggregate Burlington Quarry Extension.* Savanta (April 2020);
- *Karst Investigation and Conceptual Model of Proposed Nelson Quarry Extensions.* Worthington Groundwater (April 2020); and
- *Adaptive Management Plan – Proposed Burlington Quarry Extension, Nelson Aggregates Co.* Earthfx Incorporated and Tatham Engineering Limited (April 2020).

2 Surface Water Monitoring

A surface water monitoring program has been developed and implemented over the past six (6) years to establish existing baseline conditions for the surface water features on-site and in the surrounding area. The surface water monitoring program includes streamflow, wetland hydroperiod, and shallow groundwater continuously recording monitoring locations and quarterly manual in-situ streamflow measurements and water quality sampling. The surface water monitoring locations are illustrated on the Surface Water Monitoring Locations Plan (Drawing SW-1) enclosed and are summarized in the following tables.

Table 2: Existing Streamflow Monitoring Locations

MONITORING LOCATION	NORTHING	EASTING	WATERSHED
SW1	4805833	589015	Bronte Creek
SW2	4806693	587340	Bronte Creek
SW6	4805071	590629	Grindstone Creek
SW7	4805441	588320	Bronte Creek
SW9	4805317	591235	Grindstone Creek
SW10	4803358	591283	Grindstone Creek
SW14	4804107	589227	Bronte Creek
SW15	4806484	589550	Bronte Creek
SW21	4803072	593686	Shoreacres Creek
SW22	4803267	593833	Shoreacres Creek
SW23	4803520	594087	Shoreacres Creek
SW24	4803691	594181	Shoreacres Creek
SW25	4804324	594708	Shoreacres Creek
SW26	4804448	594803	Shoreacres Creek

Table 2: Existing Streamflow Monitoring Locations (continued…)

MONITORING LOCATION	NORTHING	EASTING	WATERSHED
SW28	4803823	591609	Grindstone Creek
SW29	4804364	590180	Grindstone Creek
SW30	4809849	589826	Bronte Creek
SW31	4809367	592092	Bronte Creek
SW34	4806102	594154	Appleby Creek
SW35	4805699	594624	Appleby Creek

Table 3: Existing Wetland Hydroperiod / Shallow Groundwater Monitoring Locations

MONITORING LOCATION	NORTHING	EASTING	WETLAND
SW5	4805331	591477	13031
SW11	4805245	591177	13027
SW12	4805393	591127	13022
SW13	4805707	590935	13016
SW16	4804900	590889	13037

The existing wetland hydroperiod and shallow groundwater monitoring locations are differentiated by the naming convention A and B, respectively. For example, SW5A represents the wetland hydroperiod monitoring location in wetland 13031 while SW5B represents the shallow groundwater monitoring in this wetland.

Table 4: Existing Water Quality Sampling Summary

WATER SAMPLING LOCATIONS	SAMPLING FREQUENCY	PARAMETERS
SW1, SW2, SW6, SW10, SW14, SW15, SW24, SW28, SW29, SW30, SW31, SW32, SW35	Quarterly	Dissolved Organic Carbon, Ammonia, Alkalinity, BOD, COD, Conductivity, Total Hardness, Total Metals, Turbidity, Total Dissolved Solids, Total Suspended Solids, pH, Carbonate, Bicarbonate

In addition to the streamflow monitoring locations identified in Table 1, quarterly manual in-situ streamflow measurements are collected from 38 locations surrounding the existing Burlington Quarry (SW3 and M1 through M37). Also, the Natural Environment Technical Report (NETR) completed in support of the proposed extension identified two additional wetlands within the west extension area. Wetland hydroperiod and shallow groundwater monitoring stations will be established in the wetlands in the spring of 2020.

2.1 STREAMFLOW MONITORING

Over the past six (6) years, streamflow monitoring locations have been established on-site and in the surrounding area to establish existing baseline conditions for the various watercourses in the area. A continuously recording pressure transducer measuring water level and water temperature and a water level staff gauge has been installed in each watercourse at each streamflow monitoring location. Manual in-situ streamflow measurements are collected monthly at each streamflow monitoring location along with a staff gauge water level measurement and temperature reading. Rating curves (streamflow versus water level) have been developed for each streamflow monitoring location from the collected field measurements allowing streamflow to be calculated from the continuously recorded water level data. The field measurements are also used to calibrate the continuously recording pressure transducer data.

The streamflow monitoring data collected to date is summarized in the following sections. For the purpose of this report, September 15, 2019 was selected as the end of the reporting period for the monitoring data. However, monitoring continued throughout 2019 and will continue moving forward.

2.1.1 Bronte Creek Watershed

The existing Burlington Quarry and a portion of the west extension lands are located in the Bronte Creek Watershed. Quarry Sump 0100 discharges to the roadside ditch along Colling Road which drains southwest to a wetland feature (weir pond wetland 13202) located in the northeast corner of the Burlington Springs Golf and Country Club (BSGCC) property and the west extension lands. A weir structure constructed by the BSGCC maintains water levels in the wetland, maintains flow downstream to a tributary of Willoughby Creek and diverts flow to a series of constructed irrigation ponds on the golf course via a diversion channel.

As part of the golf course construction (between 1962 and 1965), an irrigation pond, the diversion channel and the weir structure were constructed. From the available aerial photographs of the area, the irrigation pond, diversion channel and weir structure did not exist prior to the golf course construction. The construction of the weir structure created a pond, also referred to as wetland 13202, upstream of Colling Road. Between 1972 and 1979, a second irrigation pond was constructed; connected to the first irrigation pond and diversion channel in series. In 2001, BSGCC applied for an amendment to their PTTW and a Niagara Escarpment Development Permit for the construction of an additional three (3) irrigation ponds to reduce their reliance on the discharge from the existing Burlington Quarry. PTTW 00-P-3072 issued to BSGCC allowed water to be taken from the irrigation ponds with the following conditions:

- The weir structure be modified to convey a minimum flow of 2 L/s downstream of the weir pond (wetland 13202) to the tributary of Willoughby Creek before any water is diverted to the BSGCC irrigation ponds via the diversion channel;
- The minimum water elevation before diversion of flow occurs is 269.20 m; and
- The required improvements to the weir structure be completed prior to December 31, 2011 and a report summarizing the works and describing the monitoring undertaken to confirm the above conditions are satisfied be submitted to the Ministry.

The three (3) additional irrigation ponds were constructed 2001. It is understood that a by-pass structure consisting of a head box connected to a by-pass pipe was installed in the weir pond (wetland 13202) in 2003 to convey a minimum flow of 2 L/s to the tributary of Willoughby Creek. The diversion of flow occurs at an elevation of 269.27 m.

Downstream of Colling Road, the tributary of Willoughby Creek flows northwest approximately 550 m to a karst sinkhole. As per the Karst Investigation and Conceptual Model of the Proposed Quarry Extensions (Worthington Groundwater, April 2020), the sink and sinking stream at this location is connected to two springs northeast of Cedar Springs Road. The first spring (identified as J in the Karst Investigation) daylights to the tributary of Willoughby Creek approximately 250 m northwest of Colling Road. Between the sink and spring, the tributary of Willoughby Creek is reduced to an overland flow path that is expected to convey flow only when the tributary flow exceeds the capacity of the sink. From the spring, water flows southwest to Cedar Springs Road and a concrete box culvert approximately 250 m north of Colling Road. The tributary connects to Willoughby Creek approximately 250 m southwest of Cedar Springs Road. The second spring (identified as K in the Karst Investigation) daylights to the escarpment face and an online pond on Willoughby Creek approximately 600 m north of Colling Road.

Willoughby Creek originates approximately 2,300 m upstream of the confluence with its tributary. Willoughby Creek is located in the floor of the Medad Valley and flows northwest through the Medad Valley wetland to the confluence with its tributary. Willoughby Creek flows northwest from its confluence with its tributary, through a series of online ponds, across several properties and back and forth across Cedar Springs Road three times to Britannia Road. Willoughby Creek crosses Britannia Road and Grand Boulevard before connecting with Bronte Creek approximately 900 m northwest of Britannia Road.

Within the Bronte Creek watershed, seven (7) streamflow monitoring locations have been established since 2013. The results of the monitoring collected from each streamflow monitoring location are summarized in the following section. The streamflow and water temperature monitoring data for the streamflow monitoring locations in the Bronte Creek watershed are summarized in Appendix B.

Monitoring Location SW1

Streamflow monitoring location SW1 was established in July 2015 and is located in the weir pond (wetland 13202) downstream of the Quarry Sump 0100 discharge. SW1 measures the flow through the weir structure to the tributary of Willoughby Creek downstream. The quarry discharge occurs year-round, maintaining sufficient water depth and flow at SW1 to prevent freezing of the pressure transducer during the winter months. As such, the continuously recording pressure transducer typically remains installed year-round to capture the flows at the upstream end of the tributary of Willoughby Creek.

The monitoring data collected to date shows how the tributary of Willoughby Creek and golf course irrigation is dependant on the quarry discharge. Outside the spring freshet and significant storm events, flow leaving the weir pond (wetland 13202) via the weir structure is less than the measured quarry discharge due to the diversion of flow to the golf course for irrigation. Since 2015, there are several occasions where zero flow passed through the weir structure when the quarry was discharging from Quarry Sump 0100 and when the discharge had ceased. This trend continued in 2018 and 2019 when the quarry generally maintained a discharge from Quarry Sump 0100 at a rate of 68 L/s (permitted 4,090 L/min). Its noted, during periods of zero flow through the weir structure it is assumed the minimum baseflow of 2 L/s was conveyed downstream via the by-pass structure.

During spring freshet and significant storm events, the flow leaving the weir pond (wetland 13202) via the weir structure has exceeded the quarry discharge as a result of surface runoff from the golf course. Since monitoring commenced in 2015, the highest recorded flow at SW1 is 311 L/s which occurred May 26, 2019.

The water temperature within the weir pond (wetland 13202) was also monitored over the past five (5) years. The water temperature generally followed climatic trends and was essentially the same as the ambient air temperature. During the year, the water temperature drops to near freezing ($0^{o}C$) in the winter months to highs of $25^{o}C$ during the summer months.

Monitoring Location SW2

Streamflow monitoring location SW2 was established in April 2014 and is located in Willoughby Creek immediately downstream of the crossing of Britannia Road. SW2 measures the flow in

Willoughby Creek before its confluence with Bronte Creek (approximately 900 m downstream of SW2). The water depth and flow in Willoughby Creek at SW2 is sufficient year-round to prevent freezing of the pressure transducer during the winter months. As such, the continuously recording pressure transducer typically remains installed year-round to capture the flows in Willoughby Creek.

The monitoring data collected to date shows a continuous baseflow of approximately 18 L/s in Willoughby Creek year-round. SW2 is located downstream of the Quarry Sump 0100 discharge and the discharge does increase the total flow measured at SW2. However, the dependence of Willoughby Creek on the quarry discharge is not as significant as the tributary of Willoughby Creek at SW1 due to the larger drainage area (5.7 km^2 or 5,700 ha at SW2) of Willoughby Creek at Britannia Road. The quarry discharge does contribute to the baseflow at SW2. Since monitoring commenced in 2014, the highest recorded flow at SW2 is 3,325 L/s which occurred May 13, 2014 in response to a 35 mm rain event following the spring freshet.

The water temperature within Willoughby Creek at SW2 was also monitored over the past six (6) years. The water temperature followed climatic trends and was generally 0.9^oC less than the ambient air temperature May through November. During the year, the water temperature drops to near freezing (0^oC) in the winter months to highs of 24^oC during the summer months.

Monitoring Location SW7

Streamflow monitoring location SW7 was established in September 2014 after permission was granted by the property owner to do so. SW7 is located in Willoughby Creek immediately downstream of its confluence with the tributary of Willoughby Creek. The water depth and flow in Willoughby Creek at SW7 is insufficient to prevent freezing of the pressure transducer during the winter months. As such, the continuously recording pressure transducer is removed from SW7 December through March.

The monitoring data collected to date shows a continuous baseflow of approximately 4 L/s in Willoughby Creek at SW7. SW7 is located downstream of the Quarry Sump 0100 discharge, downstream of a spring (identified as J in the Karst Investigation) and the quarry discharge increases the total streamflow measured at SW7. The quarry discharge also contributes to the baseflow at SW7 and it is expected that Willoughby Creek would run dry at SW7 if the quarry discharge were to cease. Since monitoring commenced in 2014, the highest recorded flow at SW7 is 829 L/s which occurred March 15, 2019 during spring freshet.

The water temperature within Willoughby Creek at SW7 was also monitored over the past six (6) years. The water temperature followed climatic trends and was generally 1.1^oC less than the ambient air temperature May through November. During the year, the water temperature drops to near freezing (0^oC) in the winter months to highs of 23^oC during the summer months.

Monitoring Location SW14

Streamflow monitoring location SW14 was established in October 2014 and is located in Willoughby Creek upstream of its confluence with the tributary of Willoughby Creek. SW14 is located in the floor of the Medad Valley in the No 2. Sideroad unopened road allowance. The water depth and flow in Willoughby Creek at SW14 is insufficient to prevent freezing of the pressure transducer during the winter months. As such, the continuously recording pressure transducer is removed from SW14 December through March.

The monitoring data collected to date shows that Willoughby Creek is an intermittent watercourse at SW14 (ie. it is absent of baseflow at times during the year). The discharge from Quarry Sump 0100 enters Willoughby Creek at its confluence with the tributary of Willoughby Creek downstream of SW14. As such, the quarry discharge does not contribute flow to SW14. Since monitoring commenced in 2014, the highest recorded flow at SW14 is 113 L/s which occurred March 15, 2019 during spring freshet.

The water temperature within Willoughby Creek at SW14 was also monitored over the past six (6) years. The water temperature followed climatic trends and was generally 2.5^{o}C less than the ambient air temperature May through November. During the year, the water temperature drops to near freezing (0^{o}C) in the winter months to highs of 25^{o}C during the summer months.

Monitoring Location SW15

Streamflow monitoring location SW15 was established in April 2018 and is located in the Colling Road roadside ditch immediately downstream of the existing culvert crossing at the intersection of Blind Line and Colling Road. SW15 measures the flow of water entering the existing Burlington Quarry at this location from the lands to the north. Surface runoff entering the quarry at this location drains into the quarries existing settling ponds and to Quarry Sump 0100 where it is discharged off-site. The water depth and flow in the roadside ditch at SW15 is insufficient to prevent freezing of the pressure transducer during the winter months. As such, the continuously recording pressure transducer is removed from SW15 December through March.

The monitoring data collected to date shows that while flow into the quarry at this location is intermittent and in response to spring freshet and storm events, it does add significant volumes of water to the quarry each year. Since monitoring commenced in 2018, the highest recorded flow at SW15 is 68 L/s which occurred June 5, 2019 in response to a 19 mm rain event following a sustained period of wet weather.

Monitoring Location SW30

Streamflow monitoring location SW30 was established in October 2018 and is located the north tributary of Bronte Creek crossing Britannia Road approximately 250 m southwest of Walkers

Line. This location was selected to establish baseline conditions in the tributary located northwest of the existing Burlington Quarry. The water depth and flow in the tributary of Bronte Creek at SW30 is sufficient year-round to prevent freezing of the pressure transducer during the winter months. As such, the continuously recording pressure transducer typically remains installed year-round to capture the flows in the north tributary of Bronte Creek.

The monitoring data collected to date shows a continuous baseflow of <1 L/s in the tributary of Bronte Creek year-round. In 2019, baseflow in the tributary approached 0 L/s, however the tributary never went dry. Since monitoring commenced in 2018, the highest recorded flow at SW30 is 2,953 L/s which occurred April 14, 2019 in response to a 24 mm rain event during spring freshet.

The water temperature within the north tributary of Bronte Creek at SW30 was also monitored in 2018 and 2019. The water temperature generally followed climatic trends and was essentially equal to the ambient air temperature May through November. During the year, the water temperature drops to near freezing (0°C) in the winter months to highs of 24°C during the summer months.

Monitoring Location SW31

Streamflow monitoring location SW31 was established in October 2018 and is located in the south tributary of Bronte Creek immediately upstream of its confluence with the main branch of Bronte Creek. This location was selected to establish baseline conditions in the tributary northeast of the existing Burlington Quarry. The water depth and flow in the south tributary of Bronte Creek at SW31 is sufficient year-round to prevent freezing of the pressure transducer during the winter months. As such, the continuously recording pressure transducer typically remains installed year-round to capture the flows in the south tributary of Bronte Creek.

The monitoring data collected to date shows a continuous baseflow of approximately 15 L/s in the south tributary of Bronte Creek year-round. Since monitoring commenced in 2018, the highest recorded flow at SW31 is 5,468 L/s which occurred March 14, 2019 during the spring freshet.

The water temperature within the south tributary of Bronte Creek at SW31 was also monitored in 2018 and 2019. The water temperature generally followed climatic trends and was essentially equal to the ambient air temperature May through November. During the year, the water temperature drops to near freezing (0°C) in the winter months to highs of 25°C during the summer months.

Monitoring Summary – Bronte Creek Watershed

The streamflow and water temperature monitoring data discussed in the previous sections for the various watercourses in the Bronte Creek watershed is summarized in the following table and in Appendix B for reference.

Table 5: Bronte Creek Watershed Flow and Temperature Summary

WATERCOURSE	MONITORING LOCATION	BASEFLOW (L/S)	PEAK RECORDED FLOW (L/S)	WATER TEMPERATURE (°C)
Willoughby Creek tributary	SW1	2*	311	0 – 25
Willoughby Creek	SW2	18*	3,325 (rain)	0 – 24
Willoughby Creek	SW7	4*	829 (freshet)	0 – 23
Willoughby Creek	SW14	0	113 (freshet)	0 – 25
Roadside Ditch (Colling Road)	SW15	0	68 (rain)	0 – 28
North tributary of Bronte Creek	SW30	< 1	2,953 (rain + freshet)	0 – 24
South tributary of Bronte Creek	SW31	15	5,468 (freshet)	0 – 25

Note: * Includes contributions from quarry discharge (Quarry Sump 0100)

2.1.2 Grindstone Creek Watershed

A portion of the west extension lands and the south extension lands are located in the Grindstone Creek Watershed. An unnamed tributary of Lake Medad originates immediately southeast of No. 2 Sideroad and flows south under Cedar Springs Road to Lake Medad which drains westerly to Grindstone Creek. At M33, the upstream end of a culvert has been found. However, only the obvert of the culvert is currently exposed and the culvert is obstructed with sediment and debris. The downstream end of the culvert has not been located.

Through the Natural Environment Technical Report (NETR) completed in support of the proposed extension, a wetland 13201 has been identified northwest of No. 2 Sideroad, upstream of the culvert. The wetland has a drainage area of 14.9 ha and no defined outlet except for the obstructed culvert under No. 2 Sideroad. Although monitoring will commence in this wetland in 2020, the wetland has been witnessed to go dry in the spring/summer. It is believed that the wetland and its drainage area form the headwaters of the unnamed tributary of Lake Medad and its drainage area encompass the entire portion of the west extension that drains to Grindstone Creek. The remainder of the west extension drains to Bronte Creek as previously described.

Quarry Sump 0200 discharges to the West Arm of the West Branch of the Mount Nemo Tributary southeast of No. 2 Sideroad which also flows south to Grindstone Creek. The Tributary is characterized as a unconfined channel that flows through a wetland feature (Wetland 13203) through the south extension lands, flows through a series of online ponds within the Camisle Golf property, then flows south as a natural channel to its confluence with the East Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek (East Arm) approximately 250 m north of No. 1 Sideroad. Wetland 13203 is not provincially significant and is maintained by the quarry discharge from Quarry Sump 0200. The south extension, except for approximately 0.9 ha in the north corner of the extension, currently drains to the West Arm. The north corner of the south extension drains into the existing Burlington Quarry.

A series of provincially significant wetlands east of the south extension form the headwaters of the East Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek (East Arm). Runoff accumulates in the wetlands and when full can spill downstream into the next wetland in series. The East Arm originates at the downstream end of the wetlands where sufficient runoff has accumulated to carve a defined channel in the landscape. Approximately 350 m downstream of its origin, the East Arm flows into several karst sinkholes. As per the Karst Investigation and Conceptual Model of the Proposed Quarry Extensions (Worthington Groundwater, April 2020), the sinking stream resurfaces approximately 162 m downstream of the sinkholes at several springs. Between the sinks and springs, the tributary is reduced to an overland flow path that is expected to convey flow only when the tributary flow exceeds the capacity of the sinks. Downstream of the springs, the East Arm flows south to its confluence with the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek (West Arm).

Downstream of the confluence of the West and East Arms, the West Branch flows south crossing No. 1 Sideroad and Cedar Springs Road before converging with the East Branch.

Within the Grindstone Creek watershed, five (5) streamflow monitoring locations have been established since 2013. The results of the monitoring collected from each streamflow monitoring location are summarized in the following section. The streamflow and water temperature monitoring data for the streamflow monitoring locations in the Grindstone Creek watershed are summarized in Appendix C.

Monitoring Location SW6

Streamflow monitoring location SW6 was established in September 2014 and is located in the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek downstream of the Quarry Sump 0200 discharge. SW6 measures the flow and water temperature of the West

Arm before it flows off the south extension lands, at the downstream end of Wetland 13202. In the past, the quarry discharge from Quarry Sump 0200 occurred as needed and a consistent discharge was not maintained year-round. To prevent freezing of the pressure transducer the continuously recording pressure transducer is typically uninstalled during the winter months.

The monitoring data collected to date shows how the West Arm is dependant on the quarry discharge. Outside the spring freshet and significant storm events, flow leaving the south extension lands through the West Arm is less than the measured quarry discharge. The West Arm is a losing stream between No. 2 Sideroad and SW6 meaning a portion of its flow (quarry discharge) infiltrates through the streambed into the underlying soil and groundwater table. Since 2015, the monitoring data demonstrates that the West Arm conveys zero flow when quarry discharge ceases for a majority of the year (outside spring freshet and significant storm events) and there is a delay in the response at SW6 when the quarry discharge commences as the two surface water features between SW6 and No. 2 Sideroad must fill before flow continues downstream.

Since monitoring commenced in 2015, the highest recorded flow at SW6 is approximately 95 L/s which occurred August 12, 2017 in response to a 16 mm rain event in combination with quarry discharge. Of note, the maximum quarry discharge from Quarry Sump 0200 to the West Arm is 15 L/s.

The water temperature within the West Arm was also monitored over the past five (5) years. The water temperature generally followed climatic trends and was essentially the same as the ambient air temperature. During the year, the water temperature drops to near freezing (0^{o}C) in the winter months to highs of 27^{o}C during the summer months.

Monitoring Location SW9

Streamflow monitoring location SW9 was established in October 2014 and is located in a channel connecting two wetlands upstream of the East Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek. SW9 measures the flow and water temperature in the connecting channel. The East Arm originates off-site on the neighbouring property. As access to the neighbouring property has not been granted, the location of SW9 was selected to establish baseline conditions for the flow leaving the subject property before entering the East Arm. The water depth and flow in the connecting channel at SW9 is insufficient to prevent freezing of the pressure transducer during the winter months. As such, the continuously recording pressure transducer is removed from SW9 December through March.

The monitoring data collected to date shows the connecting channel conveys flow only during the spring freshet and significant storm events. A majority of the year, the connecting channel is dry and conveys no baseflow. Since monitoring commenced in 2014, the highest recorded flow at SW9 is 100 L/s which occurred March 15, 2019 during spring freshet.

The water temperature within the connecting channel was also monitored over the past five (5) years. The water temperature generally followed climatic trends and was essentially the same as the ambient air temperature. During the year, the water temperature drops to near freezing (0°C) in the winter months to highs of 25°C during the summer months.

Monitoring Location SW10

Streamflow monitoring location SW10 was established in October 2014 and is located in the West Branch of the Mount Nemo Tributary of Grindstone Creek at No. 1 Sideroad approximately 250 m downstream of the confluence of the West and East Arms. SW10 is located immediately downstream of the West Branch crossing of No 1. Sideroad. SW10 measures the flow and water temperature in the West Branch. The water depth and flow in the West Branch at SW10 is insufficient to prevent freezing of the pressure transducer during the winter months. As such, the continuously recording pressure transducer is removed from SW10 December through March.

The monitoring data collected to date shows that the West Branch is an intermittent watercourse at SW10; absent of baseflow at times during the year. In 2015 through 2018, flow is the West Branch dropped to 0 L/s on two or more consecutive days at SW10 during the summer/early fall. In 2019, a baseflow of approximately 4 L/s was maintained in the West Branch due to quarry discharge from Quarry Sump 0200 to the West Arm. Since monitoring commenced in 2015, the highest recorded flow at SW10 is approximately 513 L/s which occurred March 15, 2019 during spring freshet.

The water temperature within the West Branch was also monitored over the past five (5) years. The water temperature generally followed climatic trends and was essentially the same as the ambient air temperature. During the year, the water temperature drops to near freezing (0°C) in the winter months to highs of 28°C during the summer months.

Monitoring Location SW28

Streamflow monitoring location SW28 was established in October 2018 and is located in the East Branch of the Mount Nemo Tributary of Grindstone Creek at No. 1 Sideroad. SW28 is located immediately upstream of the East Branch crossing of No 1. Sideroad. SW28 measures the flow and water temperature in the East Branch. The water depth and flow in the East Branch at SW28 is insufficient to prevent freezing of the pressure transducer during the winter months. As such, the continuously recording pressure transducer is removed from SW28 December through March.

The monitoring data collected to date shows that the East Branch is an intermittent watercourse at SW28; absent of baseflow at times during the year. In 2019 flow is the East Branch dropped to 0 L/s on June 18th and the watercourse remained dry through September 15th except during significant storm events. Since monitoring commenced in 2018, the highest recorded flow at SW28 is approximately 800 L/s which occurred March 15, 2019 during spring freshet.

The water temperature within the East Branch was also monitored in 2018 and 2019. The water temperature generally followed the climatic trend, however, the water temperature was approximately 4°C less than the ambient air temperature. During the year, the water temperature drops to near freezing (0°C) in the winter months to highs of 21°C during the summer months.

Monitoring Location SW29

Streamflow monitoring location SW29 was established in October 2018 and is located in the unnamed tributary of Lake Medad at Cedar Springs Road. SW29 is located immediately upstream of the unnamed tributary of Lake Medad crossing of Cedar Springs Road. SW29 measures the flow and water temperature in the tributary. The water depth and flow in the tributary at SW29 is insufficient to prevent freezing of the pressure transducer during the winter months. As such, the continuously recording pressure transducer is removed from SW29 during December through March.

The monitoring data collected to date shows that the tributary is an intermittent watercourse at SW29; absent of baseflow at times during the year. In 2019 flow in the tributary dropped to 0 L/s on June 18th and the watercourse remained dry through September 15th except during significant storm events. Since monitoring commenced in 2018, the highest recorded flow at SW29 is approximately 25 L/s which occurred March 15, 2019 during spring freshet.

The water temperature within the unnamed tributary of Lake Medad was also monitored in 2018 and 2019. The water temperature generally followed climatic trends and was essentially the same as the ambient air temperature. During the year, the water temperature drops to near freezing (0°C) in the winter months to highs of 27°C during the summer months.

Monitoring Summary – Grindstone Creek Watershed

The streamflow and water temperature monitoring data discussed in the previous sections for the various watercourses in the Grindstone Creek watershed is summarized in the following table and in Appendix C for reference.

Table 6: Grindstone Creek Watershed Flow and Temperature Summary

WATERCOURSE	MONITORING LOCATION	BASEFLOW (L/S)	PEAK RECORDED FLOW (L/S)	WATER TEMPERATURE (°C)
West Arm (West Branch)	SW6	0	95 (rain + discharge)	0 – 27
Connecting Channel	SW9	0	200 (freshet)	0 – 25
West Branch	SW10	0	513 (freshet)	0 – 28
East Branch	SW28	0	800 (freshet)	0 – 21
Tributary of Lake Medad	SW29	0	25 (freshet)	0 – 27

2.1.3 Shoreacres Creek and Appleby Creek Watersheds

Streamflow monitoring locations were established in several tributaries of Shoreacres Creek and Appleby Creek to establish baseflow conditions in the watercourses southeast of the existing Burlington Quarry and south extension. Monitoring the Shoreacres and Appleby Creek tributaries ensured that baseline conditions have been established in the various watercourses surrounding the existing Burlington Quarry and the west and south extensions. The tributaries of Shoreacres and Appleby Creeks originate generally as seeps/springs along the Niagara Escarpment, southeast of the East Branch of the Mount Nemo Tributary of Grindstone Creek. The monitoring locations (SW21 through SW26 – Shoreacres Creek; SW34 and SW35 – Appleby Creek) were established in October 2018 and measure the flow and water temperature in each tributary.

The streamflow and water temperature monitoring data collected for the tributaries of Shoreacres and Appleby Creeks is summarized in the following table and in Appendix D for reference.

Table 7: Shoreacres Creek and Appleby Creek Flow and Temperature Summary

WATERCOURSE	MONITORING LOCATION	BASEFLOW (L/S)	PEAK RECORDED FLOW (L/S)	WATER TEMPERATURE (°C)
Shoreacres	SW21	0	215 (rain + freshet)	0 – 18
Shoreacres	SW22	0	189 (rain + freshet)	0 – 24
Shoreacres	SW23	0	1,062 (rain + freshet)	0 – 26
Shoreacres	SW24	< 1	788 (rain + freshet)	0 – 26
Shoreacres	SW25	0	958 (rain + freshet)	0 – 16
Shoreacres	SW26	0	3,545 (rain + freshet)	0 – 16
Appleby	SW34	0	1,662 (freshet)	0 – 20
Appleby	SW35	0	1,081 (freshet)	0 – 17

2.1.4 Manual In-situ Streamflow Measurements

In addition to the streamflow monitoring locations established on-site and in the surrounding area, monthly manual in-situ streamflow measurements were collected at 38 locations surrounding the existing Burlington Quarry (SW3 and M1 through M37). The manual in-situ streamflow measurements were collected to establish baseline conditions prior to the proposed extensions. The data collected at each location is summarized in Appendix E for reference.

2.2 WETLAND HYDROPERIOD MONITORING

Over the past six (6) years, wetland hydroperiod monitoring locations have been established on-site and in the surrounding area to establish existing baseline conditions for the various wetlands in the area. A continuously recording pressure transducer measuring water level and water temperature and a water level staff gauge has been installed in each wetland at each wetland hydroperiod monitoring location. Staff gauge water level measurements and temperature readings are collected monthly at each wetland hydroperiod monitoring location. The field measurements are used to calibrate the continuously recording pressure transducer data.

The wetland hydroperiod monitoring data collected to date is summarized in the following sections. For the purpose of this report, September 15, 2019 was selected as the end of the reporting period for the monitoring data. However, monitoring continued throughout 2019 and will continue moving forward. The wetland hydroperiod and water temperature monitoring data for the wetland hydroperiod monitoring locations are summarized in Appendix F.

2.2.1 Monitoring Location SW5A (Wetland 13031)

Nelson has not been granted permission to access and monitor an off-site pond, referred to as Wetland 13032, east of the proposed south extension. Wetland 13032 is located approximately 80 m southeast of Nelson's property on a topographical high in the landscape. Wetland 13032 is of interest as it has been identified as Jefferson Salamander breeding habitat. Jefferson Salamander are listed as "endangered" (the highest risk status for species in Ontario) under the Endangered Species Act.

Monitoring location SW5A was established in October 2014 to monitor a wetland feature between the proposed south extension and Wetland 13032 in the absence of permission to monitor the Wetland 13032 itself. SW5A is located on Nelson's property next to the property line separating Nelson's property and the neighbouring property approximately 85 m from the Wetland 13032. SW5A is located at similar elevation to Wetland 13032 and measures water depth, and consequently wetland hydroperiod, and temperature in this wetland feature.

The monitoring data collected to date shows that water levels in the wetland can dry out as early as June 13th in the spring and a permanent pool is not always re-established each fall. From 2015 through 2017, the wetland water level remained 0.0 m during the summer and fall into the winter, except for short periods immediately following significant rain events. The wetland water level remained 0.0 m past the date the wetland hydroperiod monitoring device was removed in mid December to prevent freezing.

The water temperature within the wetland has also been monitored since October 2014. The water temperature generally followed the climatic trend, however, the water temperature was approximately 1.7^{o}C less than the ambient air temperature May through November. During the year, the water temperature drops to near freezing (0^{o}C) in the winter months to highs of 22^{o}C during spring months.

The wetland water level and water temperature monitoring data collected for this wetland is summarized in the following table.

Table 8: Monitoring Location SW5A Summary

YEAR	SPRING HYDROPERIOD[1] (DATE WETLAND DRYS OUT)	FALL HYDROPERIOD[2] (START OF HYDROPERIOD)	WATER TEMPERATURE (°C)
2014	-	After device removed (December 19th)	0 – 15
2015	July 23rd	After device removed (December 11th)	5 – 18
2016	June 23rd	After device removed (December 22th)	5 – 16
2017	July 6th	After device removed (December 20th)	11 – 19
2018	June 13th	November 1st	0 – 21
2019	July 24th	-	0 – 22

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool re-established) in the fall

2.2.2 Monitoring Location SW11A (Wetland 13027)

Monitoring location SW11A was established in October 2014 to monitor the hydroperiod and water temperatures in wetland 13027. Wetland 13027 is located east of the south extension upstream of the East Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek.

The monitoring data collected to date shows that water levels in the wetland can dry out as early as May 19th in the spring and a permanent pool is not re-established each fall. In 2015 through 2017, the wetland water level remained 0.0 m during the summer and fall into the winter, except for short periods immediately following significant rain events. The wetland water level remained 0.0 m past the date the wetland hydroperiod monitoring device was removed in mid December to prevent freezing these three years.

The water temperature within the wetland has also been monitored since October 2014. The water temperature followed the climatic trend and was essentially the same as the ambient air temperature. During the year, the water temperature drops to near freezing (0°C) in the winter months to highs of 22°C during spring months.

The wetland water level and water temperature monitoring data collected for Wetland 13027 is summarized in the following table.

Table 9: Monitoring Location SW11A Summary

YEAR	SPRING HYDROPERIOD[1] (DATE WETLAND DRYS OUT)	FALL HYDROPERIOD[2] (START OF HYDROPERIOD)	WATER TEMPERATURE (°C)
2015	May 19th	After device removed (December 11th)	8 – 23
2016	May 24th	After device removed (December 22nd)	7 – 17
2017	June 11th	After device removed (December 20th)	15 – 21
2018	May 27th	October 27th	5 – 22
2019	June 20th	-	3 – 22

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool re-established) in the fall

2.2.3 Monitoring Location SW12A (Wetland 13022)

Monitoring location SW12A was established in October 2014 to monitor the hydroperiod and water temperatures in wetland 13022. Wetland 13022 is located east of the south extension upstream of the East Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek.

The monitoring data collected to date shows that water levels in the wetland can drop to 0.0 m as early as May 11th in the spring and a permanent pool is not re-established each fall. In 2015 through 2017, the wetland water level remained 0.0 m during the summer and fall into the winter, except for short periods immediately following significant rain events. The wetland water level remained 0.0 m past the date the wetland hydroperiod monitoring device was removed in mid December to prevent freezing these three years.

The water temperature within the wetland has also been monitored since October 2014. The water temperature generally followed the climatic trend and was essentially the same as the ambient air temperature May through November. During the year, the water temperature drops to near freezing (0°C) in the winter months to highs of 18°C during spring months.

The wetland water level and water temperature monitoring data collected for Wetland 13022 is summarized in the following table.

Table 10: Monitoring Location SW12A Summary

YEAR	SPRING HYDROPERIOD[1] (DATE WETLAND DRYS OUT)	FALL HYDROPERIOD[2] (START OF HYDROPERIOD)	WATER TEMPERATURE (°C)
2014	-	December 14th	6 – 8
2015	May 11th	After device removed (December 11th)	5 – 18
2016	May 23rd	After device removed (December 22nd)	1 – 8
2017	May 30th	After Device removed (December 20th)	9 – 12
2018	May 24th	After device removed (December 13th)	0 – 14
2019	June 14th	-	0 – 13

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool re-established) in the fall

2.2.4 Monitoring Location SW13A (Wetland 13016)

Monitoring location SW13A was established in October 2014 to monitor the hydroperiod and water temperatures in wetland 13016. Wetland 13016 is located east of the south extension upstream of the East Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek.

The monitoring data collected to date shows that water levels in the wetland can drop to 0.0 m as early as May 16th in the spring and a permanent pool is not re-established each fall. In 2015 through 2017, the wetland water level remained 0.0 m during the summer and fall into the winter, except for short periods immediately following significant rain events. The wetland water level remained 0.0 m past the date the wetland hydroperiod monitoring device was removed in mid December to prevent freezing these three years.

The water temperature within the wetland has also been monitored since October 2014. The water temperature generally followed the climatic trend and was essentially the same as the ambient air temperature. During the year, the water temperature drops to near freezing (0°C) in the winter months to highs of 27°C during spring months.

The wetland water level and water temperature monitoring data collected for Wetland 13016 is summarized in the following table.

Table 11: Monitoring Location SW13A Summary

YEAR	SPRING HYDROPERIOD[1] (DATE WETLAND DRYS OUT)	FALL HYDROPERIOD[2] (START OF HYDROPERIOD)	WATER TEMPERATURE (°C)
2014	-	November 24th	1 – 11
2015	May 16th	After device removed (December 11th)	3 – 15
2016	May 30th	After device removed (December 22nd)	8 – 21
2017	June 12th	After device removed (December 20th)	19 – 25
2018	June 1st	November 15th	6 – 27
2019	June 30th	-	6 - 9

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool re-established) in the fall

2.2.5 Monitoring Location SW16A (Wetland 13037)

Monitoring location SW16A was established in October 2018 to monitor the hydroperiod and water temperatures in wetland 13016. Wetland 13016 is located southeast of the south extension and drains to the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek. Wetland 13037 is located on Nelson's property and drains to the West Arm via an existing channel crossing the Camisle Golf property.

The monitoring data collected to date shows that water levels in the wetland can drop to 0.0 m as early as July 5th in the spring and a permanent pool is typically re-established by October 31st each fall. The water temperature within the wetland has also been monitored since October 2018. The water temperature generally followed the climatic trend and was essentially the same as the ambient air temperature. During the year, the water temperature drops to near freezing (0°C) in the winter months to highs of 25°C during spring months. Additional monitoring data will be collected during the approvals process to verify the wetland hydroperiod and water temperatures prior to extraction in the south extension.

The wetland water level and water temperature monitoring data collected for Wetland 13037 is summarized in the following table.

Table 12: Monitoring Location SW16A Summary

YEAR	SPRING HYDROPERIOD[1] (DATE WETLAND DRYS OUT)	FALL HYDROPERIOD[2] (START OF HYDROPERIOD)	WATER TEMPERATURE (°C)
2018	-	October 31st	3 – 9
2019	July 5th	-	0 – 25

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool maintained) in the fall

2.3 SHALLOW GROUNDWATER MONITORING

In 2018, shallow groundwater monitoring locations were established next to each wetland hydroperiod monitoring location to establish existing baseline conditions to help understand the surface water/ groundwater interactions in each wetland. A continuously recording pressure transducer measuring water level and water temperature has been installed in a drive point well in each wetland at each shallow groundwater monitoring location. Manual in-situ water level measurements are collected monthly at each shallow groundwater monitoring location. The field measurements are used to calibrate the continuously recording pressure transducer data.

The monitoring data collected to date shows shallow groundwater levels drop through the dryer summer months until the reach a relatively constant equilibrium depth below surface by August/September. The groundwater levels then rise in the late fall in response to wetter fall conditions. Additional monitoring data will be collected during the approvals process to verify the shallow groundwater conditions prior to extraction in the south extension.

The shallow groundwater monitoring data for each wetland is summarized in the following table and in Appendix G for reference.

Table 13: Shallow Groundwater Monitoring summary

MONITORING LOCATION (WETLAND)	STATIC LOW DEPTH BELOW SURFACE (m)	STATIC LOW WATER SURFACE ELEVATION (m)	DATE LOW WATER EQUILIBRIUM IS REACH[1]
SW5B	0.82	283.82	September 3, 2019
SW11B (13027)	1.05	274.01	September 18, 2019
SW12B (13022)	1.12	275.04	August 24, 2019
SW13B (13016)	0.95	276.57	September 4, 2019
SW16B (13037)	0.73	271.05	August 6, 2019

Note: 1) Earliest date shallow groundwater achieves static low

2.4 WATER QUALITY MONITORING

Quarterly water quality samples were collected from select surface water monitoring locations in 2018 and 2019 to establish baseline water quality at each location. Samples were collected October 24, 2018, April 24, 2019, June 19, 2019 and September 25, 2019 from 13 total streamflow and manual in-situ streamflow monitoring locations. The water quality results for each sample are summarized in the following table and in Appendix H for reference.

Table 14: Shallow Groundwater Monitoring summary

MONITORING LOCATION	TOTAL SUSPENDED SOLIDS (mg/L)[1]	FIELD pH	CONDUCTIVITY (µS/cm)[2]
SW1	1.00 – 3.67	8.5 – 8.8	742 – 877
SW2	1.00 – 6.00	8.7 – 8.9	668 – 881
SW6	< 0.67 – 2.00	8.4 – 8.7	798 – 934
SW10	< 0.67 – 3.30	8.2 – 8.8	517 – 882
SW14	3.67 – 5.70	8.6 – 8.8	457 – 696
SW15	1.67 – 6.00	8.6	289 – 376
SW24	1.33 – 33.00	8.6 – 8.9	540 – 781
SW28	< 0.67 – 5.30	8.2 – 8.6	576 – 829
SW29	7.67 – 13.30	8.3	648 – 878
SW30	< 0.67 – 3.33	8.7 – 9.0	642 – 865
SW31	1.33 – 14.00	8.7 – 9.0	624 – 877
SW32	1.30 – 8.00	9.1 – 9.5	592 – 674
SW35	3.00 – 4.33	8.4 – 8.5	483 – 1270

Note: 1) Total Suspended Solids minimum detention limit (MDL) – 0.67 mg/L; Conductivity MDL – 1 µS/cm

3 Existing Conditions

Establishing the existing surface water drainage conditions across the Burlington Quarry, south extension and west extension lands, and of the surrounding area is an important step in assessing the potential impacts from the proposed quarry extension. To establish the existing drainage conditions, the existing drainage patterns were identified, and water balance and event based hydrologic models were prepared. The integrated surface water groundwater model prepared as part of the Level 1 and Level 2 Hydrogeological Assessment was also referenced in the assessment of existing drainage conditions. The existing drainage conditions are described in the following sections.

3.1 EXISTING DRAINAGE PATTERNS

The existing topography, ground cover, land uses and drainage patterns across the Burlington Quarry, south extension and west extension lands were established through site visits, interpretation of topographic maps, aerial photography, and topographic survey. For consistency, the same topographic mapping used in the integrated surface water groundwater model was used to delineate the subcatchments for the water balance and event based hydrologic model described later in this report. For additional information regarding the topographic mapping used refer to Section 3.1 Topography of the Level 1 and Level 2 Hydrogeological Assessment. An Existing Condition Drainage Plan (Drawing DP-1) illustrating the existing surface water drainage conditions of the Burlington Quarry, south extension and west extension lands and the surrounding area is enclosed and should be referenced when reviewing Section 3 of this report. The existing drainage patterns are described in the following sections.

3.1.1 Existing Burlington Quarry Site

Operations began in the Burlington Quarry in 1953 and continue today. Burlington Quarry has a licenced area of 218 ha and an extraction area of 210 ha. Extraction in the northeast corner of the quarry is complete and this area has been rehabilitated. The rehabilitated form is a wetland constructed on the quarry floor. The wetland receives intercepted groundwater, direct rainfall and runoff from external sources outside the quarry property. The wetland drains southwest via two outlets and a series of drainage channels and culverts around and through the active quarry operation to a series of settling ponds in the south and southwest corners of the property. The active quarry operation also drains overland via ditches and culverts to these same settling ponds. Intercepted groundwater, direct rainfall and runoff are stored and treated (through settling) in the settling ponds before being discharged off-site from Quarry Sumps 0100 or 0200.

As previously discussed, Quarry Sump 0100 discharges to a tributary of Willoughby Creek northwest of the existing quarry and Quarry Sump 0200 discharges southeast to the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek. As such, the Burlington Quarry site and discharge is part of both the Bronte Creek and Grindstone Creek watersheds. The Burlington Quarry drainage system described above has a total drainage area of 390 ha including external sources (Catchments S100, S101 and S113 through S116).

Approximately 58 ha of external drainage (Catchments S113 through S116) enters the quarry from a mix of residential, commercial, agricultural and forested lands east of No. 2 Sideroad and Guelph Line. These lands drain west overland as sheet flow to No. 2 Sideroad and Guelph Line. A series of culverts convey the runoff under the roadways to ditches entering the quarry property. The ditches convey the runoff to the wetland constructed in the quarry floor as part of site rehabilitation.

Northwest of the site, northwest of Colling Road, approximately 84 ha (Catchment S101) drains overland to a series of wetlands and ponds which drain to the north corner of the intersection of Blind Line and Colling Road. A culvert conveys the runoff from the external drainage area under Colling Road to the Colling Road southeast roadside ditch. A second culvert conveys the runoff through a visual screen berm entering the quarry property at this location. The runoff then drains southwest into the on-site settling ponds before being discharged off-site into the Colling Road southeast roadside ditch from Quarry Sump 0100.

As part of ongoing operations within the existing Burlington Quarry, Nelson is exploring options to divert this external drainage from northwest of Colling Road directly to the discharge location of Quarry Sump 0100; preventing the runoff from entering the existing quarry. This would include the construction of a conveyance system (a culvert, ditch or combination of the two) alongside Colling Road within Nelson's property between Blind Line and the quarries existing discharge location (Quarry sump 0100). With this in place, the external runoff would drain to its existing outlet, the tributary of Willoughby Creek, without entering the active quarry operation. This will reduce the surface water management requirements of the active operation.

3.1.2 South Extension

Runoff from the south extension lands drains to one of two watercourses, the West Arm or the East Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek. Approximately 36 ha of land within the study area drains to the West Arm, including a portion of the south extension lands and wetland 13037. As discussed, Quarry Sump 0200 also discharges southeast to the West Arm. The remainder of the south extension lands drain overland as sheet flow into the series of wetlands east of the south extension that form the headwaters of the East Arm. Runoff accumulates in the wetlands and spills downstream into the next wetland in series (cascading series of wetlands) with the East Arm originating at the downstream end of the wetlands where sufficient runoff has accumulated to form a defined channel in the landscape.

3.1.3 West Extension

The Burlington Springs Golf and Country Club (BSGCC) occupies the west extension lands. As part of the golf course construction (between 1962 and 1965), an irrigation pond, a diversion channel and a weir control structure were constructed on-site. From the available aerial photographs of the area, the irrigation pond, diversion channel and weir structure did not exist prior to the golf course construction. The construction of the weir structure created a weir pond, now referred to as wetland 13202, upstream of Colling Road. Between 1972 and 1979, a second irrigation pond was constructed; connecting to the first irrigation pond and diversion channel in series. Three (3) additional irrigation ponds upstream of and connected to the second irrigation pond were constructed in 2001. It is understood that a by-pass structure consisting of a head box connected to a by-pass pipe was installed in the weir pond (wetland 13202) in 2003 to convey a minimum flow of 2 L/s to the tributary of Willoughby Creek prior to allowing flow to be diverted to the irrigation ponds.

Approximately 31 ha of the west extension lands drains to the irrigation ponds, diversion channel or weir pond (Catchments S106 through S110). During periods of the year, specifically spring freshet and significant storm events, the runoff draining to the irrigation ponds will exceed the available storage capacity in the ponds and drain northwest via the diversion channel to the weir pond (wetland 13202) and through the weir control structure to the tributary of Willoughby Creek. However, for most of the year, the quarry discharge from Quarry Sump 0100 is diverted at the weir pond (wetland 13202) southeast through the diversion channel to the irrigation ponds for irrigation of the golf course.

The west expansion lands also drain to five (5) additional outlets; four within the Bronte Creek watershed and one (1) in the Grindstone Creek watershed. The four outlets within the Bronte Creek watershed are described as follows:

- Approximately 6.7 ha of the golf course and neighbouring residential properties fronting onto Cedar Springs Road (Catchment S102) drain overland as sheet flow to the east corner of the intersection of Colling Road and Cedar Springs Road. No culvert to drain this area has been found at this location.
- Approximately 16.5 ha of the golf course and neighbouring residential properties fronting onto Cedar Springs Road (Catchment S103) drain overland as sheet flow to a culvert crossing Cedar Springs Road immediately south of the BSGCC entrance. Runoff conveyed by this culvert ultimately drains into Willoughby Creek southwest of Cedar Springs Road.

- Approximately 6.9 ha of the golf course and neighbouring residential properties fronting onto Cedar Springs Road (Catchment S104) drain overland as sheet flow to a culvert crossing Cedar Springs Road immediately east of Cedar Springs Court. Runoff conveyed by this culvert ultimately drains into Willoughby Creek southwest of Cedar Springs Road.
- Approximately 1.7 ha of the golf course (Catchment S105) drains overland as sheet flow to a culvert crossing Cedar Springs Road at No. 2 Sideroad. Runoff conveyed by this culvert ultimately drains into Willoughby Creek southwest of Cedar Springs Road.

Its noted, the drainage systems, specifically roadside ditches, downstream of the culvert crossings Cedar Springs Road are poorly defined or nonexistent. It is expected that any surface runoff draining through the culverts will either, evaporate, infiltrate or drain overland following the topographic low through the road allowance or across private property to the Medad Valley and Willoughby Creek.

Portions of the site contributes to the unnamed tributary of Lake Medad originating immediately southeast of No. 2 Sideroad and flows south under Cedar Springs Road to Lake Medad. The upstream end of a culvert has been found under No. 2 Sideroad upstream of the unnamed tributary of Lake Medad, however, only the obvert of the culvert is exposed and the culvert is obstructed with sediment and debris. The downstream end of the culvert has not been located. A wetland (wetland 13201) has been identified northwest of No. 2 Sideroad, upstream of the obstructed culvert on the BSGCC property. The wetland has a drainage area of 14.9 ha which is comprised of the remainder of the BSGCC property and a small portion of the Burlington Quarry property (Catchment S111). The wetland has no defined outlet except for the obstructed culvert under No. 2 Sideroad. It is believed that the wetland and its drainage area would form the headwaters of the unnamed tributary of Lake Medad and Grindstone Creek via the blocked culvert.

A wetland (wetland 13200) has also been identified on the BSGCC property northeast of the existing irrigation ponds. The wetland has a drainage area of approximately 7.4 ha and no defined outlet. If the storage volume of the wetland is exceeded, runoff will spill southwest overland into the irrigation ponds.

3.2 EXISTING CONDITION WATER BALANCE

Existing condition water balances were prepared to predict the existing wetland hydroperiods and outlet runoff volumes at key points of interest. The water balances allow the wetland hydroperiods and outlet runoff volumes to be predicted for periods outside the available monitoring period from the available climatological data for the area; providing a greater period of assessment. The water balances also allow the potential impacts of the proposed extraction and quarry dewatering to be evaluated and quantified using predictive models.

Two methodologies were used for the existing condition water balance. A daily water balance was completed to predict the existing wetland hydroperiods and outlet runoff volumes at key points of interest. A monthly water balance was also completed to verify the results of the daily water balance. The water balance methodologies, calibration and results are described in the following sections.

3.2.1 Climate Data

For consistency, the climate data used in the integrated surface water groundwater model was used in the daily and monthly water balance. For the integrated surface water groundwater model, the following three primary datasets were used:

- Precipitation;
- Maximum and minimum daily air temperature; and
- Net incoming solar radiation.

The Level 1 and Level 2 Hydrogeological Assessment, specifically Section 4.1 Climate, can be referenced for additional details regarding theses climate datasets.

For the daily water balance, the integrated surface water groundwater model climate datasets were supplemented with saturated vapour pressure based on the mean daily air temperature and the total daylight hours per day for Hamilton based on the day of the year (National Research Council Canada). Saturated vapour pressure and the total daylight hours per day are used in the Hamon Equation to calculate the potential evapotranspiration.

3.2.2 Daily Water Balance Methodology

For the wetland and outlet water balances, the daily climate data described previously was used to calculate water balances on a daily time step for the entire period of record to predict the existing wetland hydroperiods and outlet runoff volumes at key points of interest. The daily water balance methodology applied generally follows the Thornthwaite and Mather methodology as follows:

- A water surplus/deficit has been calculated as the excess of rainfall and snowmelt minus the evapotranspiration.
- Snowmelt has been calculated using the available climate data and the simplified energy balance approach employed in the Guelph All-Weather Sequential-Events Runoff Model (GAWSER).
- Potential evapotranspiration has been calculated using the Hamon equation, a simplified approach to the Penman equation that uses temperature, saturated vapour pressure and the

number of daylight hours to estimate evapotranspiration. The actual quantity is dependant on the quantity of water available as surplus or in soil storage.

- The maximum soil water holding capacity represents the maximum soil storage. The maximum soil water holding capacity has been calculated for each catchment considering the soil type and vegetative cover. The soil storage is adjusted daily depending on the water surplus/deficit. However, the soil storage can never exceed the maximum soil water holding capacity.
- Runoff was calculated using the SCS curve number method and consequently the infiltration is calculated as the difference between the runoff and available water. When the soil storage is full, no infiltration occurs and all available water becomes runoff.
- The groundwater flux into the shallow groundwater system and surface water features calculated as part of the integrated surface water groundwater model was added to the soil storage.

For the catchments, the water balance was refined such that the wetland areas and non-wetland areas are considered separately to determine the infiltration, runoff and change in storage. Additional storage capacity is available within the wetland areas such that runoff calculated from the non-wetland areas is routed to the wetland areas. Furthermore, hydraulic conductivities have been assigned to each wetland from the results of the field investigations undertaken as part of the Level 1 and Level 2 Hydrogeological Assessment and have been added to the water balance analysis to account for the drawdown of soil storage within the wetlands. No runoff occurs from the catchments until the wetland storage capacity is reached. The water balances were completed to the following locations to provide a comprehensive cross-section of the water features that could potentially be impacted by the quarry extraction:

- Monitoring location SW11A (wetland 13027);
- Monitoring location SW12A (wetland 13022);
- Monitoring location SW13A (wetland 13016); and
- Monitoring location SW16A (wetland 13037).

Each location has sufficient monitoring data (minimum four full years) to allow for calibration, except for monitoring location SW16A. Monitoring location SW16A was established in 2018 and additional monitoring data will be collected during the approvals process to verify the wetland hydroperiod and refine the water balance calibration.

As discussed, the Natural Environment Technical Report (NETR) completed in support of the proposed extension identified two additional wetlands within the west extension area. Wetland hydroperiod and shallow groundwater monitoring stations will be established in these wetlands in the spring of 2020. The monitoring data collected during the approvals process from these two new monitoring locations will be used to establish the wetland hydroperiod and calibrate the wetland water balance analysis moving forward.

3.2.3 Monthly Water Balance Methodology

A simplified water balance was completed on a monthly time step to verify the results of the daily water balance. The monthly climate data described previously was used to verify the existing wetland hydroperiods and outlet runoff rates at the same key points of interest as the daily water balance. The monthly water balance methodology applied generally follows the Thornthwaite and Mather methodology as follows:

- Drainage catchments were delineated based on conventional methodology using the topographic divides as the surface catchment areas.
- A water surplus/deficit has been calculated as the excess of rainfall and snowmelt minus evapotranspiration.
- Potential evapotranspiration has been calculated based on the Thornthwaite and Mather equation that uses mean monthly temperature, heat index and the number of daylight hours to estimate evapotranspiration. The actual quantity of evapotranspiration is dependent on the quantity of water available as a surplus or in soil storage.
- The maximum soil water holding capacity of the overburden was considered in the analysis. The maximum holding capacity was calculated for each catchment considering the soil type, land use and vegetative cover. The soil storage was adjusted monthly depending on the calculated water surplus/deficit.
- Snowmelt was factored into the analysis using melt factors for each month established from variations in monthly temperatures. The precipitation that falls as snow is assigned to melt in the late winter and spring months to more accurately represent the spring freshet that occurs each year.
- The SCS method was used to calculate infiltration according to the catchment's curve number (CN) value (based on soil type, soil moisture and land use). For the SCS method, the CN value is adjusted based on antecedent moisture conditions such that infiltration rates vary depending on how wet the soil is.
- The total infiltration calculated for each catchment is adjusted based on the water holding capacity available in the soil. The total infiltration that contributes to groundwater following dry (deficit) periods is less since this infiltration is used to recharge the soil to its holding capacity.

- The surface runoff component for each catchment is determined as that remaining following the subtraction of the total infiltration volume from the water surplus.
- For catchments that include a wetland area, the portion of the water surplus assigned to surface runoff was routed to the wetlands and analyzed to determine the quantity that contributes to storage, infiltration or runoff. Infiltration in the wetlands was calculated using hydraulic conductivities established from test hole data.

3.2.4 Water Balance Calibration

Monitoring data has been collected since 2014 at the five wetland monitoring locations (SW5A, SW11A, SW12A, SW13A and SW16A). Subcatchments have been delineated to four of the five wetlands for evaluation. A subcatchment was not delineated to wetland 13031 (wetland hydroperiod monitoring location SW5A) due to the wetlands extremely small drainage area. Wetlands 13207, 13022, 13016 and 13037 have been included in this evaluation. The monitoring data has been used to calibrate the daily water balance for the wetlands evaluated. The primary parameters identified for calibration are the wetland storage correction factor and the wetland overflow correction factor. The storage correction factor accounts for the vegetation and topographic variations that impact the volume available for storage. To calibrate the storage correction factor, the total wetland volumes were calculated from available topographic survey data and assigned to each wetland. The storage correction factor was then adjusted for each wetland to fit the water balance results to the corresponding monitoring data.

The wetland overflow correction factor accounts for the variations in the topography and discharge parameters that impact the flow from the wetland. To calibrate the wetland overflow correction factor, a stage-discharge curve was established for each wetland outlet from the available topographic survey data using the broad crested weir equation. The wetland overflow correction factor was set for each wetland to fit the water balance results to the corresponding monitoring data.

The focus of the calibration is to accurately represent the wetland hydroperiod that has been measured such that potential impacts can be assessed as conditions change through quarry operations. The variation in water level and the duration of hydroperiods have been calibrated. These are the most significant elements of the wetland that can be impacted by quarry operations and as such, accurate calibration of the hydroperiod is important to evaluate potential impacts and develop mitigative strategies. Graphs comparing the water level in each wetland against the predicted water balance water level are included in Appendix I for reference. The daily water balance results are discussed in the following section of this report.

The daily water balance calibration has also been applied to the monthly water balance for consistency. It is noted that the water balance calibration factors both focused on wetland characteristics (storage and discharge). The hydrologic parameters (hydraulic conductivities, soil types, land uses, vegetation cover, etc.) calculated for each subcatchment and the climatological parameters (snowmelt factors, number of daylight hours, saturated vapour pressure, etc.) were not altered through our initial calibration. From a review of the water balance calibration results, the hydrologic and climatological parameter estimations used in the water balances were deemed reasonable and did not warrant adjustment.

3.2.5 Wetland Water Balance Results

As illustrated in the following tables and on the graphs included in Appendix I, the calibrated daily water balance accurately reflect the wetland hydroperiods for each wetland at the four wetland monitoring locations evaluated. The spring hydroperiod for 2016 through 2018 has generally been predicted within seven (7) days or less at each wetland monitoring location. Although less monitoring data is available to define the fall hydroperiod, the fall hydroperiods have generally been predicted within ten (10) days or less at each wetland monitoring location. As such, it is our opinion the daily water balance is a reasonable predictor of the wetland hydroperiod and can be used to predict potential impacts from the proposed quarry extensions and dewatering.

Table 15: SW11A (Wetland 13027) Monitoring Data / Water Balance Comparison

YEAR	MONITORING DATA		WETLAND WATER BALANCE RESULTS	
	Spring Hydroperiod[1] (Date Wetland Drys Out)	Fall Hydroperiod[2] (Start of Hydroperiod)	Spring Hydroperiod[1] (Date Wetland Drys Out)	Fall Hydroperiod[2] (Start of Hydroperiod)
2015	May 19th	After device removed (December 11th)	May 7th	November 9th
2016	May 24th	After device removed (December 22nd)	June 1st	December 27th
2017	June 11th	After device removed (December 20th)	June 12th	November 18th
2018	May 27th	October 27th	May 29th	November 3rd
2019	June 20th	-	July 3rd	-

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool re-established) in the fall

Table 16: SW12A (Wetland 13022) Monitoring Data / Water Balance Comparison

YEAR	MONITORING DATA		WETLAND WATER BALANCE RESULTS	
	Spring Hydroperiod[1] (Date Wetland Drys Out)	Fall Hydroperiod[2] (Start of Hydroperiod)	Spring Hydroperiod[1] (Date Wetland Drys Out)	Fall Hydroperiod[2] (Start of Hydroperiod)
2015	May 11th	After device removed (December 11th)	April 27th	January 26th
2016	May 23rd	After device removed (December 22nd)	May 24th	January 11th
2017	May 30th	After Device removed (December 20th)	June 4th	January 11th
2018	May 24th	After device removed (December 13th)	May 23rd	December 13th
2019	June 14th	-	July 3rd	-

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool re-established) in the fall

Table 17: SW13A (Wetland 13016) Monitoring Data / Water Balance Comparison

YEAR	MONITORING DATA		WETLAND WATER BALANCE RESULTS	
	Spring Hydroperiod[1] (Date Wetland Drys Out)	Fall Hydroperiod[2] (Start of Hydroperiod)	Spring Hydroperiod[1] (Date Wetland Drys Out)	Fall Hydroperiod[2] (Start of Hydroperiod)
2015	May 16th	After device removed (December 11th)	May 15th	February 18th
2016	May 30th	After device removed (December 22nd)	May 29th	January 12th
2017	June 12th	After device removed (December 20th)	June 14th	January 10th
2018	June 1st	November 15th	June 1st	November 25th
2019	June 30th	-	July 10th	-

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool re-established) in the fall

Table 18: SW16A (Wetland 13037) Monitoring Data / Water Balance Comparison

YEAR	MONITORING DATA		WETLAND WATER BALANCE RESULTS	
	Spring Hydroperiod[1] (Date Wetland Drys Out)	Fall Hydroperiod[2] (Start of Hydroperiod)	Spring Hydroperiod[1] (Date Wetland Drys Out)	Fall Hydroperiod[2] (Start of Hydroperiod)
2018	-	October 31st	-	October 25th
2019	July 5th	-	July 1st	-

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool re-established) in the fall

3.2.6 Outlet Water Balance Results

The runoff volumes at key points of interest predicted through the daily water balance are summarized in the following table and in Appendix J. The key points of interest have been selected to evaluate the potential impact of extraction and quarry dewatering on the volume of water directed to local surface water features. We note, the drainage areas contributing to each key point of interest are complex with significant variation in drainage characteristics and storage which can be further complicated by the addition of the quarry discharge. As such, the important consideration is for the potential impacts to be evaluated based on the relative change from existing conditions.

Table 19: Existing Condition Outlet Water Balance Results Summary

YEAR	TOTAL PRECIPITATION (mm)	RUNOFF VOLUME (mm)				
		West Arm	East Arm	Weir Pond	Burlington Quarry	Wetland 13201
2009	1016	168	113	117	473	205
2010	847	38	26	31	326	41
2011	1088	173	117	111	544	222
2012	780	20	11	12	271	35
2013	969	100	62	52	410	138
2014	838	64	34	45	355	95
2015	756	39	25	33	270	41
2016	819	47	22	23	310	68
2017	996	127	83	70	433	167
2018	970	99	64	56	432	120

3.3 EXISTING CONDITION INTEGRATED SURFACE WATER GROUNDWATER ANALYSIS

The integrated surface water groundwater model prepared as part of the Level 1 and 2 Hydrogeological Assessment has been prepared to establish the existing hydrogeologic and hydrologic conditions of the Burlington Quarry, south extension and west extension lands, and of the surrounding area. The results of integrated surface water groundwater model for the Medad Valley are summarized in this Surface Water Assessment. The Level 1 and Level 2 Hydrogeological Assessment, specifically Section 6 Integrated Model Development and Calibration and Section 7 Baseline Conditions Analysis, can be referenced for additional details regarding the integrated surface water groundwater model development, calibration and results.

The integrated surface water groundwater model predicts the Willoughby Creek streamflow through the Medad Valley from the available climatological data for periods outside the available monitoring period; providing a greater period of assessment. The integrated surface water groundwater model also allows the potential impacts of the proposed extraction and quarry dewatering to be evaluated and quantified using predictive models.

The results of of the existing condition (baseline) integrated surface water groundwater model at surface water monitoring locations SW7 and SW14 are presented in the following table and illustrated on the graphs included in Appendix K.

It is noted the integrated surface water groundwater model simulates the quarry discharge which contributes flow to surface water monitoring location SW7. The quarry discharge has been simulated as a fixed outflow at a rate of 67 L/s (5,760 m^3/day) from Quarry Sump 0100. As previously discussed, the quarry discharge enters a karst sinkhole and resurfaces at two springs (identified as J and K in the Karst Investigation). The total streamflow measured at surface water monitoring location SW7 includes only a portion of the quarry discharge, only a portion of the 67 L/s. The portion of the quarry discharge assigned to Spring J is determined through numerical analysis within the integrated surface water groundwater model. The balance of the quarry discharge resurfaces at Spring K which drains to Willoughby Creek downstream of SW7.

Table 20: Existing Condition Integrated Surface Water Groundwater Model Results

MONTH	MONTHLY AVERAGE STREAMFLOW (L/S)					
	SW7			SW14		
	Average	Maximum	Minimum	Average	Maximum	Minimum
January	39.9	53.6	25.3	17.2	22.9	11.6
February	32.4	44.4	21.3	13.4	18.7	9.5
March	57.4	108.1	28.0	24.3	46.3	11.4
April	48.2	75.4	16.6	20.1	31.6	7.1
May	31.5	68.7	9.7	13.1	28.6	4.1
June	17.3	27.6	10.3	7.2	12.7	4.4
July	8.6	18.3	2.8	3.4	8.3	0.7
August	6.5	9.1	2.1	2.5	3.3	0.5
September	13.1	16.6	10.5	6.2	7.8	5.0
October	19.3	34.6	14.4	10.0	16.8	8.3
November	21.5	36.4	16.7	10.2	16.5	8.0
December	31.7	53.5	17.1	15.3	23.1	11.3

3.4 EXISTING CONDITION EVENT BASED HYDROLOIGC ANALYSIS

An existing condition event based hydrologic analysis was prepared to quantify the peak flows at key points of interest for the 25 mm storm, 1:2-year through 1:100-year design storms and the Regional (Hurricane Hazel) Storm. The existing peak flow rates have been established for consideration in the development of the surface water management strategy for the Burlington Quarry and proposed extension. The proposed condition, both during operations and rehabilitation, peak flow rates at the key points of interest must be maintained at or below existing rates through the implementation of a surface water management strategy on-site. As such, the surface water management strategy developed for the Burlington Quarry and proposed extensions has been designed to restrict peak flow rates to existing levels during both operations and post rehabilitation. The existing condition event based hydrologic analysis is described in the following sections.

3.4.1 Climate Data

The climate data used in the event based hydrologic model was obtained from the Ministry of Transportation (MTO) IDF Curve Lookup website. The IDF data obtained for the Burlington Quarry from the website is included in Appendix L for reference. The intensity-duration-frequency (IDF) data was applied to the Chicago 4-hour design storm distribution to generate high intensity short duration design storms for the event base hydrologic model. Similarly, a 25 mm rainfall depth was applied to the Chicago 4-hour design storm distribution to generate the 25 mm design storm for the event base hydrologic model. The intensity-duration-frequency (IDF) data was applied to the SCS type II 24-hour design storm distribution to generate low intensity long duration design storms for the event based hydrologic model. The historic rainfall distribution for the Hurricane Hazel Storm was used as the Regional Storm for the area.

3.4.2 Methodology

A Visual OTTHYMO 6 event based hydrologic model was created using the same subcatchment delineation as the existing condition water balance illustrated on the Existing Condition Drainage Plan (Drawing DP-1). The hydrologic model input parameters (curve number, initial abstraction and time to peak) were calculated from the available topographic mapping, soils maps and land use information for the area. The Soils Map of Halton County (Soil Survey Report No. 43) was used to establish the existing soil conditions in the study area and aerial photographs and data from the Southern Ontario Land Resource Information System (SOLRIS) were used to establish the existing land use conditions.

3.4.3 Hydrologic Model Results

The results of the existing condition event based hydrologic analysis at key points of interest are included in the following table and illustrated on the graphs included in Appendix L. It is noted that the event based hydrologic analysis excludes the off-site discharge from Quarry Sump 0100 and 0200 and the groundwater flux into the existing quarry and surface water features in the study area. The results represent the runoff from the design storms and Regional (Hurricane Hazel) Storm.

Table 21: Existing Condition Hydrologic Model Results Summary

DESIGN STORM	PEAK FLOW (m^3/s)			
	West Arm	Weir Pond	Burlington Quarry	Wetland 13201
25 mm	0.07	0.04	0.97	0.05
1:2-Year	0.44	0.25	4.34	0.32
1:5-Year	0.76	0.42	7.17	0.54
1:10-Year	0.99	0.55	9.18	0.71
1:25-Year	1.31	0.72	11.83	0.94
1:50-Year	1.56	0.86	13.88	1.11
1:100-Year	1.81	1.00	15.94	1.30
Regional	2.55	1.24	27.04	1.56

Note: Table summarizes results of SCS Type II 24-hour design storms

3.5 NATURAL HAZARDS ASSESSMENT – WEST ARM OF THE WEST BRANCH

Through agency consultation as part of the development of the Terms of Reference for this Surface Water Assessment, Conservation Halton requested the flood and erosion hazard limits associated with the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek be delineated downstream of No. 2 Sideroad through the south extension lands. It is understood the flood and erosion hazard limits are required to confirm the extraction limit in the south extension is located outside the natural hazards.

A Natural Hazards Assessment has been completed for the subject reach of the West Arm following the guidelines outlined in the Ministry of Natural Resources and Forestry (MNRF) Natural Hazards Technical Guides supporting the natural hazards policy (Policy 3.1) of the

Provincial Policy Statement of the Planning Act. As previously discussed, the flow in the West Arm is primarily a result of quarry discharge from Quarry Sump 0200. This is a unique situation as it relates to a natural hazards assessment. The natural hazards assessment completed, including the methodology applied, is fully described in the following sections.

3.5.1 Limits of the Assessment

The West Arm runs southeast from No. 2 Sideroad downstream parallel to the proposed extraction limit of the south extension. The West Arm runs southeast across the south extension lands for approximately 575 m before entering the Camisle Golf property to the west. The limits of the natural hazards study were selected as the first 700 m of watercourse downstream of No. 2 Sideroad to define the flood and erosion hazard limits across the south extension lands and a sufficient distance downstream.

A detailed topographic survey of the West Arm was completed through the study area. The topographic survey included channel cross-sections, from top of bank to top and bank, and defined the watercourse sinuosity and longitudinal slope. The online ponds and structures (culverts and bridges) were also surveyed for inclusion in the assessment of the natural hazards. The topographic survey data was incorporated into the overall topographic mapping obtained for the Burlington Quarry extensions and used in the integrated surface water groundwater model previously described. The topographic survey and mapping has been used to define the channel geometry of the HEC-RAS hydraulic model, which establishes the flood hazard limit along the West Arm, and the meander belt axis and bankfull width of the West Arm to establish the erosion hazard limit.

3.5.2 Flood Hazard Limit Delineation

To establish the flood hazard limit, a hydrologic analysis of the West Arm watershed upstream of the downstream limit of the study was completed along with a hydraulic analysis of the West Arm through the study area. An existing condition event based hydrologic analysis was prepared to quantify the Regional (Hurricane Hazel) Storm peak flow for the subject reach of the West Arm. The hydrologic analysis was prepared using the same methodology described in Section 3.3 of this report.

As discussed, the flow in the West Arm is unique as its primarily a result of quarry discharge. Permit to Take Water No. 96-P-3009 allows Nelson to discharge water from Quarry Sump 0200 at a maximum rate of 945 L/min (~16 L/s) to the West Arm. As such, a conservative maximum peak flow equal to the Regional (Hurricane Hazel) Storm peak flow plus the maximum allowable quarry discharge rate was assumed for this natural hazards assessment. The peak flows are summarized in the following table.

Table 22: Natural Hazards Assessment Peak Flow Summary

WATERSHED	PEAK FLOW (m^3/s)		
	Regional Storm	Quarry Discharge	Total
West Arm	1.988	0.016	2.004

A HEC-RAS hydraulic model of the West Arm through study area was created using the topographic survey and map data and the peak flows described above. Channel cross-sections were established roughly every 30 m and extend to an elevation that contains the Regional (Hurricane Hazel) Storm peak flow to accurately define the flood hazard limit across the property. The manning's roughness coefficients used in the hydraulic model represent those conditions witnessed on-site during field investigations and the downstream boundary condition was set as normal depth. The existing culvert crossings are included in the HEC-RAS model to evaluate their impact on the flood levels.

The results of the hydraulic analysis, specifically the Regional (Hurricane Hazel) Storm water levels and the corresponding flood hazard limit, are illustrated on the Natural Hazards Plan (Drawing NH-1) enclosed. The extraction limit in the south extension is included on the Natural Hazards Plan (Drawing NH-1). As illustrated, the extraction limit is located outside the flood hazard limit associated with the West Arm through the south extension lands. The detailed results of the hydrologic and hydraulic analysis are enclosed in Appendix M for reference.

3.5.3 Erosion Hazard Limit Delineation

The West Arm is an unconfined watercourse and its erosion hazard limit is defined by the greater of the flood hazard limit or a meander belt allowance plus an erosion access allowance. The flood hazard limit was established in the previous section using the HEC-RAS hydraulic model. The meander belt allowance for a natural channel is typically defined as 20 times the channels bankfull width centred on the meander belt axis. The bankfull width being the width of the primary channel at the channels top of bank formed by the 1:2-year design storm peak flow. The meander belt axis is a theoretical line along the channel representing the center axis of the meandering watercourse.

The West Arm through the study area has a relatively simple linear meander pattern and meander belt axis as illustrated on the Natural Hazards Plan (Drawing NH-1) enclosed. A review of the channel geometry provided a maximum channel bankfull width of 7.2 m. As such, a 144 m wide meander belt allowance centered over the meander belt axis has been established for the West Arm through the study area. This equates to a 72 m meander belt allowance east of the meander belt axis.

As mentioned, the erosion hazard limit is defined by the meander belt allowance plus an erosion access allowance. In this case, the erosion access allowance is a setback from the meander belt allowance, for emergency, construction or maintenance access as determined by a detailed investigation or set at a conservative 6 m. In the absence of a detailed investigation the erosion access allowance has been set at 6 m. The meander belt axis, meander belt allowance, erosion access allowance and consequently the erosion hazard limit are illustrated on the Natural hazards Plan (Drawing NH-1) enclosed.

The extraction limit in the south extension is included on the Natural Hazards Plan (Drawing NH-1). As illustrated, the extraction limit is located outside the erosion hazard limit associated with the West Arm through the south extension lands.

3.5.4 Erosion Threshold Analysis

An erosion threshold analysis has been completed for the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek under existing conditions and for the proposed South Extension discharge. The erosion threshold analysis was completed under existing conditions as this represents the worst-case scenario as runoff from the contributing area will be reduced as the catchment area will be reduced (26.2 ha to 14.5 ha) due to the South Extension. The existing and proposed catchment areas are illustrated on the Existing Condition and Proposed Condition Drainage Plans (Drawings DP-1 through DP-3) enclosed.

A topographic survey of the West Arm of the West Branch through the subject property previously completed in addition to several site walks were completed to establish the existing conditions and geomorphic parameters of the watercourse. The West Arm of the West Branch through the subject property is well vegetated and there was no evidence of erosion witnessed along this reach of the watercourse. Additional site walks are completed each year when collecting the streamflow monitoring data from surface water monitoring location SW6 and there has been no visible change in the conditions of the West Arm of the West Branch since the topographic survey was completed.

A natural hazards assessment was completed previously as documented in the Surface Water Assessment. To complete the natural hazards assessment, specifically the flood hazard assessment, a hydraulic model of the West Arm of the West Branch was prepared which defined the water levels, flow velocities, bed shear stress, etc. under various peak flows. An erosion hazard assessment in accordance with the Provincial Policy Statement and MNRF Technical Guide, River & Stream Systems: Erosion Hazard Limit was also completed which defined additional geomorphic parameters such as bank full width. The Regional Floodplain and erosion hazard limit are illustrated on the Natural Hazards Plan (Drawing NH-1) enclosed.

An erosion threshold analysis has been completed at cross-sections C and D as illustrated on the Natural Hazards Plan (Drawing NH-1) using the information available for the West Arm of the West Branch and the hydraulic model. These cross-sections were selected as they are located immediately upstream and downstream of the proposed temporary discharge from the South Extension, and they closely mimic the average geomorphic conditions along the West Arm (see Geomorphic Parameters summary included in Appendix M). The erosion threshold analysis was completed using the Shields Method and diagram using a substrate D_{50} of 5 mm. The erosion threshold analysis established the critical flow to be 790 L/s for the West Arm of the West Branch at cross-section C-C (see Erosion Threshold Assessment attached). The critical flow exceeds:

- the 1:50-year Chicago (720 L/s) and the 1:5-year SCS (760 L/s) design storm peak flows under existing conditions;
- the 1:100-year Chicago (440 L/s) and the 1:25-year SCS (680 L/s) design storm peak flows under proposed conditions (Phase 2 operations and rehabilitation); and
- the maximum existing (16 L/s) and proposed (66 L/s) discharge rates from the existing quarry and South Extension.

Based on the erosion threshold assessment completed, the proposed quarry expansion will not adversely impact erosion along the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek.

In addition to the erosion threshold assessment, the hydraulic model was reviewed to confirm the subject reach of the West Arm of the West Branch has sufficient capacity to convey the proposed discharge within the bankfull channel. The hydraulic model demonstrates the bankfull channel and the existing culvert crossing have sufficient capacity to convey the proposed combined discharge from both Sump 0200 of the existing quarry and the South Extension of 66 L/s (see HEC-RAS cross-sections included in Appendix M).

4 Proposed Conditions - Operations

To evaluate the potential impacts on the surface water features on-site and in the surrounding area during operations, the proposed drainage conditions have been analyzed and compared against the existing drainage conditions detailed in Section 3 of this report. To establish the proposed drainage conditions, the proposed drainage patterns were identified, and the water balance, event based hydrologic models and integrated surface water groundwater model were updated. The proposed drainage conditions during operations are described in the following sections.

4.1 PROPOSED DRAINAGE PATTERNS - OPERATIONS

The proposed drainage patterns during operations for the south and west extensions were developed from the Burlington Quarry Extension Site Plans prepared by MHBC. The Site Plans have been prepared through an iterative process considering the following:

- The natural heritage features on-site and in the surrounding area;
- Potential impacts to surface water and groundwater features in the area;
- The monitoring data collected to date;
- The results of this Surface Water Assessment and the integrated surface water/ground water model; and
- Quarry operations within the existing Burlington Quarry and the future operational requirements in the south and west extensions.

A Proposed Condition (Operations) Drainage Plan (Drawing DP-2) illustrating the proposed drainage conditions of the Burlington Quarry, south extension and west extension lands and the surrounding area are enclosed and should be referenced when reviewing Section 4 of this report. The proposed drainage patterns are described in the following sections.

4.1.1 Burlington Quarry

The existing drainage patterns within Burlington Quarry will remain unchanged through extraction in the south and west extensions. The quarry will drain internally to a series of settling ponds constructed in the quarry floor and water is proposed to continue to be discharged off-site from Quarry Sump 0100 and 0200 to the two existing discharge locations. The configuration of the existing settling ponds will be altered during different phases of extraction in the west extension as operations require to facilitate extraction in the west expansion lands and to maintain dry operating conditions. However, the off-site discharge is proposed to continue as per the conditions of Nelson's PTTW and ECA.

As discussed, Nelson is exploring options to construct a conveyance system (a culvert, ditch or combination of the two) alongside Colling Road within Nelson's property between Blind Line and the quarries existing discharge location to redirect the external drainage from northwest of Colling Road to the discharge location of Quarry Sump 0100. The conveyance system construction has been evaluated through the proposed conditions water balance and event based hydrologic model.

4.1.2 South Extension

The drainages areas contributing to each wetland east and south of the south extension will remain unaltered through extraction. The extraction limit proposed through the development of the Site Plans maintains the surface water catchments to each wetland east and south the south extension and the East Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek.

During extraction, the West Arm watershed will be reduced in size as the open extraction will intercept rainfall, groundwater and surface runoff. The south extension includes 14.5 ha of extraction within the licence boundary which currently drains to the West Arm. During extraction, water from the disturbed lands will accumulate on the quarry floor in a sump and be discharged to a settling pond constructed at surface within the extraction area for water quality treatment. The settling pond will discharge to the West Arm after treating the quarry water at rates set to mimic existing conditions.

A temporary settling pond will be constructed for this purpose during the initial stages of extraction until sufficient extraction has occurred in Phase 2 of the south extension to construct an adequately sized sump (to both store and treat the quarry water) in the quarry floor. Water accumulating in the quarry floor will be pumped to the settling pond at a maximum rate of 50 L/s (3,000 L/min) for treatment prior to its release to the West Arm. Limiting the maximum pumping rate to 50 L/s will ensure the discharge to the West Arm occurs at rates less than or equal to existing conditions for the 1:2-year through 1:100-year design storms. A three-cell settling pond with a permanent pool depth and volume of 1 m and 1,800 m^3, respectively, will treat a maximum flow rate of 50 L/s to the effluent limits specified in Nelson's Environmental Compliance Approval. Detailed design of the settling pond will be completed as part of the approval process.

Once approximately 5 ha of extraction has occurred in the south extension an adequately sized sump can be constructed in the quarry floor to store and treat the quarry water. Assuming approximately 1 million tonnes of extraction per year, extraction in the south extension will take roughly nine (9) years to complete. It will take approximately three (3) years until sufficient extraction has occurred before an adequately sized sump can be constructed. As extraction continues in the south extension over the final six (6) years, the quarry sump will be enlarged to accommodate the additional intercepted rainfall, groundwater and surface runoff from the increasing size of the open extraction area. Similar to the temporary settling pond, the discharge from the quarry sump will be restricted to a discharge rate of 50 L/s and will provide adequate treatment to satisfy the effluent limits of Nelson's Environmental Compliance Approval.

Discharge to the West Arm from Quarry Sump 0200 is proposed to continue throughout operations in accordance with the conditions of Nelson's PTTW and ECA that will require an amendment to include the discharge from the south extension. The settling pond design, discharge location, discharge rates and effluent limits for the south extension will be finalized through the PTTW and ECA amendment application process in consultation with the MNRF, Halton Conservation, the MECP and applicable commenting agencies.

4.1.3 West Extension

Extraction in the west extension will reduce the size of the subcatchments draining to several of its existing outlets. Extraction and quarry dewatering will also lower groundwater levels surrounding the west extension within 350 m of the extraction face. As such, a series of mitigation measures are proposed to address any potential adverse impact that could result from extraction and quarry dewatering. The proposed mitigation measures are described next.

The integrated surface water groundwater model results predict groundwater mounding beneath the existing irrigation ponds on the BSGCC property. This groundwater mounding is generally maintained year-round by the diversion of quarry discharge into the irrigation ponds and raises groundwater levels in the area artificially. Through extraction, the irrigation ponds will be eliminated, and groundwater water levels will be lowered in the area. To replicate the existing artificial groundwater mounding produced by the irrigation ponds, a pond (replica pond) will be constructed outside the extraction area within the licence boundary between the extraction limit and Cedar Springs Road. The replica pond will be constructed at depths and elevations consistent with the existing irrigation ponds.

As discussed, Quarry Sump 0100 discharges to the roadside ditch along Colling Road which drains southwest to wetland 13202 (weir pond) located in the northeast corner of the west extension lands. A weir structure and diversion channel maintain flow to the irrigation ponds on the golf course. The diversion channel will be eliminated through extraction and will be replaced by a diversion pipe proposed to divert a portion of the quarry discharge to the proposed replica pond between the extraction limit and Cedar Springs Road. The diversion pipe will consist of an adequately sized culvert installed between Colling Road/Cedar Springs road and the extraction limit. The diversion pipe will divert flow to the proposed replica pond in a similar manner and elevation as the existing diversion channel.

Extraction will reduce the drainage area to wetland 13201 northwest of No. 2 Sideroad. Reducing the drainage area of the wetland has the potential to adversely impact the wetlands hydroperiod, therefore, a mitigation strategy has been developed to supplement the flow into the wetland during operations. A bottom draw outlet will be constructed in the southeast corner of the proposed replica pond and an outlet pipe complete with a control valve will be installed to discharge water into the roadside ditch along No. 2 Sideroad feeding the wetland. The wetland hydroperiod will be monitored and water will be discharged to the wetland as required to mimic existing conditions and maintain the wetland hydroperiod. The discharge of water, both rate and quantity, will be controlled by the control valve.

Extraction will also reduce the drainage area to wetland 13200 located northeast of the existing irrigation ponds within the BSGCC property. Reducing the drainage area of the wetland also has the potential to adversely impact the wetlands hydroperiod. As such, a mitigation strategy has been developed to supplement the flow into the wetland during operations as required. Quarry water will be pumped from Quarry Sump 0100 directly into the wetland at specified rates and volumes to maintain the wetland hydroperiod.

The drainage areas of the four additional outlets within the Bronte Creek watershed will also be reduced. The proposed conditions (during operations) for the four outlets within the Bronte Creek watershed are described as follows:

- The catchment (Catchment S102) draining overland as sheet flow to the east corner of the intersection of Colling Road and Cedar Springs Road will be reduced to 5.0 ha (1.0 ha reduction).
- The catchment (Catchment S103) draining overland as sheet flow to the culvert crossing Cedar Springs Road immediately south of the BSGCC entrance will be reduced to 4.1 ha (12.4 ha reduction).
- The catchment (Catchment S104) draining overland as sheet flow to the culvert crossing Cedar Springs Road immediately east of Cedar Springs Court will be reduced to 1.8 ha (5.2 reduction).
- The catchment (Catchment S105) draining overland as sheet flow to the culvert crossing Cedar Springs Road at No. 2 Sideroad will be reduced to 0.4 ha (1.6 ha reduction).

Catchments 102 through 105 drain overland to municipal drainage systems (roadside ditches) along Cedar Springs Road, Cedar Springs Court and No. 2 Sideroad. As mentioned, the drainage systems (roadside ditches) downstream of the culvert crossings Cedar Springs Road are poorly defined or nonexistent. It is expected that any surface runoff draining through the culverts will either evaporate, infiltrate or drain overland following the topographic low through the road allowance or across private property to the Medad Valley and Willoughby Creek. Reducing the drainage area to the roadside ditches will reduce flows to these drainage systems and improve their function. The municipal drainage systems were not identified as Natural Heritage Features through the Natural Environment Technical Report (NETR) completed in support of the proposed extension and a reduction in drainage area, and consequently peak flow, will not impact the drainage systems.

Discharge to the Colling Road roadside ditch and Willoughby Creek from Quarry Sump 0100 is proposed to continue throughout operations in accordance with the conditions of Nelson's PTTW and ECA. The PTTW and ECA will require an amendment to include the discharge from the west extension. The discharge location, discharge rates and effluent limits for the west extension will be finalized through the PTTW and ECA amendment application process in consultation with the MNRF, Halton Conservation, the MECP and applicable commenting agencies.

Within the open extraction area in the west extension, intercepted groundwater, rainfall and runoff will accumulate on the quarry floor in a sump and be drained or pumped into the existing settling ponds in the Burlington Quarry for off-site discharge from Quarry Sump 0100 or 0200. As discussed, the configuration of the existing settling ponds will be altered during different phases of extraction in the west extension as operations require. Similarly, the sump in the west extension quarry floor will be relocated as needed to facilitate extraction and maintain dry operating conditions.

4.2 PROPOSED CONDITION (OPERATIONS) WATER BALANCE

The daily water balance has been calibrated to predict the existing wetland hydroperiods and has been updated to predict potential impacts from the proposed extraction and quarry dewatering. The update includes applying the proposed drainage conditions during operations, specifically the proposed subcatchment delineation illustrated on the Proposed Condition (Operations) Drainage Plan (Drawing DP-2). Also, the proposed groundwater flux into the shallow groundwater system calculated by the integrated surface water groundwater model has been added to the soil storage. The contemplated drainage improvements along Colling Road to redirect the external drainage from northwest of Colling Road to the Quarry Sump 0100 discharge location have also been assumed to be implemented. Graphs comparing the predicted water level in each wetland under existing and proposed conditions (operations) are included in Appendix N for reference. The daily water balance results are discussed in the following section of this report.

4.2.1 Wetland Water Balance Results

As illustrated in the following tables, the proposed condition wetland water balance predicts little to no change in the wetland hydroperiod for the four wetlands evaluated. The drainages areas contributing to each wetland east and south of the south extension will remain undisturbed through extraction, therefore, the total volume and timing of surface runoff draining to each wetland will not be altered through extraction.

The results of the integrated surface water groundwater model predict drawdown of the groundwater levels below the wetlands east and south of the south extension during operations. This has the potential to alter the groundwater flux into/out of the wetland. Under existing and proposed (operations) conditions, groundwater flux into the wetlands has been estimated as summarized in the following table.

Table 23: Wetland Groundwater Flux Summary - Operations

MONITORING LOCATION (WETLAND)	EXISTING CONDITIONS		PROPOSED CONDITIONS (OPERATIONS)	
	Groundwater Inflow (m^3/day)	Groundwater Outflow (m^3/day)	Groundwater Inflow (m^3/day)	Groundwater Outflow (m^3/day)
SW11A (Wetland 13027)	0.8 (1.3%)	1.5 (2.5%)	0 (0.0%)	6.1 (5.8%)
SW12A (Wetland 13022)	0.5 (0.3%)	0 (1.3%)	0 (0.0%)	0 (1.3%)
SW13A (Wetland 13016)	0 (0.0%)	2.9 (4.0%)	0 (0.0%)	2.6 (3.9%)
SW16A (Wetland 13037)	0.5 (1.8%)	4.4 (12.8%)	0 (0.0%)	4.3 (16.0%)

Note: 1) Values in brackets represent the groundwater flow as a percentage of total flow into or out of the wetland

As illustrated in the following table, the proposed condition water balance predicts the spring hydroperiod of wetland 13027 to be reduced by five days or less in 2010 through 2018. On average, the wetland will become dry approximately two days earlier under proposed conditions compared to existing conditions. From 2009 to 2018, the water balance predicts the fall hydroperiod to be delayed by five days or less seven out of the ten years analyzed. During these seven years, the fall hydroperiod is delayed on average one day. The predicted change in the spring and fall hydroperiods is due to the potential reduction in groundwater inflow (1.3% reduction in total flow entering the wetland on an annual basis) to wetland 13027 as a result of quarry extraction and dewatering.

Its noted, the wetland 13207 spring and fall hydroperiods vary dramatically year to year due to weather and are driven primarily by surface water. The end of the spring hydroperiod measured varied from May 19th to June 20th (32 days). Similarly, the fall hydroperiod measured varies from October 27th to late December (2 months or more). The amount of precipitation and the weather have the greatest impact on the hydroperiod of wetland 13027. Although the groundwater influx does contribute some water to the wetland, it is estimated to have a very minor impact on the overall wetland hydroperiod and the predicted changes under proposed conditions (operations) will not be measurable given the significance of climate on wetland function.

Table 24: SW11A (Wetland 13027) Water Balance Comparison - Operations

YEAR	EXISTING CONDITIONS		PHASE 1/2 EXTRACTION		PHASE 3/4/5/6 EXTRACTION	
	Spring Hydroperiod[1]	Fall Hydroperiod[2]	Spring Hydroperiod[1]	Fall Hydroperiod[2]	Spring Hydroperiod[1]	Fall Hydroperiod[2]
2009	June 15th	Oct. 5th	June 4th	Oct. 5th	June 4th	Oct. 5th
2010	May 24th	Sept. 29th	May 22nd	Oct. 1st	May 22nd	Oct. 1st
2011	June 15th	Oct. 19th	June 14th	Oct. 19th	June 14th	Oct. 19th
2012	April 7th	Oct. 27th	April 2nd	Oct. 28th	April 2nd	Oct. 28th
2013	July 17th	Oct. 4th	July 16th	Oct. 5th	July 16th	Oct. 5th
2014	May 30th	Sept. 4th	May 28th	Sept. 4th	May 28th	Sept. 4th
2015	May 7th	Nov. 9th	May 3rd	Nov. 26th	May 3rd	Nov. 26th
2016	May 30th	Dec. 27th	May 27th	Jan. 2nd	May 27th	Jan. 2nd
2017	June 12th	Nov. 18th	June 12th	Jan. 10th	June 12th	Jan. 10th
2018	May 29th	Nov. 3rd	May 28th	Nov. 3rd	May 28th	Nov. 3rd

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool re-established) in the fall

As illustrated in the following table, the proposed condition water balance predicts a similar result for wetland 13022. The spring hydroperiod will potentially be reduced by five days or less seven out of the ten years analyzed. On average, the wetland will become dry approximately two days earlier under proposed conditions compared to existing conditions. From 2009 to 2018, the water balance predicts the fall hydroperiod to be delayed by one day or less nine out of the ten years analyzed. The predicted change in the spring and fall hydroperiods is due to the reduction in groundwater inflow (0.3% reduction in total flow entering the wetland on an annual basis) to wetland 13022 as a result of quarry extraction and dewatering.

Its noted, the wetland 13022 spring and fall hydroperiods vary dramatically year to year due to weather. The spring hydroperiod measured varies from May 11th to June 14th (34 days). Similarly, the fall hydroperiod predicted varies from September 4th to January 10th (approximately 4 months). The amount of precipitation and the weather have the greatest impact on the hydroperiod of wetland 13022. Although the groundwater influx does contribute some water to the wetland, it is estimated to have a minor impact on the overall wetland hydroperiod and the predicted changes under proposed conditions (operations) will not be measurable given the significance of climate on wetland function.

Table 25: SW12A (Wetland 13022) Water Balance Comparison - Operations

YEAR	EXISTING CONDITIONS		PHASE 1/2 EXTRACTION		PHASE 3/4/5/6 EXTRACTION	
	Spring Hydroperiod[1]	Fall Hydroperiod[2]	Spring Hydroperiod[1]	Fall Hydroperiod[2]	Spring Hydroperiod[1]	Fall Hydroperiod[2]
2009	May 18th	Oct. 8th	May 15th	Oct. 8th	May 15th	Oct. 8th
2010	July 5th	Oct. 12th	June 17th	Oct. 22nd	June 17th	Oct. 22nd
2011	June 14th	Oct. 18th	June 14th	Oct. 18th	June 14th	Oct. 18th
2012	March 20th	Oct. 28th	March 18th	Oct. 29th	March 18th	Oct. 29th
2013	May 8th	Oct. 30th	May 8th	Oct. 30th	May 8th	Oct. 30th
2014	May 26th	Nov. 21st	May 25th	Nov. 21st	May 25th	Nov. 21st
2015	April 29th	Jan. 25th	April 30th	Jan. 25th	April 30th	Jan. 25th
2016	May 24th	Jan. 10th	April 19th	Jan. 10th	April 19th	Jan. 10th
2017	June 4th	Jan. 10th	June 9th	Jan. 10th	June 9th	Jan. 10th
2018	May 23rd	Oct. 31st	May 6th	Oct. 31st	May 6th	Oct. 31st

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool re-established) in the fall

As illustrated in the following table, the proposed condition water balance predicts no change in the spring and fall hydroperiod of wetland 13016. No change is predicted as the drainage area contributing surface runoff to the wetland will not be altered through quarry operations and there is no groundwater inflow into the wetland under existing or proposed conditions.

Table 26: SW13A (Wetland 13016) Water Balance Comparison - Operations

YEAR	EXISTING CONDITIONS		PHASE 1/2 EXTRACTION		PHASE 3/4/5/6 EXTRACTION	
	Spring Hydroperiod[1]	Fall Hydroperiod[2]	Spring Hydroperiod[1]	Fall Hydroperiod[2]	Spring Hydroperiod[1]	Fall Hydroperiod[2]
2009	June 13th	Oct. 1st	June 13th	Oct. 1st	June 13th	Oct. 1st
2010	July 22nd	Nov. 15th	July 22nd	Nov. 15th	July 22nd	Nov. 15th
2011	June 20th	Oct. 18th	June 20th	Oct. 18th	June 20th	Oct. 18th
2012	May 11th	Jan. 10th	May 11th	Jan. 10th	May 11th	Jan. 10th
2013	July 18th	Oct. 31st	July 18th	Oct. 31st	July 18th	Oct. 31st
2014	June 10th	Sept. 4th	June 10th	Sept. 4th	June 10th	Sept. 4th
2015	May 15th	Feb. 18th	May 15th	Feb. 18th	May 15th	Feb. 18th
2016	May 29th	Jan. 12th	May 29th	Jan. 12th	May 29th	Jan. 12th
2017	June 14th	Jan. 10th	June 14th	Jan. 10th	June 14th	Jan. 10th
2018	June 1st	Nov. 25th	June 1st	Nov. 25th	June 1st	Nov. 25th

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool re-established) in the fall

As illustrated in the following table, the proposed condition water balance predicts the spring hydroperiod of wetland 13037 to be reduced by five days or less six out of the ten years analyzed. On average, the wetland will become dry approximately two days earlier under proposed conditions compared to existing conditions. From 2009 to 2018, the water balance predicts no delay in the fall hydroperiod seven out of the ten years analyzed. The predicted change in the spring and fall hydroperiods is due to the reduction in groundwater inflow (1.8% reduction in total flow entering the wetland on an annual basis) to wetland 13027 as a result of quarry extraction and dewatering.

Its noted, the wetland 13037 spring and fall hydroperiods varying dramatically year to year due to weather. The spring hydroperiod predicted varies from May 25th to August 3rd (approximately 2 months). Similarly, the fall hydroperiod measured varies from September 4th to December 25th (approximately 4 months). The amount of precipitation and the weather have the greatest impact on the hydroperiod of wetland 13037. Although the groundwater influx does contribute water to the wetland, it has a minor impact on the overall wetland hydroperiod and the predicted changes under proposed conditions (operations) are not measurable given the significance of climate on wetland function.

Table 27: SW16A (Wetland 13037) Water Balance Comparison - Operations

YEAR	EXISTING CONDITIONS		PHASE 1/2 EXTRACTION		PHASE 3/4/5/6 EXTRACTION	
	Spring Hydroperiod[1]	Fall Hydroperiod[2]	Spring Hydroperiod[1]	Fall Hydroperiod[2]	Spring Hydroperiod[1]	Fall Hydroperiod[2]
2009	July 18th	Oct. 1st	June 10th	Oct. 1st	June 10th	Oct. 1st
2010	August 3rd	Sept. 27th	August 3rd	Sept. 27th	August 3rd	Sept. 27th
2011	June 28th	Oct. 18th	June 16th	Oct. 18th	June 16th	Oct. 18th
2012	May 25th	Sept. 6th	May 11th	Oct. 21st	May 11th	Oct. 21st
2013	July 16th	Sept. 20th	July 15th	Sept. 20th	July 15th	Sept. 20th
2014	August 26th	Sept. 4th	August 24th	Sept. 4th	August 24th	Sept. 4th
2015	July 11th	Oct. 27th	July 11th	Oct. 27th	July 11th	Oct. 27th
2016	June 21st	Dec. 25th	May 29th	Jan. 2nd	May 29th	Jan. 2nd
2017	June 29th	Nov. 17th	July 2nd	Nov. 17th	July 2nd	Nov. 17th
2018	June 2nd	Sept. 30th	May 28th	Oct. 26th	May 28th	Oct. 26th

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool re-established) in the fall

4.2.2 Outlet Water Balance Results

As illustrated on the following table and in the tables provided in Appendix O, the proposed condition outlet water balance results predict a decrease in the runoff volume draining to the West Arm. This is due to the reduction in the drainage area during extraction. However, the main source of water to the West Arm will be the quarry discharge from Quarry Sump 0200. This quarry discharge is proposed to continue long-term to maintain baseflow in the West Arm. During operations, discharge from the quarry operation will also directed to the West Arm supplementing flows.

A minor reduction (4 - 6 %) in runoff volume is predicted to the East Arm due to the minor reduction (0.3% to 1.8%) in groundwater influx predicted to the wetlands upstream, specifically wetlands 13027, 13022, and 13037. As described this reduction is considered insignificant in the context of the total volume to this location. However, if necessary, mitigation measures have been developed that could address potential impacts on the wetlands and are discussed further in Section 6 of this report.

The proposed condition outlet water balance results predict a decrease in the direct runoff volume draining to the weir pond (wetland 13202) due to extraction in the west extension. As a result of extraction in the west extension, the drainage area draining directly to the weir pond (wetland 13202) will be reduced. The main source of water into the weir pond (wetland 13202) is the quarry discharge from Quarry Sump 0100. The quarry discharge typically occurs at constant rates in accordance with Nelson's existing PTTW. Going forward the main source of water will continue to be the quarry discharge from Quarry Sump 0100 and the discharge is proposed to continue long-term to maintain baseflow in the tributary of Willoughby Creek.

Under proposed condition, the runoff volume entering the Burlington Quarry will increase through extraction in the west extension. Under existing conditions, the existing quarry is inundated with surface runoff, direct rainfall and intercepted groundwater. To manage the additional runoff volume during operations, the settling ponds will be reconfigured and expanded to increase the available storage volume on-site and it is recommended that Nelson explore options to permanently increase the maximum allowable water taking from Quarry Sump 0200.

Under proposed conditions, the drainage area contributing to wetland 13201 will be reduced through extraction in the west extension. Consequently, the runoff volume will also be reduced and the wetland hydroperiod has the potential to be impacted. Mitigation measures have been developed to address the potential impacts on wetland 13201 during and post extraction and are discussed further in Section 6 of this report.

Table 28: Proposed Condition (Operations) Outlet Water Balance Results Summary

YEAR	TOTAL PRECIPITATION (mm)	RUNOFF VOLUME (mm)				
		West Arm	East Arm	Weir Pond	Burlington Quarry	Wetland 13201
2009	1016	92	108	786	575	111
2010	847	16	23	243	413	23
2011	1088	98	112	964	649	123
2012	780	10	8	215	364	20
2013	969	57	58	566	529	75
2014	838	34	32	428	451	56
2015	756	18	21	175	383	21
2016	819	26	21	354	400	37
2017	996	72	78	711	528	89
2018	970	49	58	582	534	63

4.3 PROPOSED CONDITION INTEGRATED SURFACE WATER GROUNDWATER ANALYSIS

To quantify the Willoughby Creek streamflow through the Medad Valley during extraction, the calibrated integrated surface water groundwater model was updated to reflect proposed conditions during operations. For the evaluation of the quarry extensions potential impact on Willoughby Creek streamflow through the Medad Valley, the worst-case scenario was evaluated, specifically the completion of extraction in the west extension. For this scenario, extraction is complete in Phases 1 through 6, however, the rehabilitation in the south extension is complete and the lake has been allowed to fill. Also, the quarry discharge from Quarry Sump 0100 has been simulated as a fixed outflow at a rate of 67 L/s (5,760 m^3/day) and apportioned to Spring J and K consistent with existing conditions. The Level 1 and Level 2 Hydrogeological Assessment, specifically Section 8 Level 2 Future Conditions Evaluation, can be referenced for additional details regarding the integrated surface water groundwater analysis under proposed conditions (operations).

The results of the proposed condition (operations) integrated surface water groundwater model at surface water monitoring locations SW7 and SW14 are presented in the following table and illustrated on the graphs included in Appendix P.

Table 29: Proposed Condition Integrated Surface Water Groundwater Model Results

MONTH	MONTHLY AVERAGE STREAMFLOW (L/S)					
	SW7[1]			SW14		
	Existing Average	Proposed Average	Reduction	Existing Average	Proposed Average	Reduction
January	39.9	37.1	2.8	17.2	16.6	0.6
February	32.4	29.9	2.5	13.4	13.3	0.5
March	57.4	54.6	2.8	24.3	23.7	0.6
April	48.2	45.3	2.9	20.1	19.5	0.6
May	31.5	29.0	2.5	13.1	12.6	0.5
June	17.3	15.3	2.0	7.2	6.9	0.3
July	8.6	7.5	1.1	3.4	3.3	0.2
August	6.5	5.4	1.1	2.5	2.3	0.2
September	13.1	11.4	1.8	6.2	5.9	0.3
October	19.3	17.3	2.1	10.0	9.7	0.3
November	21.5	19.4	2.2	10.2	9.8	0.4
December	31.7	29.1	2.7	15.3	14.8	0.5

Note: 1) Includes contributions for quarry discharge.

The Willoughby Creek watershed at SW14 will remain unaltered through extraction and a reduction is surface runoff to Willoughby Creek will not occur upstream of No. 2 Sideroad at SW14. As illustrated in the previous table, the proposed condition integrated surface water groundwater model predicts a minor reduction in Willoughby Creek average monthly streamflow through the Medad Valley due to the lowering of the groundwater table in the area through extraction and quarry dewatering. A reduction of 0.2 – 0.6 L/s is predicted at surface water monitoring location SW14. The reduction in streamflow is predicted to be greater in the fall, winter and spring (when more water is available in Willoughby Creek) and less during the summer months. However, the predicted reductions are considered minor and unmeasurable in the field. Also, the surface water monitoring data collected to date demonstrates that Willoughby Creek is an intermittent watercourse at SW14 (ie. it is absent of baseflow at times during the year). Willoughby Creek is absent of baseflow typically June through September each year.

The Willoughby Creek watershed will be reduced in area at SW7 through extraction in the west extension. The overall watershed will be reduced by approximately 19 ha or 6% at SW7. As illustrated in the previous table, the proposed condition integrated surface water groundwater model predicts a minor reduction in Willoughby Creek average monthly streamflow through the Medad Valley due to the reduction in in watershed area, and consequently reduction in surface runoff, and the lowering of the groundwater table in the area through extraction and quarry dewatering. A reduction of 1.1 – 2.9 L/s is predicted at surface water monitoring location SW7. The reduction in streamflow is predicted to be greater in the fall, winter and spring (when more water is available in Willoughby Creek) and less during the summer months. The monitoring data collected to date shows a continuous baseflow of approximately 4 L/s in Willoughby Creek at SW7. However, the quarry discharge contributes to the baseflow at SW7 and it is expected that Willoughby Creek would run dry at SW7 if the quarry discharge were to cease. As proposed, the quarry discharge from Quarry Sump 0100 will be maintained during operations and long-term post rehabilitation. Maintaining the off-site discharge will maintain baseflows in Willoughby Creek downstream of its confluence with its tributary.

4.4 PROPOSED CONDITION (OPERATIONS) EVENT BASED HYDROLOGIC ANALYSIS

To quantify the proposed condition peak flow rates to the key points of interest during operations, the existing Visual OTTHYMO 6 event based hydrologic model was updated to include the proposed drainage conditions during operations, specifically the proposed subcatchment delineation illustrated on the Proposed Condition (Operations) Drainage Plan (Drawing DP-2). Also, the contemplated drainage improvements along Colling Road to redirect the external drainage from northwest of Colling Road to the Quarry Sump 0100 discharge location have been assumed to be implemented. The results of the proposed condition (operations) event based hydrologic analysis at key points of interest are included in the following table and illustrated on graphs included in Appendix Q.

Table 30: Proposed Condition (Operations) Hydrologic Model Results Summary

DESIGN STORM	PEAK FLOW (m³/s)			
	West Arm	Weir Pond	Burlington Quarry	Wetland 13201
25 mm	0.04	0.04	3.66	0.02
1:2-Year	0.23	0.21	6.52	0.13
1:5-Year	0.39	0.36	9.88	0.23
1:10-Year	0.51	0.46	11.89	0.30
1:25-Year	0.68	0.51	14.49	0.40
1:50-Year	0.81	0.52	16.47	0.48
1:100-Year	0.94	0.53	18.44	0.56
Regional	1.33	0.71	29.89	0.73

Note: Table summarizes results of SCS Type II 24-hour design storms

As discussed, during extraction in the south extension the West Arm watershed will be reduced in size as the open extraction will intercept rainfall, groundwater and surface runoff. This reduction in drainage area will reduce the peak flows to the West Arm for each design storm. However, Quarry Sump 0200 currently discharges to the West Arm and is proposed to continue to do so long-term (post rehabilitation); maintaining baseflow in the West Arm. Also, during extraction additional water will be discharged to the West Arm from the south extension at a maximum rate of 50 L/s. Restricting the discharge from the south extension to 50 L/s will ensure the peak flow rates in the West Arm are maintained to existing levels. Upon completion of extraction in the south extension, the extraction area will be rehabilitated and the discharge from the south extension to this outlet will cease.

Through extraction of the west extension, the irrigation ponds and diversion channel on the BSGCC property will be eliminated which results in a small reduction of flow to the weir pond. Quarry Sump 0100 currently discharges to the weir pond and is the main source of water for this feature and is proposed to continue to do so long-term (post rehabilitation); maintaining baseflow in the tributary of Willoughby Creek downstream.

As a result of extraction in the west extension, the volume of surface runoff entering the existing Burlington Quarry will increase. As part of the surface water management strategy for the quarry, the settling ponds on-site will be expanded and reconfigured as required during operations to provide sufficient storage to manage on-site quarry water.

As discussed, during extraction the watershed draining to wetland 13201 will be reduced in size. Consequently, the runoff volume entering the wetland during the various design storms will be reduced. However, a mitigation strategy has been developed to supplement the flow into the wetland during operations. Water will be released into the wetland as required during operations to maintain the wetland hydroperiod.

5 Proposed Conditions - Rehabilitation

To evaluate the potential impacts on the surface water features on-site and in the surrounding area post rehabilitation, the proposed drainage conditions have been compared against the existing drainage conditions detailed in Section 3 of this report. To establish the proposed drainage conditions post rehabilitation, the proposed drainage patterns were identified, and water balance, event based hydrologic models and integrated surface water groundwater model were updated. The proposed drainage conditions post rehabilitation are described in the following sections.

5.1 APPROVED REHABILITATION

As per the approved Site Plans, the existing Burlington Quarry will be rehabilitated into a lake upon completion of extraction. To form the lake, off-site discharge will cease, and the open excavation will be allowed to fill with intercepted groundwater, direct precipitation and surface runoff. The results of the integrated surface water groundwater model predict the lake water level will fluctuate between 268.75 m and 269.30 m, with an average lake level of 269.00 m.

Long-term discharge off-site to the tributary of Willoughby Creek and the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek is not a requirement of the approved licence. As approved, off-site discharge from Quarry Sumps 0100 and 0200 will cease upon completion of extraction in the Burlington Quarry. No gravity discharge will occur to the West Arm as the channel bed elevation at its origin is above the predicted high-water level of the lake. The lake may discharge to the weir pond (wetland 13202) and the tributary of Willoughby Creek via gravity when lake water levels rise in response to wet conditions. However, on average no discharge will occur.

The predicted average lake water level (269.00 m) is below the existing sill elevation (269.08 m) of the weir structure constructed by the BSGCC in the weir pond (wetland 13202) which created the weir pond (wetland 13202), maintains water levels in the wetland and controls discharge to the tributary of Willoughby Creek and consequently Willoughby Creek. When the lake water level drops below an elevation of 269.08 m, gravity discharge to the tributary of Willoughby Creek will not occur. Also, the average water level in the weir pond (wetland 13202) is 269.27 m. The wetland water level will drop in response to the lake water levels and cessation of off-site discharge.

This is an important consideration as Willoughby Creek and the West Arm have been identified as fish habitat. Baseflow and water temperature are critical to the form and function of these watercourses from a natural heritage, habitat and spawning perspective. Rehabilitating the

Burlington Quarry as approved will negatively impact Willoughby Creek and the West Arm as flows will be reduced and/or eliminated. Similarly, the weir pond (wetland 13202) and the wetland 13203 (located along the West Arm adjacent to the south extension) are currently identified as natural heritage features. These features are dependent on the quarry discharge to maintain their hydroperiod and may dry out under the approved rehabilitation plan.

5.2 PROPOSED REHABILITATION

A new rehabilitation plan has been developed for the Burlington Quarry which includes the rehabilitation of the west extension. Rather than rehabilitating Burlington Quarry into a lake, it is proposed to convert the Burlington Quarry and west extension lands into a landform suitable for recreational, natural heritage and water management purposes. The proposed rehabilitation plan for the west extension is illustrated on the Rehabilitation Plan (Drawing No. 3 of 4) included in the Site Plans. Revised Site Plans will be prepared for the Burlington Quarry upon approval of the proposed extensions.

Long-term off-site discharge from Quarry Sump 0100 and 0200 to the tributary of Willoughby Creek and West Arm is proposed as part of the new rehabilitation plan for the Burlington Quarry and west extension. Long-term off-site discharge is required to maintain water levels and manage intercepted groundwater, direct rainfall and surface runoff in the extraction area. Off-site discharge is proposed to continue post rehabilitation consistent with existing conditions in accordance with Nelson's PTTW. For this Surface Water Assessment, the new rehabilitation plan for the Burlington Quarry has been considered.

5.3 PROPOSED DRAINAGE PATTERNS - REHABILITATION

The proposed drainage patterns post rehabilitation for the Burlington Quarry, south and west extensions were developed from the Burlington Quarry Extension Site Plans prepared by MHBC. The Site Plans have been prepared through an iterative process considering the following:

- The natural heritage features on-site and in the surrounding area;
- Potential impacts to surface water and groundwater features in the area;
- The monitoring data collected to date;
- The results of this Surface Water Assessment and the integrated surface water/ground water model; and
- The proposed future landform suitable for recreational, natural heritage and public water management purposes.

A Proposed Condition (Rehabilitation) Drainage Plan (Drawing DP-3) illustrating the proposed drainage conditions of the Burlington Quarry, south extension and west extension lands and the surrounding area is enclosed and should be referenced when reviewing Section 5 of this report. The proposed drainage patterns are described in the following sections.

5.3.1 Burlington Quarry

As proposed, Burlington Quarry will be rehabilitated into a landform suitable for recreational, natural heritage and public water management purposes. The existing wetland constructed in the quarry floor will remain and continue to receive surface runoff from the external lands east of No. 2 Sideroad and Guelph Line. The wetland will continue to drain southwest via a drainage channel through the park to a lake constructed on the quarry floor. The lake will be created by reconfiguring the settling ponds into a permanent lake extending into the west extension lands. Quarry Sump 0100 and 0200 are proposed to be maintained and continue to discharge to their respective outlets. Off-site discharge is proposed to be maintained to feed the natural heritage features downstream of each discharge location and maintain the water levels of the lake and wetland on the quarry floor.

5.3.2 South Extension

The open excavation in the south extension will be rehabilitated into a lake with a beach. Phase 1A will be converted into a sand beach, Phase 1B into a shallow water swimming area, and Phase 2 into a lake. Upon completion of extraction in the south extension, dewatering will cease, and the open extraction area will be allowed to fill with intercepted groundwater, rainfall and runoff while extraction begins in the west extension. Quarry water from the Burlington Quarry can also be pumped into the open excavation in the south extension if desired to aid in the filling of the lake.

The integrated surface water groundwater model predicts that the lake will fill to an elevation of 271 m. A water level control outlet is not proposed for the lake and the lake water level will fluctuate seasonally. A high-water level overflow weir will be graded into the south corner of the lake to ensure discharge during extremely rare storm events (less frequent than the 1:100-year storm) and freshets will drain to an appropriate outlet. Discharge from the overflow weir will drain overland into wetland 13037 and to the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek via the existing drainage channel connecting the two.

The drainages areas contributing to each wetland east and south of the south extension will remain undisturbed through extraction and rehabilitation. The extraction limit proposed was refined through the development of the Site Plans to maintain the surface water catchments to each wetland east and south of the south extension and to the East Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek.

Post extraction, the West Arm watershed will be reduced in size as the lake will intercept rainfall, groundwater and surface runoff. However, discharge to the West Arm from Quarry Sump 0200 is the primary source of water for this feature and is proposed to continue post extraction after the licence has been surrendered in accordance with the conditions of Nelson's PTTW and ECA.

5.3.3 West Extension

The open excavation in the west extension will be rehabilitated into a lake and with rehabilitated side slopes, exposed cliff faces, a pond and drainage channel. Phase 5 of extraction will be converted into a lake extending into the existing quarry. Fill will be imported into Phases 3, 4 and 6 to raise the grade of the park above the lake water levels and the park will be graded to drain directly into the lake.

As discussed, extraction in the west extension will alter the subcatchments draining to each existing outlet and wetland. Dewatering post extraction will also lower groundwater levels surrounding the west extension. As such, a series of mitigation measures are proposed to address any potential adverse impacts.

The replica pond constructed within the licence boundary, outside the extraction area, between the extraction limit and Cedar Springs Road during extraction will remain as part of the rehabilitation of the west extension to replicate the artificial groundwater mounding produced by the existing irrigation ponds and supplement the groundwater recharge in the area. The replica pond will be constructed at depths and elevations consistent with the existing irrigation ponds.

The diversion pipe (culvert) installed as part of extraction to divert flow from the weir pond (wetland 13202) to the replica pond will also remain post extraction as part of the rehabilitation. The diversion pipe will continue to divert flow from the Quarry Sump 0100 discharge to the proposed replica pond.

Extraction will reduce the drainage area to wetland 13201 northwest of No. 2 Sideroad. The bottom draw outlet constructed in the southeast corner of the proposed pond and the outlet pipe complete with a control valve installed during extraction will remain post extraction as part of the rehabilitation of the site. Monitoring of the wetland hydroperiod and discharge of water, both rate and quantity, to the wetland will be completed as required to maintain the wetland hydroperiod.

Extraction will also reduce the drainage area to wetland 13200 located northeast of the existing irrigation ponds within the BSGCC property through extraction. As part of the rehabilitation of the west extension, fill will be imported into the west extension to raise the grade around the wetland to original ground level, reinstating the wetlands drainage area. The portion of the wetland's drainage area reinstated through rehabilitation will be graded to drain overland into the wetland and will be planted with trees to mimick existing conditions.

The drainage area to the four additional outlets within the Bronte Creek watershed will also be reduced. The proposed conditions (post extraction) for the four outlets within the Bronte Creek watershed are described as follows:

- The catchment (Catchment S102) draining overland as sheet flow to the east corner of the intersection of Colling Road and Cedar Springs Road will remain the same under post extraction (rehabilitation) as during extraction.
- The catchment (Catchment S103) draining overland as sheet flow to the culvert crossing Cedar Springs Road immediately south of the BSGCC entrance will remain the same under post extraction (rehabilitation) as during extraction.
- The catchment (Catchment S104) draining overland as sheet flow to the culvert crossing Cedar Springs Road immediately east of Cedar Springs Court will remain the same under post extraction (rehabilitation) as during extraction.
- The catchment (Catchment S105) draining overland as sheet flow to the culvert crossing Cedar Springs Road at No. 2 Sideroad will remain the same under post extraction (rehabilitation) as during extraction.

As discussed, catchments 102 through 105 drain overland to municipal drainage systems (roadside ditches) along Cedar Springs Road, Cedar Springs Court and No. 2 Sideroad. Reducing the drainage area to the roadside ditches will reduce flows to these drainage systems and improve their function. The municipal drainage systems were not identified as Natural Heritage Features through the Natural Environment Technical Report (NETR) completed in support of the proposed extension and a reduction in drainage area, and consequently peak flow, will not impact the drainage systems.

5.4 PROPOSED CONDITION (REHABILITATION) WATER BALANCE

The daily water balance has been calibrated to predict of the existing wetland hydroperiods and has been updated to predict potential impacts from the rehabilitated site. The update includes applying the proposed drainage conditions post rehabilitation, specifically the proposed subcatchment delineation illustrated on the Proposed Condition (Rehabilitation) Drainage Plan (Drawing DP-3). The proposed groundwater flux into the shallow groundwater system calculated by the integrated surface water groundwater model has been added to the soil storage. Finally, the contemplated drainage improvements along Colling Road to redirect the external drainage from northwest of Colling Road to the Quarry Sump 0100 discharge location have been assumed to be implemented. Graphs comparing the predicted water level in each wetland under existing and proposed conditions (rehabilitation) are included in Appendix R for reference. The daily water balance results are discussed in the following section of this report.

5.4.1 Wetland Water Balance Results

As illustrated in the following tables, the proposed condition wetland water balance predicts little to no change in the wetland hydroperiod for the four wetlands evaluated. The drainages areas contributing to each wetland east and south of the south extension will remain undisturbed through extraction and post rehabilitation. As such, the total volume and timing of surface runoff draining to each wetland will not be altered through extraction.

The results of the integrated surface water groundwater model predict drawdown of the groundwater levels below the wetlands east and south of the south extension post rehabilitation. Under existing and proposed (operations) conditions, groundwater flux into the wetlands has been estimated as summarized in the following table.

Table 31: Wetland Groundwater Flux Summary - Rehabilitation

MONITORING LOCATION (WETLAND)	EXISTING CONDITIONS		PROPOSED CONDITIONS (REHABILITATION)	
	Groundwater Inflow (m^3/day)	Groundwater Outflow (m^3/day)	Groundwater Inflow (m^3/day)	Groundwater Outflow (m^3/day)
SW11A (Wetland 13027)	0.8 (1.3%)	1.5 (2.5%)	0.1 (0.3%)	4.0 (4.2%)
SW12A (Wetland 13022)	0.5 (0.3%)	0 (1.3%)	0 (0.0%)	0 (1.3%)
SW13A (Wetland 13016)	0 (0.0%)	2.9 (4.0%)	0 (0.0%)	2.9 (4.0%)
SW16A (Wetland 13037)	0.5 (1.8%)	4.4 (12.8%)	0 (0.0%)	4.9 (16.3%)

Note: 1) Values in brackets represent the groundwater flow as a percentage of total flow into or out of the wetland

The predicted wetland hydroperiods post rehabilitation are consistent with the predicted hydroperiods during operations discussed in Section 4.2.1. the water balance predicts very minor reductions and delays in the spring and fall hydroperiods of wetlands 13027, 13022 and 13037. The reductions/delays are a result of the predicted change in groundwater inflows to the wetlands. No change is predicted in wetland 13016. Its noted, the wetland spring and fall hydroperiods vary dramatically year to year due to weather. The amount of precipitation and the weather have the greatest impact on the hydroperiod of each wetland. Although the groundwater influx does contribute water to the wetlands, it has a minor impact on the overall wetland hydroperiod and the predicted changes under proposed conditions (rehabilitation) are unmeasurable.

Table 32: SW11A (Wetland 13027) Water Balance Comparison - Rehabilitation

YEAR	EXISTING CONDITIONS		PROPOSED REHABILITATION	
	Spring Hydroperiod[1]	Fall Hydroperiod[2]	Spring Hydroperiod[1]	Fall Hydroperiod[2]
2009	June 15th	Oct. 5th	June 4th	Oct. 5th
2010	May 24th	Sept. 29th	May 22nd	Oct. 1st
2011	June 15th	Oct. 19th	June 14th	Oct. 19th
2012	April 7th	Oct. 27th	April 2nd	Oct. 28th
2013	July 17th	Oct. 4th	July 16th	Oct. 5th
2014	May 30th	Sept. 4th	May 28th	Sept. 4th
2015	May 7th	Nov. 9th	May 3rd	Nov. 26th
2016	May 30th	Dec. 27th	May 27th	Jan. 2nd
2017	June 12th	Nov. 18th	June 12th	Jan. 10th
2018	May 29th	Nov. 3rd	May 28th	Nov. 3rd

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool maintained) in the fall

Table 33: SW12A (Wetland 13022) Water Balance Comparison - Rehabilitation

YEAR	EXISTING CONDITIONS		PROPOSED REHABILITATION	
	Spring Hydroperiod[1]	Fall Hydroperiod[2]	Spring Hydroperiod[1]	Fall Hydroperiod[2]
2009	May 18th	Oct. 8th	May 15th	Oct. 8th
2010	July 5th	Oct. 12th	June 17th	Oct. 22nd
2011	June 14th	Oct. 18th	June 14th	Oct. 18th
2012	March 20th	Oct. 28th	March 18th	Oct. 29th
2013	May 8th	Oct. 30th	May 8th	Oct. 30th
2014	May 26th	Nov. 21st	May 25th	Nov. 21st
2015	April 29th	Jan. 25th	April 30th	Jan. 25th
2016	May 24th	Jan. 10th	April 19th	Jan. 10th
2017	June 4th	Jan. 10th	June 9th	Jan. 10th
2018	May 23rd	Oct. 31st	May 6th	Oct. 31st

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool maintained) in the fall

Table 34: SW13A (Wetland 13016) Water Balance Comparison - Rehabilitation

YEAR	EXISTING CONDITIONS		PROPOSED REHABILITATION	
	Spring Hydroperiod[1]	Fall Hydroperiod[2]	Spring Hydroperiod[1]	Fall Hydroperiod[2]
2009	June 13th	Oct. 1st	June 13th	Oct. 1st
2010	July 22nd	Nov. 15th	July 22nd	Nov. 15th
2011	June 20th	Oct. 18th	June 20th	Oct. 18th
2012	May 11th	Jan. 10th	May 11th	Jan. 10th
2013	July 18th	Oct. 31st	July 18th	Oct. 31st
2014	June 10th	Sept. 4th	June 10th	Sept. 4th
2015	May 15th	Feb. 18th	May 15th	Feb. 18th
2016	May 29th	Jan. 12th	May 29th	Jan. 12th
2017	June 14th	Jan. 10th	June 14th	Jan. 10th
2018	June 1st	Nov. 25th	June 1st	Nov. 25th

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool maintained) in the fall

Table 35: SW16A (Wetland 13037) Water Balance Comparison - Rehabilitation

YEAR	EXISTING CONDITIONS		PROPOSED REHABILITATION	
	Spring Hydroperiod[1]	Fall Hydroperiod[2]	Spring Hydroperiod[1]	Fall Hydroperiod[2]
2009	July 18th	Oct. 1st	June 10th	Oct. 1st
2010	August 3rd	Sept. 27th	August 3rd	Sept. 27th
2011	June 28th	Oct. 18th	June 16th	Oct. 18th
2012	May 25th	Sept. 6th	May 11th	Oct. 21st
2013	July 16th	Sept. 20th	July 15th	Sept. 20th
2014	August 26th	Sept. 4th	August 24th	Sept. 4th
2015	July 11th	Oct. 27th	July 11th	Oct. 27th
2016	June 21st	Dec. 25th	May 29th	Jan. 2nd
2017	June 29th	Nov. 17th	July 2nd	Nov. 17th
2018	June 2nd	Sept. 30th	May 28th	Oct. 26th

Note: 1) Date wetland water level drops to zero (0.0 m water level staff gauge reading) in the spring; 2) Date after which the wetland water level rebounds (permanent pool maintained) in the fall

5.4.2 Outlet Water Balance Results

The predicted runoff volumes at each point of interest post rehabilitation are consistent with the predicted runoff volumes during operations discussed in Section 4.2.2. As illustrated in the following table and in the tables provided in Appendix S, the proposed condition outlet water balance results predict a decrease in the runoff volume draining to the West Arm due to the reduction in the drainage area during extraction. However, the quarry discharge from Quarry Sump 0200 is proposed to continue long-term to maintain baseflow in the West Arm.

A minor reduction (4 - 6 %) in runoff volume is predicted to the East Arm due to the minor reduction (0.3% to 1.8%) in groundwater influx predicted to the wetlands upstream, specifically wetlands 13027, 13022, and 13037. This reduction is considered within natural fluctuations, however, if necessary, mitigation measures have been developed to address potential impacts on the wetlands are discussed in Section 6 of this report.

The proposed condition outlet water balance results predict a decrease in the runoff volume draining to the weir pond (wetland 13202) due to the reduction in drainage area draining directly to the weir pond after extraction in the west extension. As a result, the runoff volume entering the Burlington Quarry will increase through extraction in the west extension. To manage the additional runoff volume post extraction and rehabilitation, a lake will be constructed on-site to provide the storage volume required and it is recommended that Nelson explore options to permanently increase the maximum allowable water taking from Quarry Sump 0200.

Under proposed conditions, the drainage area contributing to wetland 13201 will be reduced through extraction in the west extension. Consequently, the runoff volume will also be reduced and the wetland hydroperiod may be impacted. Mitigation measures have been developed to address the potential impacts on wetland 13201 during and post extraction which are discussed in Section 6 of this report.

Table 36: Proposed Condition (Rehabilitation) Outlet Water Balance Results Summary

YEAR	TOTAL PRECIPITATION (mm)	RUNOFF VOLUME (mm)				
		West Arm	East Arm	Weir Pond	Burlington Quarry	Wetland 13201
2009	1016	92	108	786	575	111
2010	847	16	23	243	413	23
2011	1088	98	112	964	649	123
2012	780	10	8	215	364	20
2013	969	57	58	566	529	75
2014	838	34	32	428	451	56
2015	756	18	21	175	383	21
2016	819	26	21	354	400	37
2017	996	72	78	711	528	89
2018	970	49	58	582	534	63

5.5 PROPOSED CONDITION INTEGRATED SURFACE WATER GROUNDWATER ANALYSIS

To quantify the Willoughby Creek streamflow through the Medad Valley post rehabilitation, the calibrated integrated surface water groundwater model was updated to reflect proposed conditions following rehabilitation. For this scenario, extraction is complete in Phases 1 through 6 and rehabilitation in both the south and west extensions, specifically the lake in the south extension has been allowed to fill and the proposed landform in the west extension has been created, is complete. Rehabilitation in the Burlington Quarry is also complete. The quarry discharge from Quarry Sump 0100 has been simulated as a fixed outflow at a rate of 67 L/s (5,760 m^3/day), consistent with existing and proposed conditions during operations. The Level 1 and Level 2 Hydrogeological Assessment, specifically Section 8 Level 2 Future Conditions Evaluation, can be referenced for additional details regarding the proposed integrated surface water groundwater analysis.

The results of the integrated surface water groundwater model post rehabilitation remain the same as during operations. As such, the discussion presented in Section 4.4 remains valid for the post rehabilitation scenario.

5.6 PROPOSED CONDITION (REHABILITATION) EVENT BASED HYDROLOGIC ANALYSIS

To quantify the proposed condition peak flow rates to the key points of interest post rehabilitation, the existing Visual OTTHYMO 6 event based hydrologic model was updated to include the proposed drainage conditions post rehabilitation, specifically the proposed subcatchment delineation illustrated on the Proposed Condition (Rehabilitation) Drainage Plan (Drawing DP-3). Also, the contemplated drainage improvements along Colling Road to redirect the external drainage from northwest of Colling Road to the Quarry Sump 0100 discharge location have been assumed to be implemented. The results of the proposed condition (rehabilitation) event based hydrologic analysis at key points of interest are included in the following table and illustrated on graphs included in Appendix T.

Table 37: Proposed Condition (Rehabilitation) Hydrologic Model Results Summary

DESIGN STORM	PEAK FLOW (m^3/s)			
	West Arm	Weir Pond	Burlington Quarry	Wetland 13201
25 mm	0.04	0.04	3.66	0.02
1:2-Year	0.23	0.21	6.52	0.13
1:5-Year	0.39	0.36	9.88	0.23
1:10-Year	0.51	0.46	11.89	0.30
1:25-Year	0.68	0.51	14.49	0.40
1:50-Year	0.81	0.52	16.47	0.48
1:100-Year	0.94	0.53	18.44	0.56
Regional	1.33	0.71	29.89	0.73

Note: Table summarizes results of SCS Type II 24-hour design storms

The results of the event based hydrologic model post rehabilitation remain the same as during operations as the subcatchments remain the same. As such, the discussion presented in Section 4.3 remains valid for the post rehabilitation scenario.

6 Surface Water Management Strategy

A surface water management strategy has been developed for the proposed quarry extension during and post extraction (during operations and after rehabilitation) to establish a protocol for monitoring the surface water features and identifying/investigating potential impacts, implementing mitigative measures, and managing surface water and intercepted groundwater on-site. The surface water management strategy during and post extraction is described in the following sections.

6.1 OPERATIONS

During operations, Nelson will be responsible for the implementation of the surface water management strategy described herein. This includes undertaking the prescribed surface water monitoring, implementing the mitigation measures recommended in Section 6.5, investigating potential impacts, managing and operating the surface water management systems developed for the quarry, and operating and maintaining the off-site discharge. The surface water management strategy recommended during extraction is described in the following sections.

6.1.1 Burlington Quarry

The existing drainage patterns within Burlington Quarry will remain as is through extraction in the south and west extensions. The quarry will drain internally to a series of settling ponds constructed in the quarry floor and water will be discharged off-site from Quarry Sump 0100 and 0200 to the two existing discharge locations. The configuration of the existing settling ponds will be altered during different phases of extraction in the west extension as operations require. The configuration will be altered to facilitate extraction in the west expansion lands and to maintain dry operating conditions. However, the off-site discharge will continue as per the conditions of Nelson's PTTW and ECA.

It is estimated that 700,000 to 800,000 m^3 of active storage is required on-site through all phases of extraction to manage the intercepted groundwater, rainfall and runoff collecting in the existing Burlington Quarry. The existing quarry has approximately 520,000 m^3 of storage available to manage quarry water. As such, the existing settling ponds will be expanded and reconfigured as required during operations to store and treat the quarry water prior to off-site discharge. It is recommended that the settling ponds be expanded and reconfigured to provide a 1 m and 2.5 m permanent pool and active storage depth, respectively, to satisfy the water quality and quantity objectives of the operation.

It is recommended that Nelson seek to permanently increase the maximum allowable discharge rate from Quarry Sump 0100. A permanent increase in the maximum allowable discharge rate is not mandatory, only recommended. However, the existing quarry continues to be inundated with surface runoff, direct rainfall and intercepted groundwater. It is recommended that a seasonal or varied (based on weather conditions and rainfall) allowable discharge rate(s) be established to provide Nelson with more operational flexibility to actively manage water on-site and allow discharge off-site when downstream channel capacities permit. To increase the allowable water taking rate, Nelson will have to apply for an amendment to their existing PTTW. Any proposed change to Nelson's existing PTTW will be resolved with the MECP through the PTTW approval process.

It is also recommended that Nelson construct a conveyance system (a culvert, ditch or combination of the two) alongside Colling Road within Nelson's property to direct the external drainage from northwest of Colling Road to the discharge location of Quarry Sump 0100. By constructing the conveyance system, the external runoff will drain directly to its existing outlet, the tributary of Willoughby Creek, without entering the active quarry operation. This will reduce the surface water management requirements of the active operation.

6.1.2 South Extension

During extraction, water will accumulate on the quarry floor in a sump and be discharged to a settling pond constructed at surface within the extraction area. The settling pond will discharge to the West Arm after treating the quarry water at rates set to mimic existing conditions.

A temporary settling pond will be constructed for this purpose during the initial stages of extraction until sufficient extraction has occurred in Phase 2 of the south extension to construct an adequately sized sump (to both store and treat the quarry water) in the quarry floor. Water accumulating in the quarry floor will be pumped to the settling pond at a maximum rate of 50 L/s (3,000 L/min) for treatment prior to its release to the West Arm. Limiting the maximum pumping rate to 50 L/s will ensure the discharge to the West Arm occurs at rates less than or equal to existing conditions for the 1:2-year through 1:100-year design storms. A three-cell settling pond with a permanent pool depth and volume of 1 m and 1,800 m^3, respectively, will treat a maximum flow rate of 50 L/s to the effluent limits specified in Nelson's Environmental Compliance Approval. Detailed design of the settling pond will be completed as part of the approval process.

Once approximately 5 ha of extraction has occurred in the south extension an adequately sized sump can be constructed in the quarry floor to store and treat the quarry water. Assuming approximately 1 million tonnes of extraction per year, extraction in the south extension will take roughly nine (9) years to complete. It will take approximately three (3) years until sufficient extraction has occurred before an adequately sized sump can be constructed. As extraction continues in the south extension over the final six (6) years, the quarry sump will be enlarged to accommodate the additional intercepted rainfall, groundwater and surface runoff from the increasing size of the open extraction area. Similar to the temporary settling pond, the discharge from the quarry sump will be restricted to a discharge rate of 50 L/s and will provide adequate treatment to satisfy the effluent limits of Nelson's Environmental Compliance Approval.

Discharge to the West Arm from Quarry Sump 0200 is proposed to continue throughout operations in accordance with the conditions of Nelson's PTTW and ECA that will require an amendment to include the discharge from the south extension. The settling pond design, discharge location, discharge rates and effluent limits for the south extension will be finalized through the PTTW and ECA amendment application process in consultation with the MNRF, Halton Conservation, the MECP and applicable commenting agencies.

6.1.3 West Extension

To replicate the artificial groundwater mounding produced by the existing irrigation ponds and supplement the groundwater recharge in the area, a replica pond will be constructed within the licence boundary, outside the extraction area, between the extraction limit and Cedar Springs Road. The replica pond will be constructed into the overburden at depths and elevations consistent with the existing irrigation ponds.

A diversion pipe is proposed to divert a portion of the quarry discharge to the proposed replica pond between the extraction limit and Cedar Springs Road. A 1260 mm × 1880 mm CSPA culvert will be installed between the weir pond (wetland 13202) and the proposed pond. The diversion pipe will divert flow to the proposed pond in a similar manner and elevation as the existing diversion channel on the golf course property.

A bottom draw outlet will be constructed in the southeast corner of the proposed replica pond and an outlet pipe complete with a control valve will be installed to discharge water into the roadside ditch along No. 2 Sideroad feeding wetland 13201. The wetland hydroperiod will be monitored and water will be discharged to the wetland as required to maintain the wetland hydroperiod. The discharge of water, both rate and quantity, will be controlled by the control valve.

Extraction will reduce the drainage area to wetland 13200 located northeast of the existing irrigation ponds within the BSGCC property. Reducing the drainage area of the wetland has the potential to adversely impact the wetlands hydroperiod. As such, a mitigation strategy has been developed to supplement the flow into the wetland during operations if required. Quarry water will be pumped from Quarry Sump 0100 directly into the wetland at a maximum rate of 15 L/s and daily volume of 200 m^3 to maintain the wetland hydroperiod.

Discharge to the Colling Road roadside ditch from Quarry Sump 0100 is proposed to continue throughout operations in accordance with the conditions of Nelson's PTTW and ECA. It is proposed to amend the PTTW and ECA to include the discharge from the west extension. The discharge location, discharge rates and effluent limits for the west extension will be finalized through the PTTW and ECA amendment application process in consultation with the MNRF, Halton Conservation, the MECP and applicable commenting agencies.

Within the open extraction area in the west extension, intercepted groundwater, rainfall and runoff will accumulate on the quarry floor in a sump and be drained or pumped into the existing settling ponds in the Burlington Quarry for off-site discharge from Quarry Sump 0100 or 0200. As discussed, the configuration of the existing settling ponds will be altered during different phases of extraction in the west extension as operations require. Similarly, the sump in the west extension quarry floor will be relocated as needed to facilitate extraction and maintain dry operating conditions.

6.2 REHABILITATION

During operations, Nelson will be responsible for the implementation of the surface water management strategy described herein including the implementation of the mitigation measures recommended in Section 6.5. Post rehabilitation of the site, the permanent mitigation measures discussed in Section 6.5 will remain in place and any potential impacts resulting from extraction and quarry dewatering will be resolved. The monitoring requirements will be reduced to those specified in Nelson's ECA and PTTW and a long-term discharge protocol will be developed for any impacted wetlands. Prior to the surrender of the Aggregate Resources Act Licence, the Licencee will provide to the satisfaction of the MNRF, confirmation that long-term monitoring pumping or mitigation will not result in financial liability to the public. This includes operating and maintaining the two current off-site discharges and undertaking the necessary water quality sampling and flow monitoring and reporting associated with each. The surface water management strategy recommended post rehabilitation is described in the following sections.

6.2.1 Burlington Quarry

The existing wetland constructed in the quarry floor will remain and continue to receive surface runoff from the external lands east of No. 2 Sideroad and Guelph Line. The wetland will continue to drain southwest via a drainage channel through the created landform to a lake constructed on the quarry floor. The settling ponds will be reconfigured into a permanent lake extending into the west extension lands. To manage intercepted groundwater, rainfall and runoff post extraction, the lake requires an active storage volume of approximately 553,000 m^3 (Regional Storm – Hurricane Hazel). The proposed lake has an approximate surface area of 375,000 m^2 resulting in a required active storage depth of 1.5 m.

The Burlington Quarry will be graded to drain directly into the existing wetland, drainage channel or the proposed lake. Quarry Sump 0100 and 0200 are proposed to be maintained and continue to discharge to their respective outlets. Quarry Sump 0100 will be located in the proposed Lake. A drainage channel will be required to connect the proposed lake to Quarry Sump 0200. Off-site discharge is proposed to be maintained to feed the natural heritage features downstream of each discharge location and maintain the water levels of the lake and wetland on the quarry floor.

6.2.2 South Extension

Upon completion of extraction in the south extension, dewatering will cease, and the open extraction area will be allowed to fill with intercepted groundwater, rainfall and runoff. Quarry water from the Burlington Quarry may also be pumped into the open excavation in the south extension to aid in the filling of the lake.

The integrated surface water groundwater model predicts that the lake will fill to an elevation of 271 m. A water level control outlet is not proposed for the lake and the lake water level will fluctuate seasonally. A high-water level overflow weir will be graded into the south corner of the lake to ensure discharge during extremely rare storm events (less frequent than the 1:100-year storm) and freshets will drain to an appropriate outlet. Discharge from the overflow weir will drain overland into wetland 13037 and to the West Arm via the existing drainage channel connecting the two.

Discharge to the West Arm from Quarry Sump 0200 is proposed to continue post extraction after the licence has been surrendered in accordance with the conditions of Nelson's PTTW and ECA.

6.2.3 West Extension

The pond constructed within the licence boundary, outside the extraction area, between the extraction limit and Cedar Springs Road during extraction will remain as part of the rehabilitation of the west extension to replicate the artificial groundwater mounding produced by the existing irrigation ponds and supplement groundwater recharge in the area. As discussed, the pond will be constructed into the overburden at depths and elevations consistent with the existing irrigation ponds.

The diversion pipe (culvert) installed as part of extraction to divert flow from the weir pond (wetland 13202) to the pond will remain post extraction as part of the rehabilitation. The diversion pipe will continue to divert flow from the Quarry Sump 0100 discharge to the proposed pond.

The bottom draw outlet constructed in the southeast corner of the proposed pond and the outlet pipe complete with a control valve installed to discharge water into the roadside ditch feeding wetland 13201 along No. 2 Sideroad will remain post extraction. The wetland hydroperiod will be monitored and water will be discharged to the wetland as required to maintain the wetland hydroperiod.

Discharge to the Colling Road roadside ditch and Willoughby Creek from Quarry Sump 0100 is proposed to continue post extraction after the licence has been surrendered in accordance with the conditions of Nelson's PTTW and ECA.

6.3 MONITORING

As discussed, a surface water monitoring program has been developed and implemented over the past six (6) years to establish existing baseline conditions for the surface water features on-site and in the surrounding area. Moving forward, the current surface water monitoring program, with the additions noted previously, will be undertaken throughout the duration of the approvals process of the proposed quarry extension to gather additional baseline data. It is anticipated that the surface water monitoring program may be adjusted (monitoring locations added and/or removed) during the approvals process through consultation with the requisite approval agencies.

If the proposed extension is approved, surface water monitoring will continue during the operational lifespan of the quarry to:

- Monitor streamflow, wetland hydroperiods and surface and groundwater interactions during operations and upon closure of the Burlington Quarry;
- Assess potential unforeseen changes and impacts to the surface water and natural heritage features on-site and in the surrounding area resulting from extraction and dewatering of the quarry; and
- Establish the cause of any potential unforeseen changes and impacts to the surface water and natural heritage features and determine if mitigation is required to address the changes/impacts.

Through the work completed to date in support of the proposed quarry extension; specifically this Surface Water Assessment, the integrated surface water groundwater model and Natural Environment Technical Report (NETR); key receptors, model and water balance calibration sites, waterbodies and natural heritage features have been identified considering potential impacts. The surface water monitoring locations associated with these key features form the suggested post approvals surface water monitoring program for the operational lifespan of the quarry. The post approvals surface water monitoring program recommended for the proposed quarry extension is outlined in the following tables.

Table 38: Post Approvals Streamflow Monitoring Locations

MONITORING LOCATION	NORTHING	EASTING	WATERSHED
SW1	4805833	589015	Bronte Creek
SW2	4806693	587340	Bronte Creek
SW6	4805071	590629	Grindstone Creek
SW7	4805441	588320	Bronte Creek
SW9	4805317	591235	Grindstone Creek
SW10	4803358	591283	Grindstone Creek
SW14	4804107	589227	Bronte Creek
SW15	4806484	589550	Bronte Creek
SW24	4803691	594181	Shoreacres Creek
SW28	4803823	591609	Grindstone Creek
SW29	4804364	590180	Grindstone Creek
SW30	4809849	589826	Bronte Creek
SW31	4809367	592092	Bronte Creek
SW35	4805699	594624	Appleby Creek

Table 39: Post Approvals Wetland Hydroperiod / Shallow Groundwater Monitoring Locations

MONITORING LOCATION	NORTHING	EASTING	WETLAND
SW5	4805331	591477	13031
SW11	4805245	591177	13027
SW12	4805393	591127	13022
SW13	4805707	590935	13016
SW16	4804900	590889	13037
SW36	To be Established Spring 2020		13201
SW37	To be Established Spring 2020		13200

As previously discussed, the Natural Environment Technical Report (NETR) completed in support of the proposed extension identified two additional wetlands within the west extension area. Wetland hydroperiod and shallow groundwater monitoring stations will be established in the wetlands in the spring of 2020. These two additional monitoring locations are identified as SW36 and SW37 in the previous tables.

It is recommended that the surface water monitoring associated with the south extension, specifically Phases 1 and 2, continue throughout extraction and post extraction for a period of two years following rehabilitation of the south extension. Similarly, it is recommended that the surface water monitoring associated with the west extension, specifically Phases 3 through 6, continue throughout extraction until the licence is surrendered. The only exceptions to this are the surface water monitoring that occurs at SW6 and SW36. Monitoring at SW6 should continue for the duration of extraction in all six Phases until the licence is surrendered. Monitoring at SW36 should continue long-term or until a long-term discharge protocol for the release of water into wetland 13201 has been developed to maintain the wetland hydroperiod. During Phases 3 through 6 of extraction, a long-term discharge protocol will be developed by Nelson.

To identify an adverse impact on a wetland, the wetland hydroperiod monitoring frequency will be increased to weekly starting March 1st each year until the spring hydroperiod threshold date presented in Section 6.4 has passed. Also, weekly site visits should be conducted to surface water monitoring location SW29 from March 1st until the spring hydroperiod threshold date specified for SW36 to confirm the baseflows in the unnamed tributary of Lake Medad are maintained.

Water quality sampling is also recommended during the operational lifespan of the quarry to assess the effectiveness of the quarries surface water management system in treating the quarry water prior to off-site discharge and assess the impacts the off-site discharge has on the water quality of the surface water features. The recommended post approvals water quality sampling is detailed in the following table.

Table 40: Post Approvals Water Quality Sampling Summary

WATER SAMPLING LOCATIONS	SAMPLING FREQUENCY	PARAMETERS
SW1, SW2, SW6, SW10, SW14, SW24, SW28, SW29, SW30, SW31, SW35	Quarterly	Dissolved Organic Carbon, Ammonia, Alkalinity, BOD, COD, Conductivity, Total Hardness, Total Metals, Turbidity, Total Dissolved Solids, Total Suspended Solids, pH, Carbonate, Bicarbonate

In addition to the water quality sampling prescribed above, Environmental Compliance Approval Number 5203-AN6NGV issued by the Ministry of the Environment and Climate Change specifies an effluent monitoring program Nelson must conduct to confirm the effluent discharge from the quarry remains in compliance with the concentration limits stipulated within the ECA. The ECA requires monthly and quarterly (once every three months) effluent grab samples be collected from the two off-site discharges and analyzed for a variety of parameters to confirm compliance. In addition, quarterly field temperature monitoring is required at the various key points of interest downstream of the Quarry Sump 0100 discharge location to assess seasonal impacts. The effluent monitoring program as stipulated will remain in place moving forward unless modified by the Director of the Ministry of the Environment, Conservation and Parks (MECP).

Nelson is authorized to withdraw water from the quarry sumps in accordance with Permit to Take Water No. 96-P-3009. As per the conditions of their PTTW, Nelson is responsible to measure, record and submit the quantities of water taken daily to the Ministry, notify the Ministry of any complaints arising from the water taking, and address any adverse impacts caused by the water taking. As long as Nelson withdraws water from the quarry sumps, they will be required to adhere to the conditions of their PTTW.

After the property is rehabilitated and the licence is surrendered, off-site discharge is proposed continue from Quarry Sump 0100 and 0200 in accordance with the conditions of Nelson's ECA and PTTW to maintain the quarry lake water levels and baseflows in the tributary of Willoughby Creek and the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek. Prior to surrender of the Aggregate Resources Act Licence, the Licencee will provide to the satisfaction of the MNRF, confirmation that long-term monitoring, pumping or mitigation will not result in financial liability to the public.

6.4 SURFACE WATER THRESHOLDS

Surface water thresholds will be assigned to the surface water monitoring locations associated with key receptors, calibration points, and surface water and natural heritage features. The surface water thresholds will be assigned to identify potential unforeseen changes and impacts to the surface water and natural heritage features as a result of extraction and quarry dewatering. Its recommended that the thresholds be established from the available surface water monitoring data and water balance and integrated surface water groundwater model results. The thresholds will be established to identify deviations from historic trends and ranges that have the potential to adversely impact the surface water and natural heritage features on-site and in the surrounding area. The streamflow, wetland hydroperiod and water quality thresholds are described in the following sections.

6.4.1 Streamflow and Water Temperature Thresholds

Nelson is currently authorized to withdraw water from Quarry Sump 0100 and 0200 at rates of 4,090 L/minute (5,889,600 L/day) and 945 L/minute (1,360,800 L/day), respectively in accordance with Schedule “A” of Permit to Take Water No. 96-P-3009. Water taken from Quarry Sump 0100 is discharged northwest to the roadside ditch along Colling Road which drains into a tributary of Willoughby Creek north of Colling Road. Water taken from Quarry Sump 0200 is discharged southeast across No. 2 Sideroad to the upstream end of the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek. The monitoring data collected to date shows the tributary of Willoughby Creek and West Arm depend on the quarry discharge for much of their flow.

In addition to specifying the maximum allowable water taking rates and volumes, PTTW No. 96-P-3009 requires Nelson to:

- Measure, record and submit the quantities of water taken daily to the Ministry;
- Notify the Ministry of any complaints arising from the water taking; and
- Address any negative impacts caused by the water taking.

As long as Nelson withdraws water from the quarry sumps, they will be required to adhere to the conditions of their PTTW including those listed above.

Following several significant rain events, a temporary amendment to the PTTW was issued by the Ministry of the Environment and Energy August 13, 2014 increasing the maximum water taking from Quarry Sump 0100 to 8,200 L/minute. The amendment expired September 30, 2014 and the quarry has operated under the authority of PTTW No. 96-P-3009 since. It is recommended that Nelson seek to permanently increase the maximum allowable discharge rate from Quarry Sump 0100. It is recommended that a seasonal or varied (based on weather conditions and rainfall) allowable discharge rate(s) be established to provide Nelson with more operational flexibility to actively manage water on-site and allow discharge off-site when downstream channel capacities permit. Whether Nelson seeks to increase the maximum allowable discharge or not, they will have to adhere to the terms and conditions of the their current or any future PTTW for the operational lifespan of the quarry.

Willoughby Creek and the West Arm have been identified as fish habitat. Baseflow and water temperature are critical to the form and function of the watercourses from a natural heritage, habitat and spawning perspective. Also, the predictive integrated surface water groundwater model predicts a measurable reduction in flow to the unnamed tributary of Lake Medad at monitoring location SW29 during operations due to extraction and quarry dewatering. As such, streamflow and water temperature thresholds will be established for these watercourses.

Its recommended that streamflow and water temperature thresholds be established from the results of the historic surface water monitoring completed in support of the proposed quarry extension. Specifically, seasonal baseflows and maximum seasonal water temperatures should be established for each watercourse from the available surface water monitoring data. It is anticipated that the streamflow and water temperature thresholds may be refined as additional baseline monitoring data is collected during the approvals process, prior to extraction, through consultation with the requisite approval agencies. To set initial targets, preliminary streamflow and water temperature thresholds recommended for the proposed quarry extension are outlined in the following table.

Table 41: Streamflow and Water Temperature Thresholds

MONITORING LOCATION (WATERCOURSE)	MINIMUM BASEFLOW THRESHOLD (L/s)			WATER TEMPERATURE THRESHOLD (°C)		
	Spring	Summer	Fall	Spring	Summer	Fall
SW1 (Tributary of Willoughby Creek)	2	2	2	20	30	28
SW2 (Willoughby Creek)	25	15	10	23	26	25
SW6 (West Arm of the West Branch of Mount Nemo Tributary)	2	0	1	28	29	28
SW10 (West Arm of the West Branch of Mount Nemo Tributary)	6	4	4	28	29	28
SW29 (Tributary of Medad Lake)	0.5	0	0	20	30	28

Note: Spring – March through May; Summer – June through August; Fall – September through November

Currently, a minimum baseflow of 2 L/s must be maintained to the upstream end of the tributary of Willoughby Creek as specified in PTTW No. 00-P-3072 issued to BSGCC. To maintain the baseflow in the tributary of Willoughby Creek, a continuous quarry discharge is required. Similarly, to maintain baseflow year-round in the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek discharge from Quarry Sump 0200 is required.

The predictive integrated surface water groundwater model predicts a measurable reduction in flow to the unnamed tributary of Lake Medad at monitoring location SW29 during operations due to extraction and quarry dewatering. Mitigation measures have been developed as part of the quarries surface water management plan to supplement wetland 13201 feeding the unnamed tributary with quarry water to maintain its hydroperiod and consequently baseflows in the tributary. Mitigation is discussed in Section 6.5.

If the streamflow drops below the baseflow stipulated in the previous table, the applicable mitigation measure(s) described in Section 6.5 are to be implemented while the cause of the potential impact is evaluated to determine if it has been caused by extraction and/or quarry dewatering. Similarly, if a water temperature measured in the watercourse exceeds the water temperature threshold stipulated in the previous table for three consecutive days, the applicable mitigation measure(s) described in Section 6.5 are to be implemented while the cause of the potential impact is evaluated to determine if it has been caused by extraction and/or quarry dewatering.

6.4.2 Wetland Hydroperiod Thresholds

The wetlands bordering the south extension (outside the licence boundary) and within the west extension licence boundary (outside the extraction area) have been identified as natural heritage features. The wetland hydroperiod and water temperature are critical to the form and function of the wetland from a natural heritage, habitat and breeding perspective. As such, wetland hydroperiod thresholds will be established for the key significant wetlands.

Its recommended that the wetland hydroperiod thresholds be established from the results of the historic surface water monitoring, existing condition water balance and integrated surface water groundwater model completed in support of the proposed quarry extension. Specifically, dates when the wetlands must remain wet should be established from the monitoring data and water balance and integrated surface water groundwater model results. It is anticipated that the wetland hydroperiod thresholds may be refined as additional baseline monitoring data is collected during the approvals process, prior to extraction, through consultation with the requisite approval agencies. Preliminary wetland hydroperiod thresholds recommended for the proposed quarry extension are outlined in the following table.

Table 42: Wetland Hydroperiod Thresholds

MONITORING LOCATION (WETLAND)	MONITORED HYDROPERIOD (5 YEAR PERIOD)	WATER BLANCE HYDROPERIOD (20 YEAR PERIOD)	HYDROPERIOD THRESHOLD
SW11 (13027)	May 19th (2015)	May 3rd (2001)	April 26th
SW12 (13022)	May 11th (2015)	April 27th (2015)	April 20th
SW13 (13016)	May 16th (2015)	May 7th (1999)	May 1st
SW16 (13037)	July 5th (2019)	May 25th (2012)	May 18th
SW36 (13201)	TBD	TBD	TBD
SW37 (13200)	TBD	TBD	TBD

If the wetland water level drops to zero at a monitoring location (0.0 m water level staff gauge reading) before the hydroperiod threshold stipulated in the previous table, the applicable mitigation measure(s) described in Section 6.5 are to be implemented while the cause of the potential impact is evaluated to determine if it has been caused by extraction and/or quarry dewatering.

Maintaining a standing pool of water in each wetland during its historic hydroperiod is critical to the form and function of the wetland from a natural heritage, habitat and breeding perspective. The species living and breeding in these wetlands rely on the standing pool of water for a period each spring. As such, the hydroperiod threshold represents the earliest date at which the standing pool of water reaches a depth of 0.0 m at the wetland monitoring locations as defined by the historic surface water monitoring data and predictive water balance and integrated surface water groundwater model.

It is noted that the permanent pool in each wetland was generally not re-established prior to the wetland hydroperiod monitoring device being removed mid-December to prevent freezing. The results of the wetland hydroperiod monitoring, existing condition water balance and integrated surface water groundwater model show that the re-establishment of the permanent pool each fall/winter is highly dependent on rainfall and snowmelt and can occur between the beginning of November to mid-February. As such, a fall hydroperiod threshold has not been established for each wetland. The need for a fall hydroperiod threshold will be re-evaluated as additional baseline monitoring data is collected during the approvals process, prior to extraction, through consultation with the requisite approval agencies.

The overall catchment area draining to each wetland (wetlands 13031, 13027, 13022, 13016, and 13037) adjacent to the south extension will not be altered through extraction. The integrated surface water groundwater model predicts groundwater drawdown beneath each wetland during operations due to extraction and quarry dewatering. However, adverse impacts are not predicted to the wetlands as a result of the groundwater drawdown as the wetlands are generally perched with little (less than 1.8% of the total inflow to the wetland) to no groundwater contribution during the year. The wetland hydroperiod thresholds for these wetlands have been specified to ensure no unforeseen adverse impacts occur as a result of extraction and/or quarry dewatering.

The overall catchment area draining to wetlands 13200 and 13201 (wetland monitoring locations SW36 and 37) will be reduced as part of extraction in Phases 3 through 6. Also, the integrated surface water groundwater model predicts groundwater drawdown beneath each wetland during operations due to extraction and quarry dewatering. Mitigation measures have been developed as part of the quarries surface water management plan to supplement these wetlands with quarry water to maintain their hydroperiod. Mitigation is discussed in Section 6.5.

Wetland hydroperiod and shallow groundwater monitoring stations will be established in the two additional wetlands in the spring of 2020. The wetland hydroperiod thresholds for these two wetlands will be developed from the monitoring data collected moving forward and the results of the existing conditions water balance and integrated surface water groundwater model.

6.4.3 Water Quality Thresholds

As a condition of the quarries ECA, grab samples must be collected from the discharge pipe of Quarry Sump 0100 and 0200 monthly and quarterly (once every three months) during operations. Monthly and quarterly samples are collected from the discharge pipe of each sump and analyzed for a specified set of parameters (the monthly and quarterly sample parameters differ). As the quarry discharge is proposed to continue through extension, sampling is expected to continue long-term during operations as specified in the ECA or modified by the Director of the MECP. The following effluent limits have been established for off-site discharge.

Table 43: Environmental Compliance Approval Effluent Limits

PARAMETER	CONCENTRATION LIMIT (mg/L)
Total Suspended Solids (TSS)	25
Oil and Grease	15
pH	6.5 – 8.5 (inclusive)

Non-compliance is deemed to have occurred when the concentration of any parameter listed from any single grab sample exceeds the maximum concentration limit specified or when a single pH measurement falls outside the indicated range.

A settling pond constructed at surface is required as part of Phase 1 and 2 extraction to manage precipitation and intercepted groundwater until sufficient extraction has occurred and a sump has been constructed in the Phase 2 quarry floor. To dewater the extraction area, water will be pumped to the settling pond for treatment prior to discharge to the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek. Once the quarry sump has been constructed, it will provide treatment and water from the sump will be pumped directly to the West Arm. It is recommended that this discharge adhere to the Environmental Compliance Approval Effluent Limits described above.

Downstream of each quarry discharge location (SW2 and SW10), water quality thresholds will be established to identify impacts on the water quality of the surface water features resulting from the quarry discharge. Its recommended that the water quality thresholds be established from the results of the historic water quality sampling completed in support of the proposed quarry extension. Specifically, maximum and minimum concentration limits should be established from the sample results collected while considering the Provincial Water Quality Objectives (PWQO) and role water quality plays in the Natural Heritage Features.

To date, four (4) samples have been collected from each water sampling location. Additional samples will be collected to establish suitable maximum and minimum concentration limits. As such, the water quality thresholds will be confirmed during the approvals process, prior to extraction in the extension areas, through consultation with the requisite approval agencies as additional water quality data is obtained.

6.5 MITIGATION

Mitigation measures for the potential surface water impacts identified through the predictive water balance and integrated surface water groundwater model have been developed. The mitigation measures include maintaining the existing off-site discharge locations, adjusting quarry discharge rates, and supplementing wetlands with water from the quarry sumps to maintain wetland hydroperiod. These mitigation measures have been incorporated into the surface water management strategy for the proposed expansion. Specifically, the mitigation measures proposed are summarized in the following paragraphs.

The integrated surface water groundwater model results predict groundwater mounding beneath the existing irrigation ponds on the Burlington Springs Golf and Country Club (BSGCC) property. This groundwater mounding raises groundwater levels in the area artificially and is generally maintained year-round by the diversion of quarry discharge into the irrigation ponds. Through extraction, the irrigation ponds will be eliminated, and groundwater water levels will be lowered in the area. To replicate the artificial groundwater mounding produced by the existing irrigation ponds and supplement the groundwater recharge in the area, a replica pond will be constructed within the licence boundary, outside the extraction area, between the extraction limit and Cedar Springs Road during operations. The replica pond will be constructed at depths and elevations consistent with the existing irrigation ponds. The replica pond will remain post extraction as part of the rehabilitation of the site.

As discussed, Quarry Sump 0100 discharges to the roadside ditch along Colling Road which drains southwest to wetland 13202 (weir pond) located in the northeast corner of the west extension lands. A weir structure and diversion channel maintain flow to the irrigation ponds on the golf course. The diversion channel will be eliminated through extraction and will be replaced by a diversion pipe proposed to divert a portion of the quarry discharge to the proposed replica pond between the extraction limit and Cedar Springs Road. The diversion pipe will consist of an adequately sized culvert installed between Colling Road/Cedar Springs road and the extraction limit. The diversion pipe will divert flow to the proposed replica pond in a similar manner and elevation as the existing diversion channel. The diversion pipe will be installed during operations and remain in place post extraction as part of the rehabilitation of the site.

Extraction will reduce the drainage area to wetland 13201 northwest of No. 2 Sideroad forming the headwaters of the unnamed tributary of Lake Medad. Reducing the drainage area of the wetland has the potential to adversely impact the wetlands hydroperiod. As such, a mitigation strategy has been developed to supplement the flow into the wetland during operations as required. A bottom draw outlet will be constructed in the southeast corner of the proposed replica pond and an outlet pipe complete with a control valve will be installed to discharge water into the roadside ditch along No. 2 Sideroad feeding the wetland. The wetland hydroperiod will be monitored and water will be discharged to the wetland as required to maintain the wetland hydroperiod. The discharge of water, both rate and quantity, will be controlled by the control valve operated by Nelson staff during operations. The bottom draw outlet and outlet pipe complete with a control valve will remain post extraction as part of the rehabilitation of the site. Monitoring of the wetland hydroperiod and discharge of water, both rate and quantity, to the wetland will be completed as required to maintain the wetland hydroperiod.

Extraction will also reduce the drainage area to wetland 13200 located northeast of the existing irrigation ponds within the BSGCC property. Reducing the drainage area of the wetland has the potential to adversely impact the wetlands hydroperiod. As such, a mitigation strategy has been developed to supplement the flow into the wetland during operations as required. Quarry water will be pumped from Quarry Sump 0100 directly into the wetland at specified rates and volumes to maintain the wetland hydroperiod. As part of the rehabilitation of the west extension, fill will be imported into the west extension to raise the grade around the wetland to original ground level, reinstating the wetlands drainage area. The portion of the wetland's drainage area reinstated through rehabilitation will be graded to drain overland into the wetland and will be planted with trees mimicking existing conditions.

Additional mitigative measures for potential streamflow, wetland hydroperiod, water temperature and water quality impacts resulting from extraction and/or quarry dewatering are as follows:

- If a streamflow threshold is triggered, the quarry discharge off-site will be reviewed, and the discharge rates adjusted (within the permissible discharge rates specified in Nelson's PTTW) to satisfy the specified baseflow thresholds.
- If a maximum streamflow temperature threshold is triggered, the quarry discharge off-site will be reduced to reduce the discharges influence on the water temperature in the receiving watercourse. Consequently, the depth of water in the quarry sump and settling ponds will increase reducing the temperature of the water discharged off-site. In addition, the pump intake located in the quarry sump will be reviewed to ensure it is drawing off bottom where water temperatures are lowest in the water column.
- If a wetland hydroperiod threshold is triggered, the wetland will be supplemented with water from a quarry sump. Water will be pumped from the quarry sump to the wetland as required to maintain a standing pool of water in the wetland until the hydroperiod threshold date passes. Water quality samples will be collected from the discharge to confirm the water quality adheres to the effluent limits specified in the quarries ECA.
- If the effluent limits in the quarry discharge are exceeded in any individual grab sample collected, Nelson will collect a second sample to verify the results of the original sample and report the exceedance to the MECP in accordance with the reporting requirements of their ECA. If the second sample confirms the results of the first, the quarry sump and settling pond will be reviewed and the necessary modifications will be made to address the effluent limits.
- If the water quality thresholds are triggered in any individual grab sample collected, a second sample will be collected to verify the results of the original sample and a sample will be collected from the upstream quarry discharge. In addition, the quarry discharge off-site will be reduced to limit the discharges influence on the water quality of the receiving watercourse. If the second sample confirms the results of the first, the quarry sump and settling pond will be reviewed and the necessary modifications will be made to address the effluent limits.

To ensure the potential impacts on each wetland can be mitigated expeditiously, Nelson will maintain a pump(s) and a sufficient length of hose on-site to pump water from the quarry sump to the impacted wetland. A pump(s) and sufficient hose will remain on-site to feed the wetlands east and south of the south extension and the two wetlands within the west extension licence boundary. To identify an adverse impact on a wetland, the wetland hydroperiod monitoring frequency will be increase to weekly starting March 1st each year until the spring hydroperiod threshold date has passed.

The protocol for mitigating and investigating potential impacts identified by thresholds being triggered is as follows:

- The approved mitigation plan outlined in this Adaptive Management Plan will be implemented by Nelson;
- The MNRF and MECP will be notified within 48 hours of the trigger being discovered;
- For water quality triggers, a second sample will be collected to confirm the results of the first sample;
- The cause of the trigger will be investigated;
- If the investigation determines the trigger was caused by extraction and/or quarry dewatering, the mitigation measures implemented will remain in place until the trigger is resolved;
- If the investigation determines the trigger was not caused by extraction and/or quarry dewatering, the mitigation measures implemented will cease and operations will return to normal following approval from the MNRF and MECP; and
- The MNRF and the MECP will be advised of the results of the investigation and of the plan moving forward for approval.

7 Recommendations

The following set of recommendations have been prepared for inclusion on the Site Plans and/or in the Adaptive Management Plan in support of the Aggregate Resources Act Licence for the proposed quarry extensions:

- The surface water management strategy outlined in this Surface Water Assessment, specifically the monitoring, thresholds and mitigation, is recommended for inclusion in the Adaptive Management Plan for the proposed extensions;
- It is recommended that the Adaptive Management Plan be updated from time to time and the monitoring, thresholds and mitigation be adjusted when appropriate based on the additional monitoring data collected; and
- It is recommended that the Licencee be required to operate in accordance with the Adaptive Management Plan prepared by Earthfx Incorporated and Tatham Engineering Limited dated May 2020, as may be amended from time to time under the approval of the MNRF in consultation with the NEC, Region of Halton, City of Burlington and Conservation Halton.

In addition to the above, it is recommended that the rehabilitation plan for the Burlington Quarry be amended to reflect the proposed rehabilitation scenario evaluated as part of this Surface Water Assessment. Rather than rehabilitating Burlington Quarry into a lake, it is recommended that Burlington Quarry and the west extension lands be rehabilitated into a landform suitable for recreational, natural heritage and water management purposes on the floor of the extraction area and the off-site discharge from Quarry Sumps 0100 and 0200 be maintained long-term to manage the intercepted groundwater, direct rainfall and surface runoff while protecting the natural heritage features downstream. Specifically, to protect the tributary of Willoughby Creek and the West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek which have been identified as fish habitat and the weir pond (wetland 13202) and wetland (13203) which are natural heritage features.

It is recommended that Nelson seek to permanently increase the maximum allowable discharge rate from Quarry Sump 0100. A permanent increase in the maximum allowable discharge rate is not mandatory, only recommended. The existing quarry continues to be inundated with surface runoff, direct rainfall and intercepted groundwater. It is recommended that a seasonal or varied (based on weather conditions and rainfall) allowable discharge rate(s) be established to provide Nelson with more operational flexibility to actively manage water on-site and allow discharge off-site when downstream channel capacities permit. To increase the allowable water taking rate, Nelson will have to apply for an amendment to their existing PTTW. Any proposed change to Nelson's existing PTTW will be resolved with the MECP through the PTTW approval process.

It is also recommended that Nelson construct a conveyance system (a culvert, ditch or combination of the two) alongside Colling Road within Nelson's property to direct the external drainage from northwest of Colling Road to the discharge location of Quarry Sump 0100. The conveyance system is not mandatory, only recommended. By constructing the conveyance system, the external runoff will drain directly to its existing outlet, the tributary of Willoughby Creek, without entering the active quarry operation. This will reduce the surface water management requirements of the active operation.

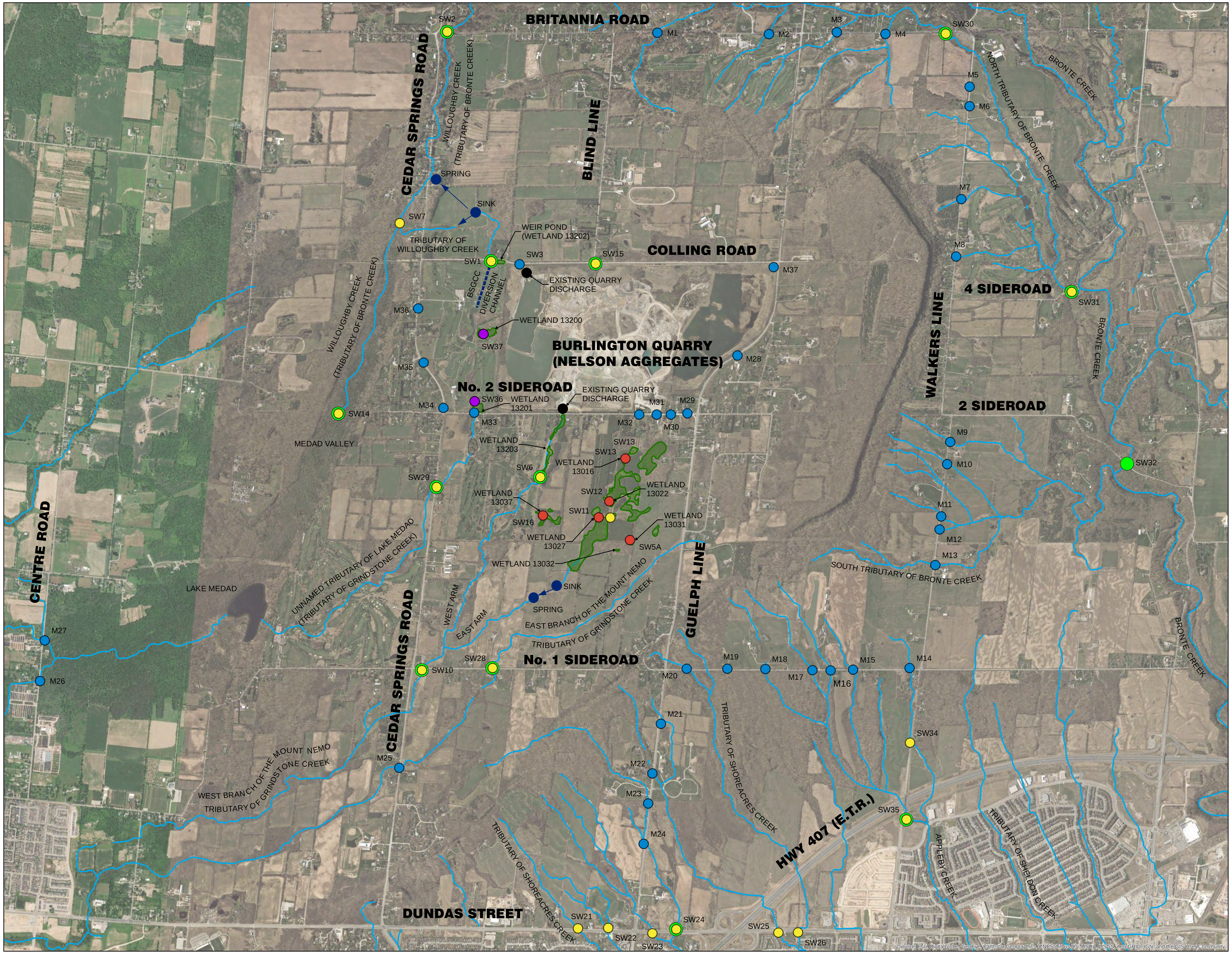
8 Summary

This surface water assessment of the proposed Burlington Quarry extension has been prepared to identify potential negative impacts to the existing surface water features within the proposed licence boundary and the surrounding area and develop mitigative measures to address any potential negative impacts. The following is a summary of the work undertaken in support of this surface water assessment:

- A comprehensive surface water monitoring program has been developed and implemented over the past six (6) years to establish existing baseline conditions for the surface water features on-site and in the surrounding area;
- An existing condition water balance has been generated and calibrated/verified to the existing surface water monitoring data collected to date to understand the seasonal hydrologic response of the surface water features to precipitation events and climatic conditions;
- A proposed condition water balance has been generated to predict potential seasonal impacts to the surface water features resulting from the proposed quarry extension;
- An existing condition event based hydrologic model has been created to understand the event based hydrologic response of the surface water features to precipitation events;
- A proposed condition event based hydrologic model has been created to predict potential event-based impacts to the surface water features resulting from the proposed quarry extension; and
- A surface water management strategy has been developed for the proposed quarry extension during and post extraction (during operations and after rehabilitation) to establish a protocol for monitoring the surface water features and identifying/investigating potential impacts, implementing mitigative measures, and managing surface water and intercepted groundwater on-site.

If the proposed extension is approved, surface water monitoring will continue during the operational lifespan of the quarry to monitor streamflow, wetland hydroperiods and surface and groundwater interactions until closure of the Burlington Quarry; to assess potential unforeseen changes and negative impacts to the surface water and natural heritage features on-site and in the surrounding area resulting from extraction and dewatering of the quarry; and to establish the cause of any potential unforeseen changes and negative impacts to the surface water and natural heritage features and determine if mitigation is required to address the changes/impacts. Surface water thresholds have been assigned to the surface water monitoring locations associated with key receptors, calibration points, and surface water and natural heritage features. Mitigation measures for the potential surface water impacts identified through the predictive water balance and integrated surface water groundwater model have been developed which include maintaining the existing off-site discharge locations, adjusting quarry discharge rates, and supplementing wetlands with water from the quarry sumps to maintain wetland hydroperiod.

In conclusions, the potential changes to the surface water systems identified through the work completed in support of the proposed Burlington Quarry extension can be effectively mitigated to address any concerns related to the surface water features on-site and in the surrounding area.



LEGEND

SURFACE WATER MONITORING LOCATIONS

- WETLAND HYDROPERIOD / SHALLOW GROUNDWATER
- MONTHLY MANUAL IN-SITU STREAMFLOW MEASUREMENTS
- CONTINUOUSLY RECORDING STREAMFLOW
- FUTURE WETLAND HYDROPERIOD/SHALLOW GROUNDWATER
- WATER QUALITY SAMPLING
- WATERCOURSE
- DIVERSION CHANNEL
- WETLANDS

No.	REVISION DESCRIPTION	DATE

ENGINEERS STAMP

BURLINGTON QUARRY

EXISTING SURFACE WATER MONITORING LOCATIONS PLAN

TATHAM ENGINEERING

DESIGN: JG	FILE: 113187	DWG:
DRAWN: SD	DATE: MAY 2020	SW-1
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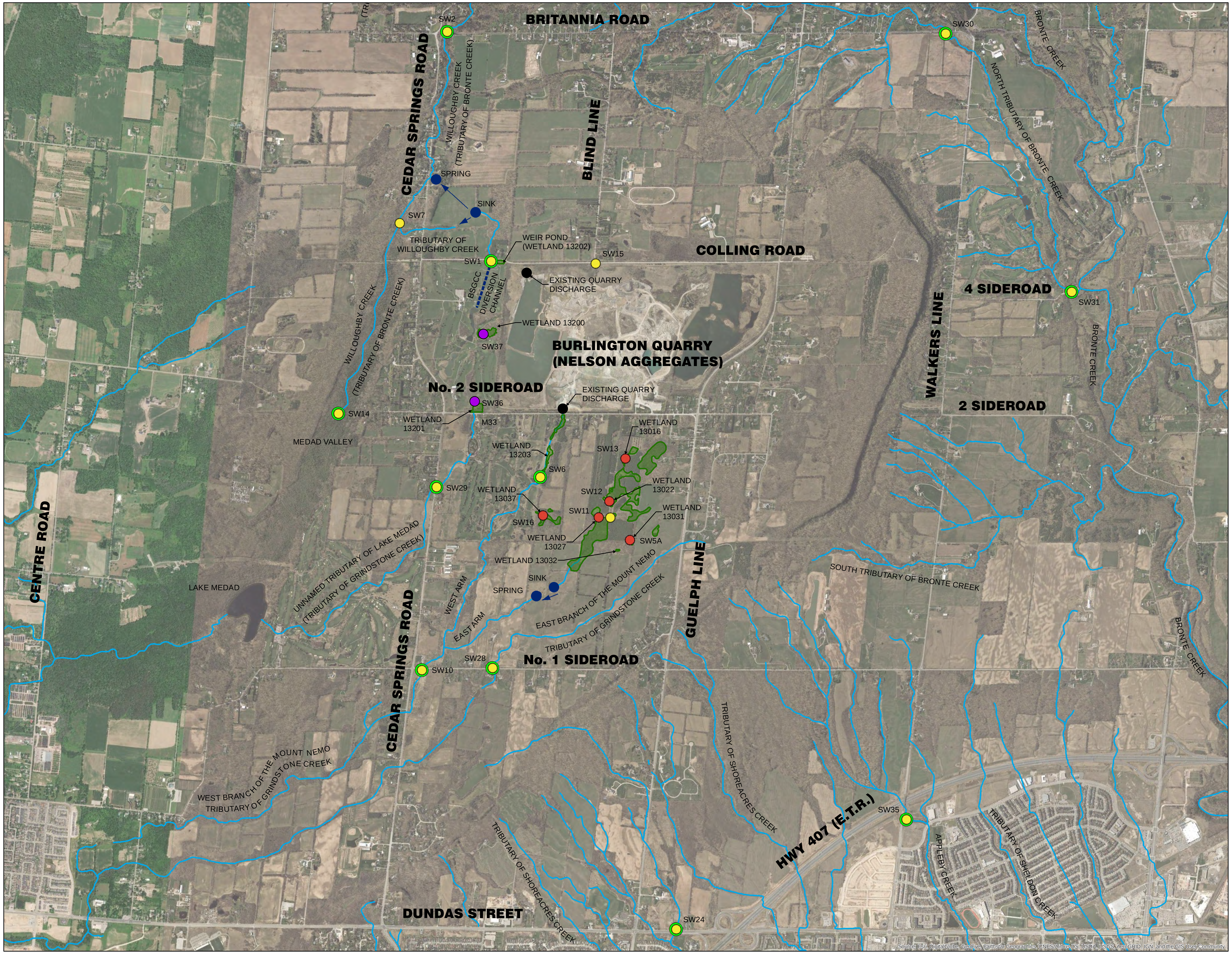

LEGEND

SURFACE WATER MONITORING LOCATIONS

- WETLAND HYDROPERIOD / SHALLOW GROUNDWATER
- CONTINUOUSLY RECORDING STREAMFLOW
- FUTURE WETLAND HYDROPERIOD/SHALLOW GROUNDWATER
- WATER QUALITY SAMPLING
- WATERCOURSE
- DIVERSION CHANNEL
- WETLANDS

No.	REVISION DESCRIPTION	DATE

ENGINEERS STAMP

BURLINGTON QUARRY

POST-APPROVALS SURFACE WATER MONITORING LOCATIONS PLAN

TATHAM ENGINEERING

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DRAWN: SD	DATE: MAY 2020	SW-2
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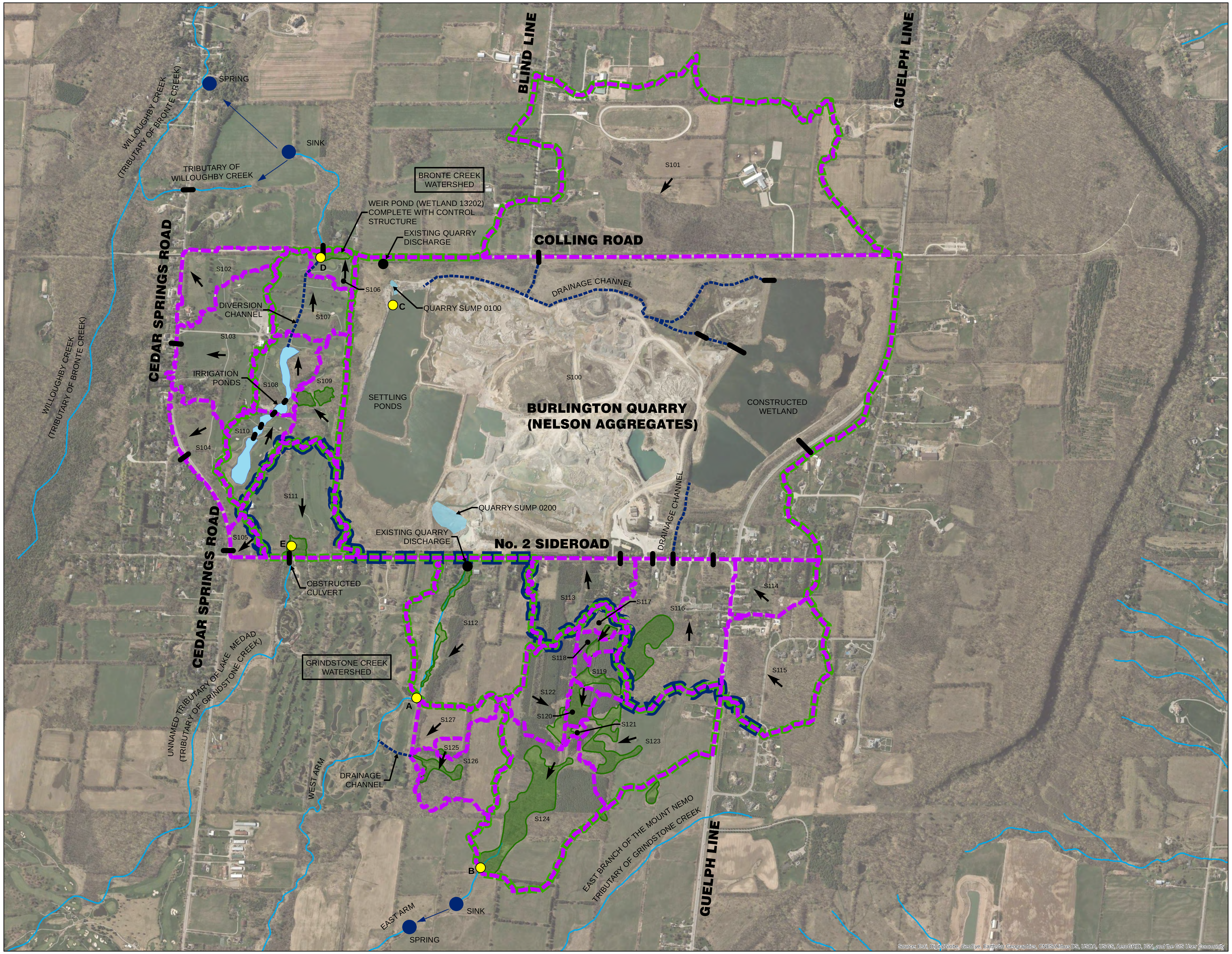


LEGEND

- KEY POINT OF INTEREST
- CULVERT CROSSING
- EXISTING CHANNEL
- WATERCOURSE
- SUBCATCHMENT BOUNDARY
- CATCHMENT BOUNDARY
- WATERSHED BOUNDARY
- IRRIGATION PONDS
- WETLANDS
- FLOW DIRECTION

SUBCATCHMENT	AREA (ha)
S100	248.1
S101	84.2
S102	6.7
S103	16.5
S104	6.9
S105	1.7
S106	2.3
S107	8.7
S108	6.5
S109	7.4
S110	6.5
S111	14.8
S112	26.2
S113	10.5
S114	6.7
S115	17.5
S116	22.7
S117	1.5
S118	1.5
S119	3.1
S120	1.6
S121	0.4
S122	8.1
S123	17.2
S124	22.0
S125	0.8
S126	9.2
S127	4.1

POINT OF INTEREST	AREA (ha)
A	26.2
B	55.5
C	389.7
D	31.4
E	14.8

No.	REVISION DESCRIPTION	DATE

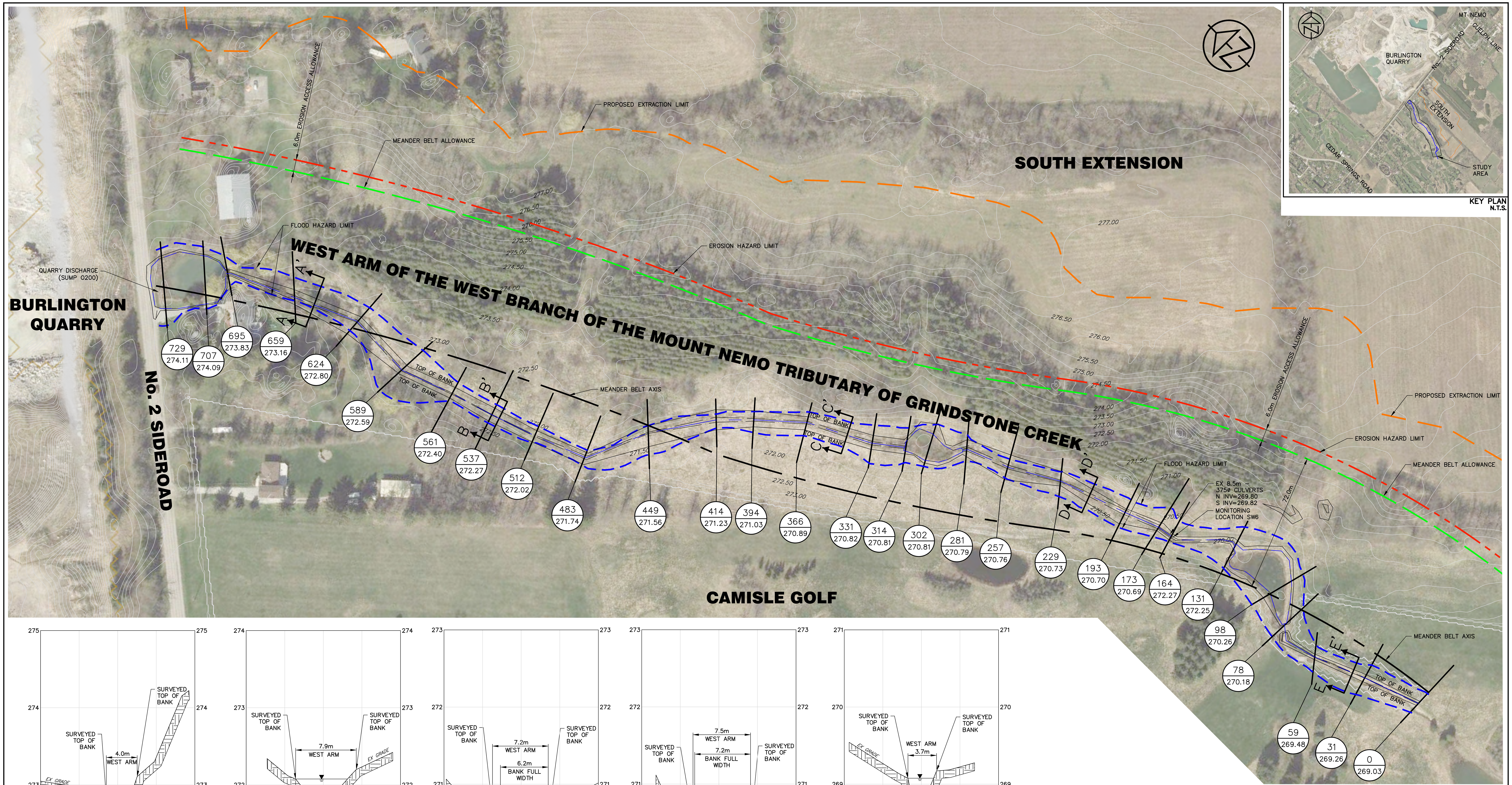
ENGINEERS STAMP

BURLINGTON QUARRY

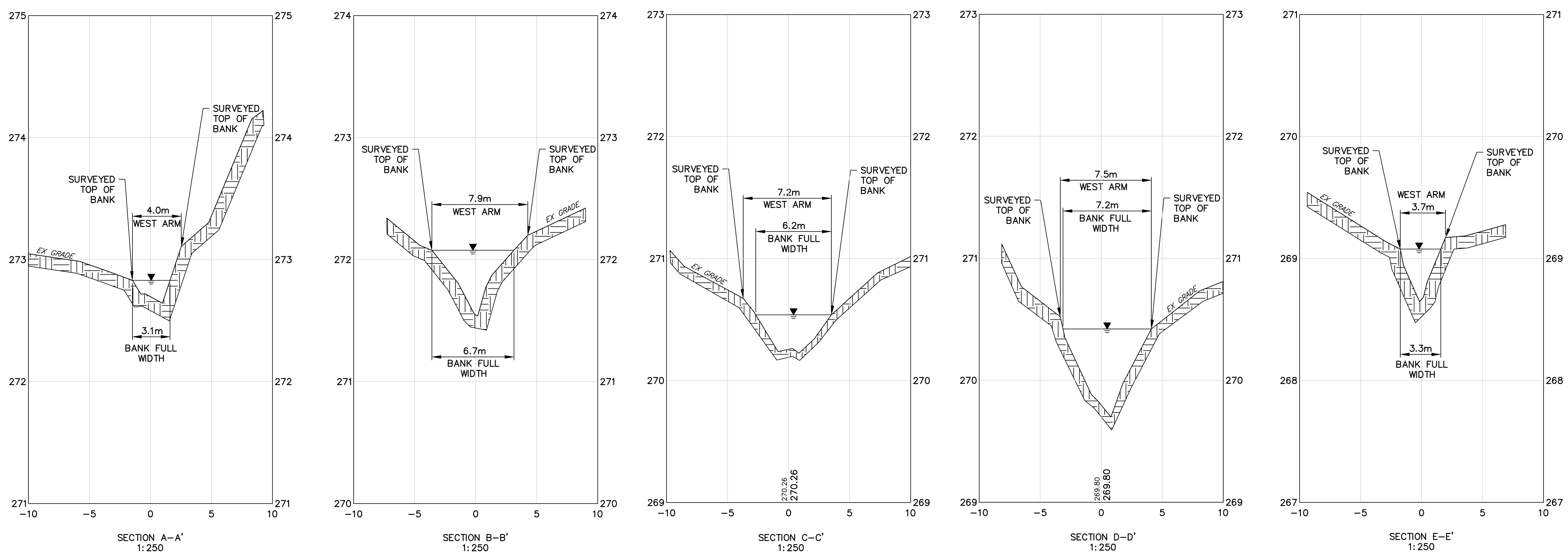
EXISTING CONDITIONS DRAINAGE PLAN

TATHAM ENGINEERING

DESIGN: JG	FILE: 113187	DWG:
DRAWN: SD	DATE: MAY 2020	**DP-1**
CHECK: DRT	SCALE: 1:7500	



KEY PLAN
N.T.S.



LEGEND

- 229 / 270.73 — CROSS-SECTION I.D.; CROSS-SECTION LOCATION; REGIONAL FLOOD ELEVATION
- FLOOD HAZARD LIMIT
- MEANDER BELT ALLOWANCE
- PROPOSED EXTRACTION LIMIT
- EROSION HAZARD LIMIT
- MEANDER BELT AXIS

DISCLAIMER AND COPYRIGHT

CONTRACTOR MUST VERIFY ALL DIMENSIONS AND BE RESPONSIBLE FOR SAME. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER BEFORE COMMENCING WORK. DRAWINGS ARE NOT TO BE SCALED.

BENCHMARKS

NOTES

No.	REVISION DESCRIPTION	DATE
1.	FIRST SUBMISSION	APRIL 2020

ENGINEER STAMP

BURLINGTON QUARRY

NATURAL HAZARDS PLAN

TATHAM ENGINEERING

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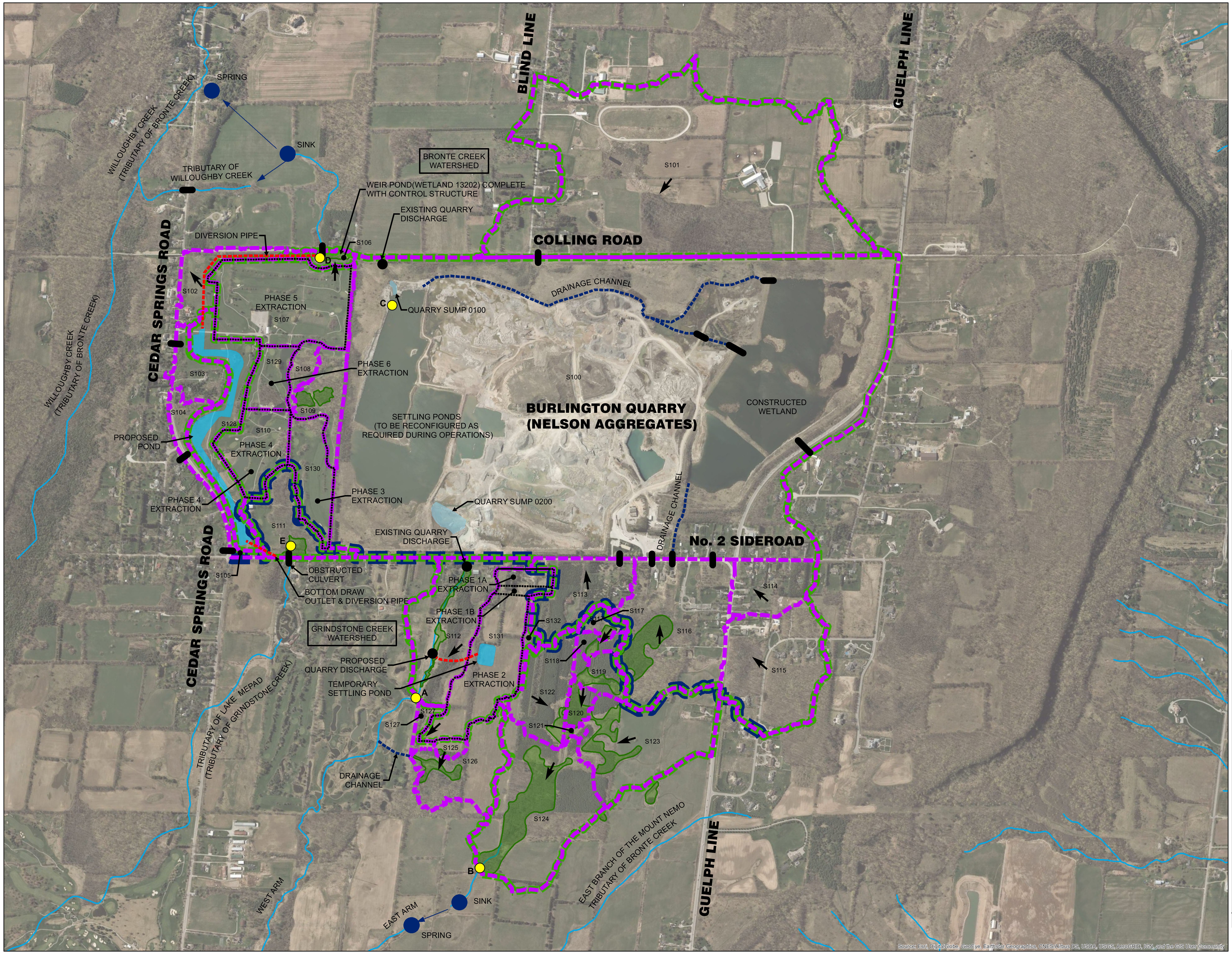

LEGEND

- KEY POINT OF INTEREST
- CULVERT CROSSING
- PROPOSED FLOW DIVERSION
- DRAINAGE CHANNEL
- EXTRACTION PHASE LIMITS
- SUBCATCHMENT BOUNDARY
- WATERCOURSE
- EXTRACTION PHASE LIMITS
- CATCHMENT BOUNDARY
- WATERSHED BOUNDARY
- PROPOSED POND
- WETLANDS
- FLOW DIRECTION

SUBCATCHMENT	AREA (ha)
S100	248.1
S101	84.2
S102	5.0
S103	4.4
S104	3.2
S105	0.6
S106	1.5
S107	18.3
S108	2.0
S109	5.4
S110	7.3
S111	7.6
S112	14.5
S113	9.5
S114	6.7
S115	17.5
S116	22.7
S117	1.5
S118	1.5
S119	3.1
S120	1.6
S121	0.4
S122	8.1
S123	17.2
S124	22.0
S125	0.8
S126	9.2
S127	1.2
S128	11.3
S129	4.0
S130	6.6
S131	14.5
S132	1.0

POINT OF INTEREST	AREA (ha)
A	30.0
B	55.5
C	304.5
D	96.9
E	7.6

No.	REVISION DESCRIPTION	DATE

ENGINEERS STAMP

BURLINGTON QUARRY

PROPOSED CONDITIONS (OPERATIONS) DRAINAGE PLAN

TATHAM ENGINEERING

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DRAWN: SD	DATE: MAY 2020	**DP-2**
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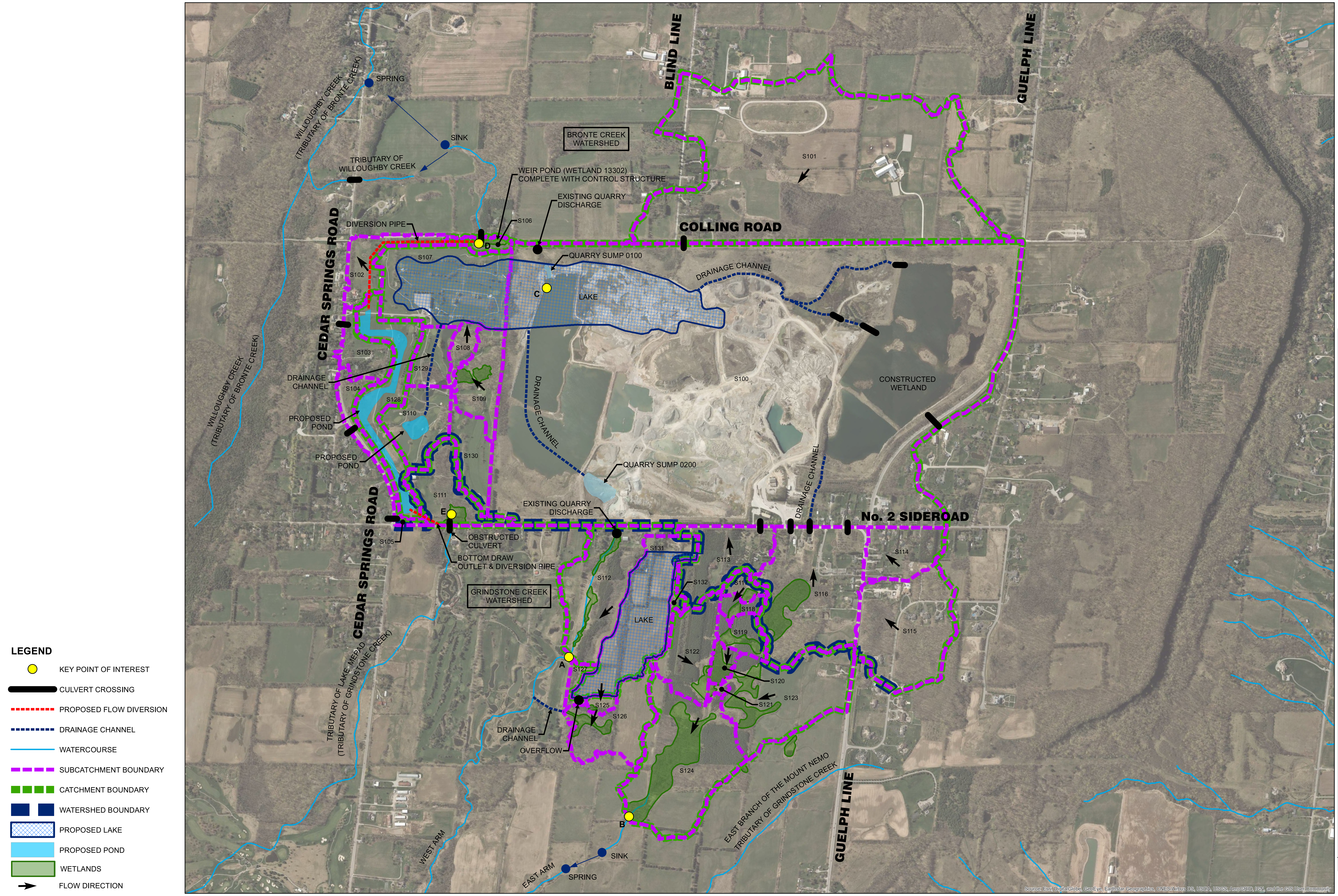


SUBCATCHMENT	AREA (ha)
S100	248.1
S101	84.2
S102	5.0
S103	4.4
S104	3.2
S105	0.6
S106	1.4
S107	18.3
S108	2.0
S109	6.5
S110	7.3
S111	7.6
S112	14.5
S113	9.5
S114	6.7
S115	17.5
S116	22.7
S117	1.5
S118	1.5
S119	3.1
S120	1.6
S121	0.4
S122	8.1
S123	17.2
S124	22.0
S125	0.8
S126	9.2
S127	1.2
S128	11.3
S129	4.0
S130	5.6
S131	14.5
S132	1.0

POINT OF INTEREST	AREA (ha)
A	14.5
B	55.5
C	304.5
D	96.9
E	7.6

No.	REVISION DESCRIPTION	DATE

ENGINEERS STAMP

BURLINGTON QUARRY

PROPOSED CONDITION (REHABILITATION) DRAINAGE PLAN

TATHAM ENGINEERING

DESIGN: JG	FILE: 113187	DWG:
DRAWN: SD	DATE: MAY 2020	DP-3
CHECK: DRT	SCALE: 1:7500	

Appendix A:
PTTW 96-P-3009 /ECA 5203-AN6NGV

Ontario

Ministry of Environment and Energy

Ministère de l'Environnement et de l'Énergie

5775 Yonge Street
8th Floor
North York, Ontario
M2M 4J1

5775, rue Yonge
8ième étage
North York (Ontario)
M2M 4J1

Central Region

Région du Centre

April 29, 1996

Burlington Quarry
Nelson Aggregate Co.
P.O. Box 1070
Burlington, Ontario
L7R 4L8

Attention: Jim Sellan
Property Manager

RE: PERMIT TO TAKE WATER FOR: DEWATERING PURPOSES
BURLINGTON QUARRY
LOT 2, CONCESSIONS 2 AND 3
CITY OF BURLINGTON, REGIONAL MUNICIPALITY OF HALTON
PERMIT TO TAKE WATER NO. 96-P-3009
FILE: SI-HP-BU-220

Please find attached Permit No. 96-P-3009 issued to Nelson Aggregate Co. which authorizes the withdrawal of water in accordance with the application for this Permit to Take Water, and Schedule "A" and Schedule "B" which are attached to and form part of this Permit.

This Permit is valid indefinitely and shall be kept available for inspection by Ontario Ministry of Environment staff.

Take notice that in issuing this Permit to Take Water, terms and conditions pertaining to the taking of water and to the results of the taking have been imposed on Nelson Aggregate Co.. The terms and conditions have been designed to allow for the development of water resources for beneficial purposes, while providing reasonable protection to existing water uses and users.

Our main concern is that the taking of water under the authority of this Permit does not cause negative impacts to other water supplies which were in use prior to the date of this Permit. If the taking of water should result in any negative impacts, the permittee will be required to restore the water supplies of those affected in a manner acceptable to the Ontario Ministry of Environment and Energy or to reduce the rate and amount of taking until any negative impacts are eliminated.

Any change of address or ownership of the property for which this Permit is issued must be reported promptly to the Director.

cont'd

The issuance of this Permit To Take Water does not relieve you from compliance with this or any other agencies' legislative requirements.

It is the responsibility of Nelson Aggregate Co. to ensure that any person taking water under the authority of this Permit is familiar with and complies with the terms and conditions.

Yours Truly,

S. Klose

S.Klose
Director, Section 34
Ontario Water Resources Act

cc: Halton-Peel District Office
File AP-08, City of Burlington

pttw\96-P-3009

Ministry of Environment and Energy
Ministère de l'Environnement et de l'Énergie
Ontario

Notice of Terms and Conditions
Section 100, Ontario Water Resources Act, R.S.O. 1990

Pursuant to Section 34 of the Ontario Water Resources Act, R.S.O. 1990 permission is hereby granted to:

Nelson Aggregate Co.
P.O. Box 1070
Burlington, Ontario
L7R 4L8

for the taking of water for commercial purposes in accordance with the application for this Permit to Take Water, and Schedule "A" and Schedule "B", which are attached to and form part of this Permit.

Located at: **Lot 2, Concessions 2 and 3**
City of Burlington
Regional Municipality of Halton

DEFINITIONS

1. (a) "Director " means a Director, Section 34, Ontario Water Resources Act, R.S.O. 1990.

   (b) "District Office" means Halton-Peel District Office, Central Region, Ontario Ministry of Environment and Energy.

   (c) "District Manager" means District Manager, Halton-Peel District Office, Central Region, Ontario Ministry of Environment and Energy.

   (d) "Ministry" means Ontario Ministry of Environment and Energy.

   (e) "Permit" means this entire Permit to Take Water including its schedules, if any, issued in accordance with Section 34 of the Ontario Water Resources Act, R.S.O. 1990.

   (f) "Permit Holder" means Nelson Aggregate Co.

GENERAL CONDITIONS

2. This Permit shall be kept available for inspection by Ministry staff.

3. The Director may, from time to time, where a situation of interference or anticipated interference with water supply exists, or in a situation requiring information on water takings for purposes of water resource inventory and planning, give written notice to the Permit Holder to undertake any of the following actions. The Permit Holder shall comply with any such notice:

   (a) To establish and maintain a system for the measurement of the quantities of water taken;

   (b) To operate such a system and to record measurements of the quantities of water taken on forms provided by the District Manager or the Director, with such a frequency or for such periods of time as the District Manager or the Director may specify;

   (c) To return to the District Manager or the Director records made pursuant to clause 3(b) at such times or with such frequency as the District Manager or the Director may specify; and

   (d) To keep records made pursuant to clause 3(b) available for inspection by Ministry staff until such time as they are returned to the District Manager or the Director pursuant to clause 3(c).

4. The Permit Holder shall immediately notify the District Manager of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint.

5. For Groundwater Takings, if the taking of water is forecast to cause any negative impact, or is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to the initial issuance of a permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of so doing, or shall reduce the rate and amount of taking to prevent the forecasted negative impact or alleviate the observed negative impact. Pending permanent restoration of the affected supplies, the Permit Holder shall provide, to those affected, temporary water supplies adequate to meet their normal requirements, or shall compensate such persons for their reasonable cost of so doing.

6. The Permit Holder shall report to the Director any changes of address or telephone number, or change of ownership of the property for which this Permit is issued within thirty days of any such change. The Permit Holder shall not assign his rights under this Permit to another person without the written consent of the Director.

7. This Permit does not release the Permit Holder from any legal liability or obligation and remains in force subject to all limitations, requirements and liabilities imposed by law. This Permit shall not be construed as precluding or limiting any legal claims or rights of action that any person, including the Crown in right of Ontario or any agency thereof, has or may have against the Permit Holder, its officer, employees, agents, and contractors.

8. The Permit Holder must forthwith, upon presentation of credentials, allow Ministry personnel, or a Ministry authorized representative(s) to carry out any and all inspections authorized by Section 15, 16 or 17 of the Ontario Water Resources Act, R.S.O. 1990, Section 156, 157 or 158 of the Environmental Protection Act, R.S.O. 1990 or Section 19 or 20 of the Pesticides Act, R.S.O. 1990.

Schedule "A"

This Schedule "A" forms part of Permit to Take Water 96-P-3009 dated April 29, 1996.

Table 1 NW SE

Source	1	2
Source Name or Description	Quarry Sump 0100	Quarry Sump 0200
Maximum Amount of Water Taken per Minute (Litres/Minute)	4090	945
Maximum Amount of Water Taken per Day (Litres/Day)	5,889,600	1,360,800
Maximum Number of Hours of Taking per Day	24	24
Average Number of Hours of Taking per Day	12	12
Maximum Number of Days of Taking per Year	365	365

Schedule "B"

This Schedule "B" forms part of Permit to Take Water 96-P-3009 dated April 29, 1996.

1. Application for Permit to Take Water dated January 23, 1996, signed by Graeme Goodchild.

2. Letter from J. Sellan of Nelson Aggregate Co. to R. Stewart of MOEE, dated January 23, 1996.

You may by written notice served upon me and the Environmental Appeal Board within 15 days after receipt of this Notice, require a hearing by the Board. Section 101 of the Ontario Water Resources Act, R.S.O. 1990, as amended, provides that the Notice requiring the hearing shall state:

1. The portions of the approval of each term or condition in the approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

In addition to these legal requirements, the Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Permit to Take Water number;
6. The date of the Permit to Take Water;
7. The name of the Director;
8. The municipality within which the works are located;

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary
Environmental Appeal Board
112 St.Clair Avenue West, Suite 502
Toronto, Ontario
M4V 1N3

AND

The Director, Section 34
Ontario Water Resources Act, R.S.O. 1990
Ministry of Environment and Energy
5775 Yonge Street, 8th Floor
North York, Ontario
M2M 4J1

AND

The Environmental Commissioner
1075 Bay Street, Suite 605, 6th Floor
Toronto, Ontario
M5G 2W5

DATED AT TORONTO this 29 day of April, 1996.

S. Klose

Director, Section 34
Ontario Water Resources Act

Ontario

Ministry of the Environment and Climate Change
Ministère de l'Environnement et de l'Action en matière de changement climatique

ENVIRONMENTAL COMPLIANCE APPROVAL

NUMBER 5203-AN6NGV
Issue Date: June 29, 2017

Lafarge Canada Inc. and Steed & Evans Holdings Inc.
operating as Nelson Aggregate Co.
Post Office Box, No. 1070
Burlington, Ontario
L7R 4L8

Site Location: Burlington Quarry - Nelson Aggregates
2433 No. 2 Side Rd
City of Burlington, Regional Municipality of Halton
L7P 0G8

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

Existing sewage works for the collection, transmission, treatment and disposal of surface water and quarry water from Burlington Quarry - Nelson Aggregates located in City of Burlington, Ontario, Consisting of the following:

- one (1) settling pond (North Pond), collecting groundwater and surface water runoff from the active area of the quarry, with an estimated storage volume of 230,000 m^3 at an average depth of 2.4 m, equipped with a discharge sump within the pond and submersible pump (North Discharge), discharging at a maximum release rate of 4,090 L/min to the roadside ditch of Colling Road and a tributary watercourse of Bronte Creek;

- one (1) settling pond (South Pond), collecting groundwater and surface water runoff from the active area of the quarry, with an estimated storage volume of 204,800 m^3 at an average depth of 1.8 m, equipped with a discharge sump within the pond and submersible pump (South Discharge), discharging at a maximum release rate of 945 L/min to the West Mount Nemo Tributary;

including all other controls, electrical equipment, instrumentation, piping, pumps, valves and associated appurtenances for the proper operations of the aforementioned sewage works;

all in accordance with the submitted supporting documents listed in Schedule "A" forming part of this Approval.

For the purpose of this environmental compliance approval, the following definitions apply:

"Approval" means this entire document including the application and any supporting documents listed in any schedules in this Approval;

"Director" means a person appointed by the Minister pursuant to section 5 of the EPA for the purposes of Part II.1 of the EPA;

"District Manager" means the District Manager of the Halton-Peel District Office of the Ministry;

"EPA" means the *Environmental Protection Act* , R.S.O. 1990, c.E.19, as amended;

"Ministry" means the ministry of the government of Ontario responsible for the EPA and OWRA and includes all officials, employees or other persons acting on its behalf;

"Owner" means Lafarge Canada Inc. and Steed & Evans Holdings Inc. operating as Nelson Aggregate Co. and its successors and assignees;

"OWRA" means the *Ontario Water Resources Act* , R.S.O. 1990, c. O.40, as amended;

"Works" means the sewage works described in the Owner's application, and this Approval.

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL PROVISIONS

(1) The Owner shall ensure that any person authorized to carry out work on or operate any aspect of the Works is notified of this Approval and the terms and conditions herein and shall take all reasonable measures to ensure any such person complies with the same.

(2) Except as otherwise provided by these terms and conditions, the Owner shall design, build, install, operate and maintain the Works in accordance with this Approval.

(3) Where there is a conflict between a provision of this environmental compliance approval and any document submitted by the Owner, the conditions in this environmental compliance approval shall take precedence. Where there is a conflict between one or more of the documents submitted by the Owner, the Application shall take precedence unless it is clear that the purpose of the document was to amend the application.

(4) Where there is a conflict between the documents listed in the Schedule A, and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

(5) The terms and conditions of this Approval are severable. If any term and condition of this environmental compliance approval, or the application of any requirement of this environmental compliance approval to any circumstance, is held invalid or unenforceable, the application of such condition to other circumstances and the remainder of this Approval shall not be affected thereby.

(6) The issuance of, and compliance with the Conditions of this Approval does not:

(a) relieve any person of any obligation to comply with any provision of any applicable statute, regulation or other legal requirement, including, but not limited to, the obligation to obtain approval from the local conservation authority necessary to construct or operate the sewage Works; or

(b) limit in any way the authority of the Ministry to require certain steps be taken to require the Owner to furnish any further information related to compliance with this Approval.

2. CHANGE OF OWNER

(1) The Owner shall notify the District Manager and the Director, in writing, of any of the following changes within **thirty (30) days** of the change occurring:

(a) change of Owner;

(b) change of address of the Owner;

(c) change of partners where the Owner is or at any time becomes a partnership, and a copy of the most recent declaration filed under the Business Names Act, R.S.O. 1990, c. B17 shall be included in the notification to the District Manager;

(d) change of name of the corporation where the Owner is or at any time becomes a corporation, and a copy of the most current information filed under the Corporations Information Act, R.S.O. 1990, c. C39 shall be included in the notification to the District Manager.

(2) In the event of any change in ownership of the Works, other than a change in ownership to the municipal, i.e. assumption of the Works, the Owner shall notify the succeeding owner in writing of the existence of this Approval, and a cop

3. OPERATIONS MANUAL

(1) The Owner shall prepare an operations manual for the sewage works described in this Approval within three months of the date of its issuance including, but not necessarily limited to, the following information:

(a) operating procedures for routine operation of the works;

(b) inspection programs, including frequency of inspection, for the works and the methods or tests employed to detect when maintenance is necessary;

(c) repair and maintenance programs, including the frequency of repair and maintenance for the works;

(d) contingency plans and procedures for dealing with potential spill, bypasses and any other abnormal situations and for notifying the District Manager; and

(e) complaint procedures for receiving and responding to public complaints.

(2) The Owner shall maintain the operations manual up to date through revisions undertaken from time to time and retain a copy at the location of the sewage works. Upon request, the Owner shall make the manual available for inspection and copying by Ministry personnel.

4. EFFLUENT LIMITS

(1) The Owner shall operate and maintain the Works such that the compliance limits of the materials named below as effluent parameters are not exceeded in the effluent from the works.

Table 1 - Effluent Limits	
Effluent Parameter	**Concentration Limit** (milligrams per litre unless otherwise indicated)
Column 1	Column 2
Total Suspended Solids	25.0
Oil and Grease	15.0
pH of the effluent maintained between 6.5 to 8.5, inclusive, at all times	

(2) For the purposes of determining compliance with and enforcing subsection (1):

(a) non-compliance with respect to a Concentration Limit is deemed to have occurred when any single (grab) sample analyzed for a parameter named in Column 1 of subsection (1) is greater than the corresponding maximum concentration set out in Column 2 of subsection (1);

(b) non-compliance with respect to pH is deemed to have occurred when any single measurement is outside of the indicated range.

5. EFFLUENT - VISUAL OBSERVATIONS

Notwithstanding any other condition in this certificate, the Owner shall ensure that the effluent from the works is essentially free of floating and settleable solids and does not contain oil or any other substance in amounts sufficient to create a visible film, sheen or foam on the receiving waters.

6. OPERATION AND MAINTENANCE

(1) The Owner shall inspect the Works at least once a year and periodically measure the amount of sediment accumulating in the settling ponds and remove the sediment, if necessary, to ensure continued suspended solids removal performance of the ponds.

(2) The Owner shall record, in a log book, the day measurement of sediment was undertaken, the amount of sediment measured, if sediment removal was undertaken and where any removed sediment

was disposed.

(3) The log book shall be retained at the site and be made available for Ministry inspection upon request.

7. MONITORING AND RECORDING

The Owner shall, upon the issuance of the Approval, carry out the following monitoring program:

(1) All samples and measurements taken for the purposes of this Approval are to be taken at a time and in a location characteristic of the quality and quantity of the effluent stream over the time period being monitored.

(2) For the purposes of this condition, the following definitions apply:

a. Monthly means once every month;
b. Quarterly means once every three months.

(3) Samples shall be collected at the following sampling points, at the frequency specified, by means of the specified sample type and analyzed for each parameter listed and all results recorded.

Table 2 - Effluent Monitoring	
Sampling Locations	1. at the end of the North Discharge pipe 2. at the end of the South Discharge pipe
Sampling Frequency	Monthly and Quarterly during Operation (see below)
Sample Type	Grab
Parameters	Monthly Monitoring Parameters pH (field), Temperature (field), Dissolved Oxygen (field), Conductivity (field), Total Suspended Solids, Total Dissolved Solids, Alkalinity, Hardness, Total Ammonia, calculated Unionized Ammonia, Oil and Grease Quarterly Monitoring Parameters Chloride, Sulphate, Total Kjeldahl Nitrogen, Dissolved Organic Carbon, Total Phosphorus, Nitrate, Nitrite, Phenols, PAHs, Metals (Total Aluminum, Antimony, Arsenic, Barium, Boron, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Selenium, Silver and Zinc)

(4) The Owner shall conduct **quarterly field temperature monitoring** (four times per year representing seasonal changes) at the following locations identified in the submitted documents of this application:

a. SW1: Outlet of the North Discharge;

b. SW14: second tributary upstream of the quarry discharge;

c. SW7: downstream of the SW1 tributary's confluence with a second tributary;

d. SW2: tributary of Bronte Creek downstream of the Britannia Rd crossing;

(5) The methods and protocols for sampling, analysis, and recording shall conform, in order of precedence, to the methods and protocols specified in the following:

(a) the Ministry's publication "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater" (August 1994), ISBN 0-7778-1880-9, as amended from time to time by more recently published editions;

(b) the publication "Standard Methods for the Examination of Water and Wastewater" (21st edition) as amended from time to time by more recently published editions; and,

(c) in respect of any parameters not mentioned in (a) or (b), the written approval of the District Manager, which approval shall be obtained prior to sampling.

(6) The temperature and pH of the effluent from the works shall be determined in the field at the time of sampling for total ammonia. The concentration of un-ionized ammonia shall be calculated using the total ammonia concentration, pH and temperature using the methodology stipulated in "Ontario's Provincial Water Quality Objectives" dated July 1994, as amended, for ammonia (un-ionized).

(7) The Owner shall conduct flow monitoring for the North Discharge and South Discharge during operation.

(8) The measurement frequencies and parameters specified in subsection (3) are minimum requirements which may, after two (2) years of monitoring in accordance with this Condition, be modified by the Director in writing from time to time.

(9) The Owner shall retain for a minimum of five (5) years from the date of their creation, all records and information related to or resulting from the monitoring activities required by this Approval.

8. SPILL CONTINGENCY AND POLLUTION PREVENTION PLAN

(1) Before the commencement of operation of the Works, the Owner shall prepare a Spill Contingency and Pollution Prevention Plan that outlines procedures as to how to mitigate the impacts of a spill within the drainage areas serviced by the Works and prevent pollution incidents, and provide a copy to the District Manager. The said plan shall include as a minimum, but not limited to:

(a) the name, job title and 24-hour telephone number of the person(s) responsible for activating the Spill Contingency and Pollution Prevention Plan;

(b) a site plan drawn to scale showing the types of business, streets, catch basins and/or manholes and/or ditches and/or drainage channels , drainage patterns (including direction(s) of flow in storm sewers) and any features which need to be taken into account in terms of potential impacts on access and response (including physical obstructions and location of response and clean-up equipment);

(c) steps to be taken to report, contain, clean up and dispose of contaminants following a spill;

(d) a listing of telephone numbers for: local clean-up companies who may be called upon to assist in responding to spills; local emergency responders including health institution(s); and Ministry of the Environment and Climate Change (MOECC) Spills Action Centre 1-800-268-6060;

(e) Materials Safety Data Sheets (MSDS) for each and every hazardous material which may be transported or stored within the area serviced by the Works;

(f) a description of the spill response and pollution prevention training provided to employees assigned to work in the area serviced by the Works, the date(s) on which the training was provided and to whom;

(g) an inventory of response and clean-up equipment available to implement the Spill Contingency and Pollution Prevention Plan, location and date of maintenance/replacement if warranted, including testing and calibration of the equipment; and

(h) the date on which the Spill Contingency and Pollution Prevention Plan was prepared and subsequently, amended.

(2) The Spill Contingency and Pollution Prevention Plan shall be kept in a conspicuous place near the reception area on site.

(3) The Spill Contingency and Pollution Prevention Plan will be amended from time to time as needed by changes in the operation of the facility or to reflect updates in the Municipal By-Laws, or improved Best Management Practices by the Owner.

9. REPORTING

(1) The Owner shall report to the District Manager or designate, any exceedance of any parameter specified in Condition 4 orally, as soon as reasonably possible, and in writing within seven (7) days of the exceedance.

(2) The Owner shall, upon request, make all manuals, plans, records, data, procedures and supporting documentation available to Ministry staff.

(3) In addition to the obligations under Part X of the *Environmental Protection Act* , the Owner shall, within ten (10) working days of the occurrence of any reportable spill as defined in Ontario Regulation 675/98, bypass or loss of any product, by-product, intermediate product, oil, solvent, waste material or any other polluting substance into the environment, submit a full written report of the occurrence to the District Manager describing the cause and discovery of the spill or loss, clean-up and recovery measures

taken, preventative measures to be taken and schedule of implementation.

(4) The Owner shall prepare and submit a performance report to the District Manager on an annual basis within 60 days following the end of the period being reported upon. The first such report shall cover the first annual period following the commencement of operation of the works and subsequent reports shall be submitted to cover successive annual periods following thereafter. The reports shall contain, but shall not be limited to, the following information:

(a) a summary and interpretation of all monitoring data and a comparison to the effluent limits outlined in Condition 4, including an overview of the success and adequacy of the Works;

(b) a description of any operating problems encountered and corrective actions taken;

(c) a summary of all inspection, maintenance and clean-out carried out on any major structure, equipment, apparatus, mechanism or thing forming part of the Works;

(d) a summary of any effluent quality assurance or control measures undertaken in the reporting period;

(e) a summary of the calibration and maintenance carried out on all effluent monitoring equipment;

(f) a summary of any complaints received during the reporting period and any steps taken to address the complaints;

(g) a summary of all spill or abnormal discharge events; and,

(h) a summary of any Notifications and Contingency Plan undertaken during the reporting period and a discussion regarding their adequacy.

Schedule "A"

1. Application for Approval of Industrial Sewage Works, dated March 10, 2016, submitted by Daniel Twigger, C.C. Tatham & Associates Ltd.;

2. Environmental Compliance Application Report dated March 10, 2016, prepared by C.C. Tatham & Associates Ltd.;

3. Supplemental Information memo dated April 21, 2017, prepared by Dan Hurley from C.C. Tatham & Associates Ltd.;

4. All additional supporting information submitted by Daniel Twigger and Dan Hurley from C.C. Tatham & Associates Ltd. from July 2016 to June, 2017.

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the Works are constructed and operated in the manner in which they were described and upon which approval was granted. This condition is also included to emphasize the precedence of Conditions in the Approval and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review.

2. Condition 2 is included to ensure that the Ministry records are kept accurate and current with respect to approved Works and to ensure that subsequent owners of the Works are made aware of the Approval and continue to operate the Works in compliance with it.

3. Condition 3 is included to ensure that a comprehensive operations manual governing all significant areas of operation, maintenance and repair is prepared, implemented and kept up-to-date by the owner and made available to the Ministry. Such a manual is an integral part of the operation of the works. Its compilation and use should assist the owner in staff training, in proper plant operation and in identifying and planning for contingencies during possible abnormal conditions. The manual will also act as a benchmark for Ministry staff when reviewing the owner's operation of the work.

4. Conditions 4 and 5 are imposed to ensure that the effluent discharged from the Works to the environment meets the Ministry's effluent quality requirements thus minimizing environmental impact on the receiver and to protect water quality, fish and other aquatic life in the receiving water body.

5. Condition 6 is included to require that the Works be properly operated and maintained such that the environment is protected.

6. Condition 7 is included to enable the Owner to evaluate and demonstrate the performance of the Works, on a continual basis, so that the Works are properly operated and maintained at a level which is consistent with the design objectives specified in the Approval and that the Works do not cause any impairment to the receiving watercourse.

7. Condition 8 is included to ensure that the Ministry is immediately informed of the occurrence of an emergency or otherwise abnormal situation so that appropriate steps are taken to address the immediate concerns regarding the protection of public health and minimizing environmental damage and to be able to devise an overall abatement strategy to prevent long term degradation and the re-occurrence of the situation.

8. Condition 9 is included to provide a performance record for future references, to ensure that the Ministry is made aware of problems as they arise, and to provide a compliance record for all the terms and conditions outlined in this Approval,so that the Ministry can work with the Owner in resolving any problems in a timely manner.

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me, the Environmental Review Tribunal and in accordance with Section 47 of the *<u>Environmental Bill of Rights, 1993</u>*, *S.O. 1993, c. 28 (Environmental Bill of Rights), the Environmental Commissioner, within 15* *days after receipt of this Notice, require a hearing by the Tribunal. The Environmental Commissioner will place notice of your appeal on the Environmental Registry. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:*

a. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
b. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

1. The name of the appellant;
2. The address of the appellant;
3. The environmental compliance approval number;
4. The date of the environmental compliance approval;
5. The name of the Director, and;
6. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary* Environmental Review Tribunal 655 Bay Street, Suite 1500 Toronto, Ontario M5G 1E5	AND	The Environmental Commissioner 1075 Bay Street, Suite 605 Toronto, Ontario M5S 2B1	AND	The Director appointed for the purposes of Part II.1 of the Environmental Protection Act Ministry of the Environment and Climate Change 135 St. Clair Avenue West, 1st Floor Toronto, Ontario M4V 1P5

* **Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 326-5370 or www.ert.gov.on.ca**

This instrument is subject to Section 38 of the Environmental Bill of Rights, 1993, that allows residents of Ontario to seek leave to appeal the decision on this instrument. Residents of Ontario may seek leave to appeal within 15 days from the date this decision is placed on the Environmental Registry. By accessing the Environmental Registry at www.ebr.gov.on.ca , you can determine when the leave to appeal period ends.

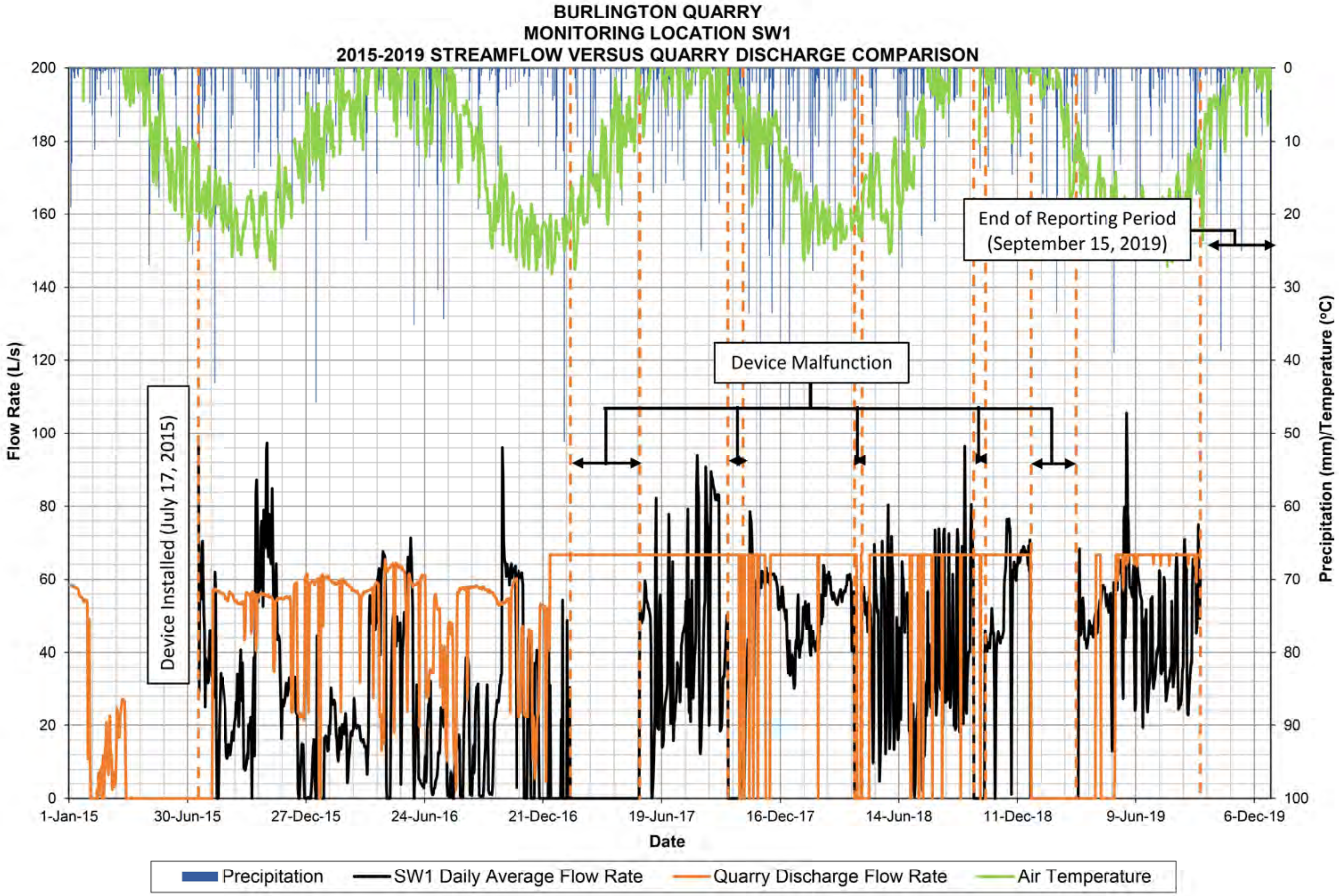
The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 29th day of June, 2017

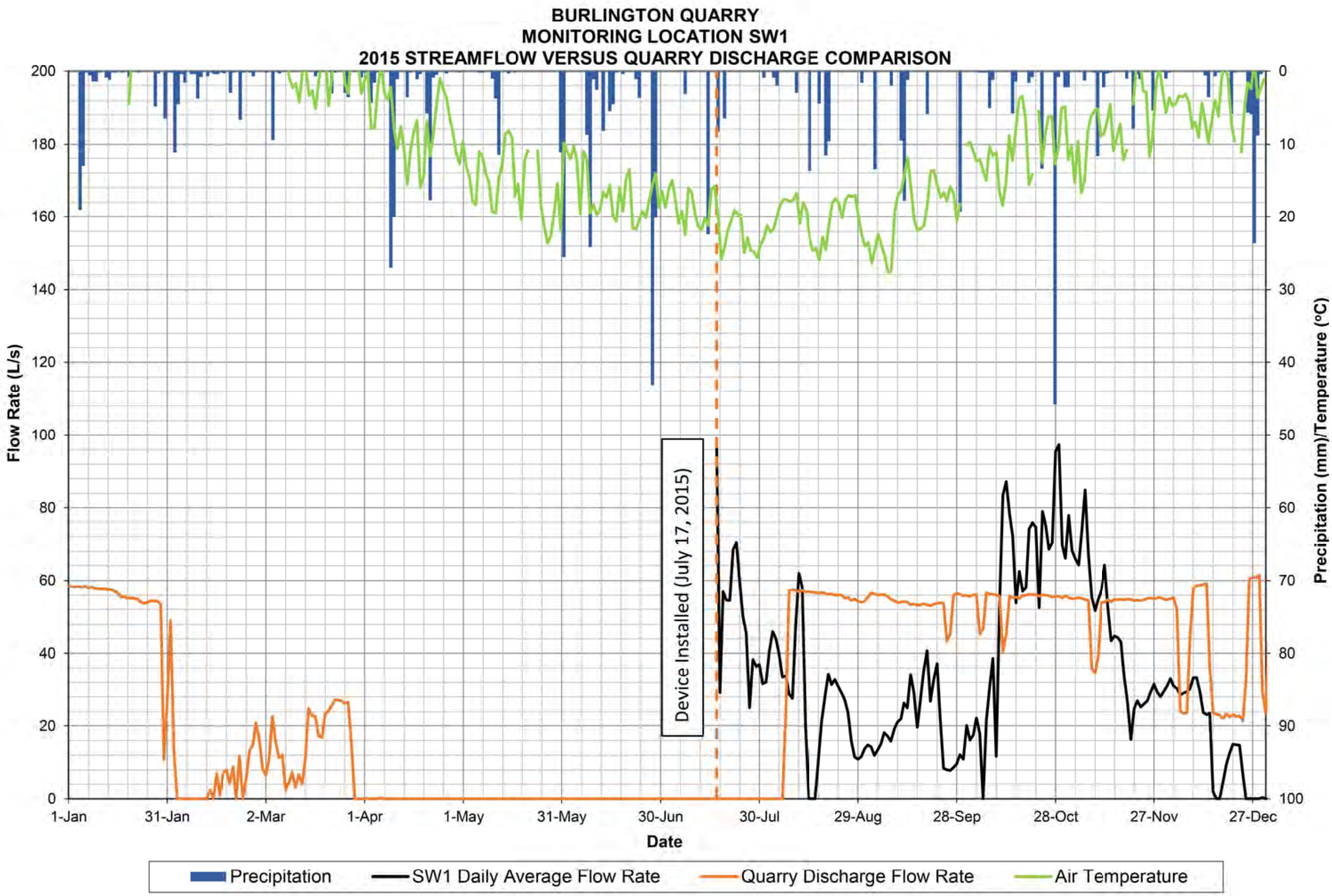
Fariha Pannu, P.Eng.
Director
appointed for the purposes of Part II.1 of the *Environmental Protection Act*

YZ/
c: District Manager, MOECC Halton-Peel District Office
Daniel Twigger, C.C. Tatham & Associates Ltd.

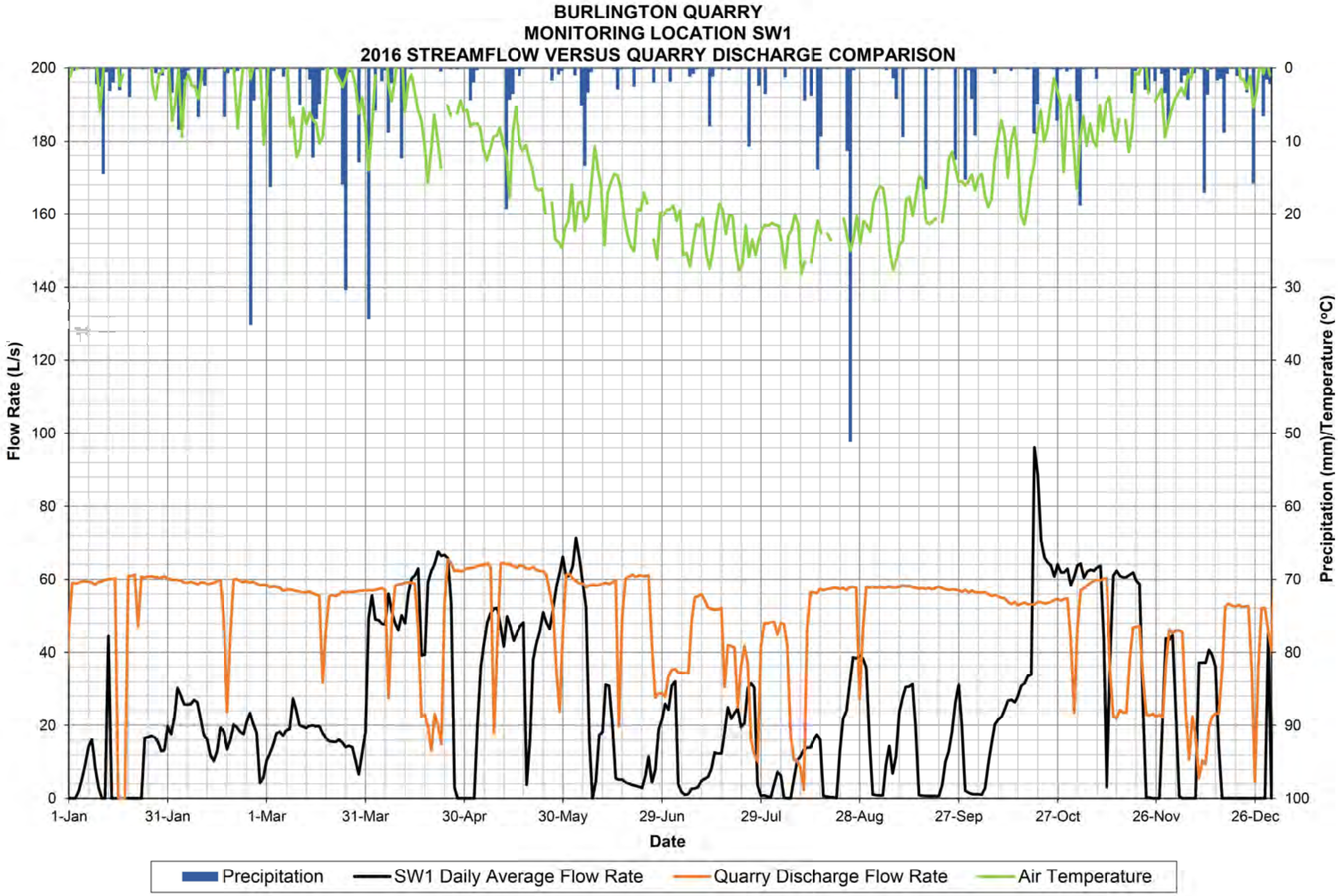
Appendix B:
Bronte Creek Watershed Streamflow Monitoring Results

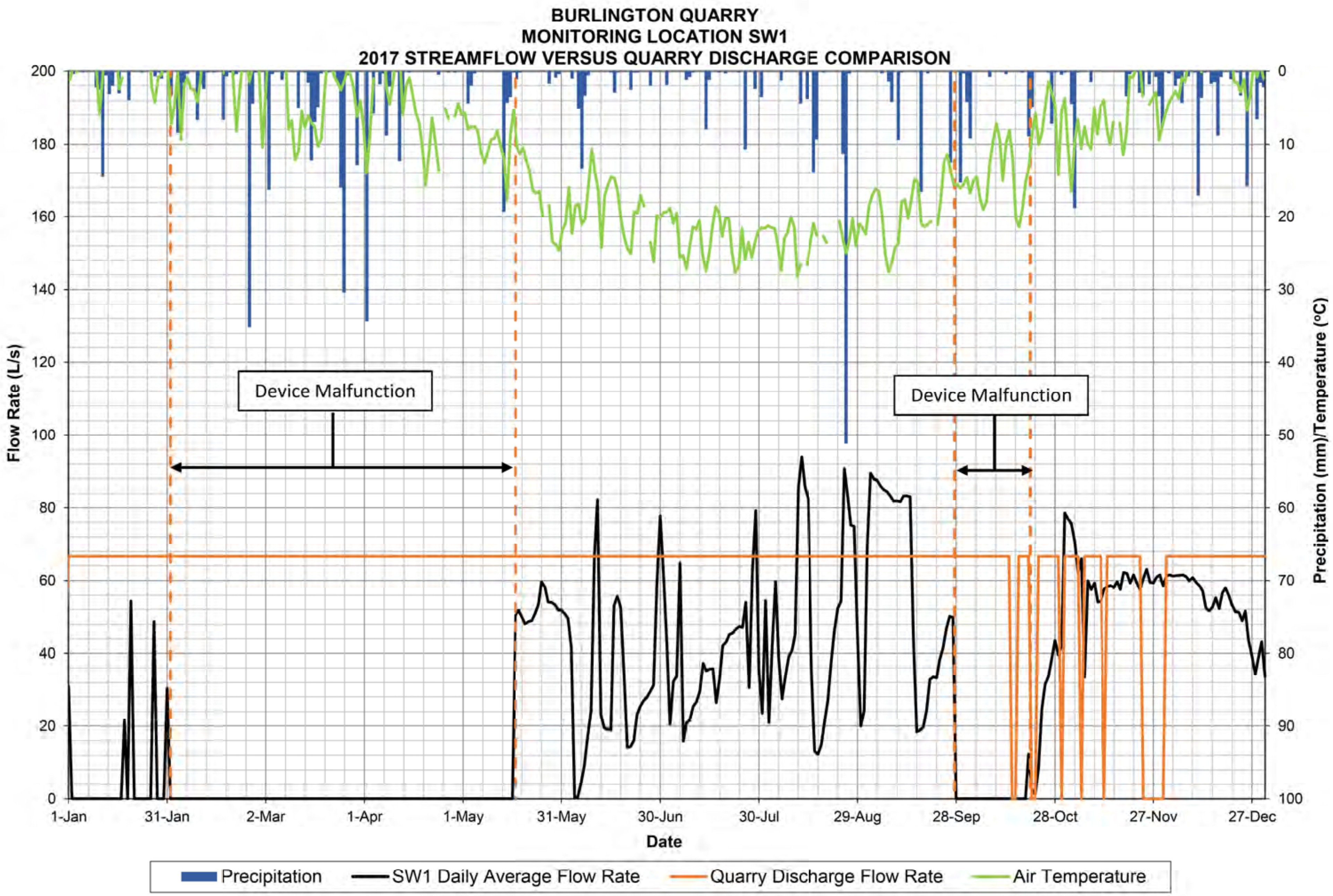


BURLINGTON QUARRY
MONITORING LOCATION SW1
2015-2019 STREAMFLOW VERSUS QUARRY DISCHARGE COMPARISON
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan-15
30-Jun-15
27-Dec-15
24-Jun-16
21-Dec-16
19-Jun-17
16-Dec-17
14-Jun-18
11-Dec-18
9-Jun-19
6-Dec-19
Device Installed (July 17, 2015)
Device Malfunction
End of Reporting Period
(September 15, 2019)
Precipitation
SW1 Daily Average Flow Rate
Quarry Discharge Flow Rate
Air Temperature



BURLINGTON QUARRY
MONITORING LOCATION SW1
2015 STREAMFLOW VERSUS QUARRY DISCHARGE COMPARISON
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (July 17, 2015)
Precipitation
SW1 Daily Average Flow Rate
Quarry Discharge Flow Rate
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW1
2016 STREAMFLOW VERSUS QUARRY DISCHARGE COMPARISON
Flow Rate (L/s)
Precipitation (mm)/Temperature (ºC)
0
20
40
60
80
100
120
140
160
180
200
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
SW1 Daily Average Flow Rate
Quarry Discharge Flow Rate
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW1
2017 STREAMFLOW VERSUS QUARRY DISCHARGE COMPARISON
Device Malfunction
Device Malfunction
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
0
20
40
60
80
100
120
140
160
180
200
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
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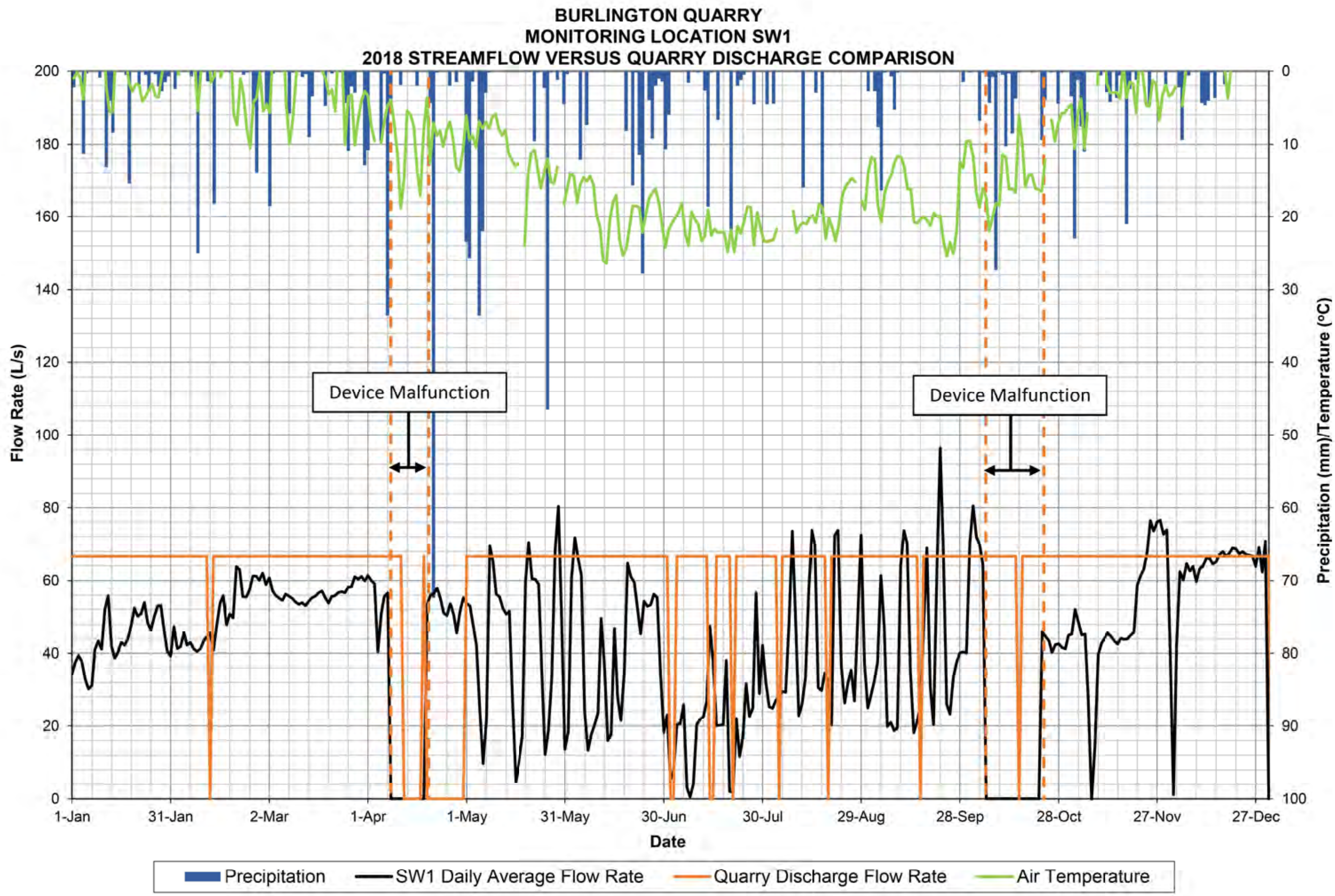
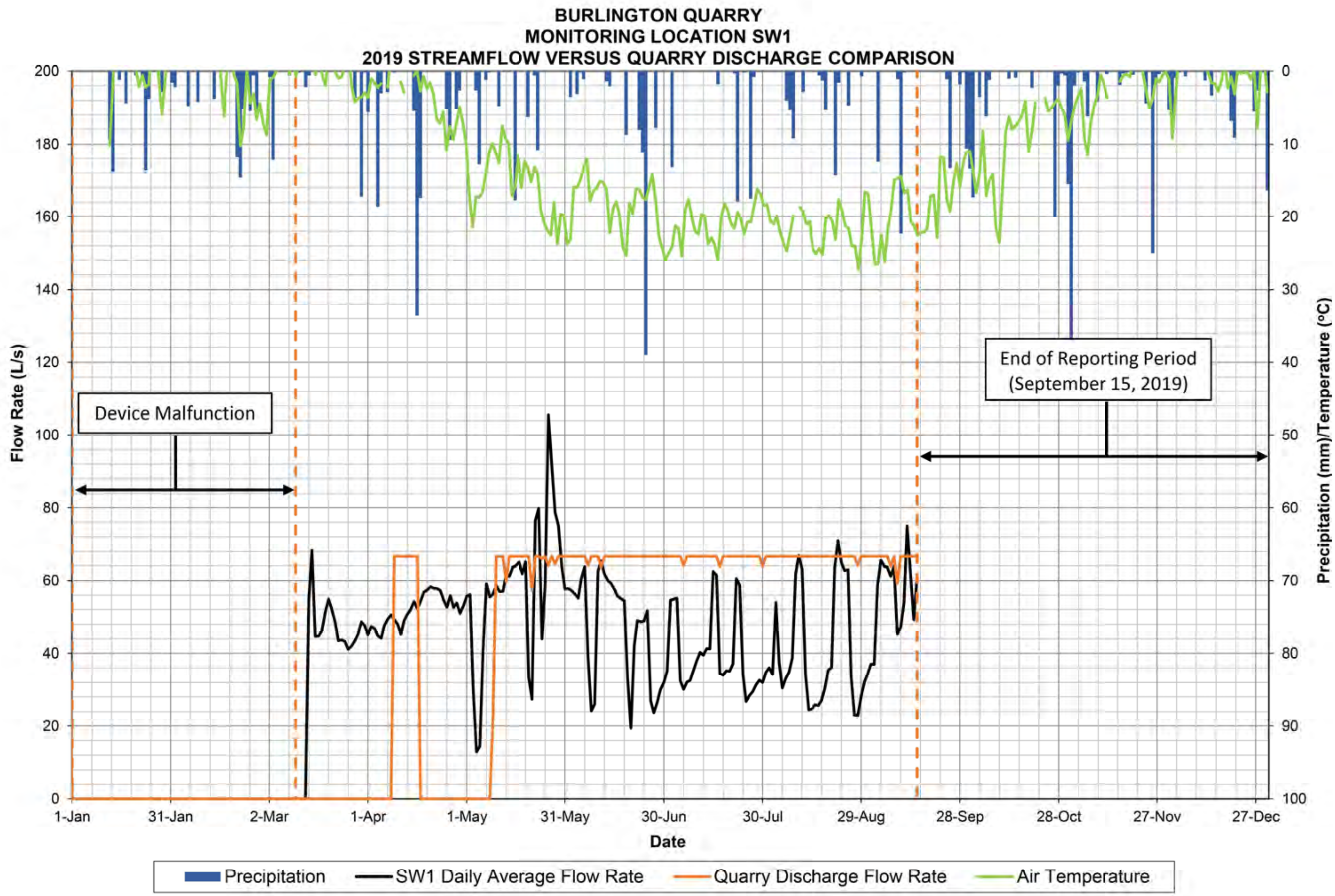
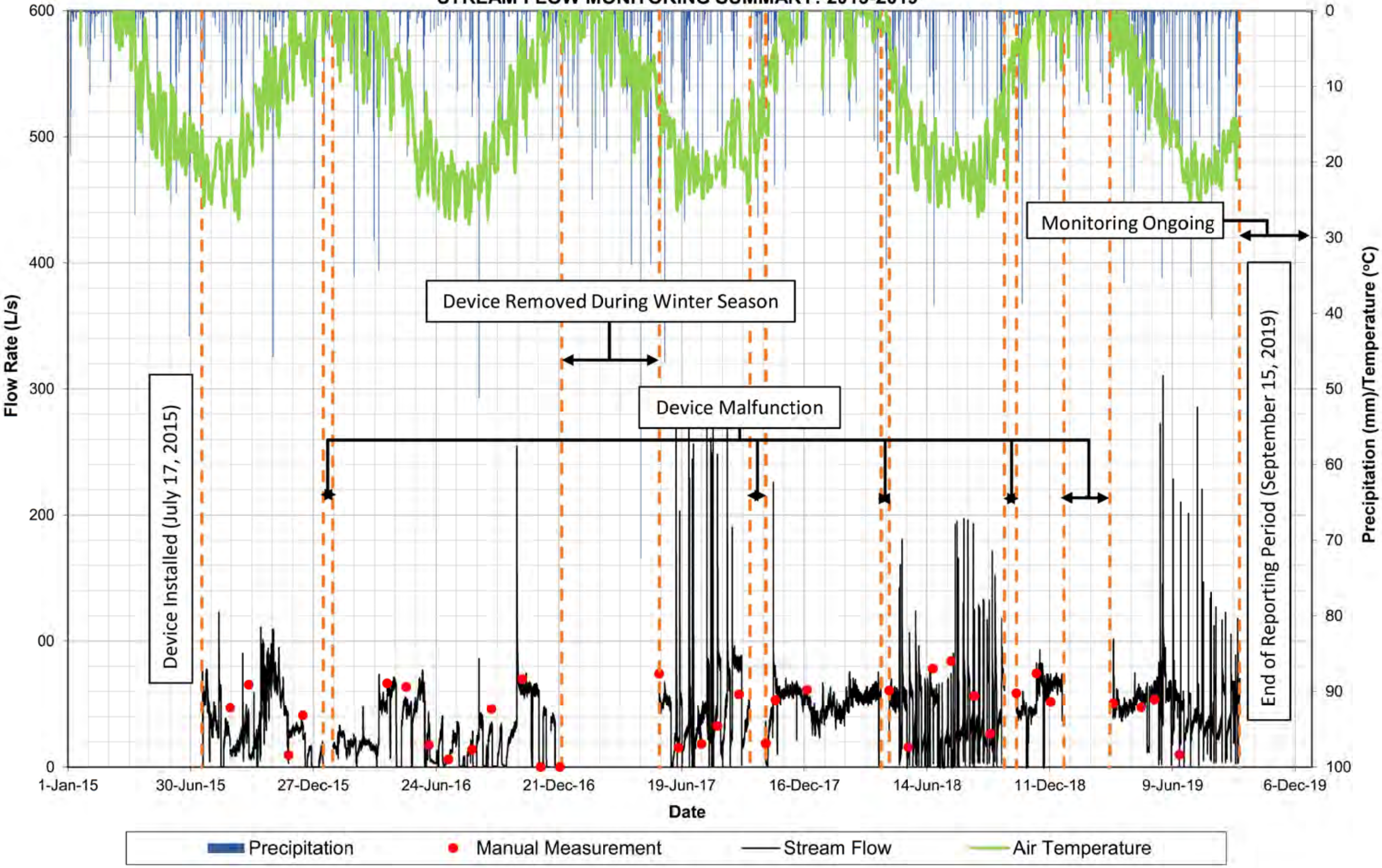
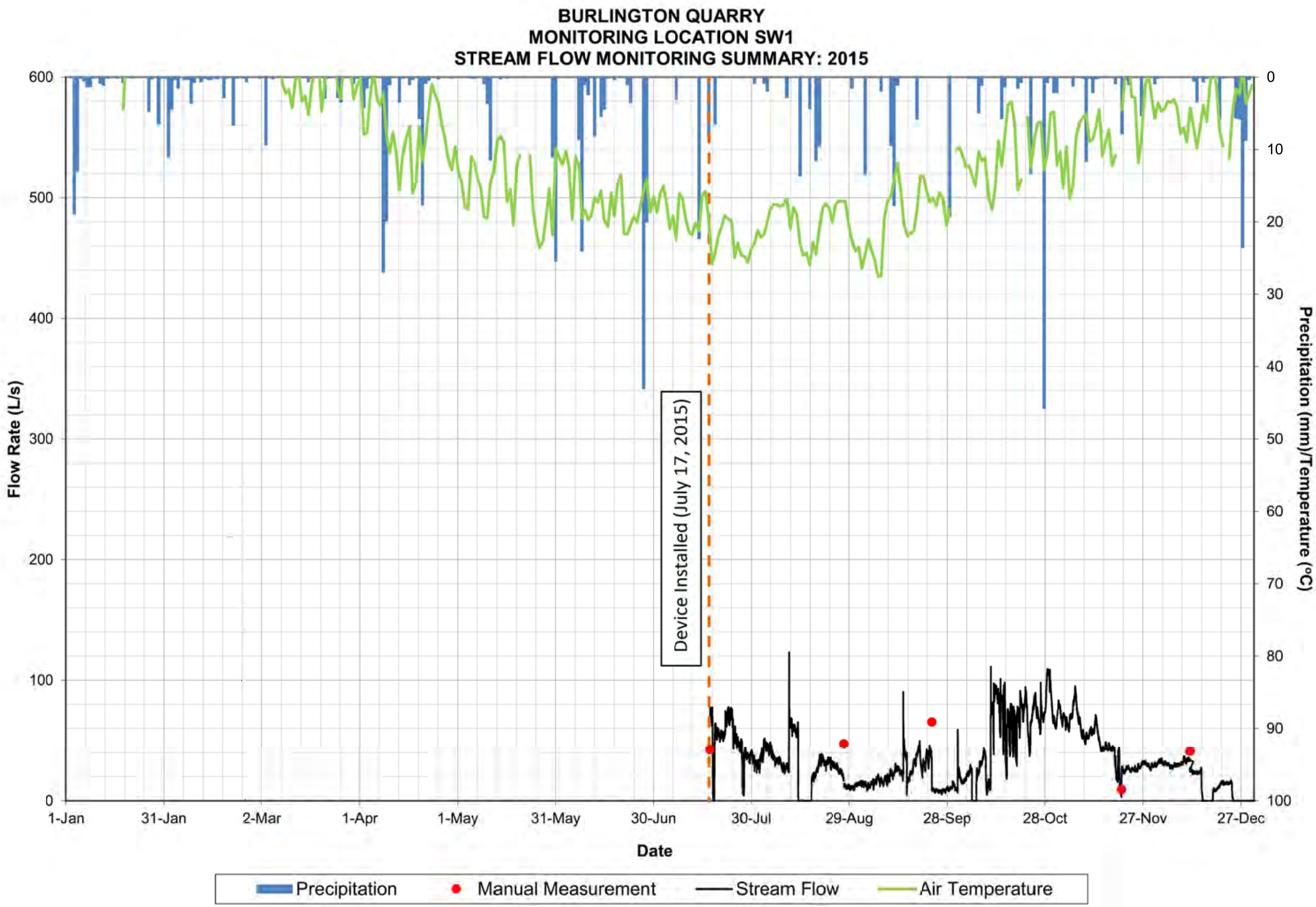
27-Dec
Precipitation
SW1 Daily Average Flow Rate
Quarry Discharge Flow Rate
Air Temperature

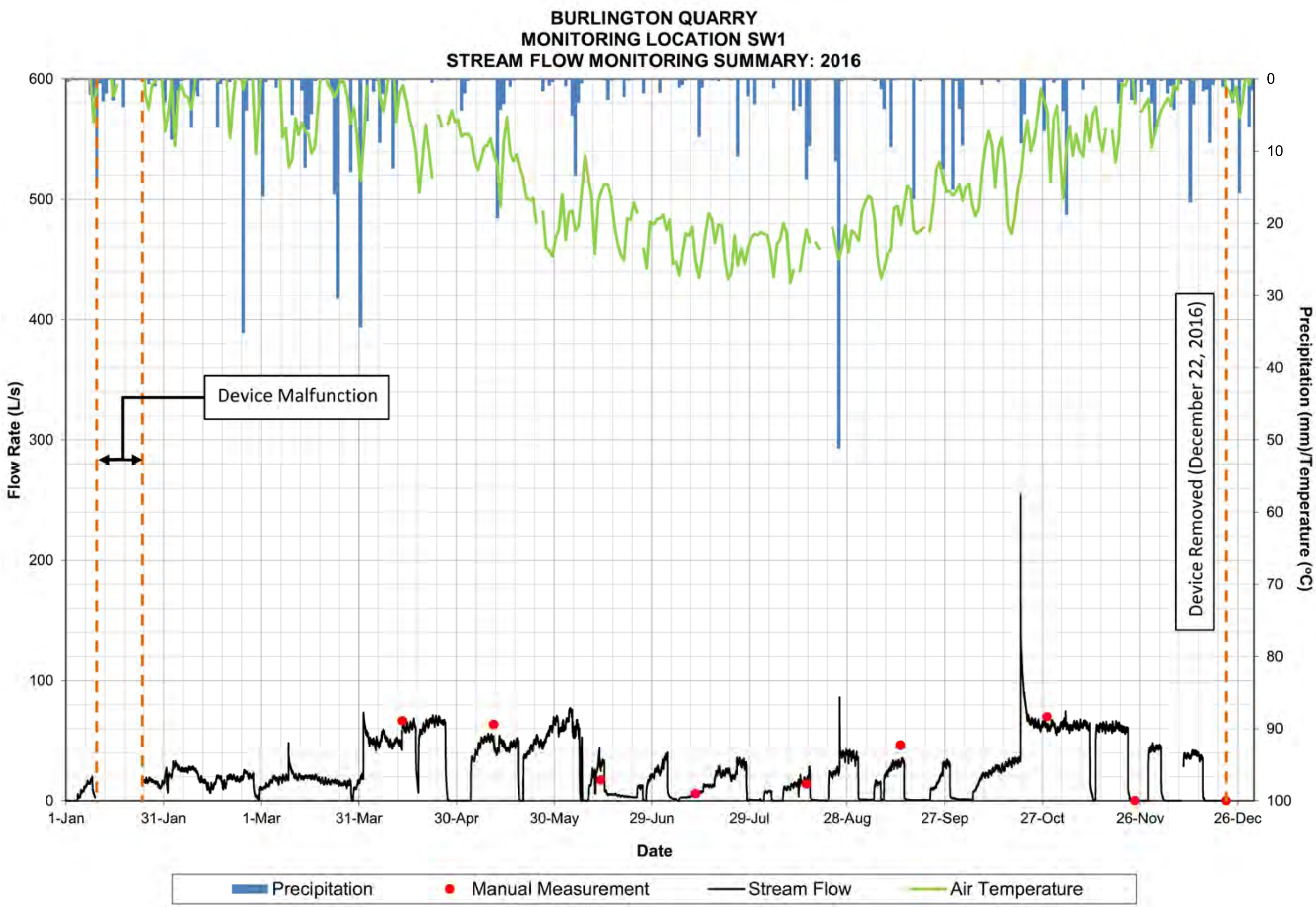

BURLINGTON QUARRY
MONITORING LOCATION SW1
2018 STREAMFLOW VERSUS QUARRY DISCHARGE COMPARISON
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Malfunction
Device Malfunction
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
SW1 Daily Average Flow Rate
Quarry Discharge Flow Rate
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW1
2019 STREAMFLOW VERSUS QUARRY DISCHARGE COMPARISON
Flow Rate (L/s)
Precipitation (mm)/Temperature (ºC)
Date
Device Malfunction
End of Reporting Period
(September 15, 2019)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
SW1 Daily Average Flow Rate
Quarry Discharge Flow Rate
Air Temperature

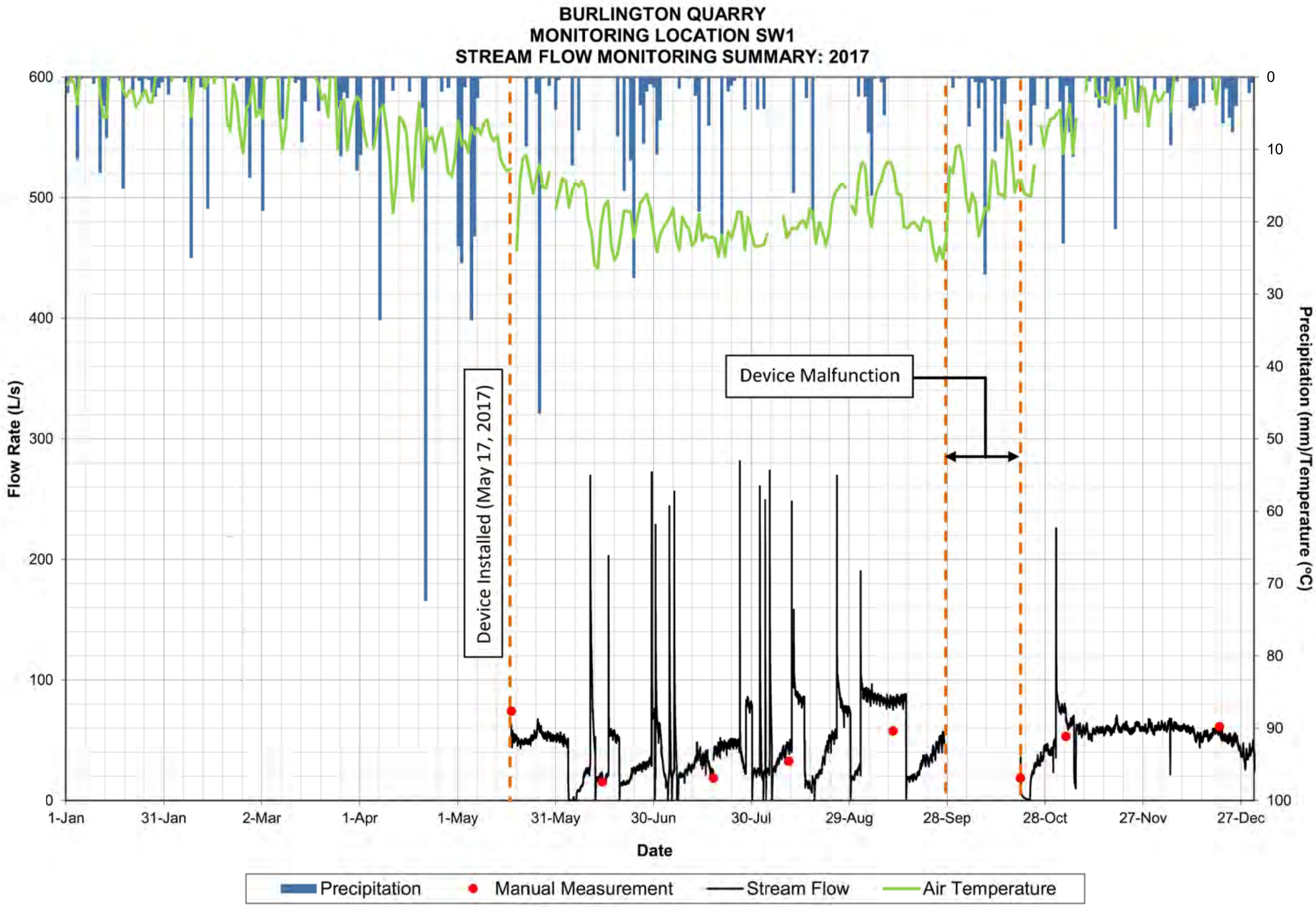
BURLINGTON QUARRY
MONITORING LOCATION SW1
STREAM FLOW MONITORING SUMMARY: 2015-2019



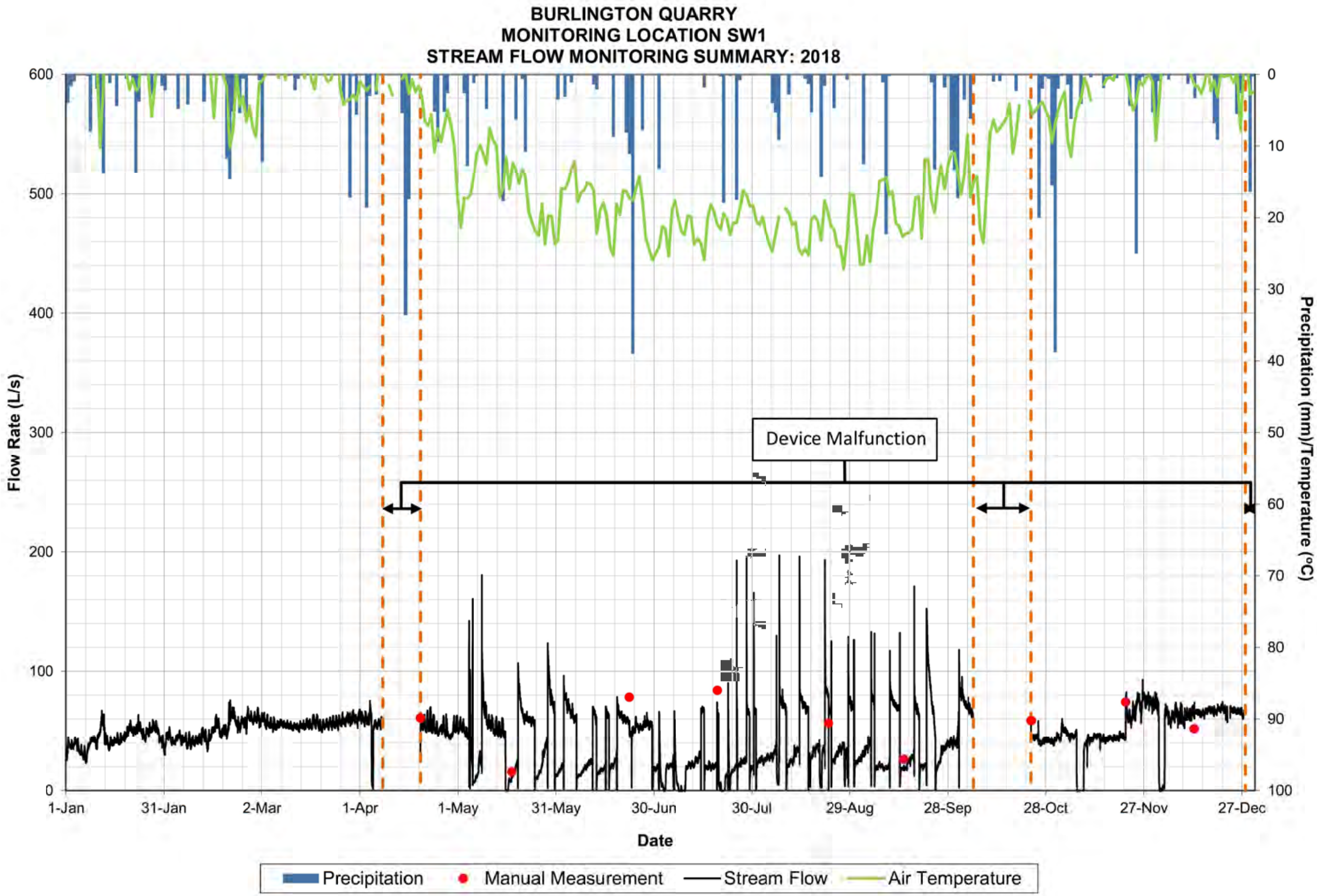

BURLINGTON QUARRY
MONITORING LOCATION SW1
STREAM FLOW MONITORING SUMMARY: 2015
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (July 17, 2015)
0
100
200
300
400
500
600
10
20
30
40
50
60
70
80
90
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Manual Measurement
Stream Flow
Air Temperature

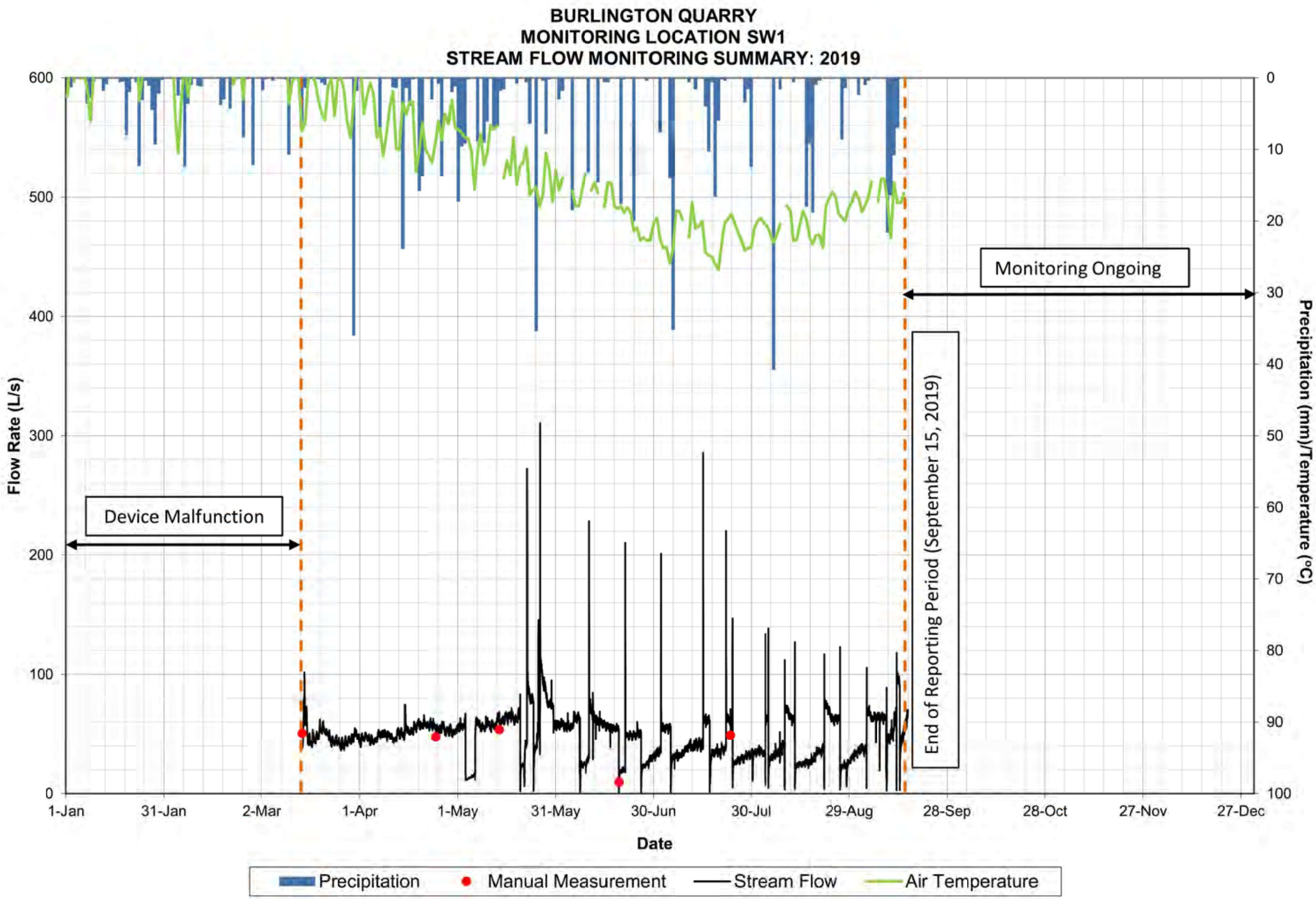


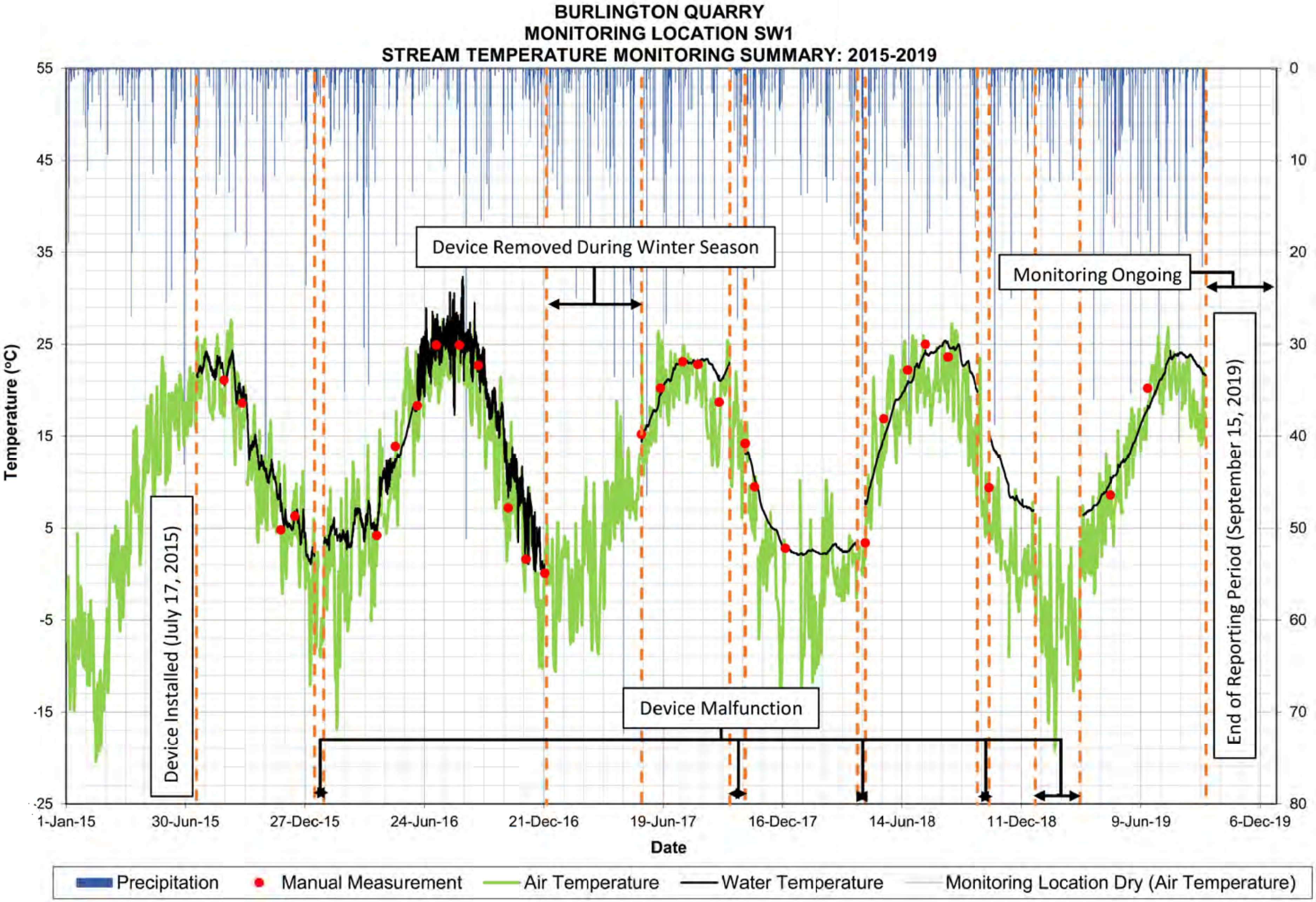
BURLINGTON QUARRY
MONITORING LOCATION SW1
STREAM FLOW MONITORING SUMMARY: 2016
Flow Rate (L/s)
600
500
400
300
200
100
0
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
Date
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Device Malfunction
Device Removed (December 22, 2016)
Precipitation
Manual Measurement
Stream Flow
Air Temperature



BURLINGTON QUARRY
MONITORING LOCATION SW1
STREAM FLOW MONITORING SUMMARY: 2017
Flow Rate (L/s)
600
500
400
300
200
100
0
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
Device Installed (May 17, 2017)
Device Malfunction
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Manual Measurement
Stream Flow
Air Temperature

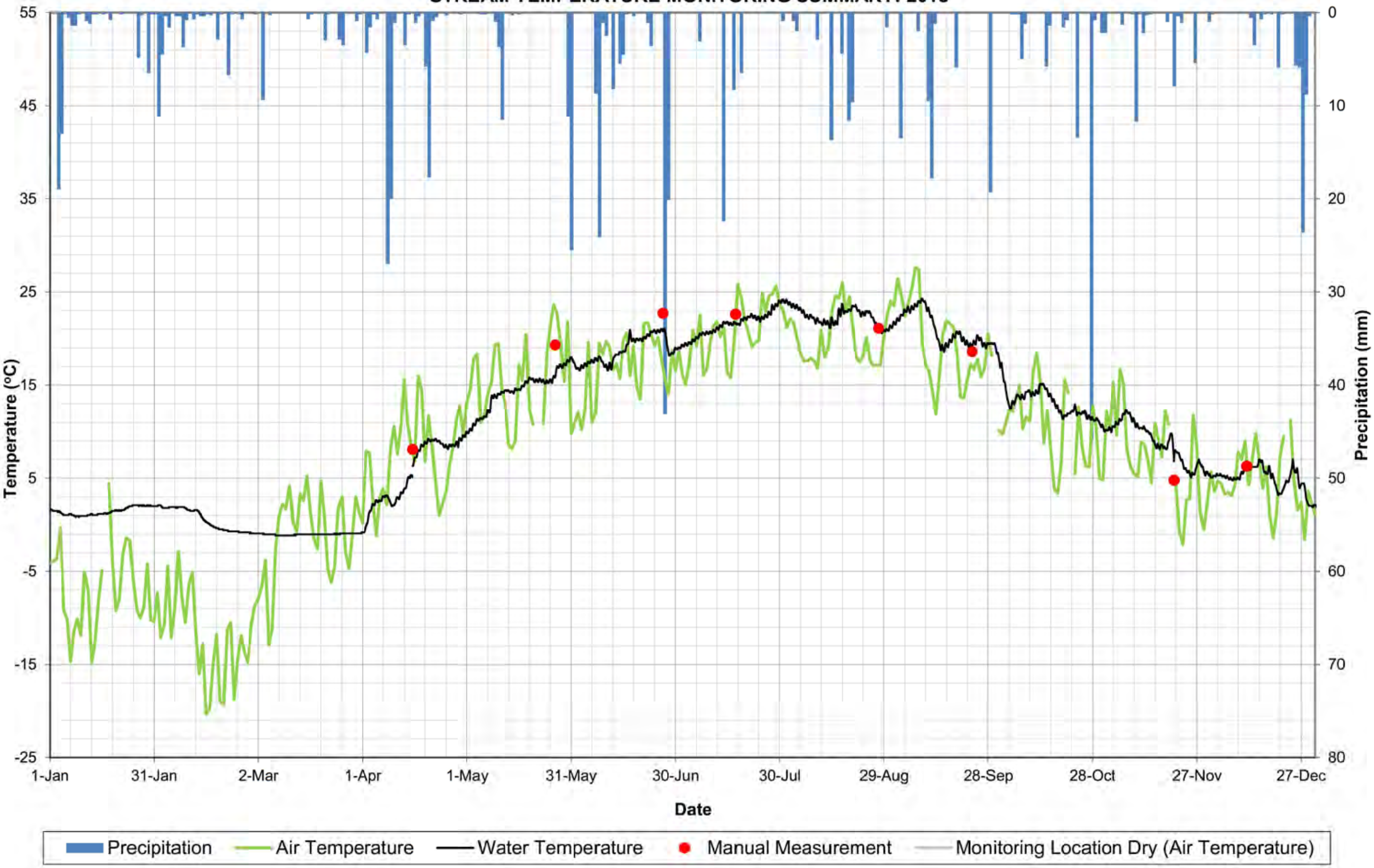

BURLINGTON QUARRY
MONITORING LOCATION SW1
STREAM FLOW MONITORING SUMMARY: 2018
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Malfunction
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Manual Measurement
Stream Flow
Air Temperature

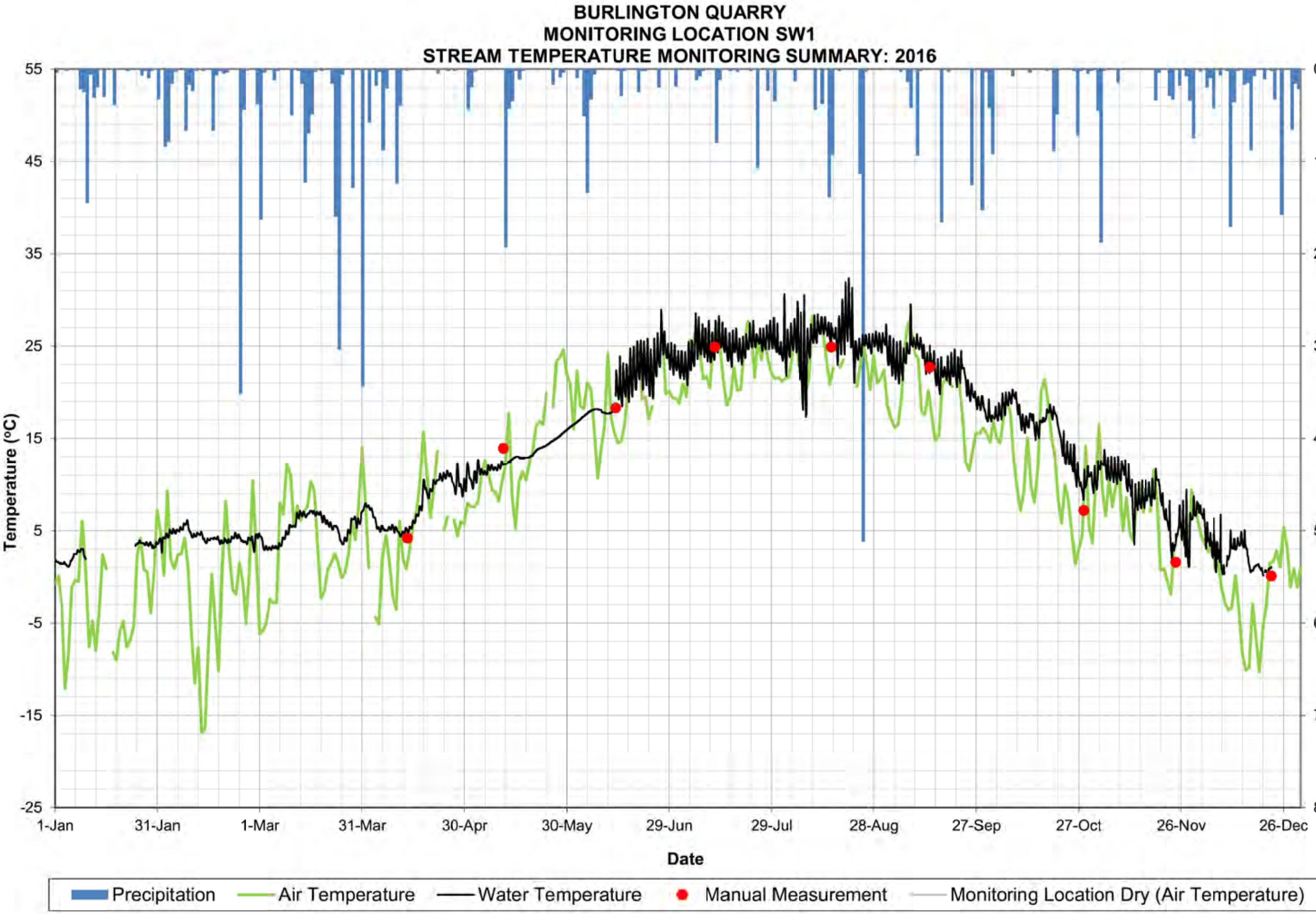

BURLINGTON QUARRY
MONITORING LOCATION SW1
STREAM FLOW MONITORING SUMMARY: 2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
600
500
400
300
200
100
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Malfunction
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Stream Flow
Air Temperature



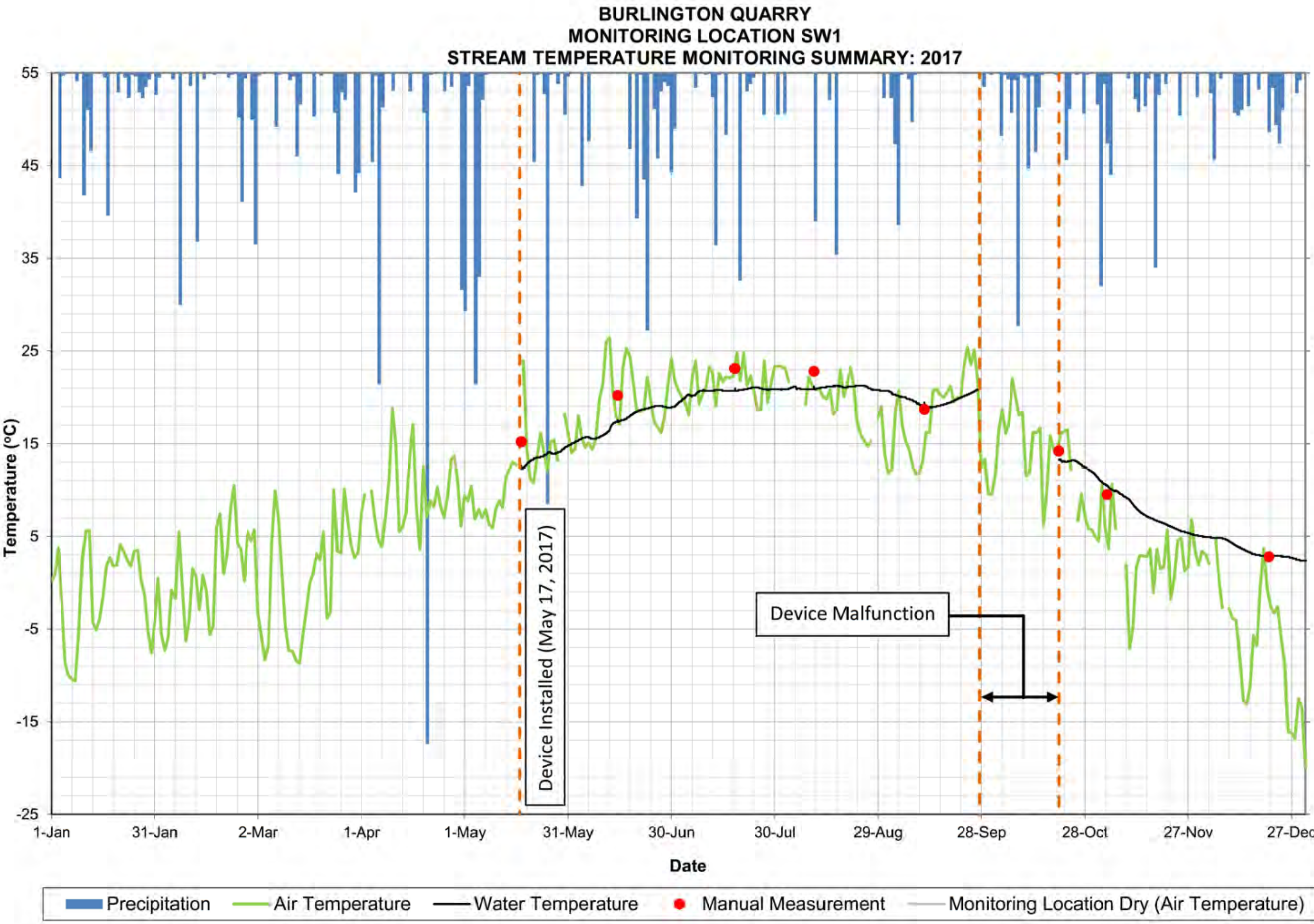
BURLINGTON QUARRY
MONITORING LOCATION SW1
STREAM TEMPERATURE MONITORING SUMMARY: 2015-2019
Temperature (°C)
Precipitation (mm)
Date
Device Removed During Winter Season
Monitoring Ongoing
Device Installed (July 17, 2015)
Device Malfunction
End of Reporting Period (September 15, 2019)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan-15
30-Jun-15
27-Dec-15
24-Jun-16
21-Dec-16
19-Jun-17
16-Dec-17
14-Jun-18
11-Dec-18
9-Jun-19
6-Dec-19
Precipitation
Manual Measurement
Air Temperature
Water Temperature
Monitoring Location Dry (Air Temperature)

BURLINGTON QUARRY
MONITORING LOCATION SW1
STREAM TEMPERATURE MONITORING SUMMARY: 2015



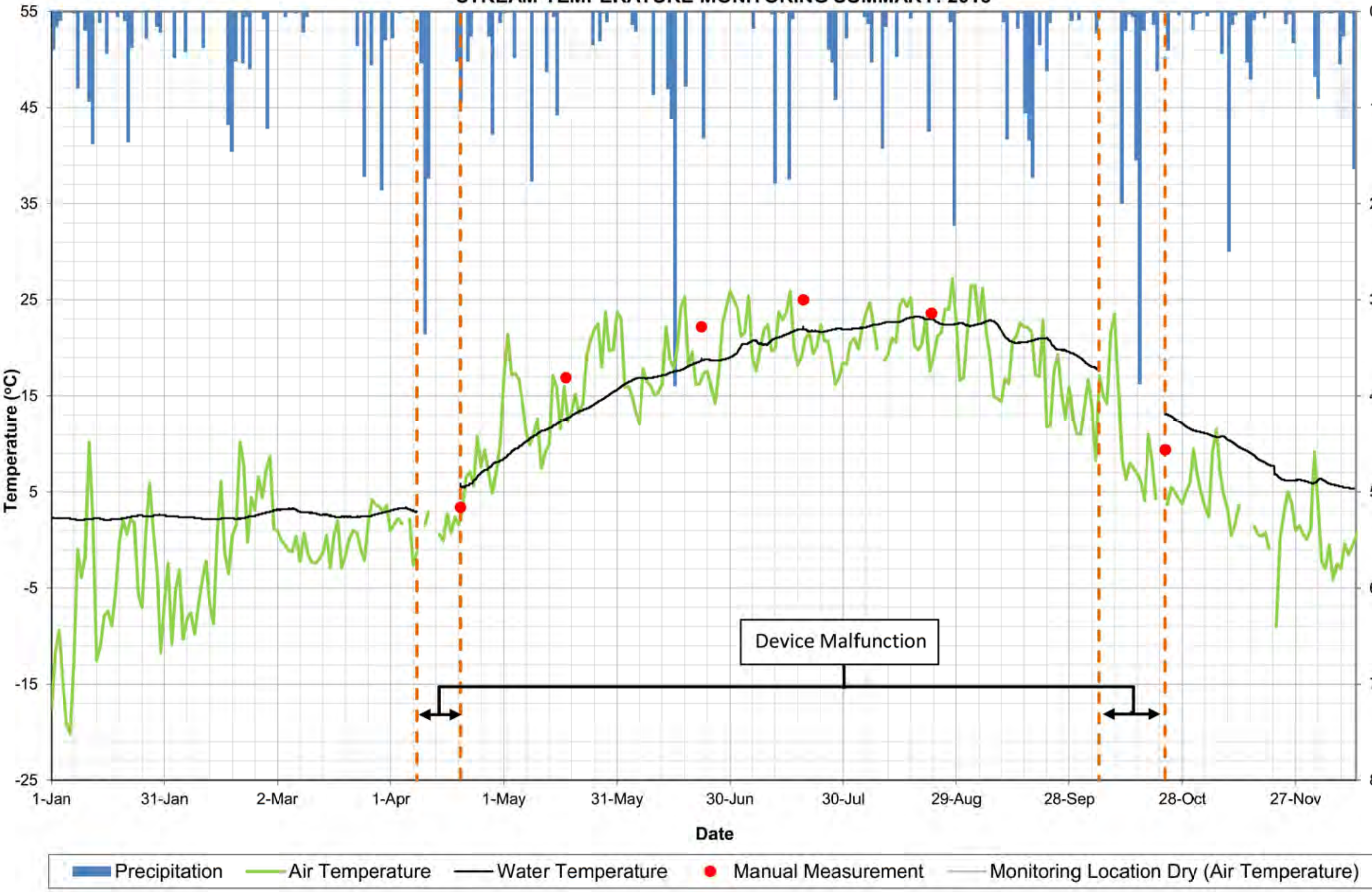


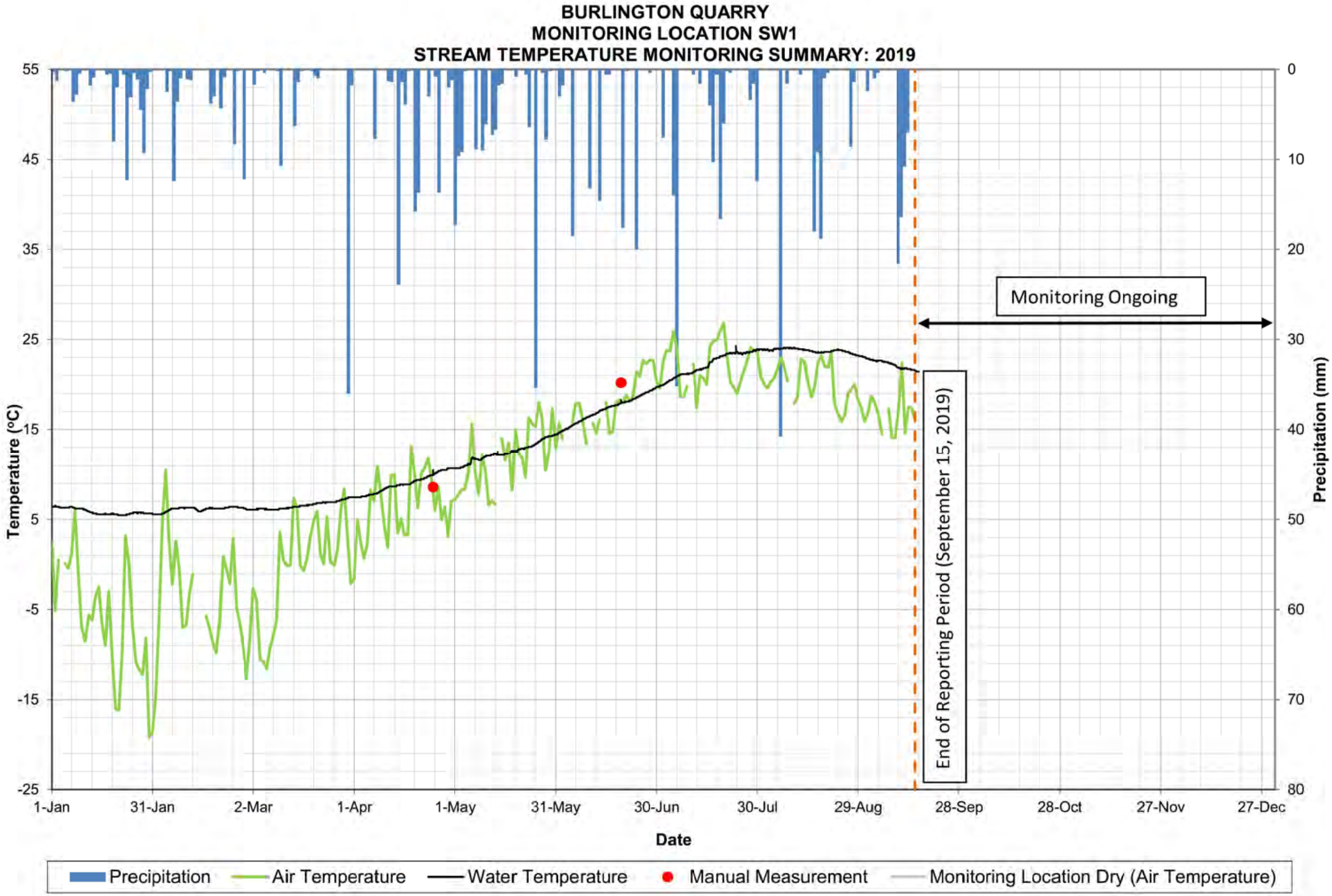
BURLINGTON QUARRY
MONITORING LOCATION SW1
STREAM TEMPERATURE MONITORING SUMMARY: 2016
Temperature (ºC)
Precipitation (mm)
Date
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

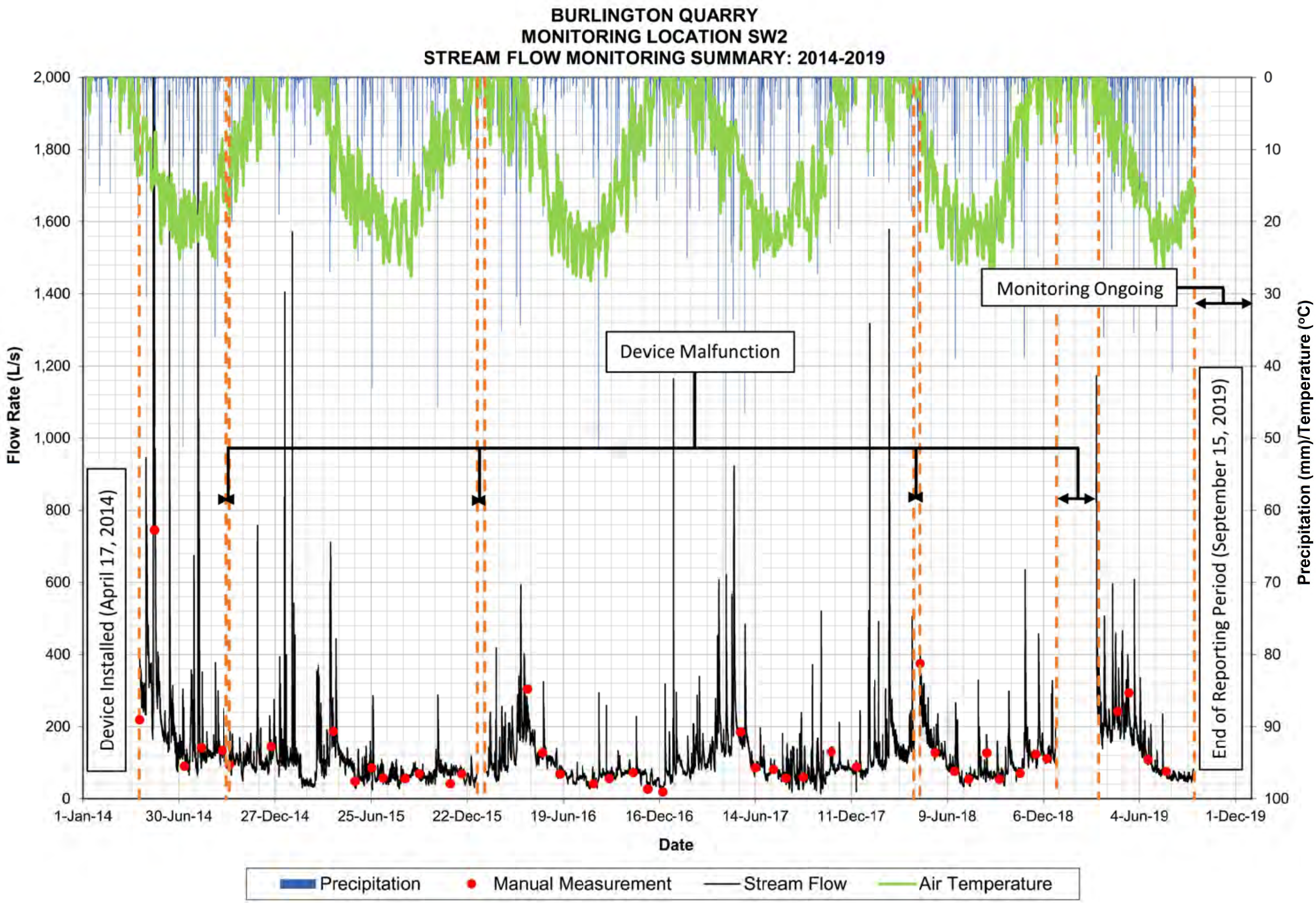


BURLINGTON QUARRY
MONITORING LOCATION SW1
STREAM TEMPERATURE MONITORING SUMMARY: 2017
Temperature (°C)
Precipitation (mm)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Device Installed (May 17, 2017)
Device Malfunction
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

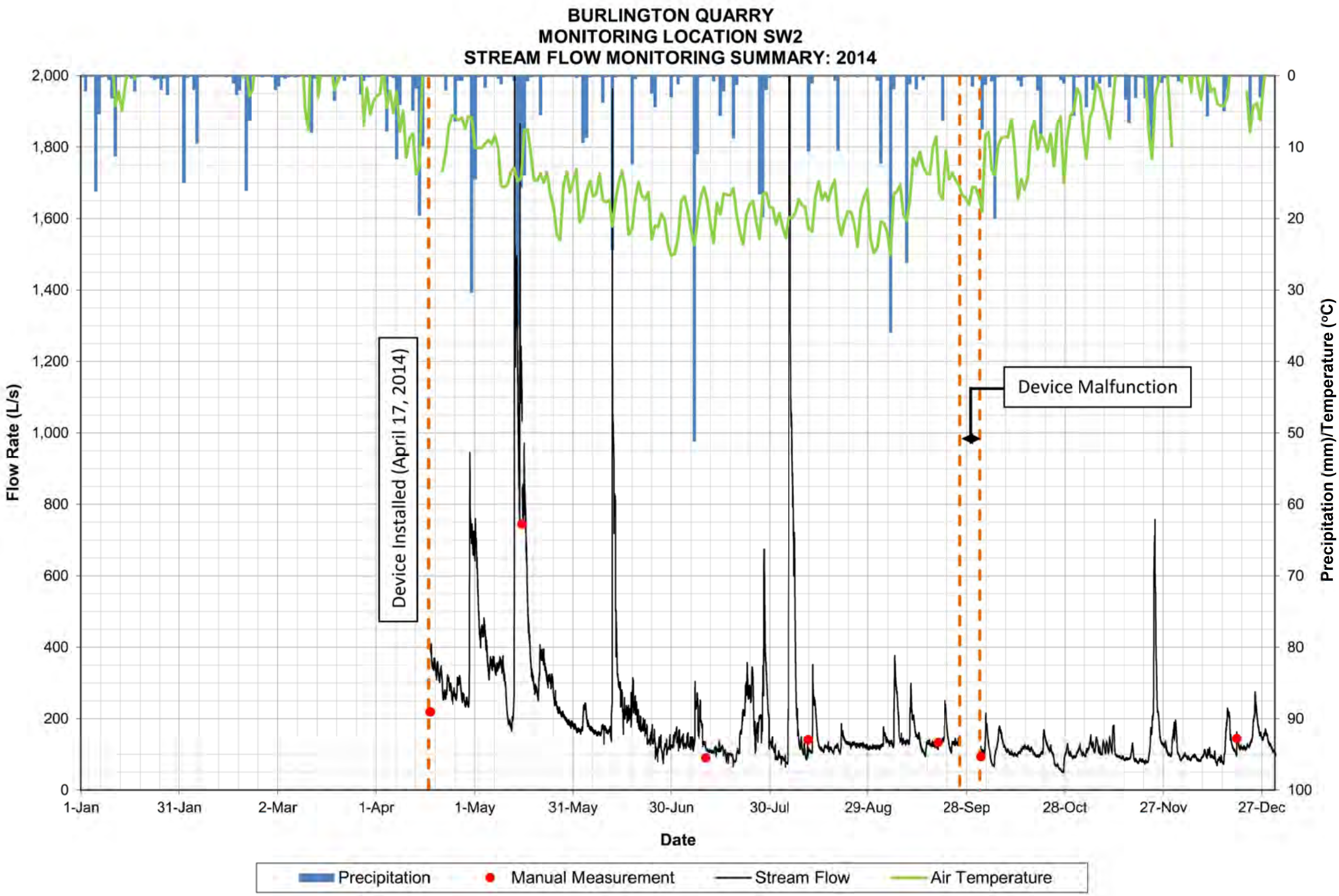
BURLINGTON QUARRY
MONITORING LOCATION SW1
STREAM TEMPERATURE MONITORING SUMMARY: 2018



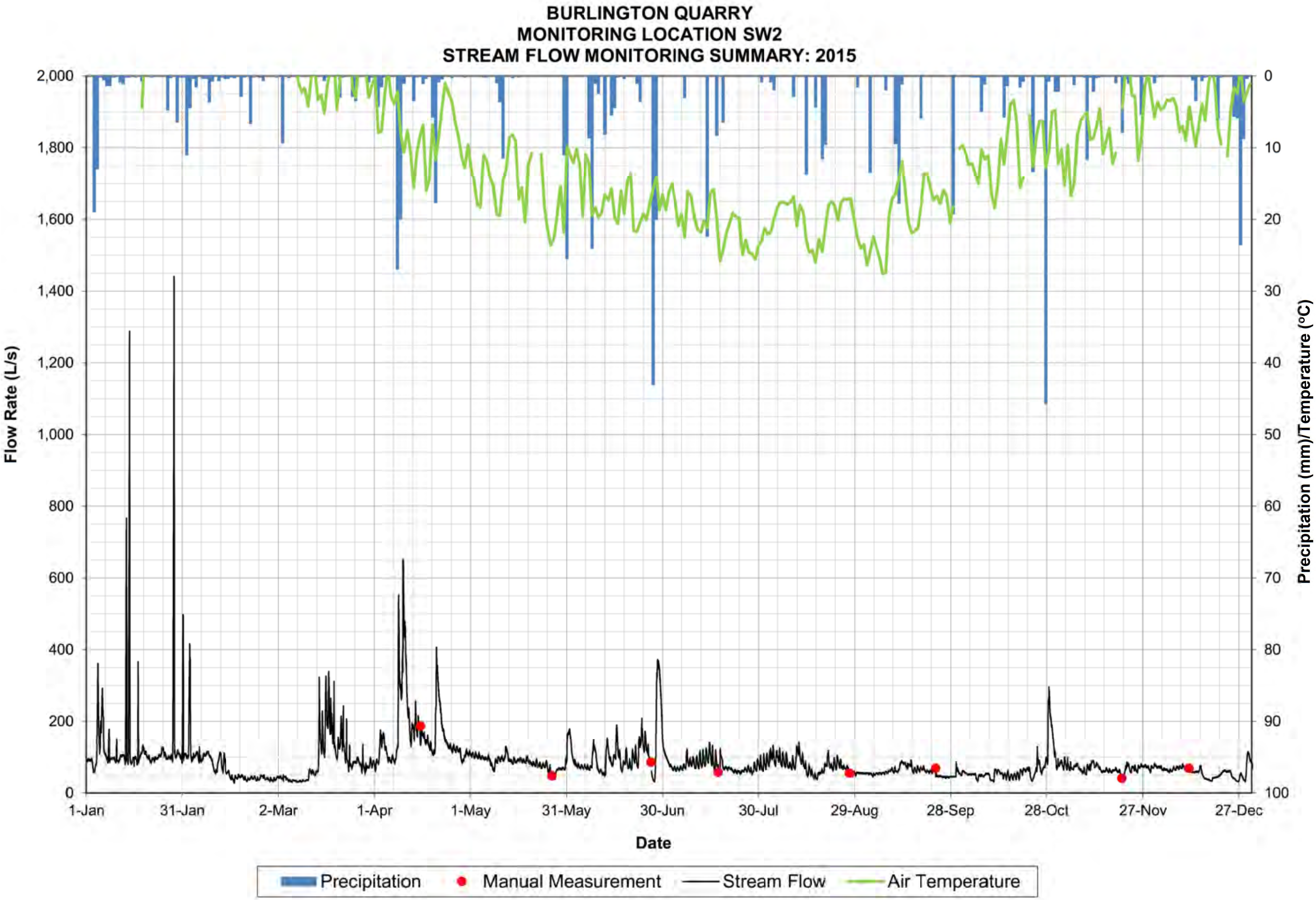

BURLINGTON QUARRY
MONITORING LOCATION SW1
STREAM TEMPERATURE MONITORING SUMMARY: 2019
Temperature (°C)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

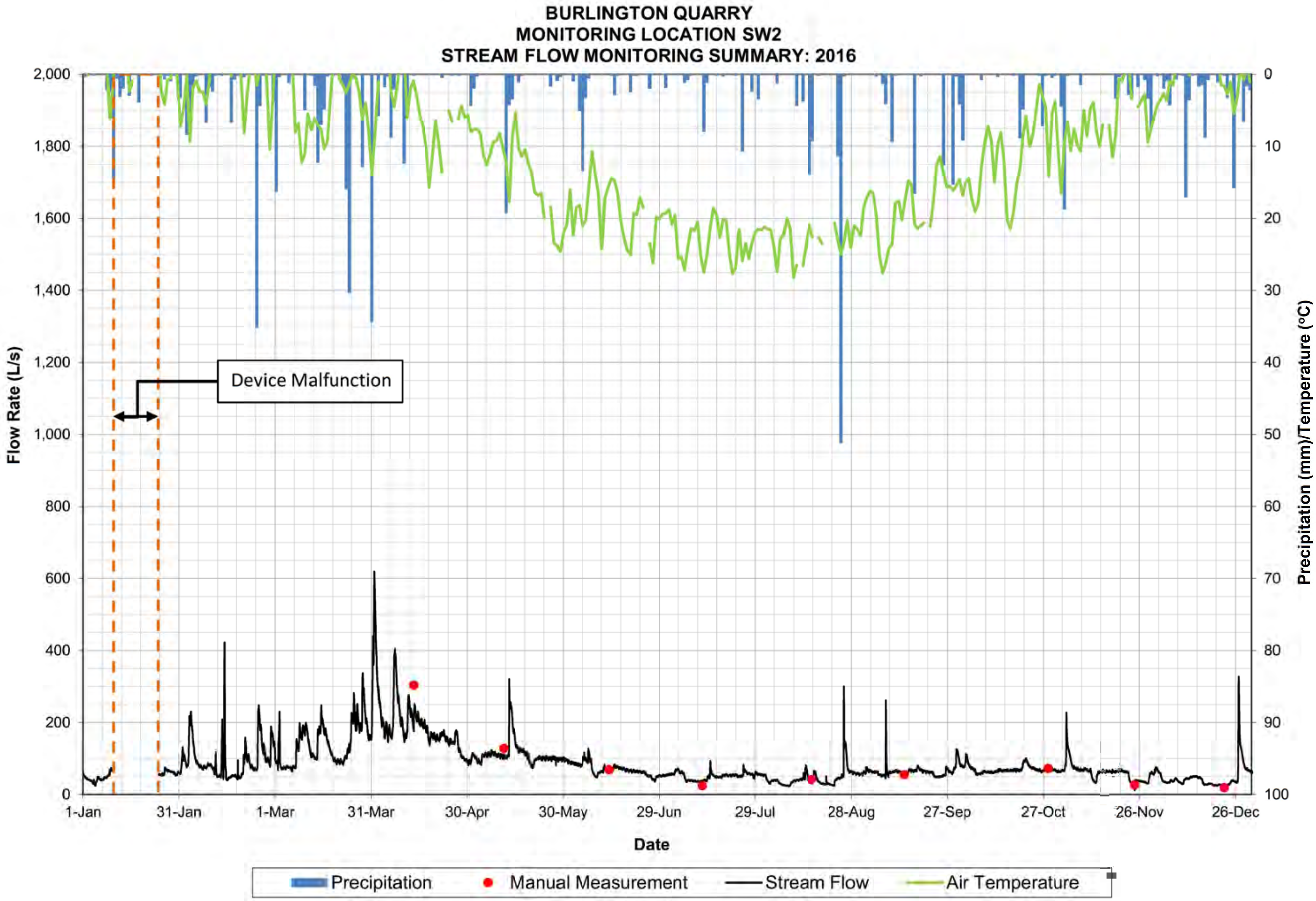


BURLINGTON QUARRY
MONITORING LOCATION SW2
STREAM FLOW MONITORING SUMMARY: 2014-2019
Flow Rate (L/s)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
Device Installed (April 17, 2014)
Device Malfunction
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
1-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
9-Jun-18
6-Dec-18
4-Jun-19
1-Dec-19
Date
Precipitation
Manual Measurement
Stream Flow
Air Temperature



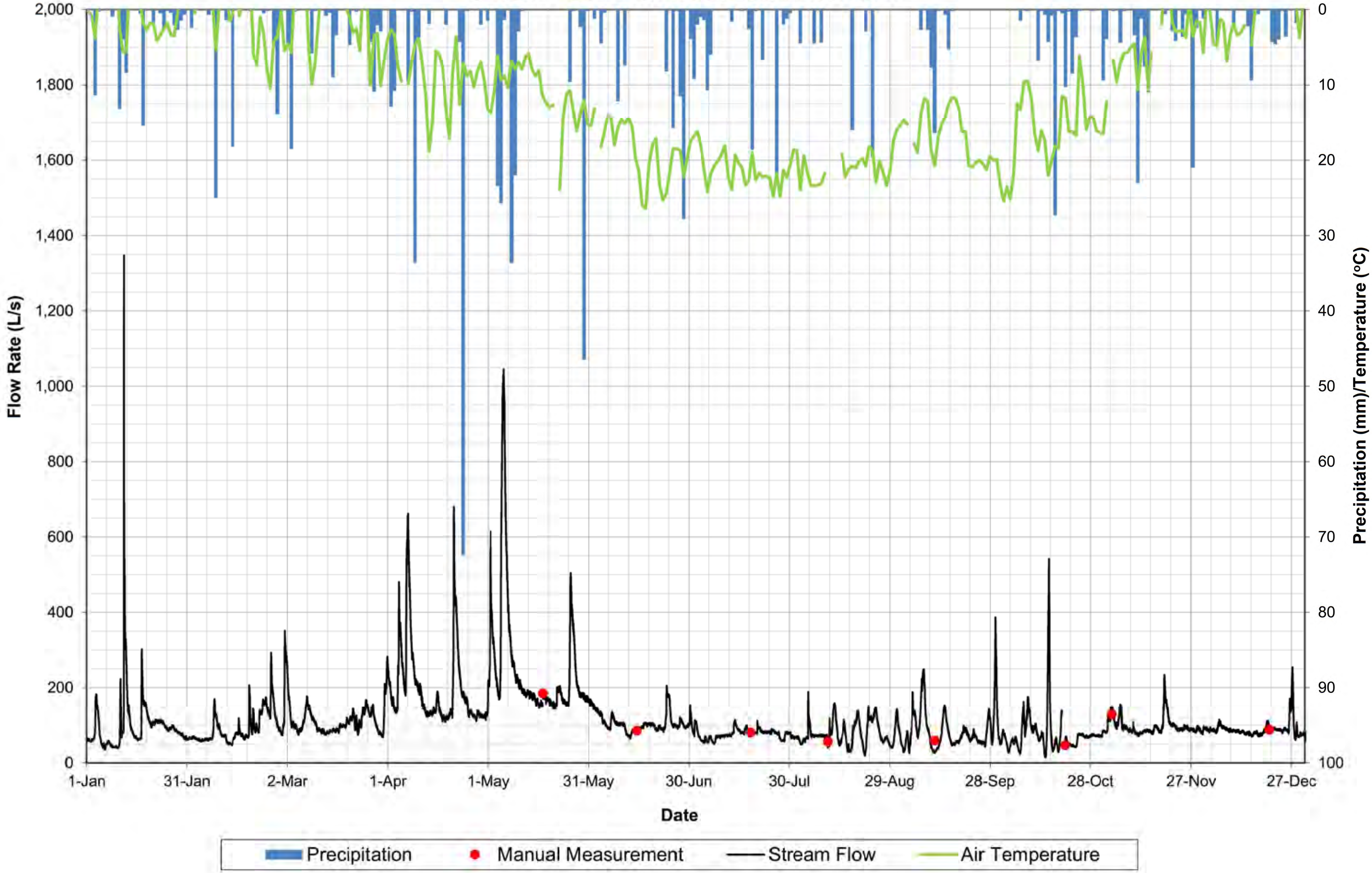
BURLINGTON QUARRY
MONITORING LOCATION SW2
STREAM FLOW MONITORING SUMMARY: 2014
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (April 17, 2014)
Device Malfunction
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Manual Measurement
Stream Flow
Air Temperature

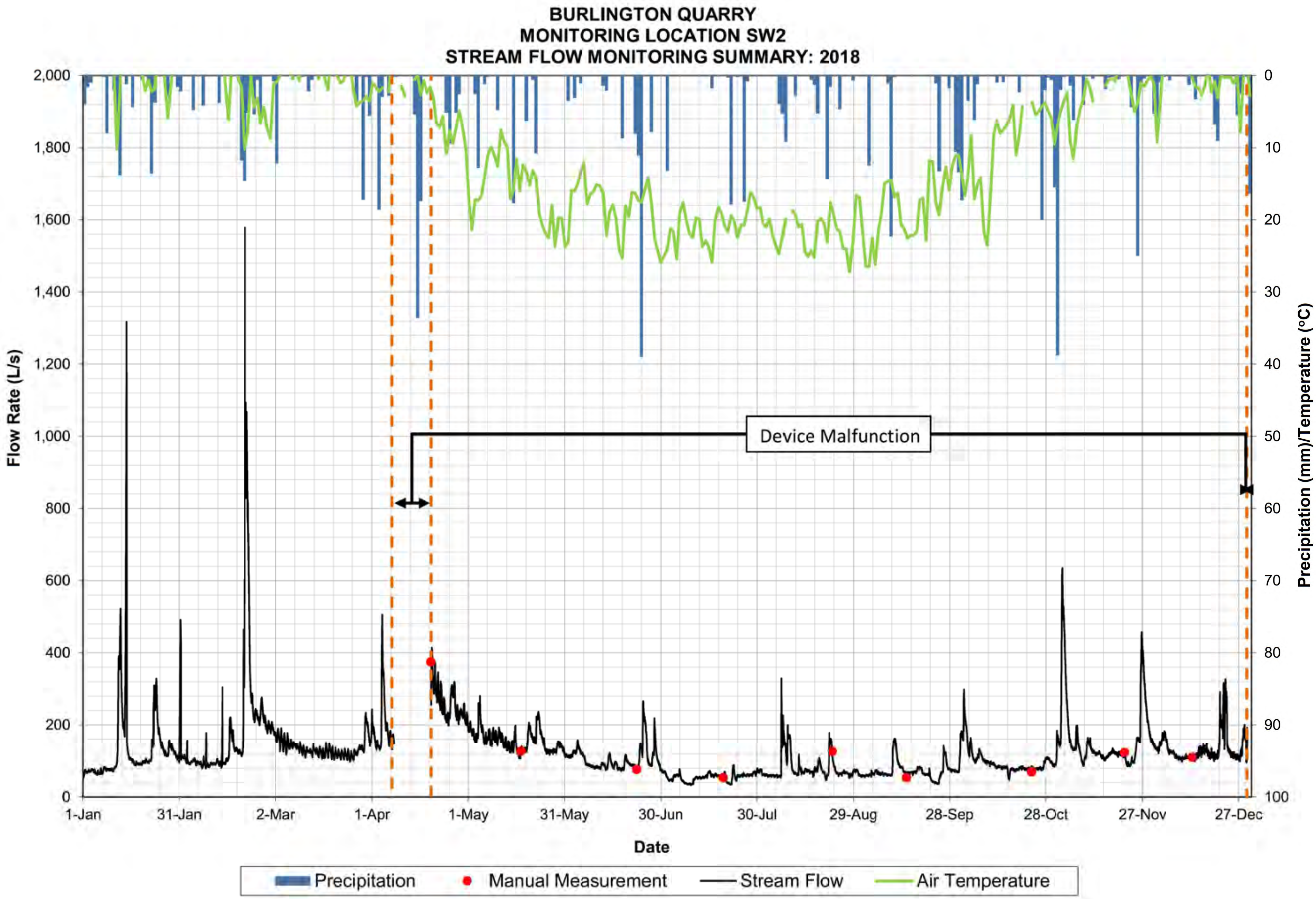

BURLINGTON QUARRY
MONITORING LOCATION SW2
STREAM FLOW MONITORING SUMMARY: 2015
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
0
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Manual Measurement
Stream Flow
Air Temperature



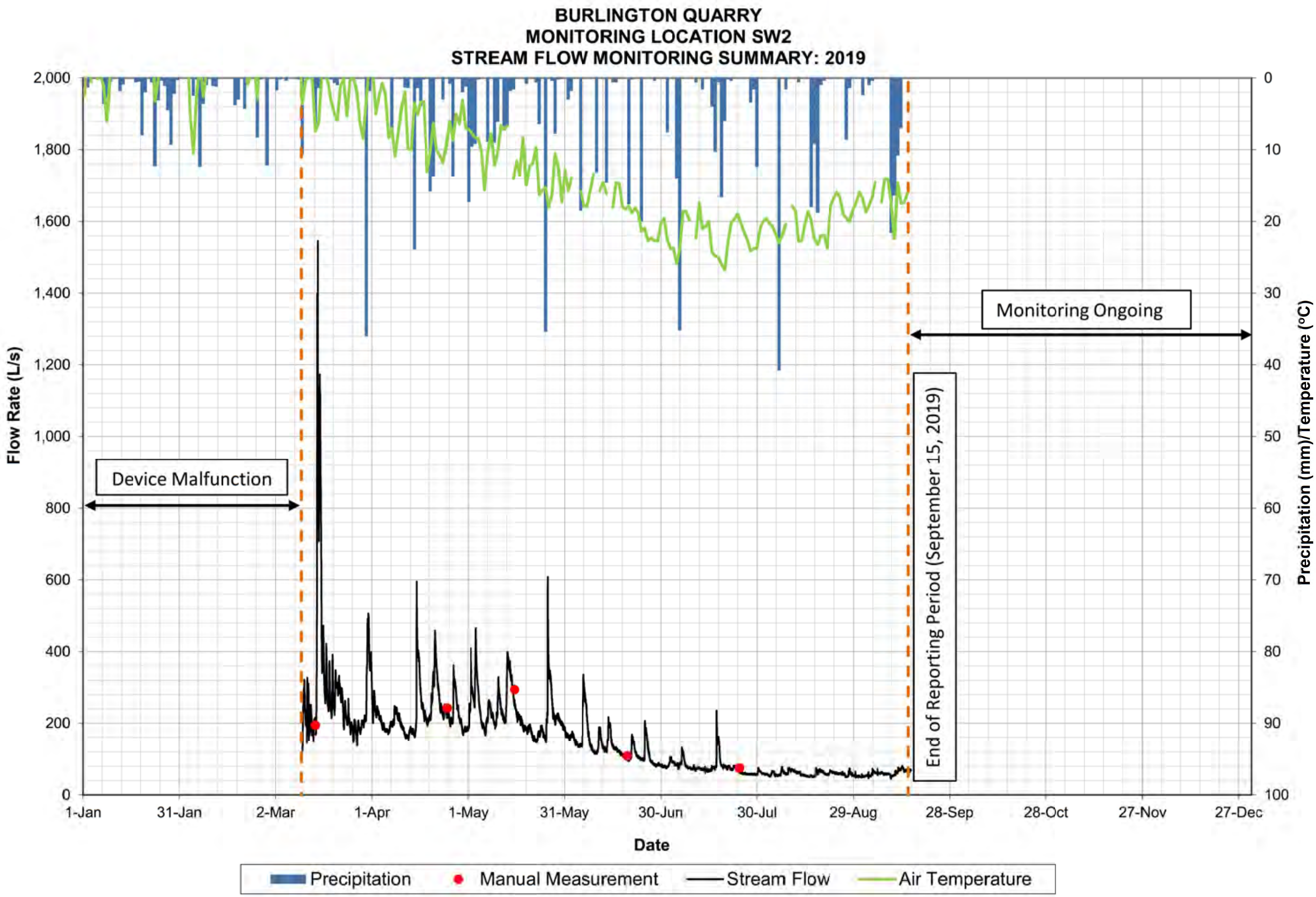
BURLINGTON QUARRY
MONITORING LOCATION SW2
STREAM FLOW MONITORING SUMMARY: 2016
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Device Malfunction
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Manual Measurement
Stream Flow
Air Temperature

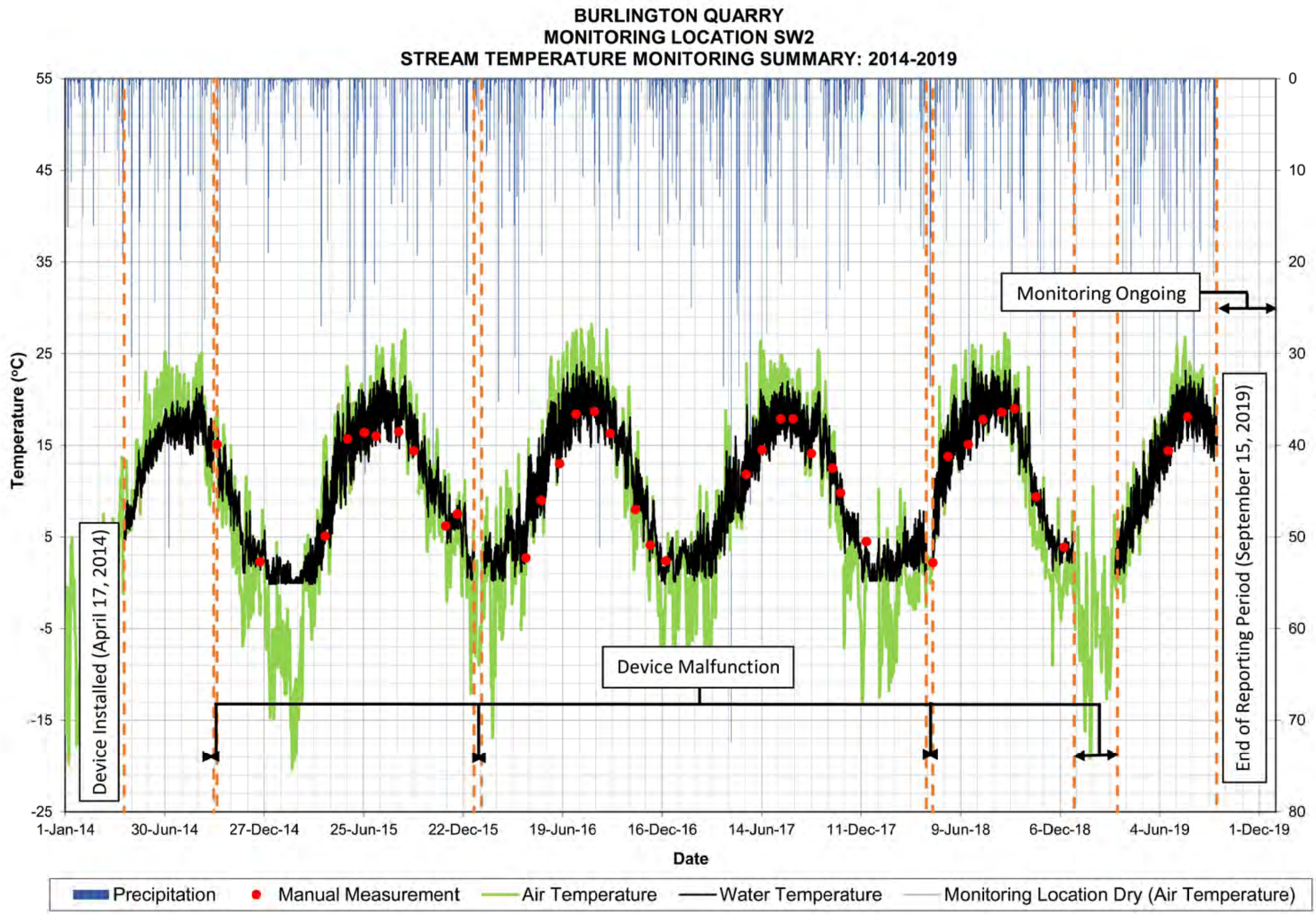
BURLINGTON QUARRY
MONITORING LOCATION SW2
STREAM FLOW MONITORING SUMMARY: 2017



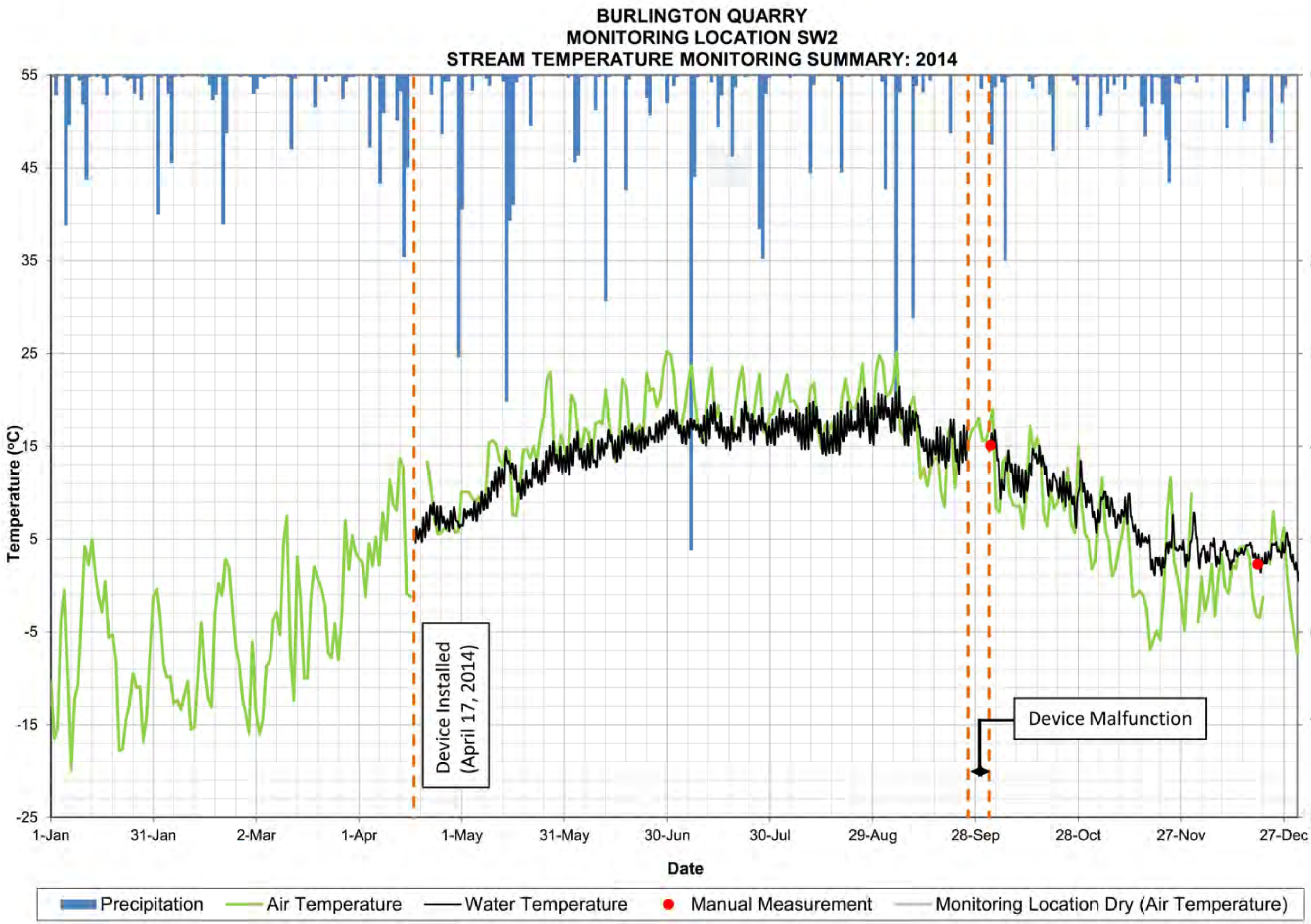


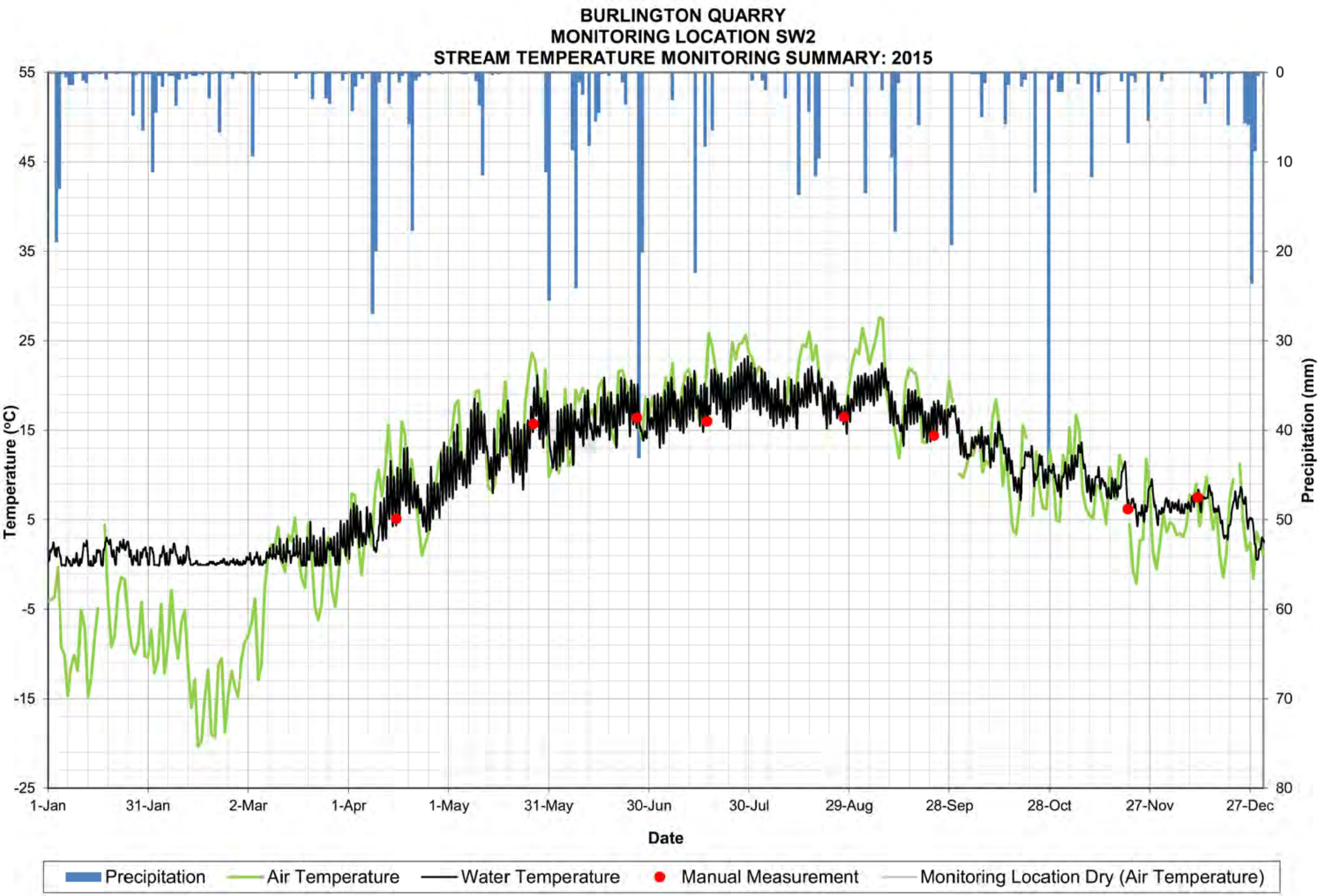
BURLINGTON QUARRY
MONITORING LOCATION SW2
STREAM FLOW MONITORING SUMMARY: 2018
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Device Malfunction
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Manual Measurement
Stream Flow
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW2
STREAM FLOW MONITORING SUMMARY: 2019
Flow Rate (L/s)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
Device Malfunction
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Manual Measurement
Stream Flow
Air Temperature

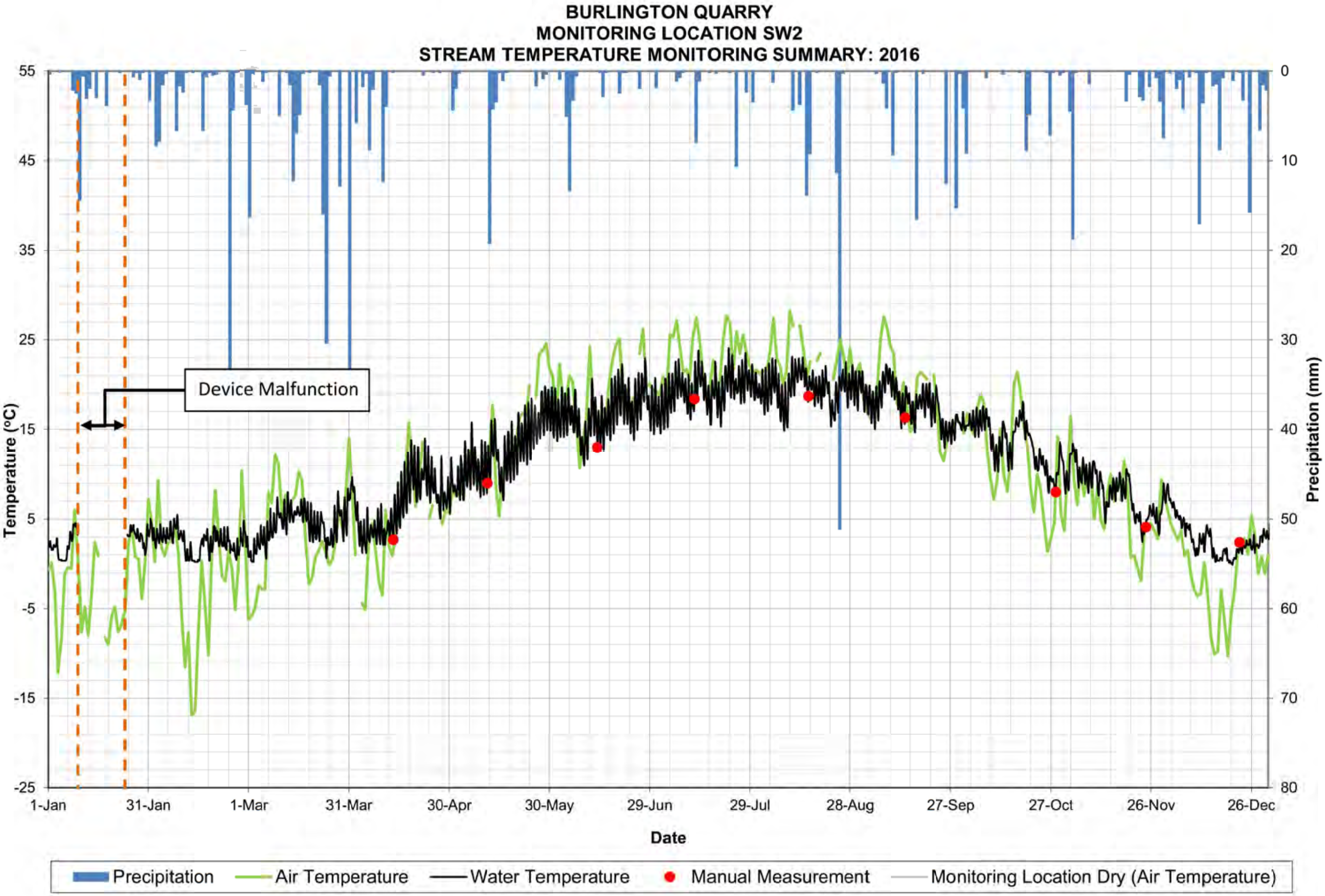


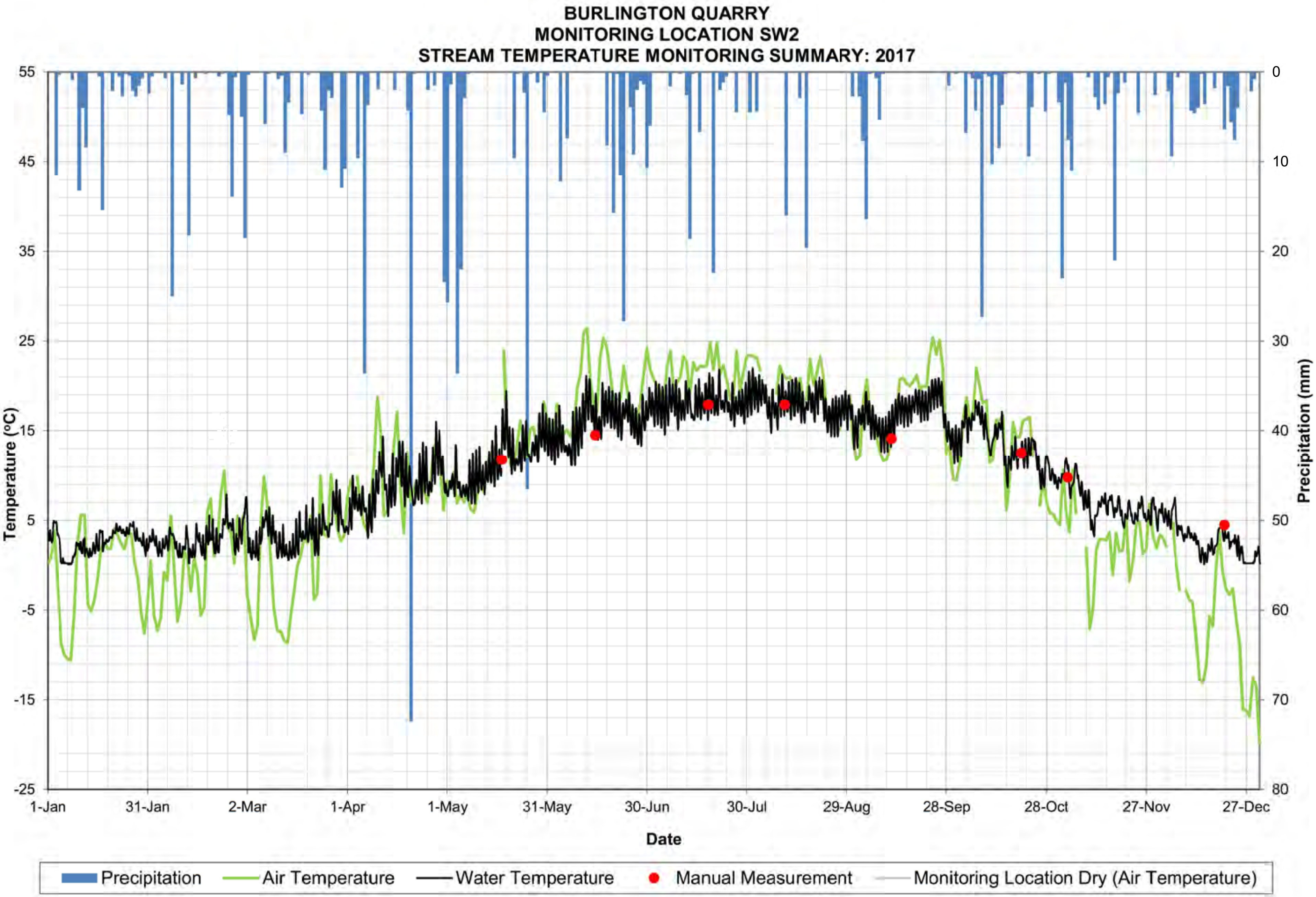
BURLINGTON QUARRY
MONITORING LOCATION SW2
STREAM TEMPERATURE MONITORING SUMMARY: 2014-2019
Temperature (°C)
Precipitation (mm)
Date
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
9-Jun-18
6-Dec-18
4-Jun-19
1-Dec-19
Monitoring Ongoing
Device Installed (April 17, 2014)
Device Malfunction
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Air Temperature
Water Temperature
Monitoring Location Dry (Air Temperature)

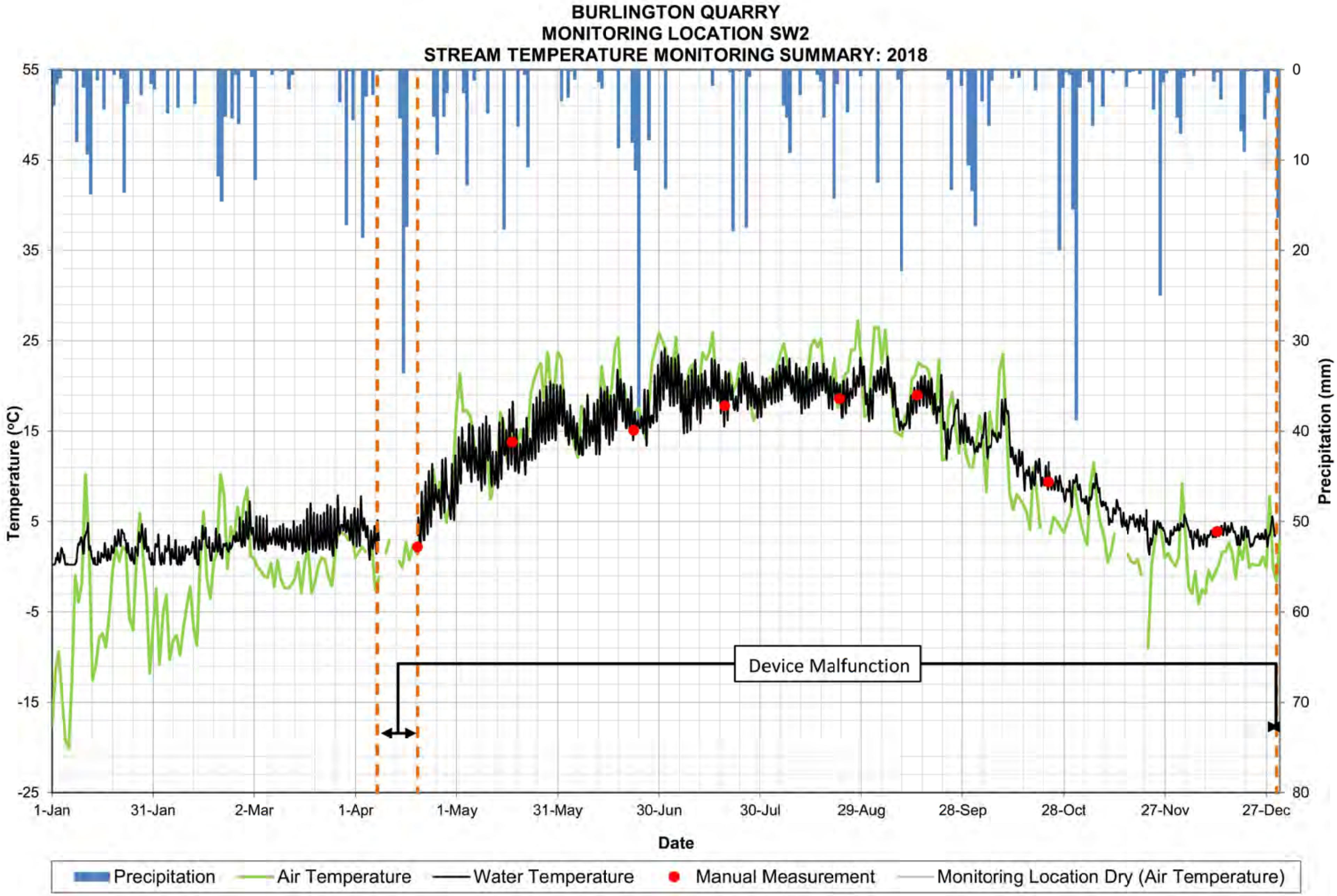

BURLINGTON QUARRY
MONITORING LOCATION SW2
STREAM TEMPERATURE MONITORING SUMMARY: 2014
Temperature (°C)
Precipitation (mm)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Device Installed
(April 17, 2014)
Device Malfunction
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

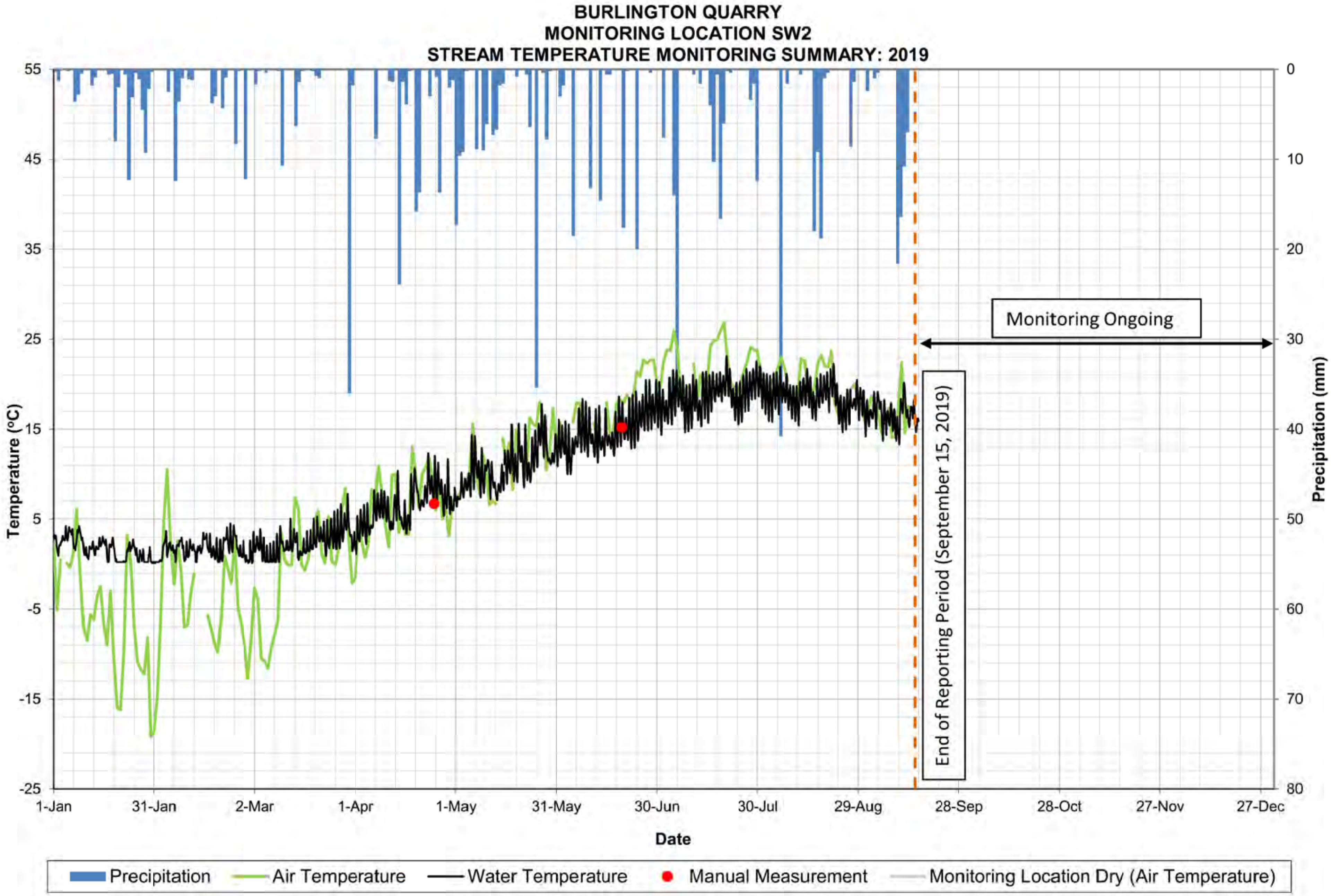


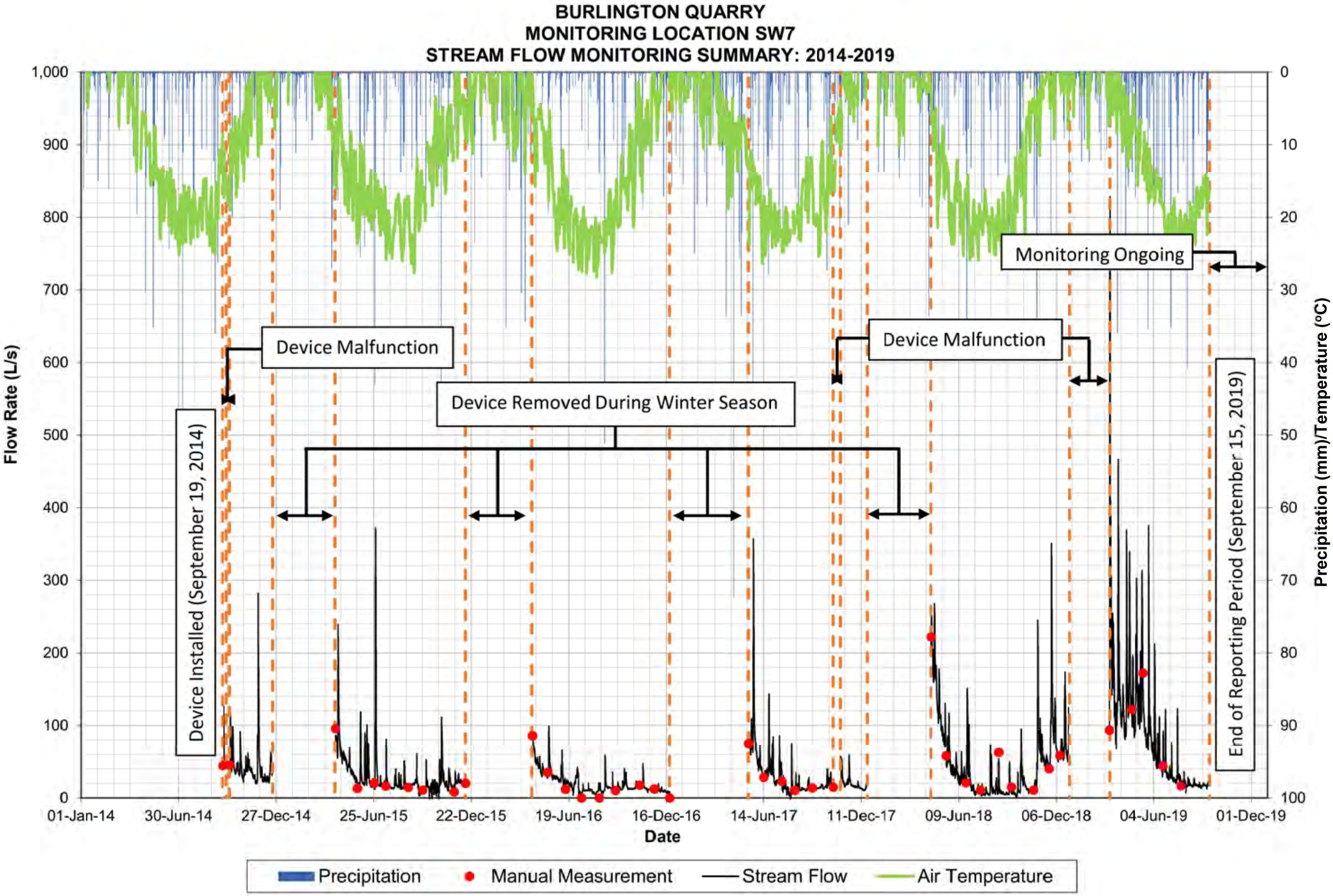
BURLINGTON QUARRY
MONITORING LOCATION SW2
STREAM TEMPERATURE MONITORING SUMMARY: 2015
Temperature (ºC)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

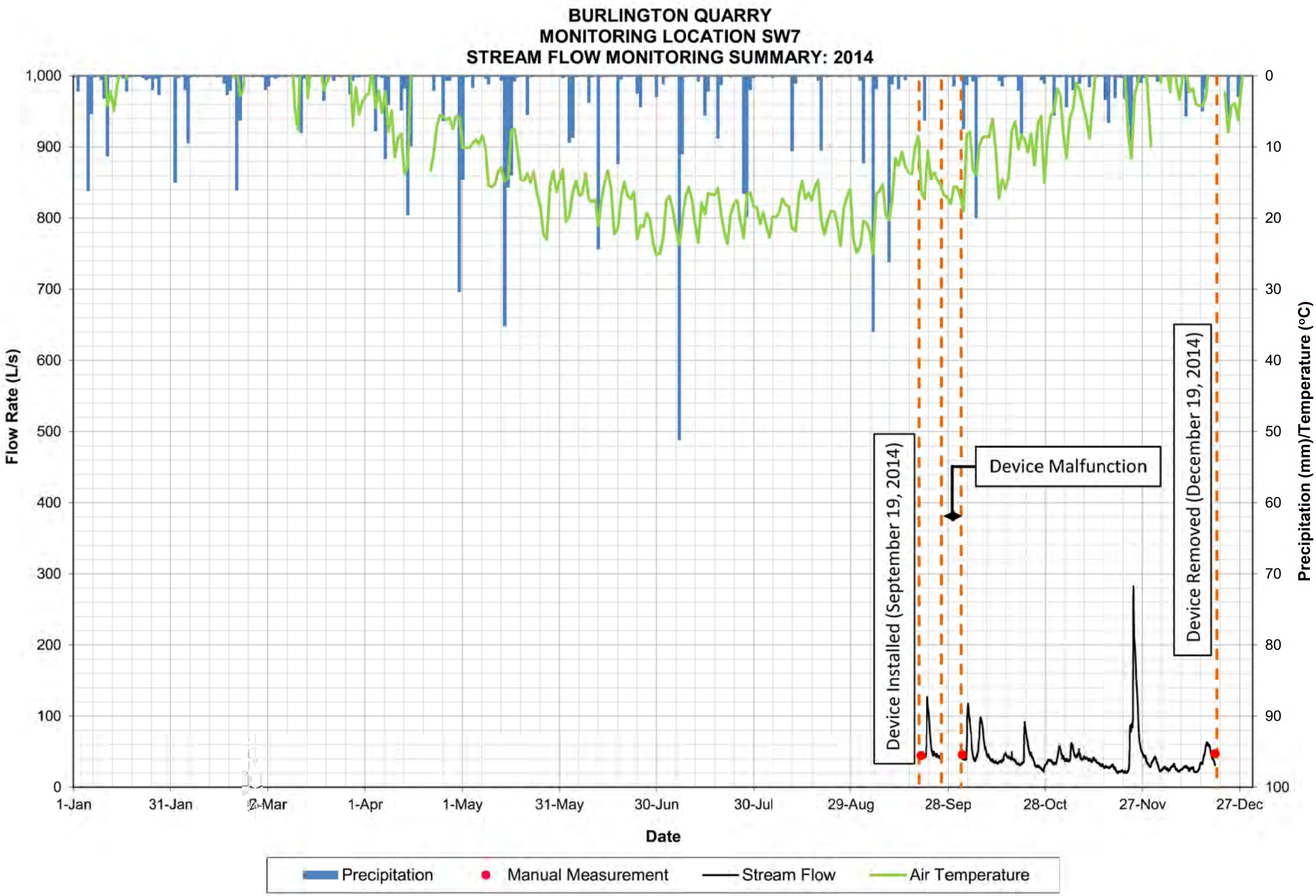

BURLINGTON QUARRY
MONITORING LOCATION SW2
STREAM TEMPERATURE MONITORING SUMMARY: 2016
Device Malfunction
Temperature (°C)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)


BURLINGTON QUARRY
MONITORING LOCATION SW2
STREAM TEMPERATURE MONITORING SUMMARY: 2017
Temperature (°C)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

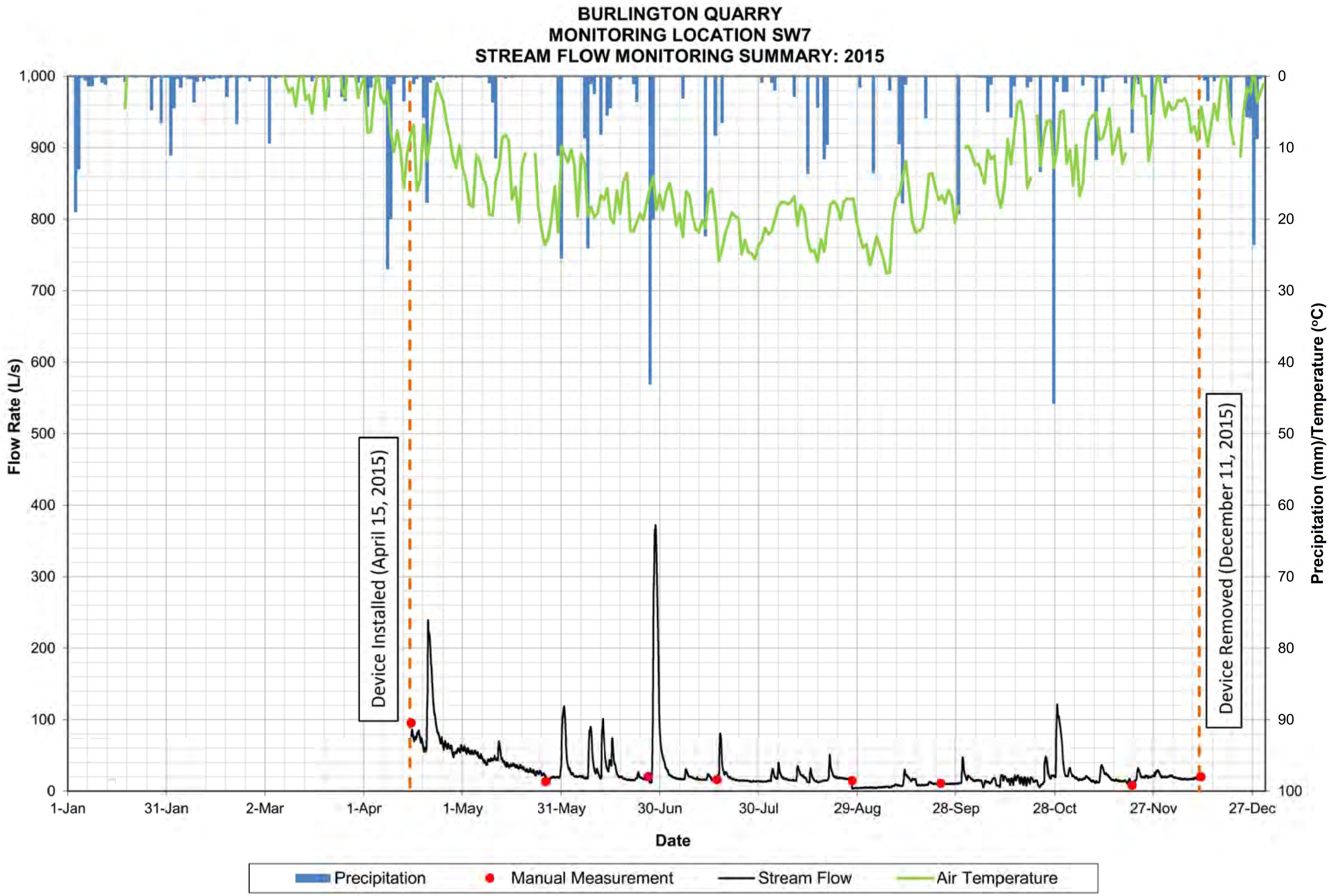

BURLINGTON QUARRY
MONITORING LOCATION SW2
STREAM TEMPERATURE MONITORING SUMMARY: 2018
Temperature (ºC)
Precipitation (mm)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Device Malfunction
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)


BURLINGTON QUARRY
MONITORING LOCATION SW2
STREAM TEMPERATURE MONITORING SUMMARY: 2019
Temperature (°C)
Precipitation (mm)
Date
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

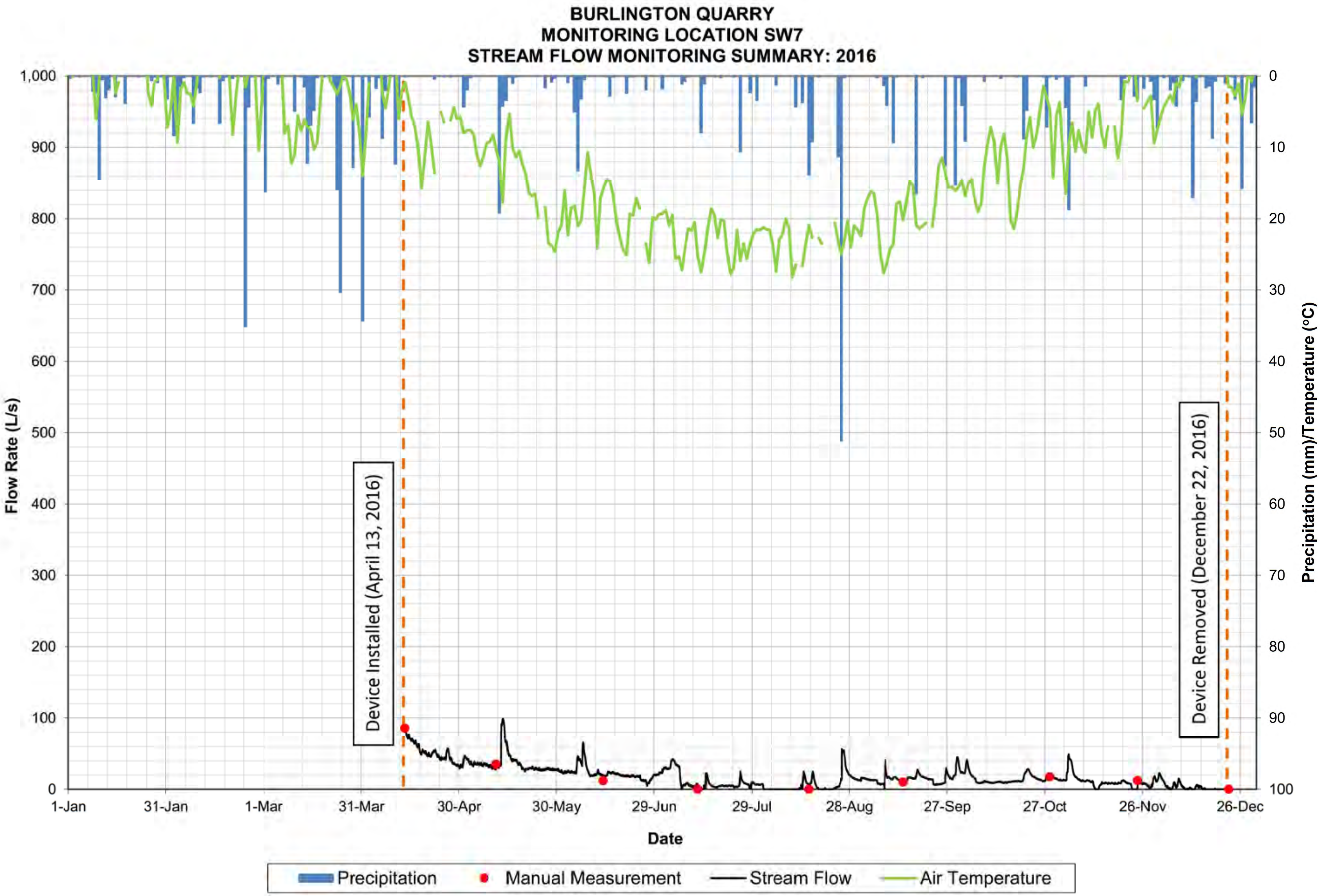

BURLINGTON QUARRY
MONITORING LOCATION SW7
STREAM FLOW MONITORING SUMMARY: 2014-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Malfunction
Device Removed During Winter Season
Device Installed (September 19, 2014)
Device Malfunction
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
01-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
09-Jun-18
06-Dec-18
04-Jun-19
01-Dec-19
Precipitation
Manual Measurement
Stream Flow
Air Temperature

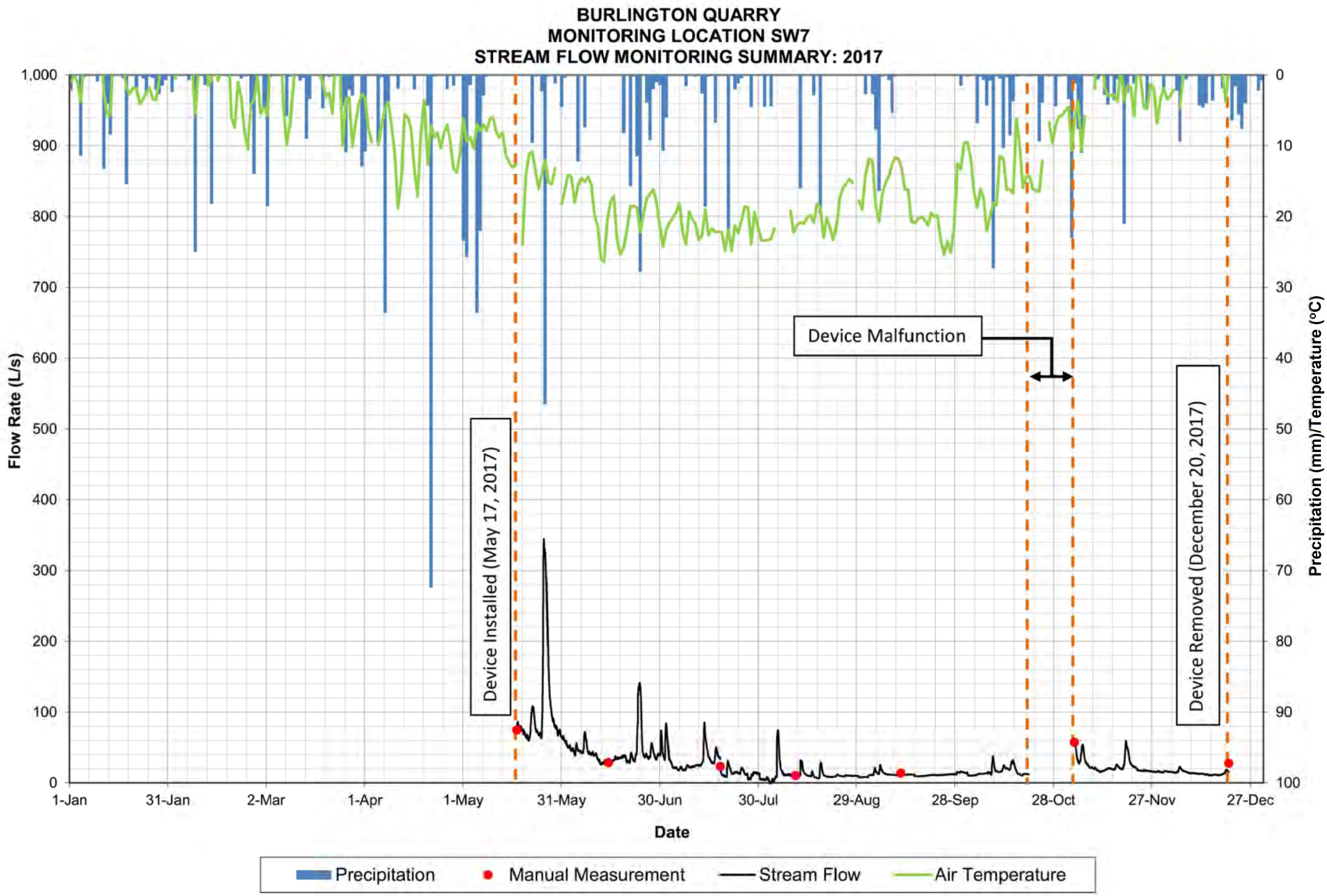


BURLINGTON QUARRY
MONITORING LOCATION SW7
STREAM FLOW MONITORING SUMMARY: 2014
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (September 19, 2014)
Device Malfunction
Device Removed (December 19, 2014)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Manual Measurement
Stream Flow
Air Temperature

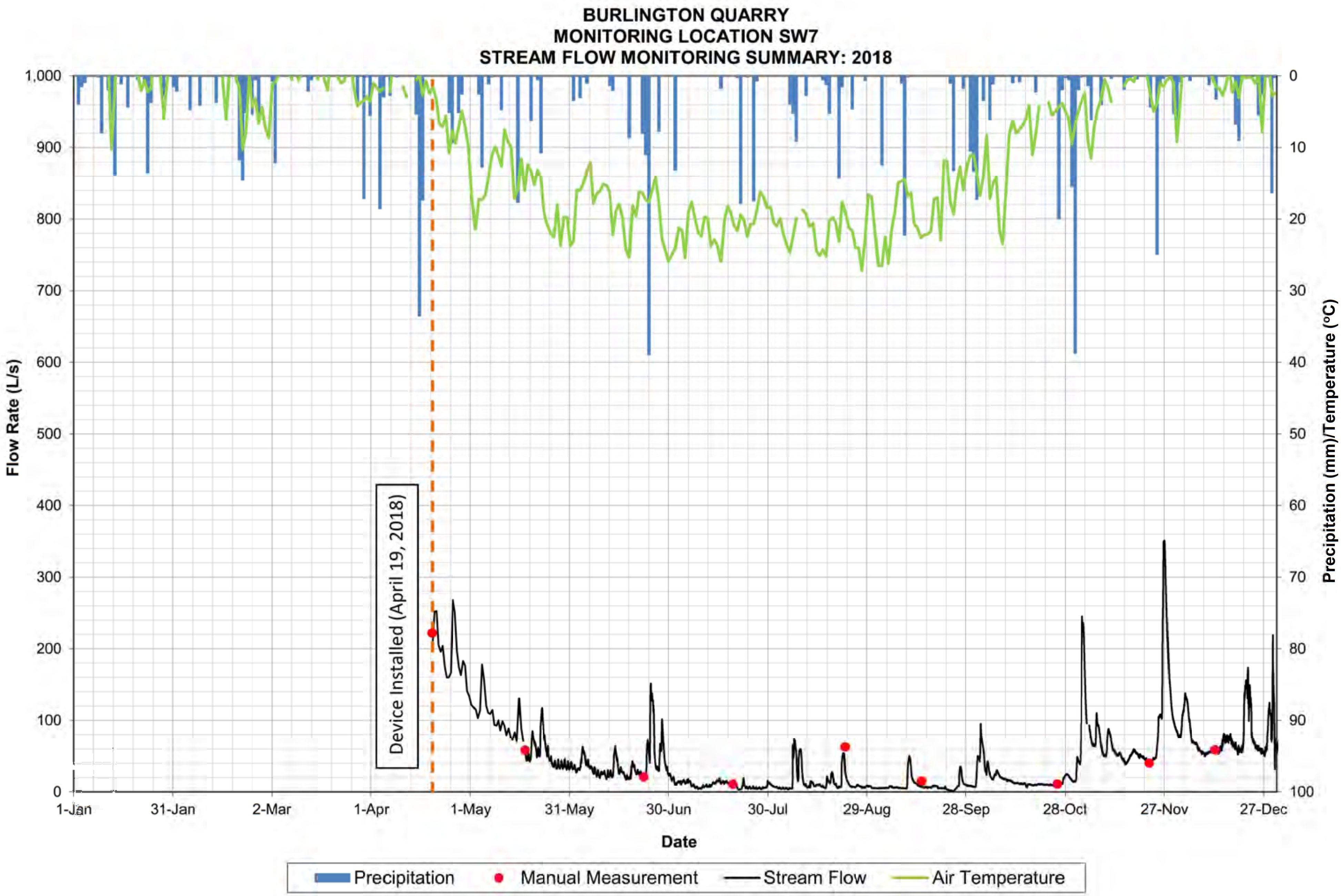


BURLINGTON QUARRY
MONITORING LOCATION SW7
STREAM FLOW MONITORING SUMMARY: 2015
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1,000
900
800
700
600
500
400
300
200
100
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (April 15, 2015)
Device Removed (December 11, 2015)
Precipitation
Manual Measurement
Stream Flow
Air Temperature

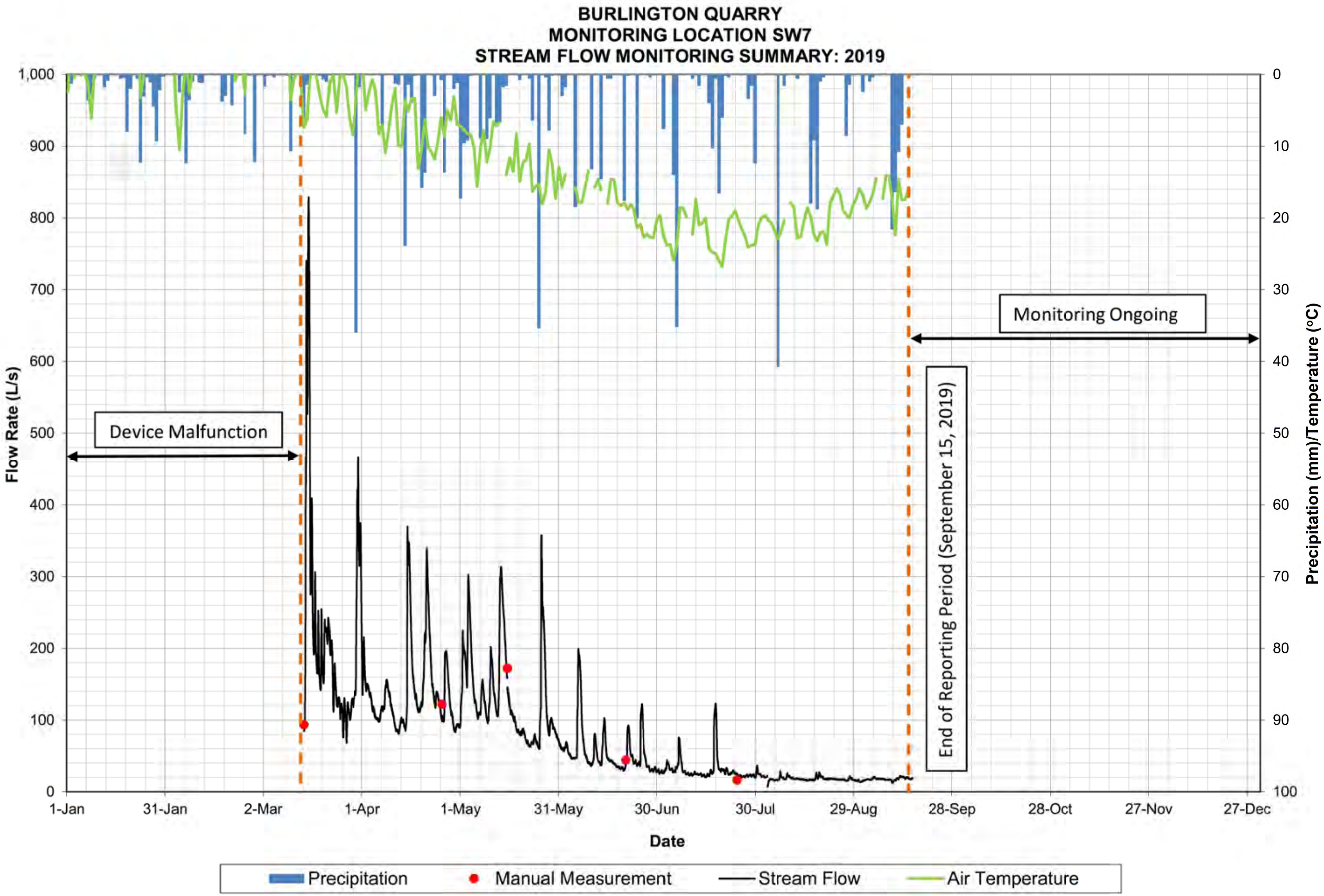

BURLINGTON QUARRY
MONITORING LOCATION SW7
STREAM FLOW MONITORING SUMMARY: 2016
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1,000
900
800
700
600
500
400
300
200
100
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Device Installed (April 13, 2016)
Device Removed (December 22, 2016)
Precipitation
Manual Measurement
Stream Flow
Air Temperature



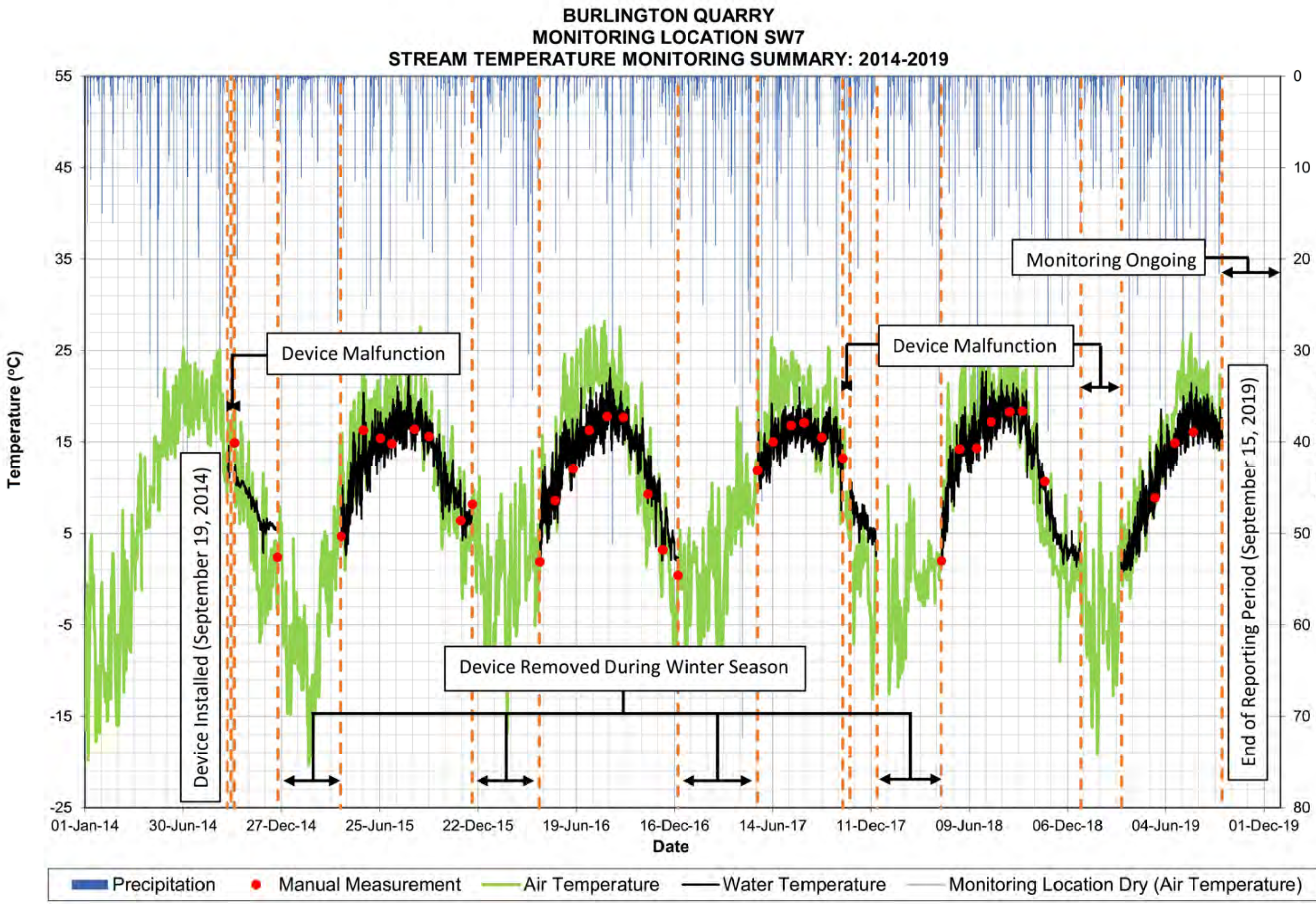
BURLINGTON QUARRY
MONITORING LOCATION SW7
STREAM FLOW MONITORING SUMMARY: 2017
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1,000
900
800
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (May 17, 2017)
Device Malfunction
Device Removed (December 20, 2017)
Precipitation
Manual Measurement
Stream Flow
Air Temperature

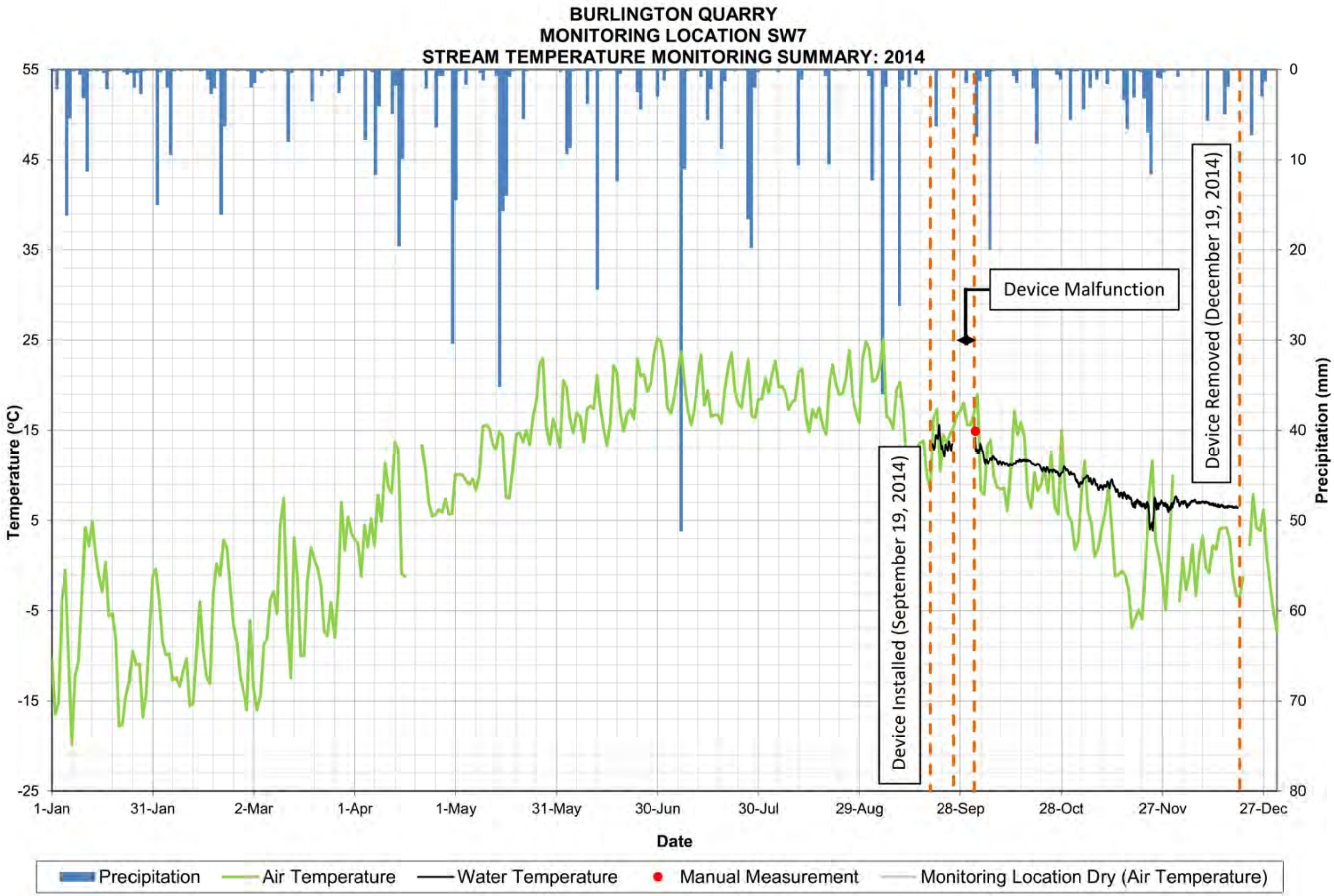


BURLINGTON QUARRY
MONITORING LOCATION SW7
STREAM FLOW MONITORING SUMMARY: 2018
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (April 19, 2018)
1,000
900
800
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Manual Measurement
Stream Flow
Air Temperature

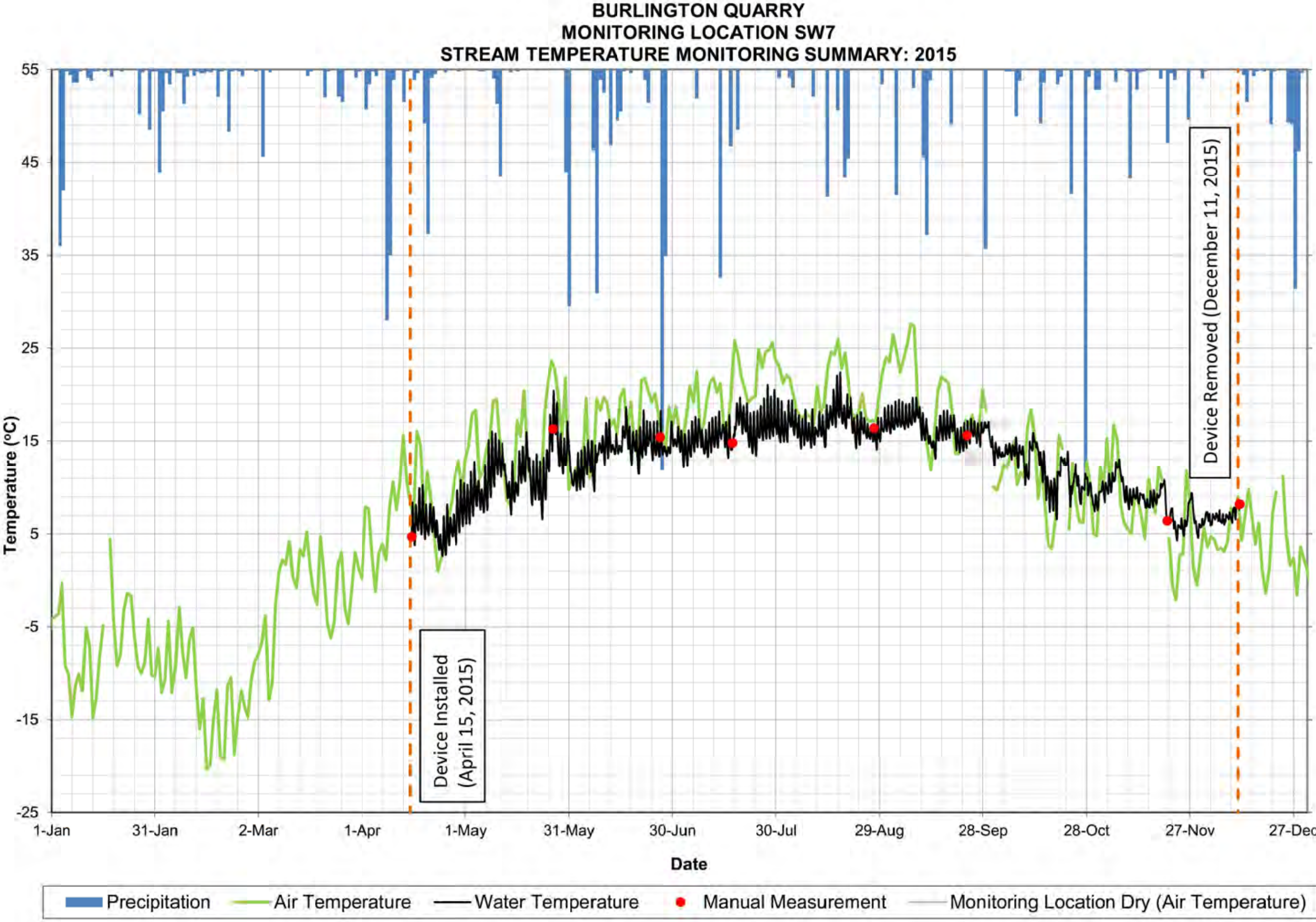


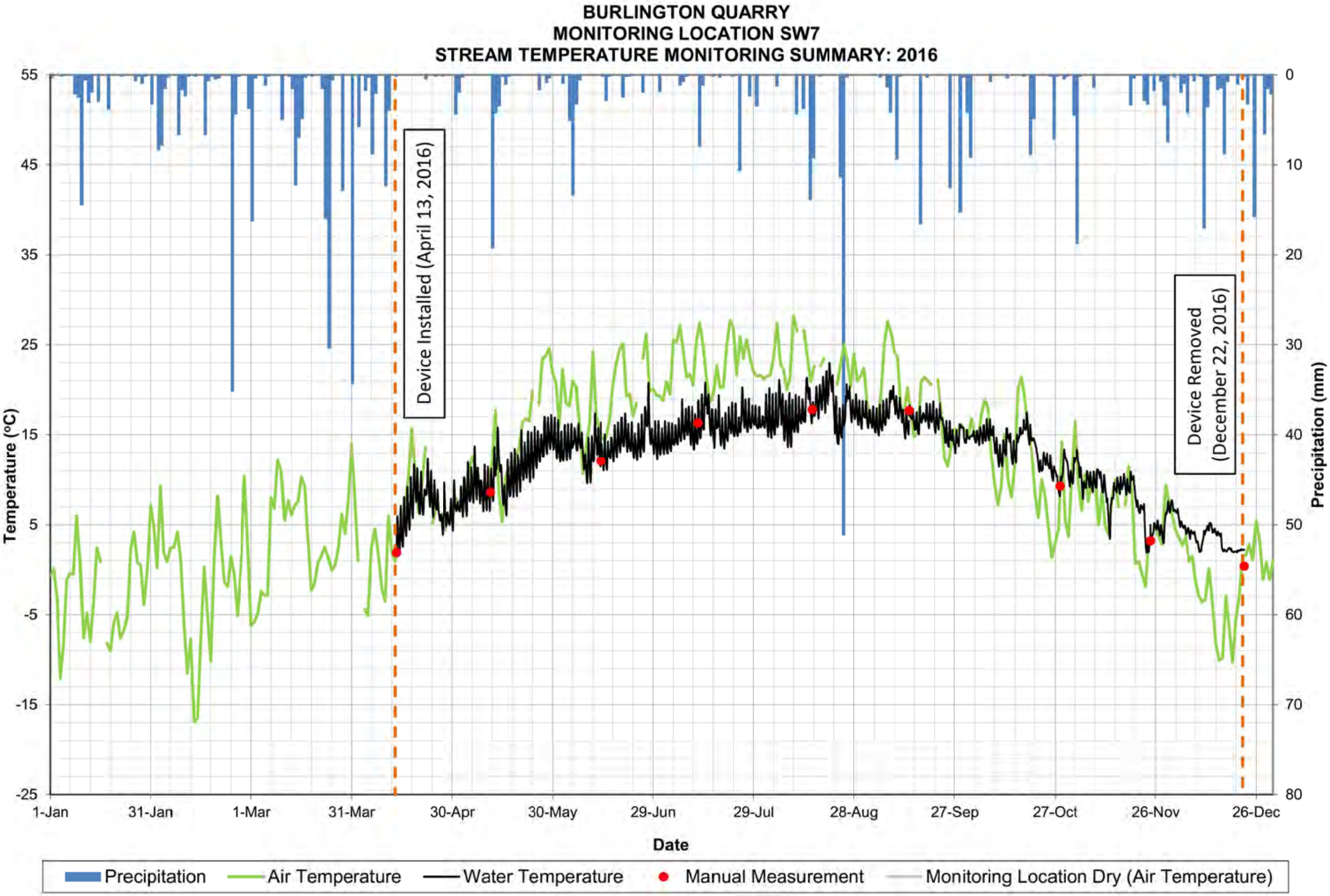
BURLINGTON QUARRY
MONITORING LOCATION SW7
STREAM FLOW MONITORING SUMMARY: 2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1,000
900
800
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Malfunction
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Stream Flow
Air Temperature

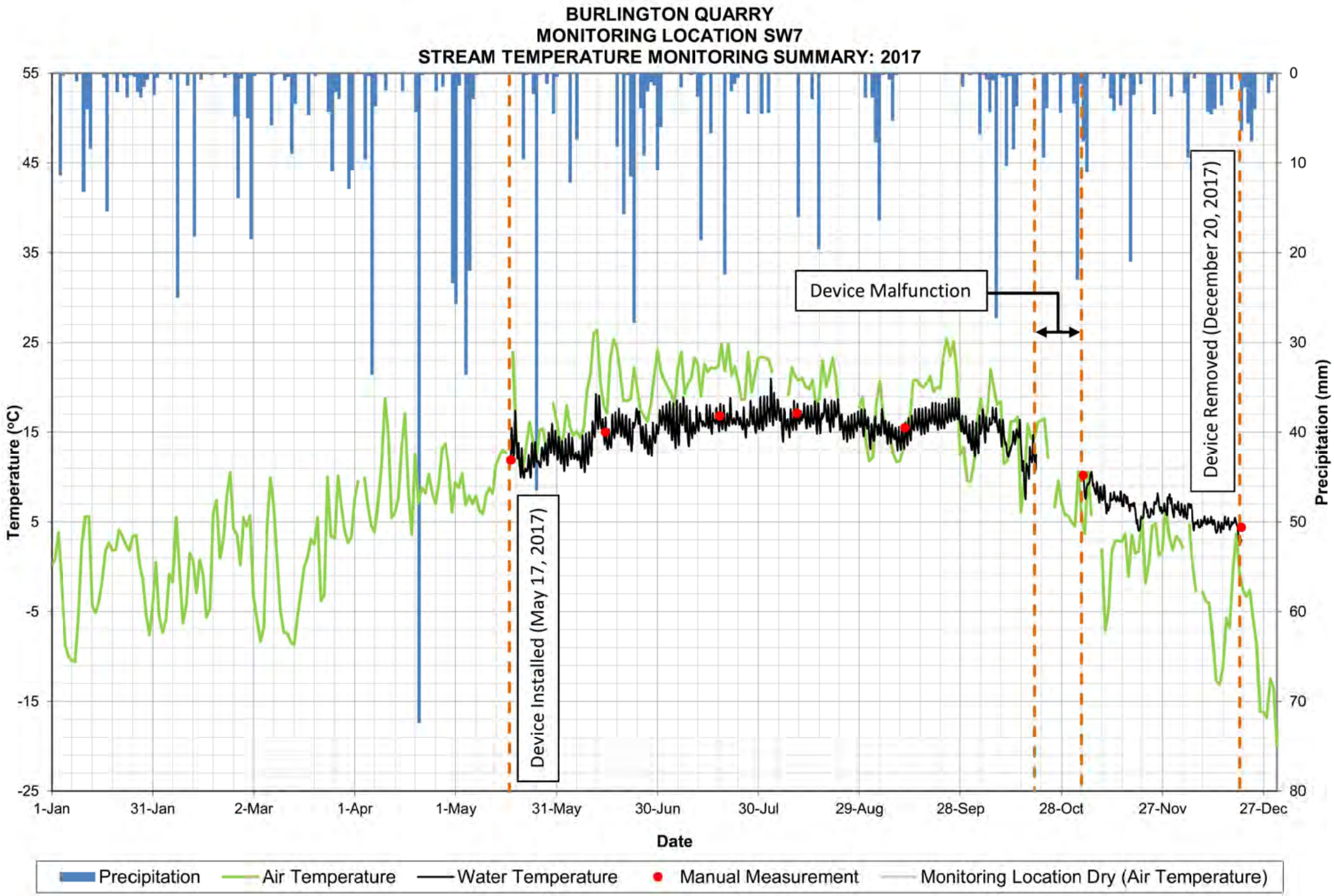

BURLINGTON QUARRY
MONITORING LOCATION SW7
STREAM TEMPERATURE MONITORING SUMMARY: 2014-2019
Temperature (°C)
Precipitation (mm)
Date
01-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
09-Jun-18
06-Dec-18
04-Jun-19
01-Dec-19
Device Installed (September 19, 2014)
Device Malfunction
Device Malfunction
Monitoring Ongoing
Device Removed During Winter Season
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Air Temperature
Water Temperature
Monitoring Location Dry (Air Temperature)

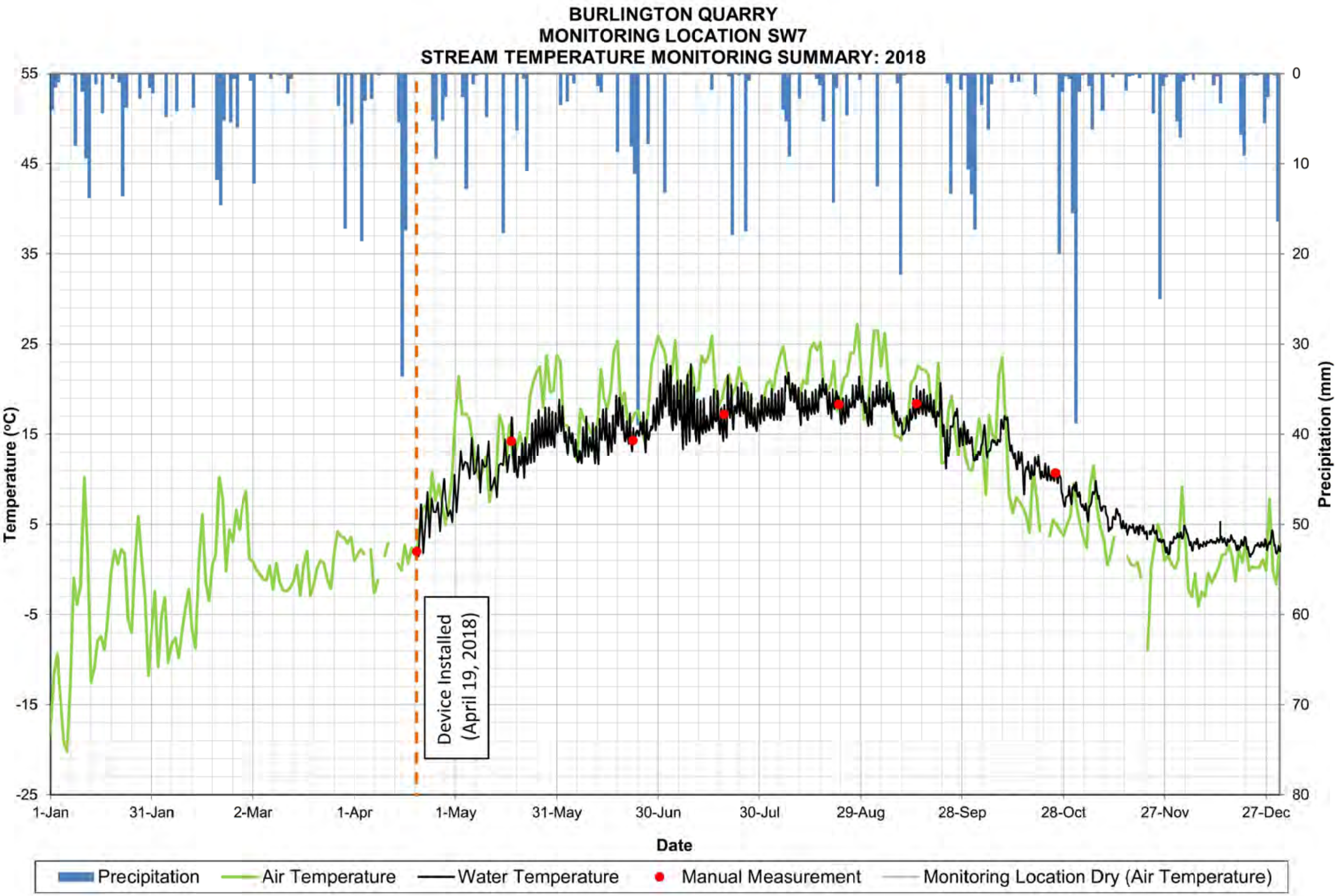


BURLINGTON QUARRY
MONITORING LOCATION SW7
STREAM TEMPERATURE MONITORING SUMMARY: 2014
Temperature (°C)
Precipitation (mm)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Device Malfunction
Device Installed (September 19, 2014)
Device Removed (December 19, 2014)
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

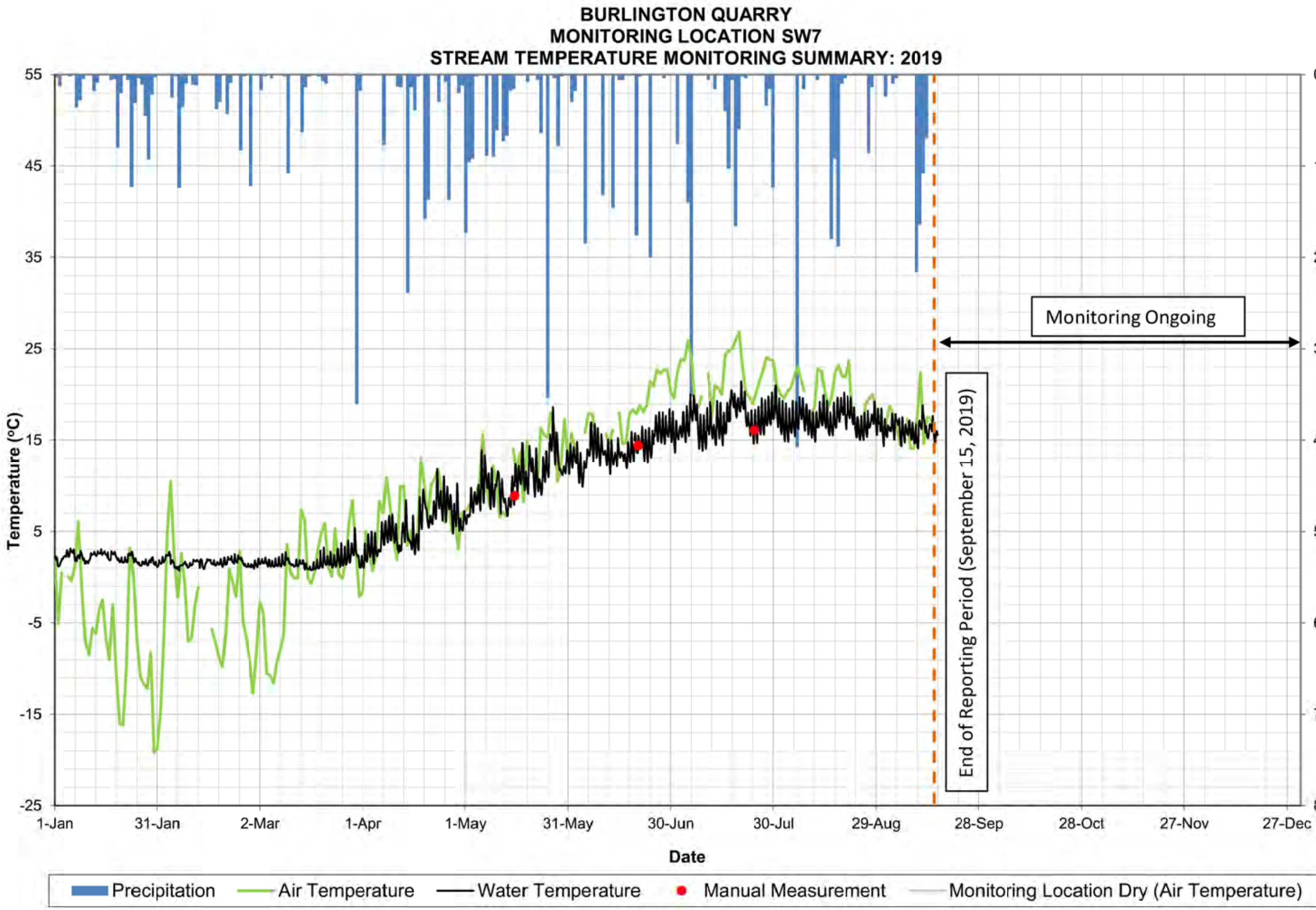

BURLINGTON QUARRY
MONITORING LOCATION SW7
STREAM TEMPERATURE MONITORING SUMMARY: 2015
Temperature (ºC)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Device Installed (April 15, 2015)
Device Removed (December 11, 2015)
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

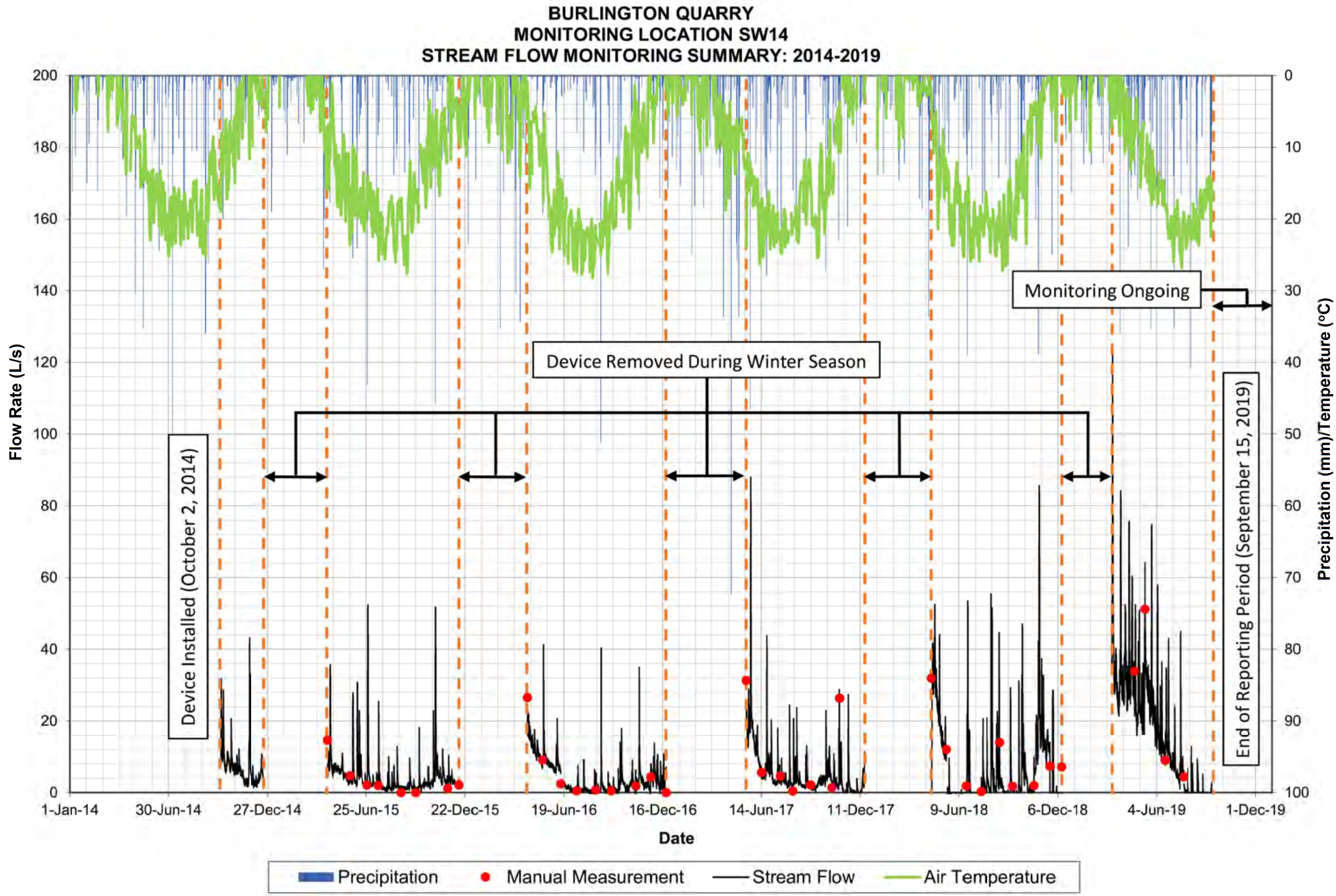

BURLINGTON QUARRY
MONITORING LOCATION SW7
STREAM TEMPERATURE MONITORING SUMMARY: 2016
Device Installed (April 13, 2016)
Device Removed
(December 22, 2016)
Temperature (ºC)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

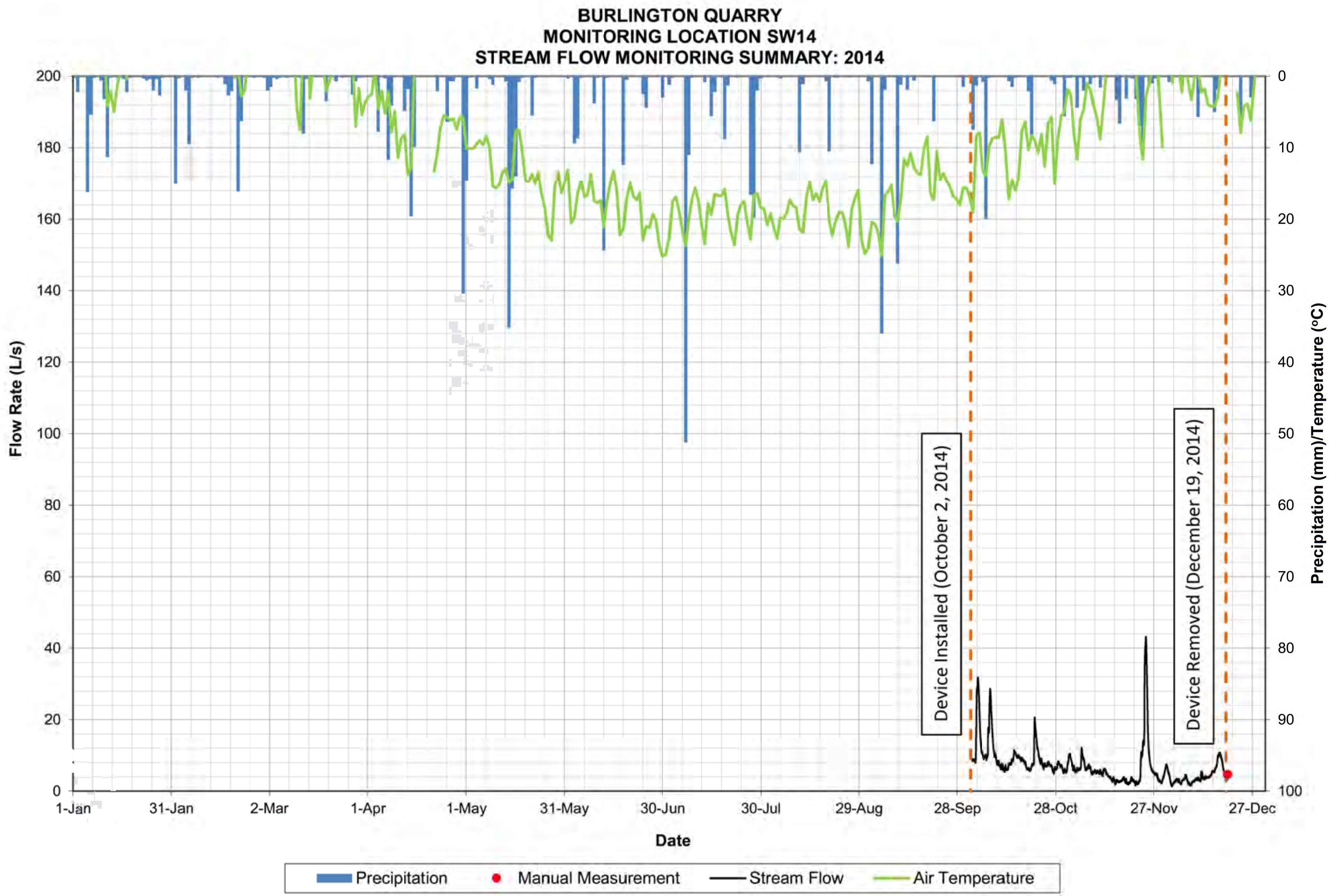

BURLINGTON QUARRY
MONITORING LOCATION SW7
STREAM TEMPERATURE MONITORING SUMMARY: 2017
Temperature (°C)
Precipitation (mm)
Date
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (May 17, 2017)
Device Malfunction
Device Removed (December 20, 2017)
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

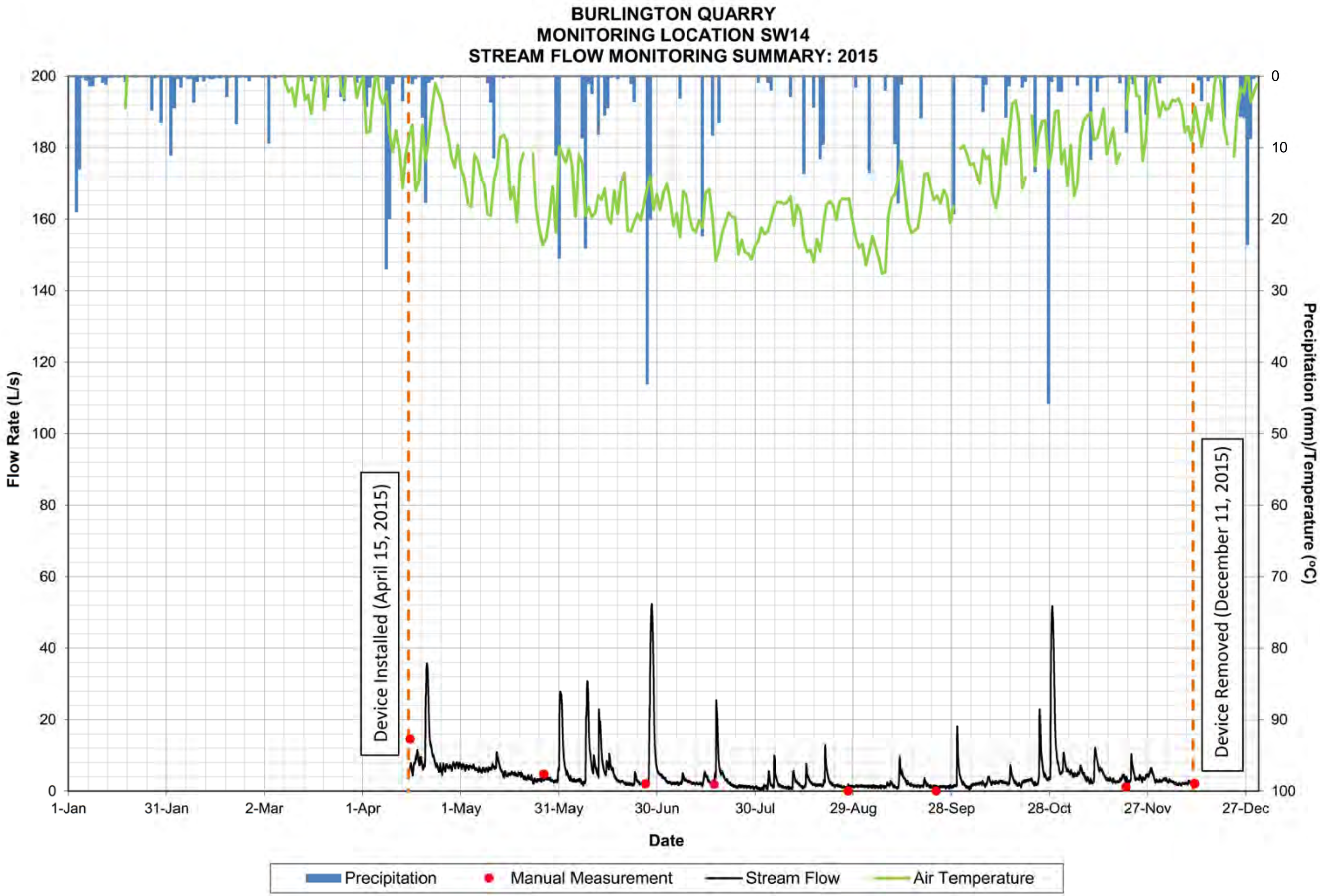


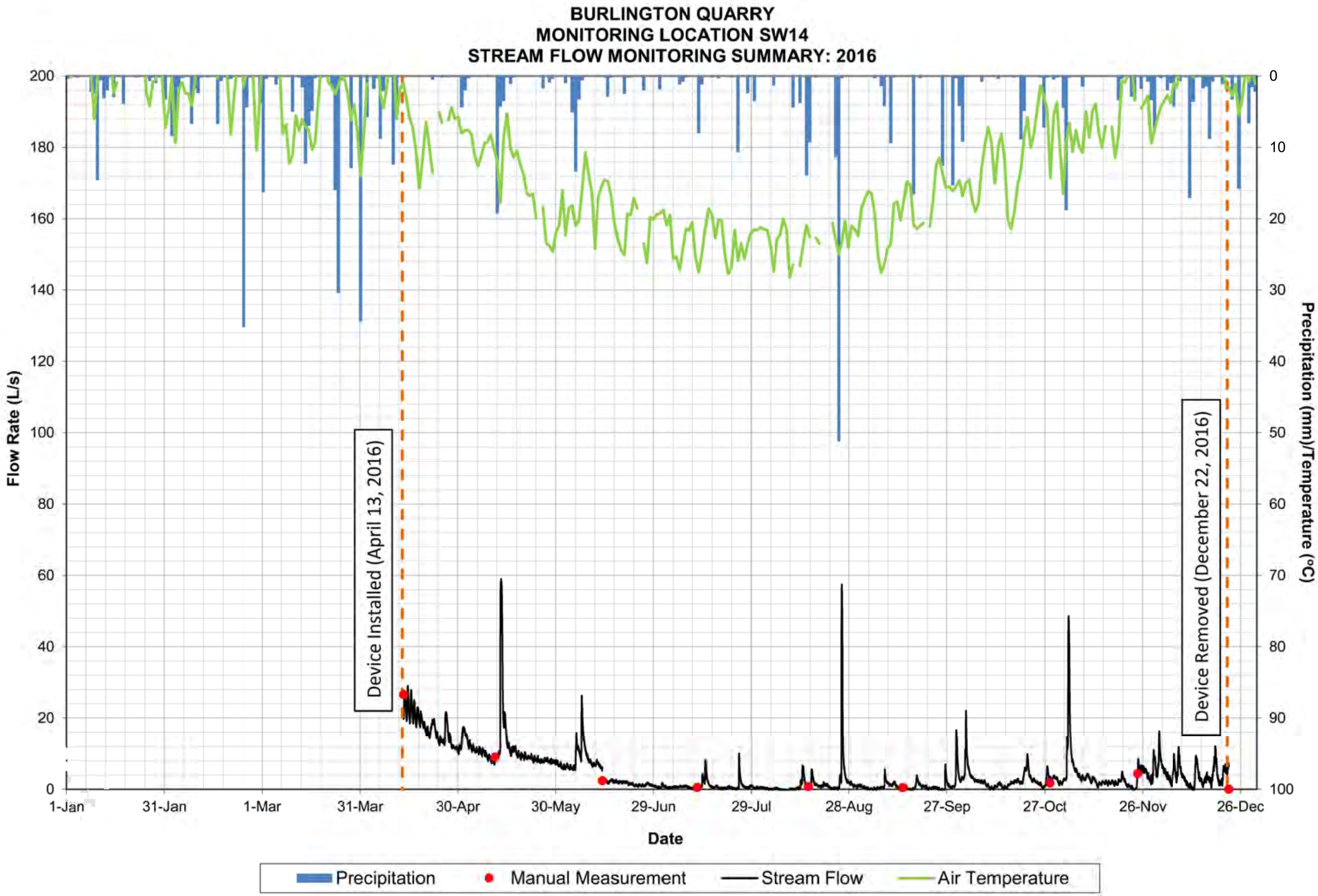
BURLINGTON QUARRY
MONITORING LOCATION SW7
STREAM TEMPERATURE MONITORING SUMMARY: 2018
Temperature (°C)
Precipitation (mm)
Device Installed
(April 19, 2018)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

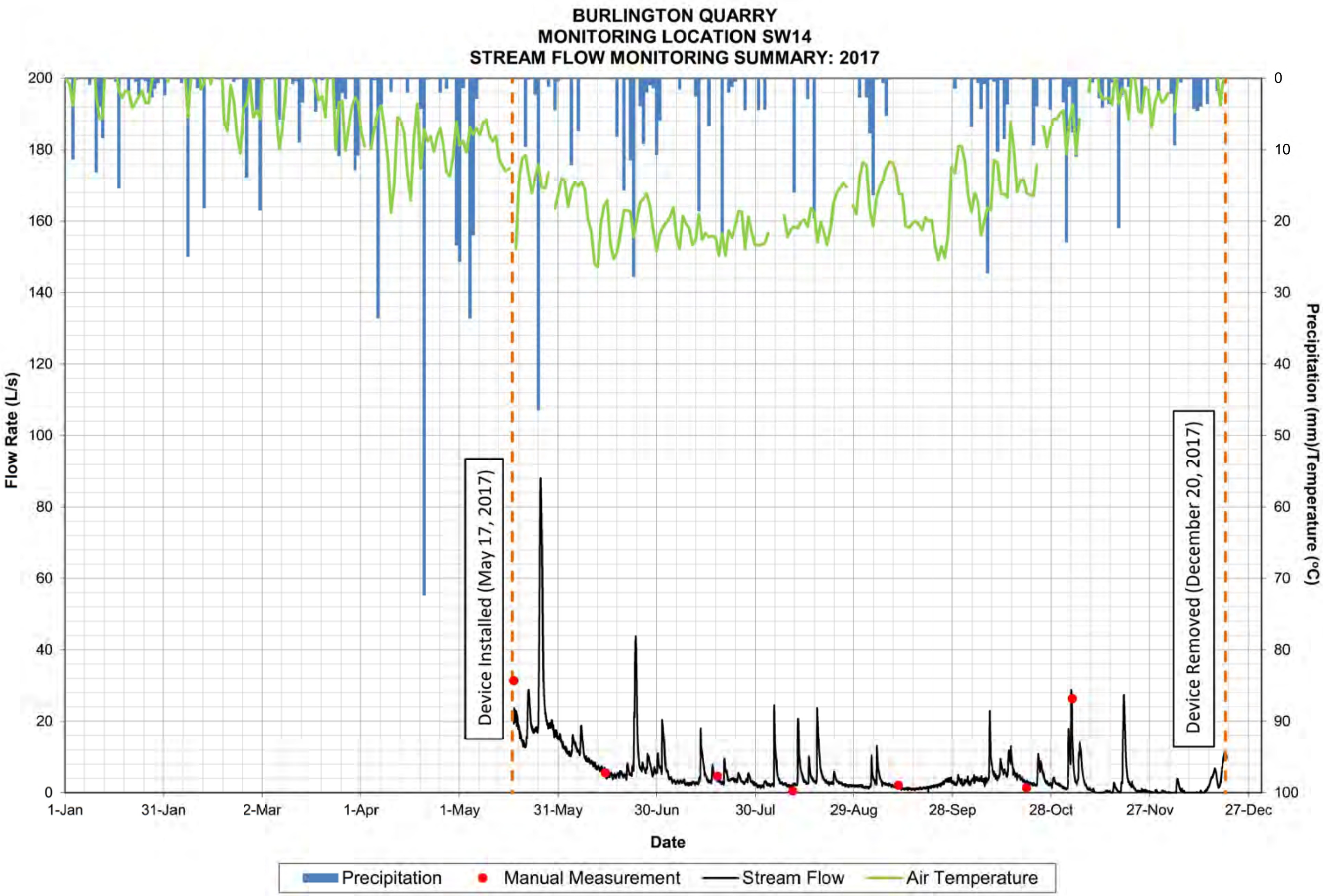

BURLINGTON QUARRY
MONITORING LOCATION SW7
STREAM TEMPERATURE MONITORING SUMMARY: 2019
Temperature (ºC)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

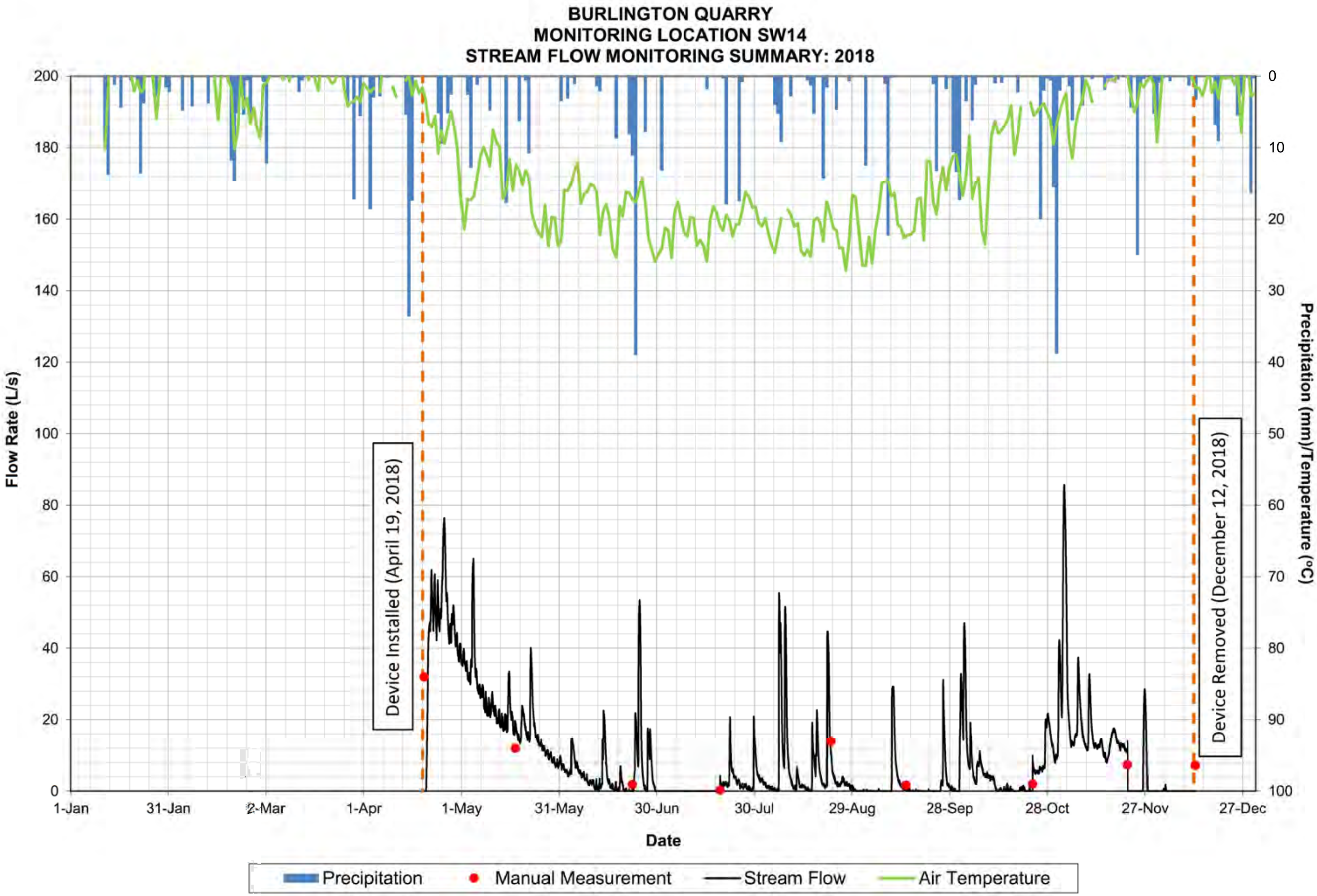

BURLINGTON QUARRY
MONITORING LOCATION SW14
STREAM FLOW MONITORING SUMMARY: 2014-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (October 2, 2014)
Device Removed During Winter Season
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
1-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
9-Jun-18
6-Dec-18
4-Jun-19
1-Dec-19
Precipitation
Manual Measurement
Stream Flow
Air Temperature

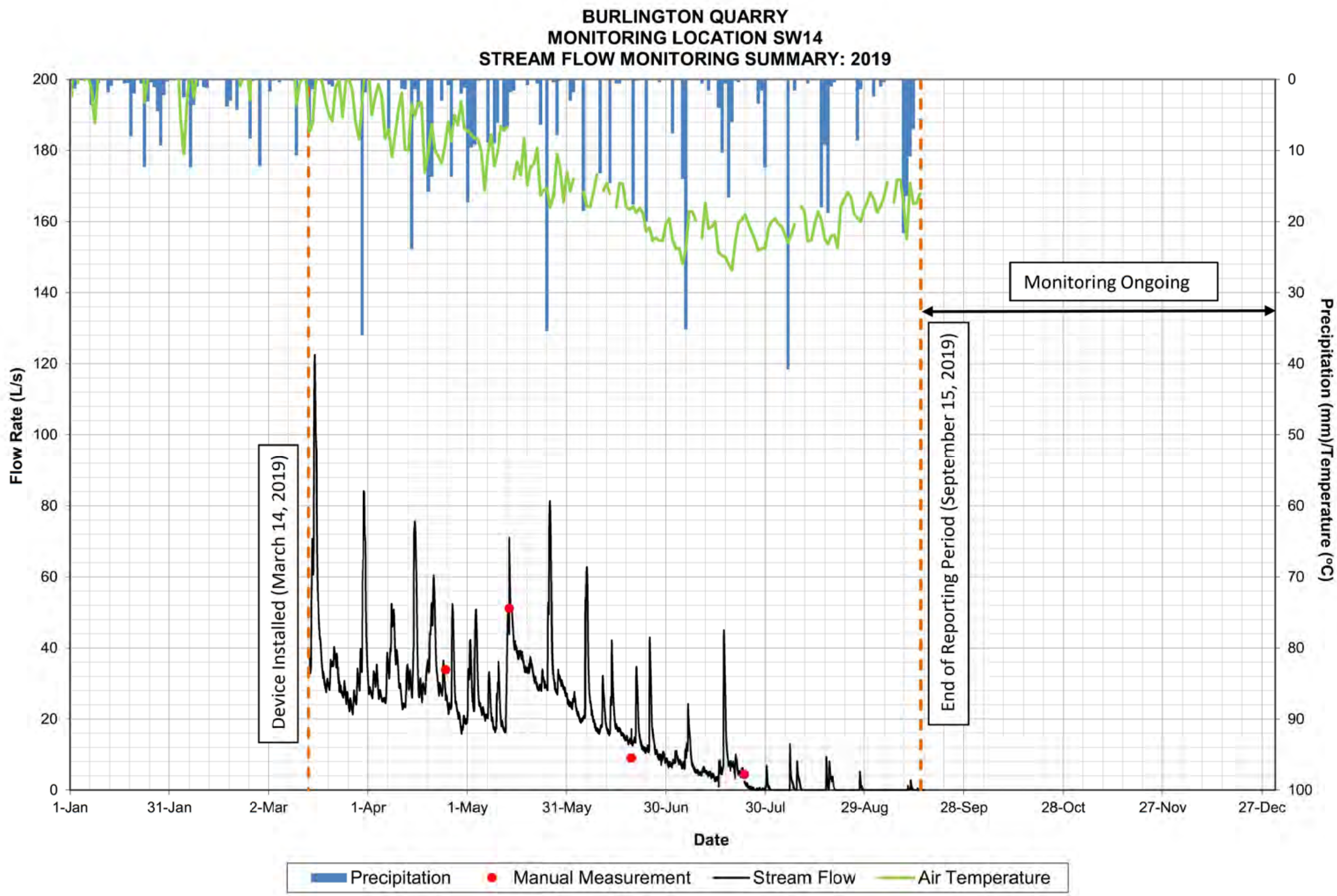

BURLINGTON QUARRY
MONITORING LOCATION SW14
STREAM FLOW MONITORING SUMMARY: 2014
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (October 2, 2014)
Device Removed (December 19, 2014)
Precipitation
Manual Measurement
Stream Flow
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW14
STREAM FLOW MONITORING SUMMARY: 2015
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Device Installed (April 15, 2015)
Device Removed (December 11, 2015)
200
180
160
140
120
100
80
60
40
20
0
10
30
50
70
90
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Manual Measurement
Stream Flow
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW14
STREAM FLOW MONITORING SUMMARY: 2016
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Device Installed (April 13, 2016)
Device Removed (December 22, 2016)
Precipitation
Manual Measurement
Stream Flow
Air Temperature

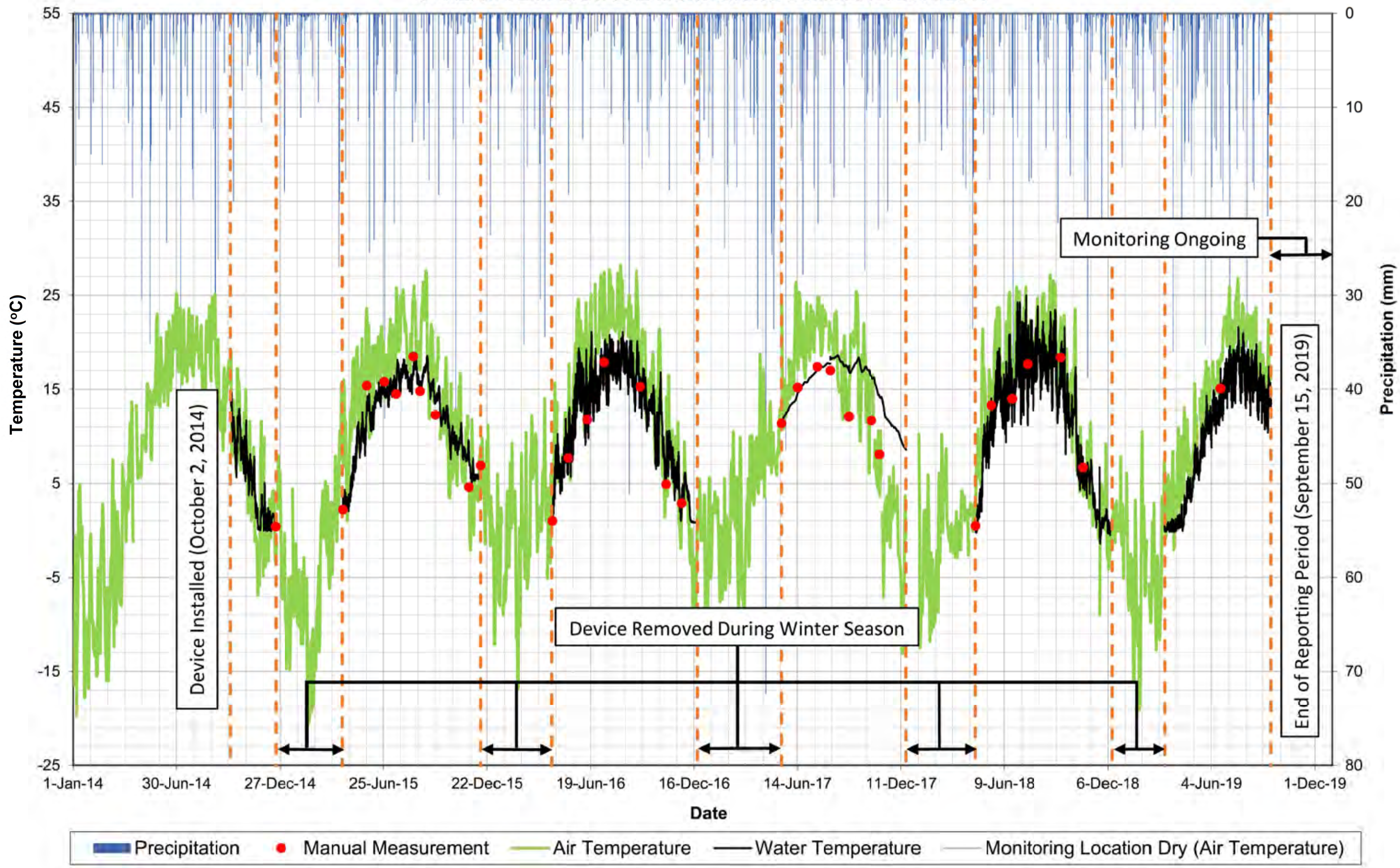

BURLINGTON QUARRY
MONITORING LOCATION SW14
STREAM FLOW MONITORING SUMMARY: 2017
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
0
20
40
60
80
100
120
140
160
180
200
10
30
50
70
90
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (May 17, 2017)
Device Removed (December 20, 2017)
Precipitation
Manual Measurement
Stream Flow
Air Temperature

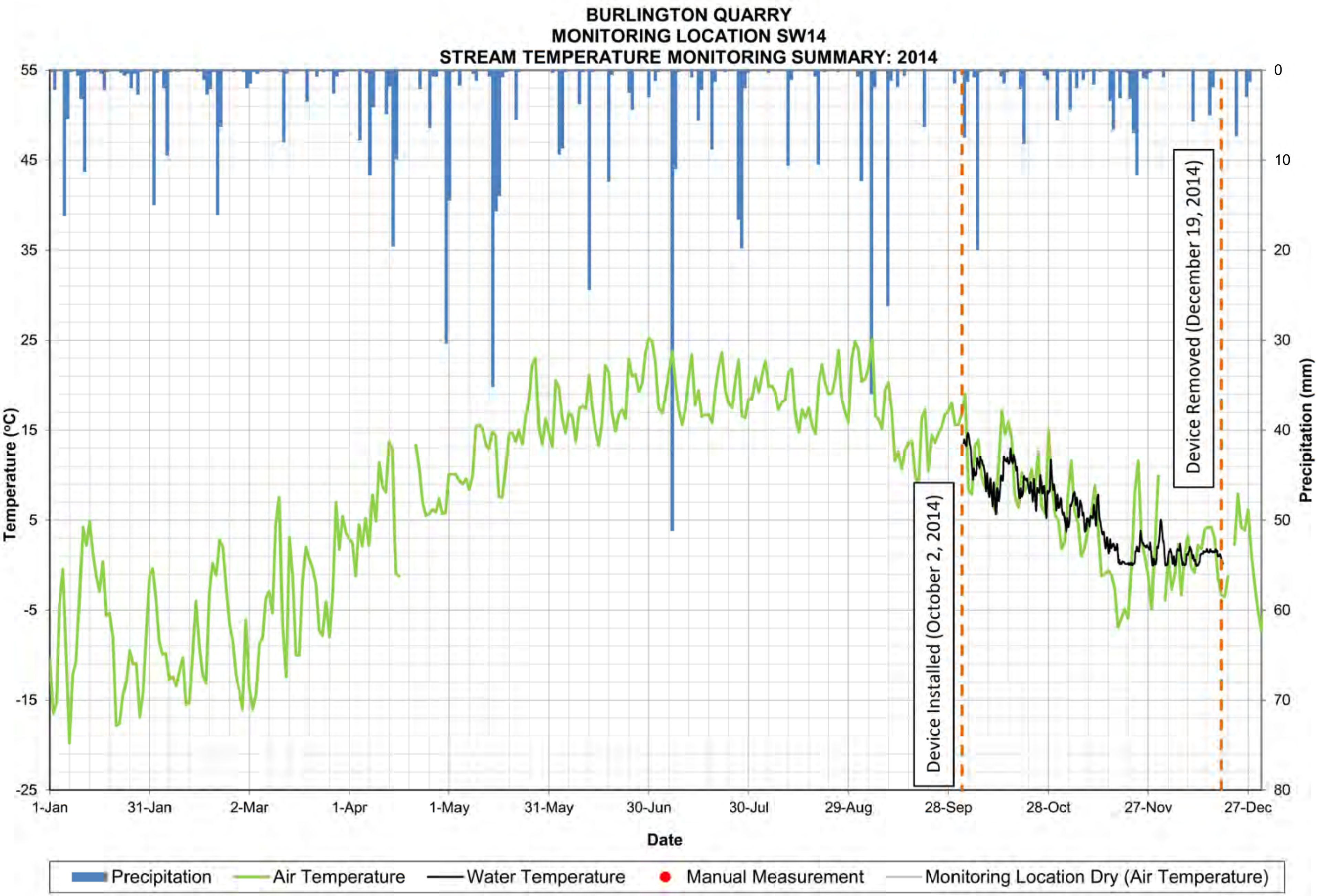

BURLINGTON QUARRY
MONITORING LOCATION SW14
STREAM FLOW MONITORING SUMMARY: 2018
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Device Installed (April 19, 2018)
Device Removed (December 12, 2018)
0
20
40
60
80
100
120
140
160
180
200
10
30
50
70
90
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Manual Measurement
Stream Flow
Air Temperature

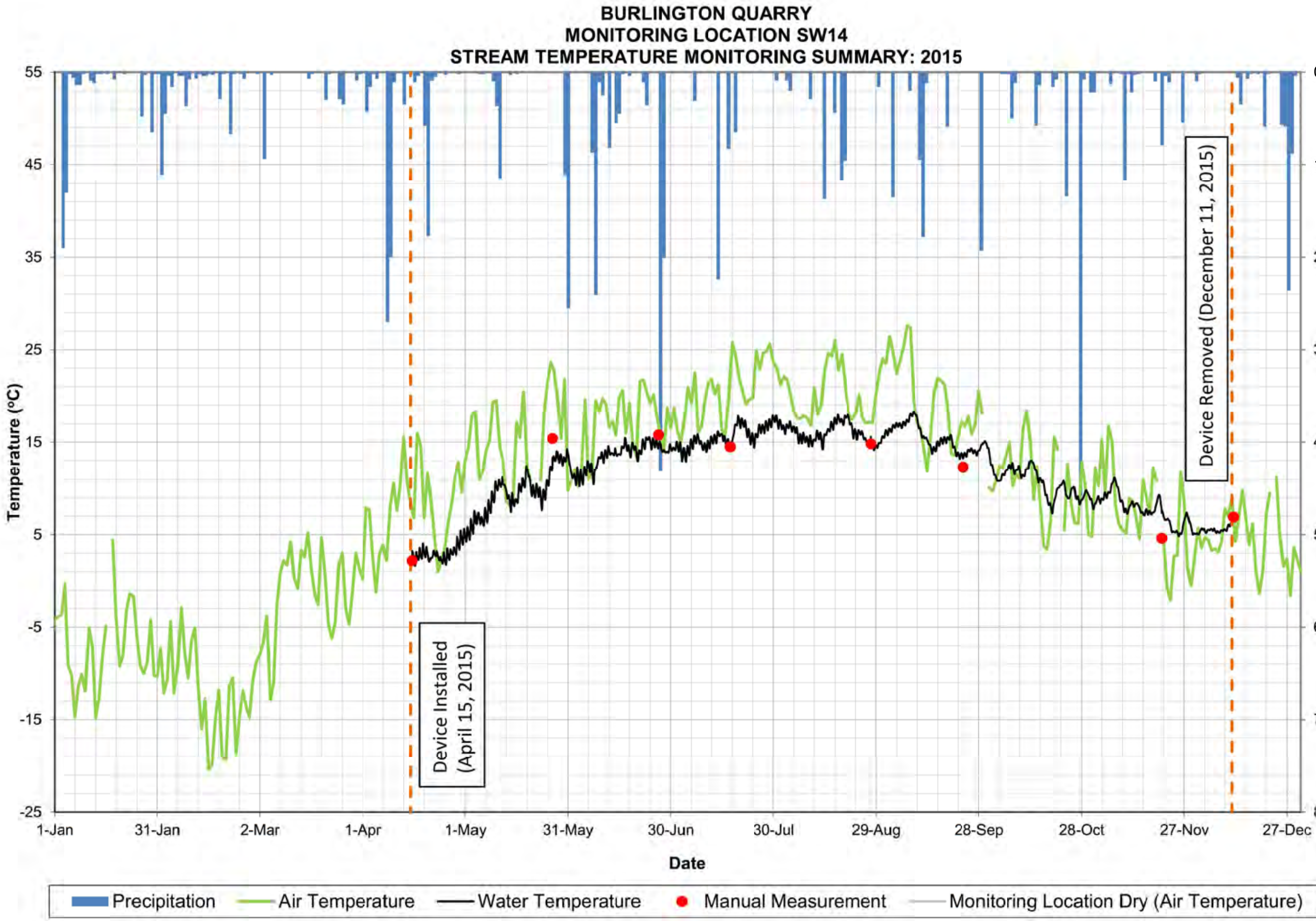


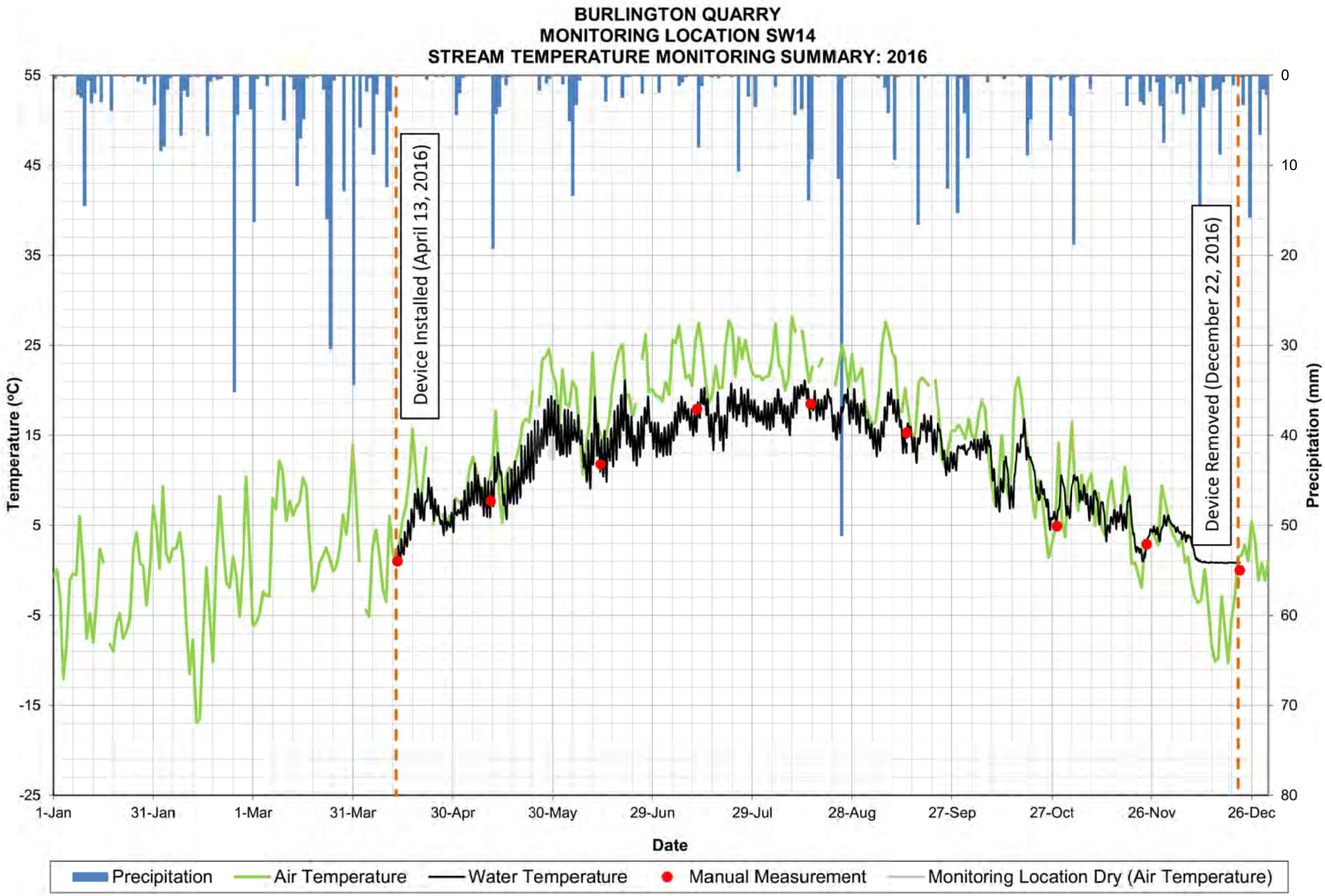
BURLINGTON QUARRY
MONITORING LOCATION SW14
STREAM FLOW MONITORING SUMMARY: 2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
200
180
160
140
120
100
80
60
40
20
0
10
30
50
70
90
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Device Installed (March 14, 2019)
End of Reporting Period (September 15, 2019)
Monitoring Ongoing
Precipitation
Manual Measurement
Stream Flow
Air Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW14
STREAM TEMPERATURE MONITORING SUMMARY: 2014-2019

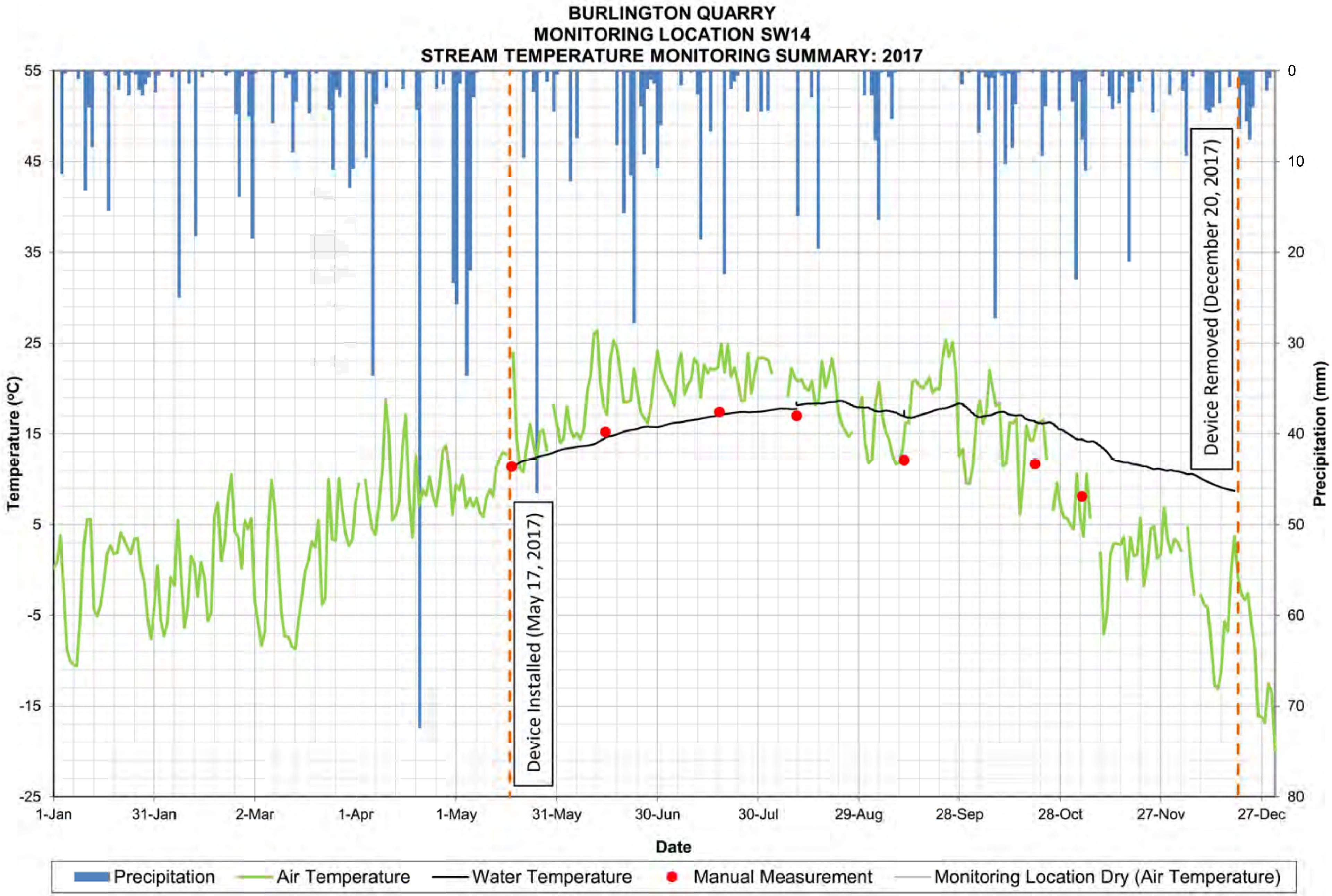



BURLINGTON QUARRY
MONITORING LOCATION SW14
STREAM TEMPERATURE MONITORING SUMMARY: 2014
Temperature (ºC)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Device Installed (October 2, 2014)
Device Removed (December 19, 2014)
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)


BURLINGTON QUARRY
MONITORING LOCATION SW14
STREAM TEMPERATURE MONITORING SUMMARY: 2015
Temperature (ºC)
Precipitation (mm)
Date
Device Installed (April 15, 2015)
Device Removed (December 11, 2015)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

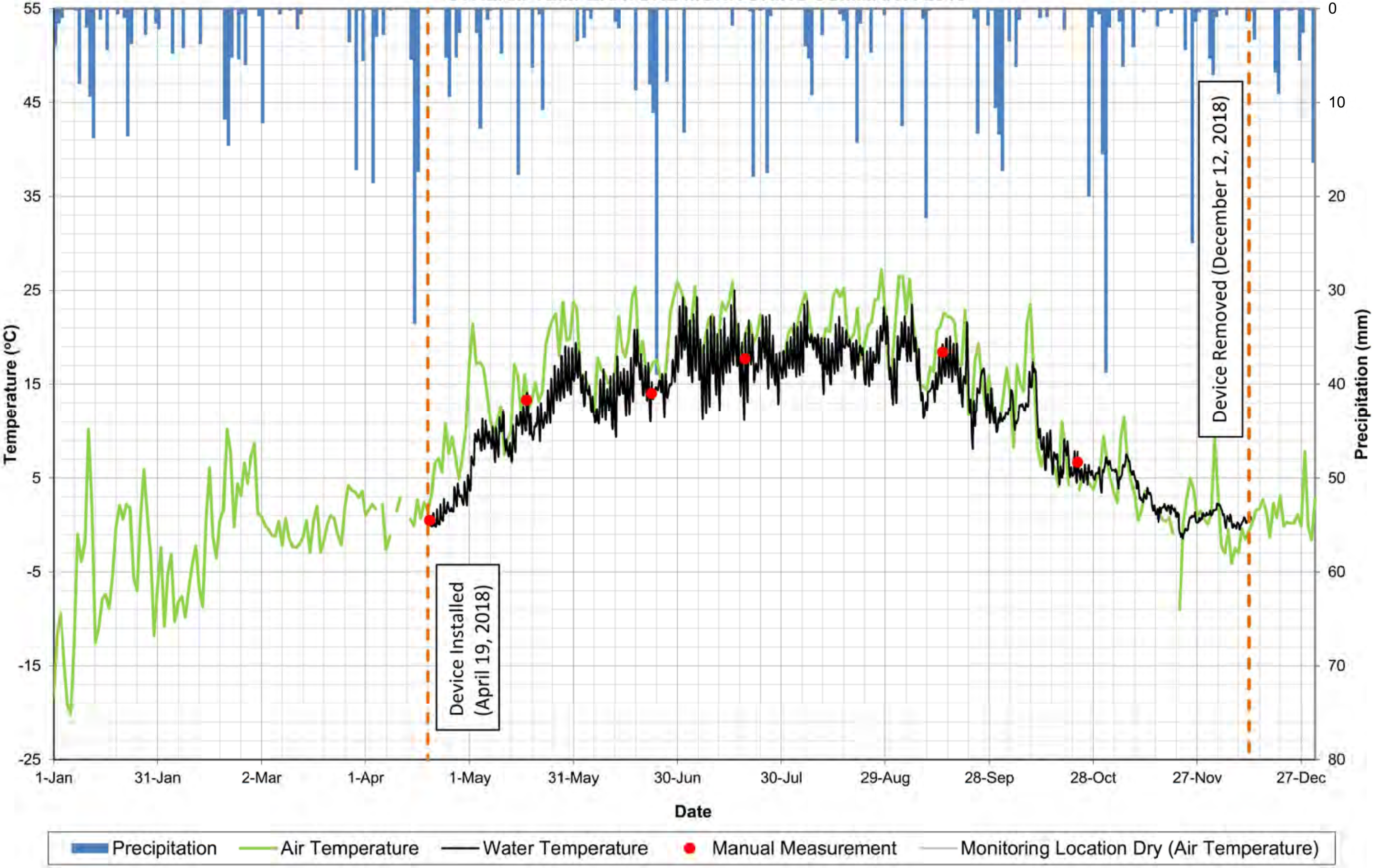


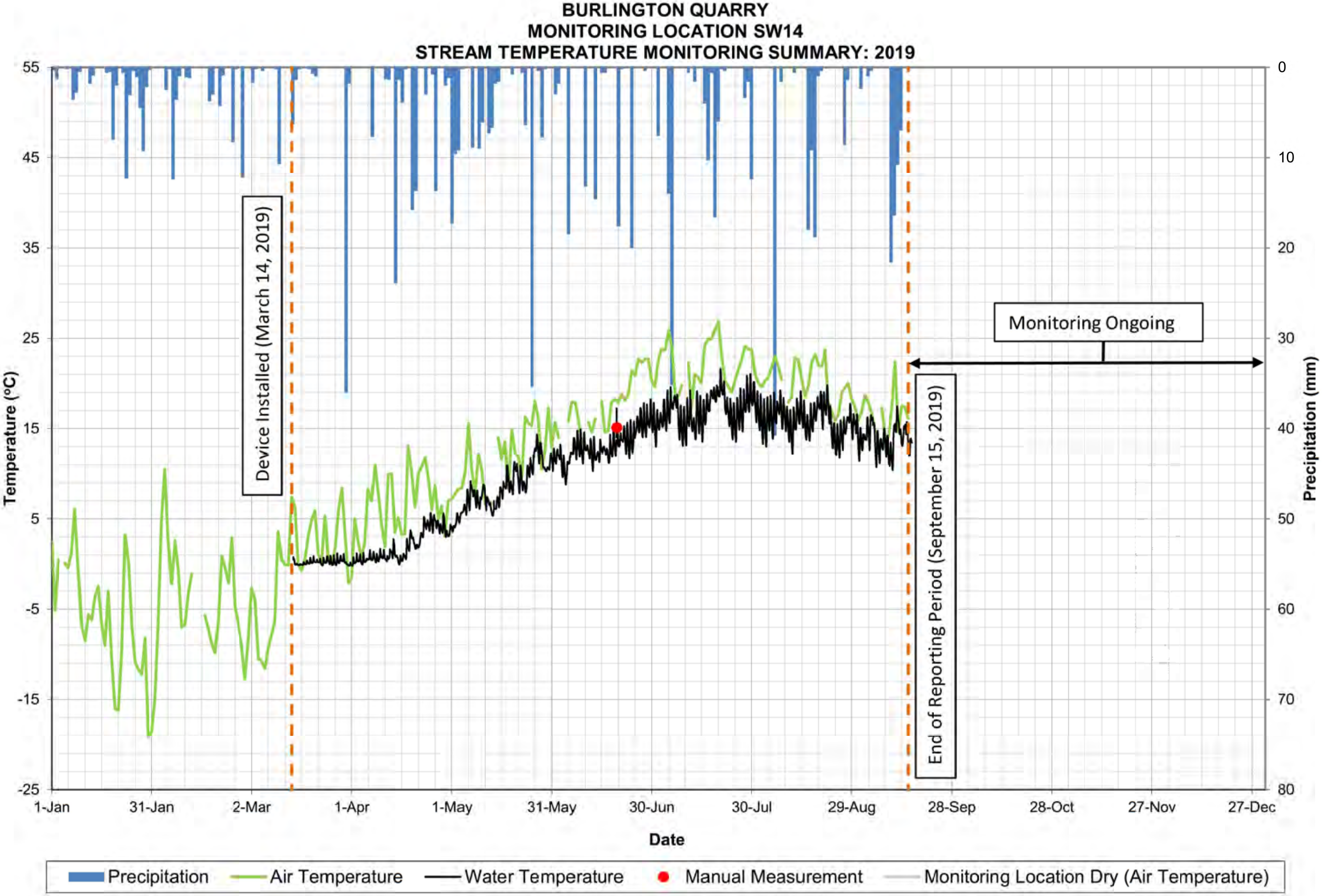
BURLINGTON QUARRY
MONITORING LOCATION SW14
STREAM TEMPERATURE MONITORING SUMMARY: 2016
Device Installed (April 13, 2016)
Device Removed (December 22, 2016)
Temperature (°C)
Precipitation (mm)
Date
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

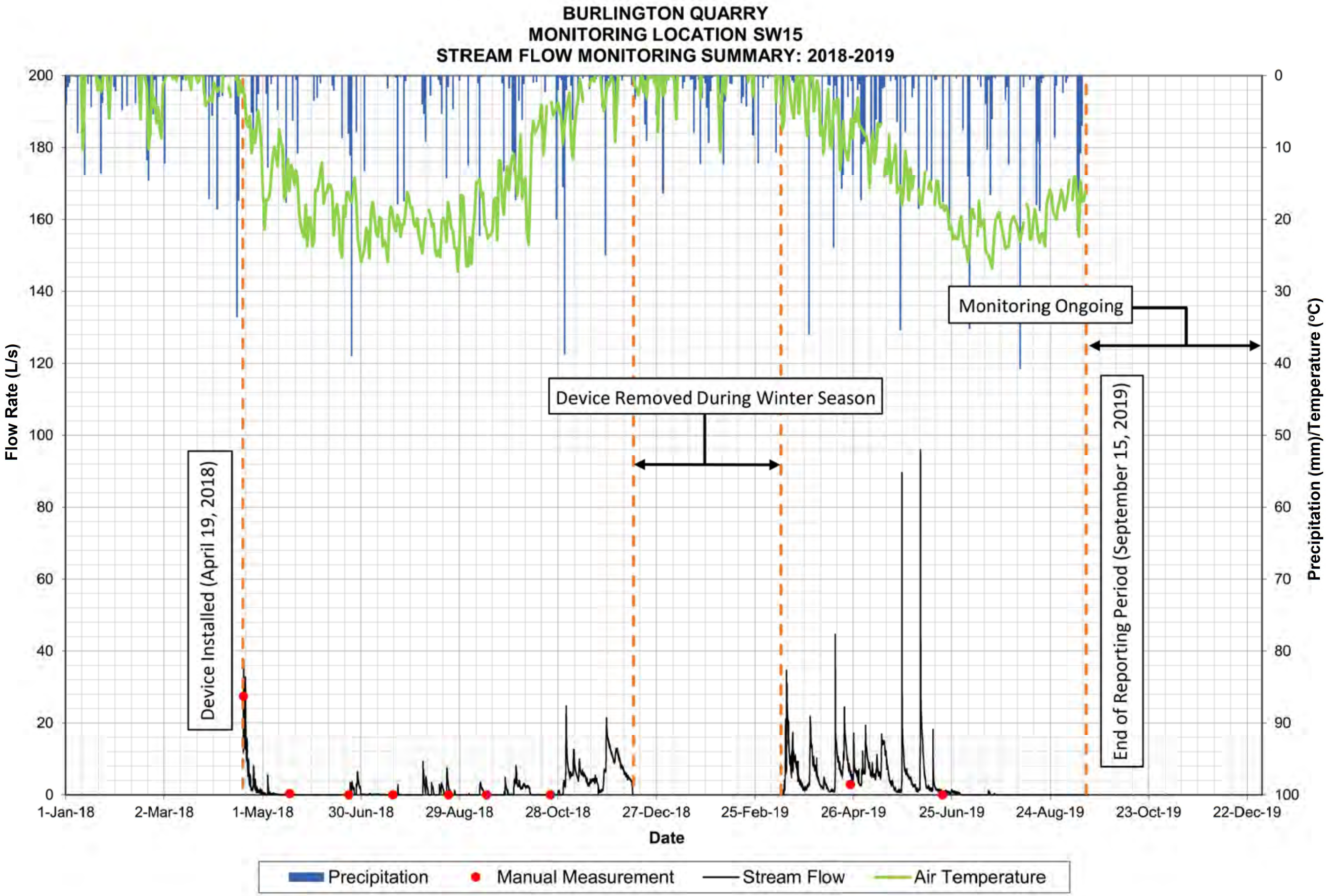


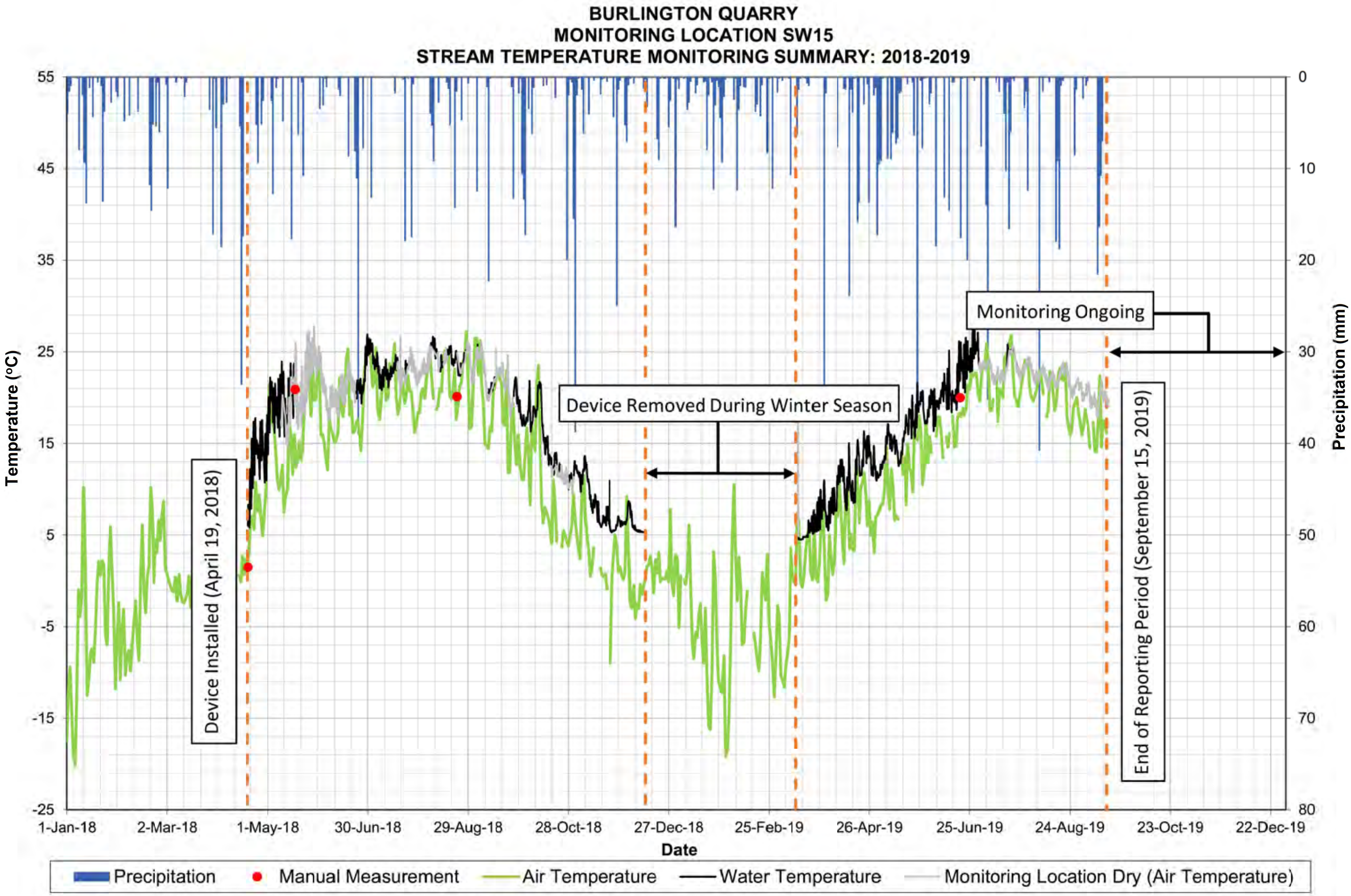
BURLINGTON QUARRY
MONITORING LOCATION SW14
STREAM TEMPERATURE MONITORING SUMMARY: 2017
Temperature (ºC)
Precipitation (mm)
Date
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (May 17, 2017)
Device Removed (December 20, 2017)
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

BURLINGTON QUARRY
MONITORING LOCATION SW14
STREAM TEMPERATURE MONITORING SUMMARY: 2018



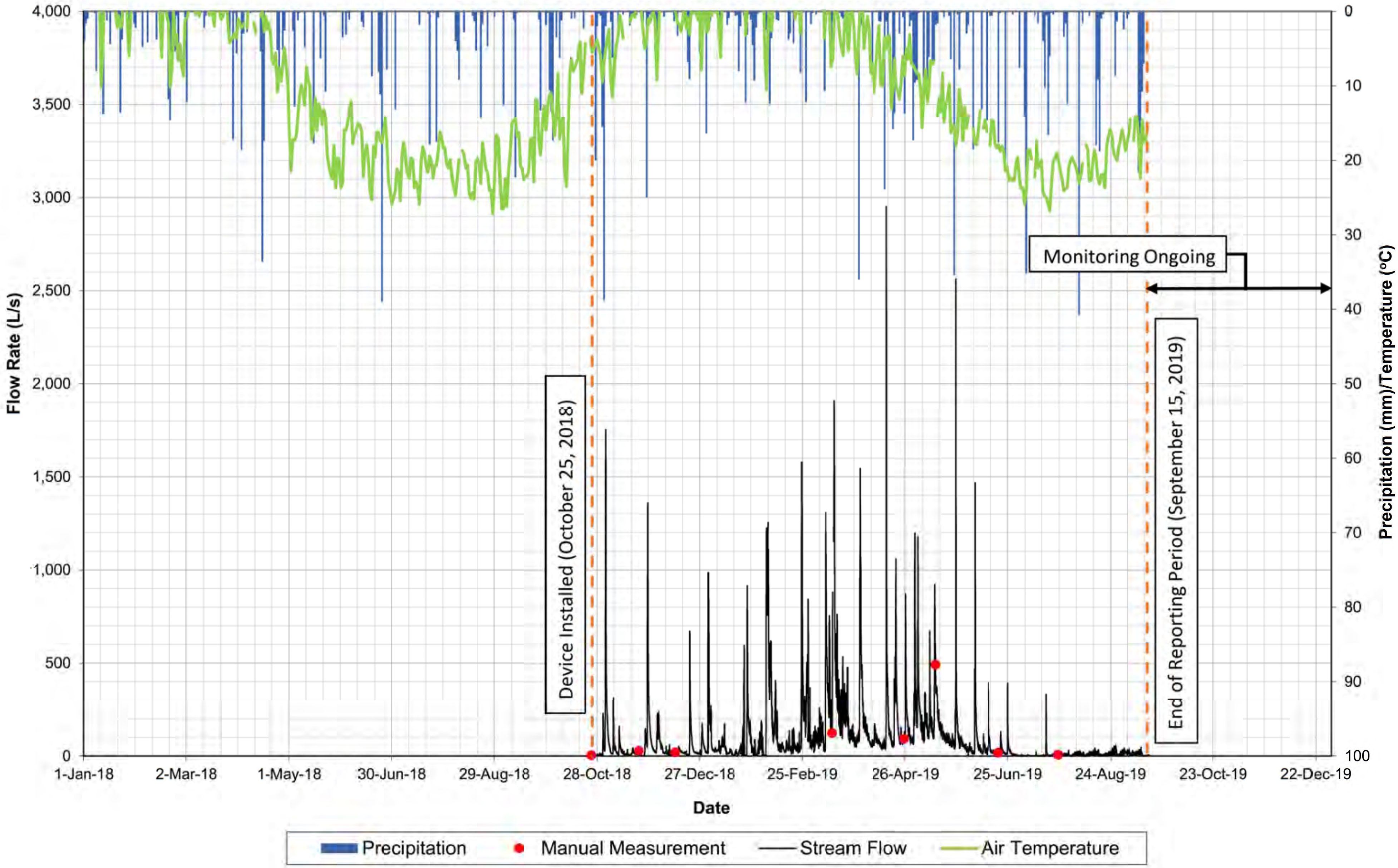

BURLINGTON QUARRY
MONITORING LOCATION SW14
STREAM TEMPERATURE MONITORING SUMMARY: 2019
Temperature (ºC)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Device Installed (March 14, 2019)
End of Reporting Period (September 15, 2019)
Monitoring Ongoing
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

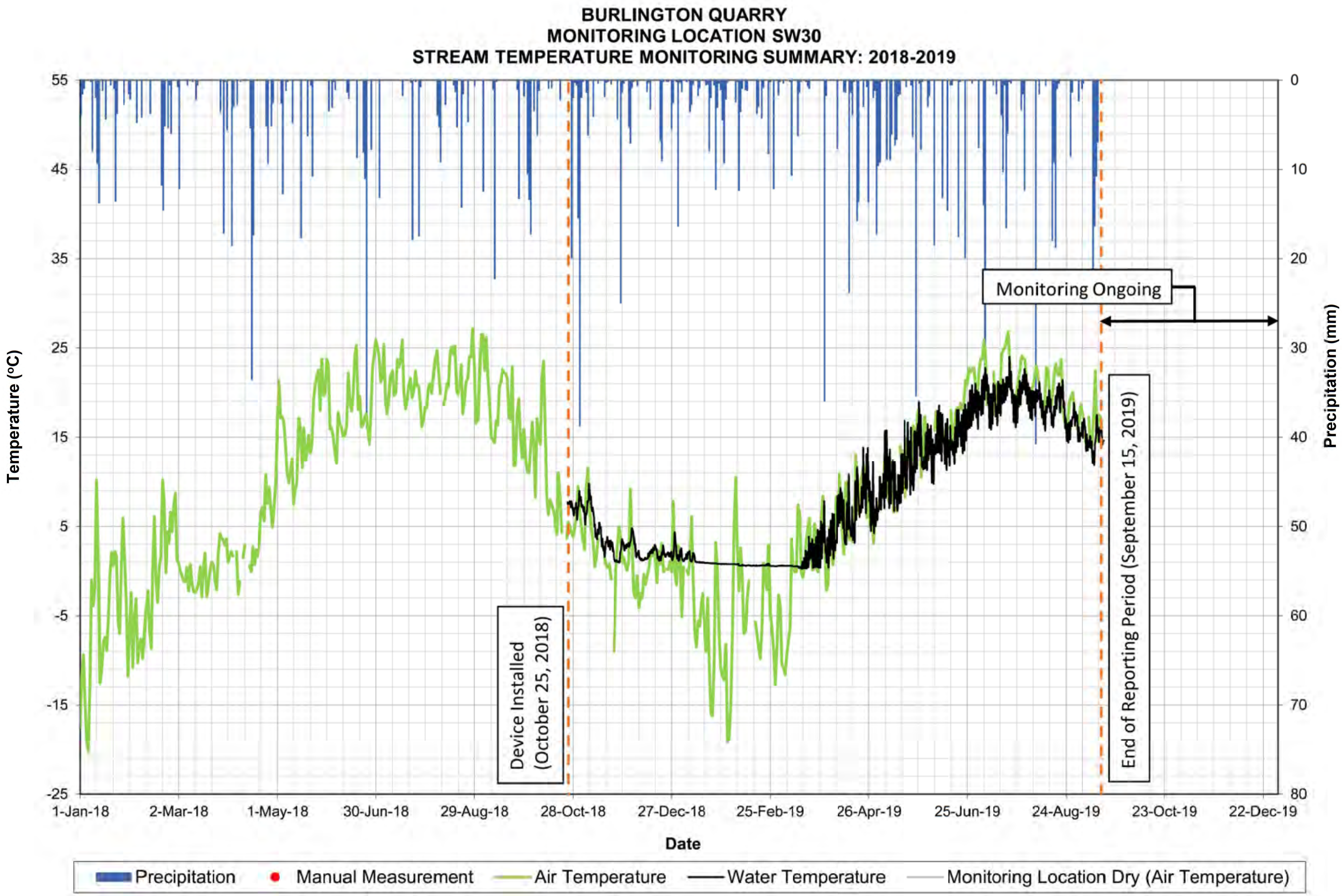

BURLINGTON QUARRY
MONITORING LOCATION SW15
STREAM FLOW MONITORING SUMMARY: 2018-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Device Installed (April 19, 2018)
Device Removed During Winter Season
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Stream Flow
Air Temperature

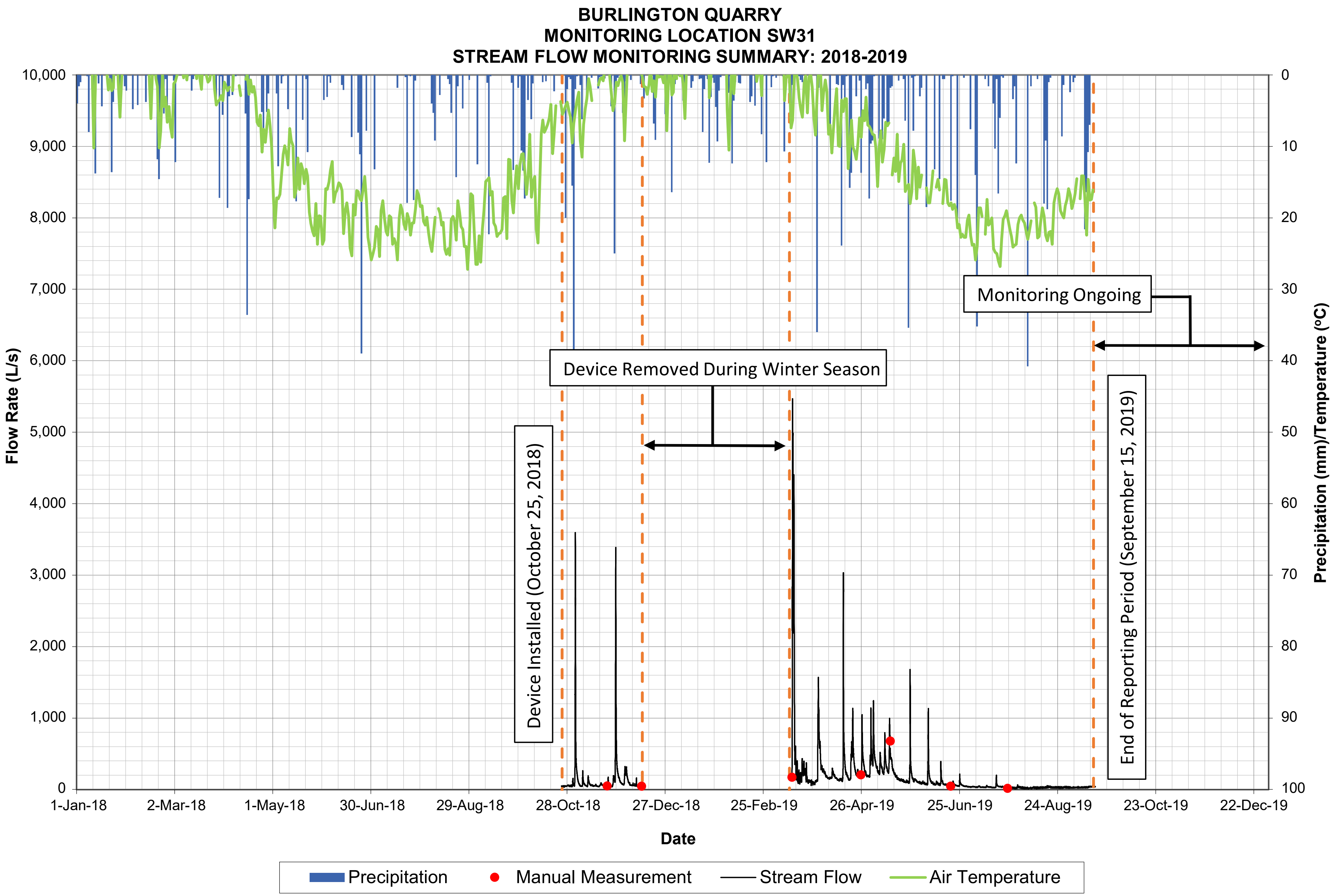


* Grey data indicates the monitoring location was dry and therefore the recorded values are representative of the air temperature.

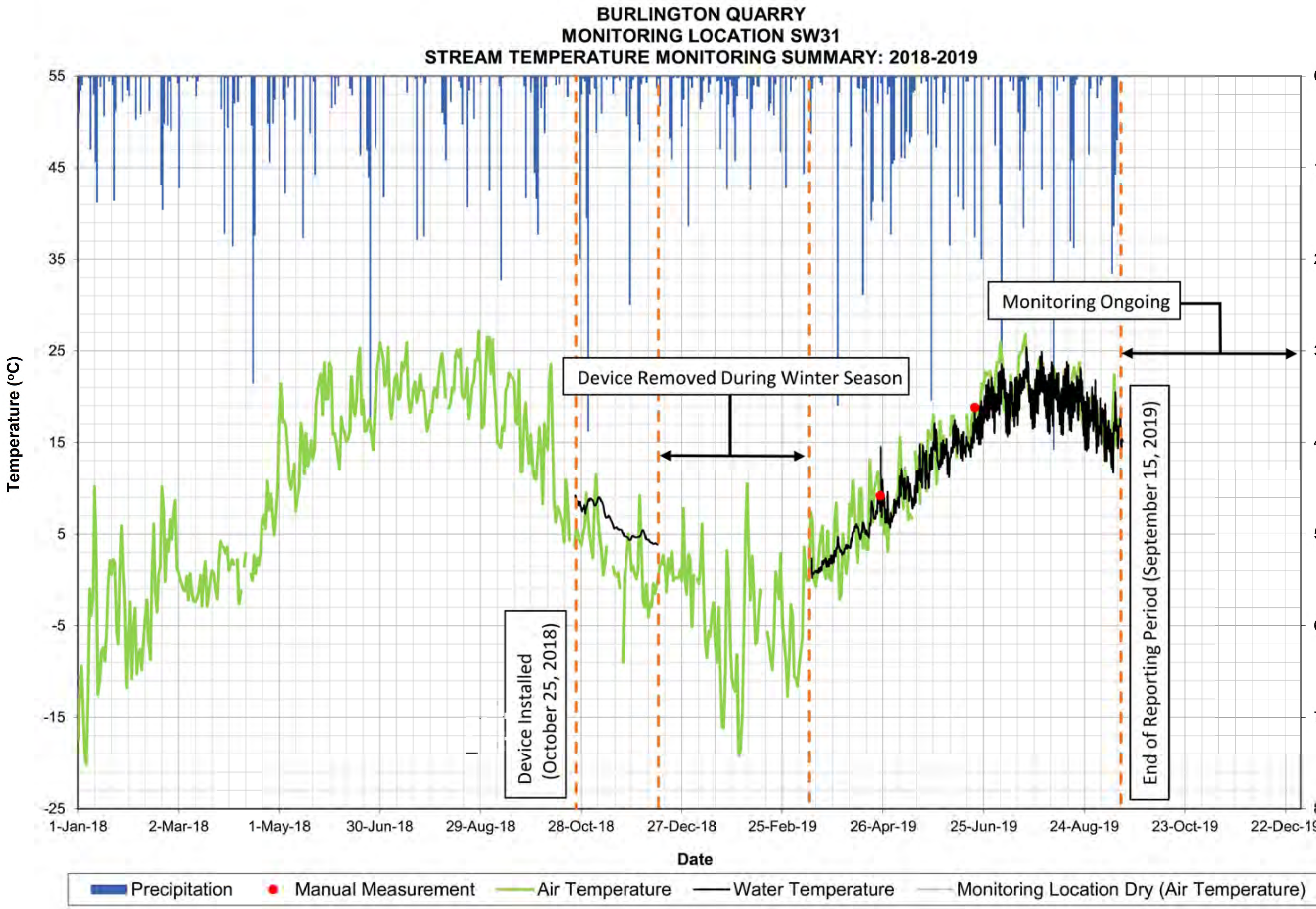
BURLINGTON QUARRY
MONITORING LOCATION SW30
STREAM FLOW MONITORING SUMMARY: 2018-2019



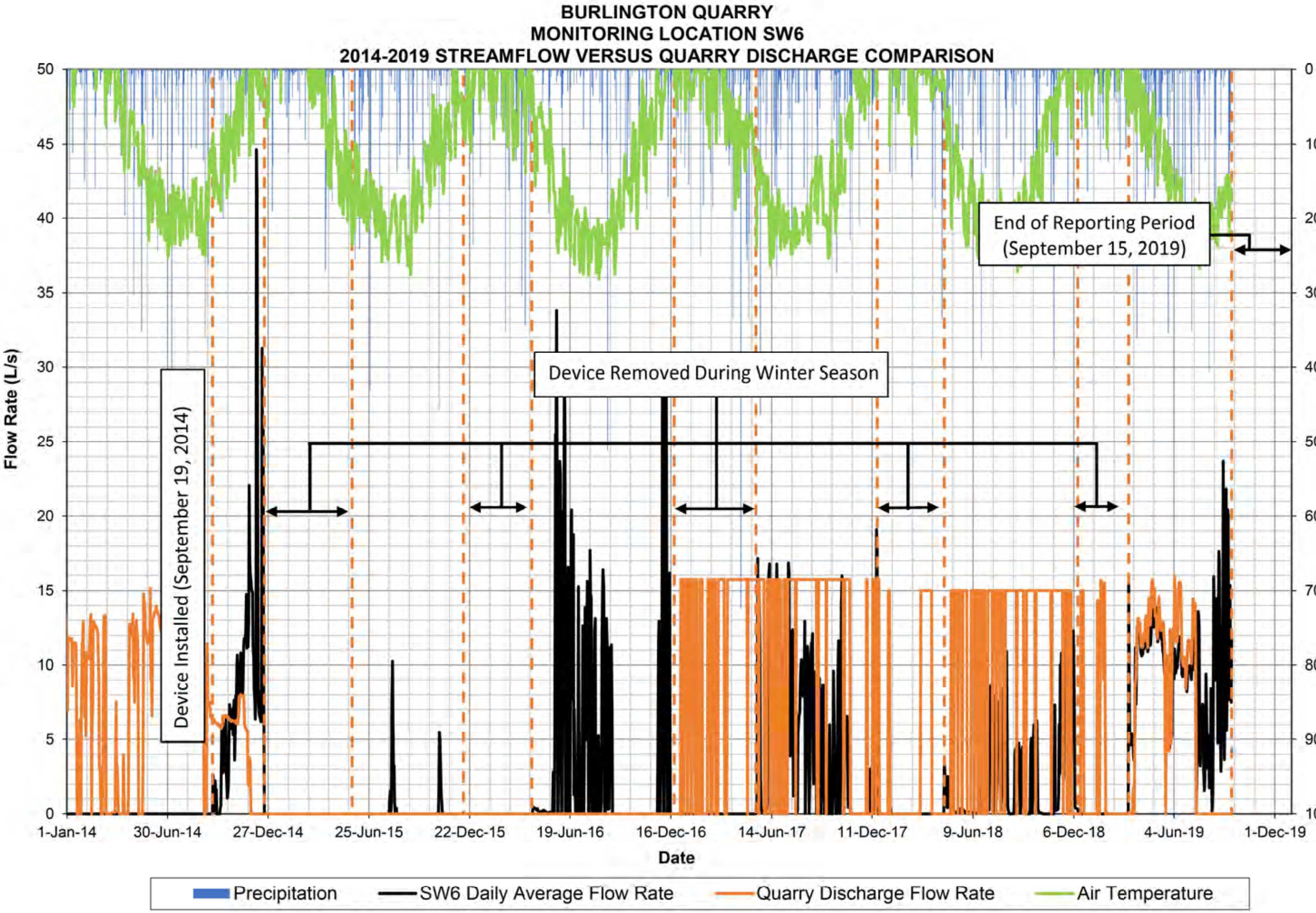

BURLINGTON QUARRY
MONITORING LOCATION SW30
STREAM TEMPERATURE MONITORING SUMMARY: 2018-2019
Temperature (°C)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Monitoring Ongoing
Device Installed (October 25, 2018)
End of Reporting Period (September 15, 2019)
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Date
Precipitation
Manual Measurement
Air Temperature
Water Temperature
Monitoring Location Dry (Air Temperature)



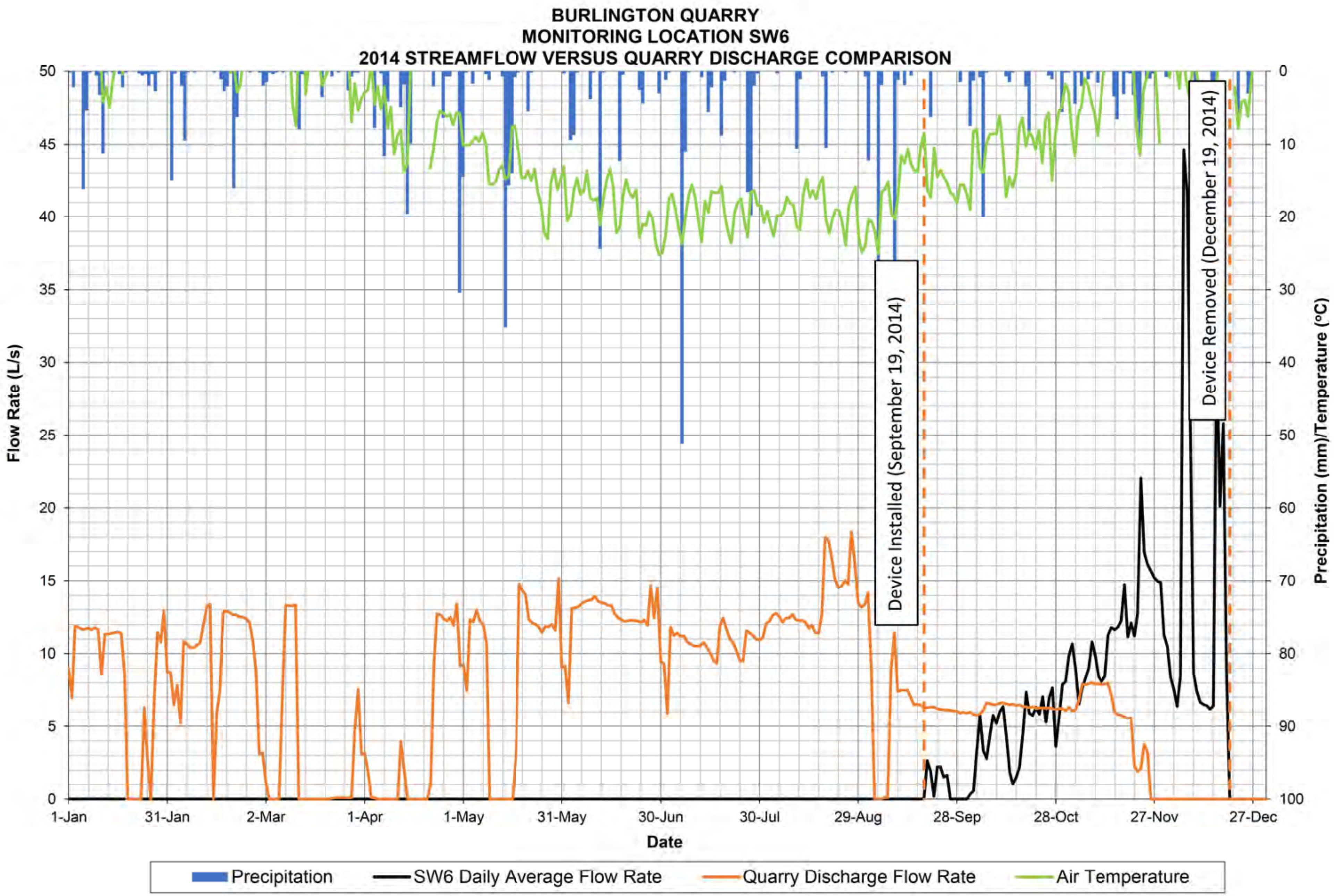
BURLINGTON QUARRY
MONITORING LOCATION SW31
STREAM FLOW MONITORING SUMMARY: 2018-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (ºC)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0
10
20
30
40
50
60
70
80
90
100
Device Installed (October 25, 2018)
Device Removed During Winter Season
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Date
Precipitation
Manual Measurement
Stream Flow
Air Temperature

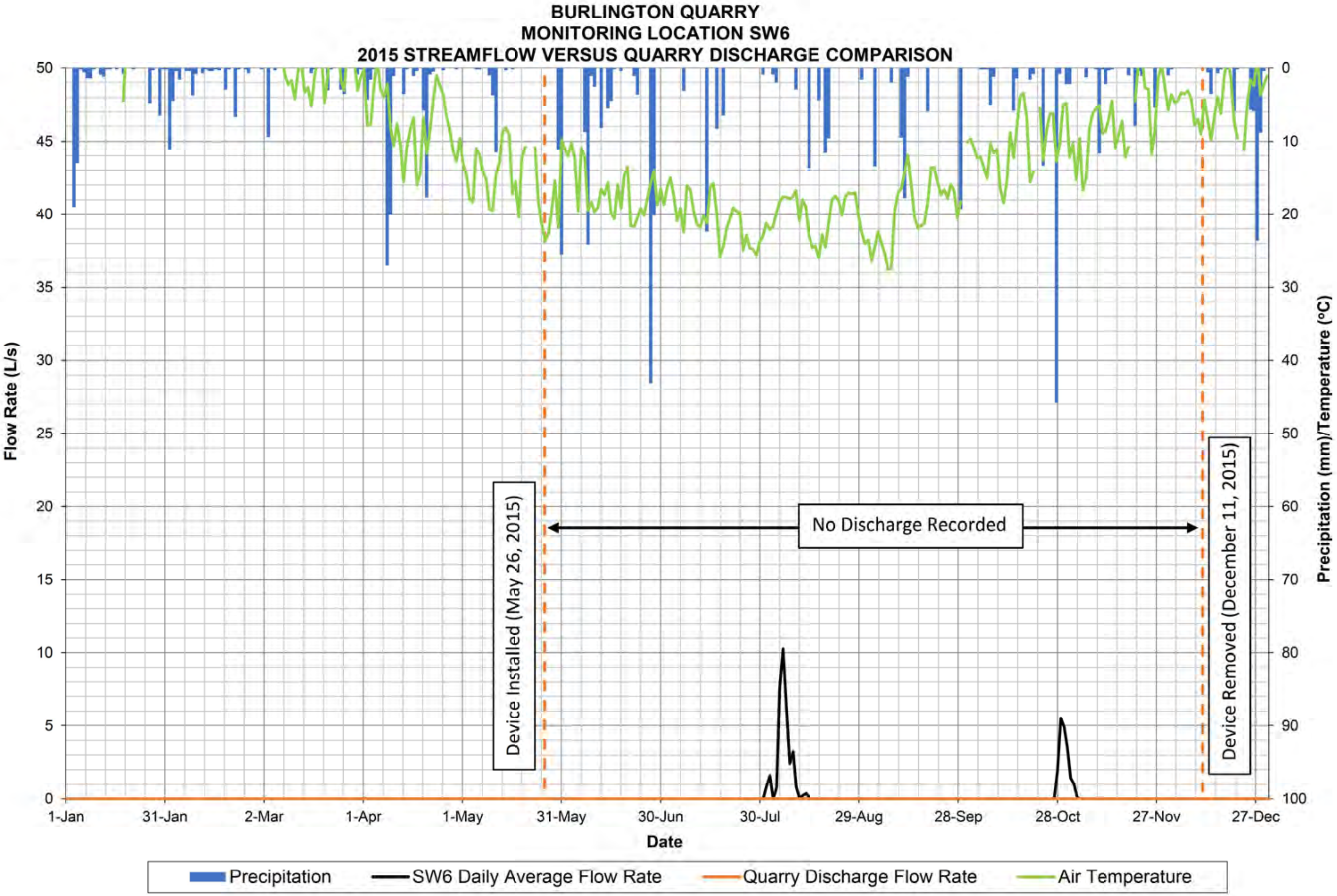

BURLINGTON QUARRY
MONITORING LOCATION SW31
STREAM TEMPERATURE MONITORING SUMMARY: 2018-2019
Temperature (°C)
Precipitation (mm)
Date
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Device Installed (October 25, 2018)
Device Removed During Winter Season
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Air Temperature
Water Temperature
Monitoring Location Dry (Air Temperature)

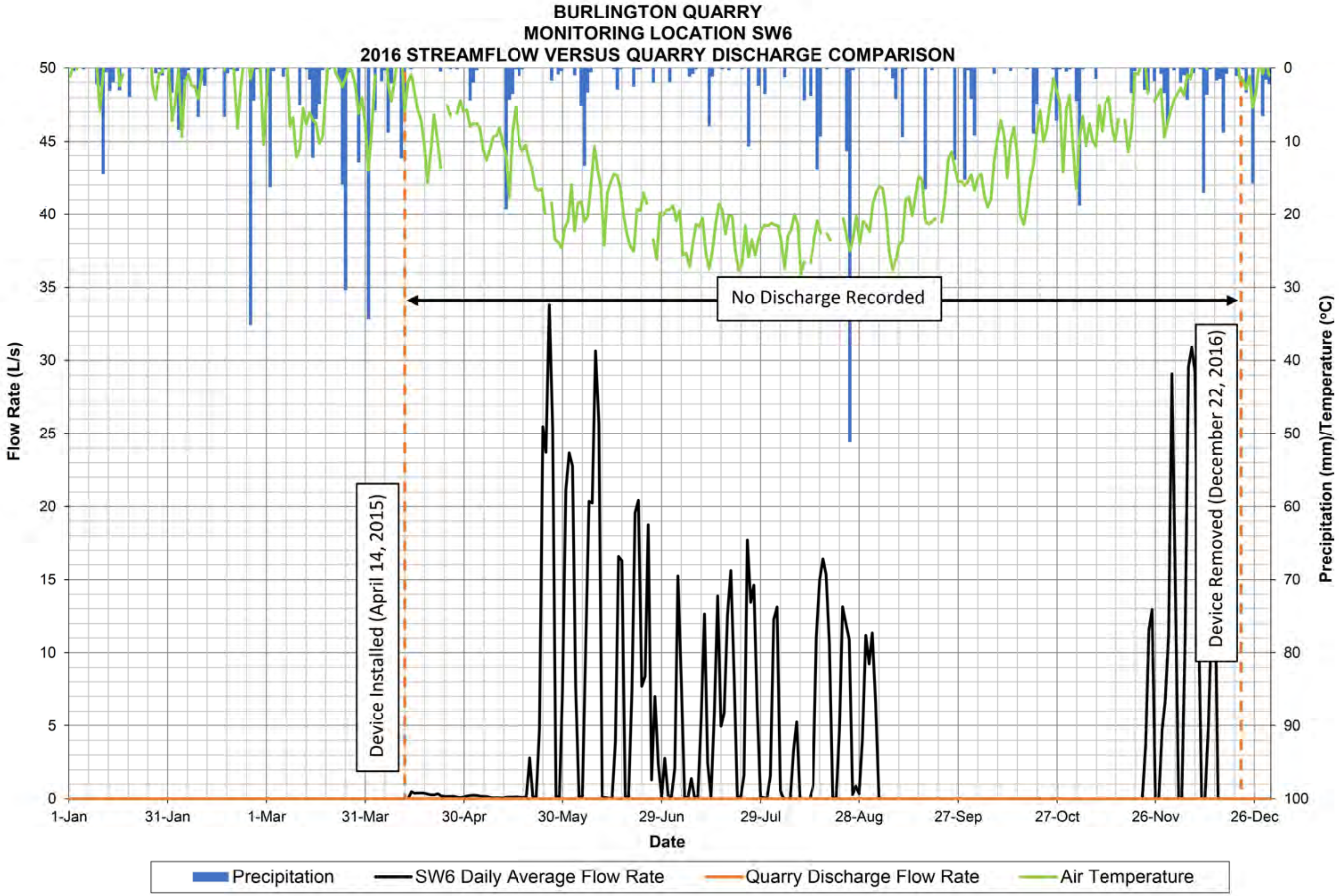
Appendix C:
Grindstone Creek Watershed Streamflow Monitoring Results



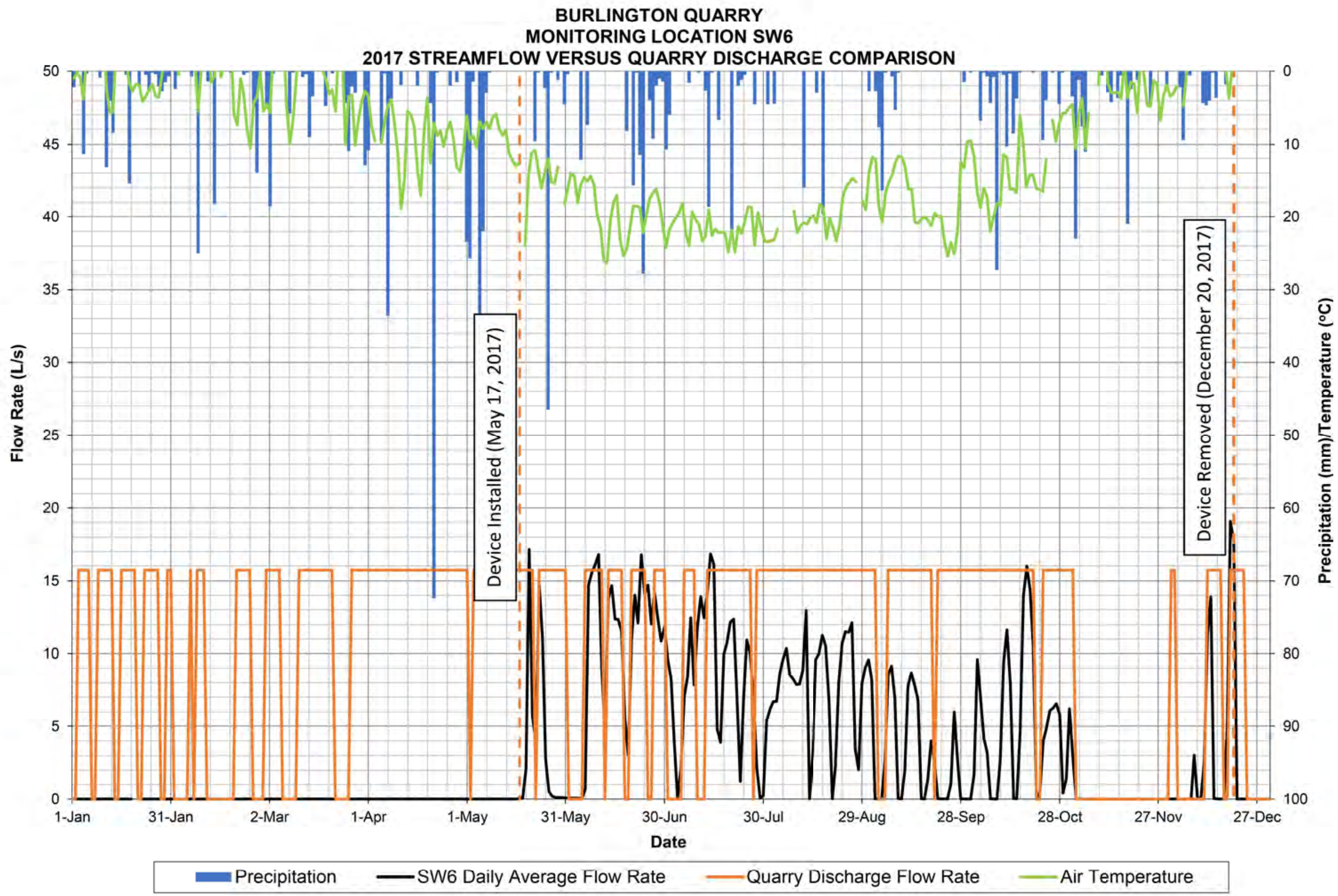
BURLINGTON QUARRY
MONITORING LOCATION SW6
2014-2019 STREAMFLOW VERSUS QUARRY DISCHARGE COMPARISON
Flow Rate (L/s)
Precipitation (mm)/Temperature (ºC)
Date
Device Installed (September 19, 2014)
Device Removed During Winter Season
End of Reporting Period (September 15, 2019)
1-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
9-Jun-18
6-Dec-18
4-Jun-19
1-Dec-19
Precipitation
SW6 Daily Average Flow Rate
Quarry Discharge Flow Rate
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW6
2014 STREAMFLOW VERSUS QUARRY DISCHARGE COMPARISON
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (September 19, 2014)
Device Removed (December 19, 2014)
Precipitation
SW6 Daily Average Flow Rate
Quarry Discharge Flow Rate
Air Temperature

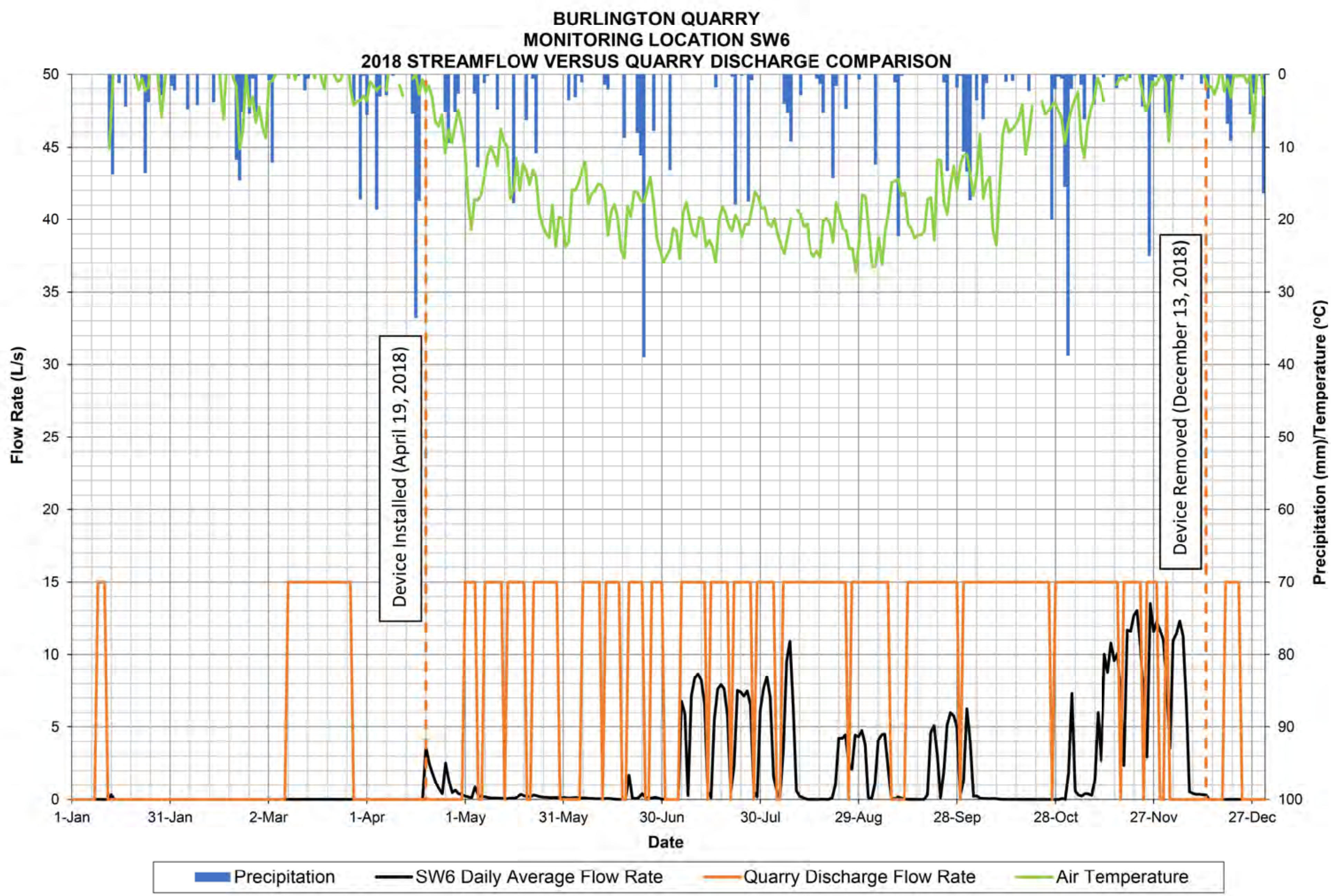

BURLINGTON QUARRY
MONITORING LOCATION SW6
2015 STREAMFLOW VERSUS QUARRY DISCHARGE COMPARISON
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (May 26, 2015)
No Discharge Recorded
Device Removed (December 11, 2015)
Precipitation
SW6 Daily Average Flow Rate
Quarry Discharge Flow Rate
Air Temperature

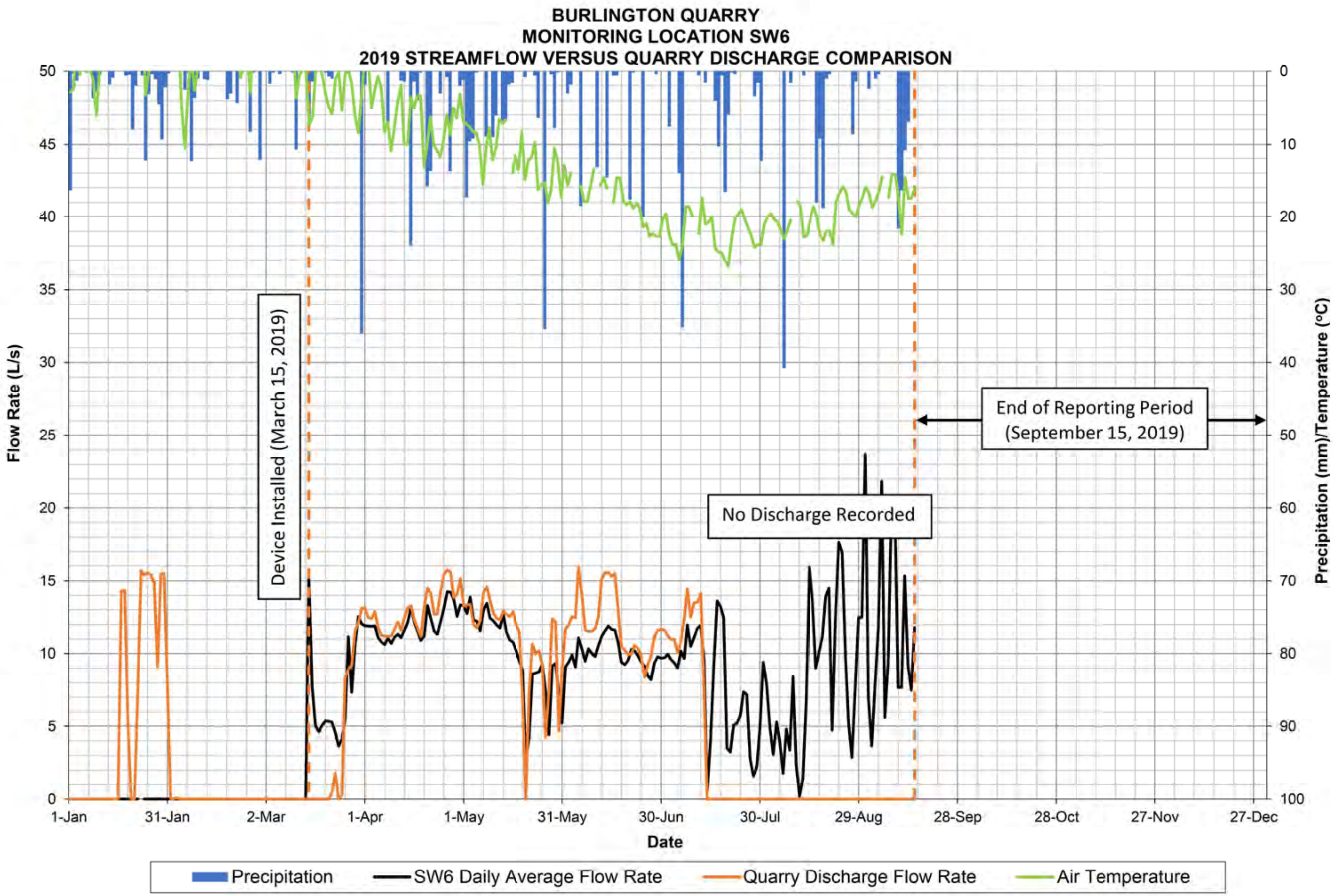


BURLINGTON QUARRY
MONITORING LOCATION SW6
2016 STREAMFLOW VERSUS QUARRY DISCHARGE COMPARISON
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
0
5
10
15
20
25
30
35
40
45
50
100
90
80
70
60
50
40
30
20
10
0
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
No Discharge Recorded
Device Installed (April 14, 2015)
Device Removed (December 22, 2016)
Precipitation
SW6 Daily Average Flow Rate
Quarry Discharge Flow Rate
Air Temperature

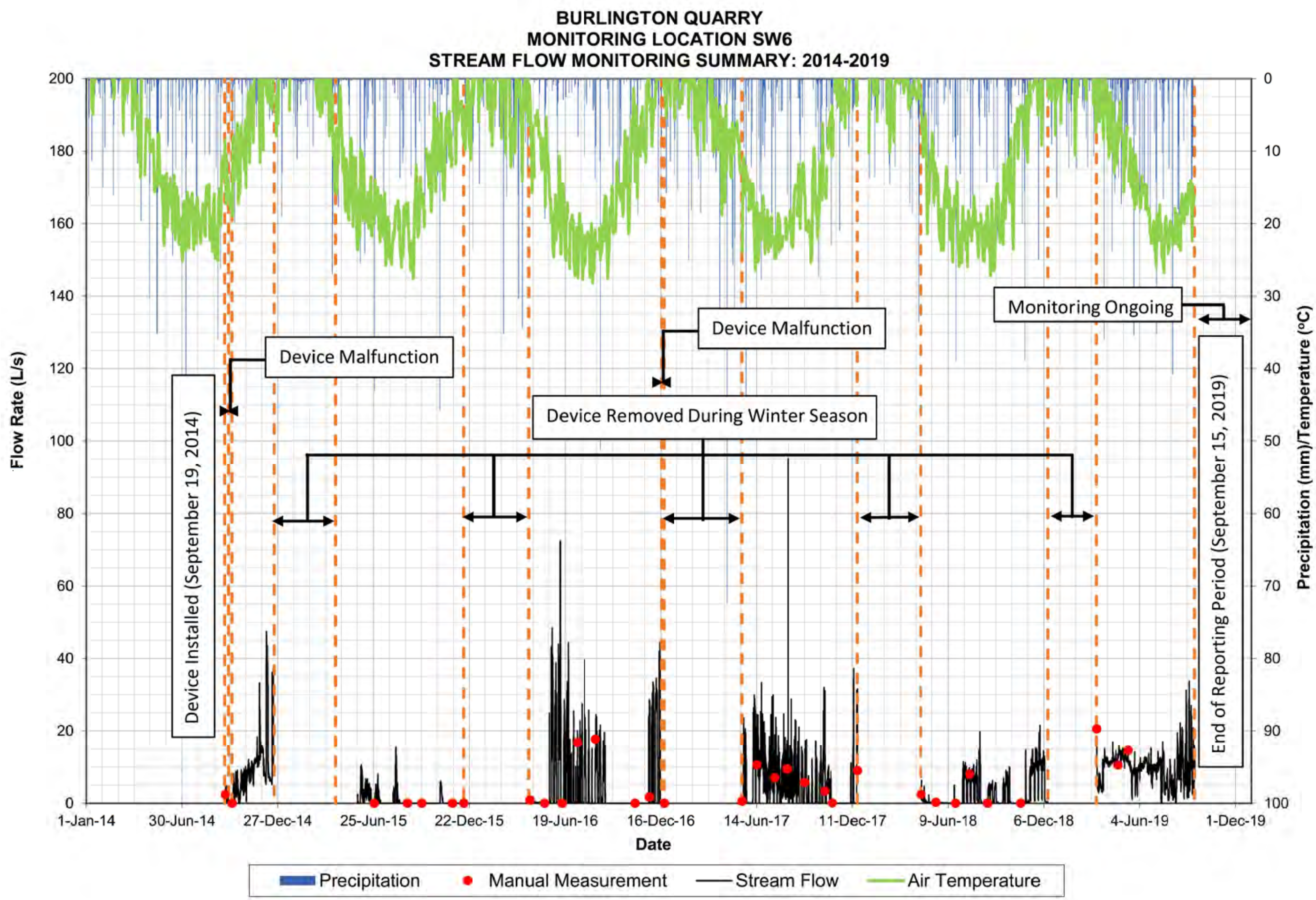


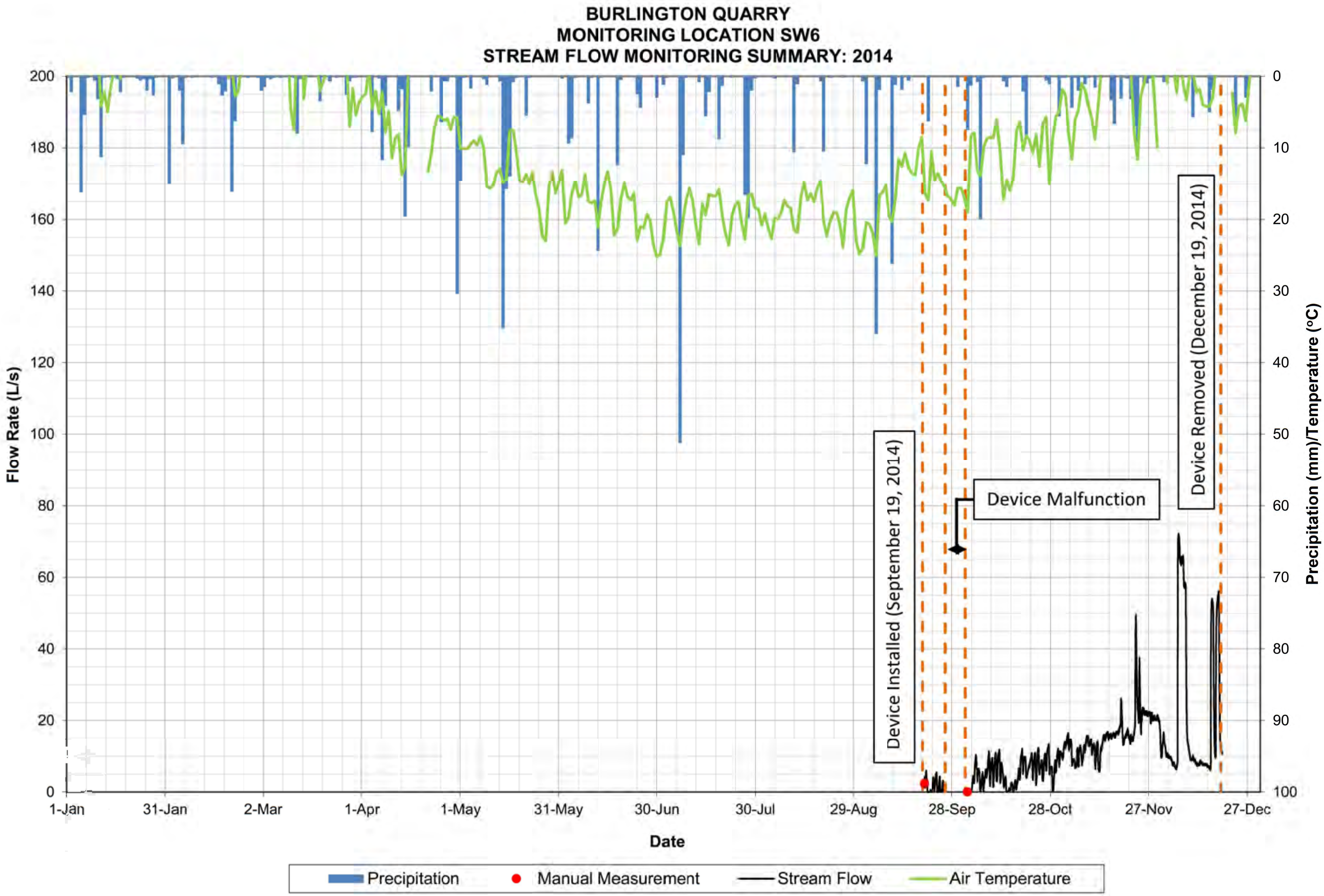
BURLINGTON QUARRY
MONITORING LOCATION SW6
2017 STREAMFLOW VERSUS QUARRY DISCHARGE COMPARISON
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (May 17, 2017)
Device Removed (December 20, 2017)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
SW6 Daily Average Flow Rate
Quarry Discharge Flow Rate
Air Temperature

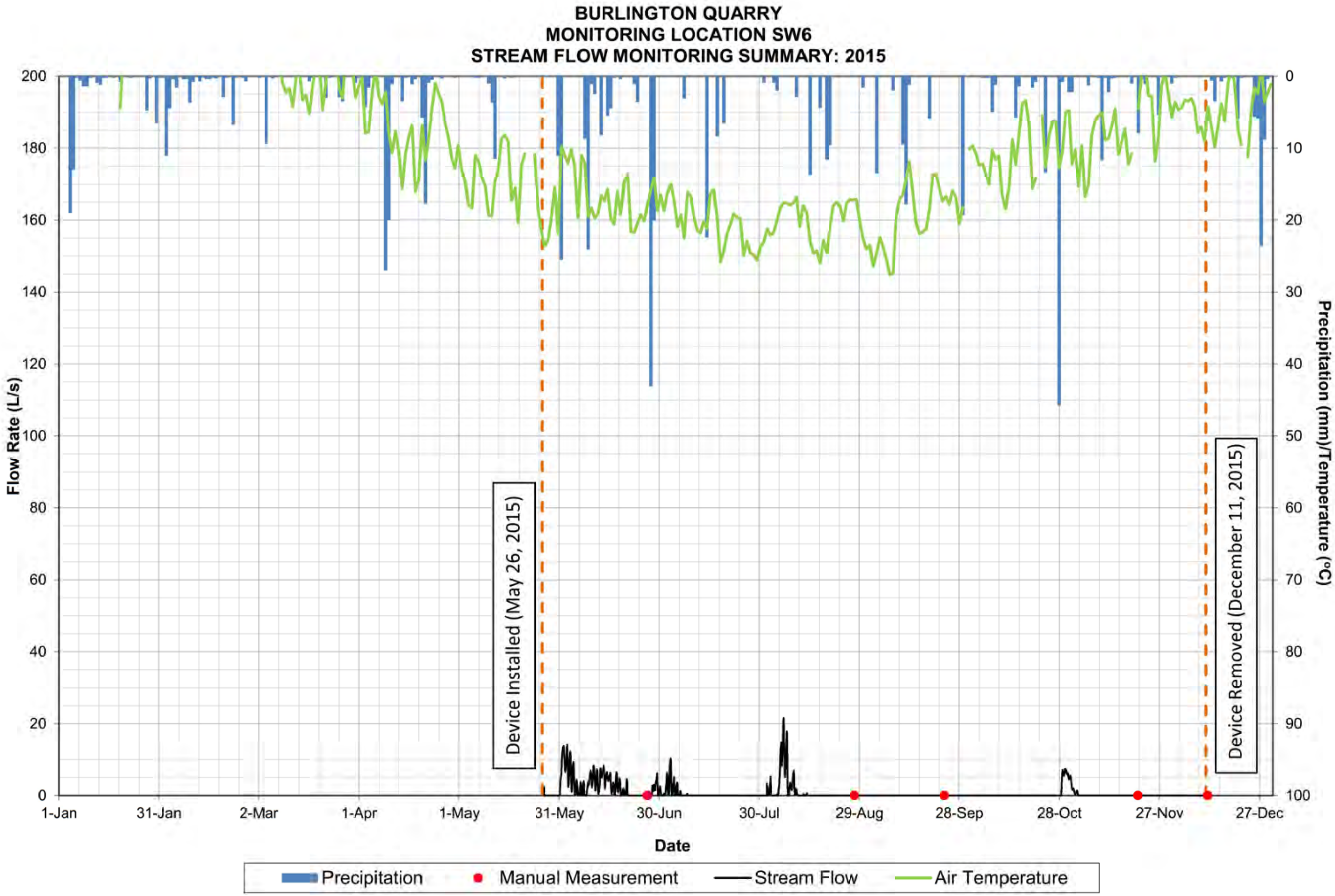

BURLINGTON QUARRY
MONITORING LOCATION SW6
2018 STREAMFLOW VERSUS QUARRY DISCHARGE COMPARISON
Flow Rate (L/s)
Precipitation (mm)/Temperature (ºC)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (April 19, 2018)
Device Removed (December 13, 2018)
Precipitation
SW6 Daily Average Flow Rate
Quarry Discharge Flow Rate
Air Temperature

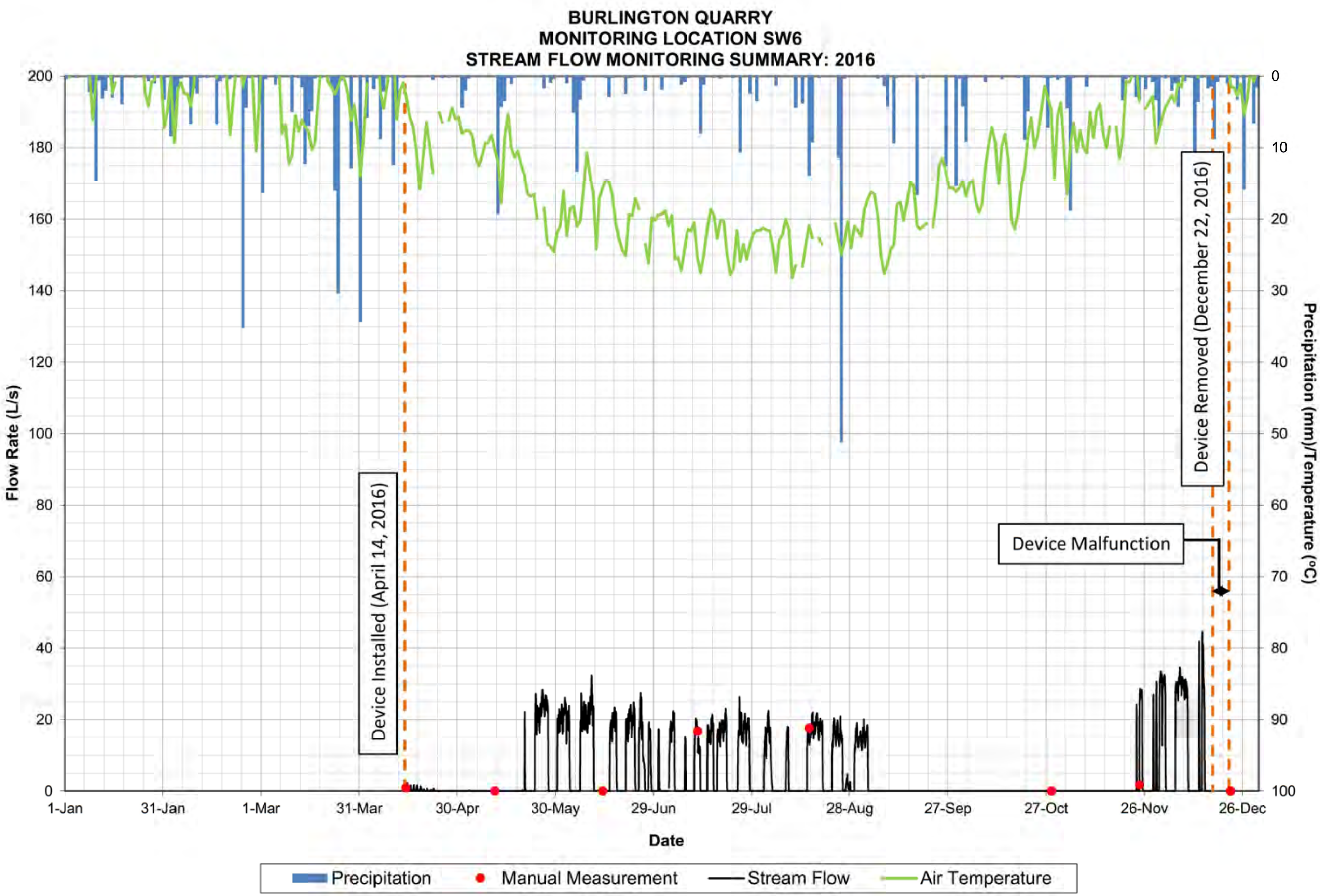


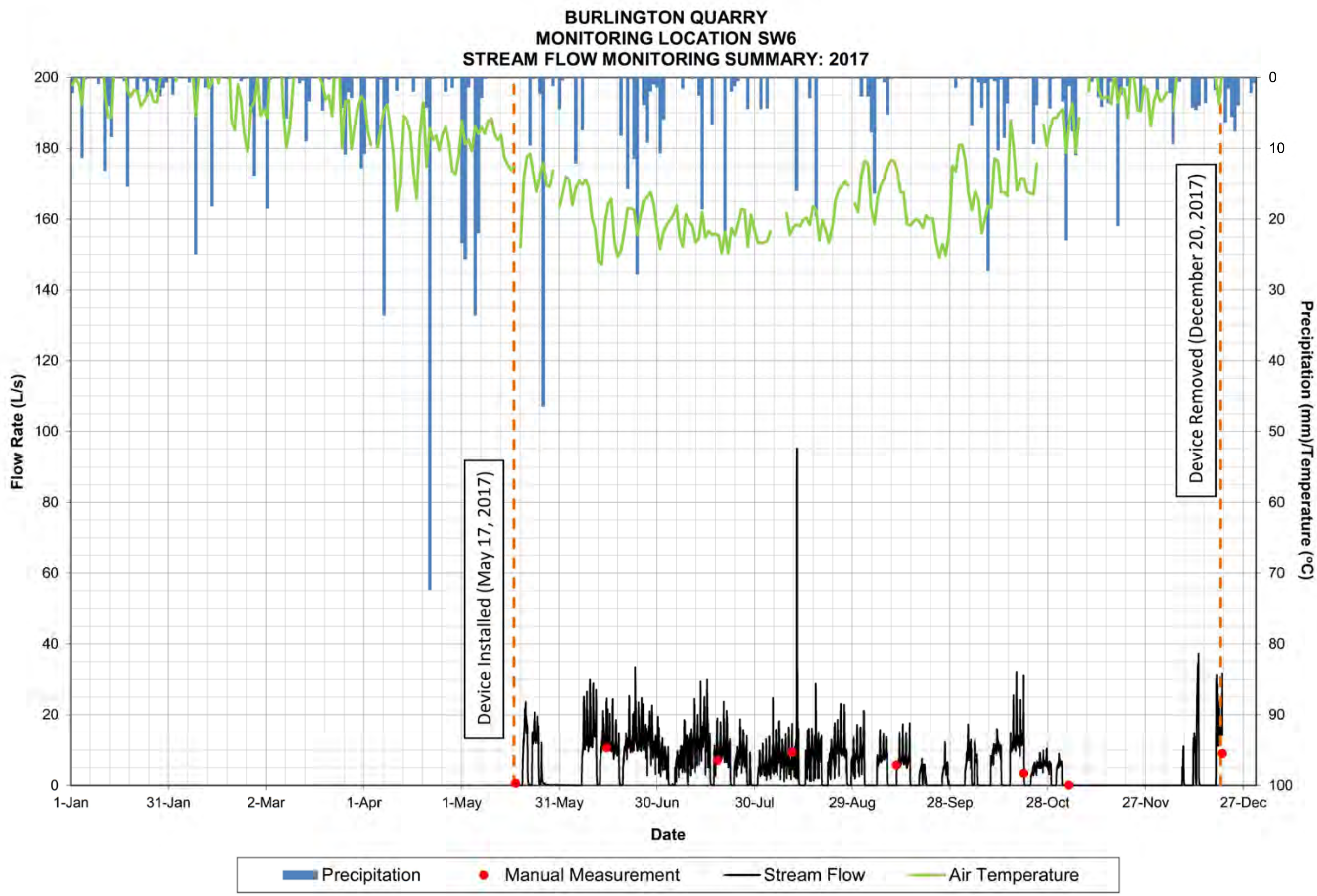
BURLINGTON QUARRY
MONITORING LOCATION SW6
2019 STREAMFLOW VERSUS QUARRY DISCHARGE COMPARISON
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (March 15, 2019)
No Discharge Recorded
End of Reporting Period
(September 15, 2019)
Precipitation
SW6 Daily Average Flow Rate
Quarry Discharge Flow Rate
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW6
STREAM FLOW MONITORING SUMMARY: 2014-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (ºC)
200
180
160
140
120
100
80
60
40
20
0
10
30
50
70
90
Device Installed (September 19, 2014)
Device Malfunction
Device Malfunction
Device Removed During Winter Season
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
1-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
9-Jun-18
6-Dec-18
4-Jun-19
1-Dec-19
Date
Precipitation
Manual Measurement
Stream Flow
Air Temperature

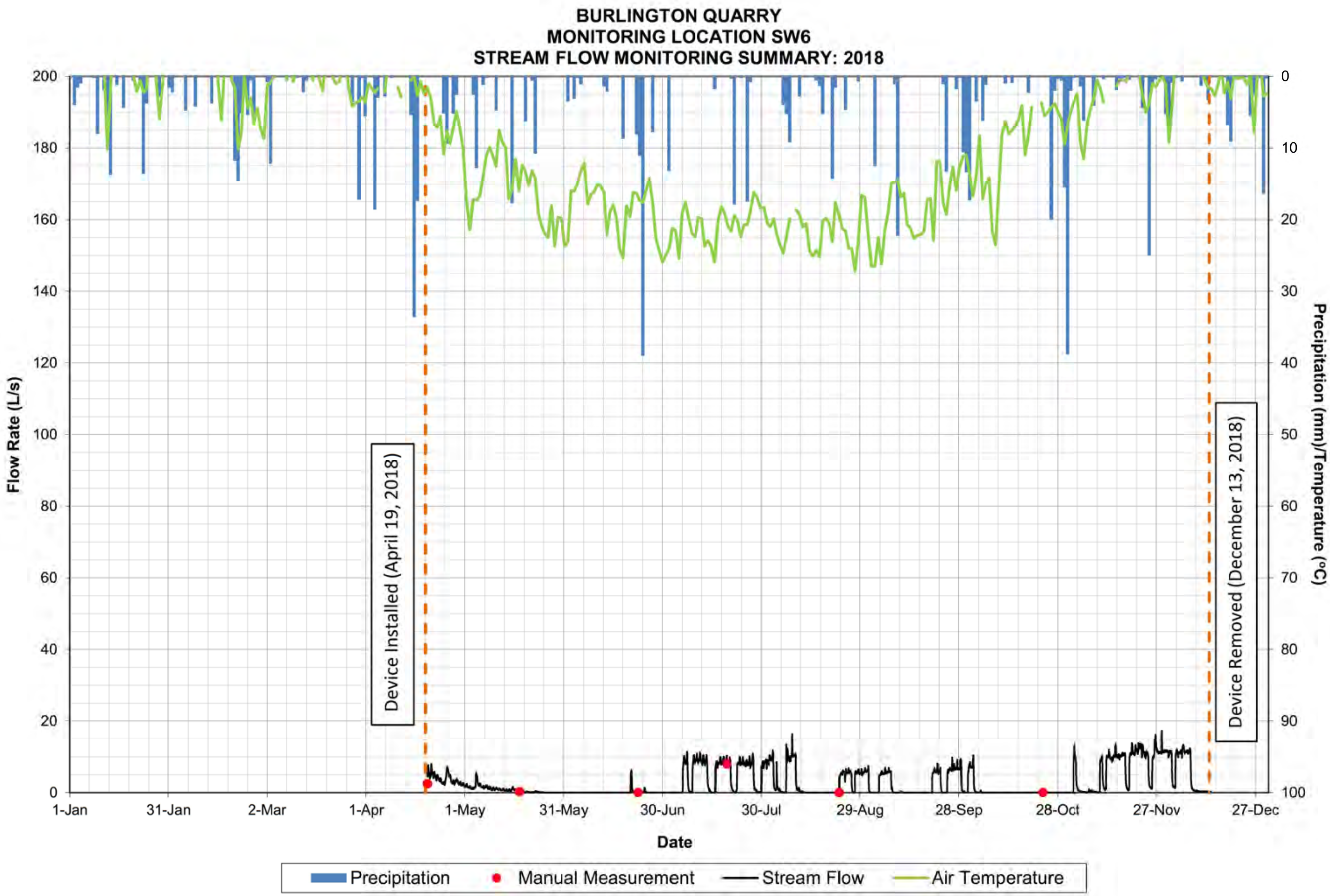

BURLINGTON QUARRY
MONITORING LOCATION SW6
STREAM FLOW MONITORING SUMMARY: 2014
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (September 19, 2014)
Device Malfunction
Device Removed (December 19, 2014)
Precipitation
Manual Measurement
Stream Flow
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW6
STREAM FLOW MONITORING SUMMARY: 2015
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (May 26, 2015)
Device Removed (December 11, 2015)
200
180
160
140
120
100
80
60
40
20
0
10
30
50
70
90
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Manual Measurement
Stream Flow
Air Temperature

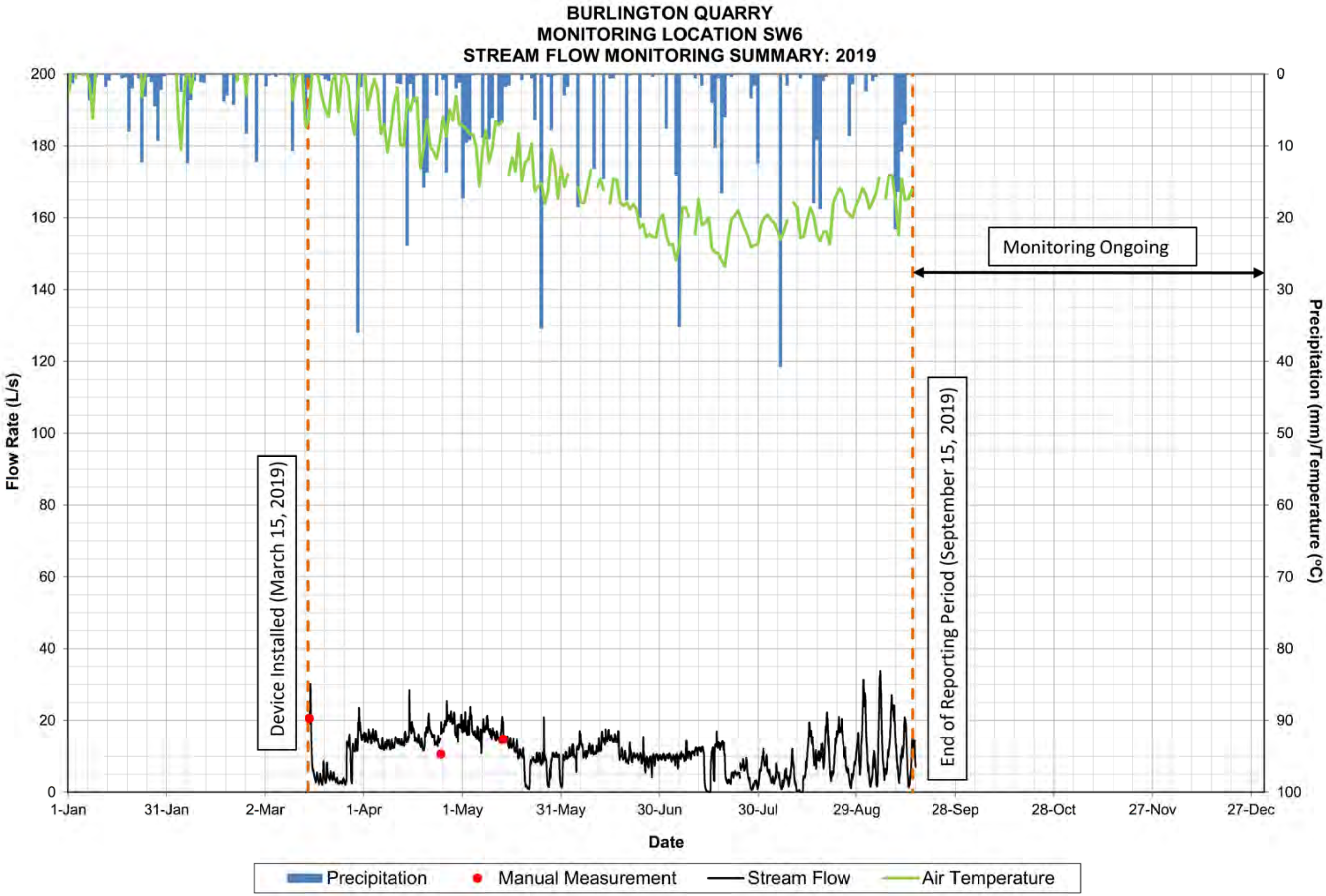

BURLINGTON QUARRY
MONITORING LOCATION SW6
STREAM FLOW MONITORING SUMMARY: 2016
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
200
180
160
140
120
100
80
60
40
20
0
10
30
50
70
90
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Device Installed (April 14, 2016)
Device Removed (December 22, 2016)
Device Malfunction
Precipitation
Manual Measurement
Stream Flow
Air Temperature



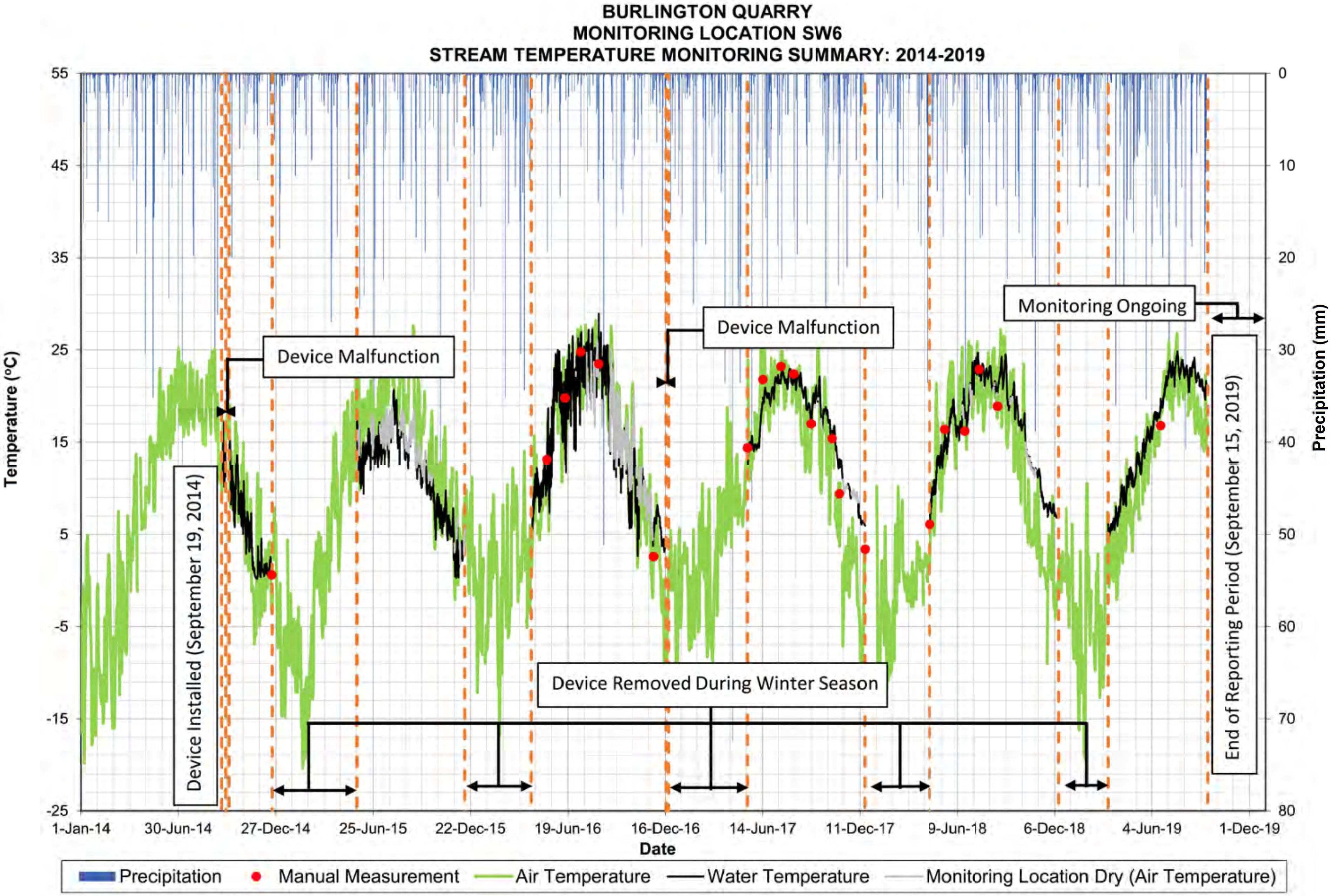
BURLINGTON QUARRY
MONITORING LOCATION SW6
STREAM FLOW MONITORING SUMMARY: 2017
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (May 17, 2017)
Device Removed (December 20, 2017)
Precipitation
Manual Measurement
Stream Flow
Air Temperature



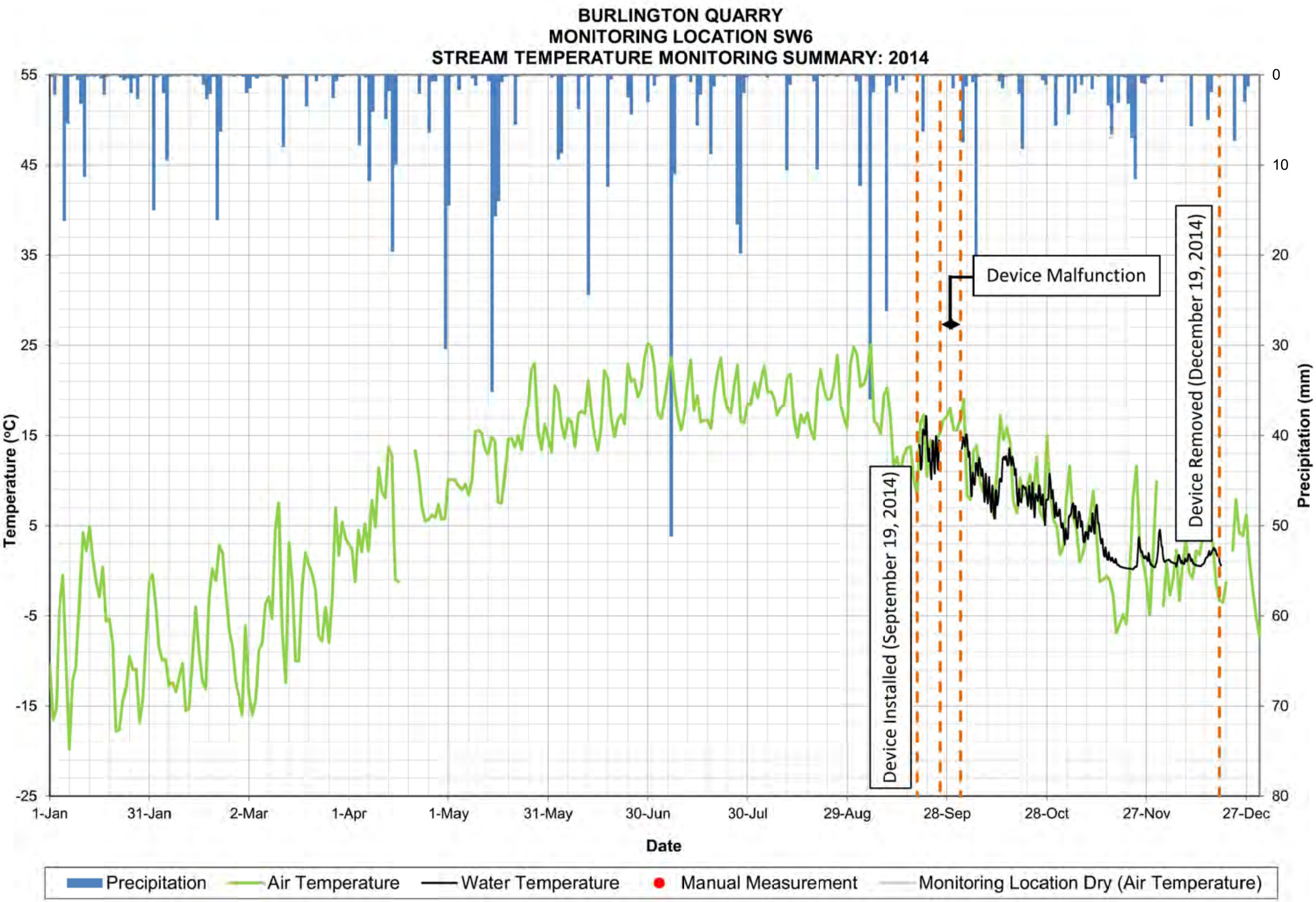
BURLINGTON QUARRY
MONITORING LOCATION SW6
STREAM FLOW MONITORING SUMMARY: 2018
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (April 19, 2018)
Device Removed (December 13, 2018)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
0
20
40
60
80
100
120
140
160
180
200
10
30
50
70
90
Precipitation
Manual Measurement
Stream Flow
Air Temperature

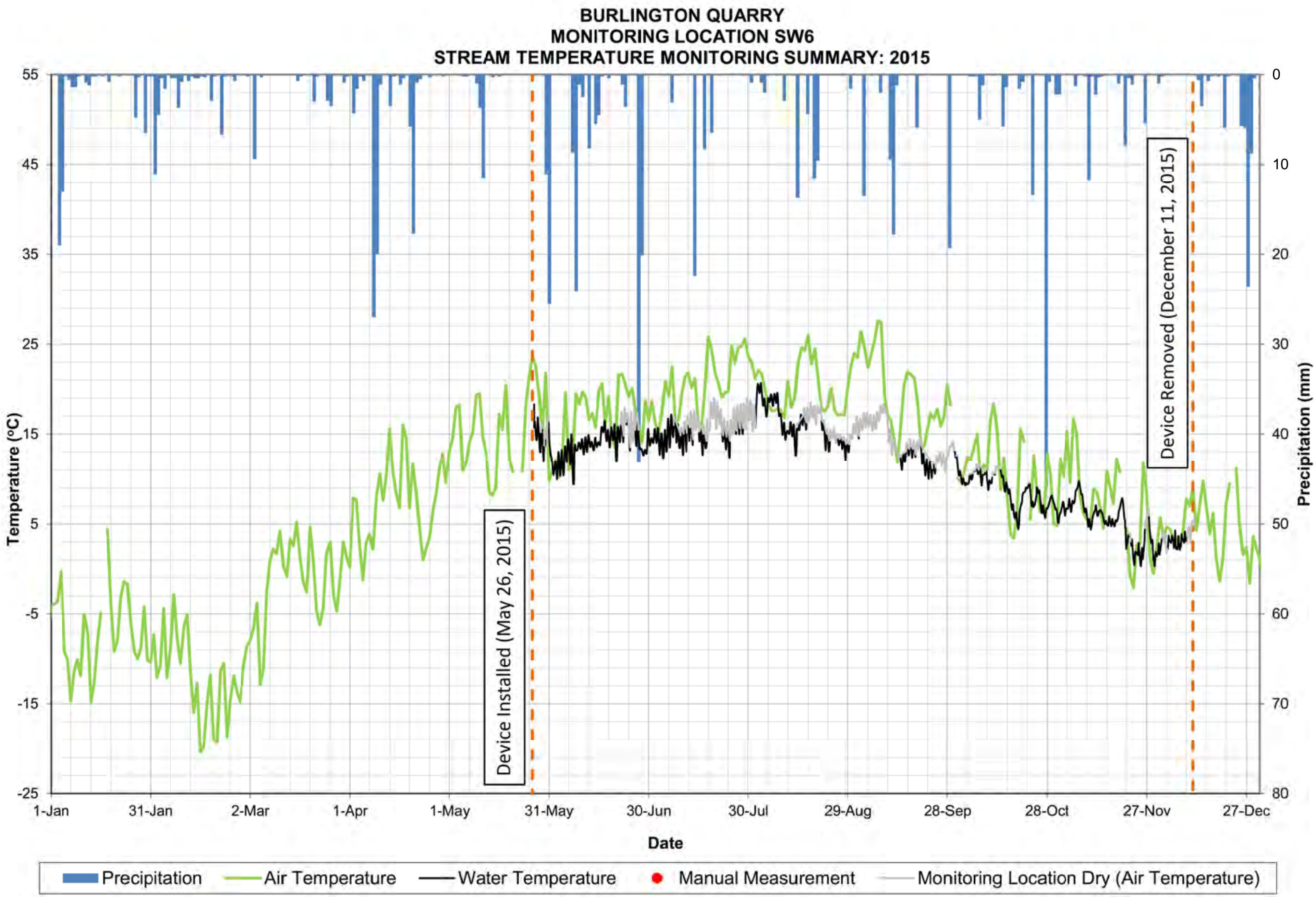


BURLINGTON QUARRY
MONITORING LOCATION SW6
STREAM FLOW MONITORING SUMMARY: 2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (March 15, 2019)
End of Reporting Period (September 15, 2019)
Monitoring Ongoing
200
180
160
140
120
100
80
60
40
20
0
10
30
50
70
90
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Manual Measurement
Stream Flow
Air Temperature

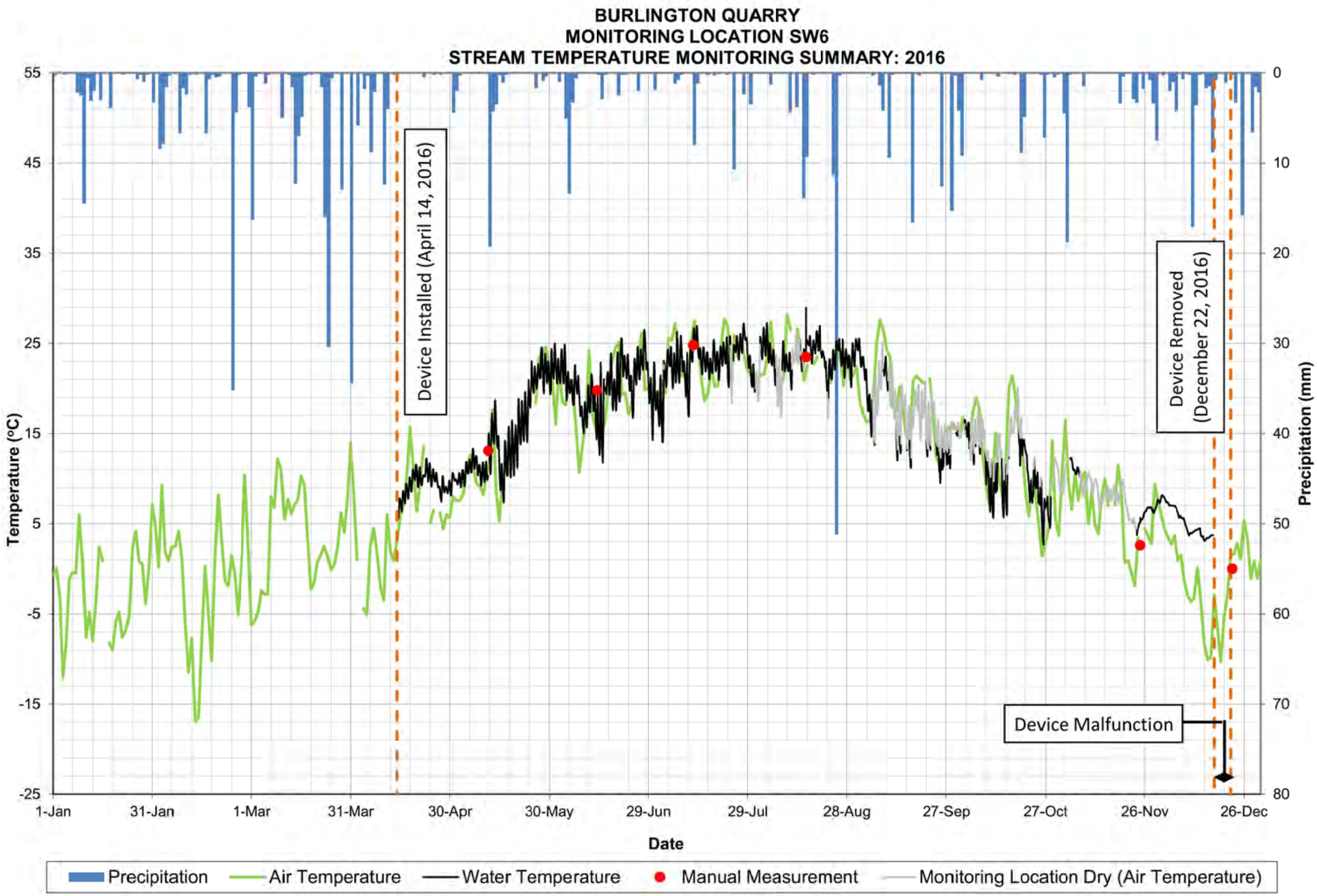


* Grey data indicates the monitoring location was dry and therefore the recorded values are representative of the air temperature.

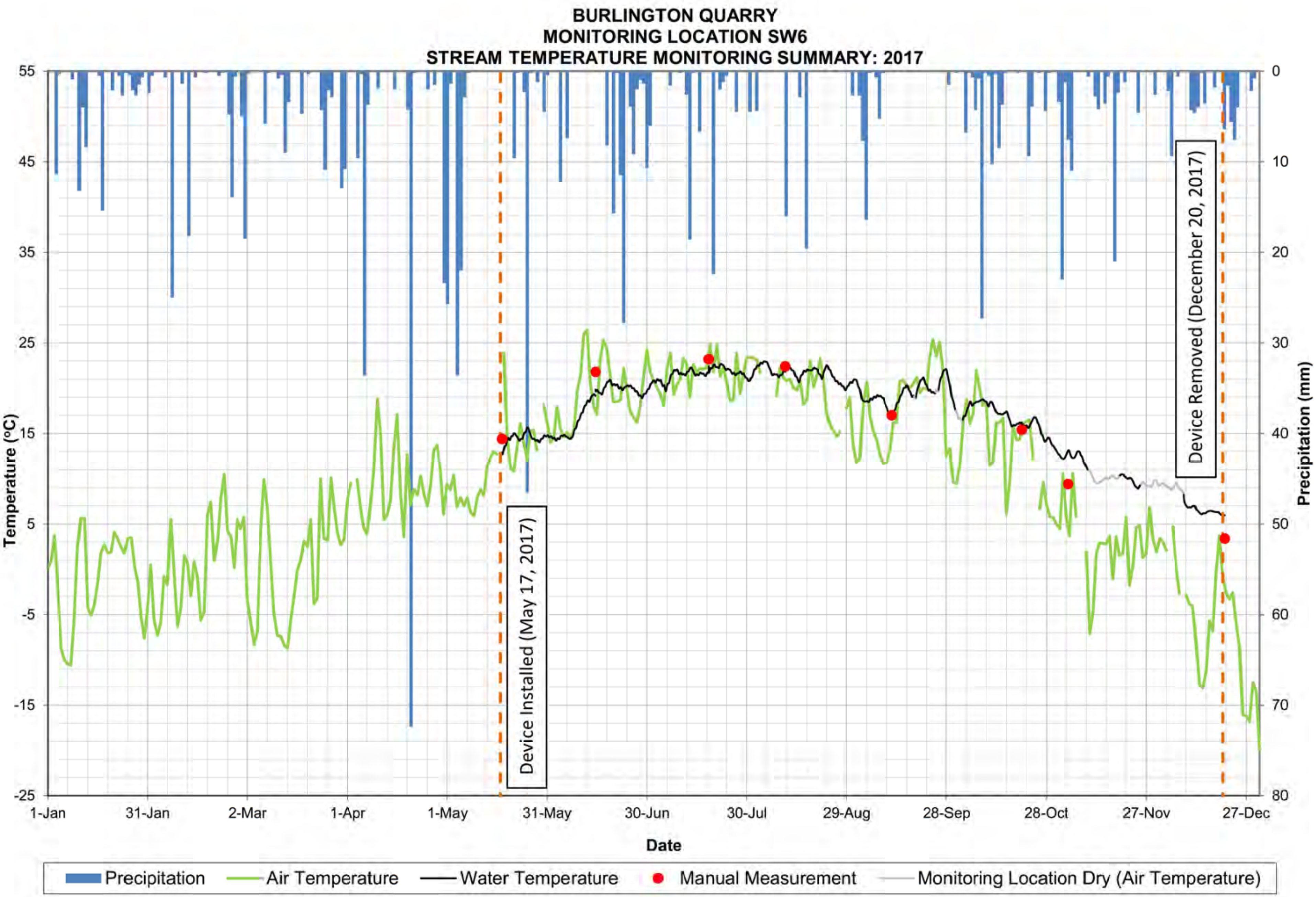

BURLINGTON QUARRY
MONITORING LOCATION SW6
STREAM TEMPERATURE MONITORING SUMMARY: 2014
Temperature (ºC)
Precipitation (mm)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Device Malfunction
Device Installed (September 19, 2014)
Device Removed (December 19, 2014)
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

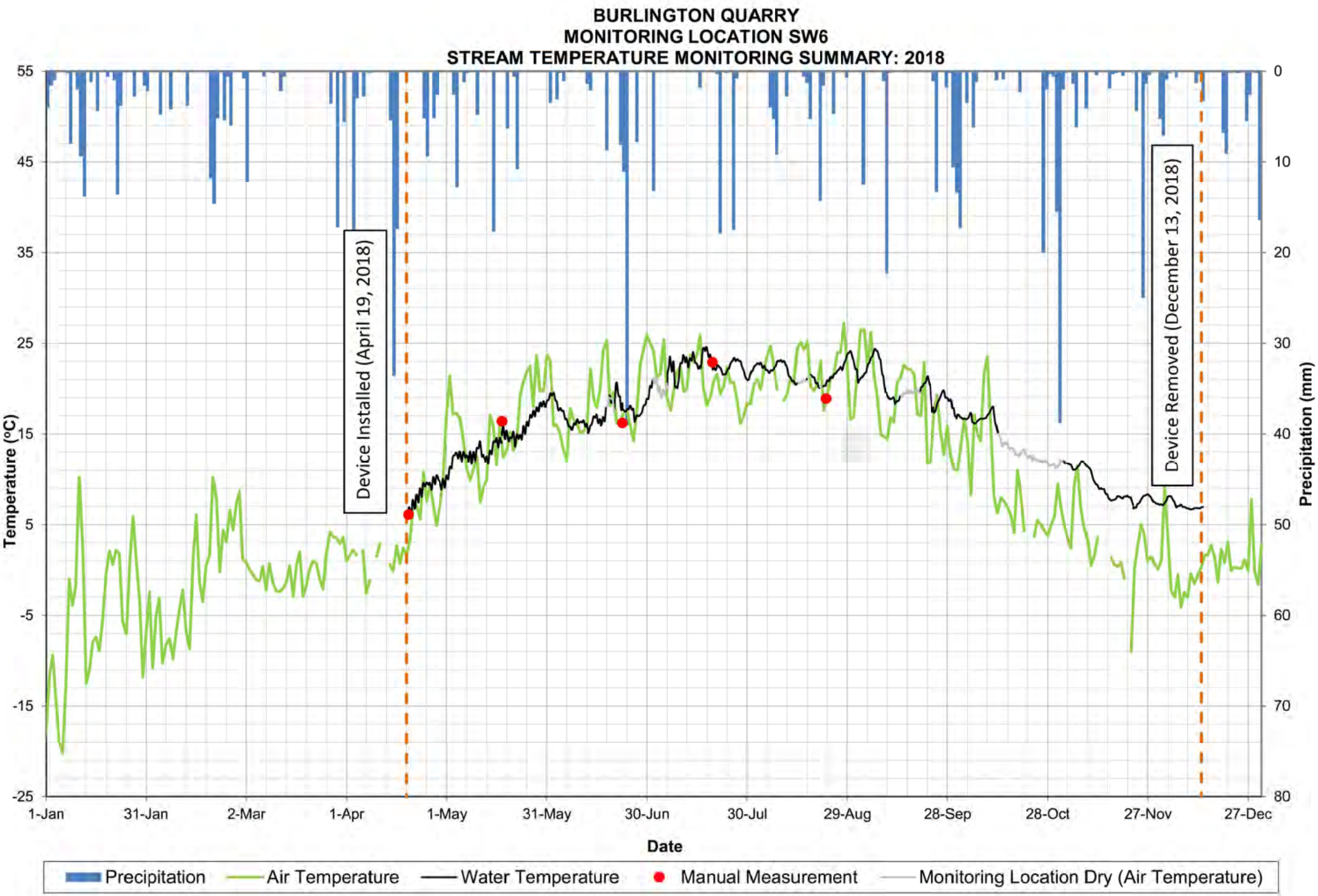


BURLINGTON QUARRY
MONITORING LOCATION SW6
STREAM TEMPERATURE MONITORING SUMMARY: 2015
Temperature (ºC)
Precipitation (mm)
Date
Device Installed (May 26, 2015)
Device Removed (December 11, 2015)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

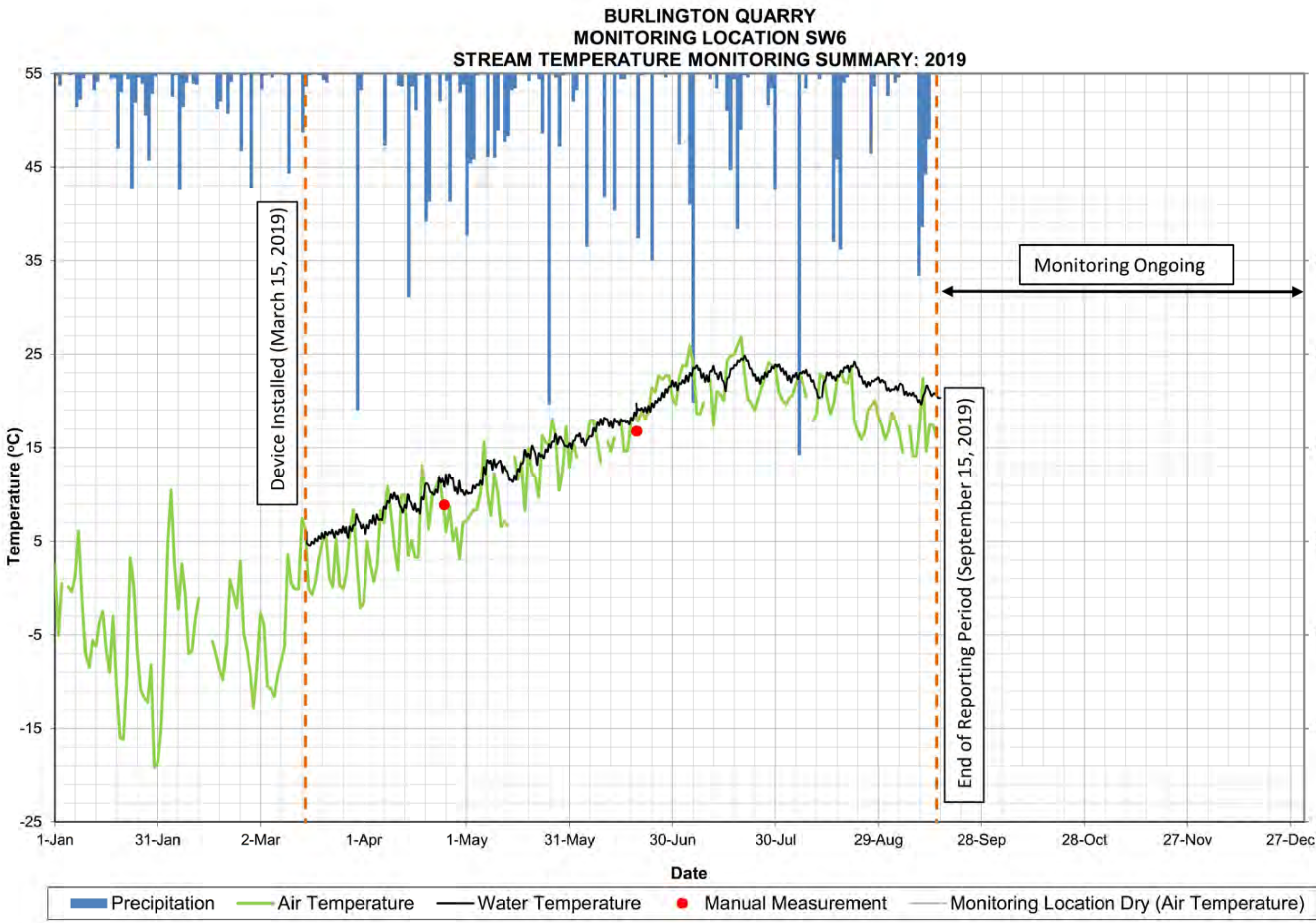


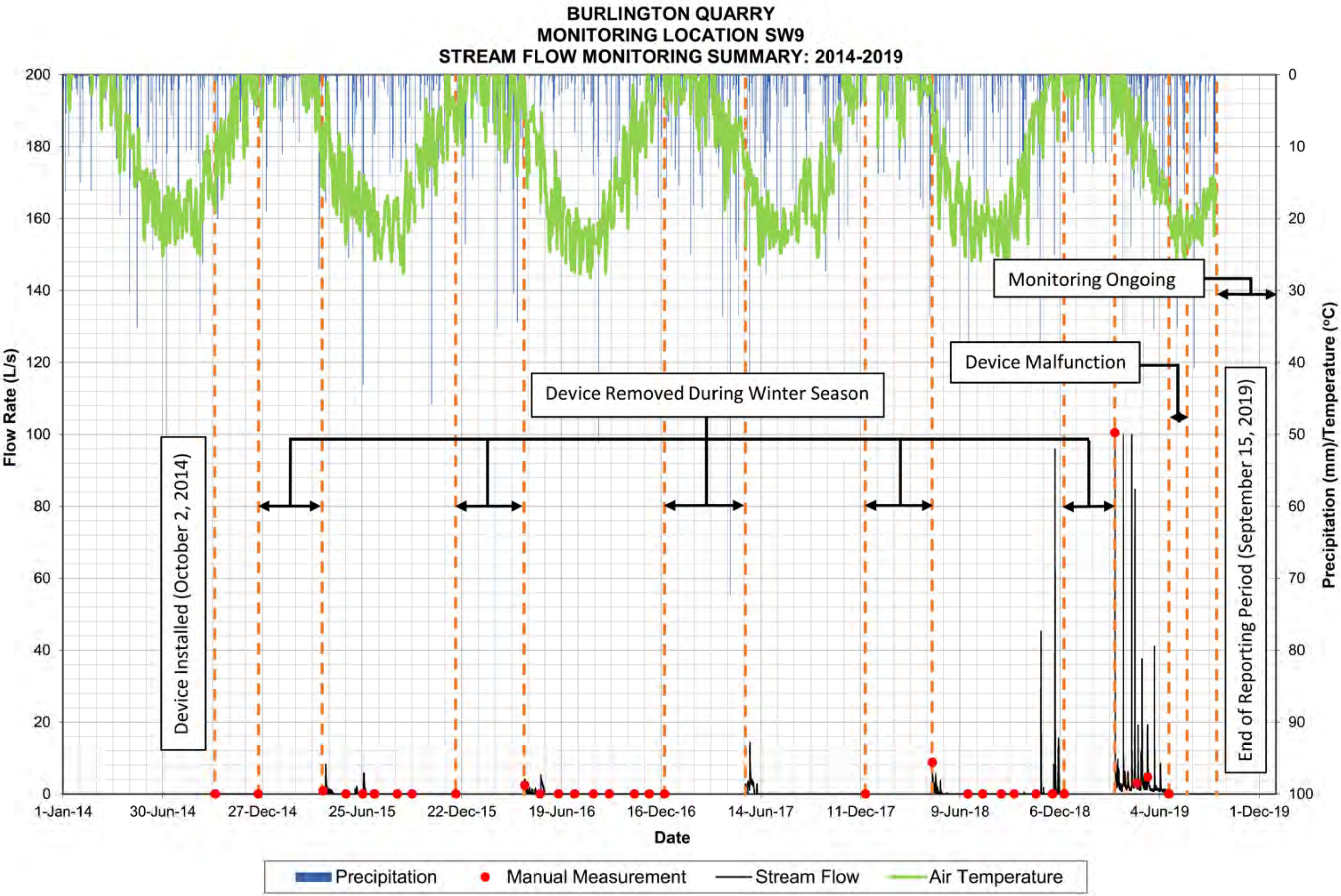
BURLINGTON QUARRY
MONITORING LOCATION SW6
STREAM TEMPERATURE MONITORING SUMMARY: 2016
Temperature (ºC)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Device Installed (April 14, 2016)
Device Removed (December 22, 2016)
Device Malfunction
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)


BURLINGTON QUARRY
MONITORING LOCATION SW6
STREAM TEMPERATURE MONITORING SUMMARY: 2017
Temperature (ºC)
Precipitation (mm)
Date
Device Installed (May 17, 2017)
Device Removed (December 20, 2017)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

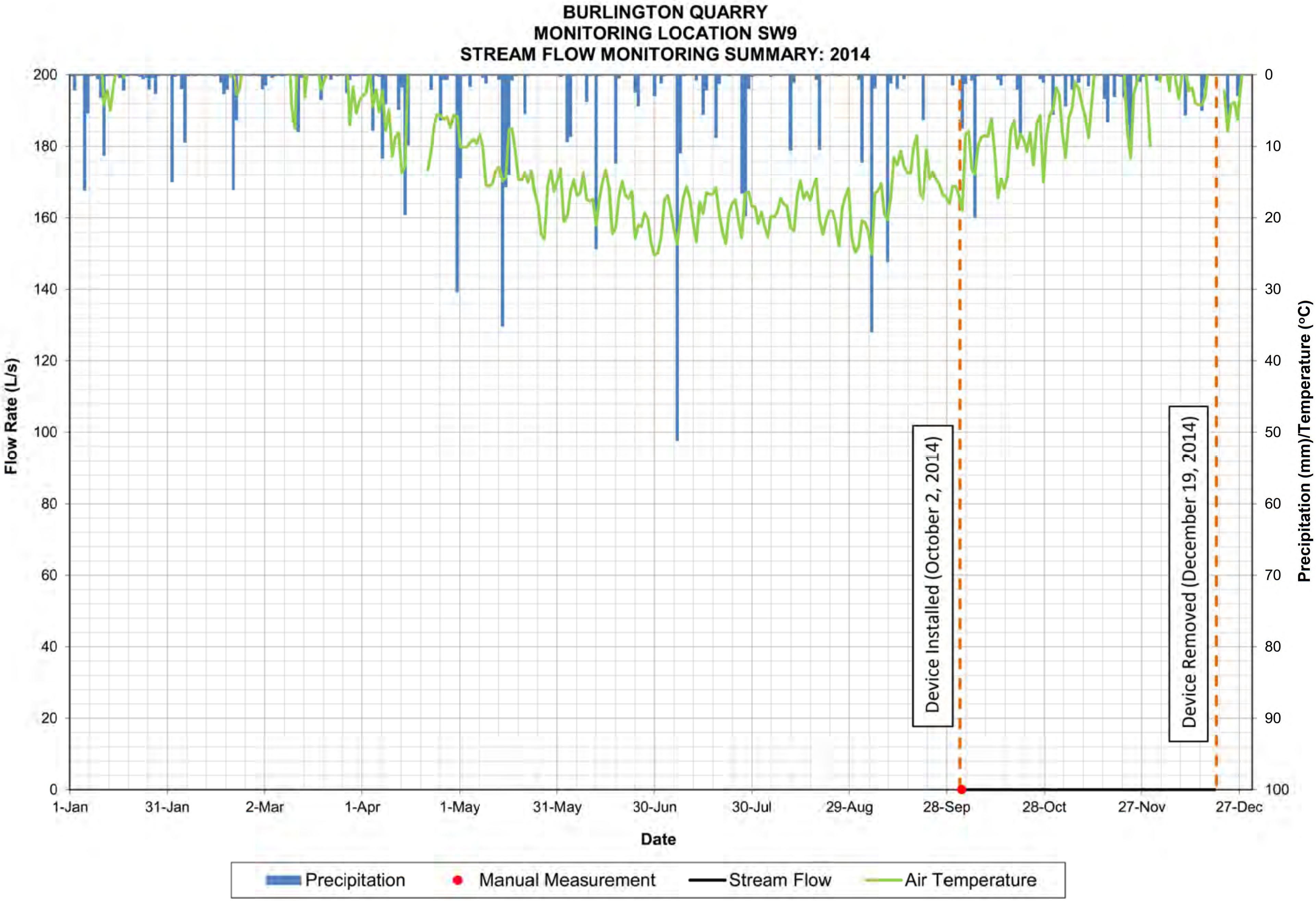


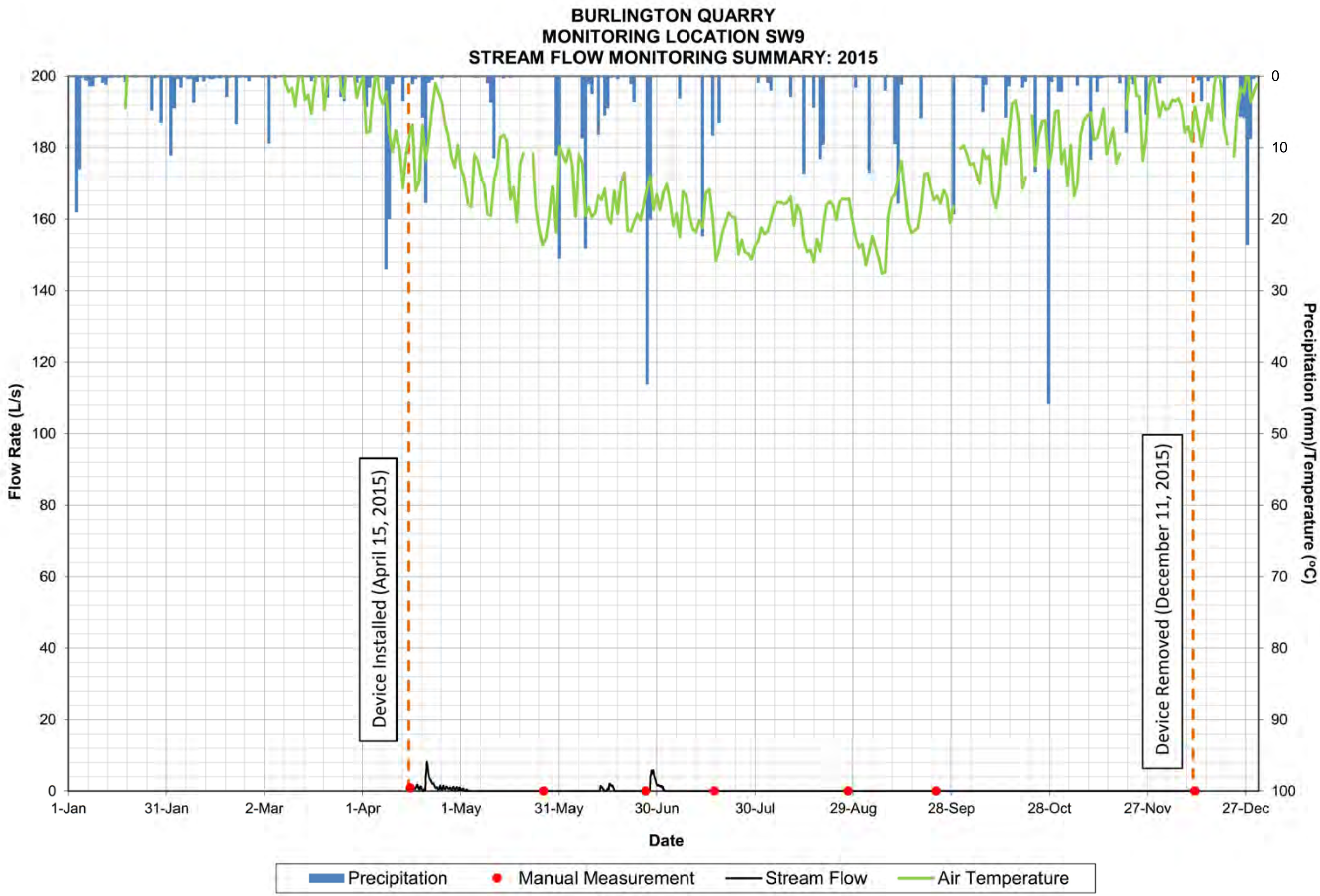
BURLINGTON QUARRY
MONITORING LOCATION SW6
STREAM TEMPERATURE MONITORING SUMMARY: 2018
Temperature (ºC)
Precipitation (mm)
Date
Device Installed (April 19, 2018)
Device Removed (December 13, 2018)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

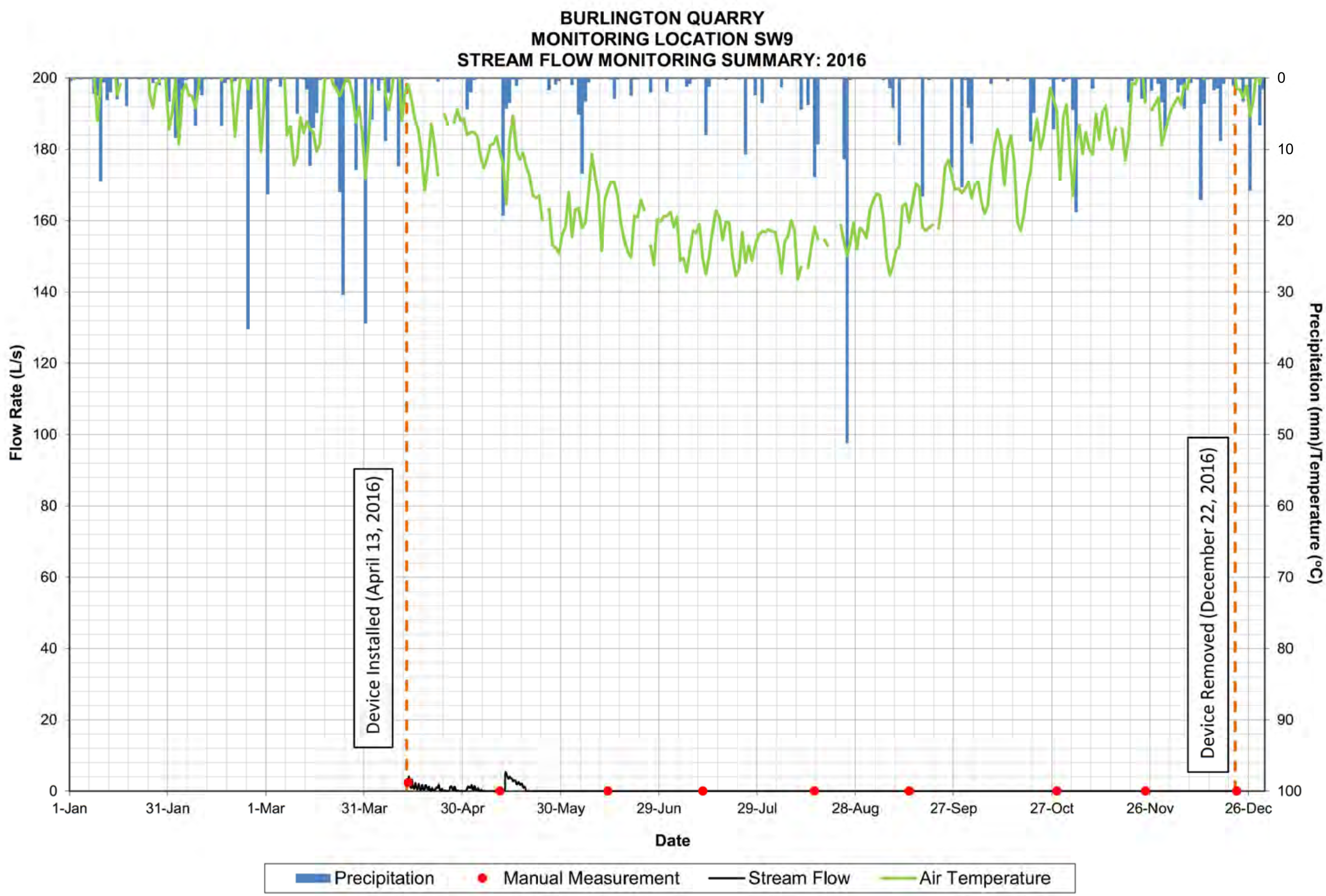

BURLINGTON QUARRY
MONITORING LOCATION SW6
STREAM TEMPERATURE MONITORING SUMMARY: 2019
Device Installed (March 15, 2019)
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
Temperature (ºC)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

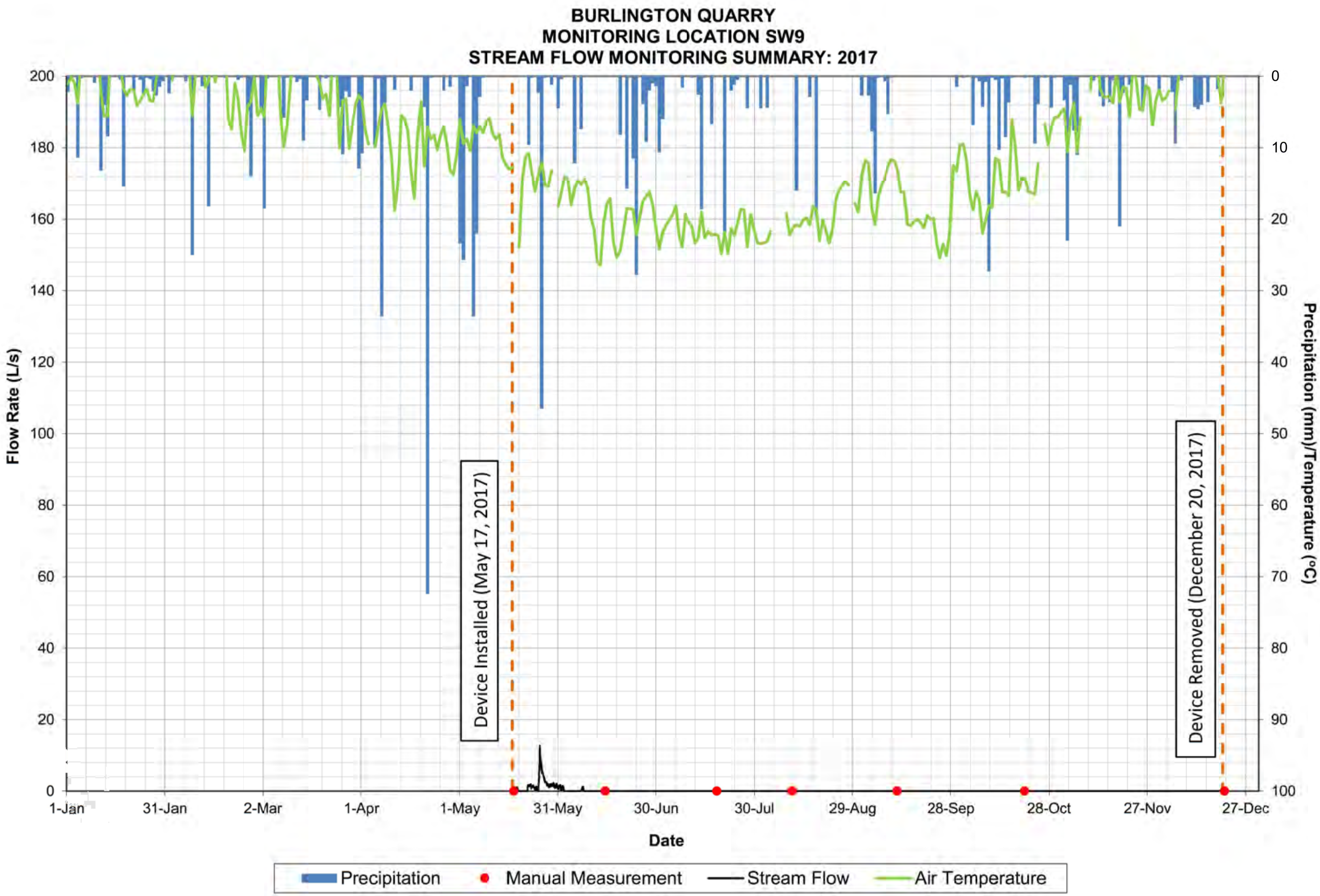


BURLINGTON QUARRY
MONITORING LOCATION SW9
STREAM FLOW MONITORING SUMMARY: 2014-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
9-Jun-18
6-Dec-18
4-Jun-19
1-Dec-19
Device Installed (October 2, 2014)
Device Removed During Winter Season
Device Malfunction
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Stream Flow
Air Temperature

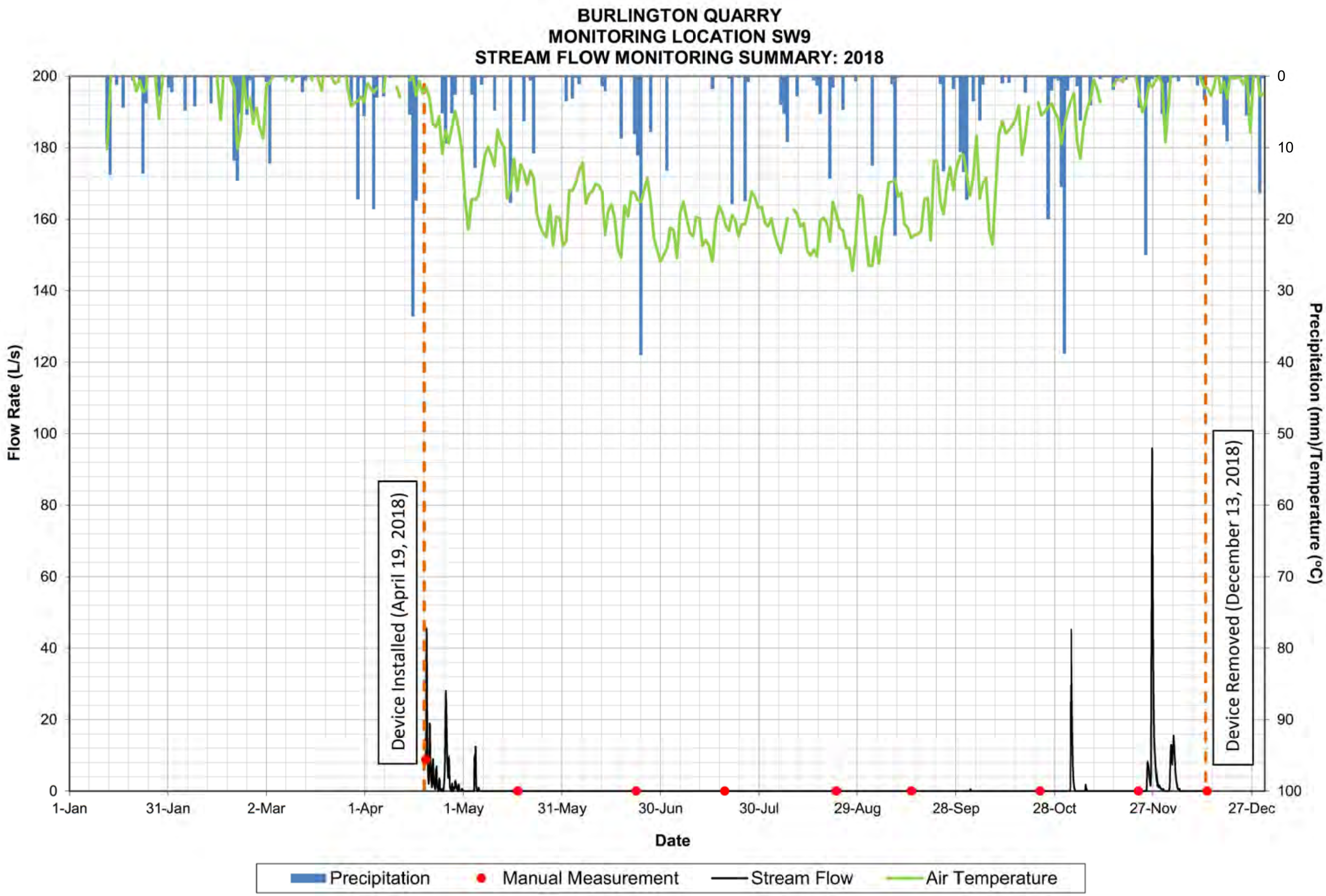

BURLINGTON QUARRY
MONITORING LOCATION SW9
STREAM FLOW MONITORING SUMMARY: 2014
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (October 2, 2014)
Device Removed (December 19, 2014)
Precipitation
Manual Measurement
Stream Flow
Air Temperature

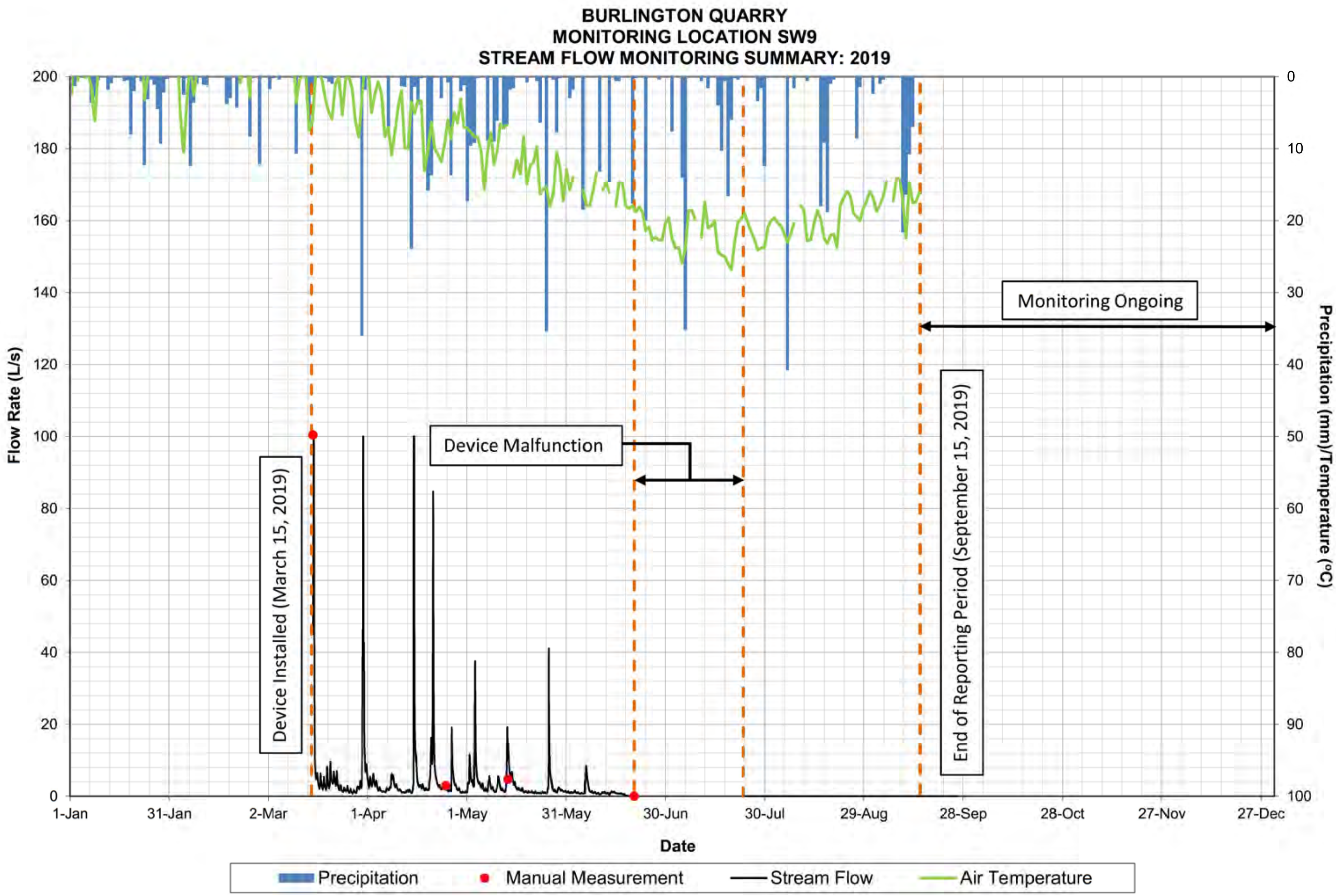

BURLINGTON QUARRY
MONITORING LOCATION SW9
STREAM FLOW MONITORING SUMMARY: 2015
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
0
20
40
60
80
100
120
140
160
180
200
0
10
20
30
40
50
60
70
80
90
100
Device Installed (April 15, 2015)
Device Removed (December 11, 2015)
Precipitation
Manual Measurement
Stream Flow
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW9
STREAM FLOW MONITORING SUMMARY: 2016
Flow Rate (L/s)
200
180
160
140
120
100
80
60
40
20
0
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
Device Installed (April 13, 2016)
Device Removed (December 22, 2016)
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Manual Measurement
Stream Flow
Air Temperature

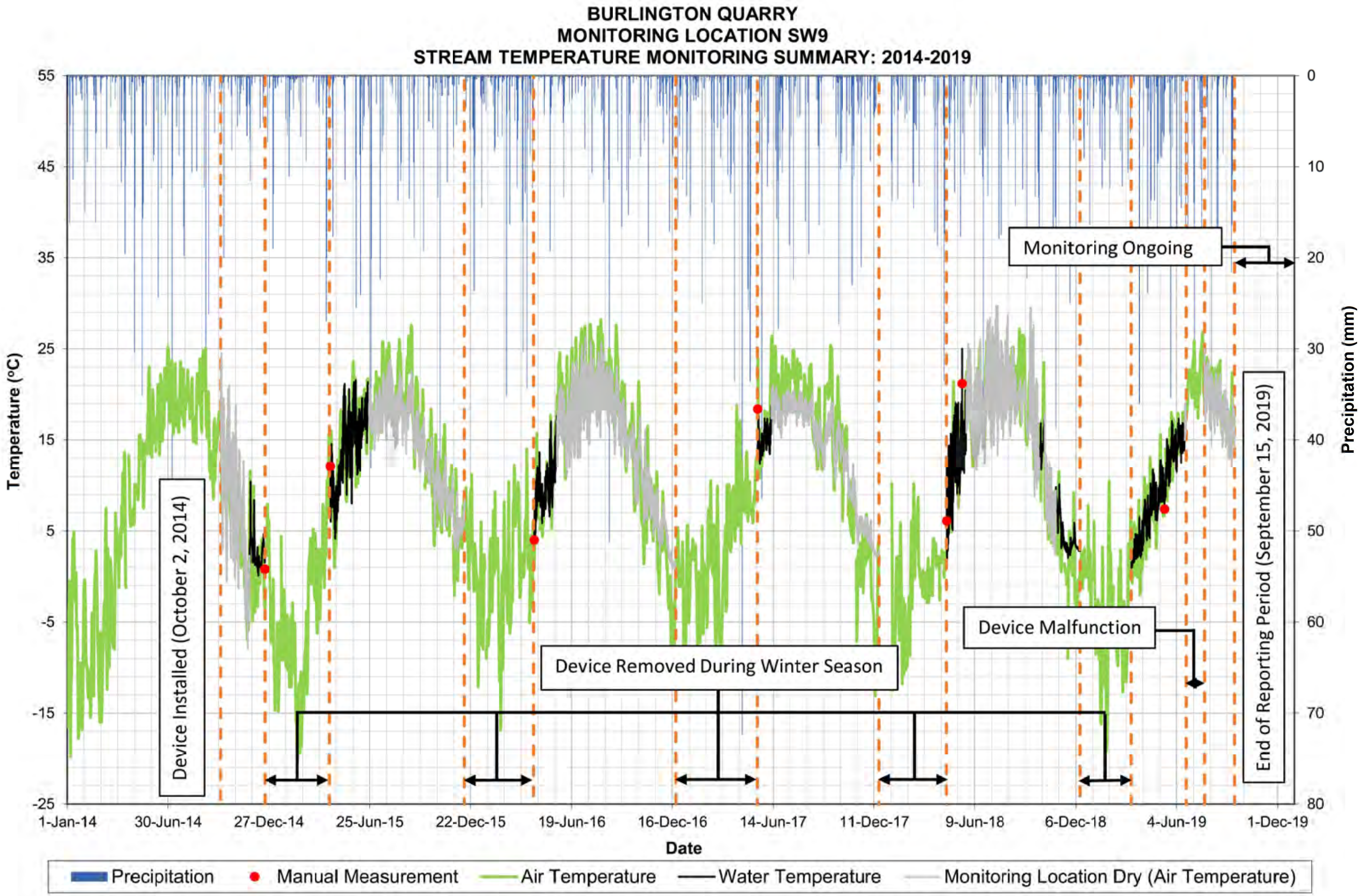


BURLINGTON QUARRY
MONITORING LOCATION SW9
STREAM FLOW MONITORING SUMMARY: 2017
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (May 17, 2017)
Device Removed (December 20, 2017)
200
180
160
140
120
100
80
60
40
20
0
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Manual Measurement
Stream Flow
Air Temperature

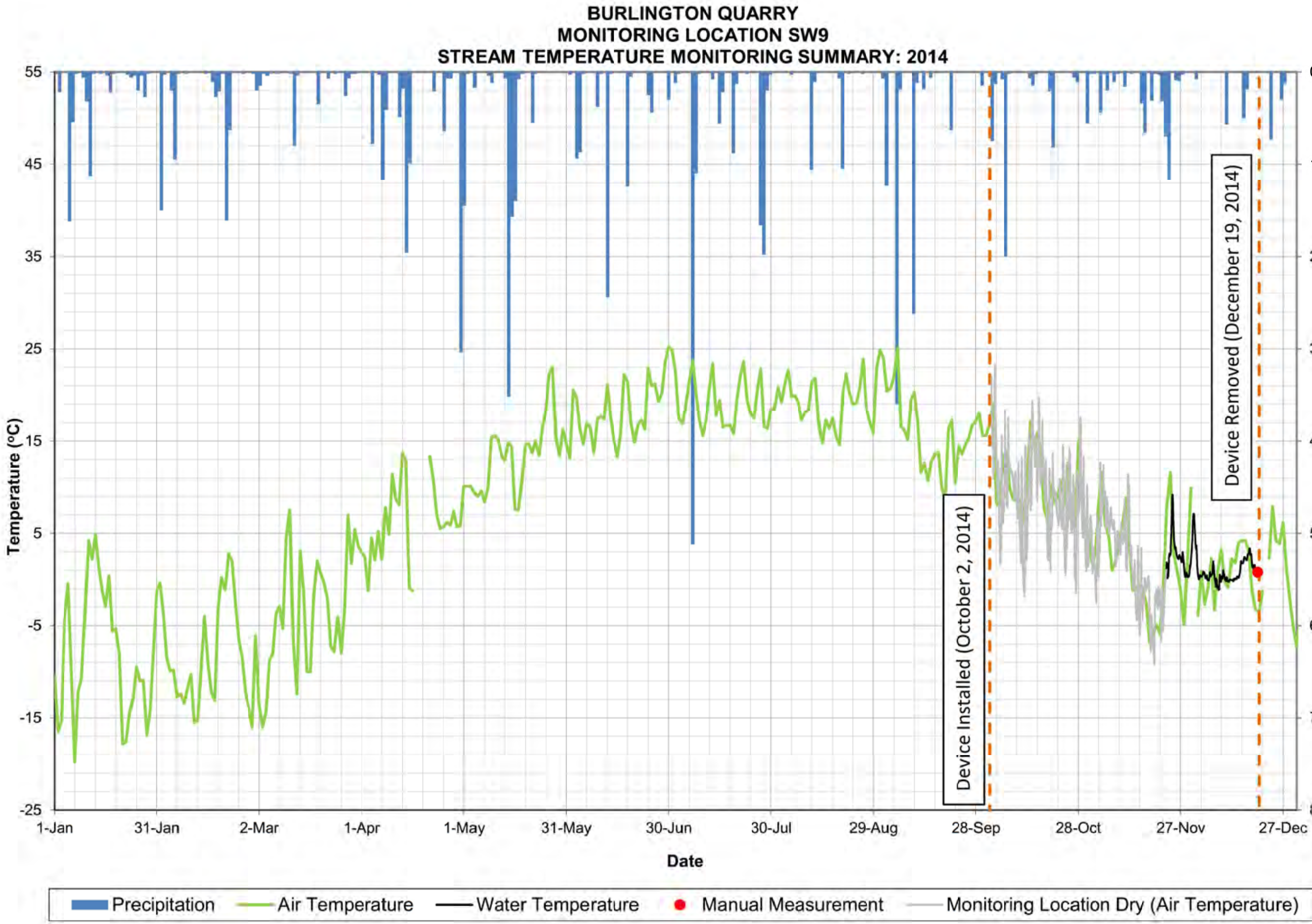

BURLINGTON QUARRY
MONITORING LOCATION SW9
STREAM FLOW MONITORING SUMMARY: 2018
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (April 19, 2018)
Device Removed (December 13, 2018)
Precipitation
Manual Measurement
Stream Flow
Air Temperature



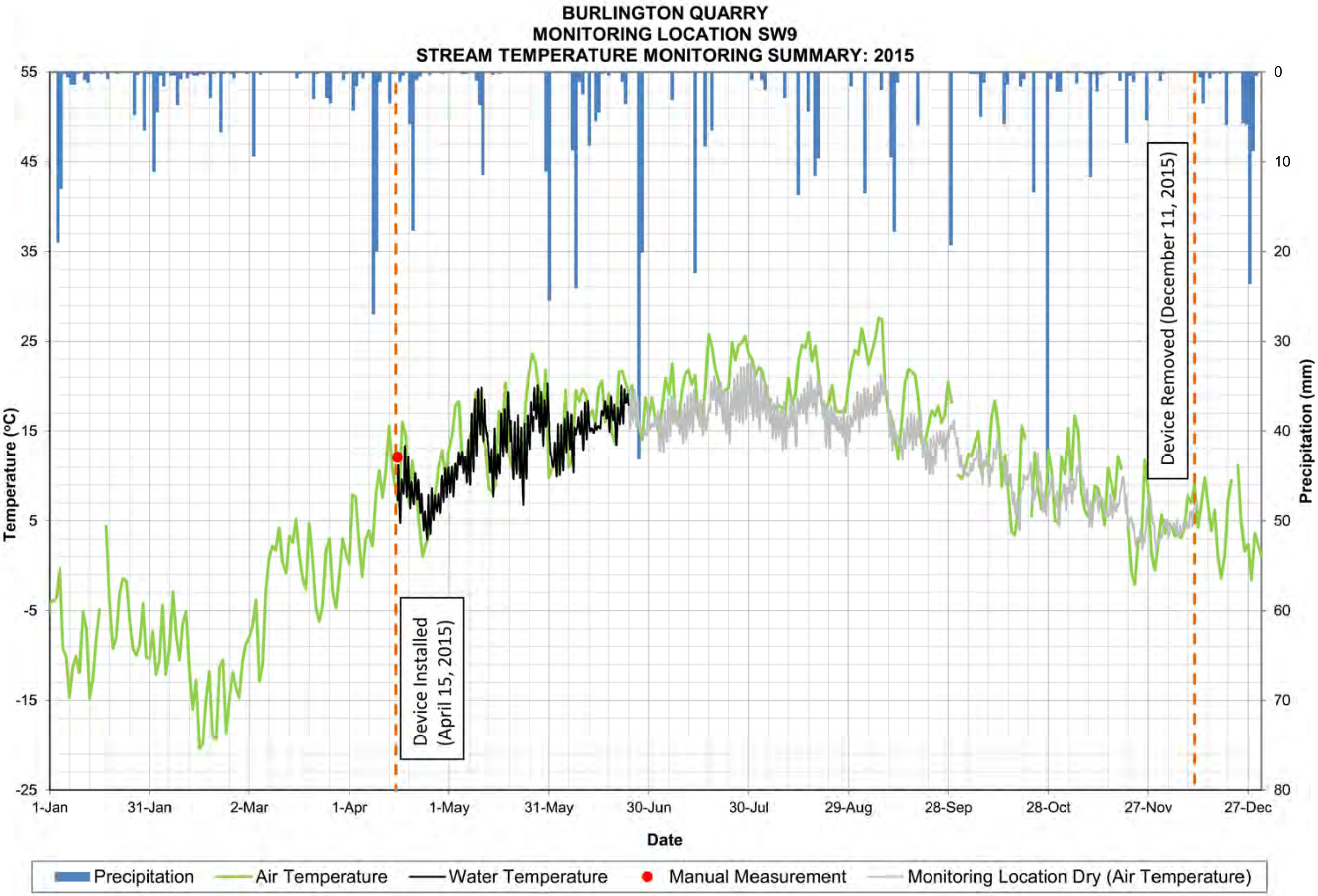
BURLINGTON QUARRY
MONITORING LOCATION SW9
STREAM FLOW MONITORING SUMMARY: 2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
200
180
160
140
120
100
80
60
40
20
0
10
30
50
70
90
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (March 15, 2019)
Device Malfunction
End of Reporting Period (September 15, 2019)
Monitoring Ongoing
Precipitation
Manual Measurement
Stream Flow
Air Temperature



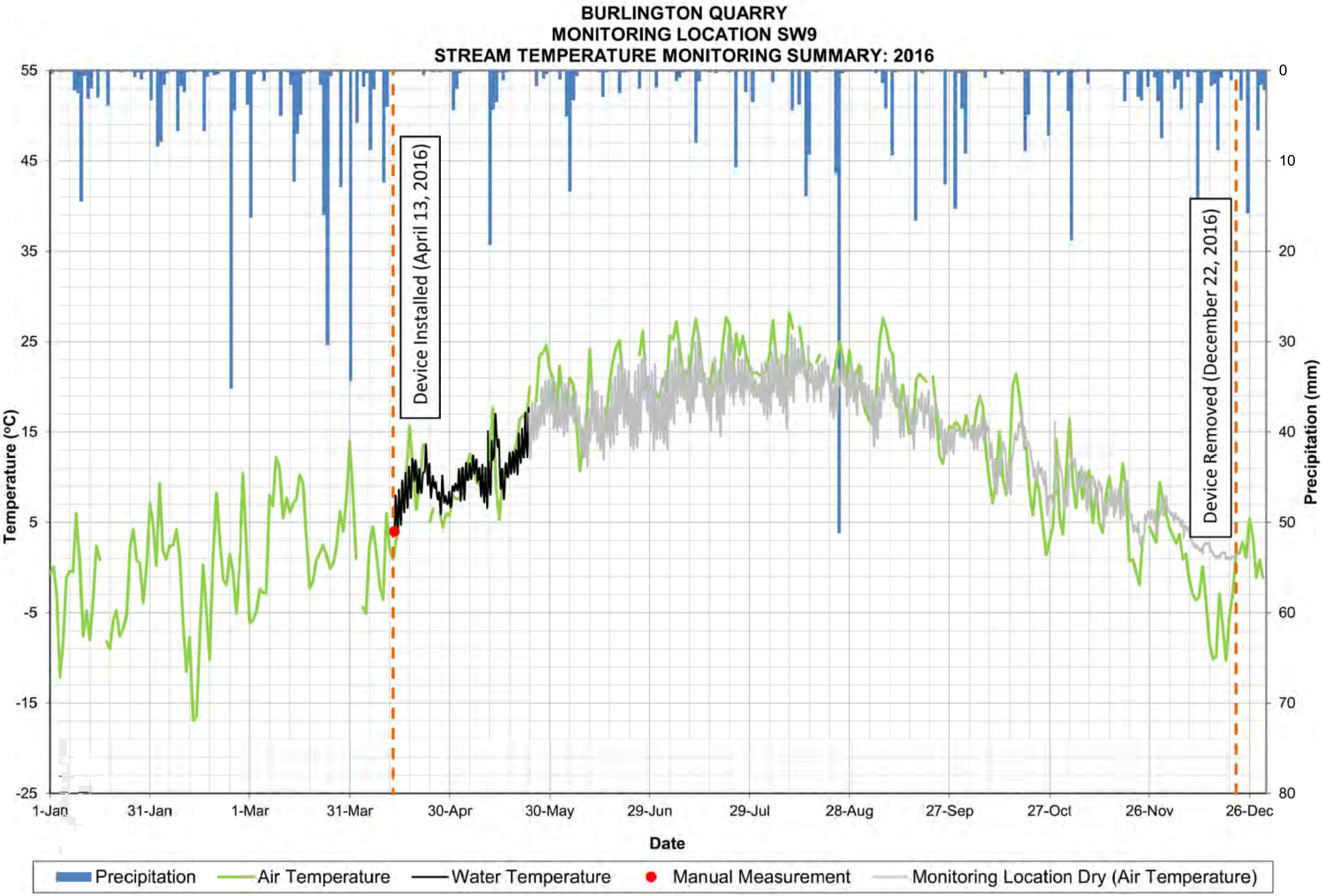
* Grey data indicates the monitoring location was dry and therefore the recorded values are respresentative of the air temperature.

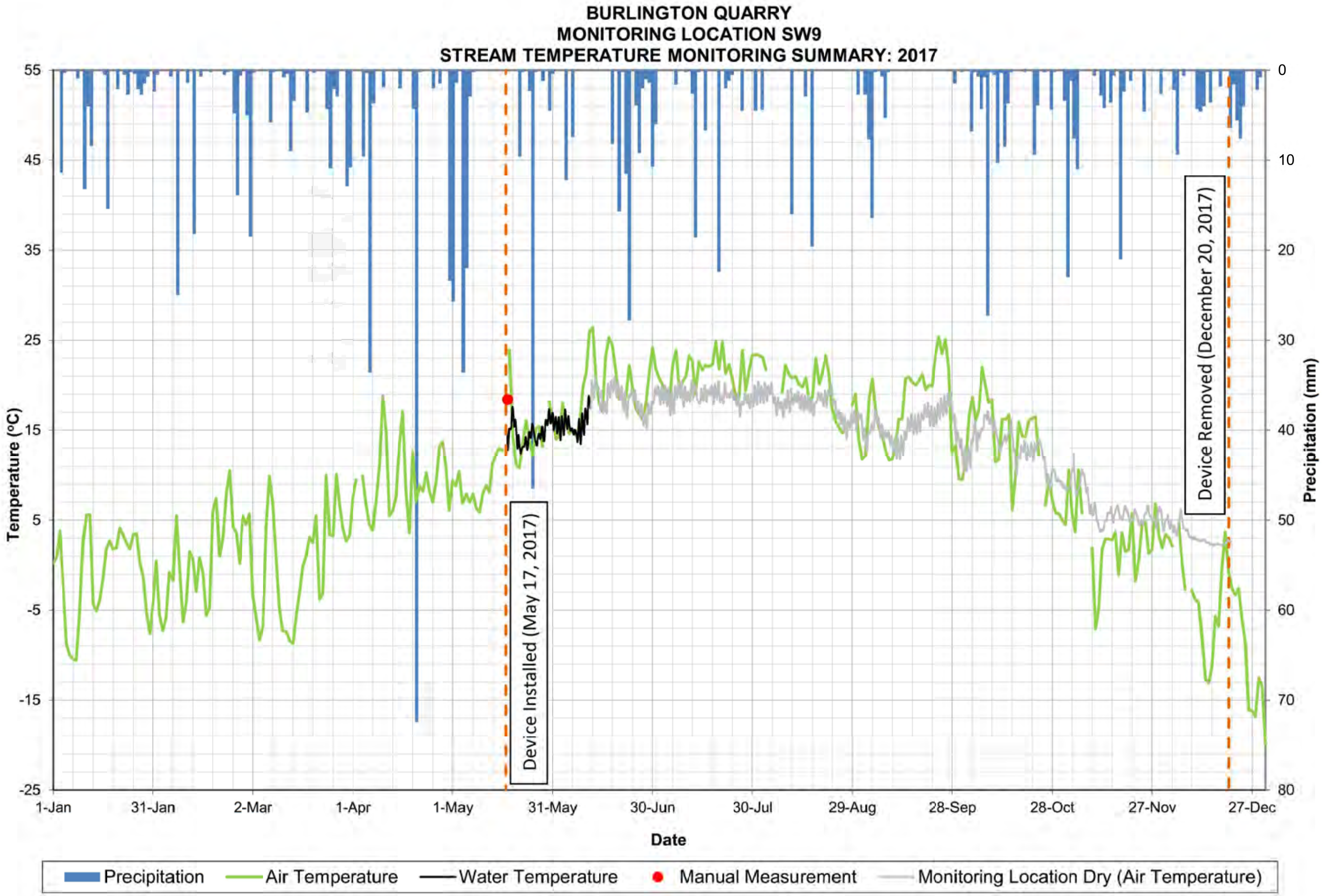


BURLINGTON QUARRY
MONITORING LOCATION SW9
STREAM TEMPERATURE MONITORING SUMMARY: 2014
Temperature (°C)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Device Installed (October 2, 2014)
Device Removed (December 19, 2014)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

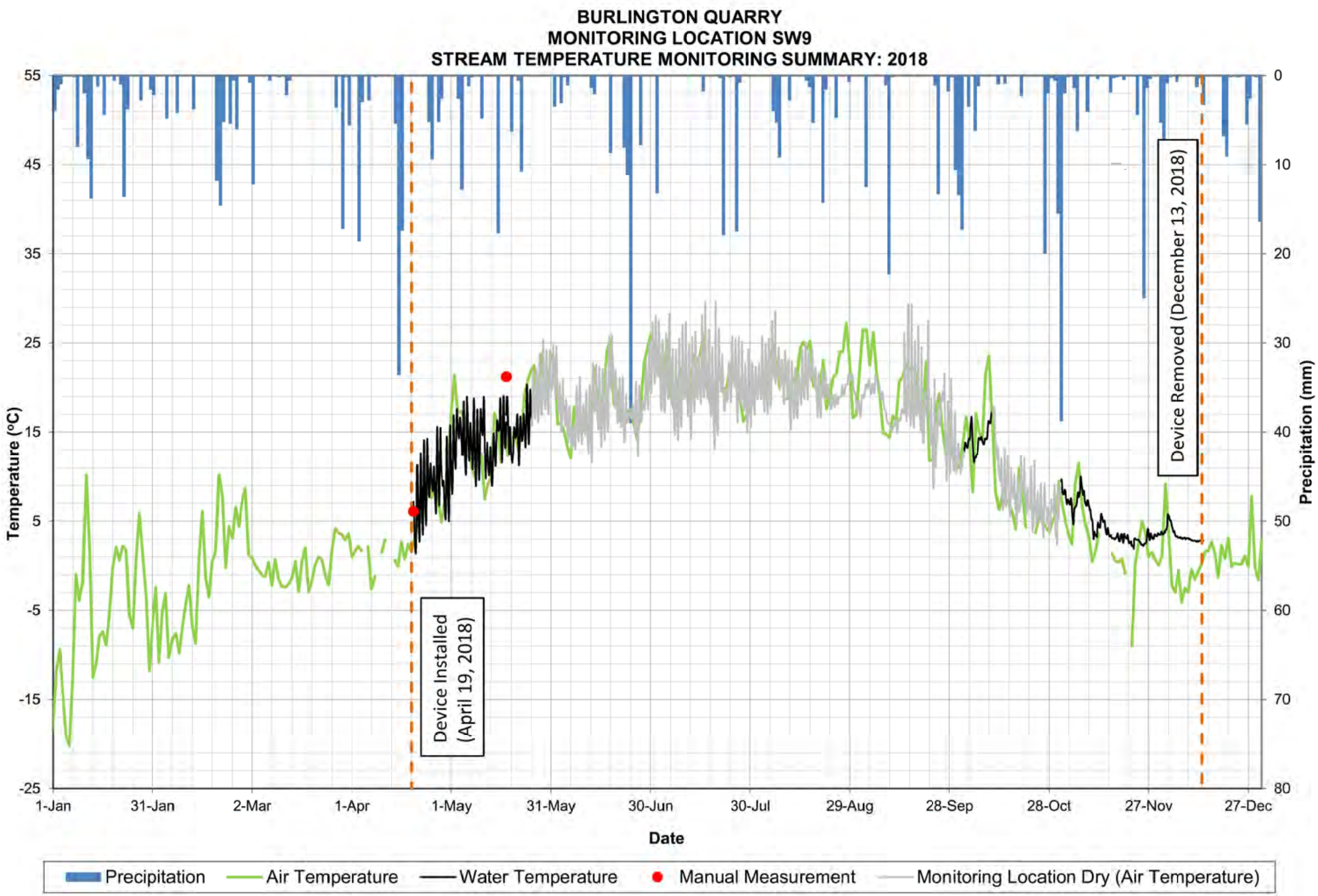


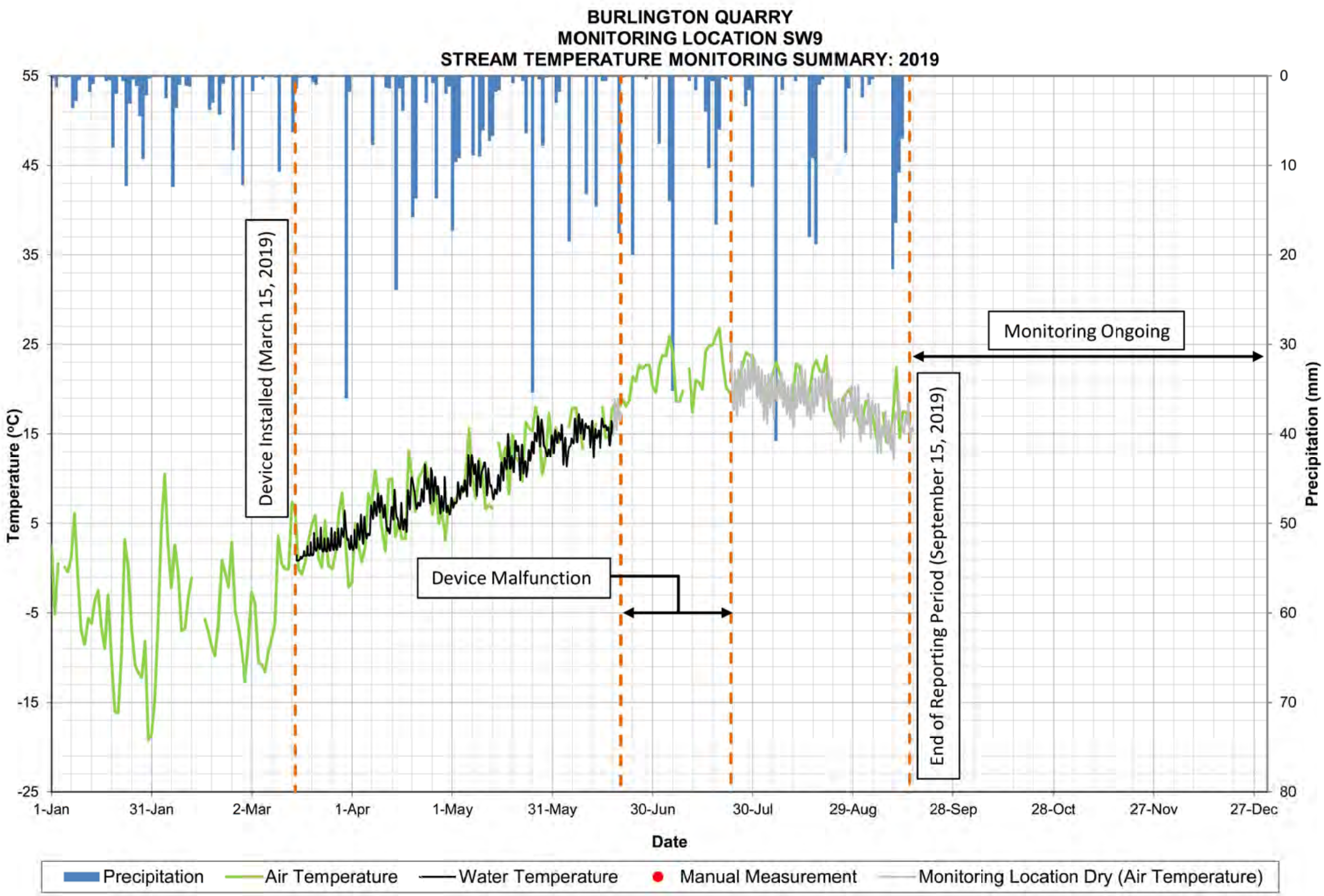
BURLINGTON QUARRY
MONITORING LOCATION SW9
STREAM TEMPERATURE MONITORING SUMMARY: 2015
Temperature (°C)
Precipitation (mm)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (April 15, 2015)
Device Removed (December 11, 2015)
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)


BURLINGTON QUARRY
MONITORING LOCATION SW9
STREAM TEMPERATURE MONITORING SUMMARY: 2016
Temperature (ºC)
Precipitation (mm)
Date
Device Installed (April 13, 2016)
Device Removed (December 22, 2016)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

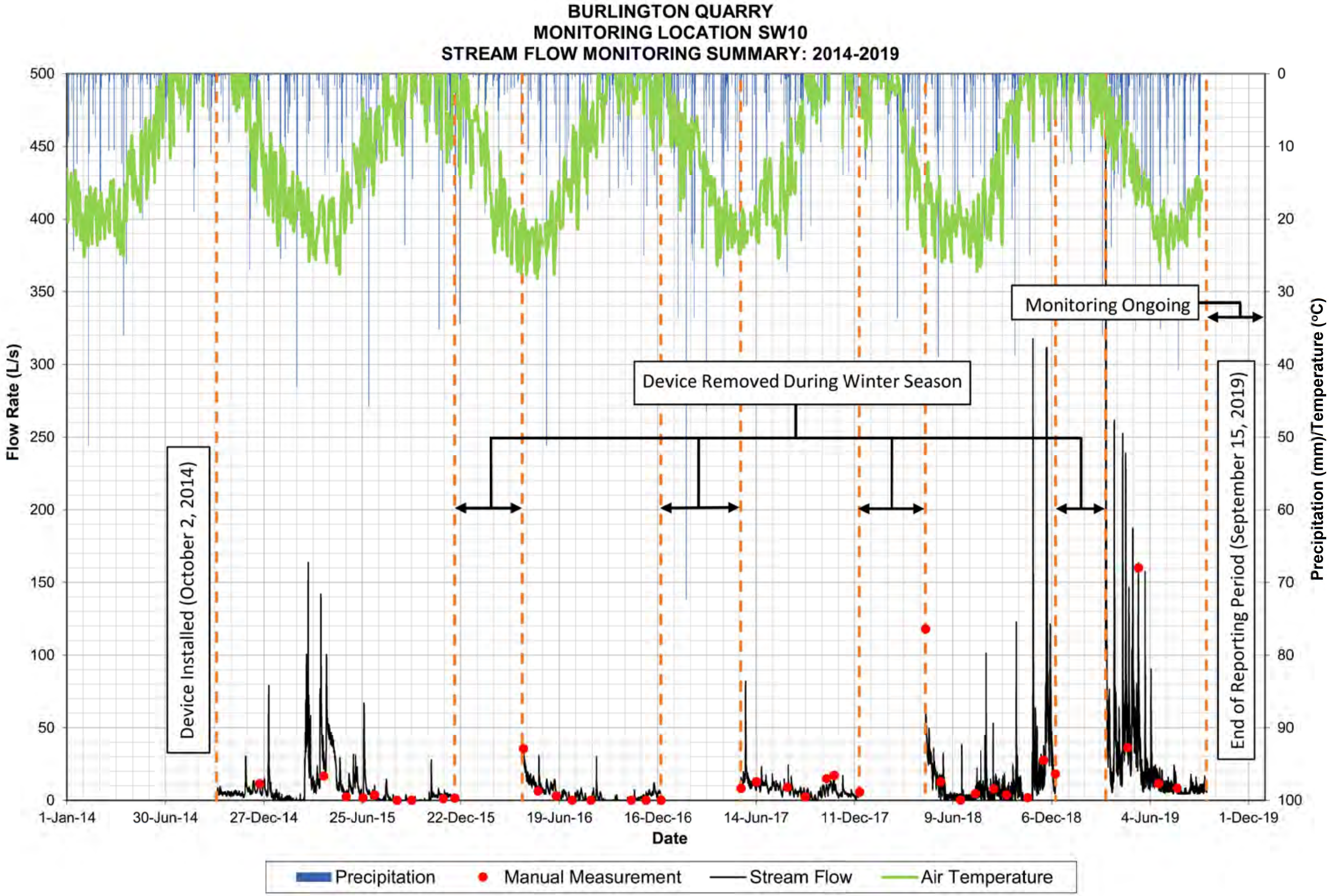


BURLINGTON QUARRY
MONITORING LOCATION SW9
STREAM TEMPERATURE MONITORING SUMMARY: 2017
Temperature (°C)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Device Installed (May 17, 2017)
Device Removed (December 20, 2017)
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

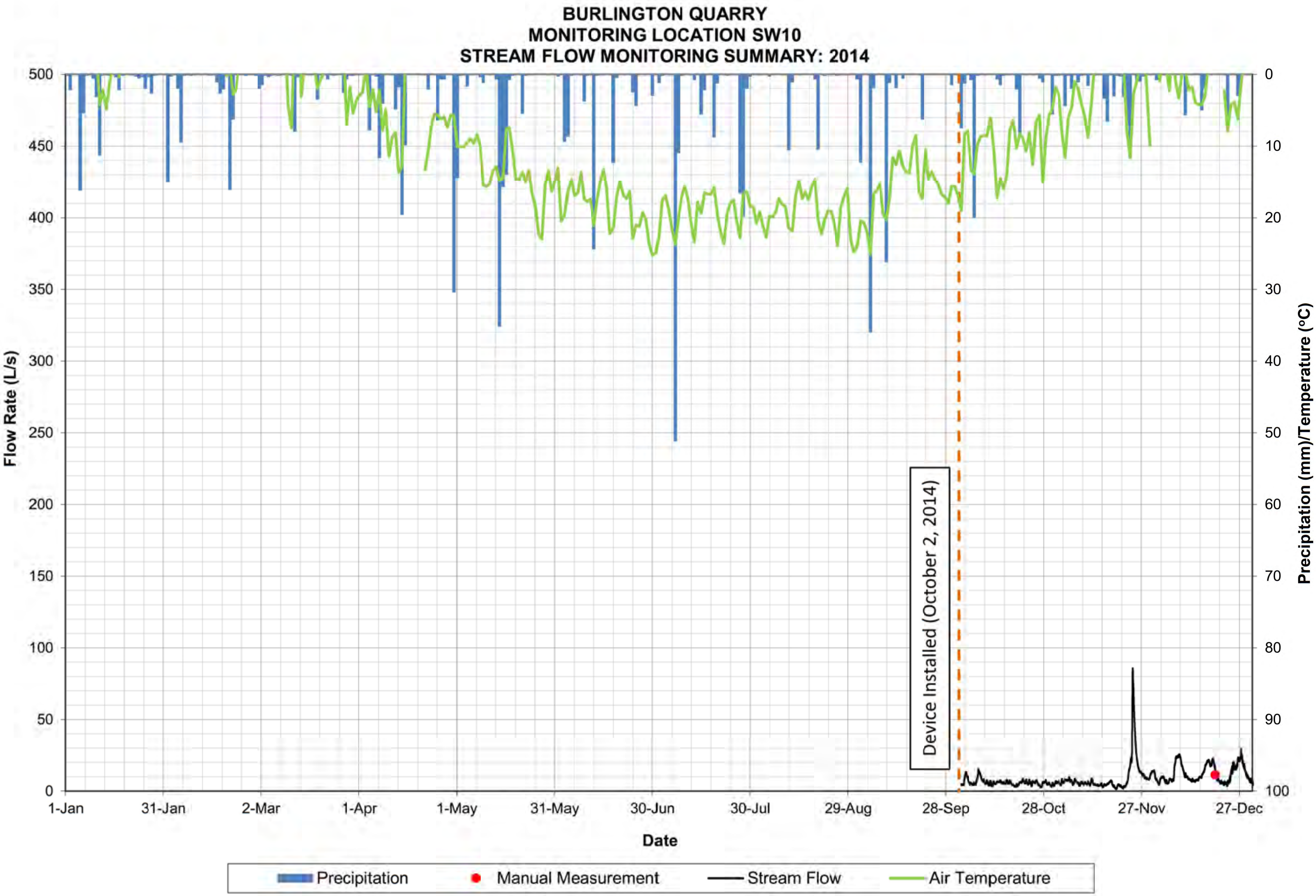

BURLINGTON QUARRY
MONITORING LOCATION SW9
STREAM TEMPERATURE MONITORING SUMMARY: 2018
Temperature (ºC)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Device Installed (April 19, 2018)
Device Removed (December 13, 2018)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

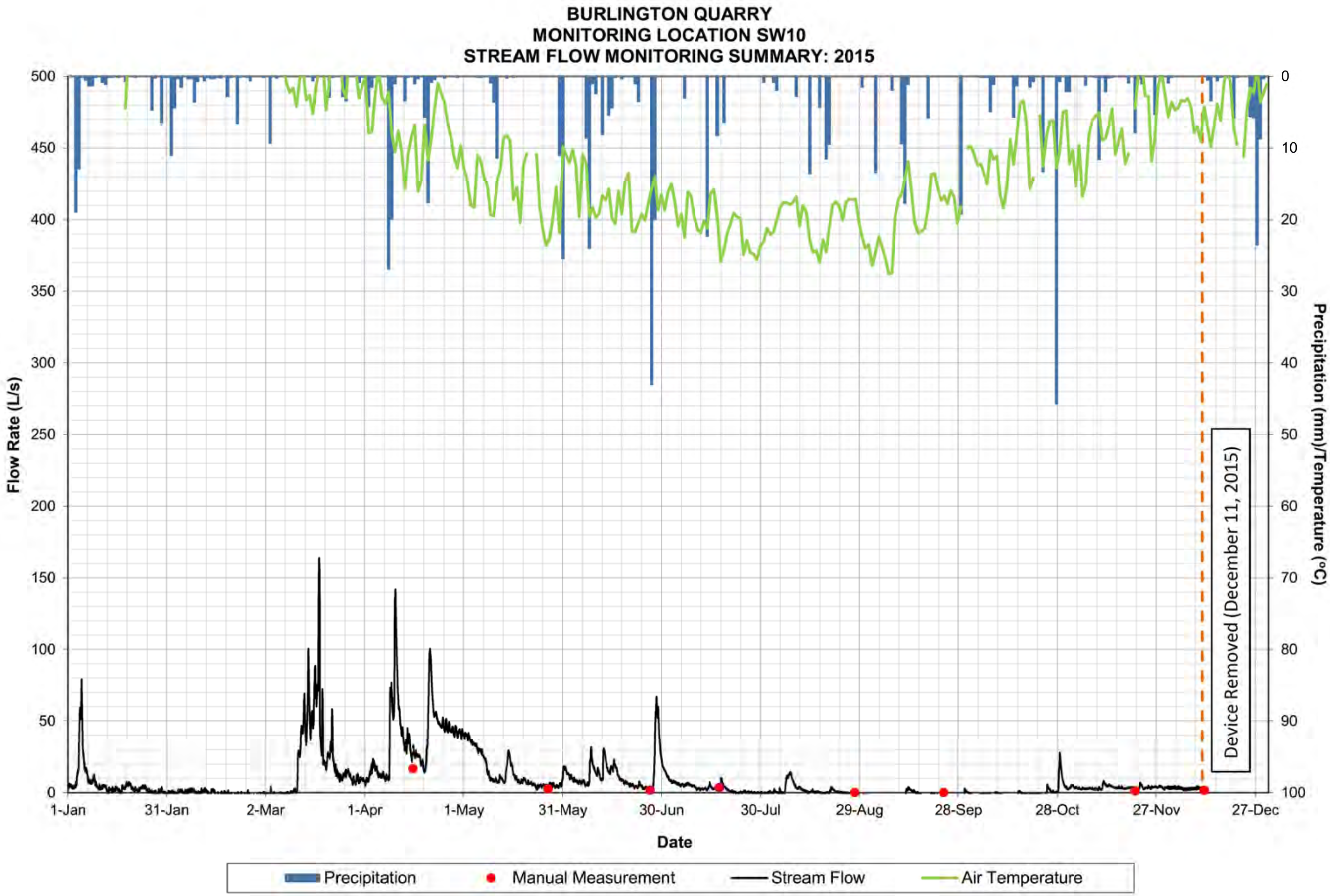


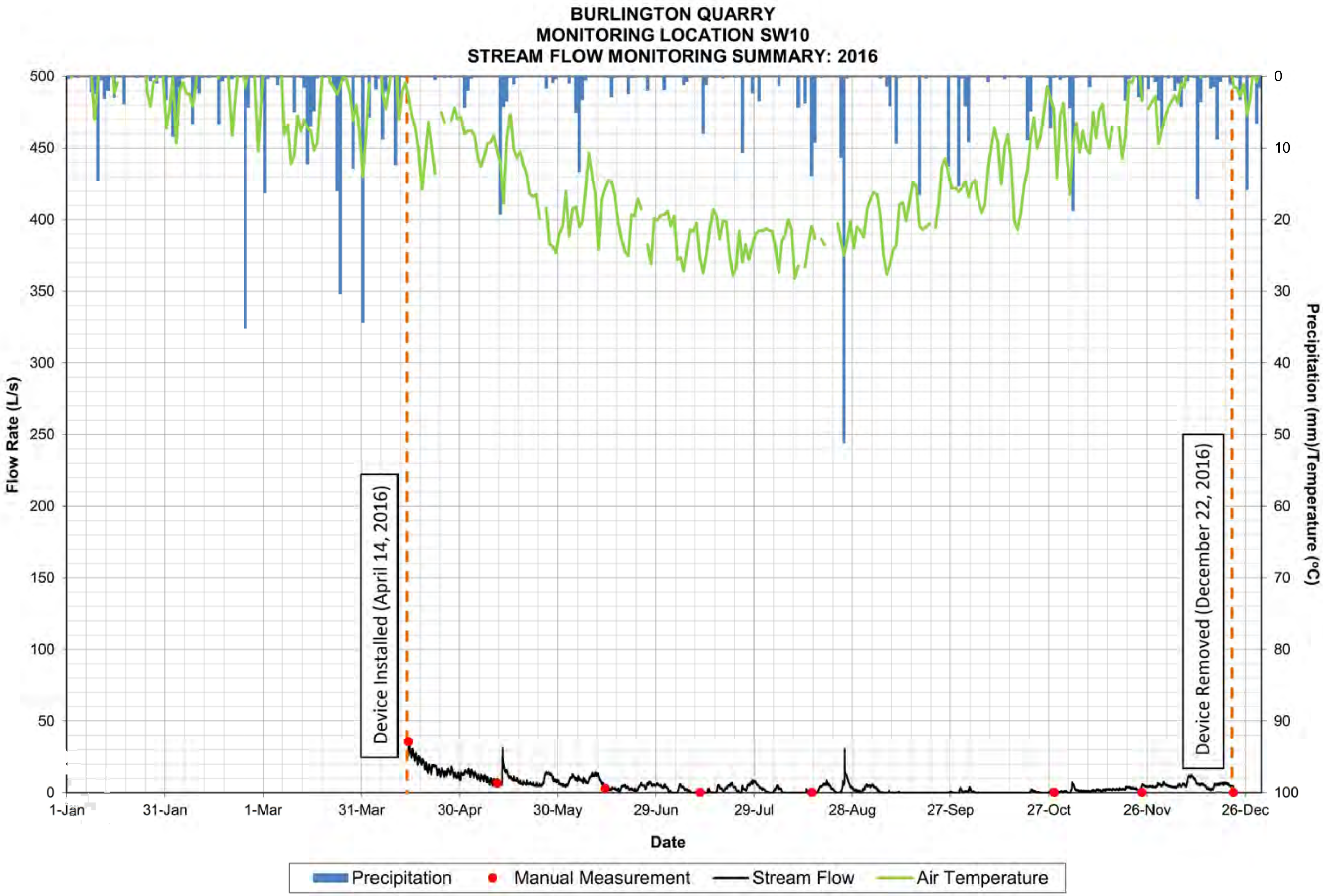
BURLINGTON QUARRY
MONITORING LOCATION SW9
STREAM TEMPERATURE MONITORING SUMMARY: 2019
Temperature (ºC)
Precipitation (mm)
Date
Device Installed (March 15, 2019)
Device Malfunction
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)

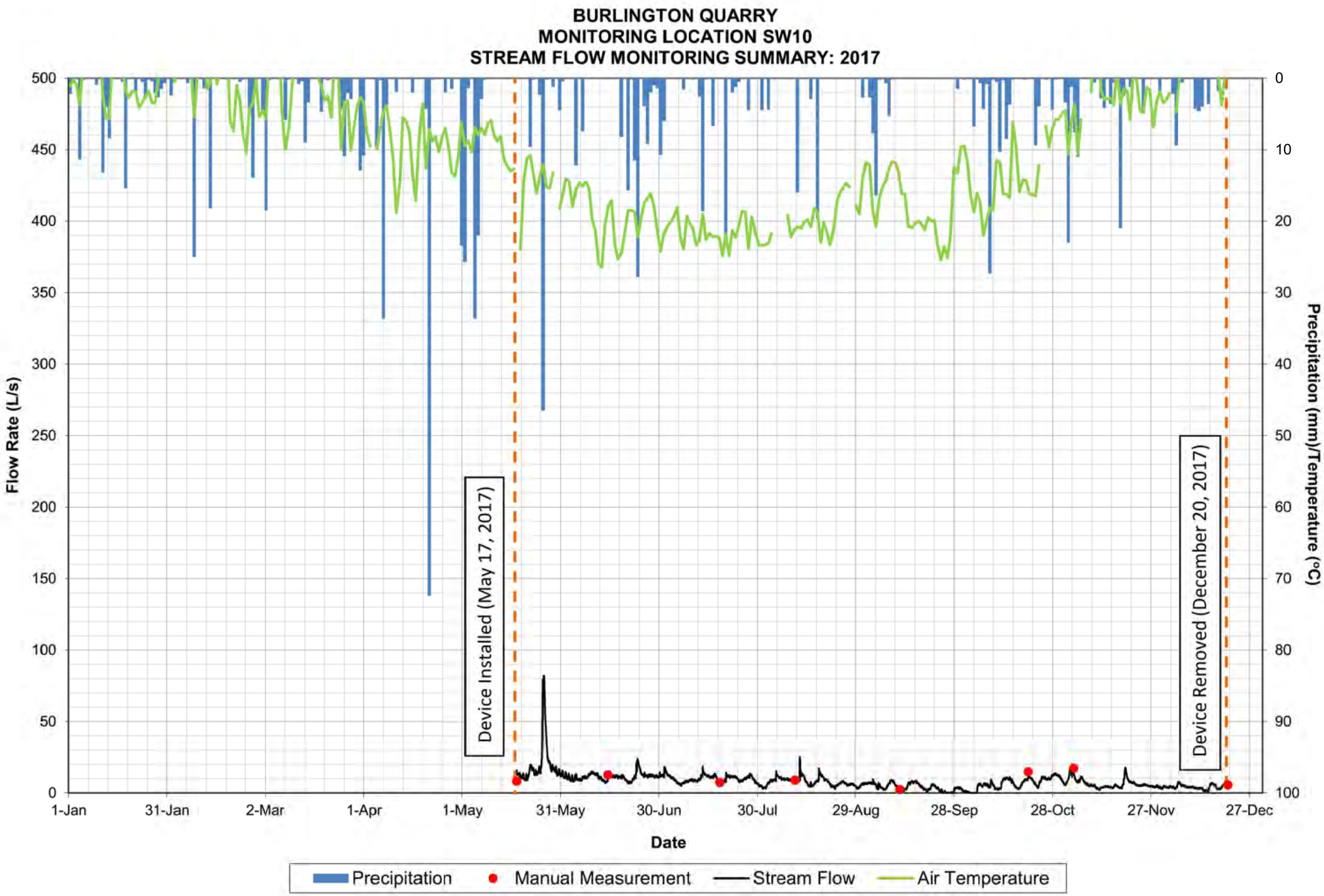


BURLINGTON QUARRY
MONITORING LOCATION SW10
STREAM FLOW MONITORING SUMMARY: 2014-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (October 2, 2014)
Device Removed During Winter Season
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
1-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
9-Jun-18
6-Dec-18
4-Jun-19
1-Dec-19
Precipitation
Manual Measurement
Stream Flow
Air Temperature

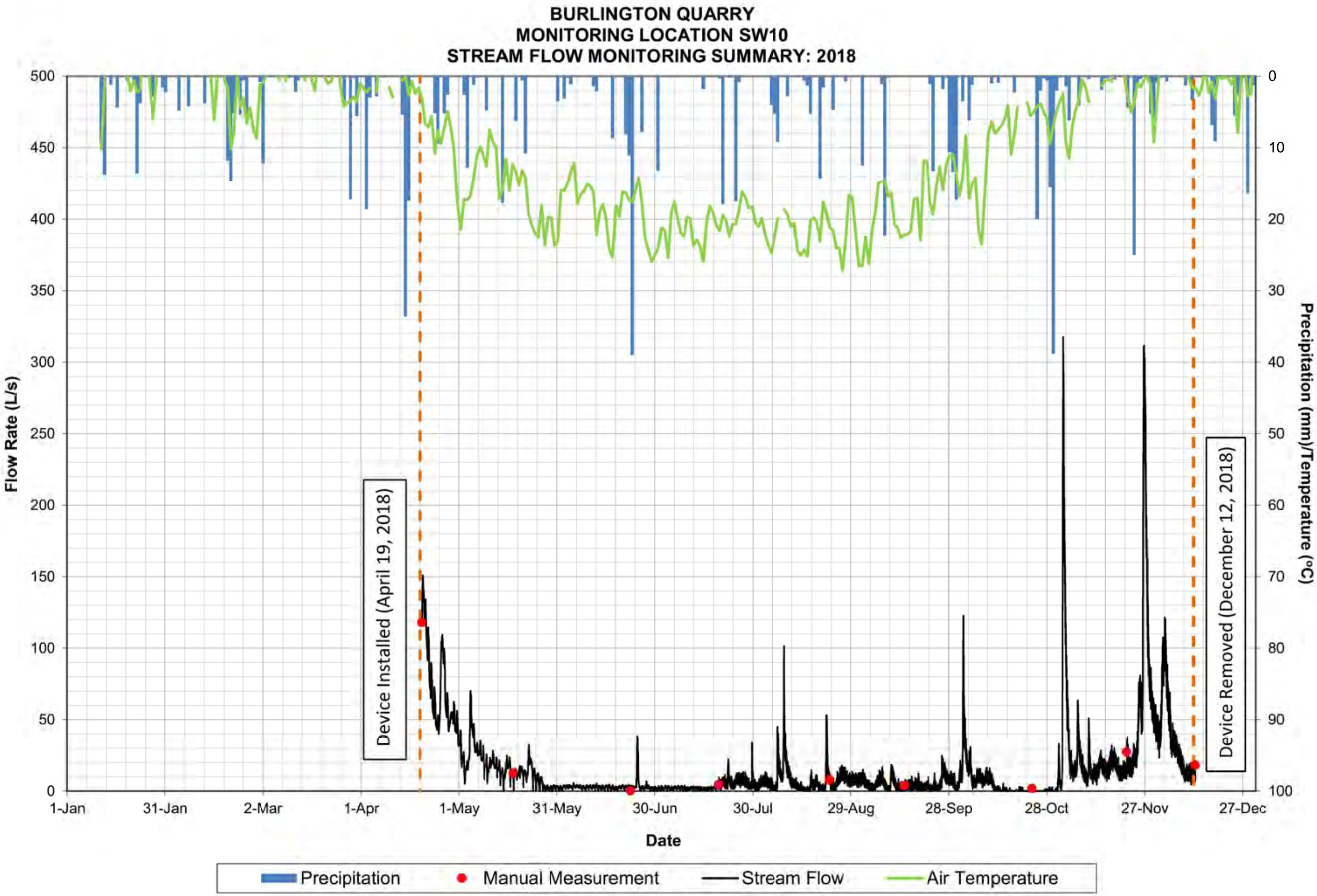

BURLINGTON QUARRY
MONITORING LOCATION SW10
STREAM FLOW MONITORING SUMMARY: 2014
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (October 2, 2014)
500
450
400
350
300
250
200
150
100
50
0
10
20
30
40
60
70
80
90
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Manual Measurement
Stream Flow
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW10
STREAM FLOW MONITORING SUMMARY: 2015
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Removed (December 11, 2015)
Precipitation
Manual Measurement
Stream Flow
Air Temperature

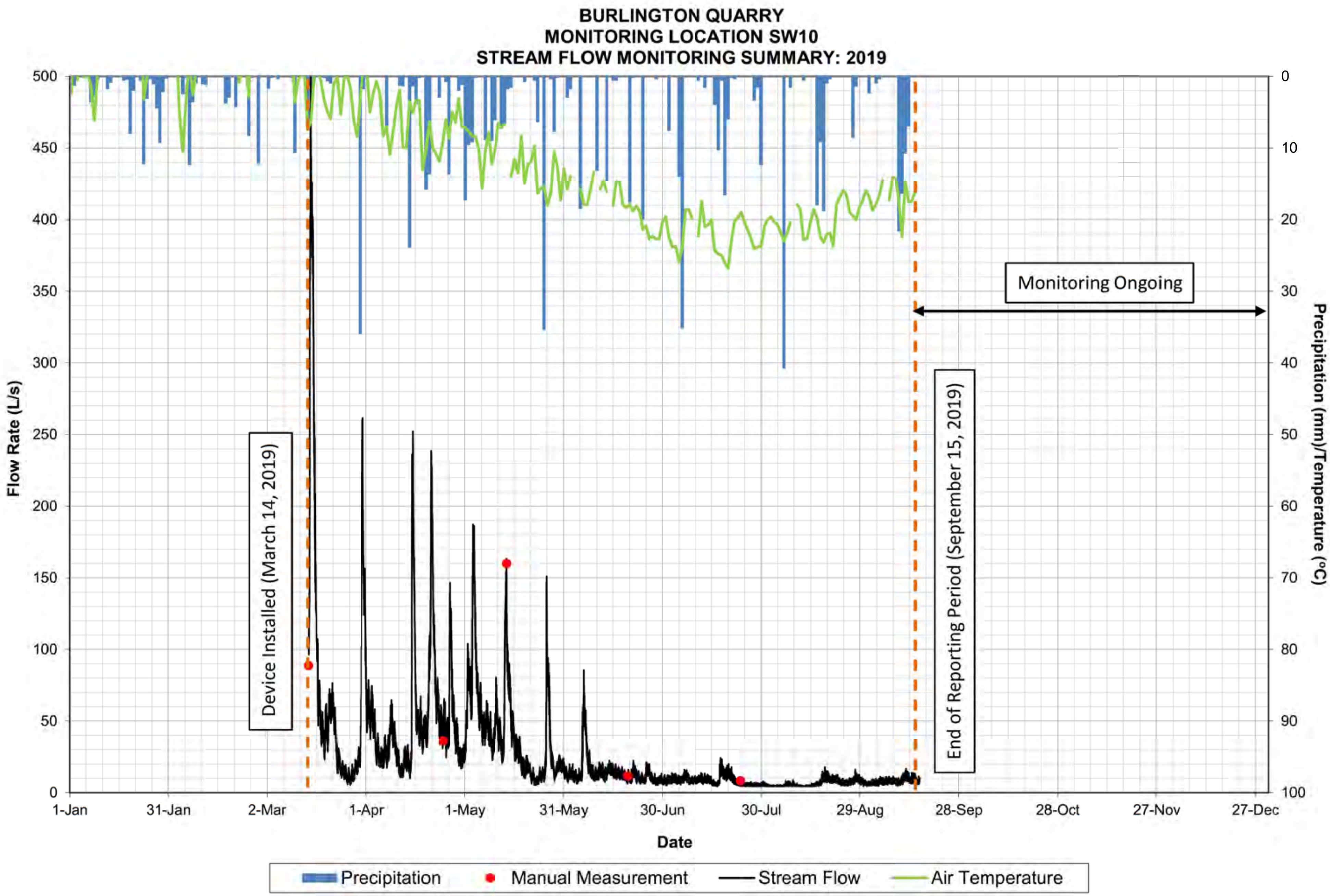

BURLINGTON QUARRY
MONITORING LOCATION SW10
STREAM FLOW MONITORING SUMMARY: 2016
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Device Installed (April 14, 2016)
Device Removed (December 22, 2016)
Precipitation
Manual Measurement
Stream Flow
Air Temperature

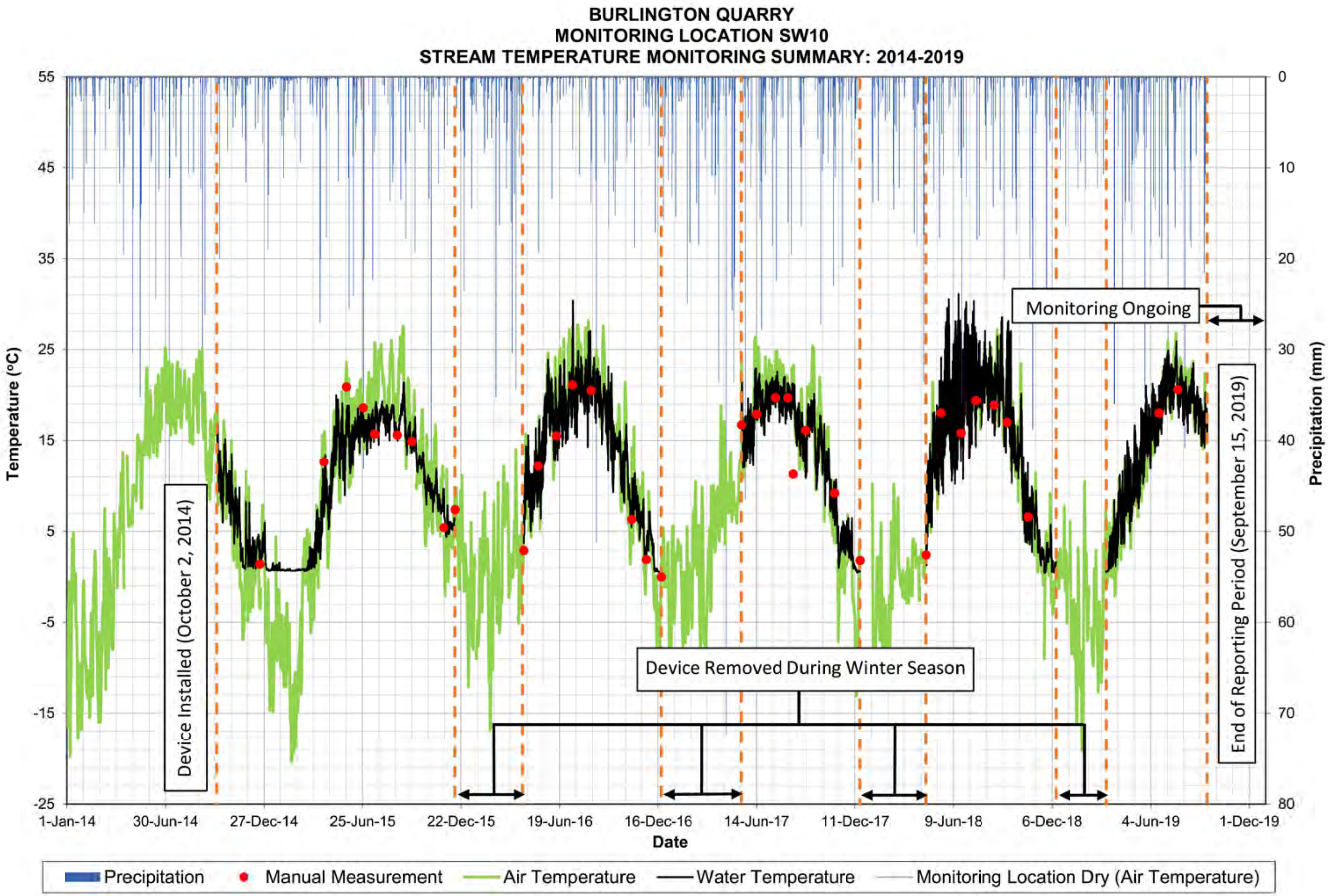


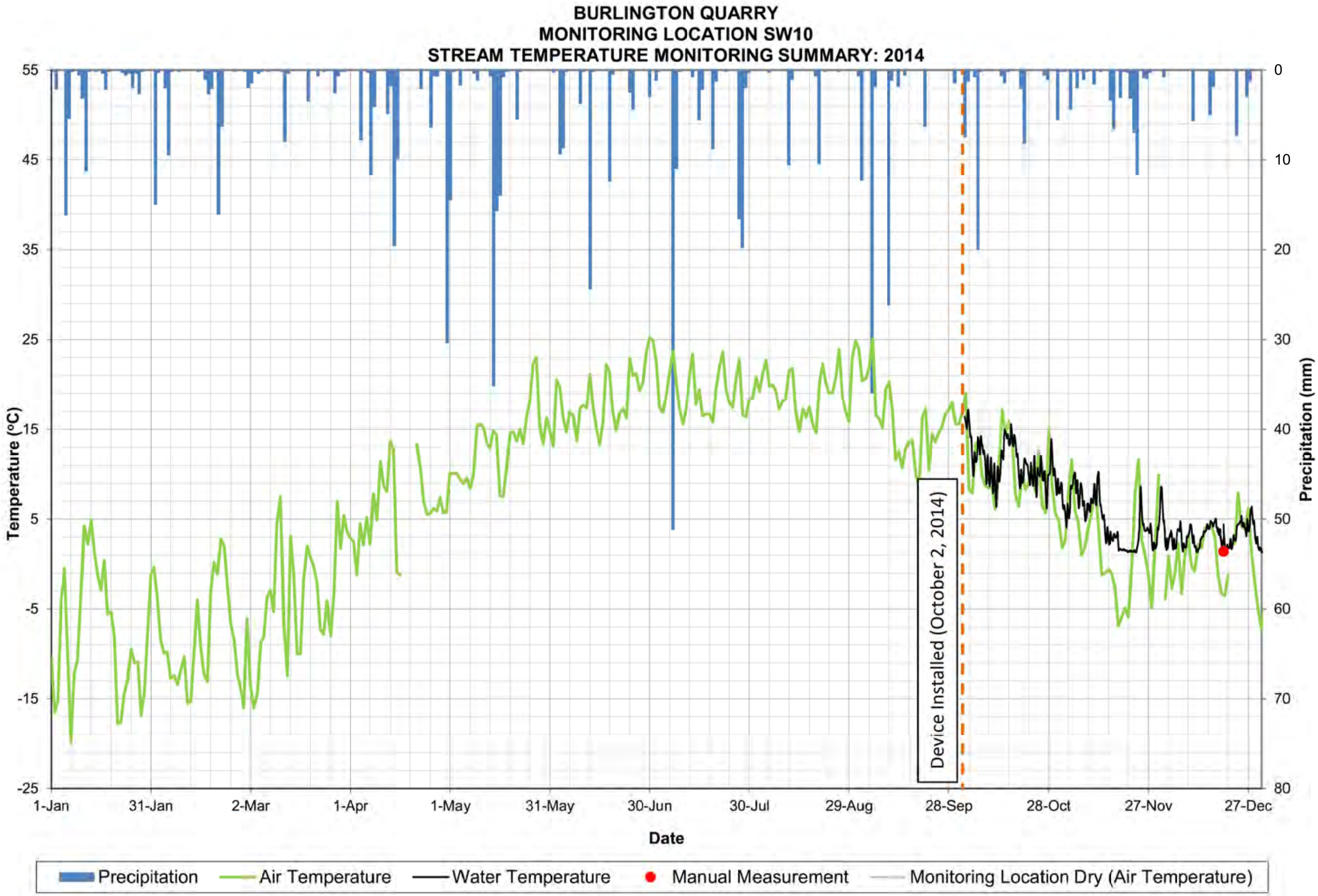
BURLINGTON QUARRY
MONITORING LOCATION SW10
STREAM FLOW MONITORING SUMMARY: 2017
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Device Installed (May 17, 2017)
Device Removed (December 20, 2017)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Manual Measurement
Stream Flow
Air Temperature

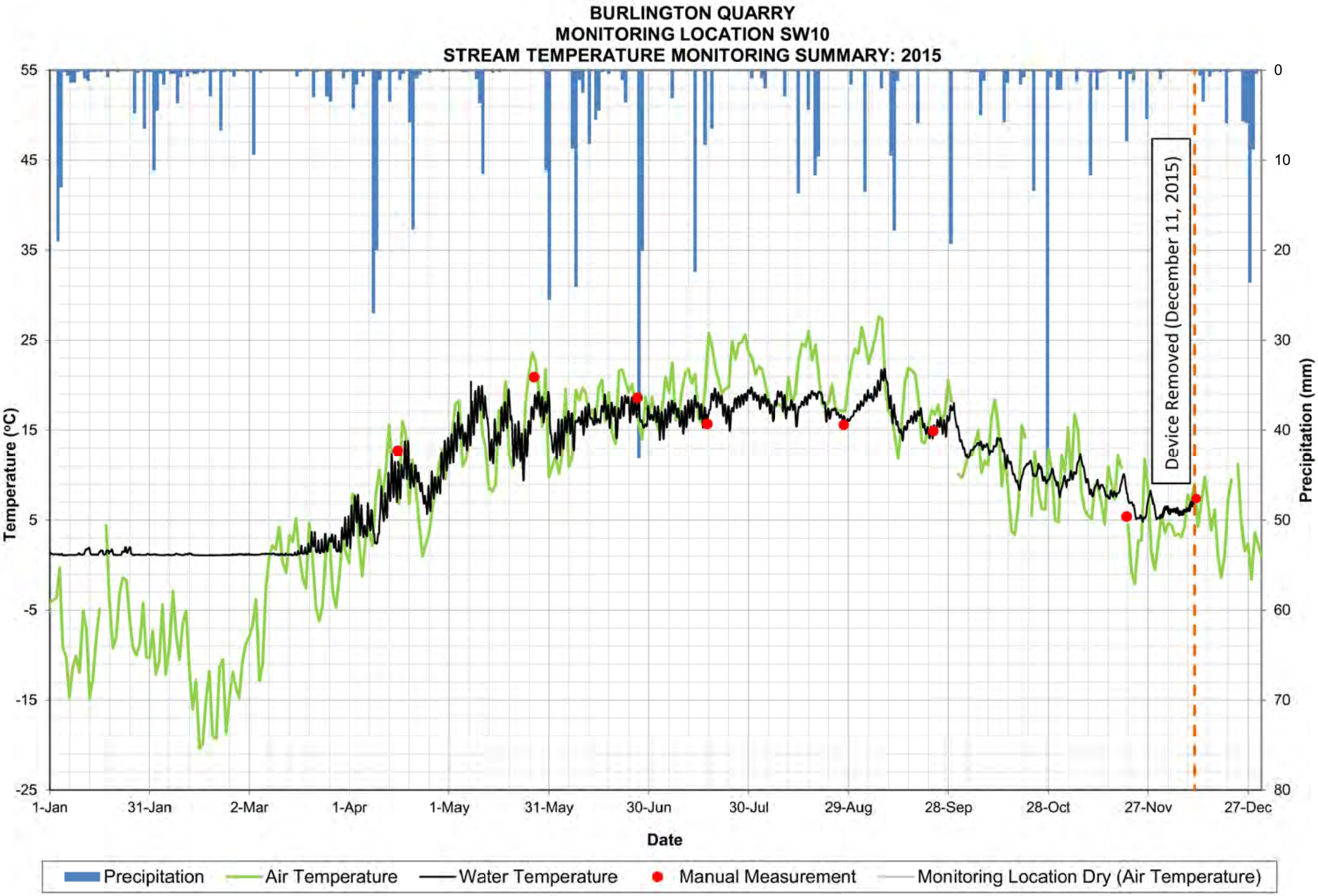


BURLINGTON QUARRY
MONITORING LOCATION SW10
STREAM FLOW MONITORING SUMMARY: 2018
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (April 19, 2018)
Device Removed (December 12, 2018)
0
50
100
150
200
250
300
350
400
450
500
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Manual Measurement
Stream Flow
Air Temperature

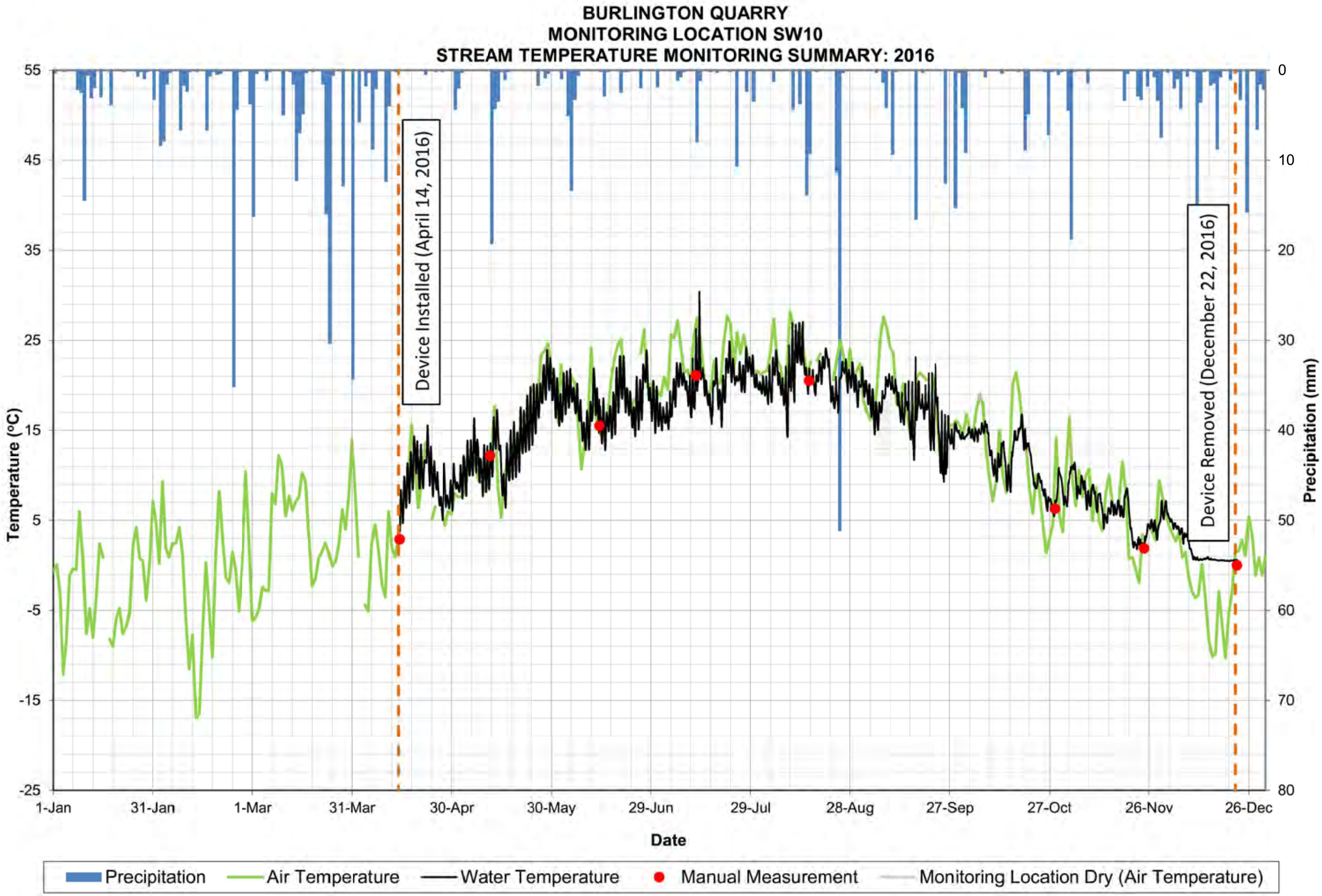

BURLINGTON QUARRY
MONITORING LOCATION SW10
STREAM FLOW MONITORING SUMMARY: 2019
Flow Rate (L/s)
500
450
400
350
300
250
200
150
100
50
0
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
Device Installed (March 14, 2019)
End of Reporting Period (September 15, 2019)
Monitoring Ongoing
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Manual Measurement
Stream Flow
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW10
STREAM TEMPERATURE MONITORING SUMMARY: 2014-2019
Temperature (°C)
Precipitation (mm)
Date
1-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
9-Jun-18
6-Dec-18
4-Jun-19
1-Dec-19
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Device Installed (October 2, 2014)
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
Device Removed During Winter Season
Precipitation
Manual Measurement
Air Temperature
Water Temperature
Monitoring Location Dry (Air Temperature)

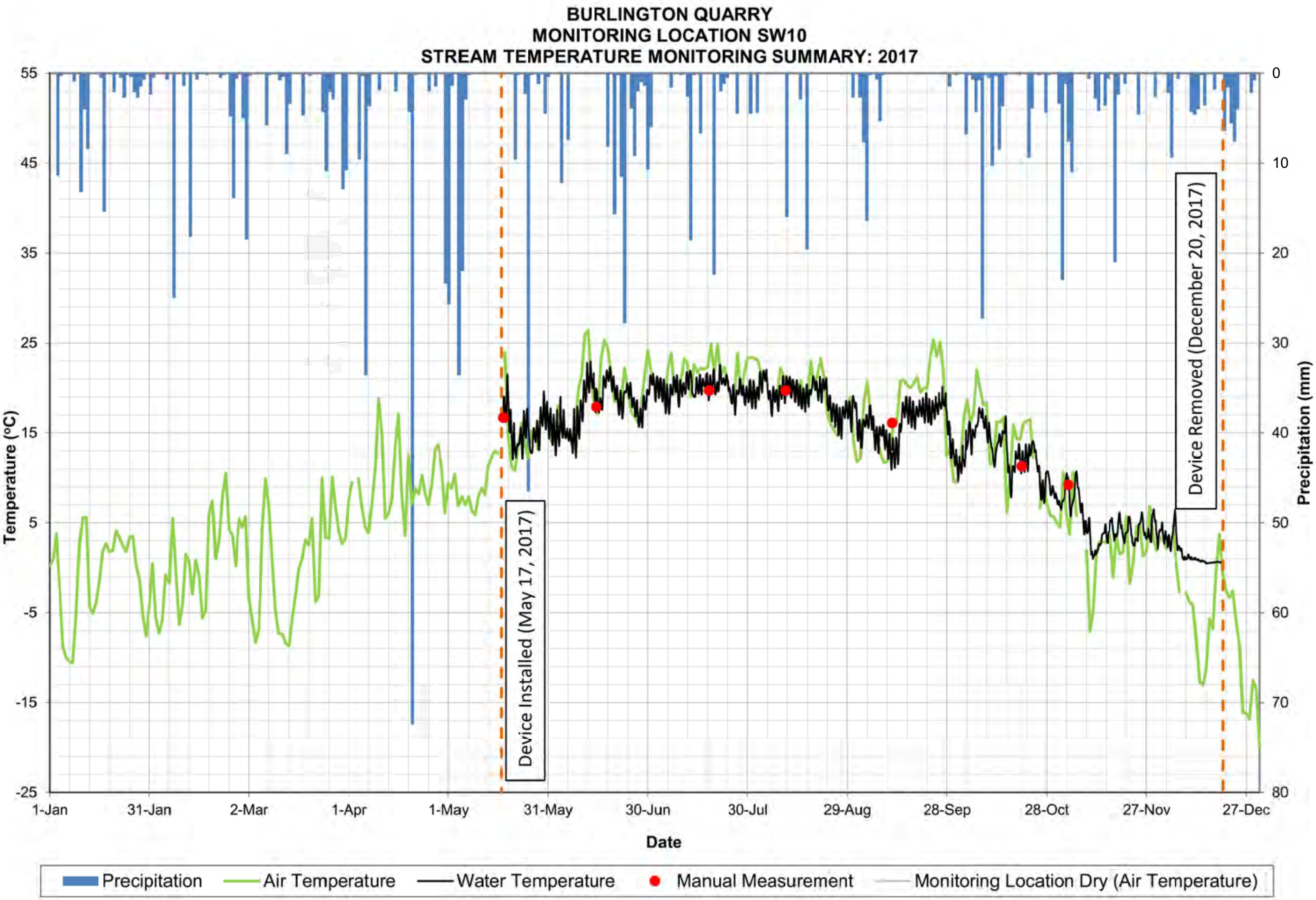

BURLINGTON QUARRY
MONITORING LOCATION SW10
STREAM TEMPERATURE MONITORING SUMMARY: 2014
Temperature (°C)
Precipitation (mm)
Date
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (October 2, 2014)
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)



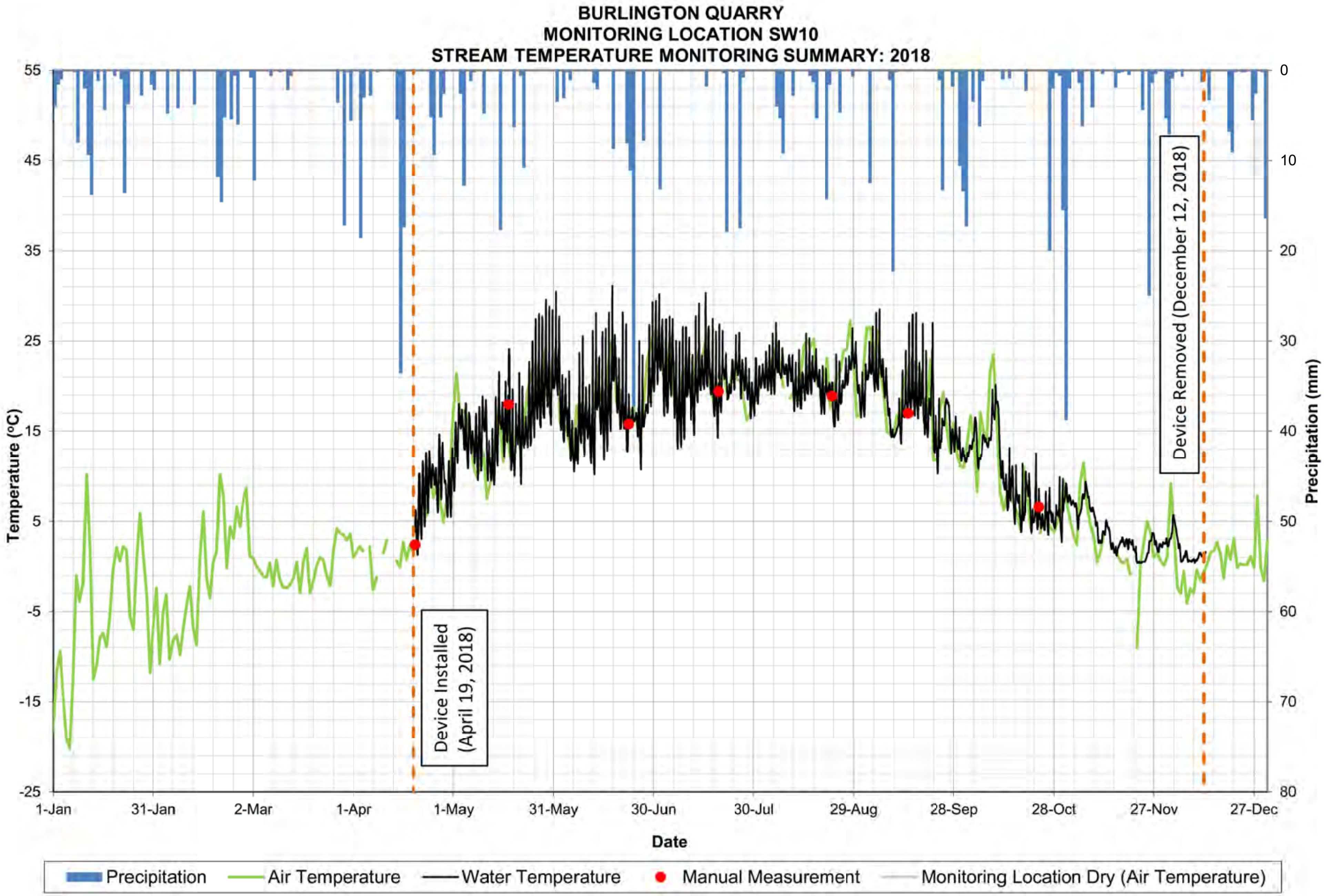
BURLINGTON QUARRY
MONITORING LOCATION SW10
STREAM TEMPERATURE MONITORING SUMMARY: 2015
Temperature (ºC)
Precipitation (mm)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Device Removed (December 11, 2015)
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)



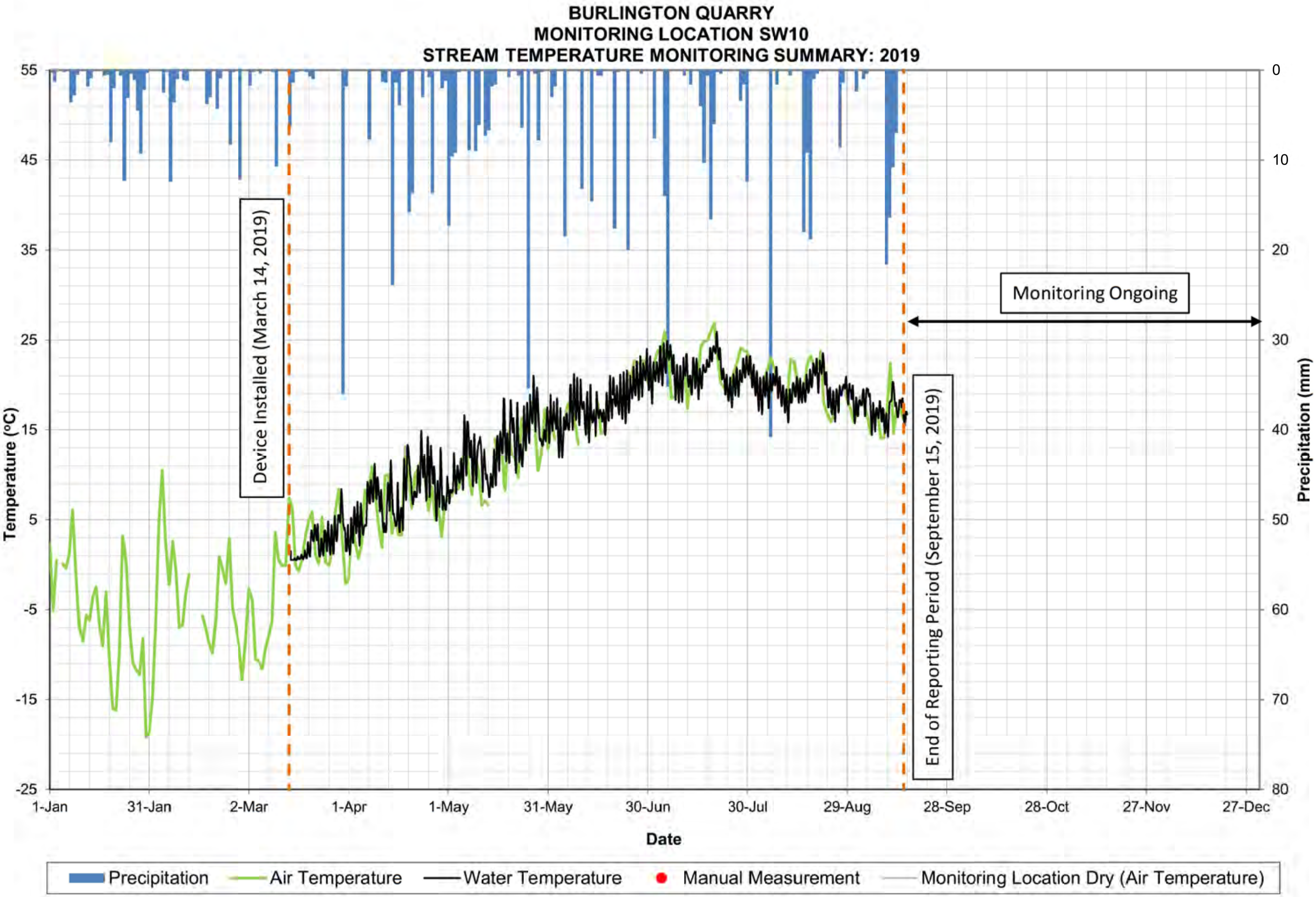
BURLINGTON QUARRY
MONITORING LOCATION SW10
STREAM TEMPERATURE MONITORING SUMMARY: 2016
Temperature (ºC)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Device Installed (April 14, 2016)
Device Removed (December 22, 2016)
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)



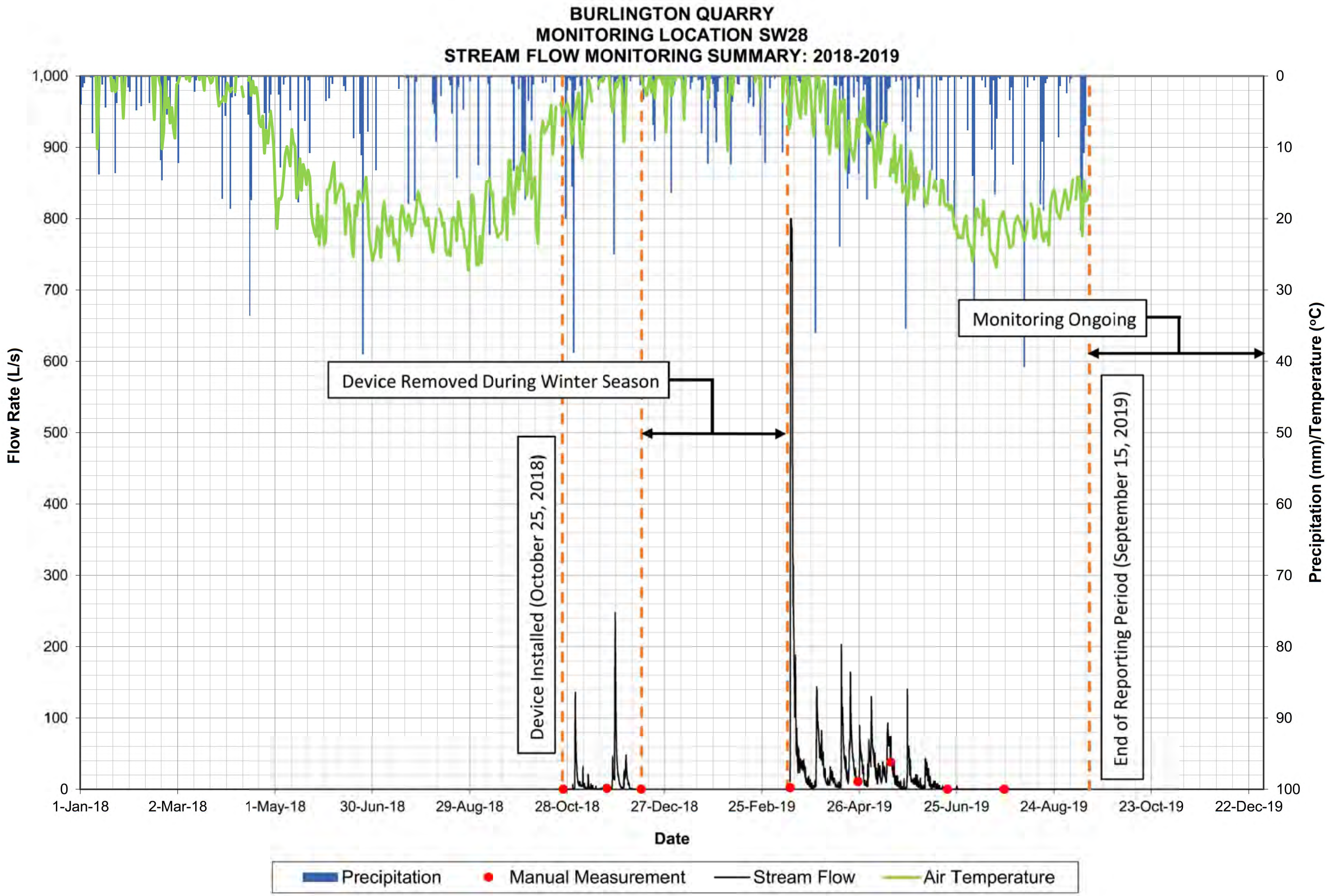
BURLINGTON QUARRY
MONITORING LOCATION SW10
STREAM TEMPERATURE MONITORING SUMMARY: 2017
Temperature (ºC)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Device Installed (May 17, 2017)
Device Removed (December 20, 2017)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)



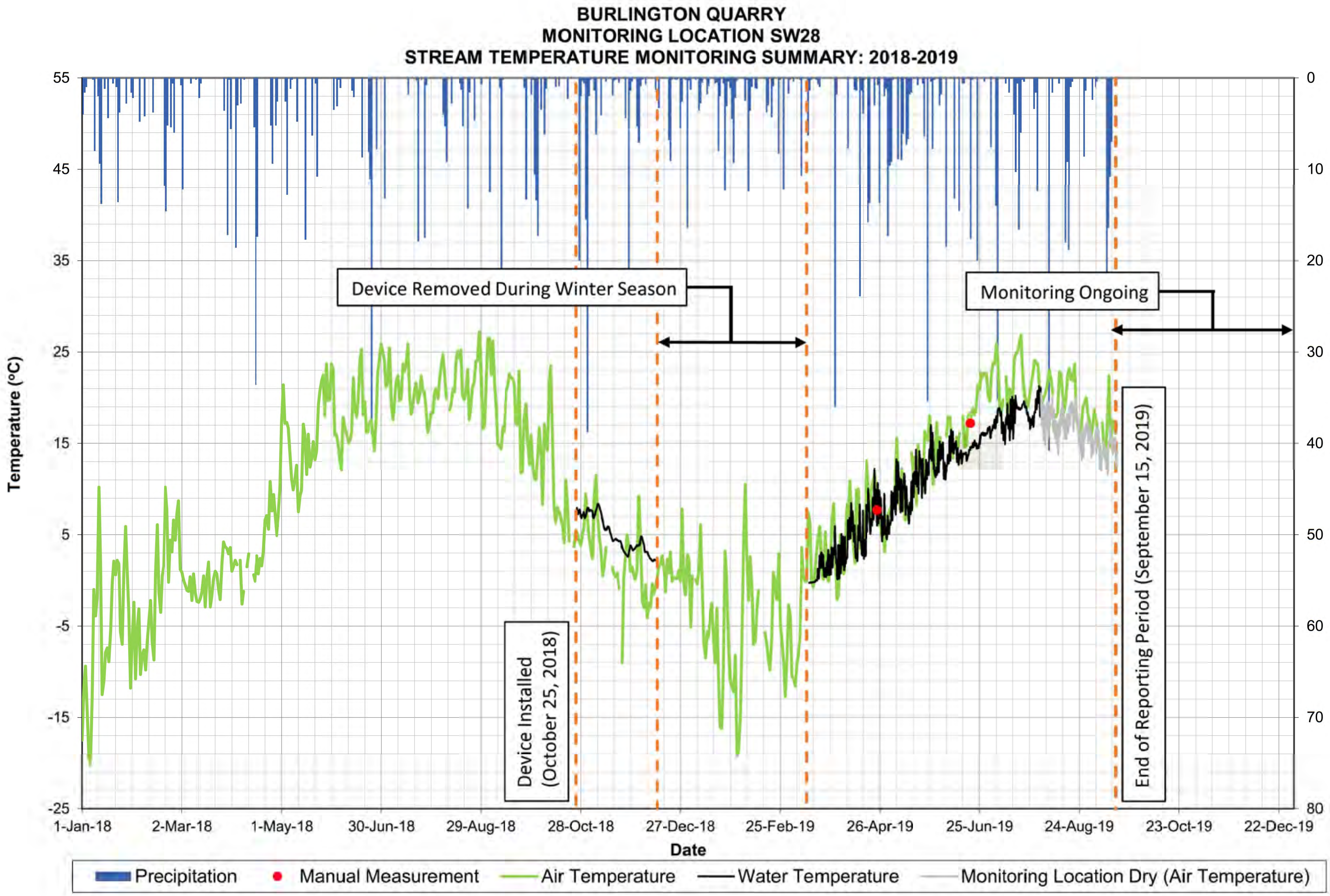
BURLINGTON QUARRY
MONITORING LOCATION SW10
STREAM TEMPERATURE MONITORING SUMMARY: 2018
Temperature (ºC)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Device Installed (April 19, 2018)
Device Removed (December 12, 2018)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)



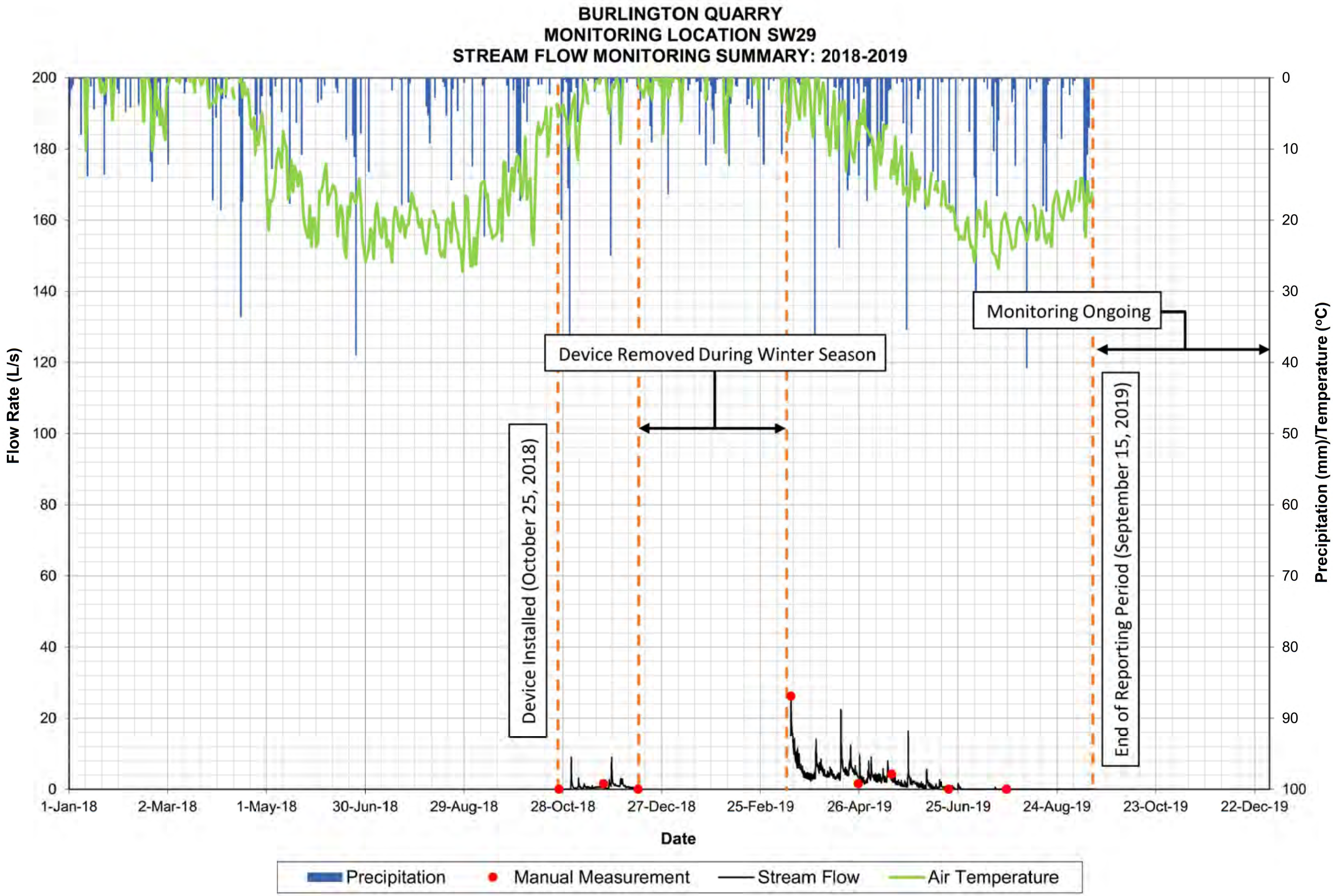
BURLINGTON QUARRY
MONITORING LOCATION SW10
STREAM TEMPERATURE MONITORING SUMMARY: 2019
Temperature (ºC)
Precipitation (mm)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
Device Installed (March 14, 2019)
End of Reporting Period (September 15, 2019)
Monitoring Ongoing
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Air Temperature
Water Temperature
Manual Measurement
Monitoring Location Dry (Air Temperature)



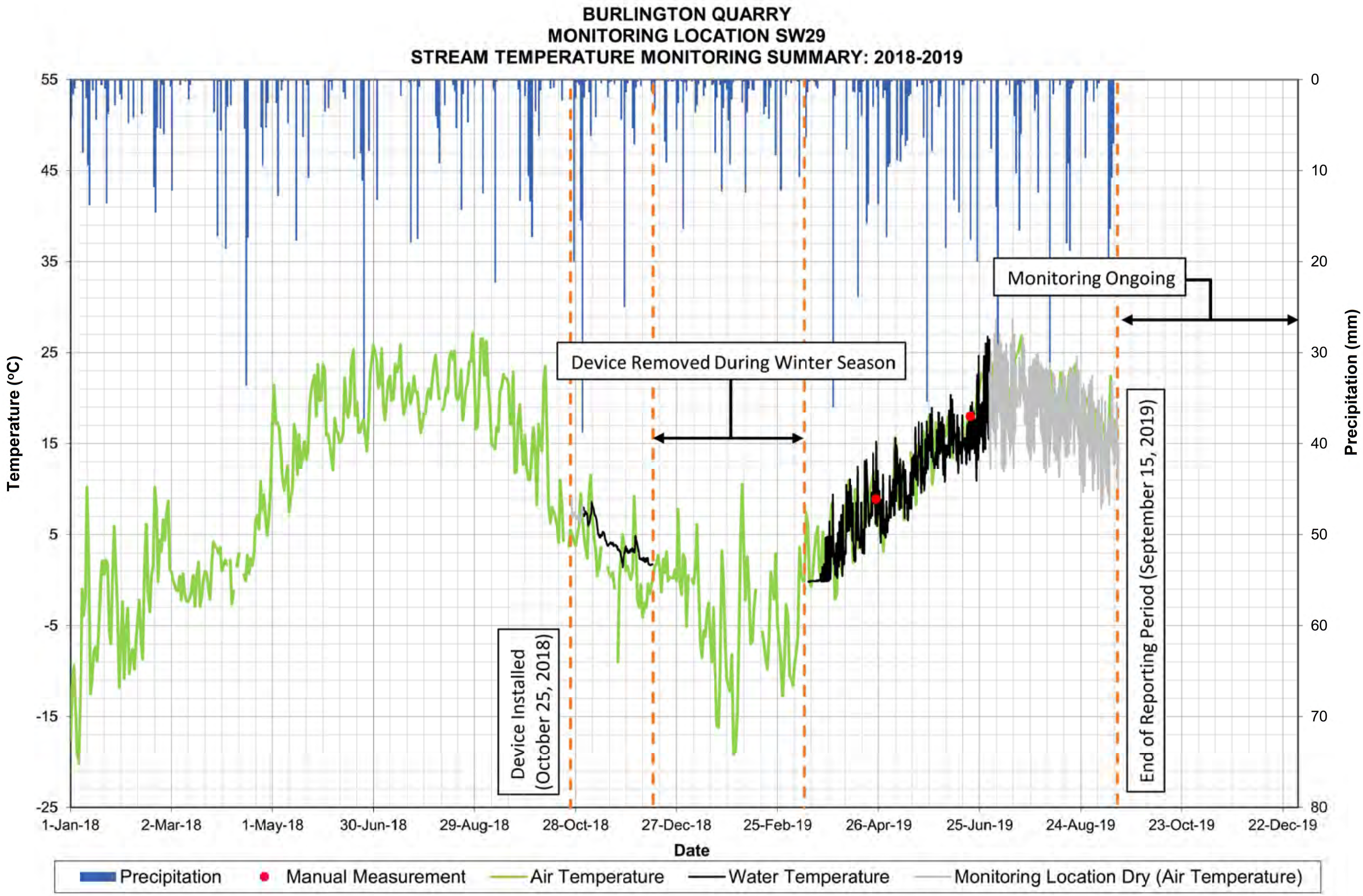
BURLINGTON QUARRY
MONITORING LOCATION SW28
STREAM FLOW MONITORING SUMMARY: 2018-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
1,000
900
800
700
600
500
400
300
200
100
0
10
20
30
40
50
60
70
80
90
100
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Date
Device Removed During Winter Season
Device Installed (October 25, 2018)
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Stream Flow
Air Temperature



* Grey data indicates the monitoring location was dry and therefore the recorded values are representative of the air temperature.

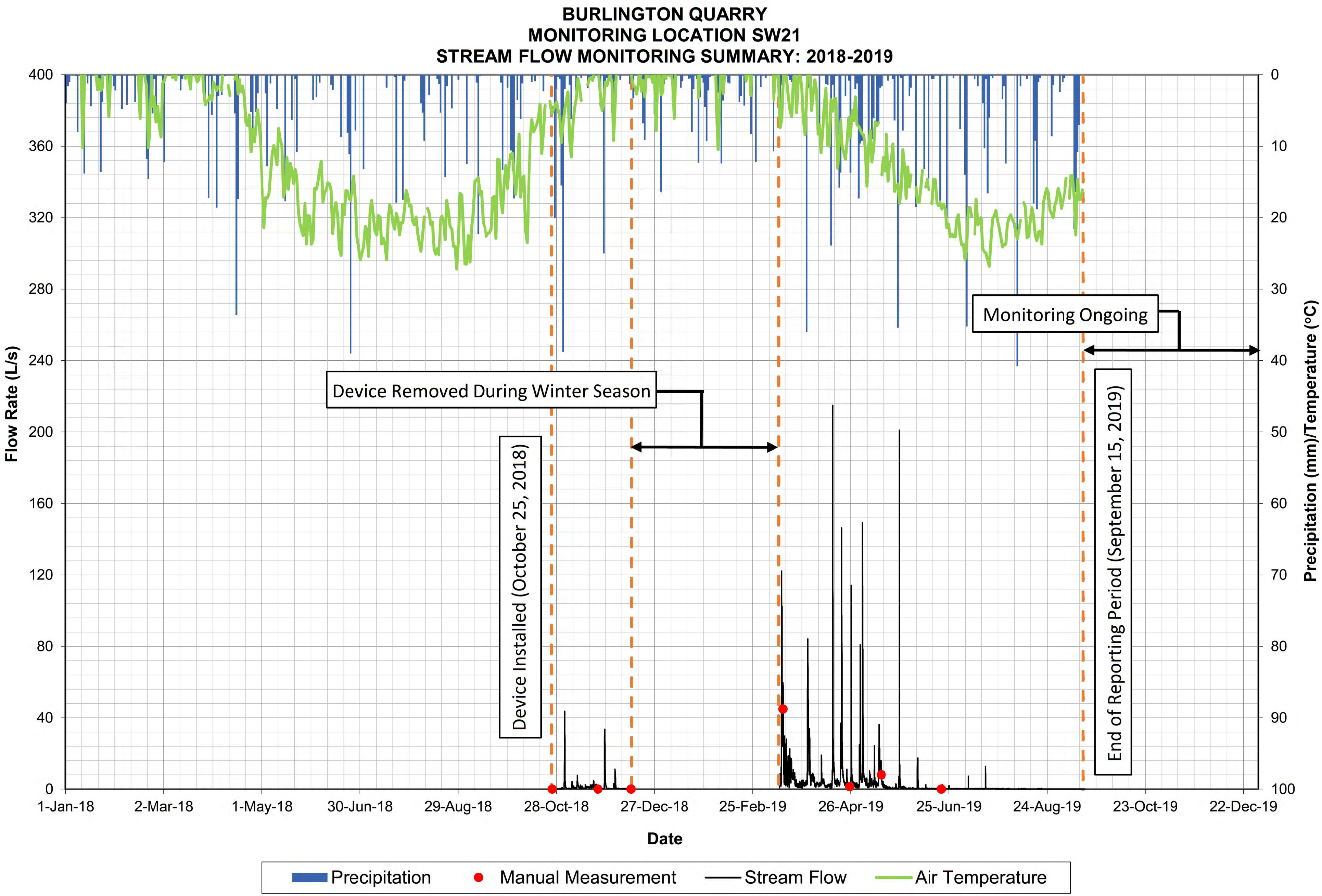


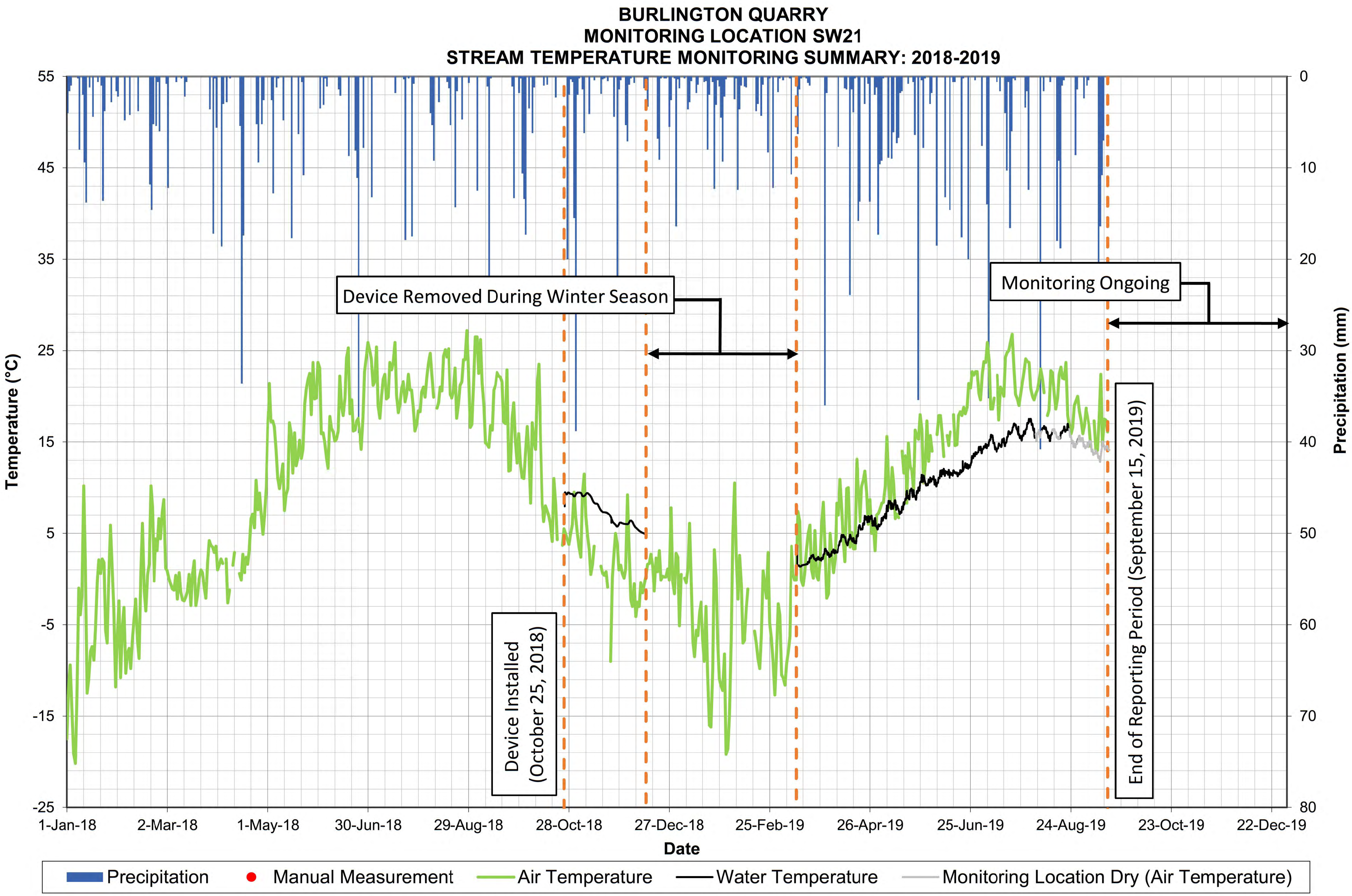
BURLINGTON QUARRY
MONITORING LOCATION SW29
STREAM FLOW MONITORING SUMMARY: 2018-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
200
180
160
140
120
100
80
60
40
20
0
10
30
50
70
90
Monitoring Ongoing
Device Removed During Winter Season
Device Installed (October 25, 2018)
End of Reporting Period (September 15, 2019)
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Date
Precipitation
Manual Measurement
Stream Flow
Air Temperature



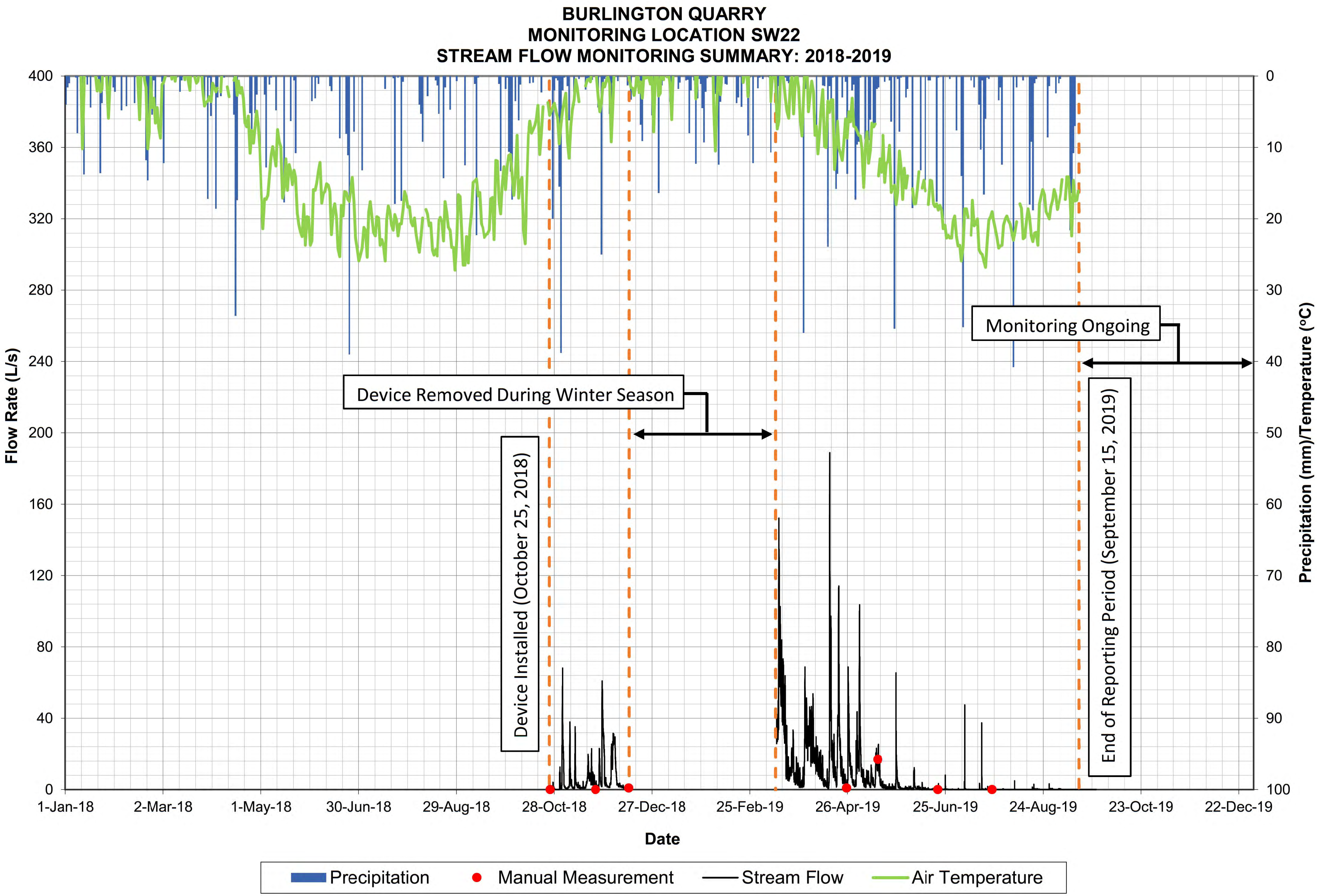
* Grey data indicates the monitoring location was dry and therefore the recorded values are respresentative of the air temperature.

Appendix D: Shoreacres and Appleby Creeks Watershed Streamflow Monitoring Results

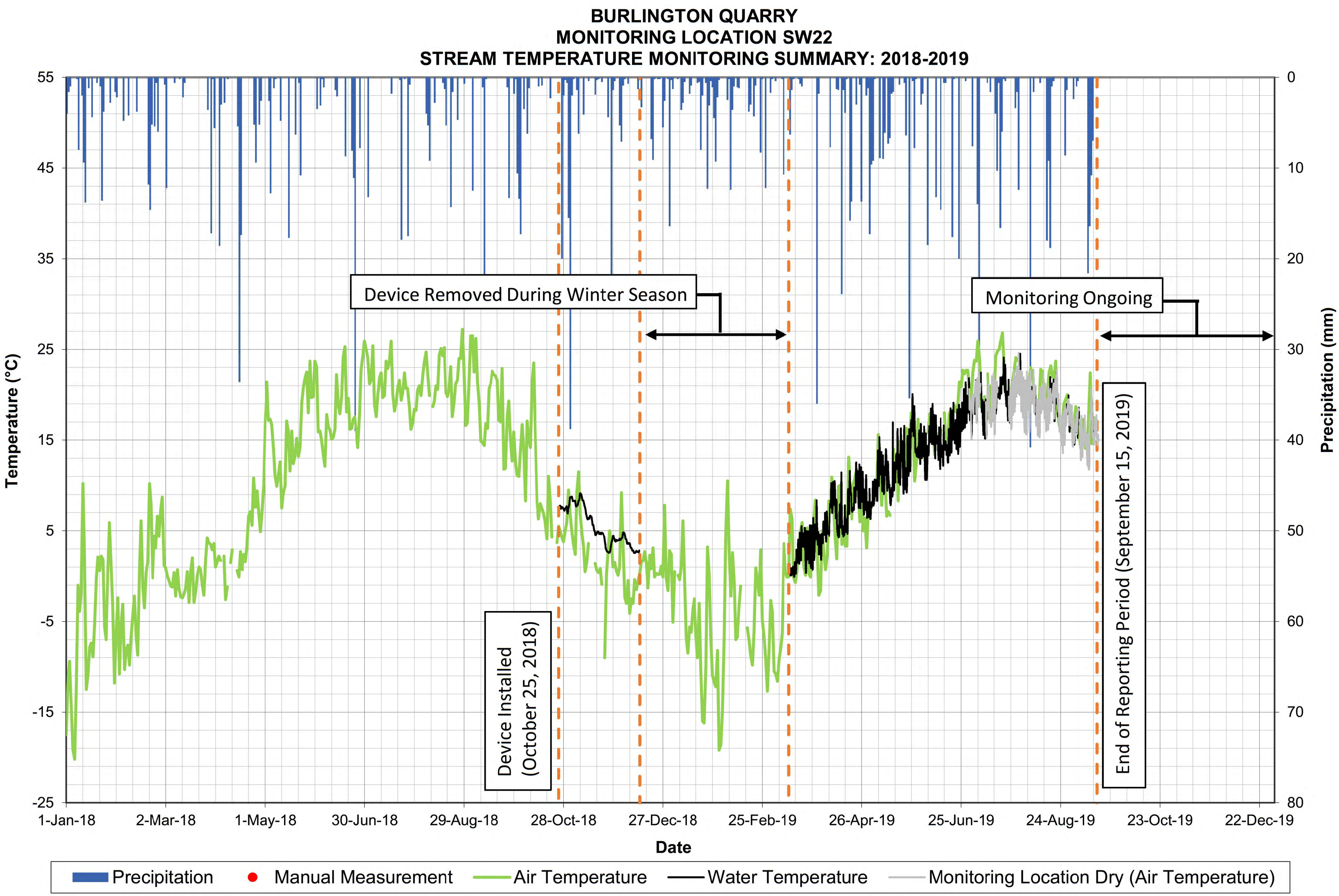

BURLINGTON QUARRY
MONITORING LOCATION SW21
STREAM FLOW MONITORING SUMMARY: 2018-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (October 25, 2018)
Device Removed During Winter Season
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Precipitation
Manual Measurement
Stream Flow
Air Temperature



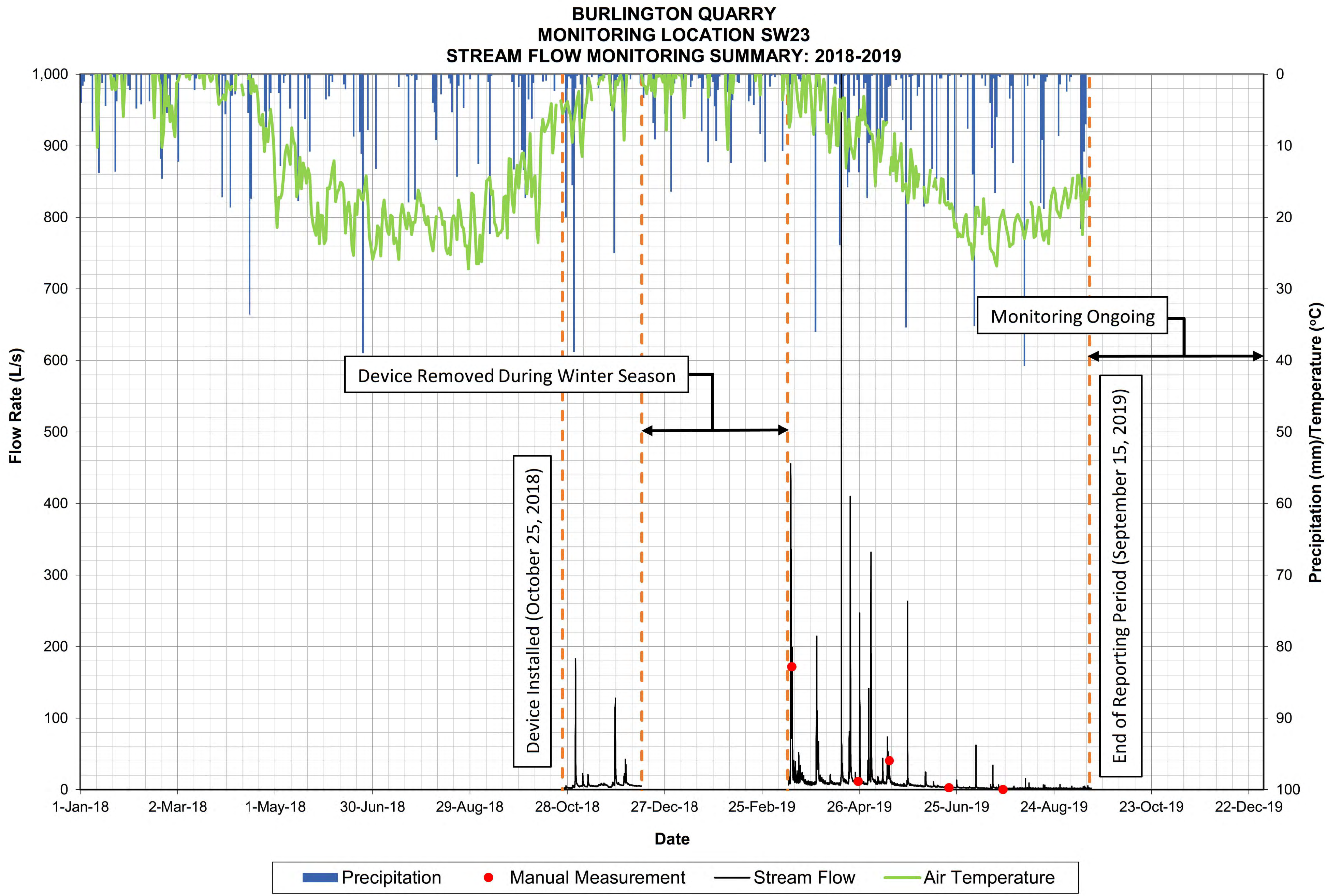
* Grey data indicates the monitoring location was dry and therefore the recorded values are respresentative of the air temperature.



BURLINGTON QUARRY
MONITORING LOCATION SW22
STREAM FLOW MONITORING SUMMARY: 2018-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Device Installed (October 25, 2018)
Device Removed During Winter Season
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Stream Flow
Air Temperature

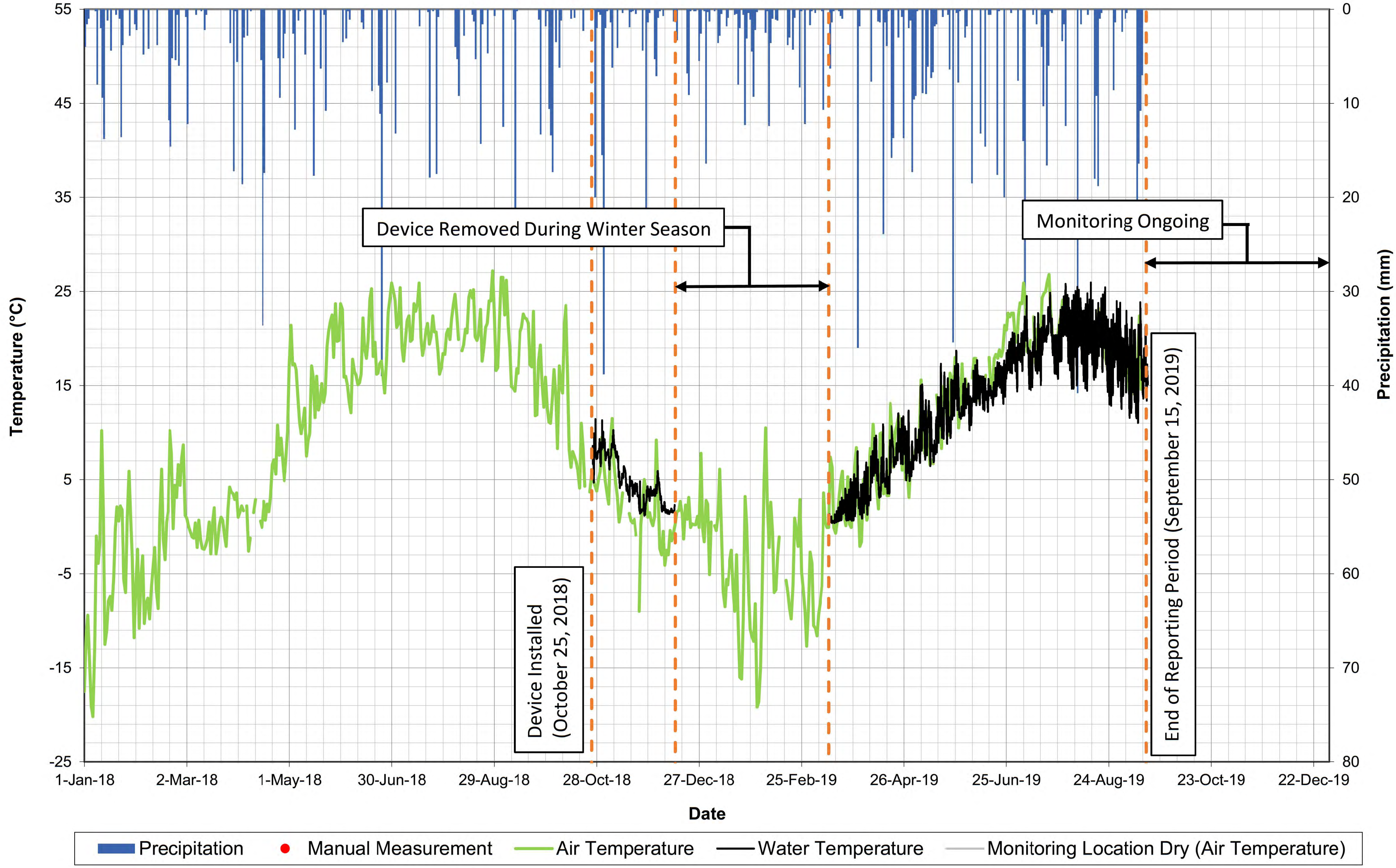


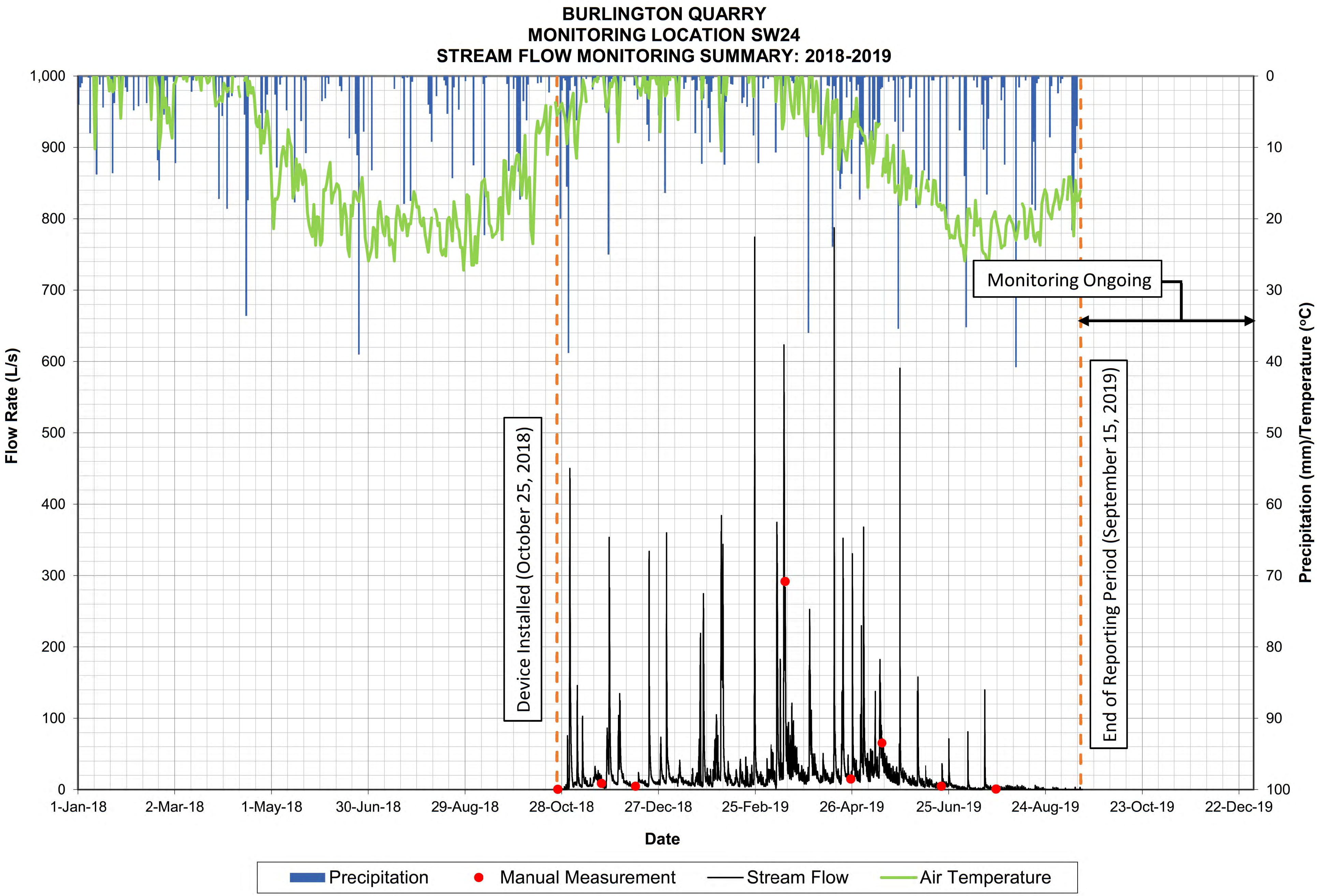
* Grey data indicates the monitoring location was dry and therefore the recorded values are respresentative of the air temperature.



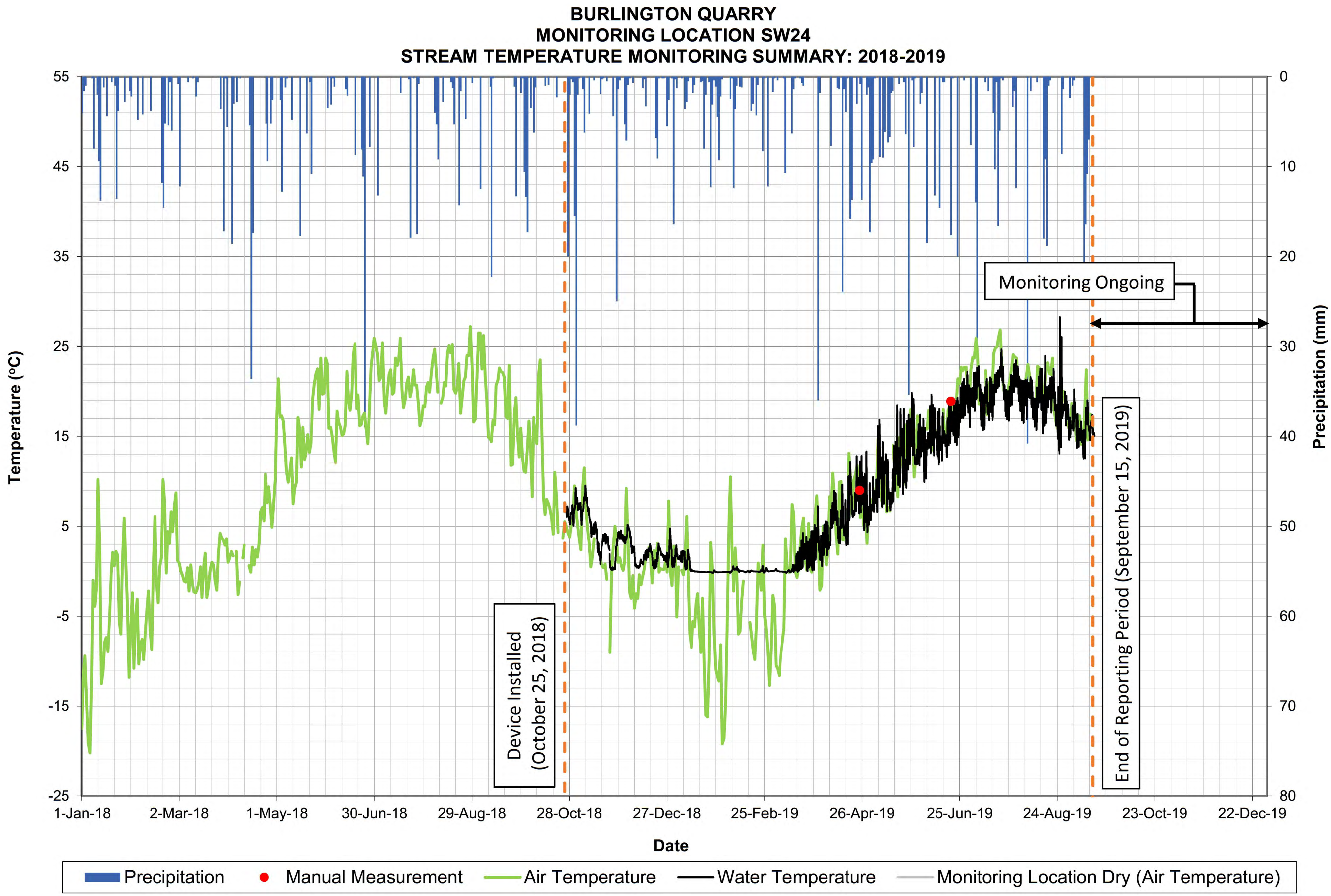
BURLINGTON QUARRY
MONITORING LOCATION SW23
STREAM FLOW MONITORING SUMMARY: 2018-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
1,000
900
800
700
600
500
400
300
200
100
0
10
20
30
40
50
60
70
80
90
100
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Device Removed During Winter Season
Device Installed (October 25, 2018)
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Stream Flow
Air Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW23
STREAM TEMPERATURE MONITORING SUMMARY: 2018-2019



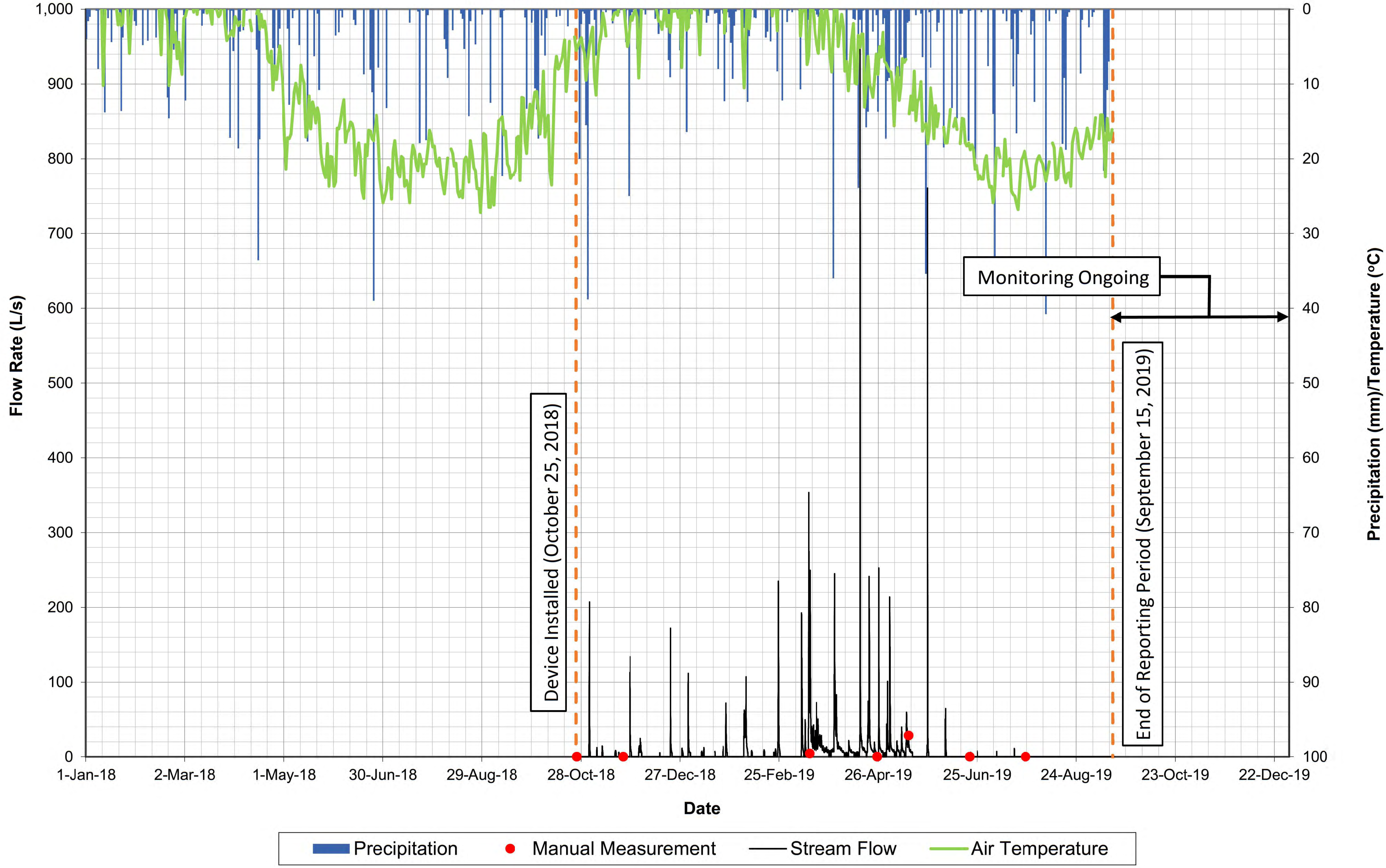


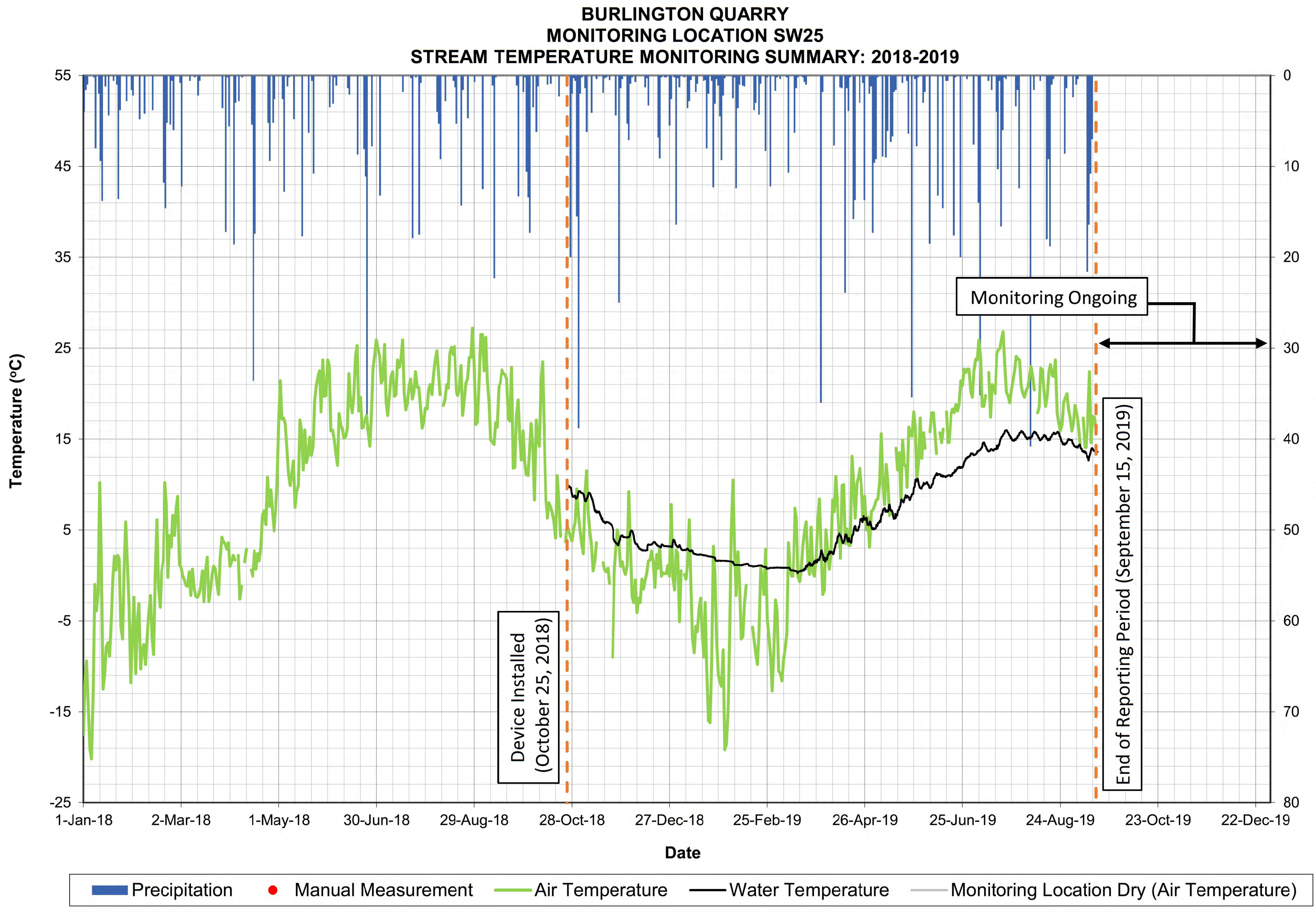
BURLINGTON QUARRY
MONITORING LOCATION SW24
STREAM FLOW MONITORING SUMMARY: 2018-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (October 25, 2018)
End of Reporting Period (September 15, 2019)
Monitoring Ongoing
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Precipitation
Manual Measurement
Stream Flow
Air Temperature

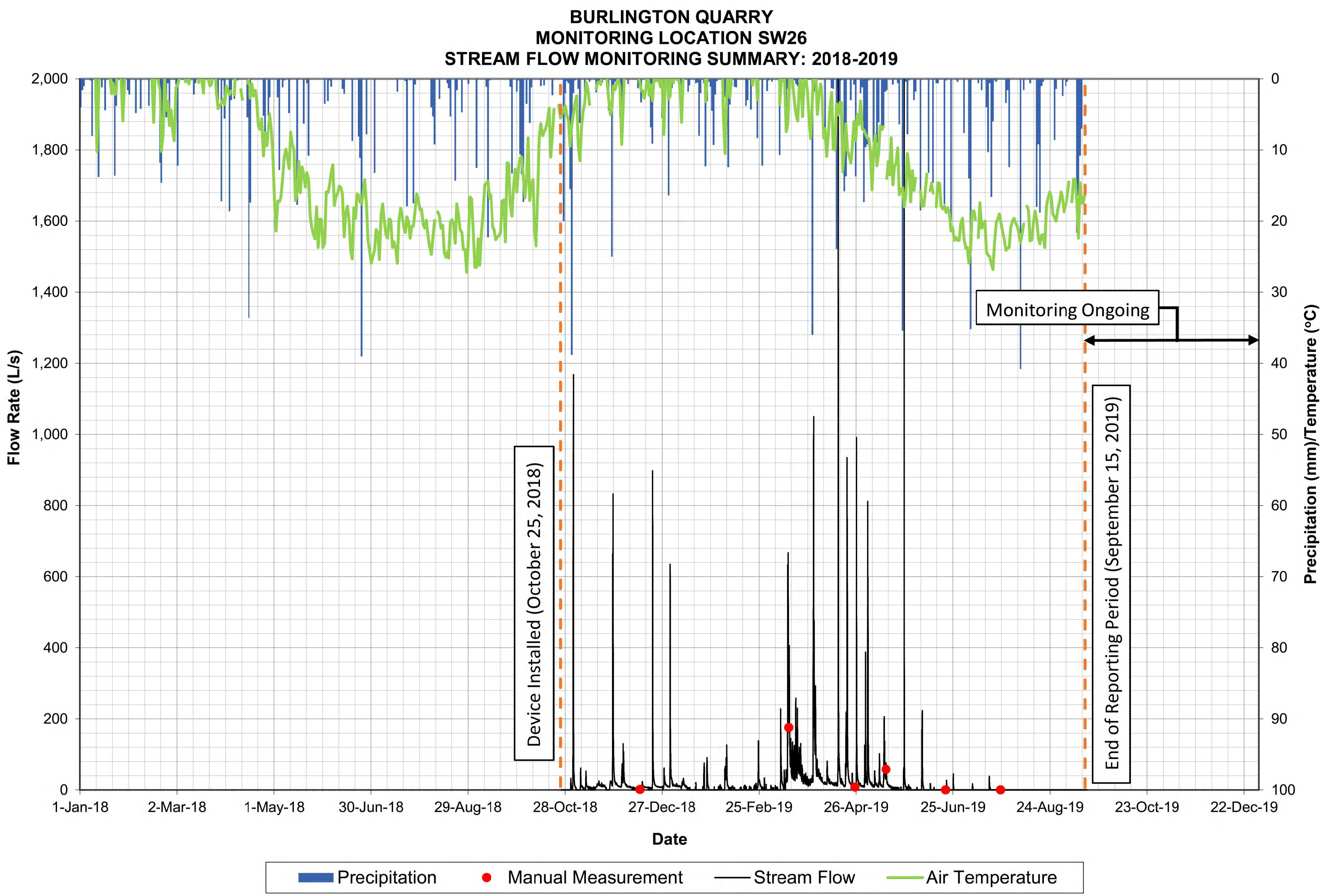


BURLINGTON QUARRY
MONITORING LOCATION SW24
STREAM TEMPERATURE MONITORING SUMMARY: 2018-2019
Temperature (°C)
Precipitation (mm)
Date
Monitoring Ongoing
Device Installed (October 25, 2018)
End of Reporting Period (September 15, 2019)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Precipitation
Manual Measurement
Air Temperature
Water Temperature
Monitoring Location Dry (Air Temperature)

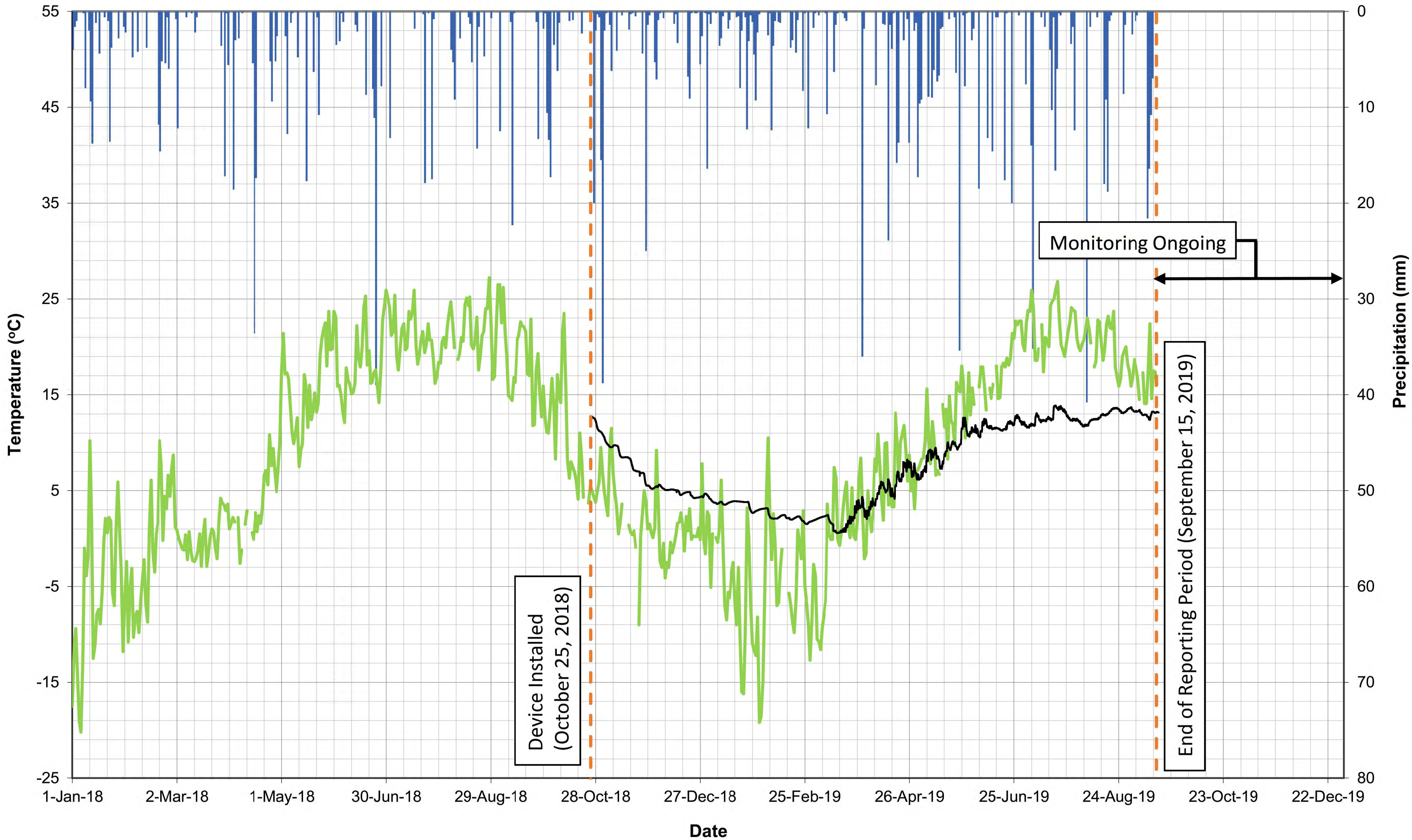
BURLINGTON QUARRY
MONITORING LOCATION SW25
STREAM FLOW MONITORING SUMMARY: 2018-2019



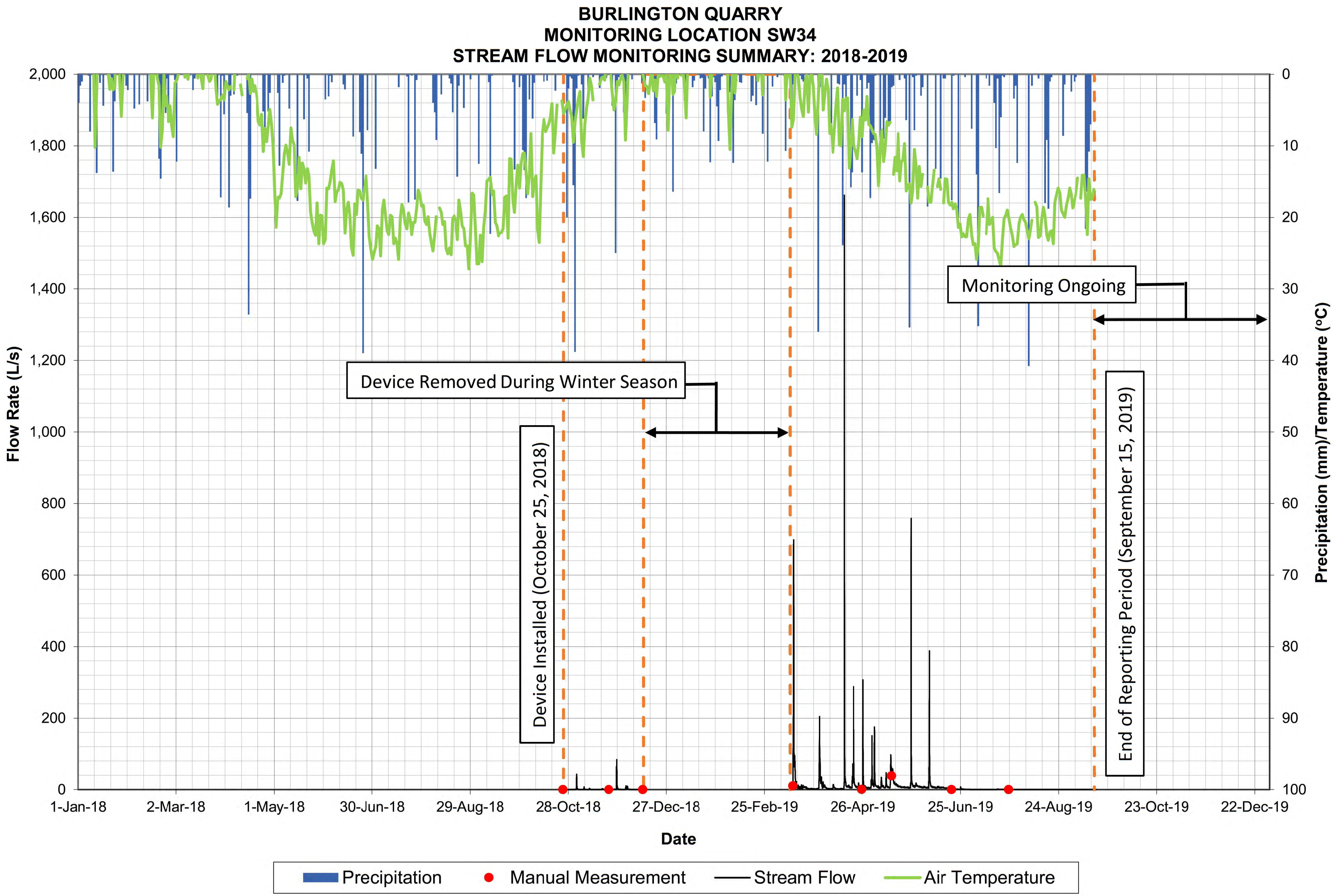

BURLINGTON QUARRY
MONITORING LOCATION SW25
STREAM TEMPERATURE MONITORING SUMMARY: 2018-2019
Temperature (°C)
Precipitation (mm)
Date
Monitoring Ongoing
Device Installed (October 25, 2018)
End of Reporting Period (September 15, 2019)
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Precipitation
Manual Measurement
Air Temperature
Water Temperature
Monitoring Location Dry (Air Temperature)


BURLINGTON QUARRY
MONITORING LOCATION SW26
STREAM FLOW MONITORING SUMMARY: 2018-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
10
20
30
40
50
60
70
80
90
100
Device Installed (October 25, 2018)
End of Reporting Period (September 15, 2019)
Monitoring Ongoing
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Date
Precipitation
Manual Measurement
Stream Flow
Air Temperature

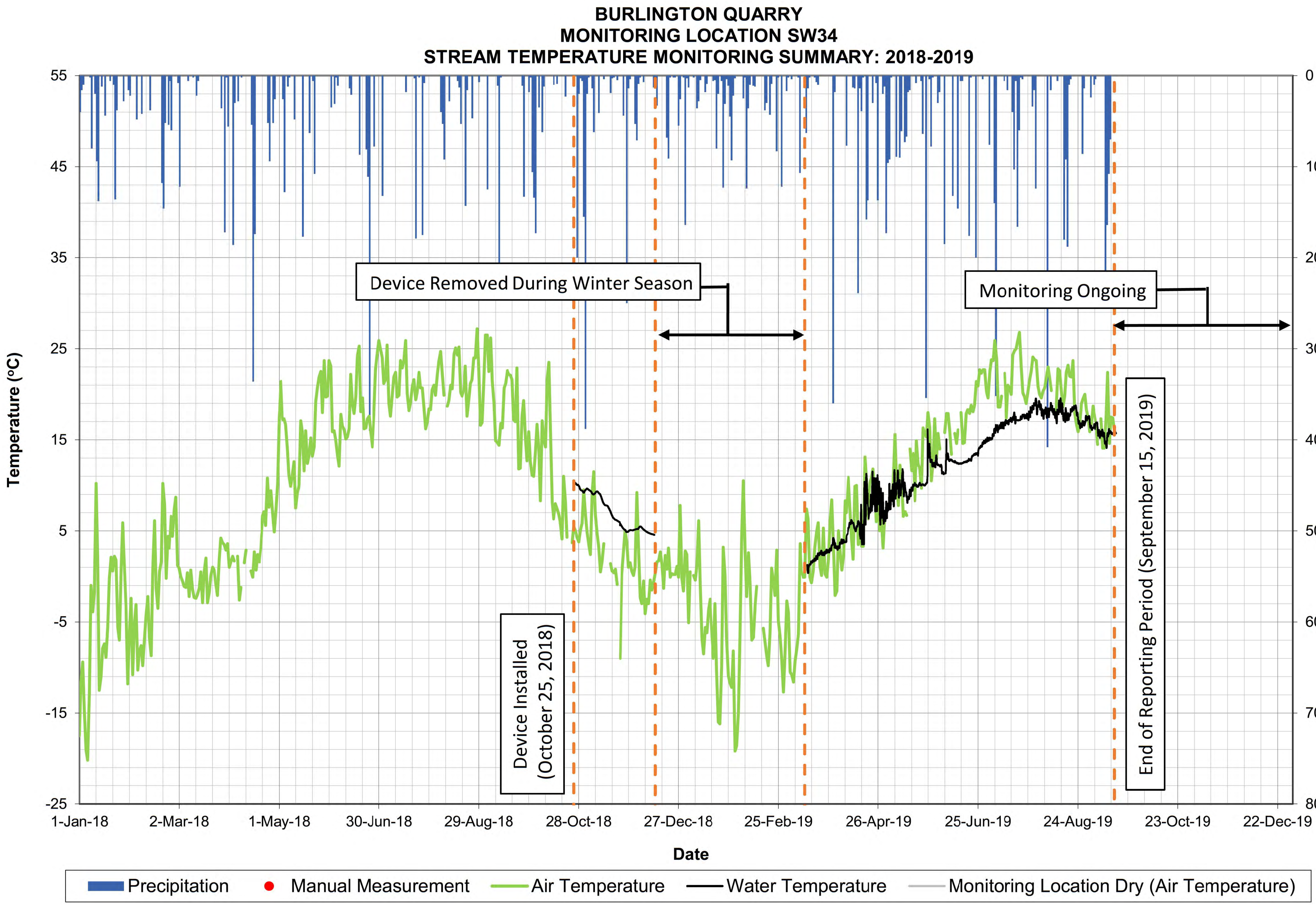
BURLINGTON QUARRY
MONITORING LOCATION SW26
STREAM TEMPERATURE MONITORING SUMMARY: 2018-2019

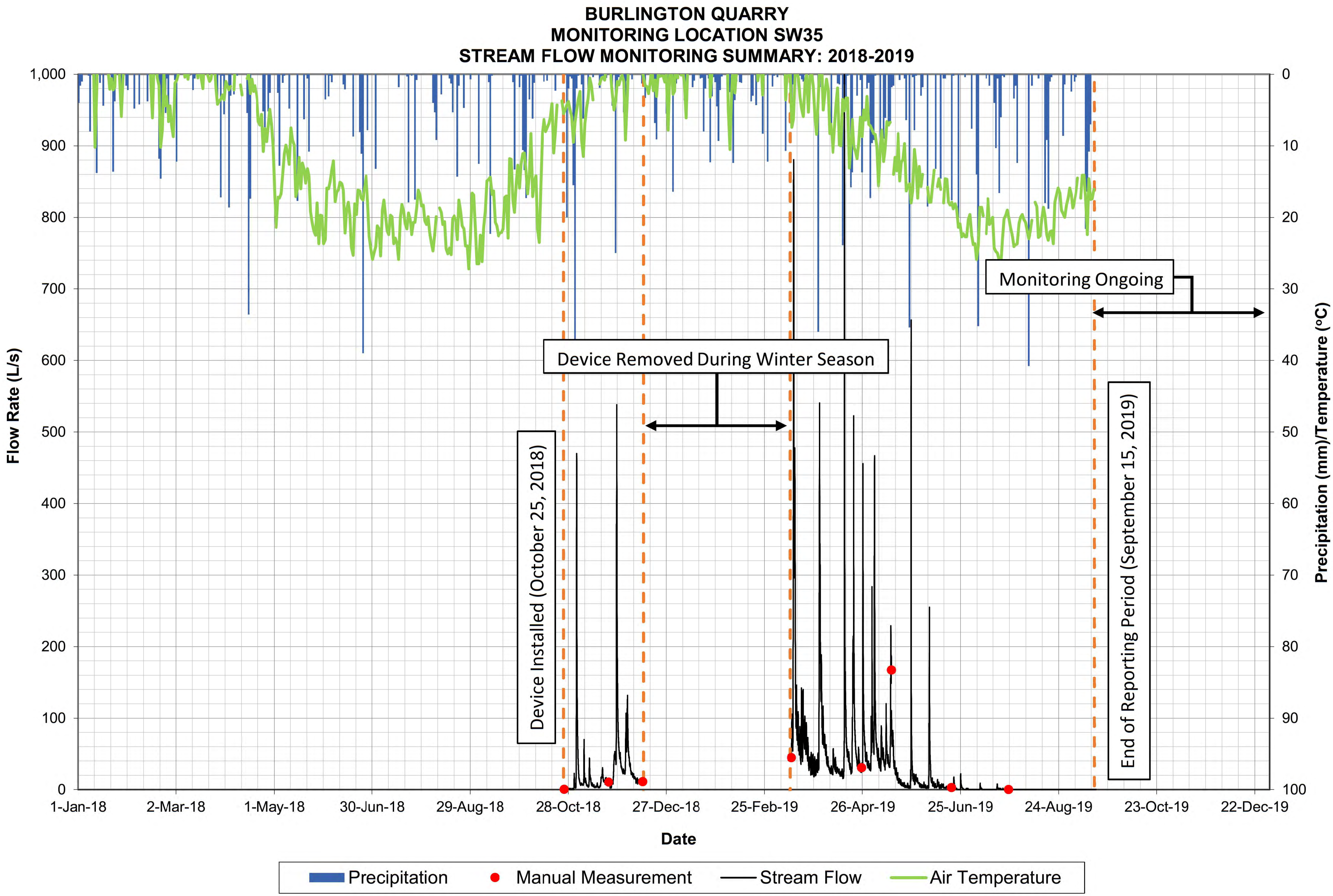


Precipitation | Manual Measurement | Air Temperature | Water Temperature | Monitoring Location Dry (Air Temperature)

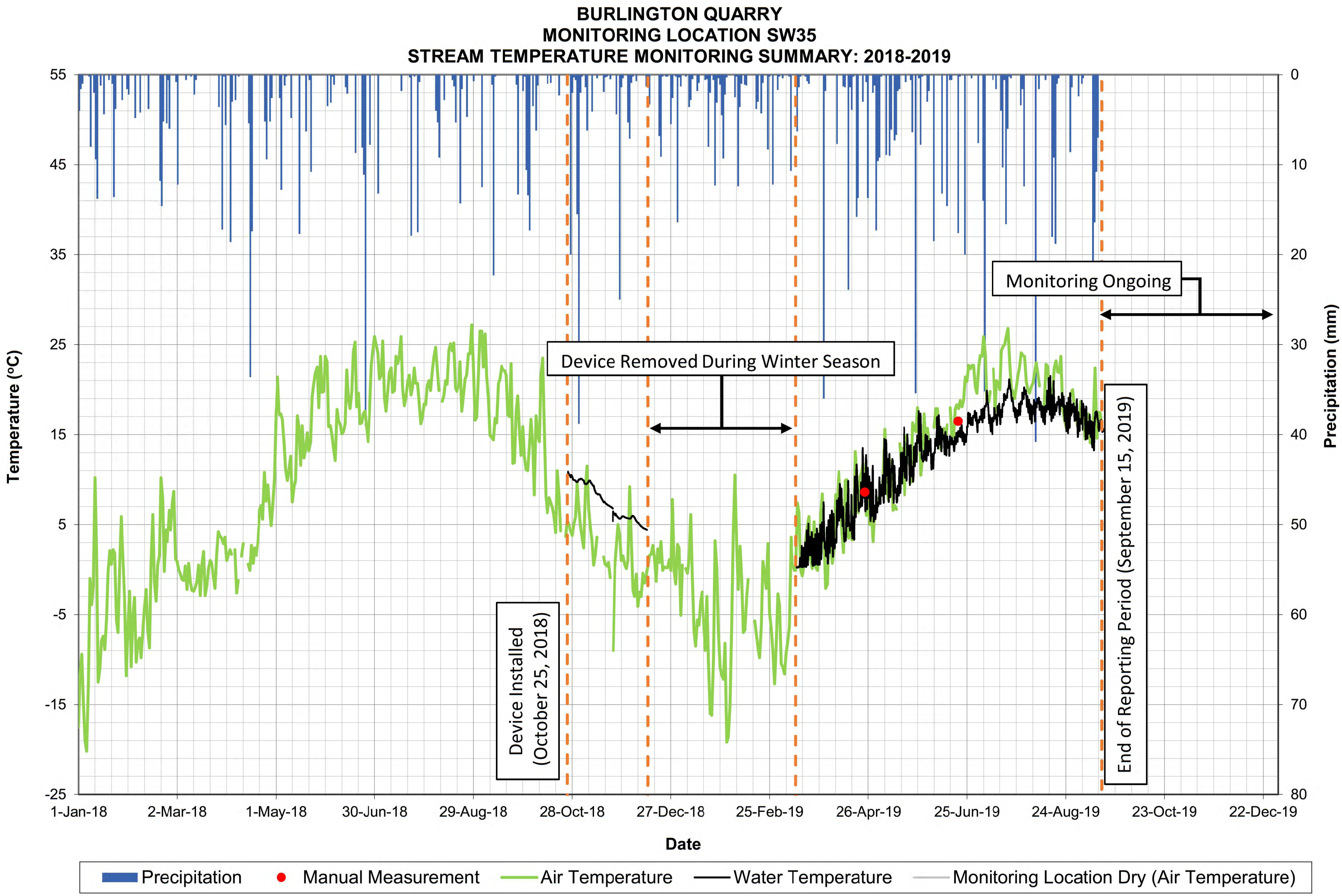


BURLINGTON QUARRY
MONITORING LOCATION SW34
STREAM FLOW MONITORING SUMMARY: 2018-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
10
20
30
40
50
60
70
80
90
100
Monitoring Ongoing
Device Removed During Winter Season
Device Installed (October 25, 2018)
End of Reporting Period (September 15, 2019)
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Date
Precipitation
Manual Measurement
Stream Flow
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW34
STREAM TEMPERATURE MONITORING SUMMARY: 2018-2019
Temperature (°C)
Precipitation (mm)
Date
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Device Removed During Winter Season
Monitoring Ongoing
Device Installed (October 25, 2018)
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Air Temperature
Water Temperature
Monitoring Location Dry (Air Temperature)



BURLINGTON QUARRY
MONITORING LOCATION SW35
STREAM FLOW MONITORING SUMMARY: 2018-2019
Flow Rate (L/s)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (October 25, 2018)
Device Removed During Winter Season
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
1,000
900
800
700
600
500
400
300
200
100
0
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Precipitation
Manual Measurement
Stream Flow
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW35
STREAM TEMPERATURE MONITORING SUMMARY: 2018-2019
Temperature (°C)
Precipitation (mm)
Date
55
45
35
25
15
5
-5
-15
-25
0
10
20
30
40
50
60
70
80
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Monitoring Ongoing
Device Removed During Winter Season
Device Installed (October 25, 2018)
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Air Temperature
Water Temperature
Monitoring Location Dry (Air Temperature)

Appendix E:
Manual In-Situ Streamflow Measurements Summary

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	March 9, 2020
SUBJECT	Manual In-situ Streamflow Measurement Summary	NAME	John Gore
		PAGE	1 OF 4

Date	Flow Rate (L/s)																			
	SW1	SW2	SW6	SW7	SW9	SW10	SW14	SW15	SW21	SW22	SW23	SW24	SW25	SW26	SW28	SW29	SW30	SW31	SW34	SW35
17-Apr-14	79	219																		
15-May-14	165	745																		
10-Jul-14	80	90																		
10-Aug-14	69	141																		
19-Sep-14	140	133	2	44																
2-Oct-14	74	93	D	46	D															
19-Dec-14	61	114	<1	47	D	11	5													
15-Apr-15	78	187	<1	96	1	17	15													
26-May-15	D	48	D	13	D	2	5													
26-Jun-15	11	86	D	20	D	2	2													
17-Jul-15	23	58	D	16	D	4	2													
27-Aug-15	37	55	D	14	D	< 1	<1													
23-Sep-15	62	69	D	11	D	< 1	< 1													
20-Nov-15	17	41	D	8	D	1	1													
10-Dec-15	65	69	D	20	D	2	2													
13-Apr-16	78	304	1	86	2	36	27													
11-May-16	64	127	D	35	D	6	9													
13-Jun-16	17	68	D	12	D	3	2													
12-Jul-16	6	24	17	D	D	D	1													
15-Aug-16	14	41	18	D	D	D	1													
13-Sep-16	46	55	D	10	D	P	<1													
28-Oct-16	70	72	D	18	D	<1	2													
24-Nov-16	D	26	2	12	D	<1	4													
17-May-17	74	185	1	75	NM	8	31													
14-Jun-17	15	85	11	28	D	13	6													
18-Jul-17	18	81	7	23	D	7	5													
10-Aug-17	33	57	10	10	D	9	<1													
11-Sep-17	58	59	6	14	D	2	2													

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	March 9, 2020
SUBJECT	Manual In-situ Streamflow Measurement Summary	NAME	John Gore
		PAGE	2 OF 4

Date	Flow Rate (L/s)																			
	SW1	SW2	SW6	SW7	SW9	SW10	SW14	SW15	SW21	SW22	SW23	SW24	SW25	SW26	SW28	SW29	SW30	SW31	SW34	SW35
20-Oct-17	19	47	3	15	D	15	1													
3-Nov-17	53	130	<1	57	D	17	26													
20-Dec-17	61	88	9	28	D	6	F													
19-Apr-18	61	375	2	222	9	118	32	27												
17-May-18	16	127	<1	58	D	13	12	<1												
22-Jun-18	78	76	P	21	D	<1	2	D												
19-Jul-18	84	105	8	11	D	5	<1	D												
22-Aug-18	57	127	P	63	D	8	14	P												
14-Sep-18	26	54	P	15	D	4	2	D												
23-Oct-18	59	70	P	11	D	2	2	D	P	P	P	<1	P	P	P	D	4	7	P	<1
21-Nov-18	74	123	2	40	D	28	7	P	P	F	F	9	F	F	1	2	29	51	<1	10
12-Dec-18	52	111	P	89	D	18	7	P	P	1	F	5	F	2	F	F	19	48	<1	11
14-Mar-19	51	194	21	94	100	89	10	NM	45	11	172	292	4	176	2	26	123	172	11	45
24-Apr-19	47	242	11	122	3	36	34	3	1	1	11	15	P	8	11	2	93	207	1	31
13-May-19	54	294	15	172	5	160	51	25	8	17	40	65	29	58	38	4	491	677	39	167
20-Jun-19	10	108	5	44	D	11	9	P	<1	<1	3	5	P	P	P	P	18	46	P	3
23-Jul-19	49	75	P	16	D	8	4	D	P	P	P	1	P	P	P	D	7	15	P	<1
25-Sep-19	104	55	10	10	D	14	<1	D	D	D	D	<1	P	P	D	D	<1	1	P	D
28-Nov-19	78	120	13	39	P	28	8	1	<1	<1	<1	4	P	3	2	D	30	52	1	3

NM - No measurement taken

D - Zero flow, monitoring location dry

P - Ponded water with no measurable velocity

F - Water frozen, unable to collect measureme

(shaded) - Prior to establishment of monitoring location

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	March 9, 2020
SUBJECT	Manual In-situ Streamflow Measurement Summary	NAME	John Gore
		PAGE	3 OF 4

Date	Flow Rate (L/s)																				
	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21
24-Oct-18	1	P	1	1	<1	NM	NM	<1	NM	NM	<1	NM	2	NM	NM	<1	NM	NM	NM	NM	NM
21-Nov-18	2	P	2	19	<1	NM	NM	1	NM	<1	2	NM	6	NM	NM	1	<1	4	NM	<1	NM
12-Dec-18	8	<1	4	14	<1	<1	<1	1	<1	1	2	<1	7	<1	<1	6	1	3	<1	1	1
14-Mar-19	12	NM	7	39	<1	<1	<1	<1	4	<1	5	4	29	11	29	11	17	8	6	1	1
24-Apr-19	34	<1	19	63	<1	1	1	5	3	2	15	1	25	<1	<1	10	3	8	1	3	<1
14-May-19	21	<1	37	148	4	1	3	5	4	6	18	4	44	<1	<1	10	5	51	3	4	NM
20-Jun-19	8	<1	10	11	P	<1	<1	2	1	1	2	P	7	D	D	<1	P	<1	P	<1	D
23-Jul-19	2	P	3	2	P	<1	1	1	<1	<1	1	P	4	P	D	D	D	D	D	<1	D
25-Sep-19	1	P	P	<1	P	P	P	<1	D	D	<1	D	<1	D	D	D	D	D	D	D	D
28-Nov-19	2	P	2	19	<1	<1	P	<1	<1	<1	2	<1	10	D	<1	1	D	1	D	<1	D

NM - No measurement taken

D - Zero flow, monitoring location dry

P - Ponded water with no measurable velocity

F - Water frozen, unable to collect measureme

- Prior to establishment of monitoring location

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	March 9, 2020
SUBJECT	Manual In-situ Streamflow Measurement Summary	NAME	John Gore
		PAGE	4 OF 4

Date	Flow Rate (L/s)														
	M22	M23	M24	M25	M26	M27	M28	M29	M30	M31	M32	M33	M34	M35	M36
24-Oct-18	NM	1	NM	NM	6	5									
21-Nov-18	NM	4	NM	1	47	26									
12-Dec-18	NM	6	<1	5	62	24									
14-Mar-19	13	72	9	37	149	97									
24-Apr-19	NM	23	2	16	284	93									
14-May-19	D	27	3	98	581	263									
20-Jun-19	D	3	<1	<1	47	12									
23-Jul-19	D	1	<1	P	15	17									
25-Sep-19	D	<1	D	D	P	1									
28-Nov-19	D	5	D	14	92	58									

NM - No measurement taken
D - Zero flow, monitoring location dry
P - Ponded water with no measurable velocity
F - Water frozen, unable to collect measureme
(shaded) - Prior to establishment of monitoring location

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	March 9, 2020
SUBJECT	Manual In-situ Water Temperature Measurement Summary	NAME	John Gore
		PAGE	1 OF 3

Date	Water Temperature (°C)													
	SW1	SW2	SW5	SW6	SW7	SW9	SW10	SW11	SW12	SW13	SW14	SW15	SW16	SW21
19-Sep-14	NM	NM		16.8	14.4	NM	NM				NM			
2-Oct-14	17.7	15.1	NM	NM	14.9	D	NM	NM	D	D	NM			
19-Dec-14	1.3	2.3	1.5	0.6	2.4	D	1.4	0.8	NM	1.5	0.4			
15-Apr-15	8.1	5.1	NM	NM	4.7	12.1	12.7	11.9	7.0	14.1	2.2			
26-May-15	19.3	15.7	D	26.6	16.3	D	20.9	D	D	D	15.4			
26-Jun-15	22.7	16.4	D	D	15.4	D	18.6	D	D	D	15.8			
17-Jul-15	22.6	16.0	D	D	14.8	D	15.7	D	D	D	14.5			
27-Aug-15	21.1	16.5	D	D	16.4	D	15.6	D	D	D	14.8			
23-Sep-15	18.6	14.4	D	D	15.6	D	14.9	D	D	D	12.3			
20-Nov-15	4.8	6.2	D	D	6.4	D	5.4	D	D	D	4.6			
10-Dec-15	6.3	7.5	D	D	8.2	D	7.4	D	D	D	6.9			
13-Apr-16	4.2	2.7	4.3	NM	1.9	4.0	2.9	7.3	2.8	8.7	1.0			
11-May-16	13.9	9.0	11.4	13.1	8.6	D	12.2	11.8	D	11.2	7.7			
13-Jun-16	18.3	13.0	D	19.8	12.1	D	15.5	D	D	D	11.8			
12-Jul-16	24.9	18.4	D	24.8	16.3	D	21.1	D	D	D	17.9			
15-Aug-16	24.9	18.7	D	23.5	17.8	D	20.5	D	D	D	18.5			
13-Sep-16	22.7	16.3	D	D	17.7	D	17.7	D	D	D	15.3			
28-Oct-16	7.2	8.0	D	D	9.3	D	6.3	D	D	D	4.9			
24-Nov-16	1.6	4.1	D	2.6	3.2	D	1.9	D	D	D	2.9			
17-May-17	15.2	11.8	18.3	14.4	11.9	18.4	16.7	20.4	D	20.8	11.4			
14-Jun-17	20.2	14.5	17.2	21.8	15.0	D	17.9	D	D	D	15.2			
18-Jul-17	23.1	17.9	D	23.2	16.8	D	19.7	D	D	D	17.4			
10-Aug-17	22.8	17.9	D	22.4	17.1	D	19.7	D	D	D	17.0			
11-Sep-17	18.7	14.1	D	17.0	15.5	D	16.1	D	D	D	12.1			
20-Oct-17	14.2	12.5	D	15.4	13.2	D	11.3	D	D	D	11.7			
3-Nov-17	9.5	9.8	D	9.4	10.2	D	9.2	D	D	D	8.1			
20-Dec-17	2.8	4.5	D	3.4	4.4	D	1.8	D	D	D	F			
19-Apr-18	3.4	2.8	3.8	6.1	2.0	6.1	2.4	6.9	1.4	6.1	0.5	1.5		

Date	Water Temperature (°C)													
	SW1	SW2	SW5	SW6	SW7	SW9	SW10	SW11	SW12	SW13	SW14	SW15	SW16	SW21
17-May-18	16.9	13.8	18.4	16.4	14.2	D	18.0	24.1	22.8	24.2	13.3	20.9		
22-Jun-18	22.2	15.1	D	16.2	14.3	D	15.8	D	D	D	14.0	D		
19-Jul-18	25.0	17.8	D	22.9	17.2	D	19.4	D	D	D	14.0	D		
22-Aug-18	23.6	18.6	20.0	18.9	18.3	D	18.9	D	D	D	18.8	20.1		
14-Sep-18	20.8	19.0	D	NM	18.4	D	17.0	D	D	D	18.4	D		
23-Oct-18	9.4	9.4	D	D	NM	D	6.6	D	D	D	6.7	D		
25-Oct-18	9.4	9.4	D	D	10.7	D	NM	D	D	D	5.4	D	D	NM
21-Nov-18	NM	NM	NM	NM	NM	NM	NM	NM	D	NM	NM	NM	NM	NM
12-Dec-18	NM	3.9	NM	NM	NM	NM	NM	NM	D	NM	NM	NM	NM	NM
14-Mar-19	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
24-Apr-19	8.6	6.7	NM	8.6	8.9	NM	8.5	NM	NM	NM	4.2	9.9	NM	NM
13-May-19	NM	NM	NM	NM	NM	7.4	NM	NM	NM	NM	NM	NM	NM	NM
20-Jun-19	17.1	14.4	18.3	16.8	16.8	D	18.0	NM	D	NM	15.1	8.6	NM	NM
23-Jul-19	22.4	18.1	D	NM	NM	D	20.6	D	D	D	NM	D	D	NM
25-Sep-19	20.4	16.1	D	16.1	NM	D	16.1	D	D	D	17.0	D	D	D
28-Nov-19	NM	NM	D	NM	3.2	D	NM	D	D	D	NM	NM	D	NM

NM - No measurement taken
D - Monitoring location dry
F - Water frozen, unable to collect measurement
(shaded) - Prior to establishment of monitoring location

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	March 9, 2020
SUBJECT	Manual In-situ Water Temperature Measurement Summary	NAME	John Gore
		PAGE	3 OF 3

Date	Water Temperature (°C)													
	SW22	SW23	SW24	SW25	SW26	SW28	SW29	SW30	SW31	SW32	SW34	SW35	SW36	SW37
23-Oct-18	NM	NM	5.5	NM	NM	6.1	D	6.0	6.3	6.2	NM	7.5		
21-Nov-18	F	F	NM	F	F	NM	NM	NM	NM	NM	NM	NM		
12-Dec-18	NM	F	NM	F	NM	F	F	NM	NM	NM	NM	NM		
14-Mar-19	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM		
24-Apr-19	NM	NM	9.0	NM	NM	7.7	8.9	9.5	9.2	9.9	NM	8.6		
13-May-19	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM		
20-Jun-19	NM	NM	18.9	NM	NM	17.2	8.3	19.1	18.7	20.6	NM	16.5		
23-Jul-19	NM	NM	NM	NM	NM	NM	D	NM	NM	NM	NM	NM		
25-Sep-19	D	D	17.7	NM	NM	D	D	16.8	19.2	19.2	D	D		
28-Nov-19	NM	NM	NM	NM	NM	NM	D	NM	NM	NM	NM	NM		

NM - No measurement taken
D - Monitoring location dry
F - Water frozen, unable to collect measurement
- Prior to establishment of monitoring location

Appendix F: Wetland Hydroperiod Monitoring Results

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	March 9, 2020
SUBJECT	Manual In-situ Water Depth Measurement Summary	NAME	John Gore
		PAGE	1 OF 2

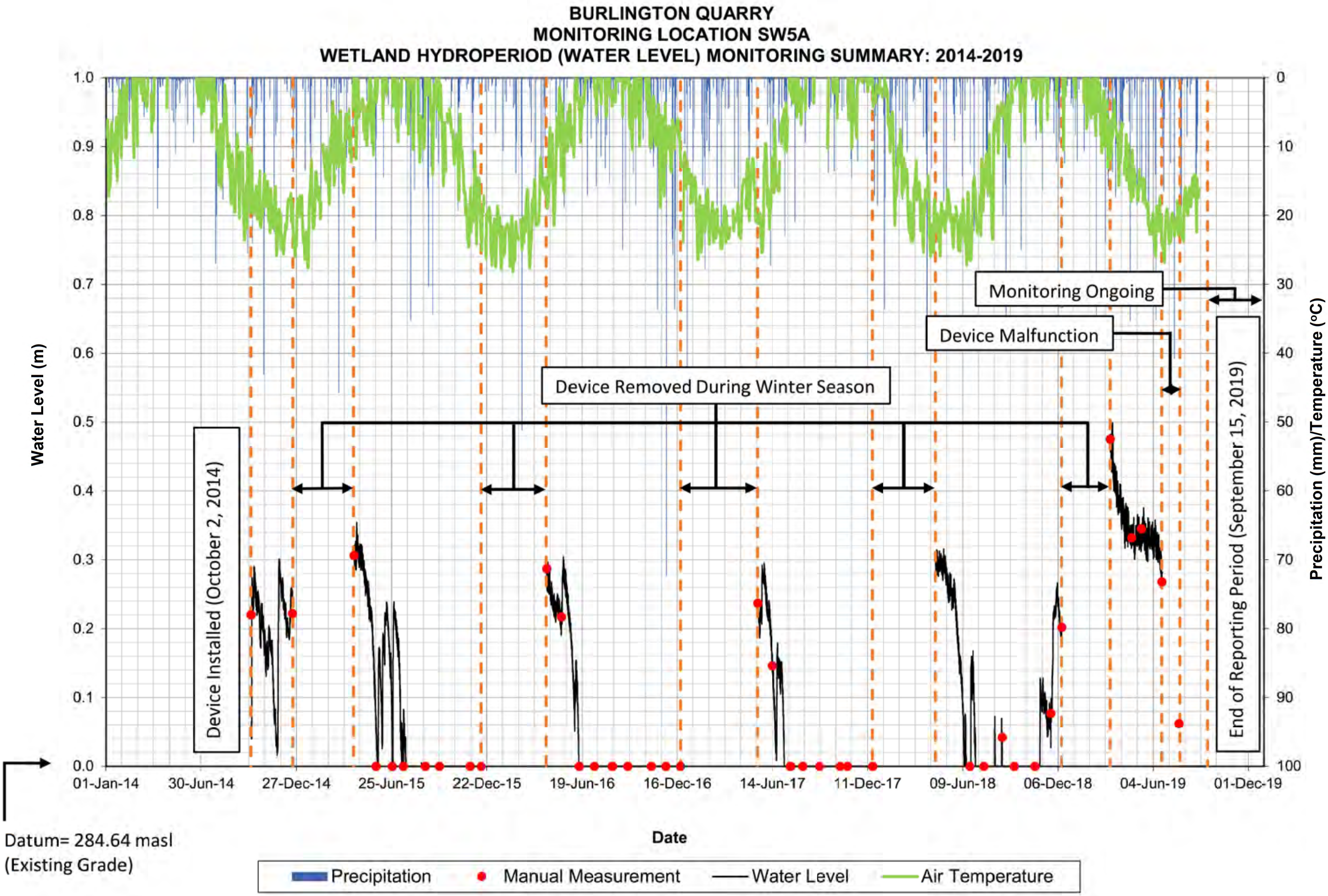
Date	Wetland Water Level (m)							Shallow Groundwater Level (m)						
	SW5	SW11	SW12	SW13	SW16	SW36	SW37	SW5B	SW11B	SW12B	SW13B	SW16B	SW36B	SW37B
2-Oct-14	0.220	D	D	D										
19-Dec-14	0.222	0.069	0.011	0.189										
15-Apr-15	0.306	0.083	0.040	0.265										
26-May-15	D	D	D	D										
26-Jun-15	D	D	D	D										
17-Jul-15	D	D	D	D										
27-Aug-15	D	D	D	D										
23-Sep-15	D	D	D	D										
20-Nov-15	D	D	D	D										
11-Dec-15	D	D	D	D										
13-Apr-16	0.287	0.101	0.045	0.292										
11-May-16	0.217	0.046	D	0.184										
22-Dec-16	NM	D	D	D										
17-May-17	0.237	0.049	-0.031	0.220										
14-Jun-17	0.146	D	D	D										
18-Jul-17	D	D	D	D										
10-Aug-17	D	D	D	D										
11-Sep-17	D	D	D	D										
20-Oct-17	D	D	D	D										
3-Nov-17	D	D	D	D										
19-Apr-18	0.302	0.112	0.055	0.307										
17-May-18	0.267	0.047	D	0.222										
22-Jun-18	D	D	D	D										
19-Jul-18	D	D	D	D										
22-Aug-18	0.042	D	D	D										
14-Sep-18	NM	D	D	D										
23-Oct-18	NM	D	D	D	D			NM	NM	NM	NM	NM		
22-Nov-18	0.077	0.047	D	0.212	0.187			0.077	D	D	0.212	NM		

TATHAM ENGINEERING

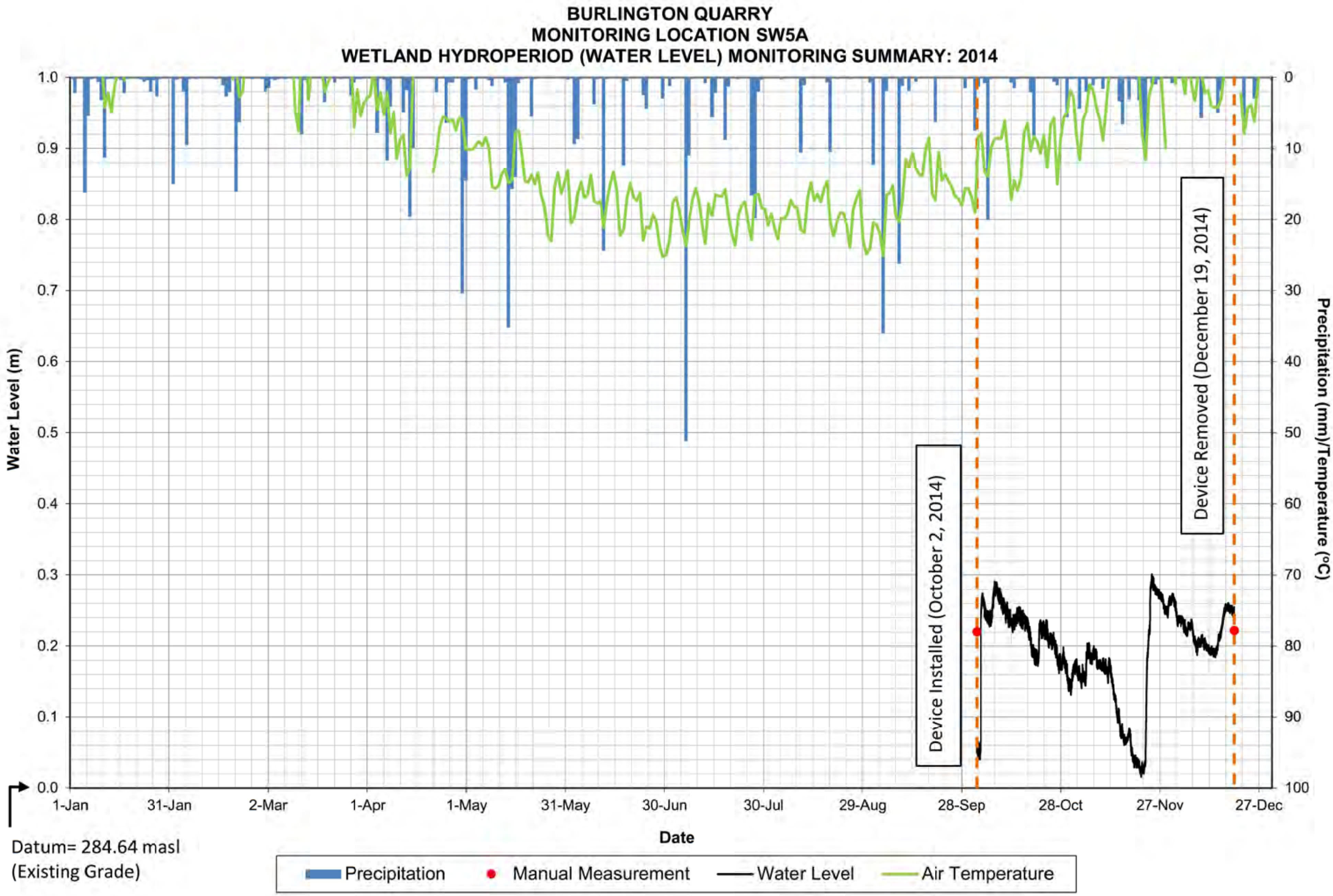
PROJECT	Burlington Quarry	FILE	113187
		DATE	March 9, 2020
SUBJECT	Manual In-situ Water Depth Measurement Summary	NAME	John Gore
		PAGE	2 OF 2

Date	Wetland Water Level (m)							Shallow Groundwater Level (m)						
	SW5	SW11	SW12	SW13	SW16	SW36	SW37	SW5B	SW11B	SW12B	SW13B	SW16B	SW36B	SW37B
13-Dec-18	0.202	0.087	0.015	0.217	0.185			0.202	0.047	NM	0.217	0.185		
15-Mar-19	0.475	0.374	0.170	0.470	0.415			0.475	0.087	0.170	0.470	0.415		
24-Apr-19	0.332	0.092	0.005	0.287	NM			0.332	0.374	0.005	0.287	NM		
13-May-19	0.345	0.150	0.065	0.327	0.240			0.345	0.092	0.065	0.327	0.240		
20-Jun-19	0.268	D	D	0.183	0.190			0.268	0.150	0.000	0.183	0.190		
23-Jul-19	0.062	D	D	D	D			-0.027	-0.335	-0.495	-0.520	-0.315		
26-Sep-19	D	D	D	D	D			-0.915	-0.955	-0.385	-0.920	-0.870		

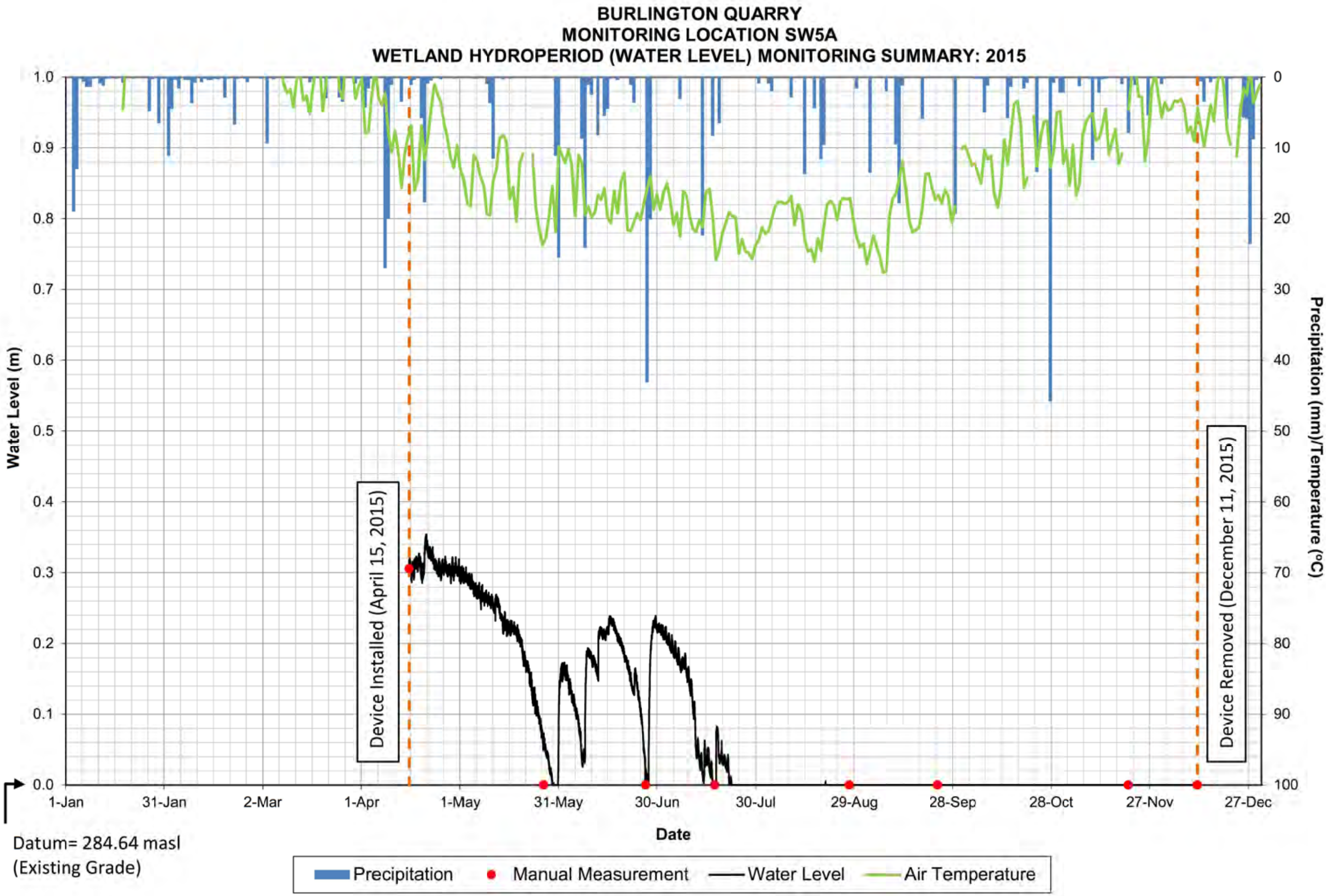
NM - No measurement taken
D - Monitoring location dry
F - Water frozen, unable to collect measurement
[shaded] - Prior to establishment of monitoring location



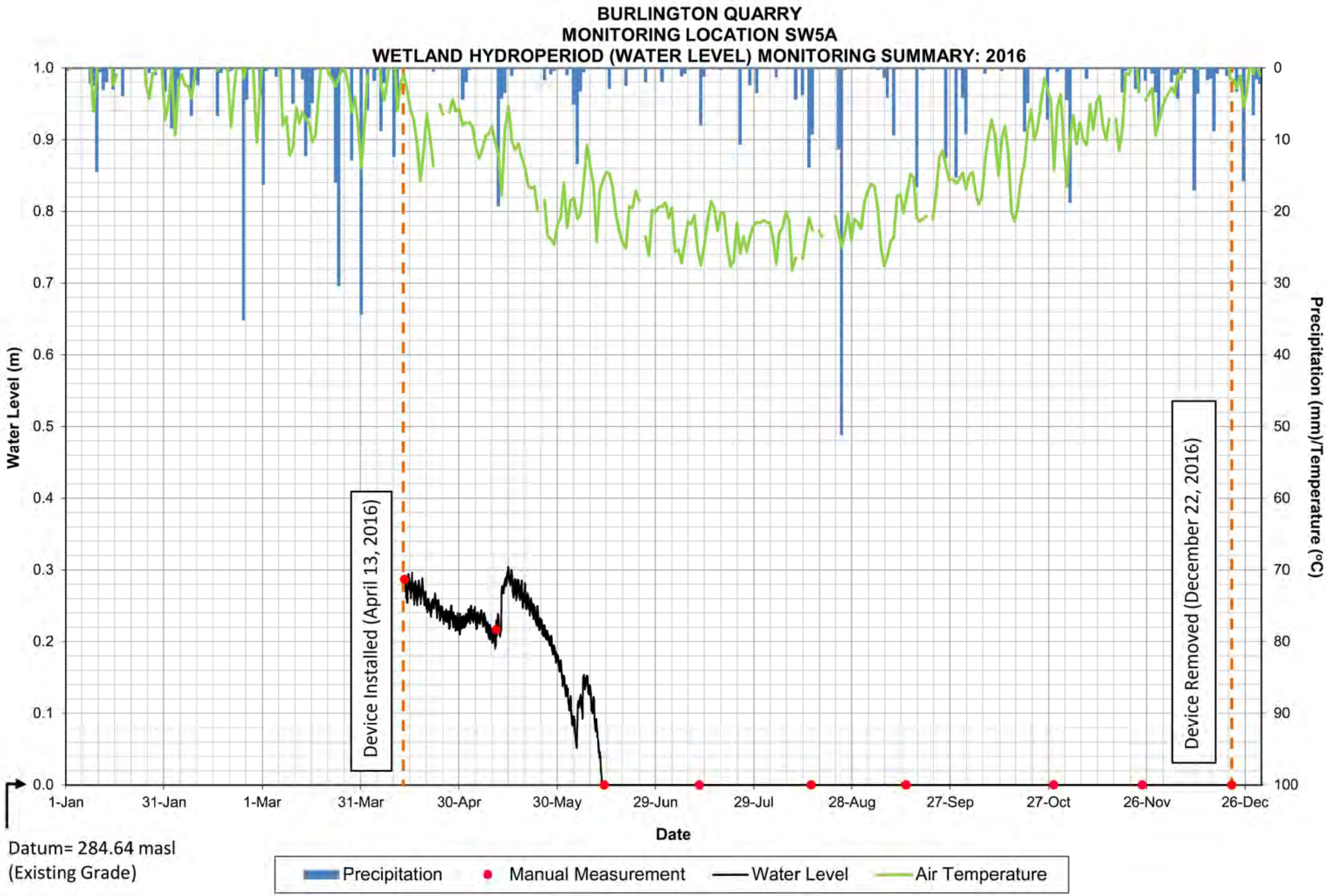
BURLINGTON QUARRY
MONITORING LOCATION SW5A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2014-2019
Water Level (m)
Precipitation (mm)/Temperature (°C)
Date
Monitoring Ongoing
Device Malfunction
Device Removed During Winter Season
Device Installed (October 2, 2014)
End of Reporting Period (September 15, 2019)
01-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
09-Jun-18
06-Dec-18
04-Jun-19
01-Dec-19
Datum= 284.64 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature



BURLINGTON QUARRY
MONITORING LOCATION SW5A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2014
Water Level (m)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (October 2, 2014)
Device Removed (December 19, 2014)
Datum= 284.64 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature

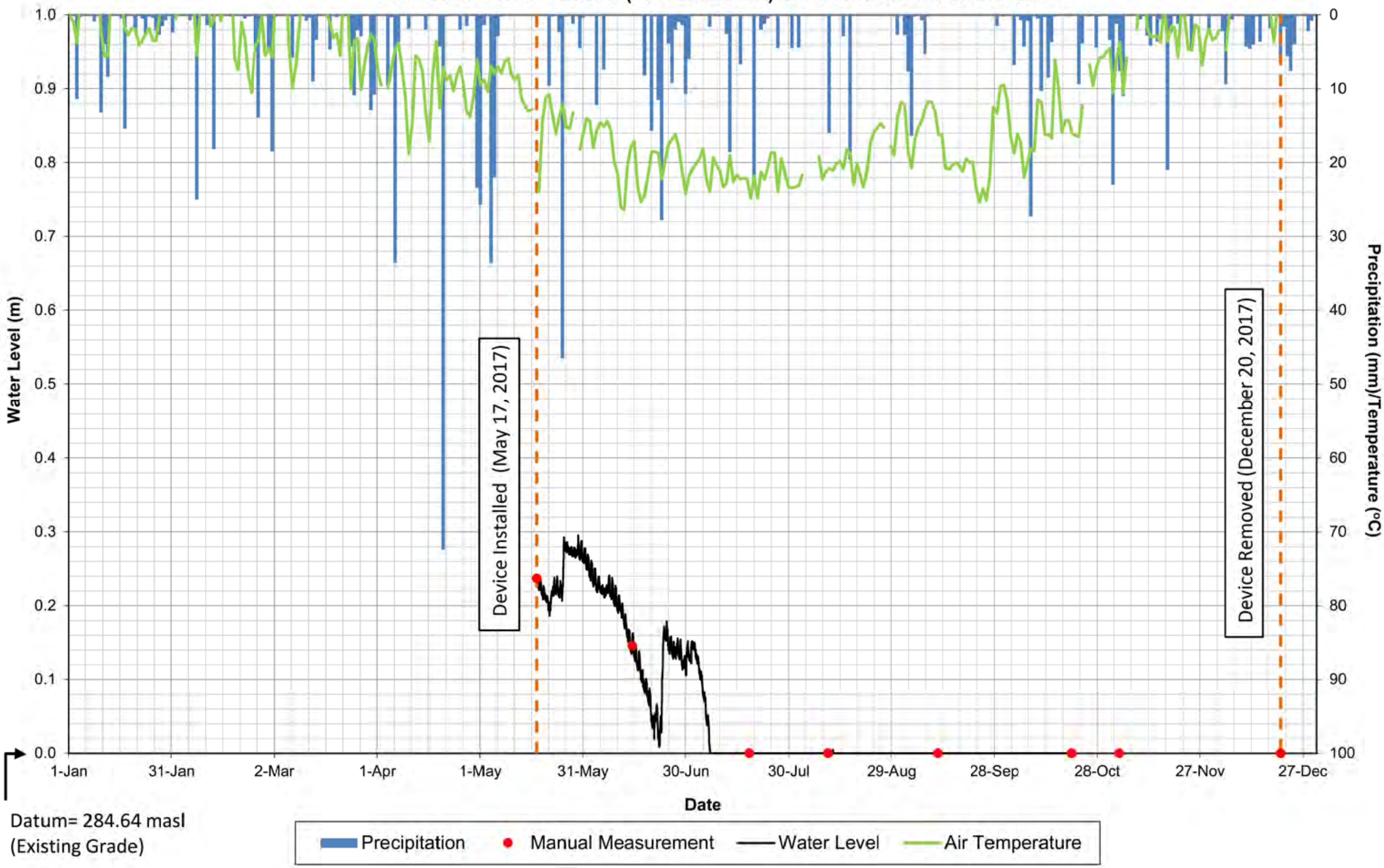


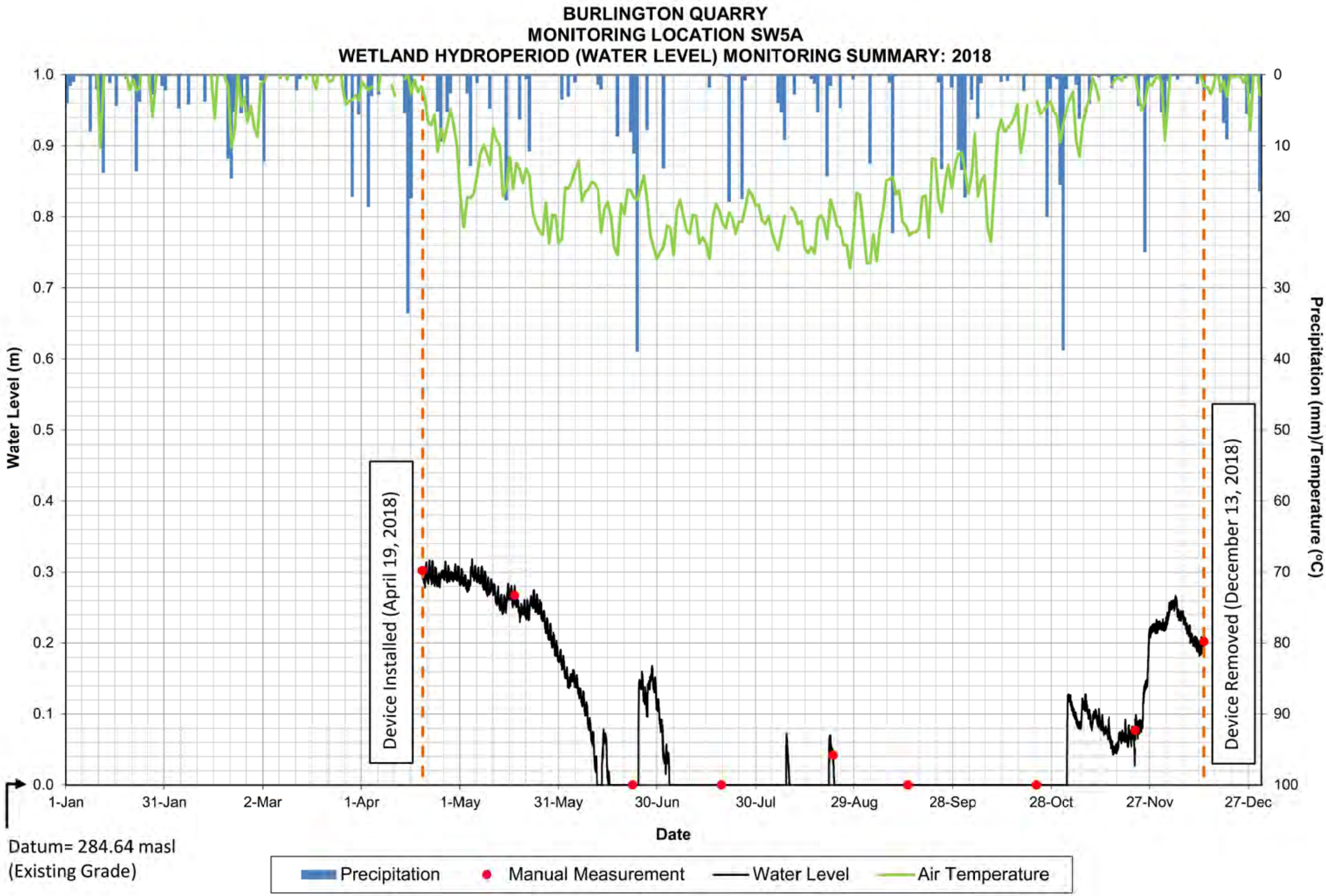
BURLINGTON QUARRY
MONITORING LOCATION SW5A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2015
Water Level (m)
Precipitation (mm)/Temperature (°C)
Date
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (April 15, 2015)
Device Removed (December 11, 2015)
Datum= 284.64 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature



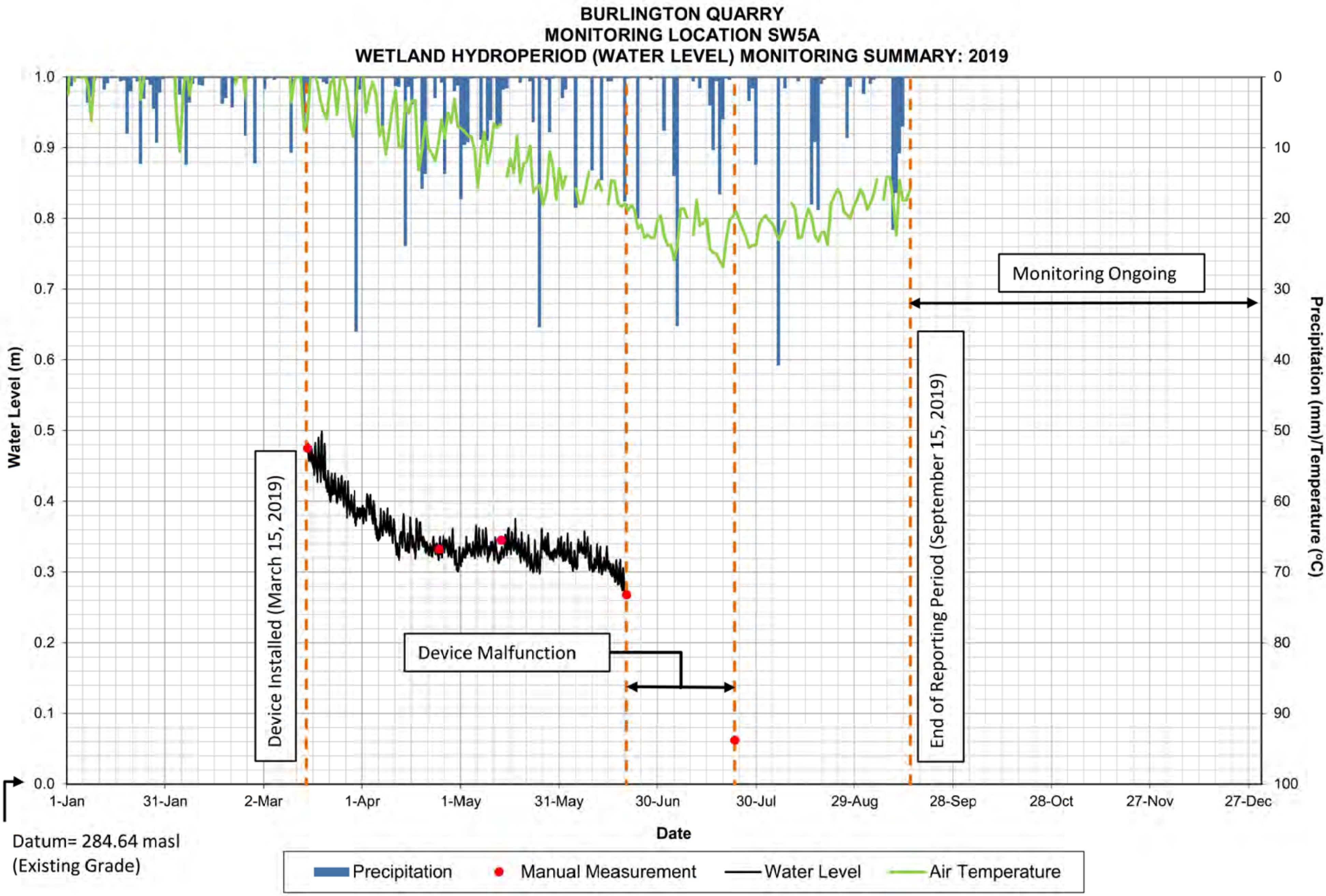
BURLINGTON QUARRY
MONITORING LOCATION SW5A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2016
Water Level (m)
Precipitation (mm)/Temperature (°C)
Device Installed (April 13, 2016)
Device Removed (December 22, 2016)
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Datum= 284.64 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature

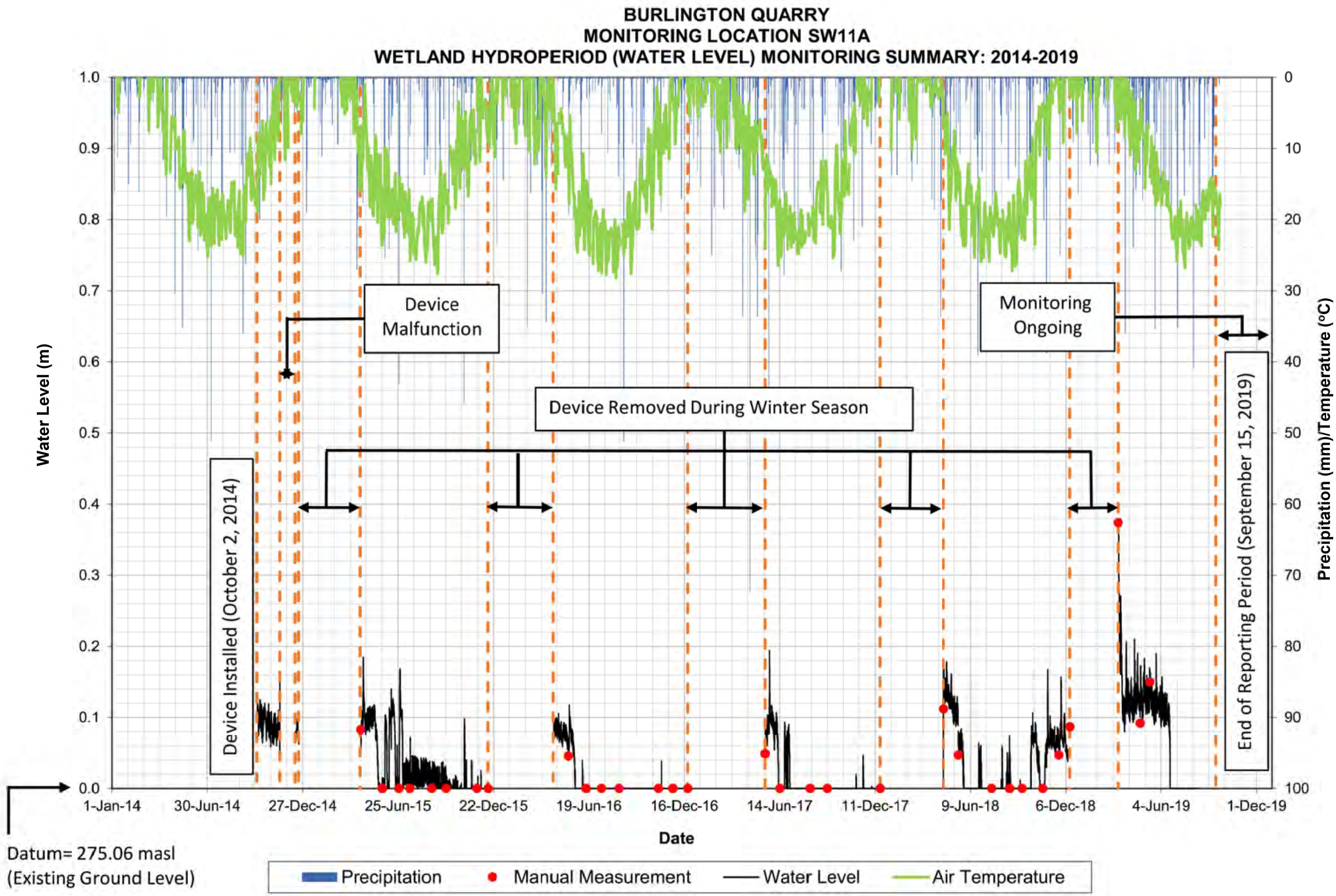
BURLINGTON QUARRY
MONITORING LOCATION SW5A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2017





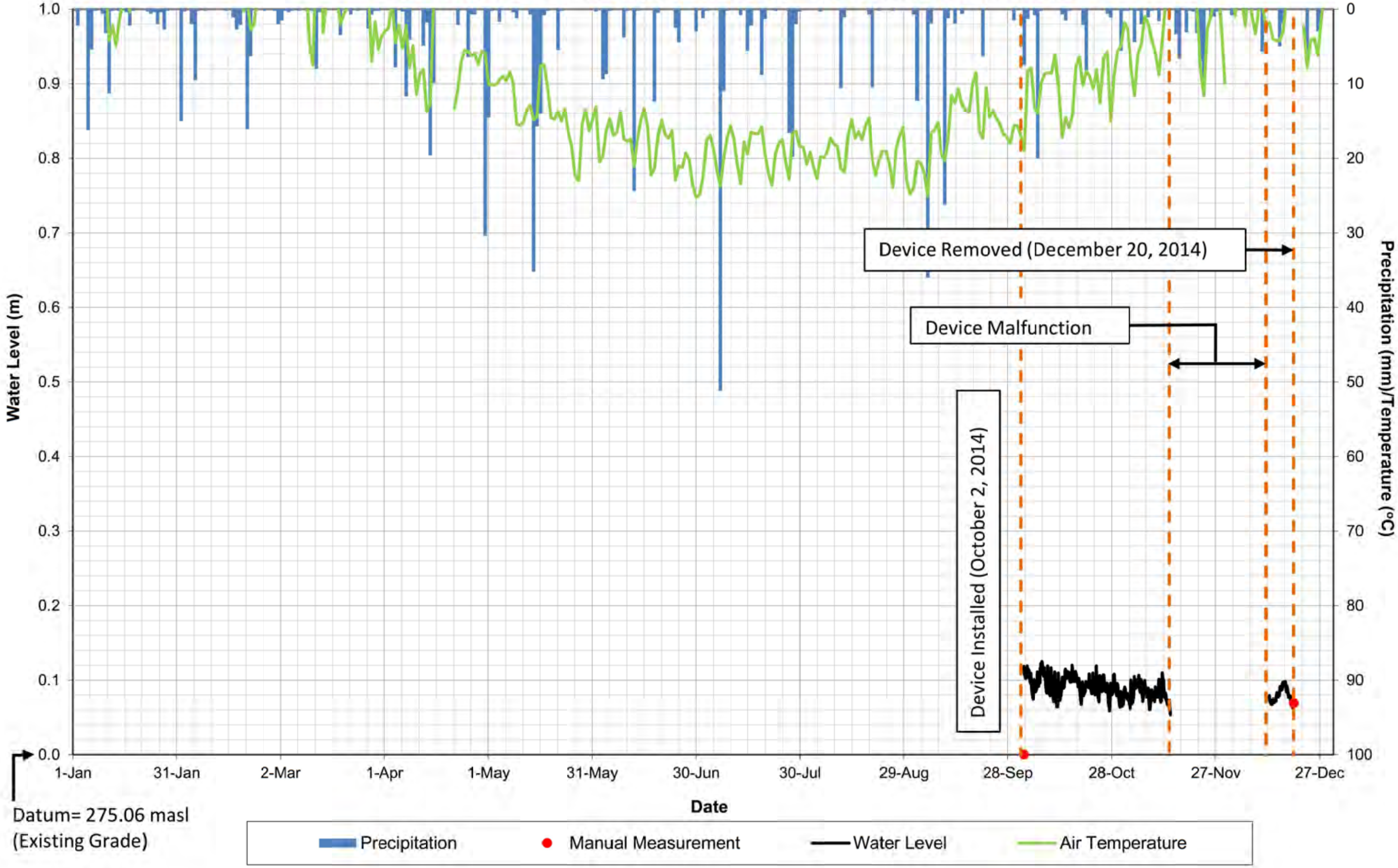
BURLINGTON QUARRY
MONITORING LOCATION SW5A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2018
Water Level (m)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (April 19, 2018)
Device Removed (December 13, 2018)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Datum= 284.64 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW5A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2019
Water Level (m)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (March 15, 2019)
Device Malfunction
End of Reporting Period (September 15, 2019)
Monitoring Ongoing
Datum= 284.64 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature

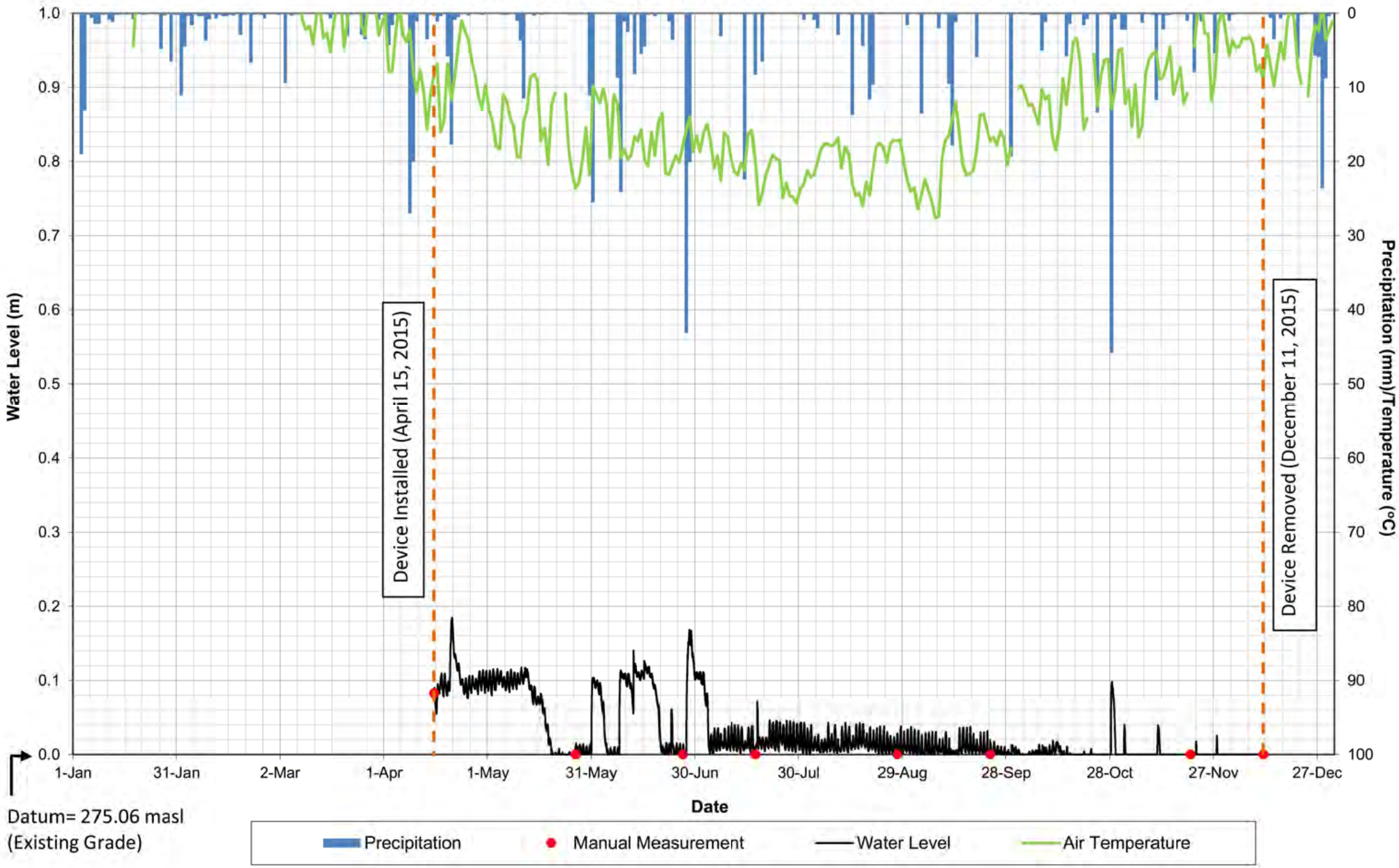


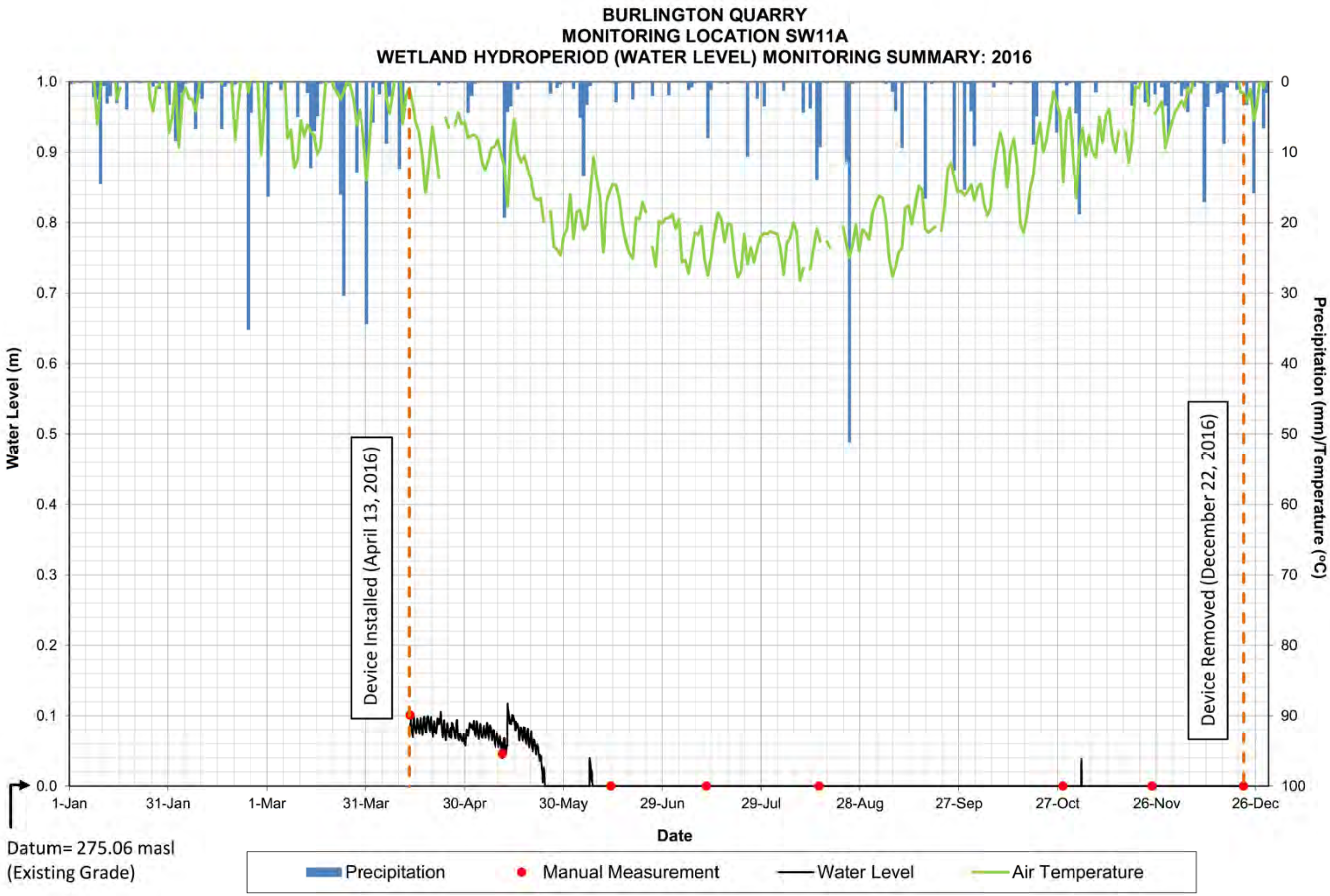
BURLINGTON QUARRY
MONITORING LOCATION SW11A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2014-2019
Water Level (m)
Precipitation (mm)/Temperature (°C)
Device Malfunction
Monitoring Ongoing
Device Removed During Winter Season
Device Installed (October 2, 2014)
End of Reporting Period (September 15, 2019)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
1-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
9-Jun-18
6-Dec-18
4-Jun-19
1-Dec-19
Date
Datum= 275.06 masl
(Existing Ground Level)
Precipitation
Manual Measurement
Water Level
Air Temperature

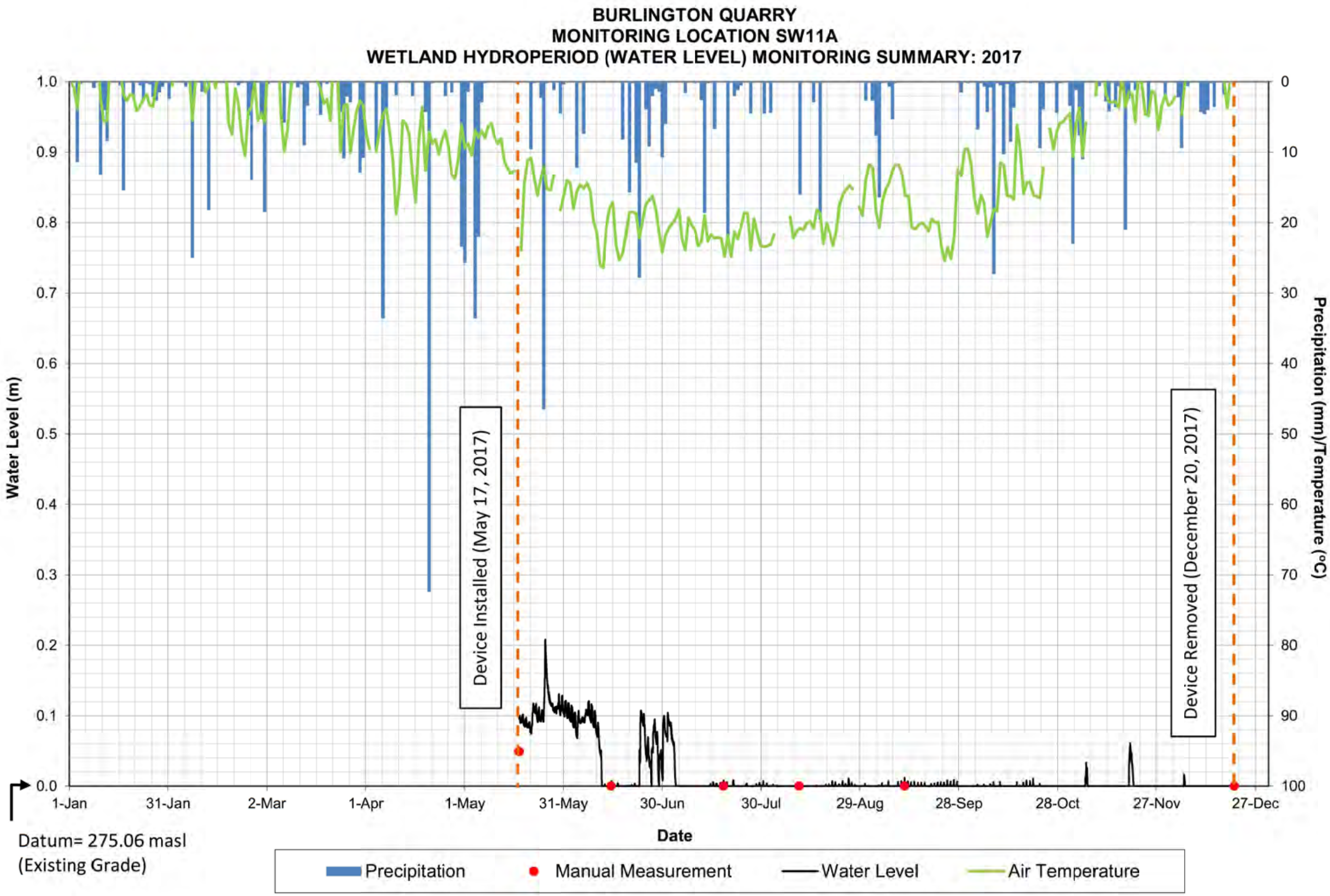
BURLINGTON QUARRY
MONITORING LOCATION SW11A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2014



BURLINGTON QUARRY
MONITORING LOCATION SW11A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2015

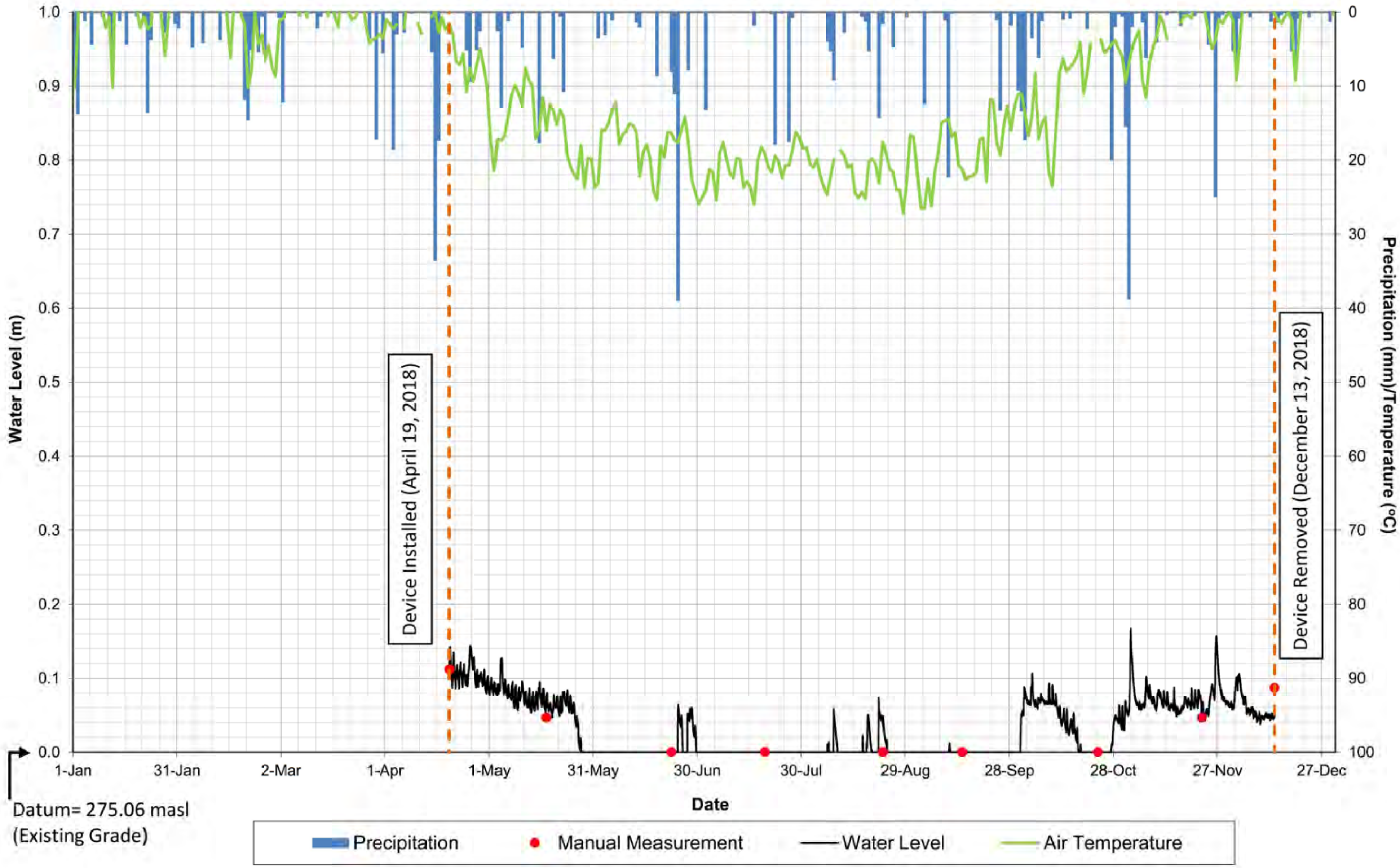


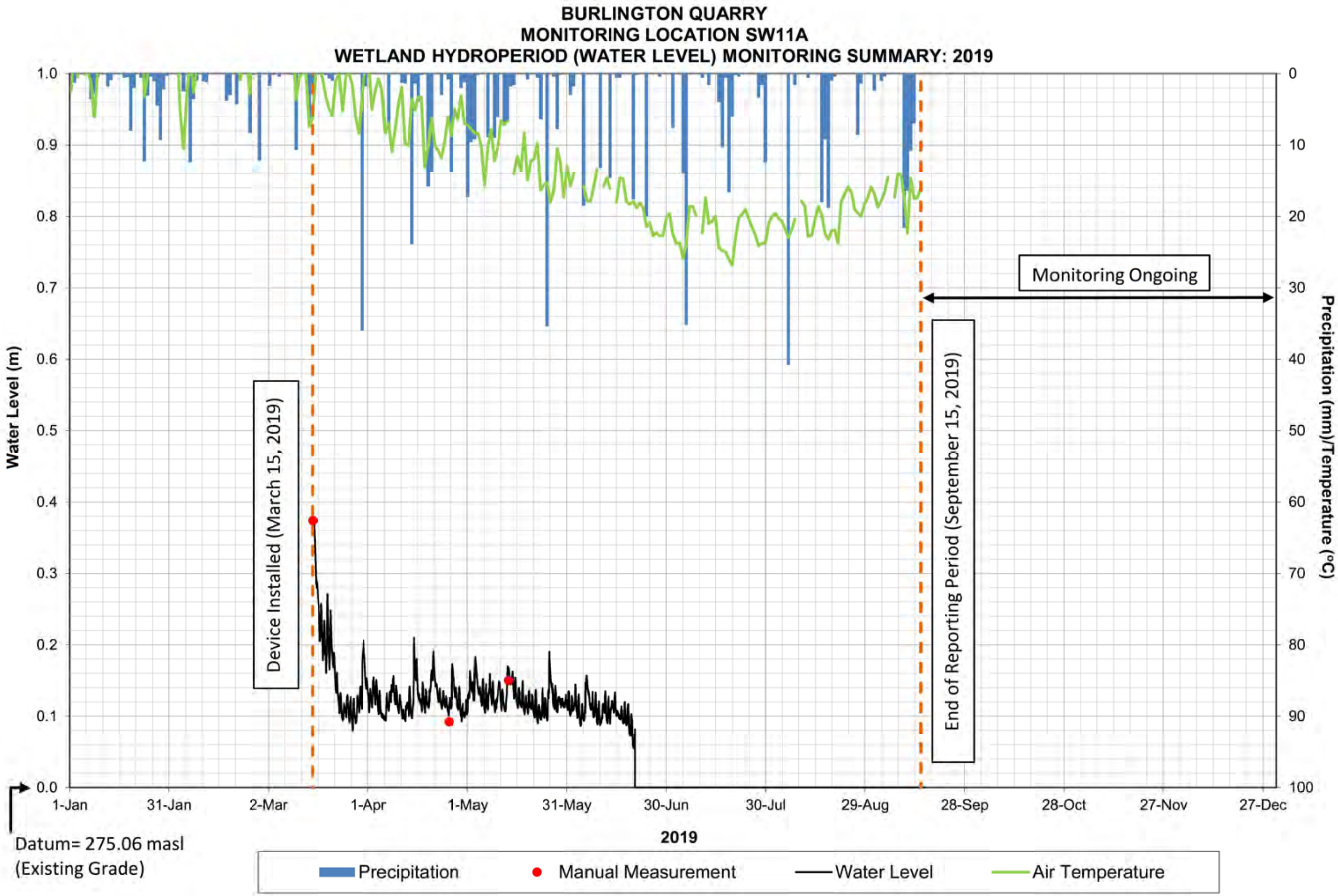

BURLINGTON QUARRY
MONITORING LOCATION SW11A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2016
Water Level (m)
Precipitation (mm)/Temperature (°C)
Device Installed (April 13, 2016)
Device Removed (December 22, 2016)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Datum= 275.06 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature



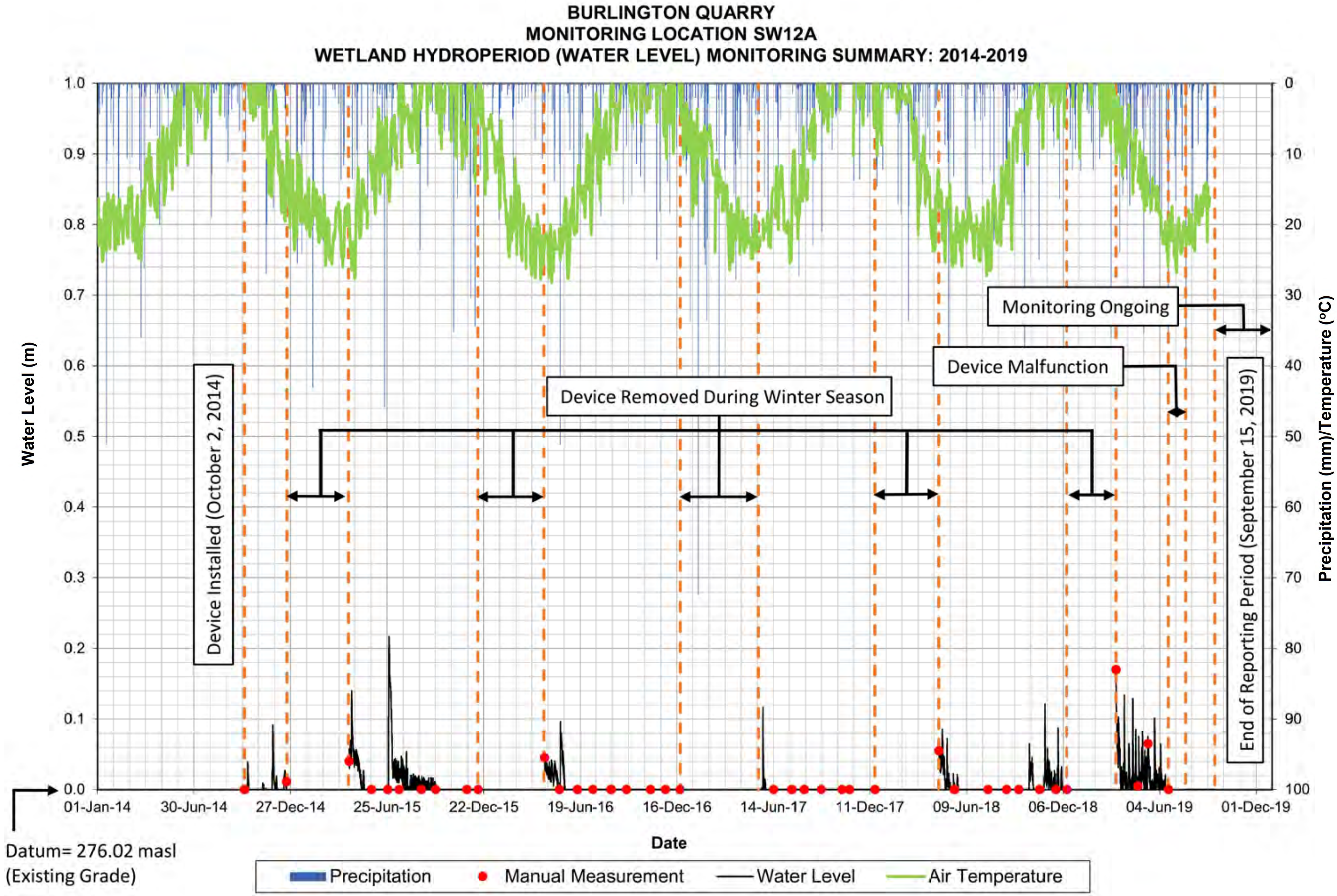
BURLINGTON QUARRY
MONITORING LOCATION SW11A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2017
Water Level (m)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (May 17, 2017)
Device Removed (December 20, 2017)
Datum= 275.06 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW11A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2018

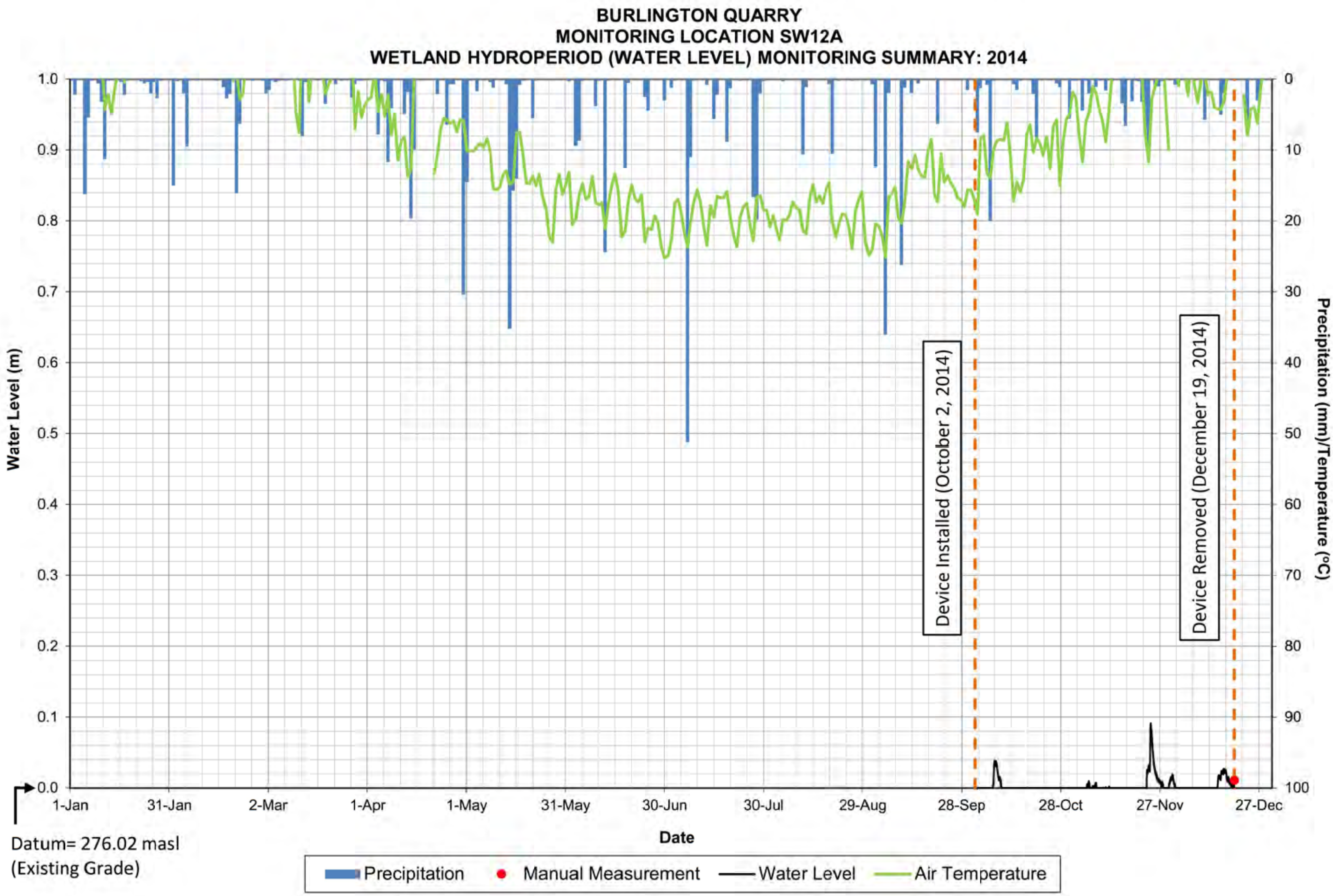




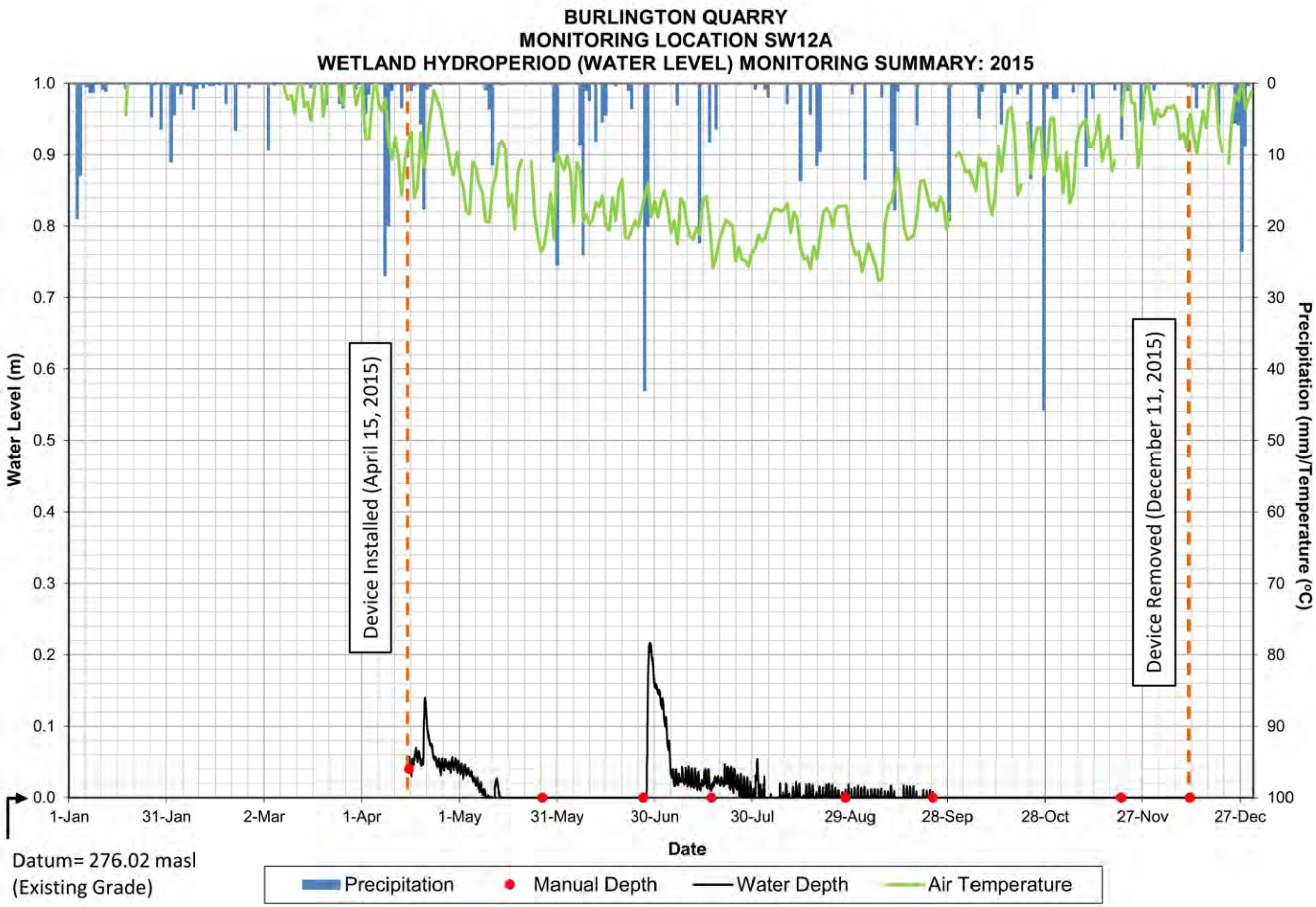
Datum= 275.06 masl
(Existing Grade)

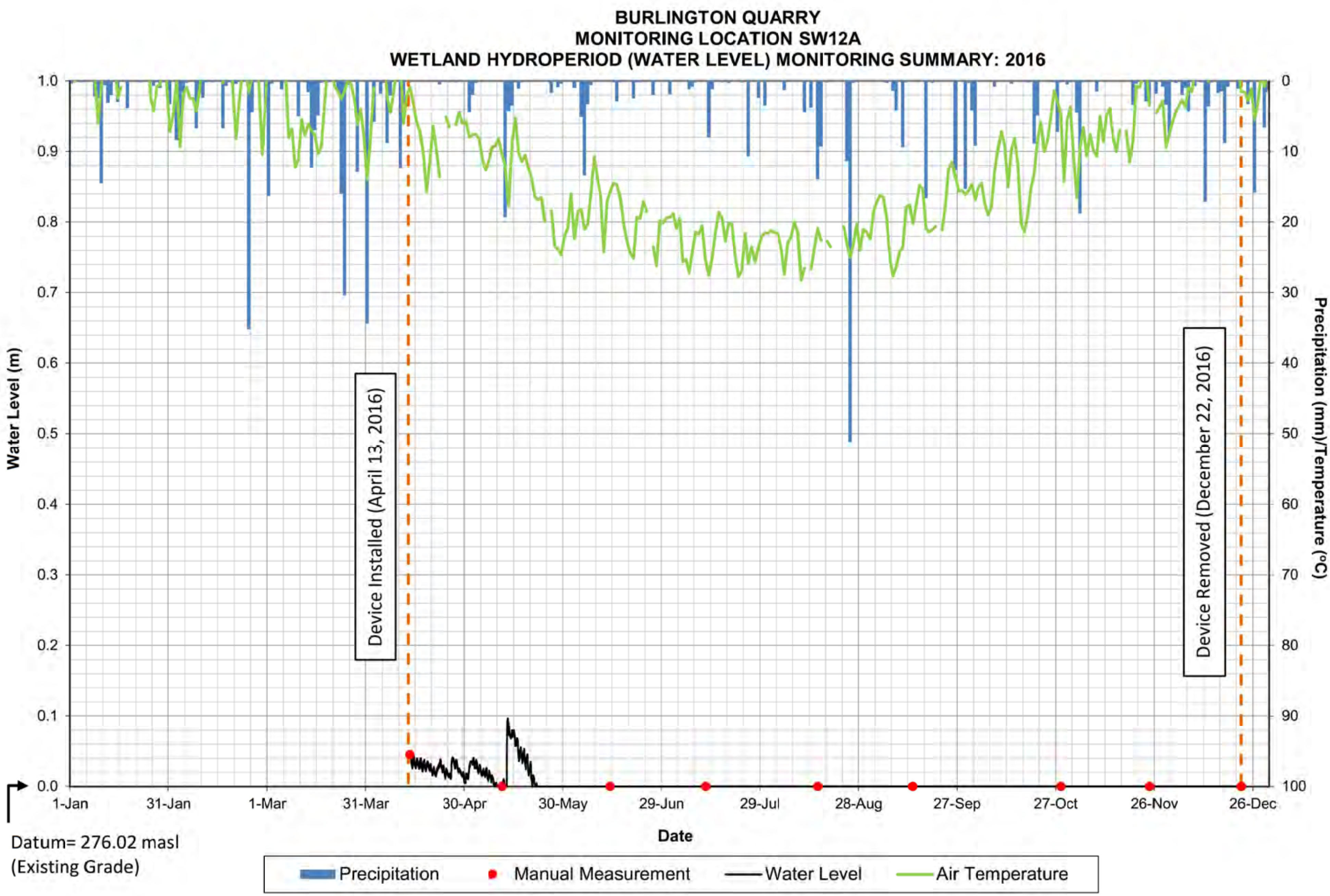


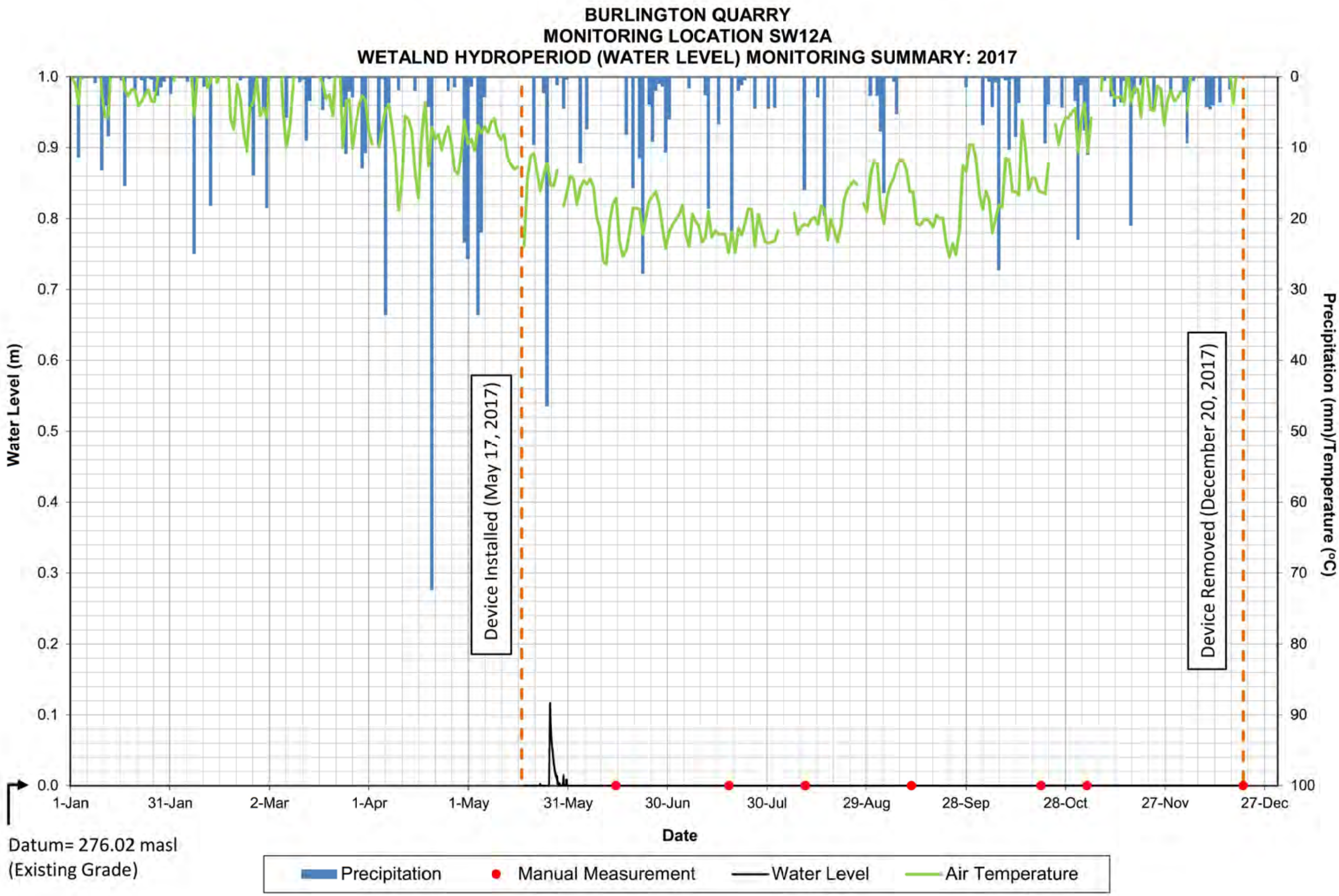
BURLINGTON QUARRY
MONITORING LOCATION SW12A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2014-2019
Water Level (m)
Precipitation (mm)/Temperature (°C)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
Device Installed (October 2, 2014)
Device Removed During Winter Season
Device Malfunction
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
01-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
09-Jun-18
06-Dec-18
04-Jun-19
01-Dec-19
Date
Datum= 276.02 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature



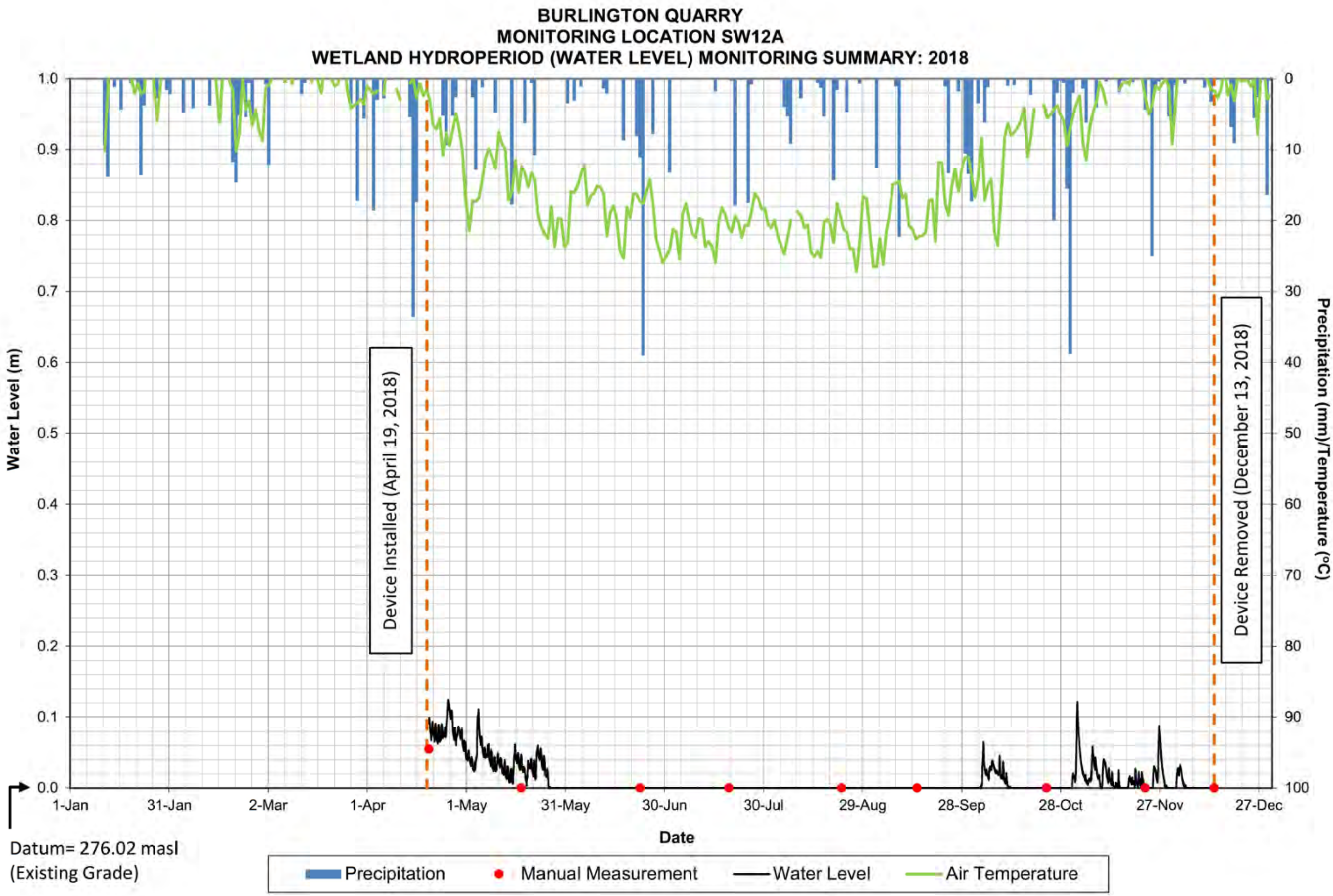
BURLINGTON QUARRY
MONITORING LOCATION SW12A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2014
Water Level (m)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Device Installed (October 2, 2014)
Device Removed (December 19, 2014)
Datum= 276.02 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature

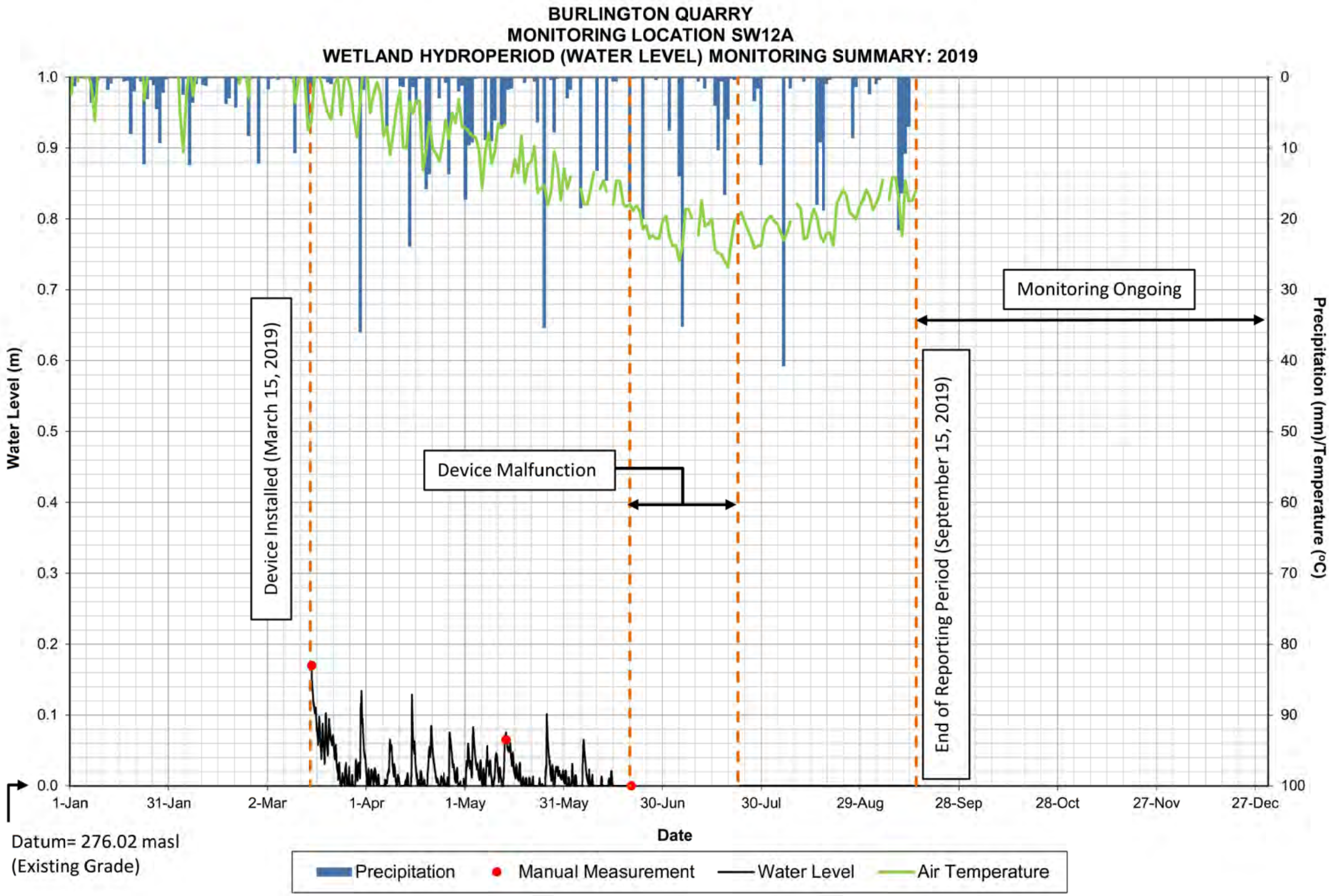

BURLINGTON QUARRY
MONITORING LOCATION SW12A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2015
Water Level (m)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
Device Installed (April 15, 2015)
Device Removed (December 11, 2015)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Datum= 276.02 masl
(Existing Grade)
Precipitation
Manual Depth
Water Depth
Air Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW12A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2016
Water Level (m)
Precipitation (mm)/Temperature (°C)
Date
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Device Installed (April 13, 2016)
Device Removed (December 22, 2016)
Datum= 276.02 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature

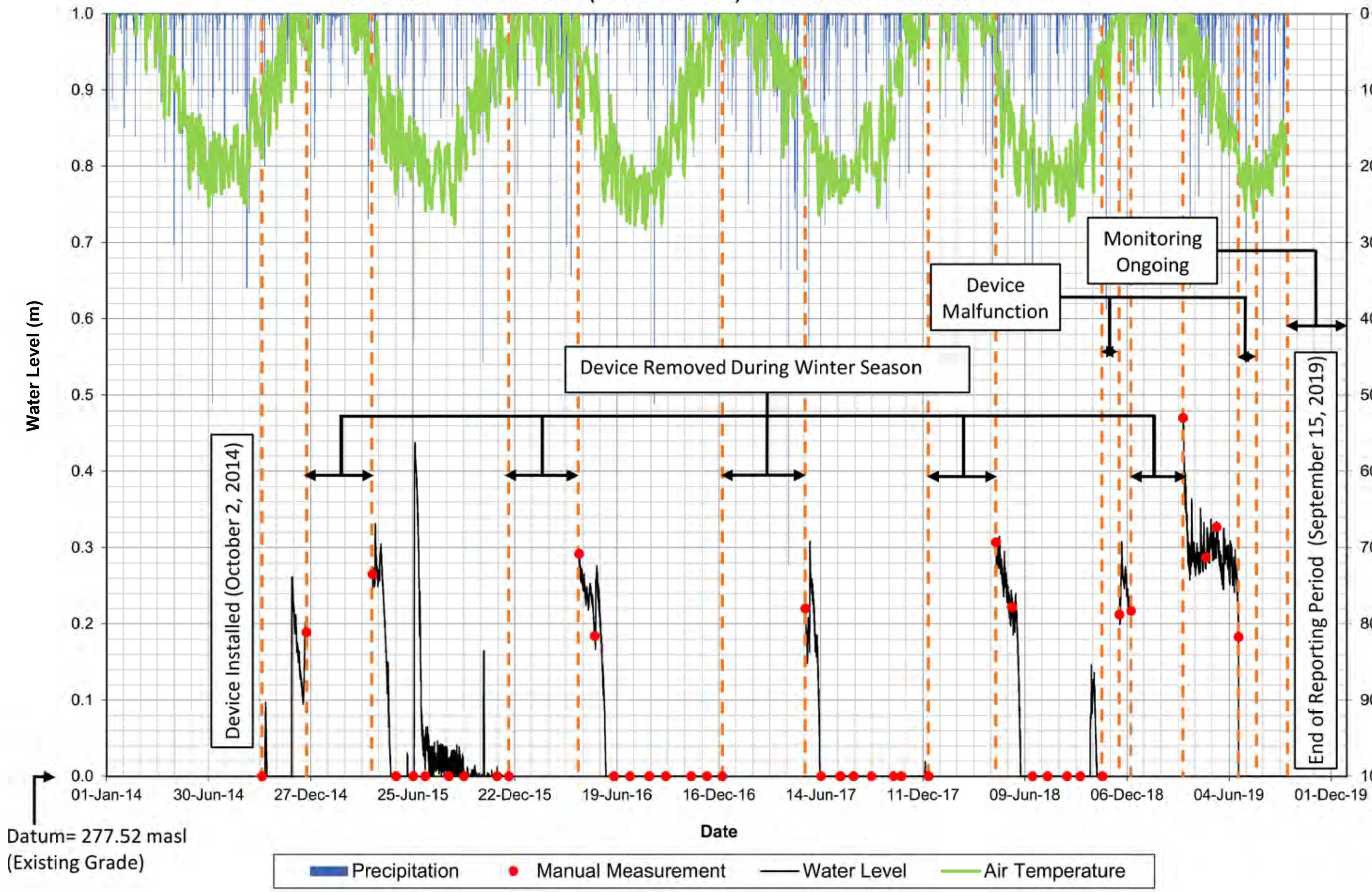


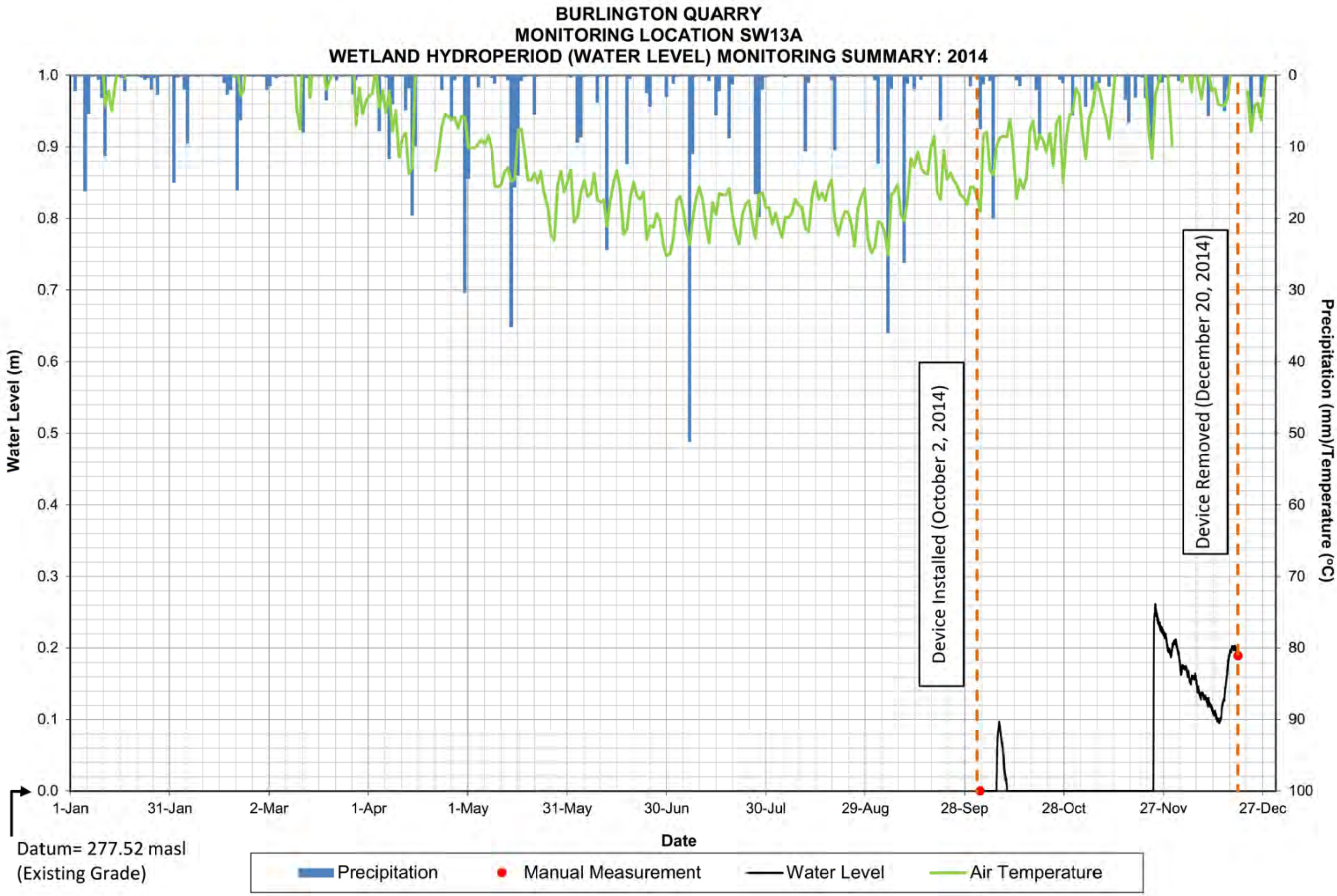
Datum= 276.02 masl
(Existing Grade)

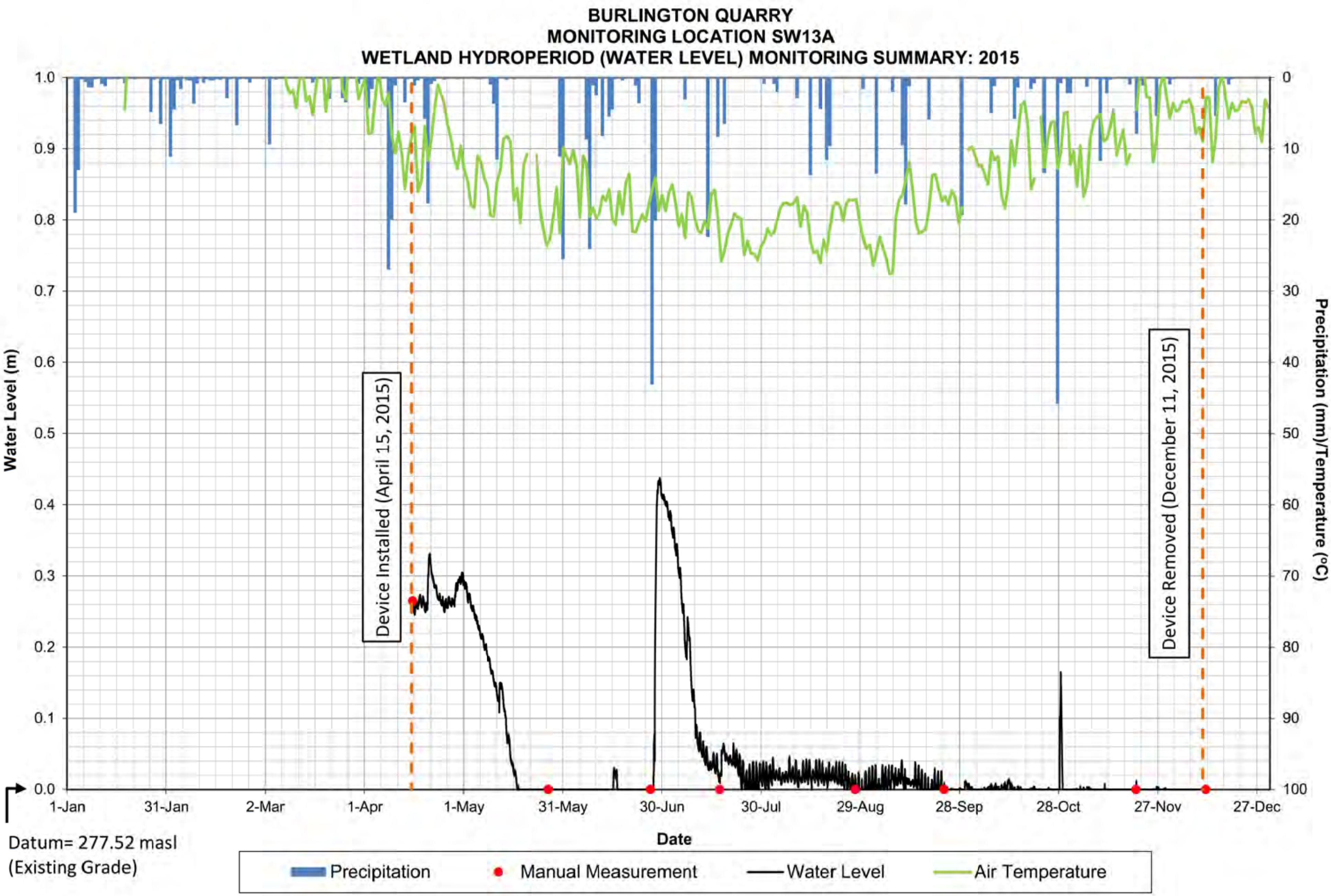

BURLINGTON QUARRY
MONITORING LOCATION SW12A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2018
Water Level (m)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
Device Installed (April 19, 2018)
Device Removed (December 13, 2018)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Datum= 276.02 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature

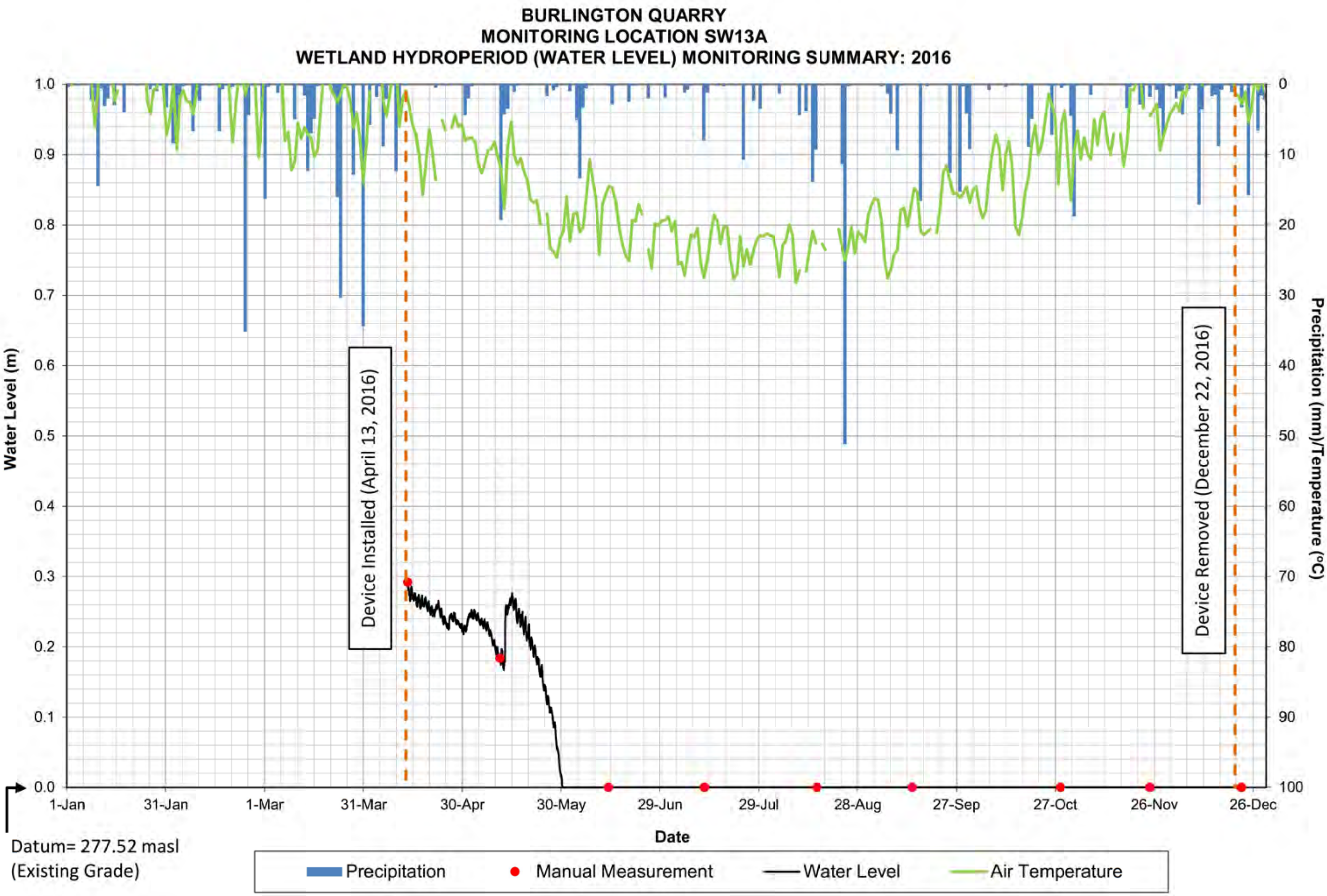

BURLINGTON QUARRY
MONITORING LOCATION SW12A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2019
Water Level (m)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (March 15, 2019)
Device Malfunction
End of Reporting Period (September 15, 2019)
Monitoring Ongoing
Datum= 276.02 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW13A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2014-2019



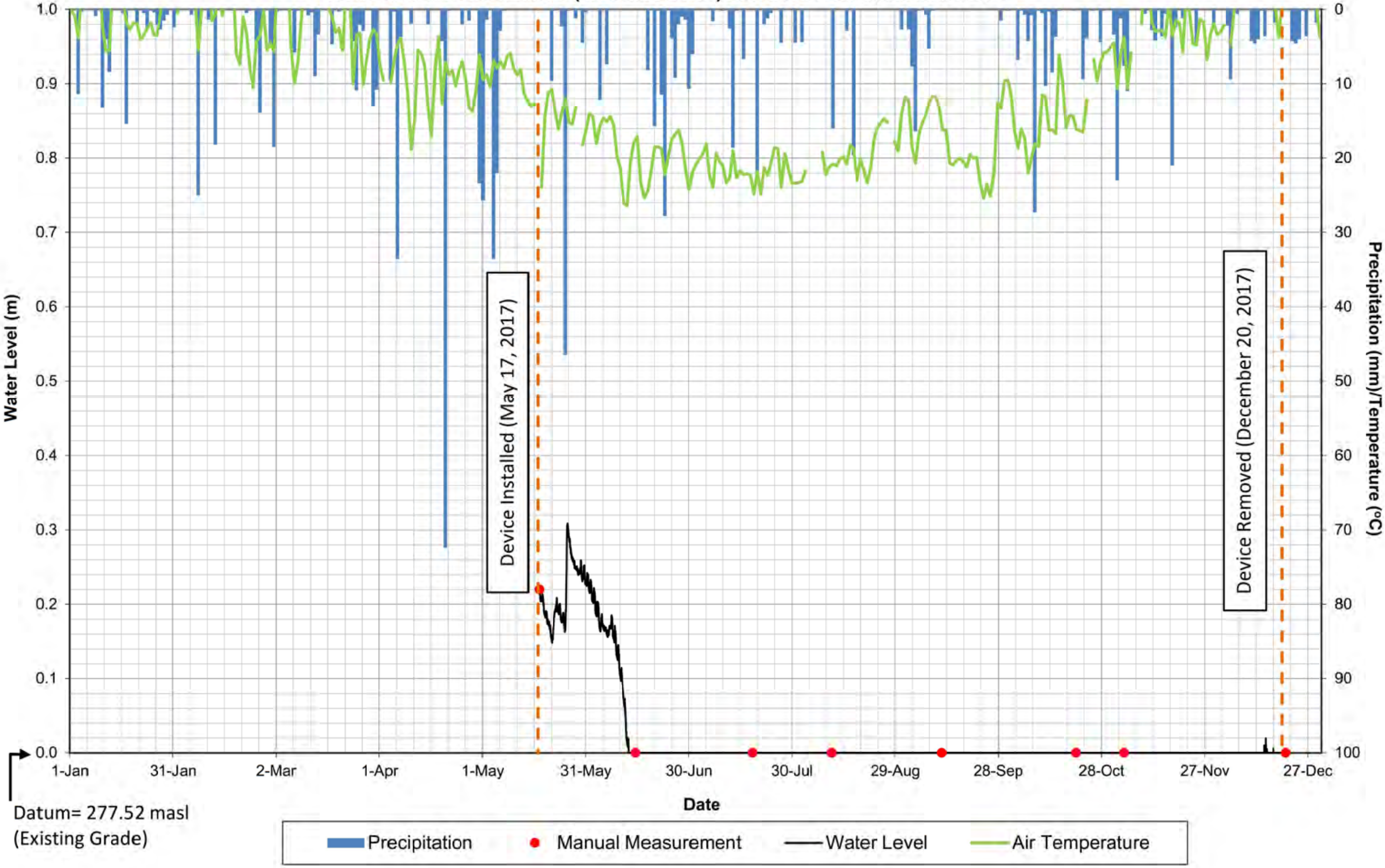

BURLINGTON QUARRY
MONITORING LOCATION SW13A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2014
Water Level (m)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Device Installed (October 2, 2014)
Device Removed (December 20, 2014)
Datum= 277.52 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature

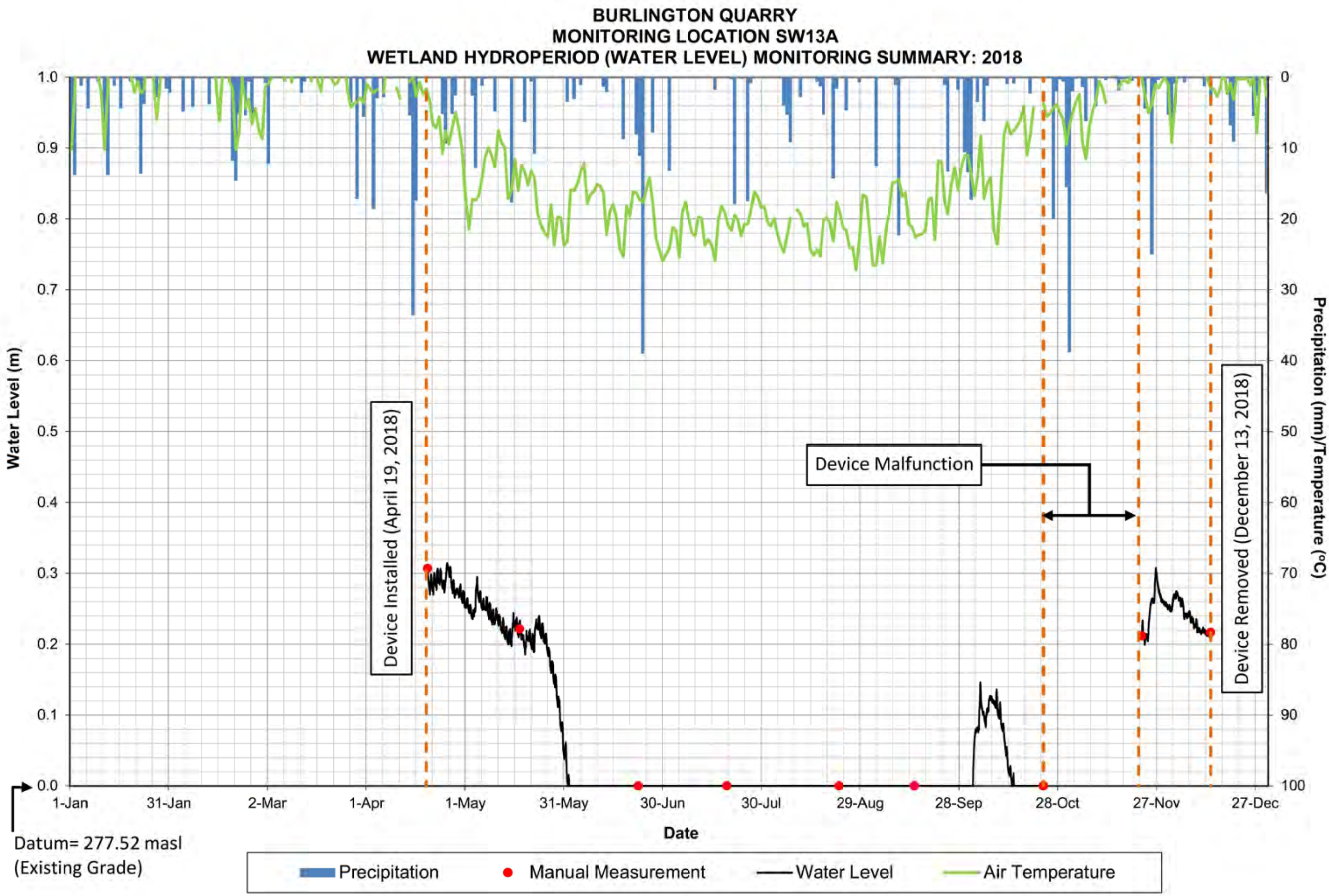

BURLINGTON QUARRY
MONITORING LOCATION SW13A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2015
Water Level (m)
Precipitation (mm)/Temperature (°C)
Device Installed (April 15, 2015)
Device Removed (December 11, 2015)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Datum= 277.52 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature



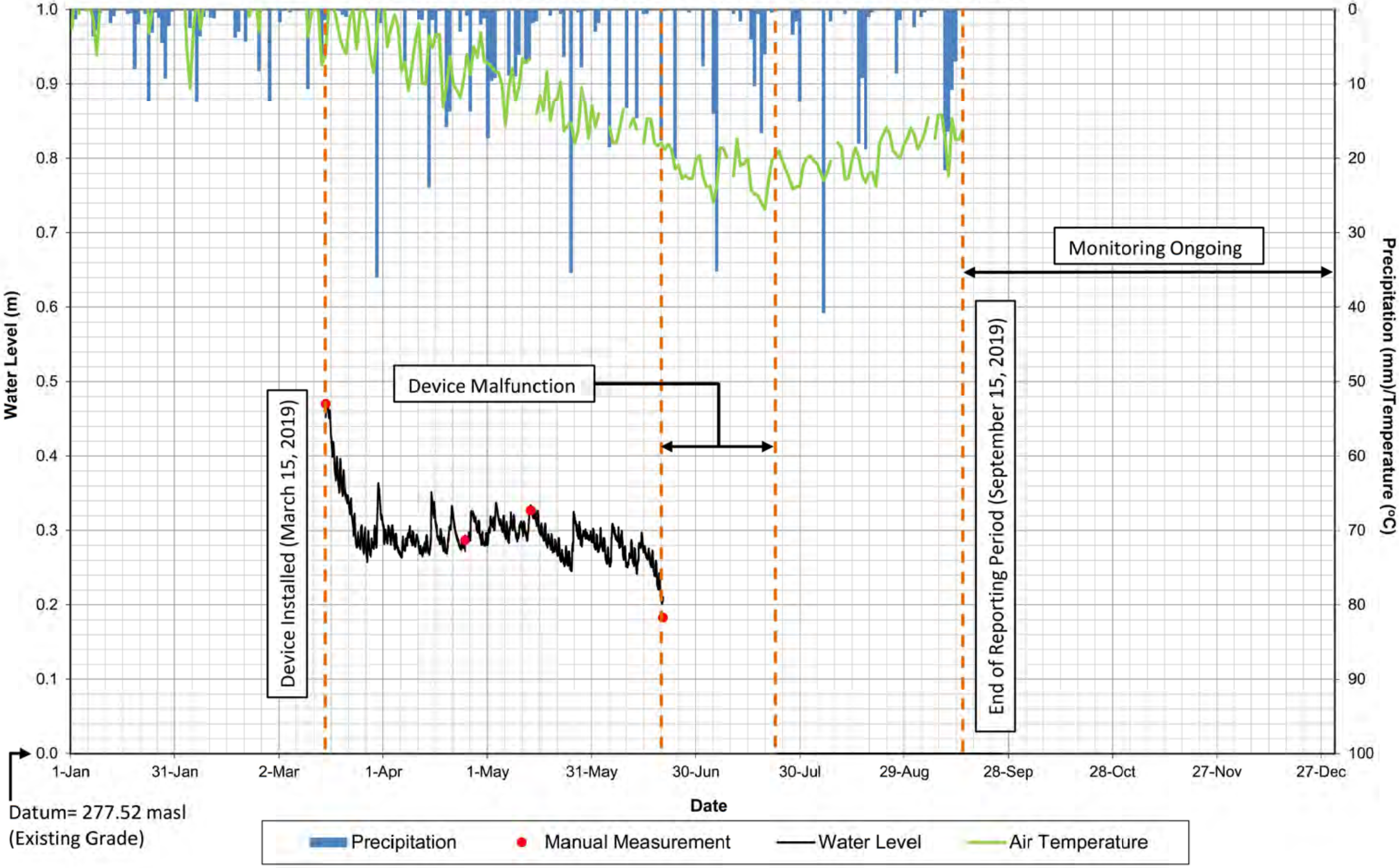
BURLINGTON QUARRY
MONITORING LOCATION SW13A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2016
Water Level (m)
Precipitation (mm)/Temperature (°C)
Device Installed (April 13, 2016)
Device Removed (December 22, 2016)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Datum= 277.52 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW13A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2017

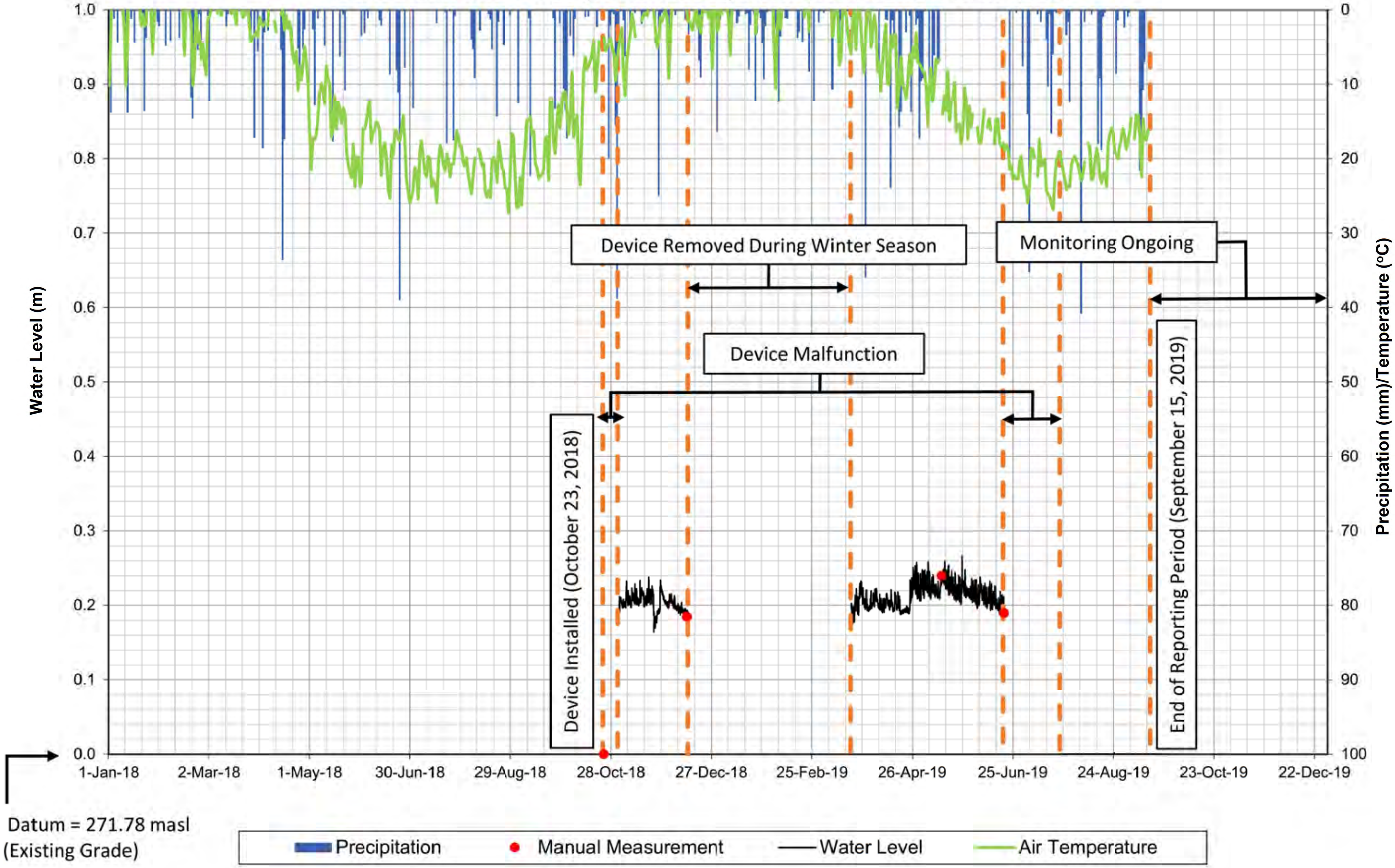



BURLINGTON QUARRY
MONITORING LOCATION SW13A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2018
Water Level (m)
Precipitation (mm)/Temperature (°C)
Device Installed (April 19, 2018)
Device Malfunction
Device Removed (December 13, 2018)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Datum= 277.52 masl
(Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature

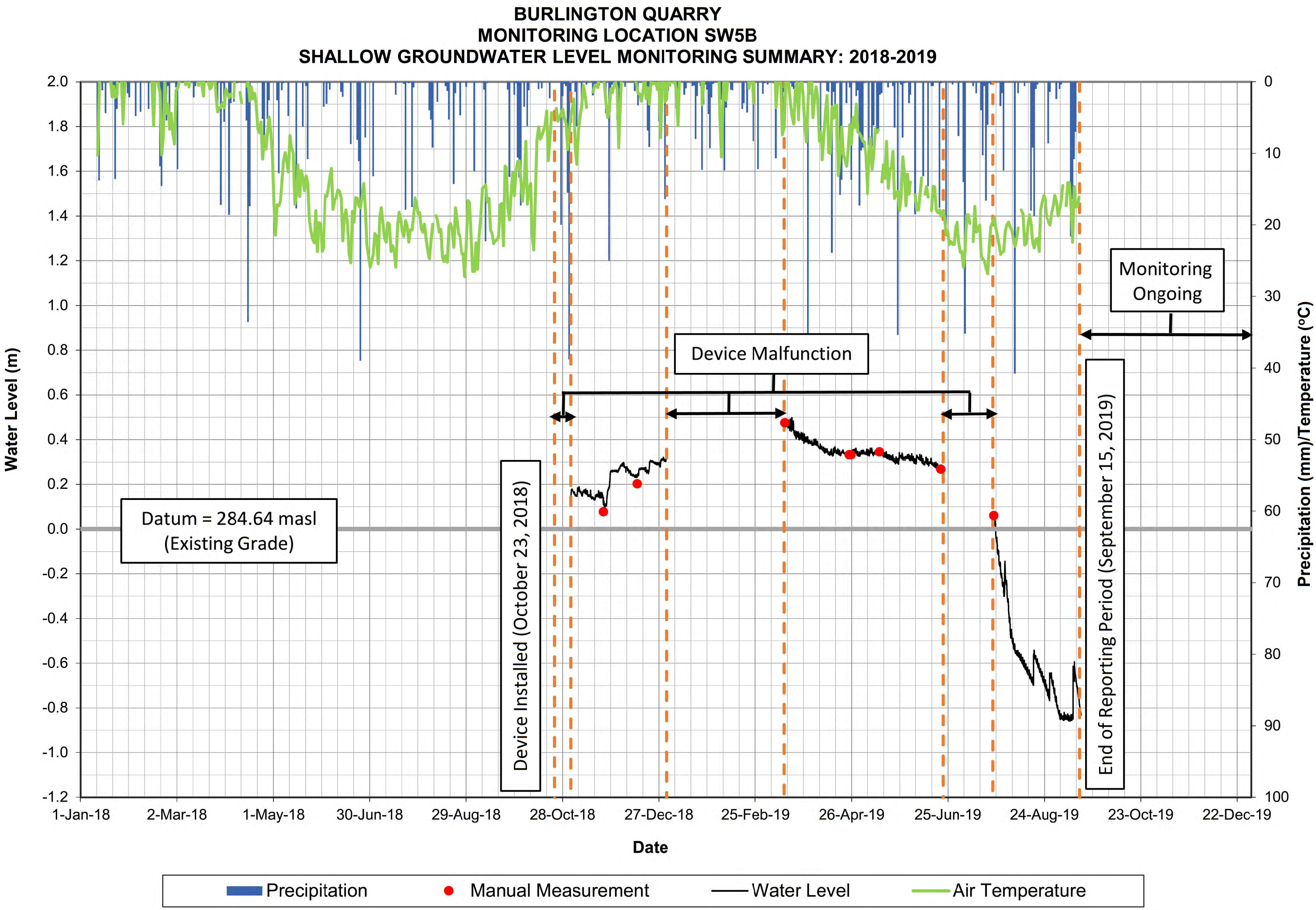
BURLINGTON QUARRY
MONITORING LOCATION SW13A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2019

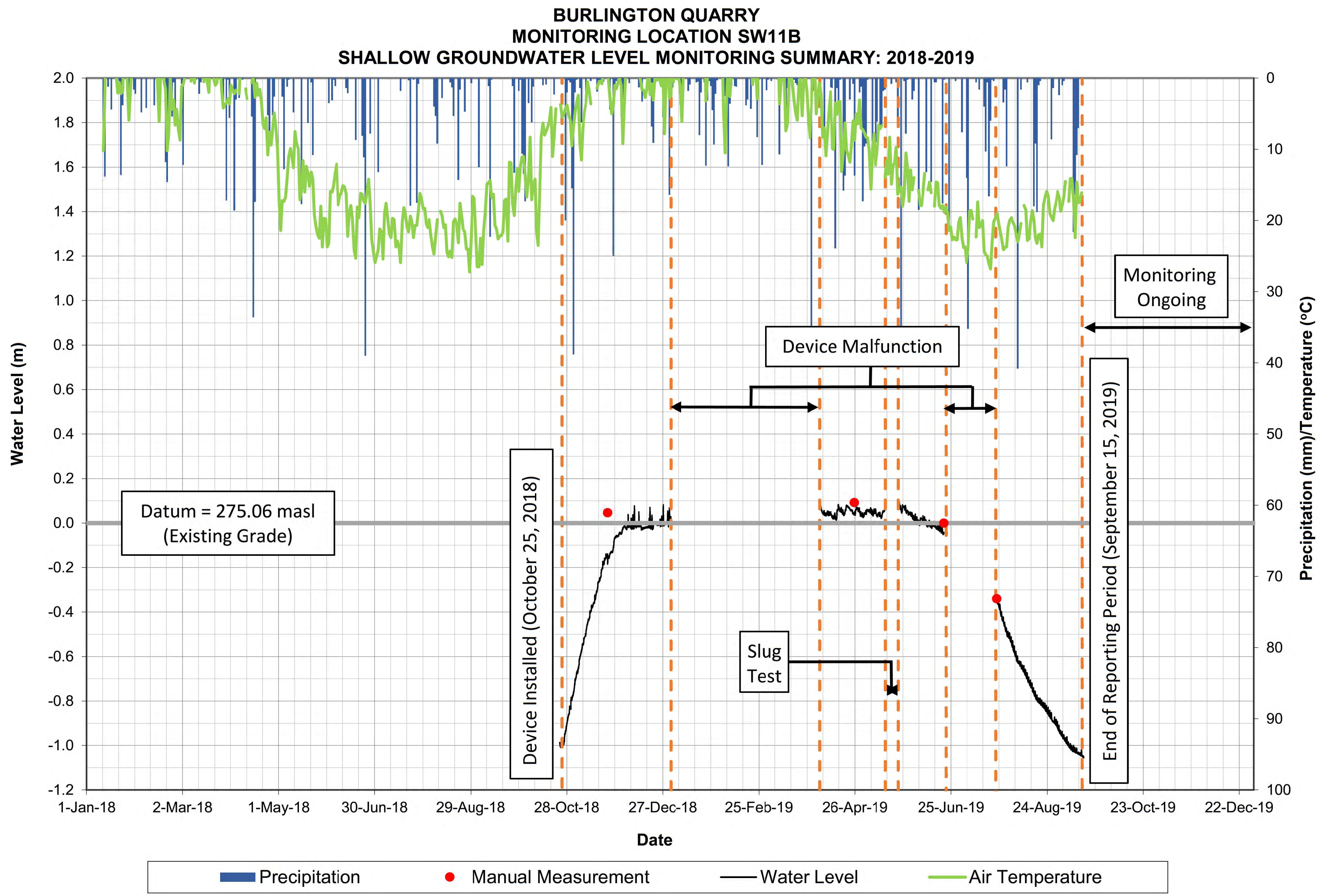


BURLINGTON QUARRY
MONITORING LOCATION SW16A
WETLAND HYDROPERIOD (WATER LEVEL) MONITORING SUMMARY: 2018-2019



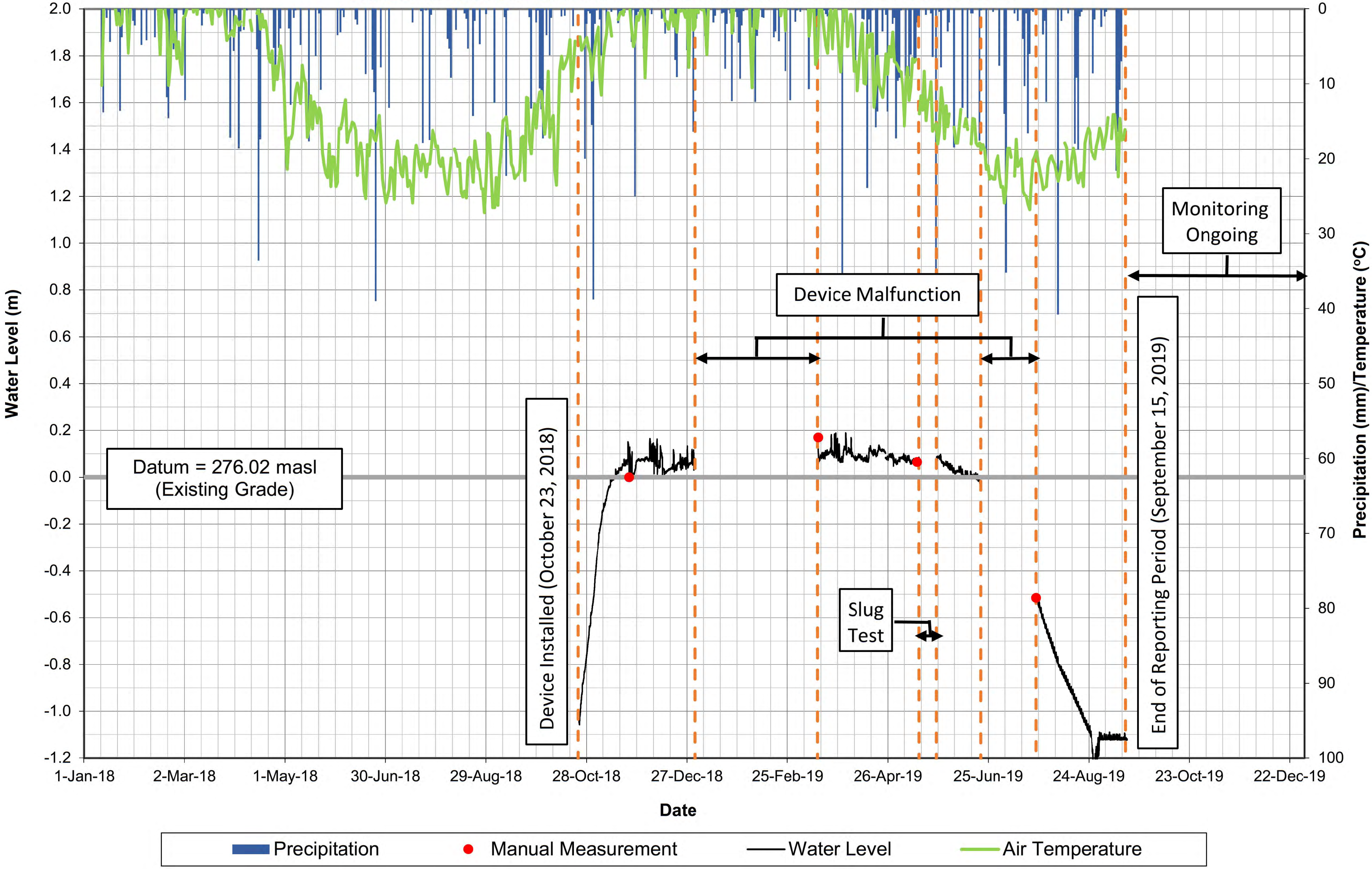
Appendix G:
Shallow Groundwater Monitoring Results

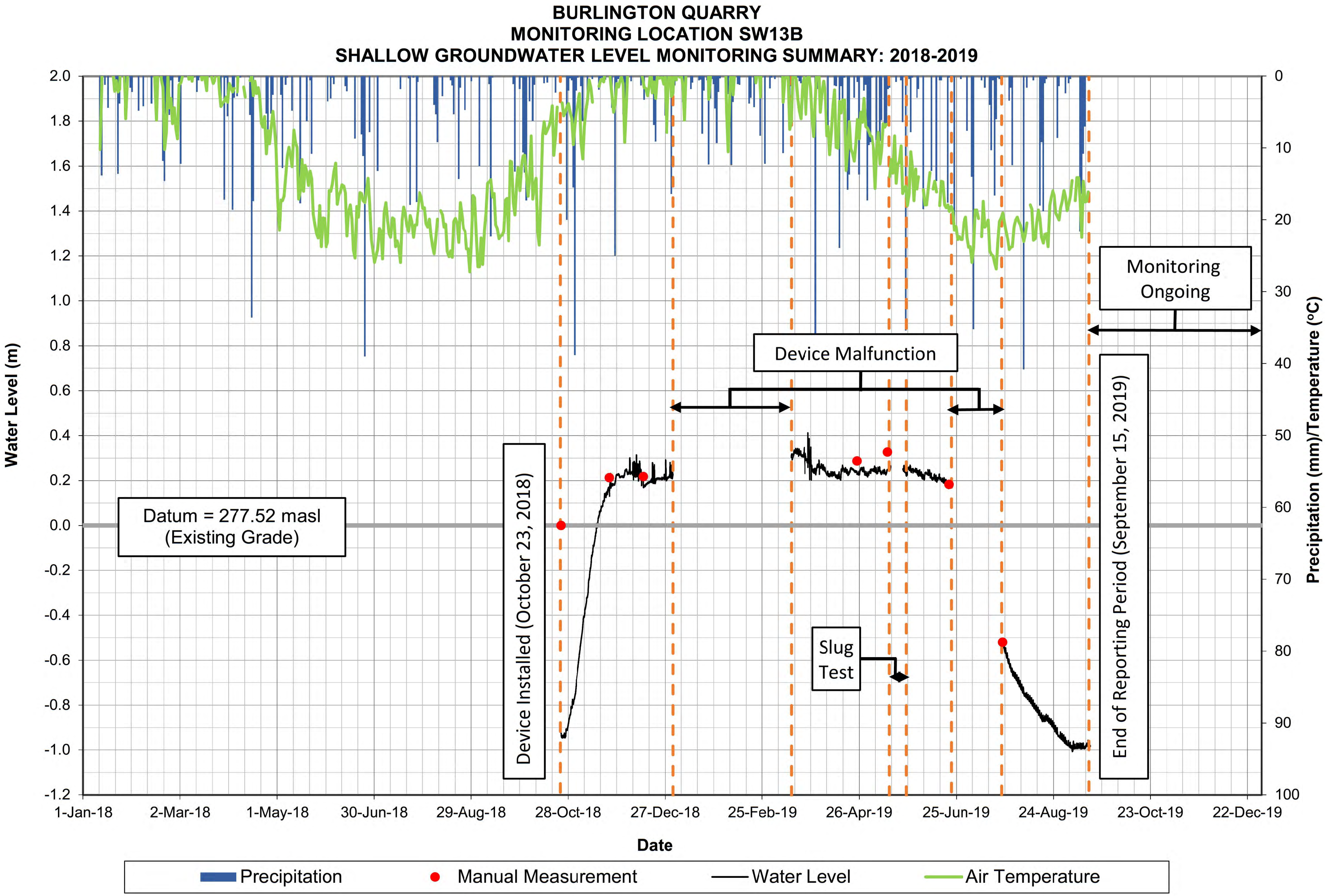

BURLINGTON QUARRY
MONITORING LOCATION SW5B
SHALLOW GROUNDWATER LEVEL MONITORING SUMMARY: 2018-2019
Water Level (m)
Precipitation (mm)/Temperature (ºC)
Date
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2
0
10
20
30
40
50
60
70
80
90
100
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Monitoring Ongoing
Device Malfunction
Device Installed (October 23, 2018)
End of Reporting Period (September 15, 2019)
Datum = 284.64 masl (Existing Grade)
Precipitation
Manual Measurement
Water Level
Air Temperature



BURLINGTON QUARRY
MONITORING LOCATION SW11B
SHALLOW GROUNDWATER LEVEL MONITORING SUMMARY: 2018-2019
Water Level (m)
Precipitation (mm)/Temperature (°C)
Date
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2
0
10
20
30
40
50
60
70
80
90
100
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Datum = 275.06 masl
(Existing Grade)
Device Installed (October 25, 2018)
Device Malfunction
Slug Test
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Water Level
Air Temperature

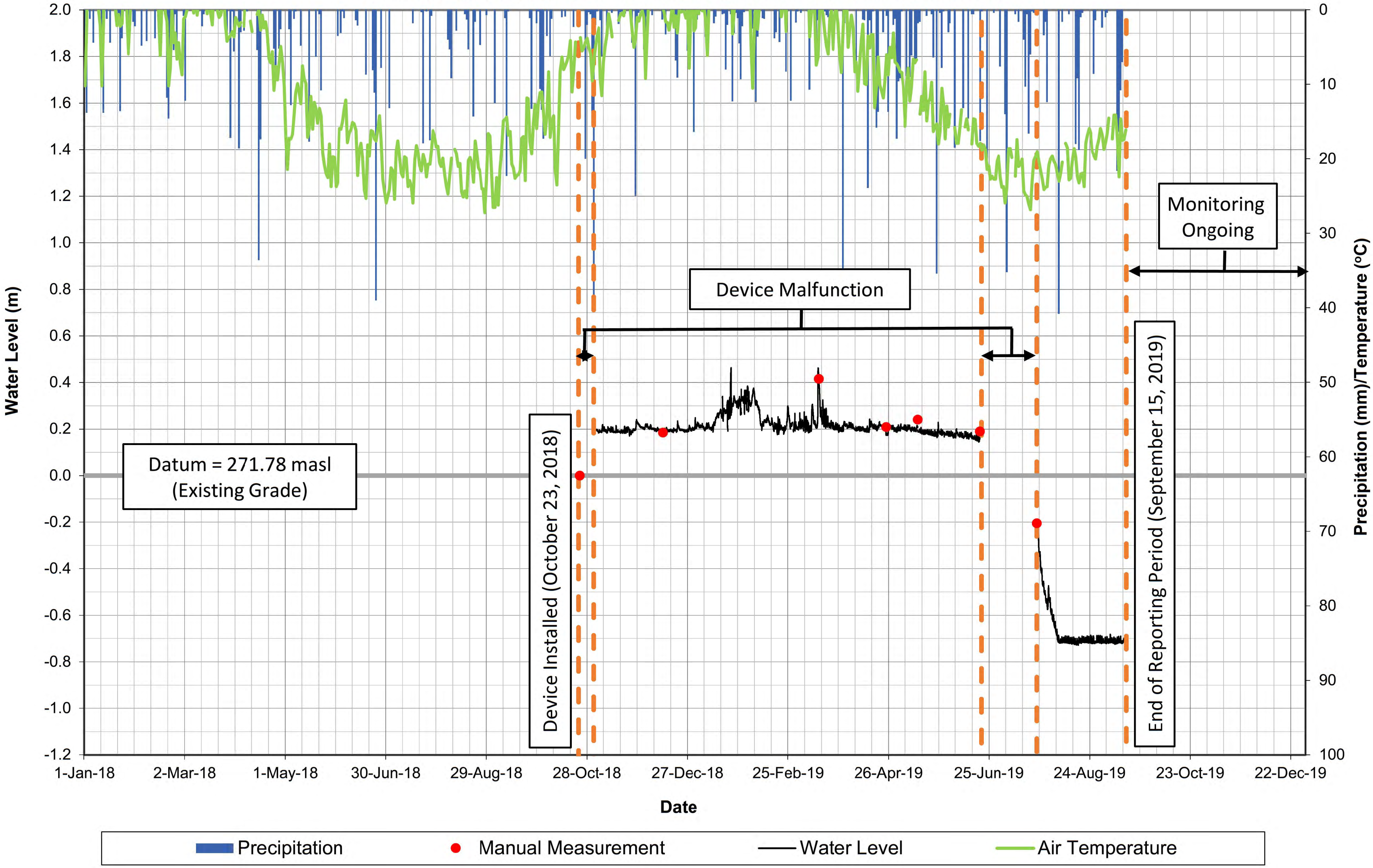
BURLINGTON QUARRY
MONITORING LOCATION SW12B
SHALLOW GROUNDWATER LEVEL MONITORING SUMMARY: 2018-2019





BURLINGTON QUARRY
MONITORING LOCATION SW13B
SHALLOW GROUNDWATER LEVEL MONITORING SUMMARY: 2018-2019
Water Level (m)
Precipitation (mm)/Temperature (°C)
Date
Datum = 277.52 masl
(Existing Grade)
Device Installed (October 23, 2018)
Device Malfunction
Slug
Test
Monitoring
Ongoing
End of Reporting Period (September 15, 2019)
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Precipitation
Manual Measurement
Water Level
Air Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW16B
SHALLOW GROUNDWATER LEVEL MONITORING SUMMARY: 2018-2019



Appendix H:
Water Quality Monitoring Results

BURLINGTON QUARRY
TATHAM ENGINEERING PROJECT NO.: 113187
SURFACE WATER MONITORING

WATER QUALITY SAMPLE RESULTS

Monitoring Location SW1									
		Sample Date:	24-Oct-18	24-Apr-19	19-Jun-19	25-Sep-19	Maximum	Minimum	Average
Parameter:	Units:	M.D.L.	CM/JG	CM/JG	CM	CM			
M-Alkalinity (pH 4.5)	mg/L as CaCO3	2	137	179	180	112	180	112	152
Ammonia (as N)	mg/L	0.01	0.11	<0.01	0.03	0.02	0.11	0.02	0.04
BOD (5 day)	mg/L	1	1	2.4	1.3	1	2.4	1.0	1.4
Bicarbonate	mg/L as CaCO3	1	136	177	-	111	177	111	141
Carbonate	mg/L as CaCO3	1	1	2	-	<1	2	1	1
Conductivity	µS/cm	1	877	742	763	755	877	742	784
Dissolved Organic Carbon	mg/L	0.4	4.3	4	3.1	3.7	4.3	3.1	3.8
Field pH	pH	N/A	8.8	8.5	8.6	8.8	8.8	8.5	8.7
Field Temp	°C	N/A	8.6	7.8	20.2	20.4	20.4	7.8	14.3
Aluminum	ug/L	1	21	64	15	9	64	9	27
Antimony	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Arsenic	ug/L	1	5	3	4	4	5	3	4
Barium	ug/L	1	38	30	32	29	38	29	32
Beryllium	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Bismuth	ug/L	1	<1	<1	<1	<1	<1	<1	1
Boron	ug/L	2	109	56	31	88	109	31	71
Cadmium	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Calcium	ug/L	500		77100	79600	51100	79600	51100	51950
Cerium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Cesium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Chromium	ug/L	1	<1	4	3	3	4	3	3
Cobalt	ug/L	0.1	0.2	0.3	0.2	0.1	0.3	0.1	0.2
Copper	ug/L	1	<1	1	8	1	8	1	3
Europium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Gallium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Iron	ug/L	20	40	160	210	140	210	40	138
Lanthanum	ug/L	1	<1	<1	<1	<1	<1	<1	1
Lead	ug/L	0.1	<1	0.1	<0.1	<0.1	0.1	0.1	0.1
Lithium	ug/L	5	9	7	8	8	9	7	8
Magnesium	ug/L	5		30700	34200	36400	36400	30700	25325
Manganese	ug/L	10	9	15	18	15	18	9	14
Mercury	ug/L	0.1	<1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Molybdenum	ug/L	1	3	2	2	3	3	2	3
Nickel	ug/L	1	4	4	3	2	4	2	3
Niobium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Phosphorus	ug/L	50	<50	124	<50	<50	124	124	68.5
Potassium	ug/L	1	5990	4230	4510	5620	5990	4230	5088
Rubidium	ug/L	1	3	2	2	3	3	2	3
Scandium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Selenium	ug/L	0.5	1.6	1.1	<0.5	1.5	1.6	1.1	1.175
Silicon	ug/L	2	1600	1560	888	659	1600	659	1177
Silver	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Sodium	ug/L	1000	50600	36500	34900	41800	50600	34900	40950
Strontium	ug/L	1	982	942	895	823	982	823	911
Sulphur	ug/L	800	63800	49400	59200	59100	63800	49400	57875
Tellurium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Thallium	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Thorium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Tin	ug/L	1	<1	<1	<1	<1	<1	<1	1
Titanium	ug/L	1	<1	2	<1	<1	2	2	1.25
Tungsten	ug/L	1	<1	<1	<1	<1	<1	<1	1
Uranium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Vanadium	ug/L	1	<1	1	1	<1	1	1	1
Yttrium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Zinc	ug/L	1	5	<1	7	4	7	4	4
Zirconium	ug/L	1	<1	<1	<1	<1	<1	<1	1
pH	pH	N/A	8.02	8.03	8	7.97	8.0	8.0	8.0
Total Hardness (as CaCO3)	mg/L	0.1	335	319	340	277	340.000	277.000	317.750
Chemical Oxygen Demand	mg/L	5	8	12	8	<5	12	8	8
Total Dissolved Solids	mg/L	3	597	517	564	576	597	517	564
Total Suspended Solids	mg/L	0.67	1.3	3.67	1	1.7	3.67	1.00	1.92
Turbidity	NTU	0.1	2.4	3.5	1.4	0.9	3.5	0.9	2.1

BURLINGTON QUARRY
TATHAM ENGINEERING PROJECT NO.: 113187
SURFACE WATER MONITORING

WATER QUALITY SAMPLE RESULTS

Monitoring Location SW2									
		Sample Date:	24-Oct-18	24-Apr-19	19-Jun-19	25-Sep-19	Maximum	Minimum	Average
Parameter:	Units:	M.D.L.	CM/JG	CM/JG	CM	CM			
M-Alkalinity (pH 4.5)	mg/L as CaCO3	2	196	250	261	166	261	166	218.25
Ammonia (as N)	mg/L	0.01	0.04	<0.01	0.02	0.02	0.04	0.02	0.02
BOD (5 day)	mg/L	1	1	0.9	0.9	0.8	1.0	0.8	0.9
Bicarbonate	mg/L as CaCO3	1	194	247	-	164	247	164	202
Carbonate	mg/L as CaCO3	1	3	3	-	2	3	2	3
Conductivity	µS/cm	1	881	668	740	793	881	668	771
Dissolved Organic Carbon	mg/L	0.4	4	4.7	0.4	2.8	4.7	0.4	3.0
Field pH	pH	N/A	8.7	8.7	8.7	8.9	8.9	8.7	8.8
Field Temp	°C	N/A	8.3	6.7	15.2	16.6	16.6	6.7	11.7
Aluminum	ug/L	1	<1	11	17	<1	17	11	8
Antimony	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Arsenic	ug/L	1	2	1	1	2	2	1	1.5
Barium	ug/L	1	55	48	57	55	57	48	54
Beryllium	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Bismuth	ug/L	1	<1	<1	<1	<1	<1	<1	1
Boron	ug/L	2	77	28	7	73	77	7	46.25
Cadmium	ug/L	0.1	0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1
Calcium	ug/L	500	-	74800	85200	66700	85200	66700	56800
Cerium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Cesium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Chromium	ug/L	1	<1	5	5	3	5	3	4
Cobalt	ug/L	0.1	0.1	0.2	0.1	<0.1	0.2	0.1	0.125
Copper	ug/L	1	<1	<1	2	<1	2	2	1
Europium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Gallium	ug/L	1	<1	1	1	<1	1	1	1
Iron	ug/L	20	<20	157	237	170	237	157	146
Lanthanum	ug/L	1	<1	<1	<1	<1	<1	<1	1
Lead	ug/L	0.1	<0.1	<0.1	0.2	<0.1	0.2	0.2	0.125
Lithium	ug/L	5	7	<5	6	8	8	6	6.5
Magnesium	ug/L	5	-	29600	32300	35200	35200	29600	24276
Manganese	ug/L	10	9	17	26	7	26	7	15
Mercury	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Molybdenum	ug/L	1	2	<1	1	2	2	1	2
Nickel	ug/L	1	4	3	3	3	4	3	3
Niobium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Phosphorus	ug/L	50	<50	<50	<50	<50	<50	<50	50
Potassium	ug/L	1	4490	2490	2840	4630	4630	2490	3613
Rubidium	ug/L	1	2	1	1	2	2	1	2
Scandium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Selenium	ug/L	0.5	0.9	0.8	<0.5	<0.5	0.9	0.8	0.675
Silicon	ug/L	2	2100	2640	2700	1960	2700	1960	2350
Silver	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Sodium	ug/L	1000	48600	27800	31800	43500	48600	27800	37925
Strontium	ug/L	1	715	417	510	678	715	417	580
Sulphur	ug/L	800	47400	20300	32500	48100	48100	20300	37075
Tellurium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Thallium	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Thorium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Tin	ug/L	1	<1	<1	<1	<1	<1	<1	1
Titanium	ug/L	1	<1	1	<1	<1	1	1	1
Tungsten	ug/L	1	<1	<1	<1	<1	<1	<1	1
Uranium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Vanadium	ug/L	1	<1	1	1	1	1	1	1
Yttrium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Zinc	ug/L	1	9	<1	4	2	9	2	4
Zirconium	ug/L	1	9	<1	<1	<1	9	9	3
pH	pH	N/A	8.16	8.14	8.18	8.09	8.2	8.1	8.1
Total Hardness (as CaCO3)	mg/L	0.1	342	309	346	312	346.000	309.000	327.250
Chemical Oxygen Demand	mg/L	5	8	12	12	<5	12	8	9
Total Dissolved Solids	mg/L	3	589	433	515	548	589	433	521
Total Suspended Solids	mg/L	0.67	1	2	6	3	6.00	1.00	3.00
Turbidity	NTU	0.1	0.9	1.7	3.6	2.6	3.6	0.9	2.2

BURLINGTON QUARRY
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SURFACE WATER MONITORING

WATER QUALITY SAMPLE RESULTS

Monitoring Location SW6									
		Sample Date:	24-Oct-18	24-Apr-19	19-Jun-19	25-Sep-19	Maximum	Minimum	Average
Parameter:	Units:	M.D.L.	CM/JG	CM/JG	CM	CM			
M-Alkalinity (pH 4.5)	mg/L as CaCO3	2	DRY	170	172	137	172	137	160
Ammonia (as N)	mg/L	0.01		<0.01	0.04	0.02	0.04	0.02	0.02
BOD (5 day)	mg/L	1		0.9	<0.9	0.9	0.9	0.9	0.9
Bicarbonate	mg/L as CaCO3	1		169		136	169	136	102
Carbonate	mg/L as CaCO3	1		1		<1	1	1	1
Conductivity	µS/cm	1		798	843	934	934	798	858
Dissolved Organic Carbon	mg/L	0.4		2.7	3	3.4	3.4	2.7	3.0
Field pH	pH	N/A			8.4	8.7	8.7	8.4	5.7
Field Temp	°C	N/A			15.1	16.1	16.1	15.1	10.4
Aluminum	ug/L	1		6	2	<1	6	2	3
Antimony	ug/L	0.5		<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Arsenic	ug/L	1		2	3	4	4	2	3
Barium	ug/L	1		31	30	32	32	30	31
Beryllium	ug/L	0.5		<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Bismuth	ug/L	1		<1	<1	<1	<1	<1	1
Boron	ug/L	2		66	71	160	160	66	99
Cadmium	ug/L	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Calcium	ug/L	500		85600	85900	74700	85900	74700	82067
Cerium	ug/L	1		<1	<1	<1	<1	<1	1
Cesium	ug/L	1		<1	<1	<1	<1	<1	1
Chromium	ug/L	1		3	3	3	3	3	3
Cobalt	ug/L	0.1		0.2	0.2	0.1	0.2	0.1	0.2
Copper	ug/L	1		<1	4	<1	4	4	2
Europium	ug/L	1		<1	<1	<1	<1	<1	1
Gallium	ug/L	1		<1	<1	<1	<1	<1	1
Iron	ug/L	20		89	211	180	211	89	160
Lanthanum	ug/L	1		<1	<1	<1	<1	<1	1
Lead	ug/L	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Lithium	ug/L	5		10	11	13	13	10	11
Magnesium	ug/L	5		35500	39100	41300	41300	35500	38633
Manganese	ug/L	10		<1	31	15	31	15	19
Mercury	ug/L	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Molybdenum	ug/L	1		4	4	3	4	3	4
Nickel	ug/L	1		4	4	3	4	3	4
Niobium	ug/L	1		<1	<1	<1	<1	<1	1
Phosphorus	ug/L	50		<50	<50	<50	<50	<50	50
Potassium	ug/L	1		3980	4380	6510	6510	3980	4957
Rubidium	ug/L	1		2	2	3	3	2	2
Scandium	ug/L	1		<1	<1	<1	<1	<1	1
Selenium	ug/L	0.5		1.7	1.1	0.9	1.7	0.9	1.2
Silicon	ug/L	2		670	900	1230	1230	670	933
Silver	ug/L	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Sodium	ug/L	1000		30400	36800	46100	46100	30400	37767
Strontium	ug/L	1		1270	1190	1380	1380	1190	1280
Sulphur	ug/L	800		63600	74400	79100	79100	63600	72367
Tellurium	ug/L	1		<1	<1	<1	<1	<1	1
Thallium	ug/L	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Thorium	ug/L	1		<1	<1	<1	<1	<1	1
Tin	ug/L	1		<1	<1	<1	<1	<1	1
Titanium	ug/L	1		2	<1	<1	2	2	1
Tungsten	ug/L	1		<1	<1	<1	<1	<1	1
Uranium	ug/L	1		<1	<1	<1	<1	<1	1
Vanadium	ug/L	1		<1	<1	<1	<1	<1	1
Yttrium	ug/L	1		<1	<1	<1	<1	<1	1
Zinc	ug/L	1		<1	3	1	3	1	2
Zirconium	ug/L	1		<1	<1	<1	<1	<1	1
pH	pH	N/A		7.89	7.82	7.85	7.9	7.8	7.9
Total Hardness (as CaCO3)	mg/L	0.1		360	376	357	376	357	364
Chemical Oxygen Demand	mg/L	5		8	12	<5	12	8	8
Total Dissolved Solids	mg/L	3		593	631	695	695	593	640
Total Suspended Solids	mg/L	0.67		<0.67	<0.67	2	2.00	2.00	1.11
Turbidity	NTU	0.1		0.5	0.4	0.2	0.5	0.2	0.4

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SURFACE WATER MONITORING

WATER QUALITY SAMPLE RESULTS

Monitoring Location SW10B									
		Sample Date:	24-Oct-18	24-Apr-19	19-Jun-19	25-Sep-19	Maximum	Minimum	Average
Parameter:	Units:	M.D.L.	CM/JG	CM/JG	CM	CM			
M-Alkalinity (pH 4.5)	mg/L as CaCO3	2	261	208	217	152	261	152	209.5
Ammonia (as N)	mg/L	0.01	0.07	<0.01	0.04	0.02	0.07	0.02	0.04
BOD (5 day)	mg/L	1	<1	0.9	<0.9	0.9	0.9	0.9	1.0
Bicarbonate	mg/L as CaCO3	1	259	206		151	259	151	154
Carbonate	mg/L as CaCO3	1	2	2		<1	2	2	1.25
Conductivity	µS/cm	1	754	517	689	882	882	517	711
Dissolved Organic Carbon	mg/L	0.4	3.5	4.8	4.2	4.3	4.8	3.5	4.2
Field pH	pH	N/A	8.8	8.5	8.2	8.3	8.8	8.2	8.5
Field Temp	°C	N/A	5.4	8.5	19.5	17.8	19.5	5.4	12.8
Aluminum	ug/L	1	<1	<1	4	<1	4	4	2
Antimony	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Arsenic	ug/L	1	<1	<1	<1	1	1	1	1
Barium	ug/L	1	63	37	51	66	66	37	54
Beryllium	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Bismuth	ug/L	1	<1	<1	<1	<1	<1	<1	1
Boron	ug/L	2	46	22	26	131	131	22	56.25
Cadmium	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Calcium	ug/L	500	-	61800	76600	75800	76600	61800	53675
Cerium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Cesium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Chromium	ug/L	1	<1	4	4	4	4	4	3
Cobalt	ug/L	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.125
Copper	ug/L	1	<1	<1	<1	<1	<1	<1	1
Europium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Gallium	ug/L	1	1	<1	<1	<1	1	1	1
Iron	ug/L	20	130	104	270	207	270	104	178
Lanthanum	ug/L	1	<1	<1	<1	<1	<1	<1	1
Lead	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Lithium	ug/L	5	<5	<5	7	10	10	7	6.75
Magnesium	ug/L	5	-	22900	33900	41100	41100	22900	24476
Manganese	ug/L	1	168	5	109	103	168	5	96
Mercury	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Molybdenum	ug/L	1	2	<1	2	2	2	2	2
Nickel	ug/L	1	4	3	3	3	4	3	3
Niobium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Phosphorus	ug/L	50	<50	<50	<50	52	52	52	50.5
Potassium	ug/L	1	2300	2090	1130	5740	5740	1130	2815
Rubidium	ug/L	1	<1	<1	<1	2	2	2	1
Scandium	ug/L	1	1	<1	<1	<1	1	1	1
Selenium	ug/L	0.5	1.1	0.7	<0.5	1.3	1.3	0.7	0.9
Silicon	ug/L	2	3550	703	1880	2200	3550	703	2083
Silver	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Sodium	ug/L	100	18400	13200	24900	46100	46100	13200	25650
Strontium	ug/L	1	582	443	663	1080	1080	443	692
Sulphur	ug/L	800	30000	18400	42200	69600	69600	18400	40050
Tellurium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Thallium	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Thorium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Tin	ug/L	1	<1	<1	<1	<1	<1	<1	1
Titanium	ug/L	1	1	<1	<1	<1	1	1	1
Tungsten	ug/L	1	<1	<1	<1	<1	<1	<1	1
Uranium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Vanadium	ug/L	1	<1	1	1	1	1	1	1
Yttrium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Zinc	ug/L	1	10	<1	1	1	10	1	3
Zirconium	ug/L	1	<1	<1	<1	<1	<1	<1	1
pH	pH	N/A	7.85	7.97	7.81	7.79	8.0	7.8	7.9
Total Hardness (as CaCO3)	mg/L	0.1	354	249	331	359	359	249	323
Chemical Oxygen Demand	mg/L	5	<5	16	16	8	16	8	11
Total Dissolved Solids	mg/L	3	492	337	481	673	673	337	496
Total Suspended Solids	mg/L	0.67	<0.67	<0.67	1.33	3.3	3.30	1.33	1.49
Turbidity	NTU	0.1	1.4	0.7	0.9	1	1.4	0.7	1.0

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SURFACE WATER MONITORING

WATER QUALITY SAMPLE RESULTS

Monitoring Location SW14									
		Sample Date:	24-Oct-18	24-Apr-19	19-Jun-19	25-Sep-19	Maximum	Minimum	Average
Parameter:	Units:	M.D.L.	CM/JG	CM/JG	CM	CM			
M-Alkalinity (pH 4.5)	mg/L as CaCO3	2	303	239	302	324	324	239	292
Ammonia (as N)	mg/L	0.01	0.04	<0.01	0.07	0.03	0.07	0.03	0.04
BOD (5 day)	mg/L	1	<1	0.8	<0.9	1	1.0	0.8	1.0
Bicarbonate	mg/L as CaCO3	1	300	237		319	319	237	214
Carbonate	mg/L as CaCO3	1	3	2		4	4	2	2.25
Conductivity	µS/cm	1	646	457	549	696	696	457	587
Dissolved Organic Carbon	mg/L	0.4	10.7	7.4	<0.4	5.1	10.7	5.1	5.9
Field pH	pH	N/A	8.6	8.8	8.8	8.8	8.8	8.6	8.8
Field Temp	°C	N/A	5.4	4.2	15.1	17	17.0	4.2	10.4
Aluminum	ug/L	1	<1	5	5	19	19	5	8
Antimony	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Arsenic	ug/L	1	<1	<1	<1	<1	<1	<1	1
Barium	ug/L	1	63	48	64	82	82	48	64
Beryllium	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Bismuth	ug/L	1	<1	<1	<1	<1	<1	<1	1
Boron	ug/L	2	6	8	<2	17	17	6	8.25
Cadmium	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Calcium	ug/L	500	-	57000	72500	80000	80000	57000	52500
Cerium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Cesium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Chromium	ug/L	1	<1	3	5	7	7	3	4
Cobalt	ug/L	0.1	0.2	<0.1	0.1	0.1	0.2	0.1	0.125
Copper	ug/L	1	<1	<1	1	<1	1	1	1
Europium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Gallium	ug/L	1	1	<1	1	1	1	1	1
Iron	ug/L	20	150	137	191	319	319	137	199
Lanthanum	ug/L	1	<1	<1	<1	<1	<1	<1	1
Lead	ug/L	0.1	<0.1	0.4	0.2	1	1	0.2	0.425
Lithium	ug/L	5	<5	<5	<5	<5	<5	<5	5
Magnesium	ug/L	5	-	23400	29300	35800	35800	23400	22126
Manganese	ug/L	10	69	17	19	61	69	17	42
Mercury	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Molybdenum	ug/L	1	<1	<1	<1	<1	<1	<1	1
Nickel	ug/L	1	3	2	2	2	3	2	2
Niobium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Phosphorus	ug/L	50	<50	<50	<50	<50	<50	<50	50
Potassium	ug/L	1	1430	1160	892	1140	1430	892	1156
Rubidium	ug/L	1	<1	<1	<1	1	1	1	1
Scandium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Selenium	ug/L	0.5	0.5	<0.5	<0.5	<0.5	0.5	0.5	0.5
Silicon	ug/L	2	3550	2300	3260	4020	4020	2300	3283
Silver	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Sodium	ug/L	1000	15000	6600	8680	18800	18800	6600	12270
Strontium	ug/L	1	116	98	108	127	127	98	112
Sulphur	ug/L	800	2700	5290	5710	10100	10100	2700	5950
Tellurium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Thallium	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Thorium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Tin	ug/L	1	<1	<1	<1	<1	<1	<1	1
Titanium	ug/L	1	1	<1	<1	2	2	1	1.25
Tungsten	ug/L	1	<1	<1	<1	<1	<1	<1	1
Uranium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Vanadium	ug/L	1	<1	1	2	2	2	1	1.5
Yttrium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Zinc	ug/L	1	11	<1	3	12	12	3	7
Zirconium	ug/L	1	<1	<1	<1	<1	<1	<1	1
pH	pH	N/A	8.06	7.96	8.11	8.17	8.2	8.0	8.1
Total Hardness (as CaCO3)	mg/L	0.1	318	239	302	347	347	239	302
Chemical Oxygen Demand	mg/L	5	20	24	20	20	24	20	21
Total Dissolved Solids	mg/L	3	416	313	371	479	479	313	395
Total Suspended Solids	mg/L	0.67	5.7	4	3.67	5	5.70	3.67	4.59
Turbidity	NTU	0.1	1.9	2	1.3	2.1	2.1	1.3	1.8

BURLINGTON QUARRY
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SURFACE WATER MONITORING

WATER QUALITY SAMPLE RESULTS

Monitoring Location SW15									
		Sample Date:	24-Oct-18	24-Apr-19	19-Jun-19	25-Sep-19	Maximum	Minimum	Average
Parameter:	Units:	M.D.L.	CM/JG	CM/JG	CM	CM			
M-Alkalinity (pH 4.5)	mg/L as CaCO3	2	DRY	132	204	DRY	204	132	168
Ammonia (as N)	mg/L	0.01		<0.01	0.04		0.04	0.04	0.03
BOD (5 day)	mg/L	1		1.3	2.1		2.1	1.3	1.7
Bicarbonate	mg/L as CaCO3	1		131			131	131	131
Carbonate	mg/L as CaCO3	1		<1			<1	<1	<1
Conductivity	µS/cm	1		289	376		376	289	333
Dissolved Organic Carbon	mg/L	0.4		17.7	20.6		20.6	17.7	19.2
Field pH	pH	N/A			8.6		8.6	8.6	4.3
Field Temp	°C	N/A			20		20.0	20.0	10.0
Aluminum	ug/L	1		27	16		27	16	22
Antimony	ug/L	0.5		<0.5	<0.5		<0.5	<0.5	0.5
Arsenic	ug/L	1		<1	2		2	2	1.5
Barium	ug/L	1		21	25		25	21	23
Beryllium	ug/L	0.5		<0.5	<0.5		<0.5	<0.5	0.5
Bismuth	ug/L	1		<1	<1		<1	<1	1
Boron	ug/L	2		10	<2		10	10	6
Cadmium	ug/L	0.1		<0.1	<0.1		<0.1	<0.1	0.1
Calcium	ug/L	500		36500	55300		55300	36500	45900
Cerium	ug/L	1		<1	<1		<1	<1	1
Cesium	ug/L	1		<1	<1		<1	<1	1
Chromium	ug/L	1		3	4		4	3	4
Cobalt	ug/L	0.1		0.1	0.8		0.8	0.1	0.45
Copper	ug/L	1		1	2		2	1	2
Europium	ug/L	1		<1	<1		<1	<1	1
Gallium	ug/L	1		<1	<1		<1	<1	1
Iron	ug/L	20		273	549		549	273	411
Lanthanum	ug/L	1		<1	<1		<1	<1	1
Lead	ug/L	0.1		<0.1	0.2		0.2	0.2	0.15
Lithium	ug/L	5		<5	<5		<5	<5	5
Magnesium	ug/L	5		7860	10500		10500	7860	9180
Manganese	ug/L	10		18	646		646	18	332
Mercury	ug/L	0.1		<0.1	<0.1		<0.1	<0.1	0.1
Molybdenum	ug/L	1		<1	<1		<1	<1	1
Nickel	ug/L	1		2	3		3	2	3
Niobium	ug/L	1		<1	<1		<1	<1	1
Phosphorus	ug/L	50		<50	95		95	95	72.5
Potassium	ug/L	1		3580	4380		4380	3580	3980
Rubidium	ug/L	1		<1	1		1	1	1
Scandium	ug/L	1		<1	<1		<1	<1	1
Selenium	ug/L	0.5		0.5	<0.5		0.5	0.5	0.5
Silicon	ug/L	2		3470	3300		3470	3300	3385
Silver	ug/L	0.1		<0.1	<0.1		<0.1	<0.1	0.1
Sodium	ug/L	1000		9380	13200		13200	9380	11290
Strontium	ug/L	1		100	136		136	100	118
Sulphur	ug/L	800		1740	1310		1740	1310	1525
Tellurium	ug/L	1		<1	<1		<1	<1	1
Thallium	ug/L	0.1		<0.1	<0.1		<0.1	<0.1	0.1
Thorium	ug/L	1		<1	<1		<1	<1	1
Tin	ug/L	1		<1	<1		<1	<1	1
Titanium	ug/L	1		2	1		2	1	1.5
Tungsten	ug/L	1		<1	<1		<1	<1	1
Uranium	ug/L	1		<1	<1		<1	<1	1
Vanadium	ug/L	1		1	1		1	1	1
Yttrium	ug/L	1		<1	<1		<1	<1	1
Zinc	ug/L	1		<1	6		6	6	4
Zirconium	ug/L	1		<1	<1		<1	<1	1
pH	pH	N/A		7.6	7.66		7.7	7.6	7.6
Total Hardness (as CaCO3)	mg/L	0.1		124	181		181	124	153
Chemical Oxygen Demand	mg/L	5		44	64		64	44	54
Total Dissolved Solids	mg/L	3		219	273		273	219	246
Total Suspended Solids	mg/L	0.67		1.67	6		6.00	1.67	3.84
Turbidity	NTU	0.1		0.8	3.6		3.6	0.8	2.2

BURLINGTON QUARRY
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SURFACE WATER MONITORING

WATER QUALITY SAMPLE RESULTS

Monitoring Location SW24									
		Sample Date:	24-Oct-18	24-Apr-19	19-Jun-19	25-Sep-19	Maximum	Minimum	Average
Parameter:	Units:	M.D.L.	CM/JG	CM/JG	CM	CM			
M-Alkalinity (pH 4.5)	mg/L as CaCO3	2	248	203	235	208	248	203	223.5
Ammonia (as N)	mg/L	0.01	0.04	<0.01	0.03	<0.01	0.04	0.03	0.02
BOD (5 day)	mg/L	1	1.1	1.4	<1	1.1	1.4	1.1	1.2
Bicarbonate	mg/L as CaCO3	1	244	199		206	244	199	162
Carbonate	mg/L as CaCO3	1	4	4		2	4	2	2.5
Conductivity	µS/cm	1	781	540	593	604	781	540	630
Dissolved Organic Carbon	mg/L	0.4	5.1	4.9	5.8	4.7	5.8	4.7	5.1
Field pH	pH	N/A	8.7	8.9	8.7	8.6	8.9	8.6	8.7
Field Temp	°C	N/A	5.5	9	18.9	17.7	18.9	5.5	12.8
Aluminum	ug/L	1	<1	252	87	23	252	23	91
Antimony	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Arsenic	ug/L	1	<1	<1	<1	1	1	1	1
Barium	ug/L	1	35	29	32	31	35	29	32
Beryllium	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Bismuth	ug/L	1	<1	<1	<1	<1	<1	<1	1
Boron	ug/L	2	49	28	10	50	50	10	34.25
Cadmium	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Calcium	ug/L	500	-	58100	66100	49900	66100	49900	43650
Cerium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Cesium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Chromium	ug/L	1	<1	4	4	5	5	4	4
Cobalt	ug/L	0.1	0.2	0.2	0.1	0.1	0.2	0.1	0.15
Copper	ug/L	1	2	2	5	2	5	2	3
Europium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Gallium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Iron	ug/L	20	150	273	237	160	273	150	205
Lanthanum	ug/L	1	<1	<1	<1	<1	<1	<1	1
Lead	ug/L	0.1	<0.1	<0.1	0.1	0.2	0.2	0.1	0.125
Lithium	ug/L	5	<5	<5	<5	<5	<5	<5	5
Magnesium	ug/L	5	-	17000	20900	22100	22100	17000	15001
Manganese	ug/L	10	164	149	79	59	164	59	113
Mercury	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Molybdenum	ug/L	1	<1	<1	<1	1	1	1	1
Nickel	ug/L	1	3	3	3	2	3	2	3
Niobium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Phosphorus	ug/L	50	<50	<50	<50	51	51	51	50.25
Potassium	ug/L	1	4160	2930	2870	4250	4250	2870	3553
Rubidium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Scandium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Selenium	ug/L	0.5	0.7	0.7	<0.5	0.5	0.7	0.5	0.6
Silicon	ug/L	2	1980	2960	2410	2580	2960	1980	2483
Silver	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Sodium	ug/L	1000	57500	29400	33000	35800	57500	29400	38925
Strontium	ug/L	1	390	321	337	340	390	321	347
Sulphur	ug/L	800	10200	9780	10800	9660	10800	9660	10110
Tellurium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Thallium	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Thorium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Tin	ug/L	1	<1	<1	<1	<1	<1	<1	1
Titanium	ug/L	1	1	7	5	2	7	1	3.75
Tungsten	ug/L	1	<1	<1	<1	<1	<1	<1	1
Uranium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Vanadium	ug/L	1	<1	2	2	2	2	2	1.75
Yttrium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Zinc	ug/L	1	5	<1	2	2	5	2	3
Zirconium	ug/L	1	<1	<1	<1	<1	<1	<1	1
pH	pH	N/A	8.25	8.31	8.15	8.05	8.3	8.1	8.2
Total Hardness (as CaCO3)	mg/L	0.1	277	215	251	216	277	215	240
Chemical Oxygen Demand	mg/L	5	12	16	16	8	16	8	13
Total Dissolved Solids	mg/L	3	470	347	362	366	470	347	386
Total Suspended Solids	mg/L	0.67	1.7	1.33	4.33	33	33.00	1.33	10.09
Turbidity	NTU	0.1	1.1	6.2	5.9	2.3	6.2	1.1	3.9

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SURFACE WATER MONITORING

WATER QUALITY SAMPLE RESULTS

Monitoring Location SW28									
		Sample Date:	24-Oct-18	24-Apr-19	19-Jun-19	25-Sep-19	Maximum	Minimum	Average
Parameter:	Units:	M.D.L.	CM/JG	CM/JG	CM	CM			
M-Alkalinity (pH 4.5)	mg/L as CaCO3	2	276	211	371		371	211	286
Ammonia (as N)	mg/L	0.01	0.07	<0.01	0.03		0.07	0.03	0.04
BOD (5 day)	mg/L	1	<1	0.9	<1		0.9	0.9	1.0
Bicarbonate	mg/L as CaCO3	1	273	209			273	209	241
Carbonate	mg/L as CaCO3	1	2	2			2	2	2
Conductivity	µS/cm	1	829	576	737		829	576	714
Dissolved Organic Carbon	mg/L	0.4	7.8	6	8.9		8.9	6.0	7.6
Field pH	pH	N/A	8.6	8.5	8.2		8.6	8.2	8.4
Field Temp	°C	N/A	6.1	7.7	17.2		17.2	6.1	10.3
Aluminum	ug/L	1	76	34	14		76	14	41
Antimony	ug/L	0.5	<0.5	<0.5	<0.5		<0.5	<0.5	0.5
Arsenic	ug/L	1	<1	<1	1		1	1	1
Barium	ug/L	1	33	23	16		33	16	24
Beryllium	ug/L	0.5	<0.5	<0.5	<0.5		<0.5	<0.5	0.5
Bismuth	ug/L	1	<1	<1	<1		<1	<1	1
Boron	ug/L	2	9	14	<2		14	9	8
Cadmium	ug/L	0.1	<0.1	<0.1	<0.1		<0.1	<0.1	0.1
Calcium	ug/L	500	-	60200	96500		96500	60200	52400
Cerium	ug/L	1	<1	<1	<1		<1	<1	1
Cesium	ug/L	1	<1	<1	<1		<1	<1	1
Chromium	ug/L	1	<1	5	7		7	5	4
Cobalt	ug/L	0.1	0.2	0.2	0.3		0.3	0.2	0.2
Copper	ug/L	1	2	2	3		3	2	2
Europium	ug/L	1	<1	<1	<1		<1	<1	1
Gallium	ug/L	1	<1	<1	<1		<1	<1	1
Iron	ug/L	20	90	168	294		294	90	184
Lanthanum	ug/L	1	<1	<1	<1		<1	<1	1
Lead	ug/L	0.1	<0.1	<0.1	<0.1		<0.1	<0.1	0.1
Lithium	ug/L	5	<5	<5	<5		<5	<5	5
Magnesium	ug/L	5	-	16200	23400		23400	16200	13202
Manganese	ug/L	10	174	8	390	DRY	390	8	191
Mercury	ug/L	0.1	<0.1	<0.1	<0.1		<0.1	<0.1	0.1
Molybdenum	ug/L	1	<1	<1	2		2	2	1
Nickel	ug/L	1	4	3	4		4	3	4
Niobium	ug/L	1	<1	<1	<1		<1	<1	1
Phosphorus	ug/L	50	50	<50	64		64	50	55
Potassium	ug/L	1	2920	2890	134		2920	134	1981
Rubidium	ug/L	1	<1	<1	<1		<1	<1	1
Scandium	ug/L	1	<1	<1	<1		<1	<1	1
Selenium	ug/L	0.5	0.8	<0.5	0.6		0.8	0.6	0.6
Silicon	ug/L	2	3380	2370	1770		3380	1770	2507
Silver	ug/L	0.1	<0.1	<0.1	<0.1		<0.1	<0.1	0.1
Sodium	ug/L	1000	61500	38000	37600		61500	37600	45700
Strontium	ug/L	1	241	244	259		259	241	248
Sulphur	ug/L	800	6500	9730	2520		9730	2520	6250
Tellurium	ug/L	1	<1	<1	<1		<1	<1	1
Thallium	ug/L	0.1	<0.1	<0.1	<0.1		<0.1	<0.1	0.1
Thorium	ug/L	1	<1	<1	<1		<1	<1	1
Tin	ug/L	1	<1	<1	<1		<1	<1	1
Titanium	ug/L	1	3	1	<1		3	1	2
Tungsten	ug/L	1	<1	<1	<1		<1	<1	1
Uranium	ug/L	1	1	<1	1		1	1	1
Vanadium	ug/L	1	<1	2	2		2	2	2
Yttrium	ug/L	1	<1	<1	<1		<1	<1	1
Zinc	ug/L	1	8	<1	8		8	8	6
Zirconium	ug/L	1	<1	<1	<1		<1	<1	1
pH	pH	N/A	7.9	7.91	7.79		7.9	7.8	7.9
Total Hardness (as CaCO3)	mg/L	0.1	296	217	337		337	217	283
Chemical Oxygen Demand	mg/L	5	16	20	28		28	16	21
Total Dissolved Solids	mg/L	3	509	361	454		509	361	441
Total Suspended Solids	mg/L	0.67	5.3	<0.67	1.67		5.30	1.67	2.55
Turbidity	NTU	0.1	5.9	1.3	2.2		5.9	1.3	3.1

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WATER QUALITY SAMPLE RESULTS

Monitoring Location SW29									
		Sample Date:	24-Oct-18	24-Apr-19	19-Jun-19	25-Sep-19	Maximum	Minimum	Average
Parameter:	Units:	M.D.L.	CM/JG	CM/JG	CM	CM			
M-Alkalinity (pH 4.5)	mg/L as CaCO3	2		257	366		366	257	311.5
Ammonia (as N)	mg/L	0.01		0.01	0.08		0.08	0.01	0.05
BOD (5 day)	mg/L	1		1.3	1.5		1.5	1.3	1.4
Bicarbonate	mg/L as CaCO3	1		255			255	255	255
Carbonate	mg/L as CaCO3	1		2			2	2	2
Conductivity	µS/cm	1		648	878		878	648	763
Dissolved Organic Carbon	mg/L	0.4		8.1	11.4		11.4	8.1	9.8
Field pH	pH	N/A			8.3		8.3	8.3	4.2
Field Temp	°C	N/A			18		18.0	18.0	9.0
Aluminum	ug/L	1		113	79		113	79	96
Antimony	ug/L	0.5		<0.5	<0.5		<0.5	<0.5	0.5
Arsenic	ug/L	1		<1	1		1	1	1
Barium	ug/L	1		36	34		36	34	35
Beryllium	ug/L	0.5		<0.5	<0.5		<0.5	<0.5	0.5
Bismuth	ug/L	1		<1	<1		<1	<1	1
Boron	ug/L	2		10	<2		10	10	6
Cadmium	ug/L	0.1		<0.1	<0.1		<0.1	<0.1	0.1
Calcium	ug/L	500		71900	92100		92100	71900	82000
Cerium	ug/L	1		<1	<1		<1	<1	1
Cesium	ug/L	1		<1	<1		<1	<1	1
Chromium	ug/L	1		5	7		7	5	6
Cobalt	ug/L	0.1		0.2	0.3		0.3	0.2	0.25
Copper	ug/L	1		2	4		4	2	3
Europium	ug/L	1		<1	<1		<1	<1	1
Gallium	ug/L	1		<1	<1		<1	<1	1
Iron	ug/L	20		232	511		511	232	372
Lanthanum	ug/L	1		<1	<1		<1	<1	1
Lead	ug/L	0.1		0.5	0.5		0.5	0.5	0.5
Lithium	ug/L	5		<5	<5		<5	<5	5
Magnesium	ug/L	5		22200	26300		26300	22200	24250
Manganese	ug/L	10	DRY	51	529	DRY	529	51	290
Mercury	ug/L	0.1		<0.1	<0.1		<0.1	<0.1	0.1
Molybdenum	ug/L	1		<1	1		1	1	1
Nickel	ug/L	1		3	4		4	3	4
Niobium	ug/L	1		<1	<1		<1	<1	1
Phosphorus	ug/L	50		<50	104		104	104	77
Potassium	ug/L	1		2510	324		2510	324	1417
Rubidium	ug/L	1		<1	<1		<1	<1	1
Scandium	ug/L	1		<1	<1		<1	<1	1
Selenium	ug/L	0.5		0.7	<0.5		0.7	0.7	0.6
Silicon	ug/L	2		2600	2280		2600	2280	2440
Silver	ug/L	0.1		<0.1	<0.1		<0.1	<0.1	0.1
Sodium	ug/L	1000		31500	66400		66400	31500	48950
Strontium	ug/L	1		432	483		483	432	458
Sulphur	ug/L	800		11100	5920		11100	5920	8510
Tellurium	ug/L	1		<1	<1		<1	<1	1
Thallium	ug/L	0.1		<0.1	<0.1		<0.1	<0.1	0.1
Thorium	ug/L	1		<1	<1		<1	<1	1
Tin	ug/L	1		<1	<1		<1	<1	1
Titanium	ug/L	1		3	2		3	2	2.5
Tungsten	ug/L	1		<1	<1		<1	<1	1
Uranium	ug/L	1		<1	<1		<1	<1	1
Vanadium	ug/L	1		2	2		2	2	2
Yttrium	ug/L	1		<1	<1		<1	<1	1
Zinc	ug/L	1		<1	21		21	21	11
Zirconium	ug/L	1		<1	<1		<1	<1	1
pH	pH	N/A		7.97	7.8		8.0	7.8	7.9
Total Hardness (as CaCO3)	mg/L	0.1		271	338		338	271	305
Chemical Oxygen Demand	mg/L	5		32	32		32	32	32
Total Dissolved Solids	mg/L	3		437	500		500	437	469
Total Suspended Solids	mg/L	0.67		13.3	7.67		13.30	7.67	10.49
Turbidity	NTU	0.1		12.3	11.3		12.3	11.3	11.8

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SURFACE WATER MONITORING

WATER QUALITY SAMPLE RESULTS

Monitoring Location SW30									
		Sample Date:	24-Oct-18	24-Apr-19	19-Jun-19	25-Sep-19	Maximum	Minimum	Average
Parameter:	Units:	M.D.L.	CM/JG	CM/JG	CM	CM			
M-Alkalinity (pH 4.5)	mg/L as CaCO3	2	318	258	294	278	318	258	287
Ammonia (as N)	mg/L	0.01	0.05	0.01	0.04	0.01	0.05	0.01	0.03
BOD (5 day)	mg/L	1	1.3	1.3	0.9	1.1	1.3	0.9	1.2
Bicarbonate	mg/L as CaCO3	1	313	253		275	313	253	210
Carbonate	mg/L as CaCO3	1	4	5		3	5	3	3
Conductivity	µS/cm	1	856	642	682	792	856	642	743
Dissolved Organic Carbon	mg/L	0.4	5	5.2	3.9	4.3	5.2	3.9	4.6
Field pH	pH	N/A	8.7	8.9	9	8.6	9.0	8.6	8.8
Field Temp	°C	N/A	6	9.5	19.1	16.8	19.1	6.0	12.9
Aluminum	ug/L	1	<1	125	60	31	125	31	54
Antimony	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Arsenic	ug/L	1	<1	<1	1	2	2	1	1.25
Barium	ug/L	1	52	38	46	54	54	38	48
Beryllium	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Bismuth	ug/L	1	<1	<1	<1	<1	<1	<1	1
Boron	ug/L	2	31	20	<2	40	40	20	23.25
Cadmium	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Calcium	ug/L	500	-	67900	79100	76200	79100	67900	55925
Cerium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Cesium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Chromium	ug/L	1	2	5	5	6	6	2	5
Cobalt	ug/L	0.1	0.2	0.2	0.2	0.1	0.2	0.1	0.175
Copper	ug/L	1	1	2	3	2	3	1	2
Europium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Gallium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Iron	ug/L	20	70	247	265	205	265	70	197
Lanthanum	ug/L	1	<1	<1	<1	<1	<1	<1	1
Lead	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Lithium	ug/L	5	6	<5	5	9	9	5	6.25
Magnesium	ug/L	5	-	22900	28400	31000	31000	22900	20576
Manganese	ug/L	10	20	57	48	19	57	19	36
Mercury	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Molybdenum	ug/L	1	<1	<1	<1	<1	<1	<1	1
Nickel	ug/L	1	4	3	3	3	4	3	3
Niobium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Phosphorus	ug/L	50	<50	<50	<50	<50	<50	<50	50
Potassium	ug/L	1	2830	2400	1840	3340	3340	1840	2603
Rubidium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Scandium	ug/L	1	1	<1	<1	1	1	1	1
Selenium	ug/L	0.5	0.8	0.6	<0.5	0.7	0.8	0.6	0.65
Silicon	ug/L	2	4190	2830	3580	5160	5160	2830	3940
Silver	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Sodium	ug/L	1000	46000	28100	31700	43100	46000	28100	37225
Strontium	ug/L	1	294	246	222	305	305	222	267
Sulphur	ug/L	800	10800	10100	10700	12100	12100	10100	10925
Tellurium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Thallium	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Thorium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Tin	ug/L	1	<1	<1	<1	<1	<1	<1	1
Titanium	ug/L	1	1	7	2	3	7	1	3.25
Tungsten	ug/L	1	<1	<1	<1	<1	<1	<1	1
Uranium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Vanadium	ug/L	1	<1	2	2	2	2	2	1.75
Yttrium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Zinc	ug/L	1	5	<1	2	<1	5	2	2
Zirconium	ug/L	1	<1	<1	<1	<1	<1	<1	1
pH	pH	N/A	8.17	8.33	8.35	8.12	8.4	8.1	8.2
Total Hardness (as CaCO3)	mg/L	0.1	348	264	314	318	348	264	311
Chemical Oxygen Demand	mg/L	5	12	12	12	8	12	8	11
Total Dissolved Solids	mg/L	3	542	407	406	520	542	406	469
Total Suspended Solids	mg/L	0.67	<0.67	2.67	3.33	2.7	3.33	2.67	2.34
Turbidity	NTU	0.1	1.5	4.4	4.4	2	4.4	1.5	3.1

BURLINGTON QUARRY
TATHAM ENGINEERING PROJECT NO.: 113187
SURFACE WATER MONITORING

WATER QUALITY SAMPLE RESULTS

Monitoring Location SW31									
		Sample Date:	24-Oct-18	24-Apr-19	19-Jun-19	25-Sep-19	Maximum	Minimum	Average
Parameter:	Units:	M.D.L.	CM/JG	CM/JG	CM	CM			
M-Alkalinity (pH 4.5)	mg/L as CaCO3	2	330	254	296	300	330	254	295
Ammonia (as N)	mg/L	0.01	0.04	<0.01	0.03	<0.01	0.04	0.03	0.02
BOD (5 day)	mg/L	1	1.7	1.2	0.9	1.4	1.7	0.9	1.3
Bicarbonate	mg/L as CaCO3	1	326	249		296	326	249	218
Carbonate	mg/L as CaCO3	1	4	5		4	5	4	3.25
Conductivity	µS/cm	1	877	624	656	731	877	624	722
Dissolved Organic Carbon	mg/L	0.4	5.6	5	3.9	4.7	5.6	3.9	4.8
Field pH	pH	N/A	8.7	9	8.8	8.7	9.0	8.7	8.8
Field Temp	°C	N/A	6.3	9.2	18.7	19.2	19.2	6.3	13.4
Aluminum	ug/L	1	10	258	91	30	258	10	97
Antimony	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Arsenic	ug/L	1	1	<1	<1	2	2	1	1.25
Barium	ug/L	1	50	36	40	49	50	36	44
Beryllium	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Bismuth	ug/L	1	<1	<1	<1	<1	<1	<1	1
Boron	ug/L	2	43	27	<2	78	78	27	37.5
Cadmium	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Calcium	ug/L	500	-	71400	77800	72400	77800	71400	55525
Cerium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Cesium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Chromium	ug/L	1	<1	5	5	7	7	5	5
Cobalt	ug/L	0.1	0.2	0.3	0.2	0.2	0.3	0.2	0.225
Copper	ug/L	1	1	2	3	2	3	1	2
Europium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Gallium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Iron	ug/L	20	120	360	275	237	360	120	248
Lanthanum	ug/L	1	<1	<1	<1	<1	<1	<1	1
Lead	ug/L	0.1	<0.1	0.1	<0.1	0.1	0.1	0.1	0.1
Lithium	ug/L	5	<5	<5	5	7	7	5	5.5
Magnesium	ug/L	5	-	23800	28900	34700	34700	23800	21851
Manganese	ug/L	10	78	51	35	78	78	35	61
Mercury	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Molybdenum	ug/L	1	<1	<1	<1	<1	<1	<1	1
Nickel	ug/L	1	4	3	3	3	4	3	3
Niobium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Phosphorus	ug/L	50	<50	170	<50	<50	170	170	80
Potassium	ug/L	1	3160	2390	1940	3440	3440	1940	2733
Rubidium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Scandium	ug/L	1	1	<1	<1	<1	1	1	1
Selenium	ug/L	0.5	0.8	0.7	<0.5	0.7	0.8	0.7	0.675
Silicon	ug/L	2	3680	2840	3110	4200	4200	2840	3458
Silver	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Sodium	ug/L	1000	48200	28400	28200	28700	48200	28200	33375
Strontium	ug/L	1	347	308	248	373	373	248	319
Sulphur	ug/L	800	9500	10500	9740	10400	10500	9500	10035
Tellurium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Thallium	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Thorium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Tin	ug/L	1	<1	<1	<1	<1	<1	<1	1
Titanium	ug/L	1	1	10	6	2	10	1	4.75
Tungsten	ug/L	1	<1	<1	<1	<1	<1	<1	1
Uranium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Vanadium	ug/L	1	<1	2	2	2	2	2	1.75
Yttrium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Zinc	ug/L	1	2	<1	3	<1	3	2	2
Zirconium	ug/L	1	<1	<1	<1	<1	<1	<1	1
pH	pH	N/A	8.13	8.31	8.32	8.1	8.3	8.1	8.2
Total Hardness (as CaCO3)	mg/L	0.1	361	276	313	324	361	276	319
Chemical Oxygen Demand	mg/L	5	8	16	12	8	16	8	11
Total Dissolved Solids	mg/L	3	552	363	419	472	552	363	452
Total Suspended Solids	mg/L	0.67	14	9.67	1.33	2.7	14.00	1.33	6.93
Turbidity	NTU	0.1	5.8	10.2	4.9	3.7	10.2	3.7	6.2

BURLINGTON QUARRY
TATHAM ENGINEERING PROJECT NO.: 113187
SURFACE WATER MONITORING

WATER QUALITY SAMPLE RESULTS

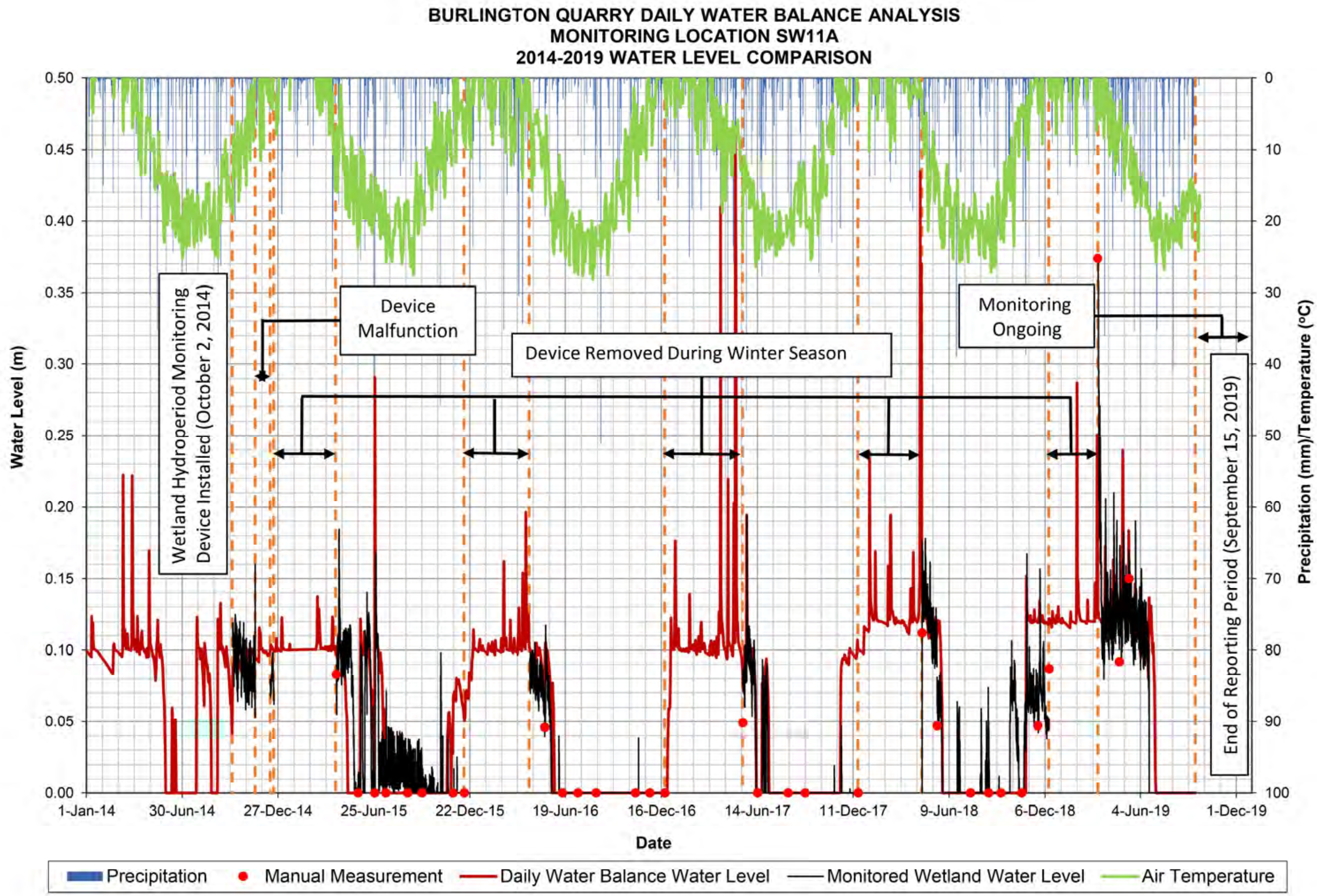
Monitoring Location SW32									
		Sample Date:	24-Oct-18	24-Apr-19	19-Jun-19	25-Sep-19	Maximum	Minimum	Average
Parameter:	Units:	M.D.L.	CM/JG	CM/JG	CM	CM			
M-Alkalinity (pH 4.5)	mg/L as CaCO3	2	230	225	260	197	260	197	228
Ammonia (as N)	mg/L	0.01	0.03	<0.01	0.02	0.02	0.03	0.02	0.02
BOD (5 day)	mg/L	1	1.1	1.1	1.1	1.4	1.4	1.1	1.2
Bicarbonate	mg/L as CaCO3	1	224	221		191	224	191	159
Carbonate	mg/L as CaCO3	1	5	4		6	6	4	3.75
Conductivity	µS/cm	1	674	592	633	592	674	592	623
Dissolved Organic Carbon	mg/L	0.4	7.6	7.2	5.8	6.4	7.6	5.8	6.8
Field pH	pH	N/A	9.1	9	9.5	9.1	9.5	9.0	9.2
Field Temp	°C	N/A	6.2	9.9	20.6	19.2	20.6	6.2	14.0
Aluminum	ug/L	1	<1	113	30	4	113	4	37
Antimony	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Arsenic	ug/L	1	<1	<1	<1	<1	<1	<1	1
Barium	ug/L	1	48	35	49	55	55	35	47
Beryllium	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Bismuth	ug/L	1	<1	<1	<1	<1	<1	<1	1
Boron	ug/L	2	18	16	<2	24	24	16	15
Cadmium	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Calcium	ug/L	500	-	67300	70000	50700	70000	50700	47125
Cerium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Cesium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Chromium	ug/L	1	<1	3	4	4	4	3	3
Cobalt	ug/L	0.1	0.1	0.2	0.1	<0.1	0.2	0.1	0.125
Copper	ug/L	1	<1	1	3	1	3	1	2
Europium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Gallium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Iron	ug/L	20	30	240	218	140	240	30	157
Lanthanum	ug/L	1	<1	<1	<1	<1	<1	<1	1
Lead	ug/L	0.1	<0.1	0.2	<0.1	<0.1	0.2	0.2	0.125
Lithium	ug/L	5	<5	<5	<5	<5	<5	<5	5
Magnesium	ug/L	5	-	21600	27900	26300	27900	21600	18951
Manganese	ug/L	10	12	32	19	10	32	10	18
Mercury	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Molybdenum	ug/L	1	<1	<1	<1	<1	<1	<1	1
Nickel	ug/L	1	3	3	3	2	3	2	3
Niobium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Phosphorus	ug/L	50	<50	<50	<50	<50	<50	<50	50
Potassium	ug/L	1	2060	2070	1790	2210	2210	1790	2033
Rubidium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Scandium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Selenium	ug/L	0.5	<0.5	0.6	<0.5	<0.5	0.6	0.6	0.525
Silicon	ug/L	2	1600	1600	2060	2920	2920	1600	2045
Silver	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Sodium	ug/L	1000	38300	33600	33800	35900	38300	33600	35400
Strontium	ug/L	1	337	324	277	264	337	264	301
Sulphur	ug/L	800	10100	7430	9940	12000	12000	7430	9867.5
Tellurium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Thallium	ug/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Thorium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Tin	ug/L	1	<1	<1	<1	<1	<1	<1	1
Titanium	ug/L	1	<1	4	1	<1	4	1	1.75
Tungsten	ug/L	1	<1	<1	<1	<1	<1	<1	1
Uranium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Vanadium	ug/L	1	<1	1	2	2	2	1	1.5
Yttrium	ug/L	1	<1	<1	<1	<1	<1	<1	1
Zinc	ug/L	1	8	<1	3	2	8	2	4
Zirconium	ug/L	1	<1	<1	<1	<1	<1	<1	1
pH	pH	N/A	8.4	8.29	8.65	8.53	8.7	8.3	8.5
Total Hardness (as CaCO3)	mg/L	0.1	270	257	290	235	290	235	263
Chemical Oxygen Demand	mg/L	5	20	20	12	8	20	8	15
Total Dissolved Solids	mg/L	3	421	372	419	401	421	372	403
Total Suspended Solids	mg/L	0.67	1.3	8	6	2.7	8.00	1.30	4.50
Turbidity	NTU	0.1	1.7	5.6	3.3	1.5	5.6	1.5	3.0

BURLINGTON QUARRY
TATHAM ENGINEERING PROJECT NO.: 113187
SURFACE WATER MONITORING

WATER QUALITY SAMPLE RESULTS

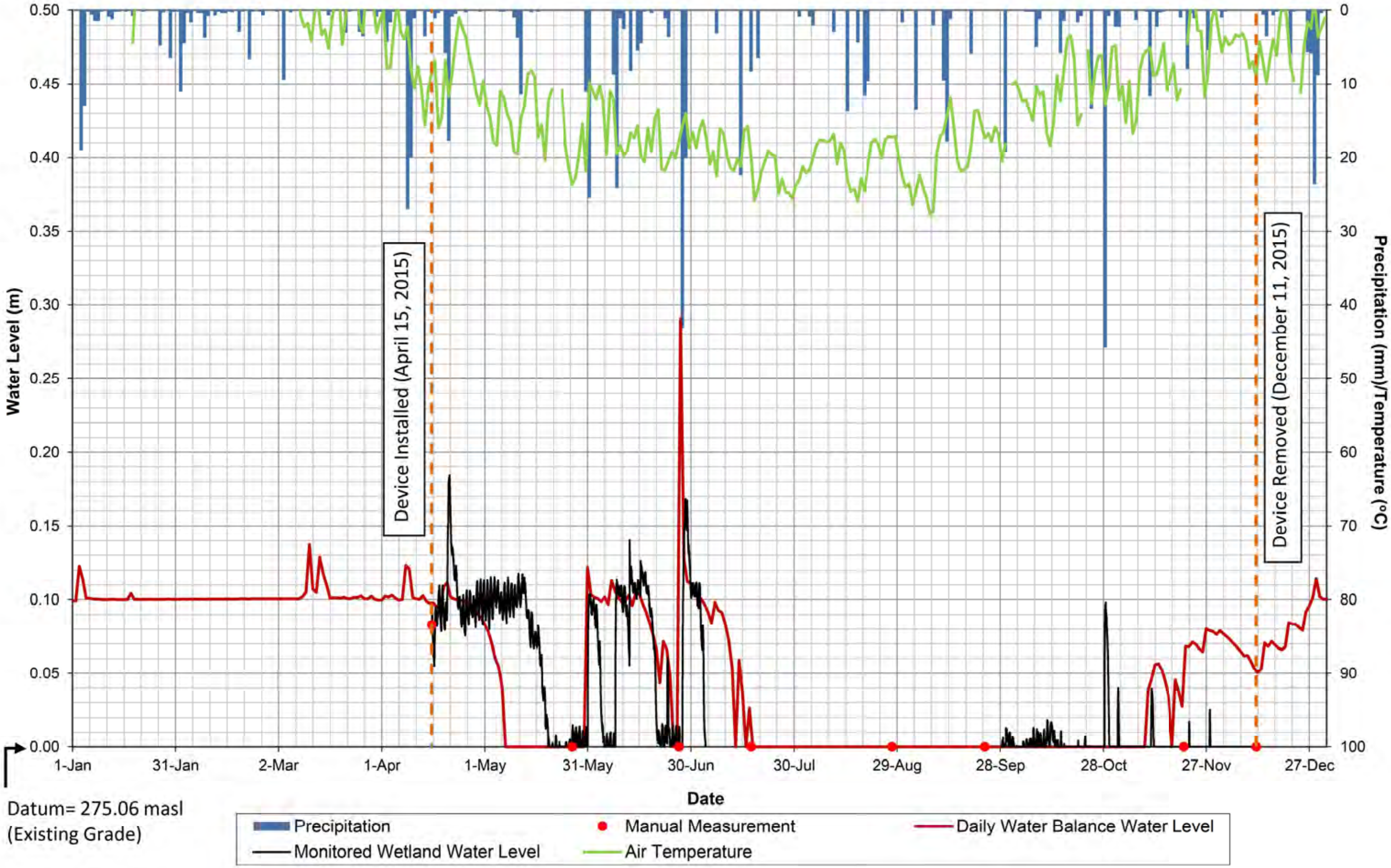
Monitoring Location SW35									
		Sample Date:	24-Oct-18	24-Apr-19	19-Jun-19	25-Sep-19	Maximum	Minimum	Average
Parameter:	Units:	M.D.L.	CM/JG	CM/JG	CM	CM			
M-Alkalinity (pH 4.5)	mg/L as CaCO3	2	379	184	288	DRY	379	184	284
Ammonia (as N)	mg/L	0.01	0.06	<0.01	0.09		0.09	0.06	0.05
BOD (5 day)	mg/L	1	<1	1	1.1		1.1	1.0	1.0
Bicarbonate	mg/L as CaCO3	1	376	181			376	181	279
Carbonate	mg/L as CaCO3	1	4	3			4	3	3.5
Conductivity	µS/cm	1	1270	483	706		1270	483	820
Dissolved Organic Carbon	mg/L	0.4	4.3	4.3	3.9		4.3	3.9	4.2
Field pH	pH	N/A	8.5		8.4		8.5	8.4	5.6
Field Temp	°C	N/A	7.5		16.5		16.5	7.5	8.0
Aluminum	ug/L	1	<1	317	117		317	117	145
Antimony	ug/L	0.5	<0.5	<0.5	<0.5		<0.5	<0.5	0.5
Arsenic	ug/L	1	<1	<1	<1		<1	<1	1
Barium	ug/L	1	70	28	40		70	28	46
Beryllium	ug/L	0.5	<0.5	<0.5	<0.5		<0.5	<0.5	0.5
Bismuth	ug/L	1	<1	<1	<1		<1	<1	1
Boron	ug/L	2	55	38	19		55	19	37
Cadmium	ug/L	0.1	<0.1	<0.1	<0.1		<0.1	<0.1	0.1
Calcium	ug/L	500	-	52800	80400		80400	52800	44567
Cerium	ug/L	1	<1	<1	<1		<1	<1	1
Cesium	ug/L	1	<1	<1	<1		<1	<1	1
Chromium	ug/L	1	<1	3	5		5	3	3
Cobalt	ug/L	0.1	0.3	0.2	0.2		0.3	0.2	0.2
Copper	ug/L	1	2	2	3		3	2	2
Europium	ug/L	1	<1	<1	<1		<1	<1	1
Gallium	ug/L	1	1	<1	<1		1	1	1
Iron	ug/L	20	500	296	409		500	296	402
Lanthanum	ug/L	1	<1	<1	<1		<1	<1	1
Lead	ug/L	0.1	<0.1	0.2	0.3		0.3	0.2	0.2
Lithium	ug/L	5	<5	<5	<5		<5	<5	5
Magnesium	ug/L	5	-	16400	21600		21600	16400	12668
Manganese	ug/L	10	300	43	136		300	43	160
Mercury	ug/L	0.1	<0.1	<0.1	<0.1		<0.1	<0.1	0.1
Molybdenum	ug/L	1	<1	<1	<1		<1	<1	1
Nickel	ug/L	1	7	2	3		7	2	4
Niobium	ug/L	1	<1	<1	<1		<1	<1	1
Phosphorus	ug/L	50	<50	<50	<50		<50	<50	50
Potassium	ug/L	1	1940	2130	1780		2130	1780	1950
Rubidium	ug/L	1	<1	<1	<1		<1	<1	1
Scandium	ug/L	1	<1	<1	<1		<1	<1	1
Selenium	ug/L	0.5	0.9	<0.5	<0.5		0.9	0.9	0.6
Silicon	ug/L	2	3280	2570	2620		3280	2570	2823
Silver	ug/L	0.1	<0.1	<0.1	<0.1		<0.1	<0.1	0.1
Sodium	ug/L	1000	111000	24000	42300		111000	24000	59100
Strontium	ug/L	1	2470	526	832		2470	526	1276
Sulphur	ug/L	800	22900	12600	11500		22900	11500	15667
Tellurium	ug/L	1	<1	<1	<1		<1	<1	1
Thallium	ug/L	0.1	<0.1	<0.1	<0.1		<0.1	<0.1	0.1
Thorium	ug/L	1	<1	<1	<1		<1	<1	1
Tin	ug/L	1	<1	<1	<1		<1	<1	1
Titanium	ug/L	1	1	13	6		13	1	7
Tungsten	ug/L	1	<1	<1	<1		<1	<1	1
Uranium	ug/L	1	2	1	1		2	1	1
Vanadium	ug/L	1	<1	2	2		2	2	2
Yttrium	ug/L	1	<1	<1	<1		<1	<1	1
Zinc	ug/L	1	370	12	81		370	12	154
Zirconium	ug/L	1	<1	<1	<1		<1	<1	1
pH	pH	N/A	7.99	8.17	8.02		8.2	8.0	8.1
Total Hardness (as CaCO3)	mg/L	0.1	435	199	290		435	199	308
Chemical Oxygen Demand	mg/L	5	12	16	16		16	12	15
Total Dissolved Solids	mg/L	3	773	317	444		773	317	511
Total Suspended Solids	mg/L	0.67	3	4.33	3.33		4.33	3.00	3.55
Turbidity	NTU	0.1	7.5	8.1	5.4		8.1	5.4	7.0

Appendix I: Existing Conditions Wetland Water Balance Results

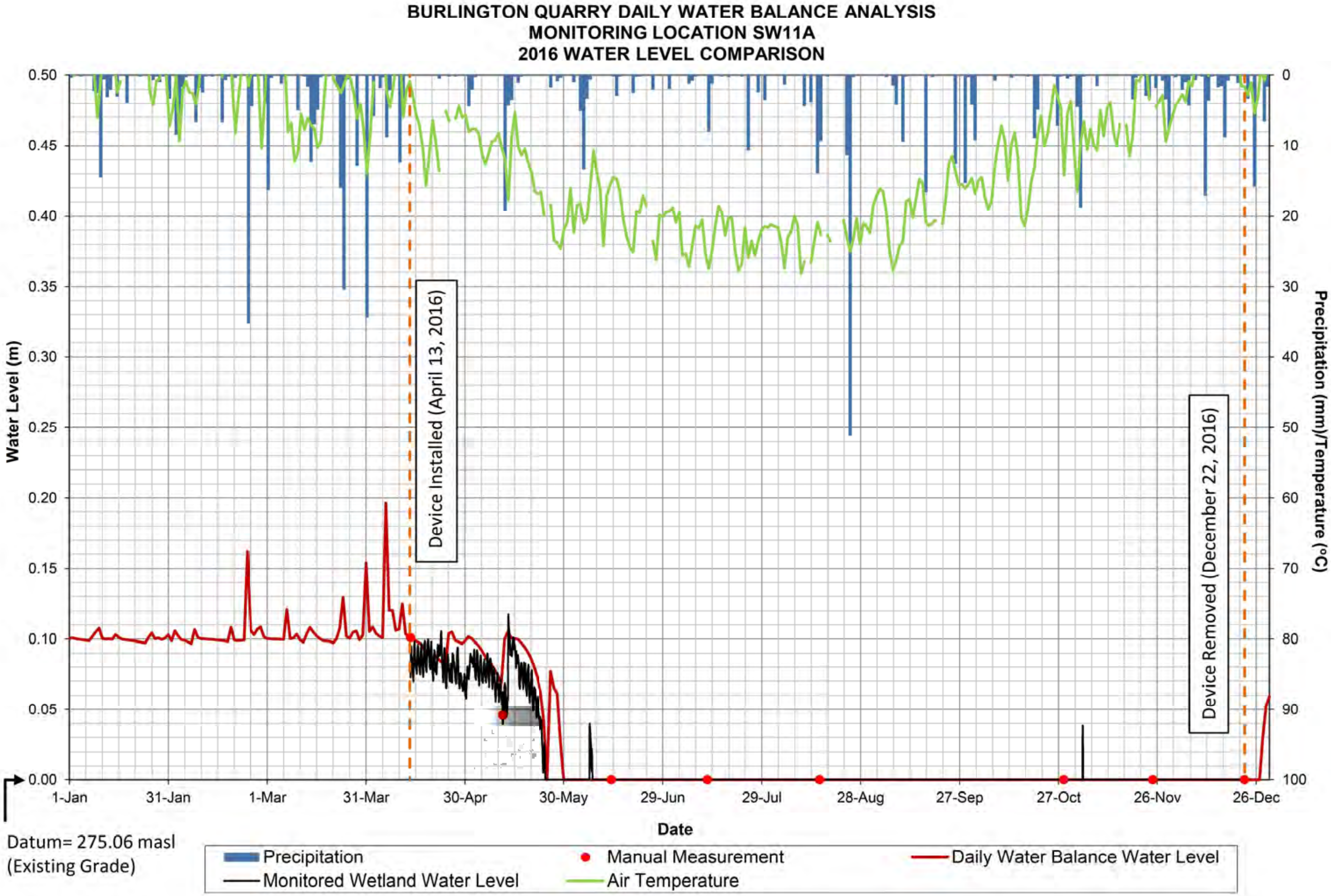


BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW11A
2014-2019 WATER LEVEL COMPARISON
Water Level (m)
Precipitation (mm)/Temperature (ºC)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
9-Jun-18
6-Dec-18
4-Jun-19
1-Dec-19
Wetland Hydroperiod Monitoring Device Installed (October 2, 2014)
Device Malfunction
Device Removed During Winter Season
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature

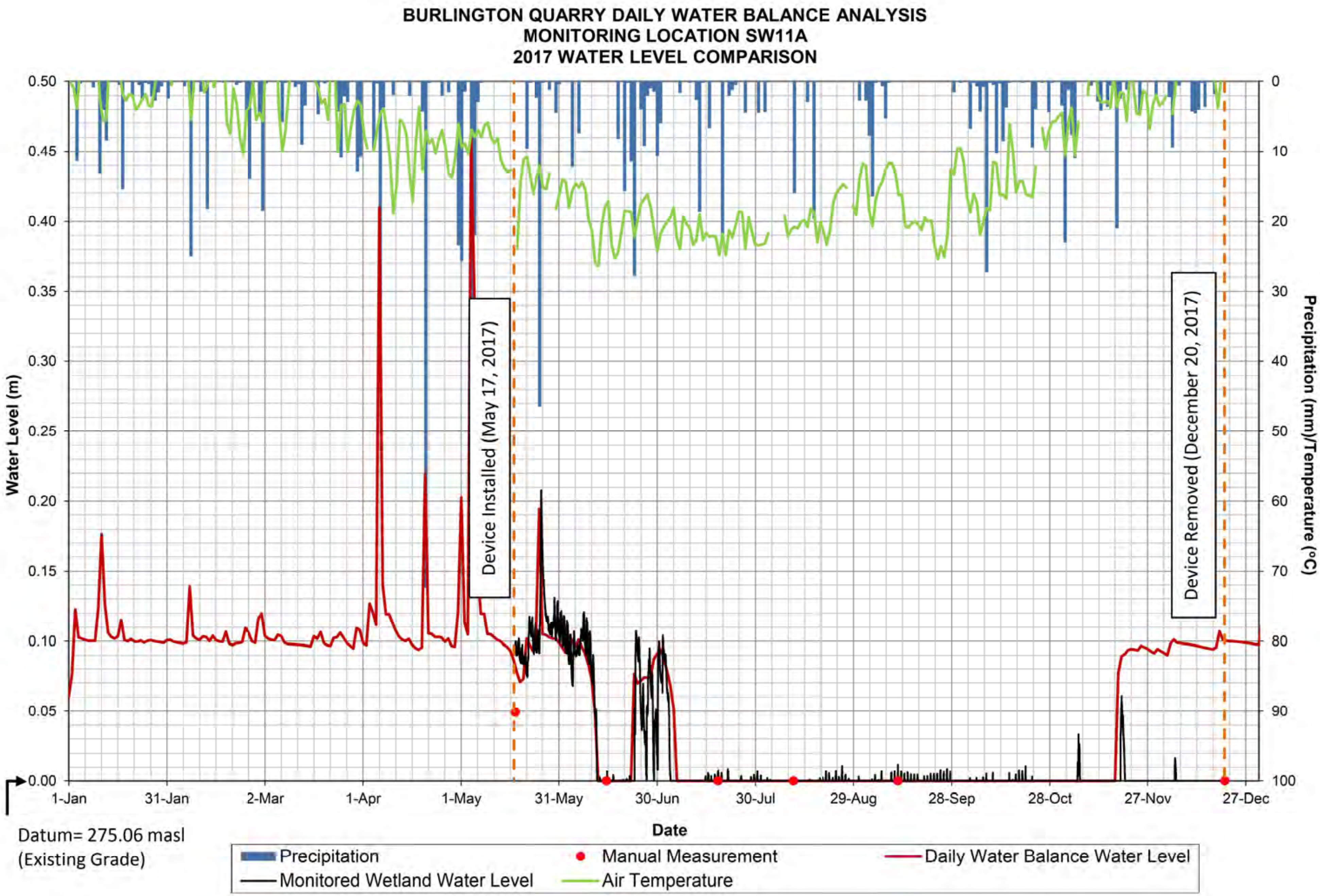
BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW11A
2015 WATER LEVEL COMPARISON



Datum= 275.06 masl
(Existing Grade)

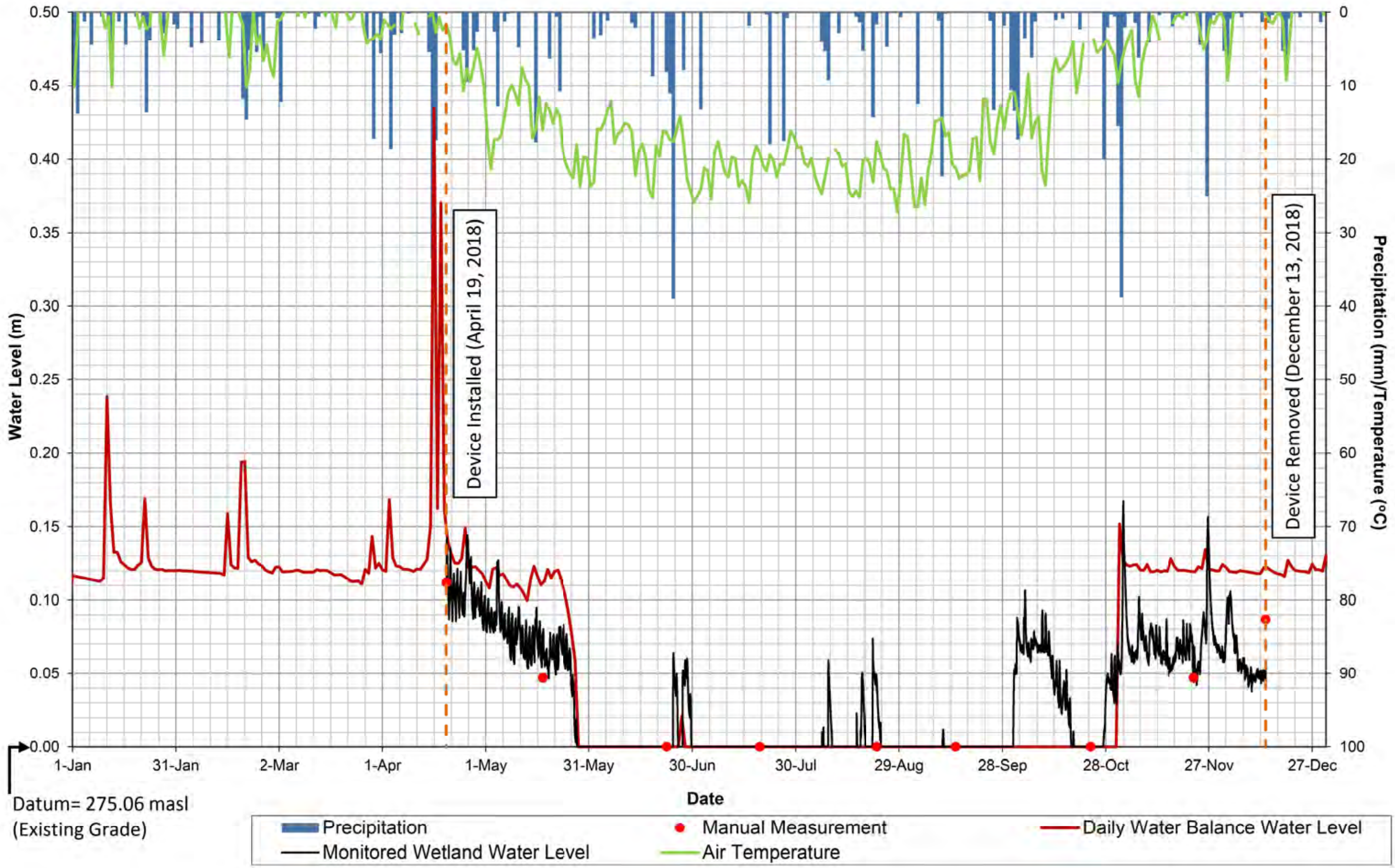


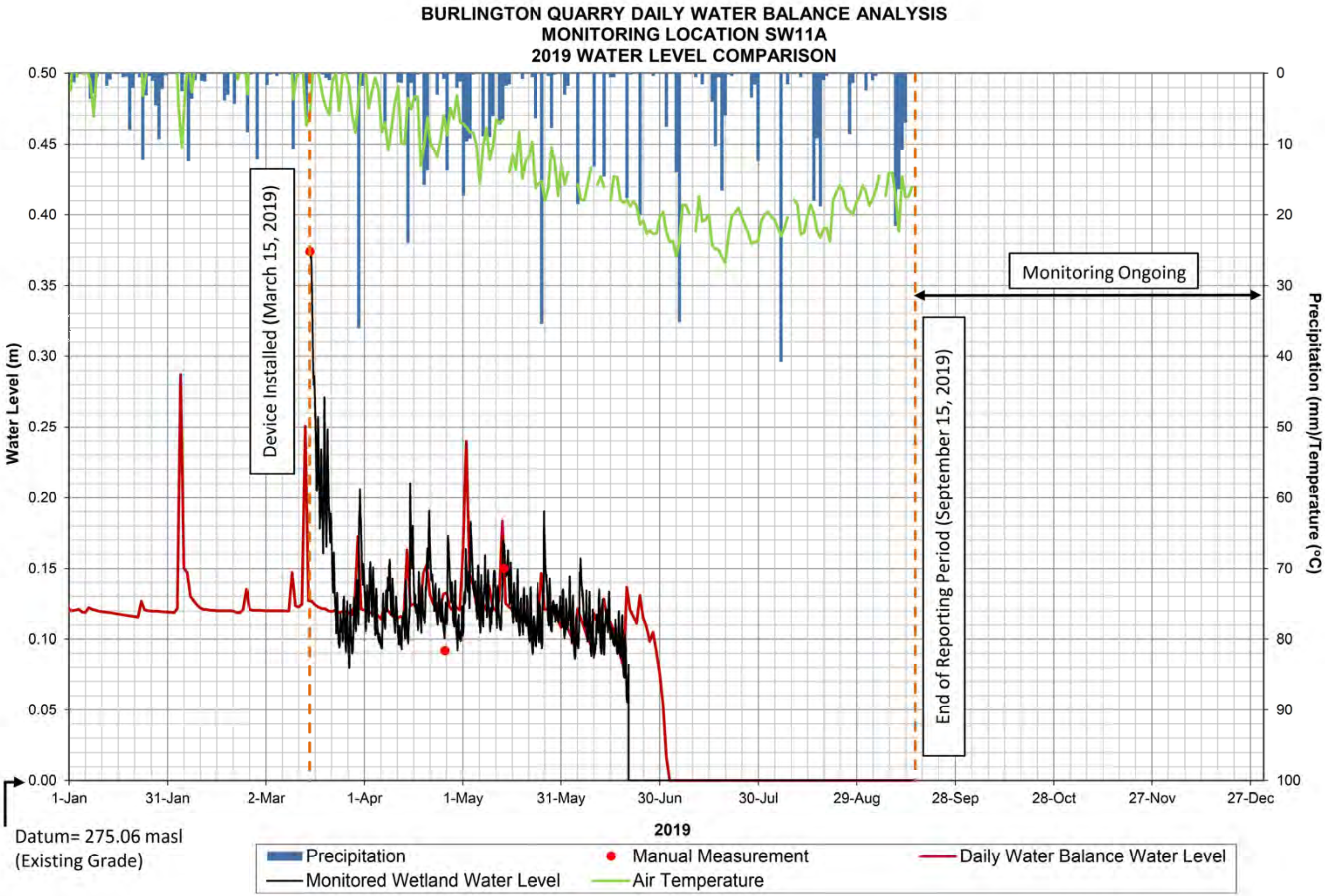
BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW11A
2016 WATER LEVEL COMPARISON
Water Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
Device Installed (April 13, 2016)
Device Removed (December 22, 2016)
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Datum= 275.06 masl
(Existing Grade)
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature



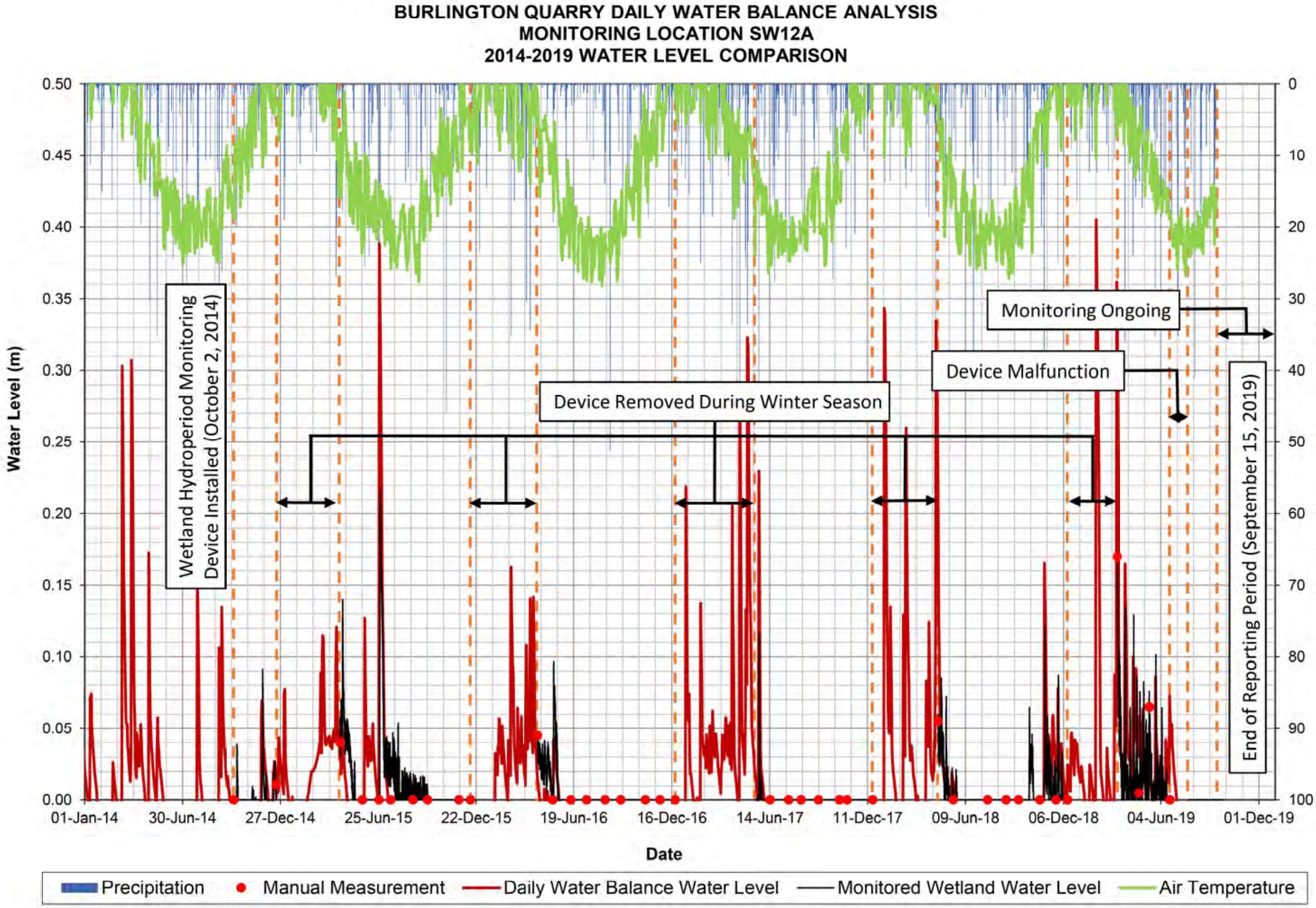
BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW11A
2017 WATER LEVEL COMPARISON
Water Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
Device Installed (May 17, 2017)
Device Removed (December 20, 2017)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Datum= 275.06 masl
(Existing Grade)
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature

BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW11A
2018 WATER LEVEL COMPARISON



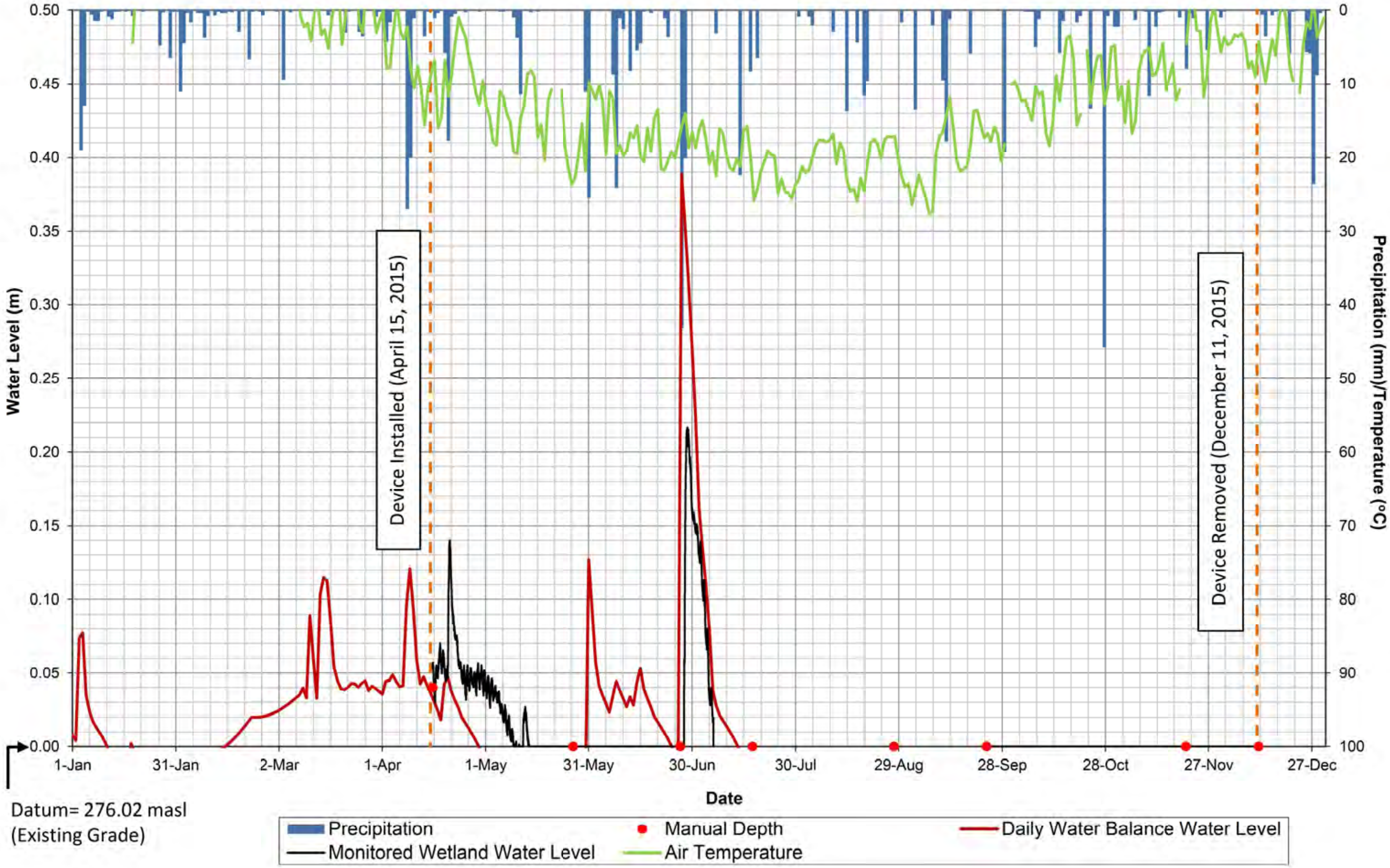


BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW11A
2019 WATER LEVEL COMPARISON
Water Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
Device Installed (March 15, 2019)
End of Reporting Period (September 15, 2019)
Monitoring Ongoing
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
2019
Datum= 275.06 masl
(Existing Grade)
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature

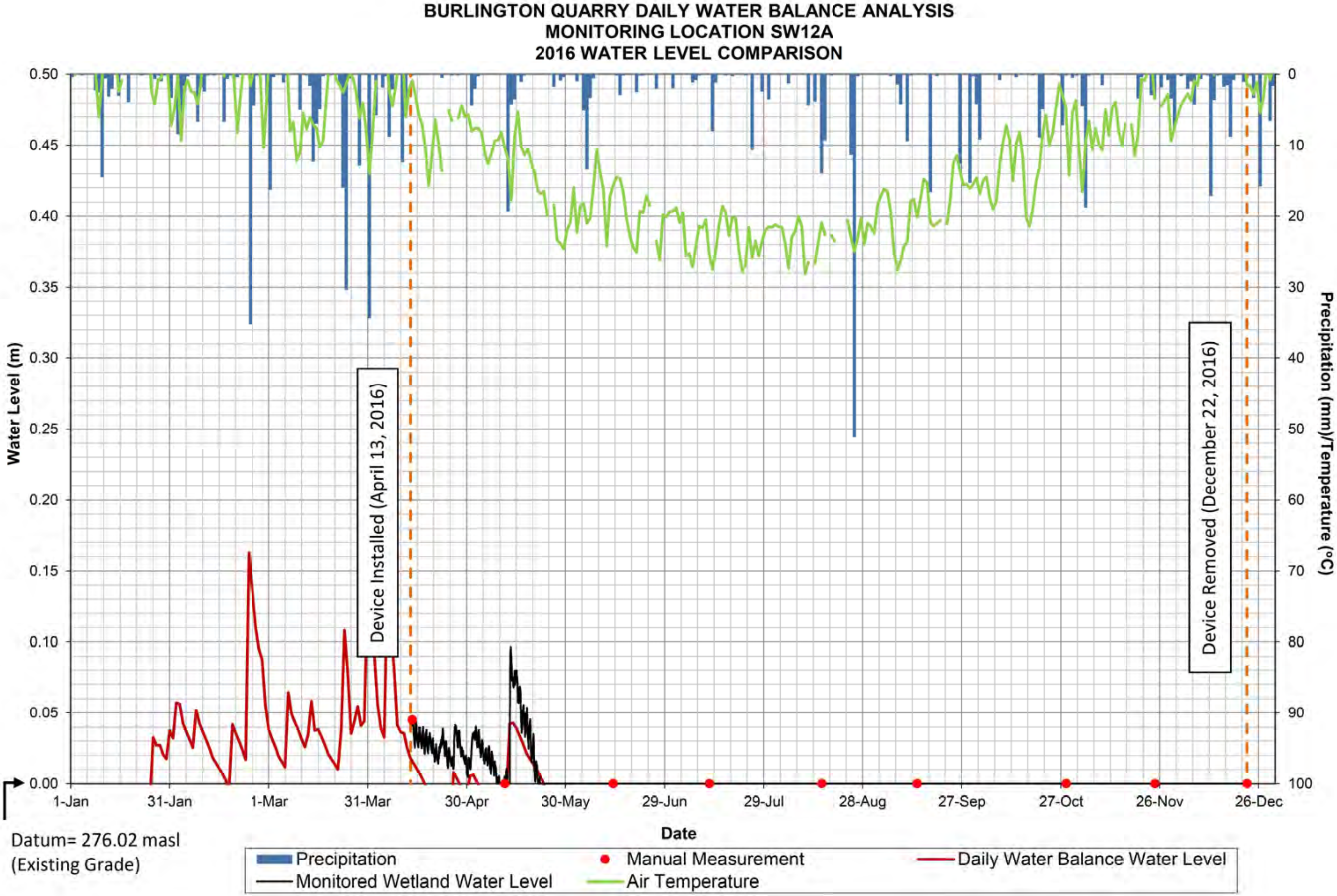


BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW12A
2014-2019 WATER LEVEL COMPARISON
Water Level (m)
Precipitation (mm)/Temperature (°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
01-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
09-Jun-18
06-Dec-18
04-Jun-19
01-Dec-19
Wetland Hydroperiod Monitoring Device Installed (October 2, 2014)
Device Removed During Winter Season
Monitoring Ongoing
Device Malfunction
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature

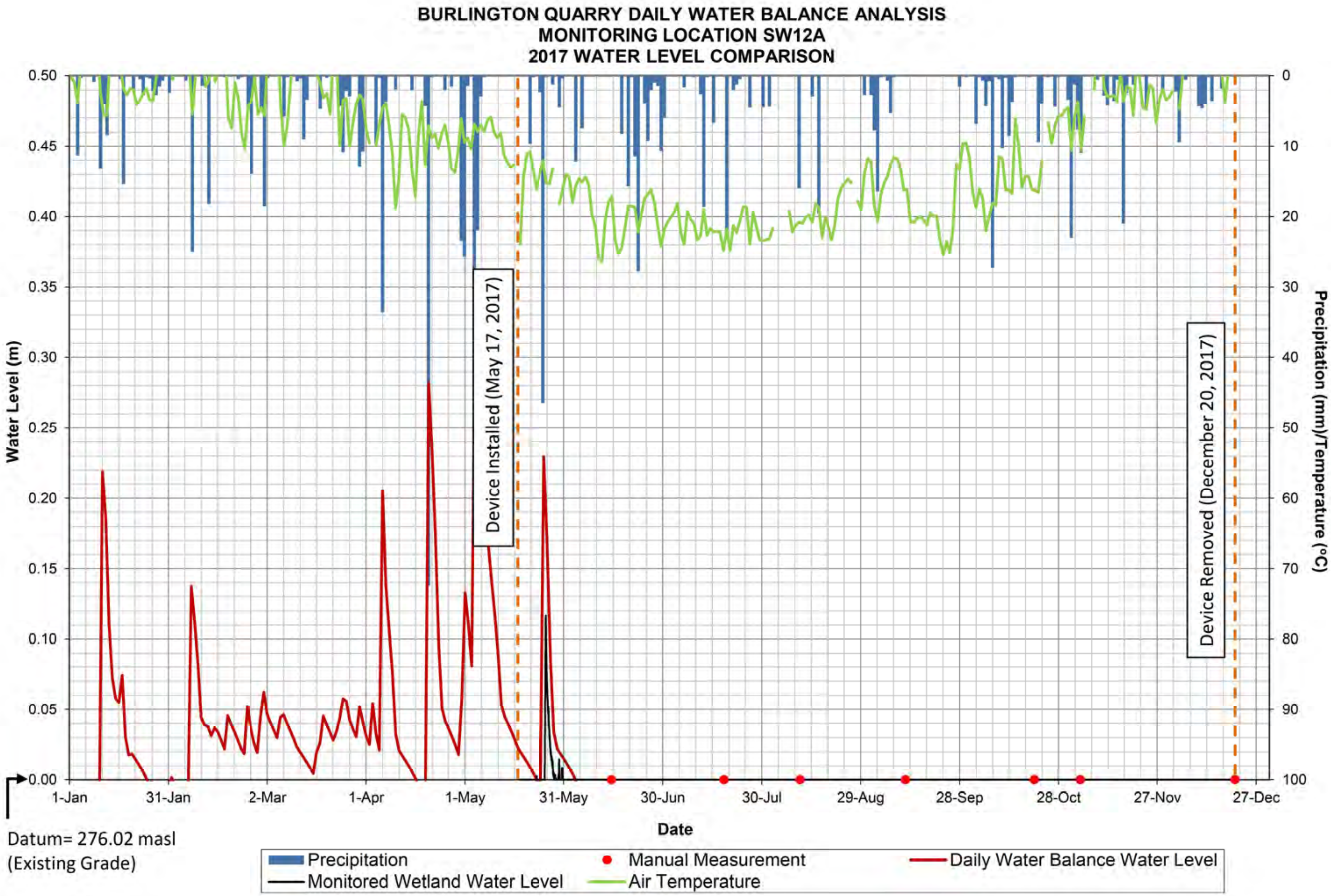
BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW12A
2015 WATER LEVEL COMPARISON



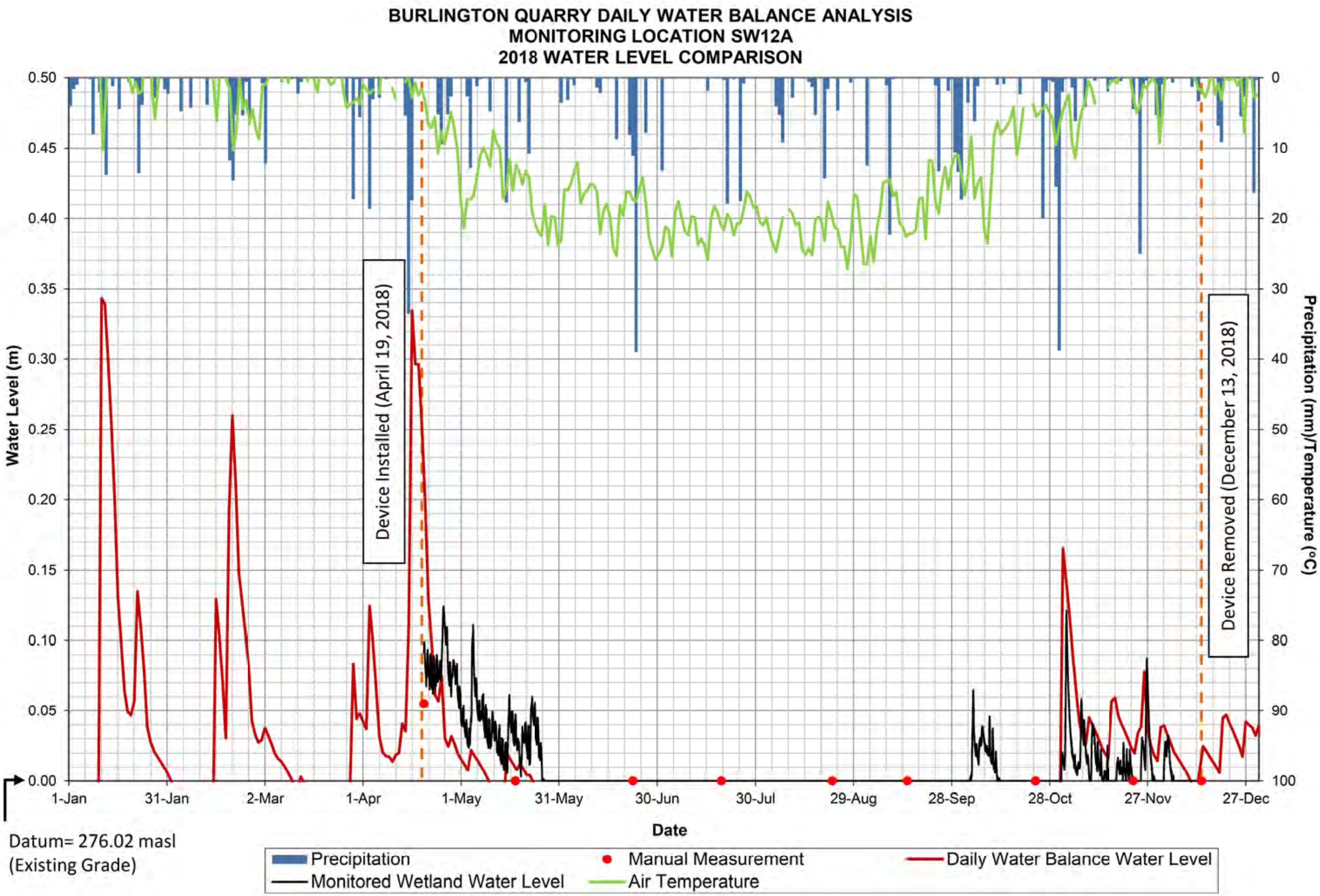
Datum= 276.02 masl
(Existing Grade)



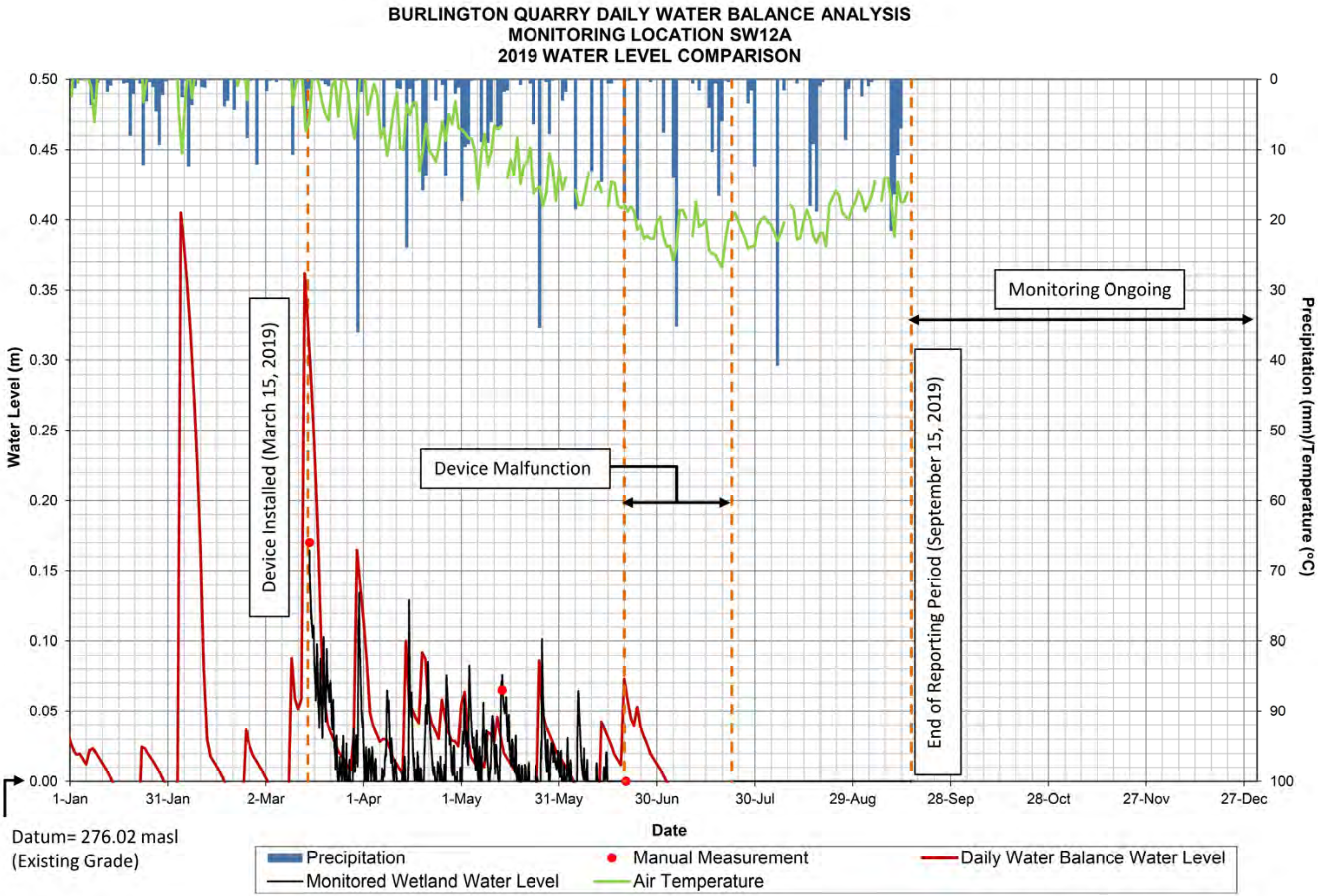
BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW12A
2016 WATER LEVEL COMPARISON
Water Level (m)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (April 13, 2016)
Device Removed (December 22, 2016)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Datum= 276.02 masl
(Existing Grade)
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature

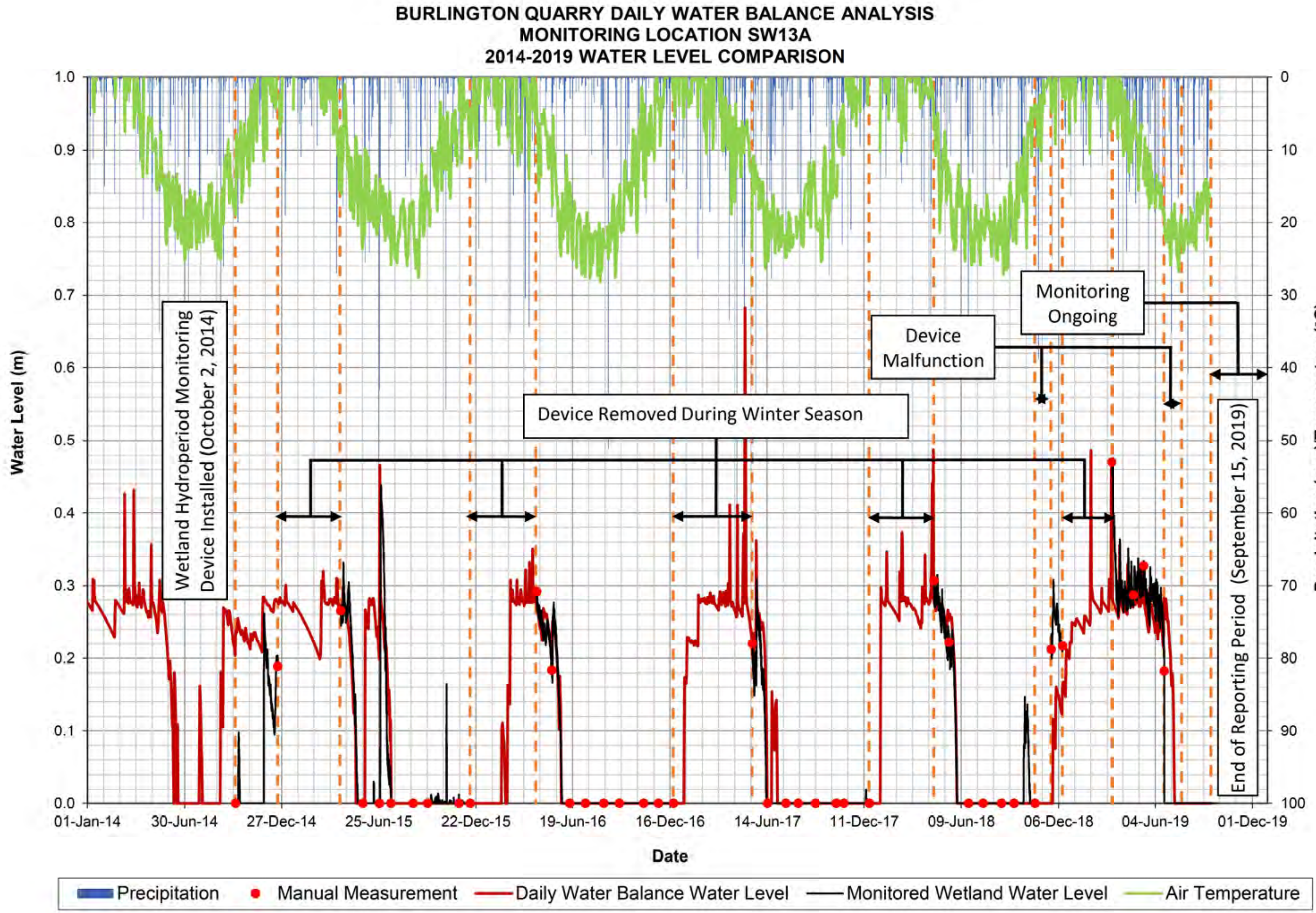


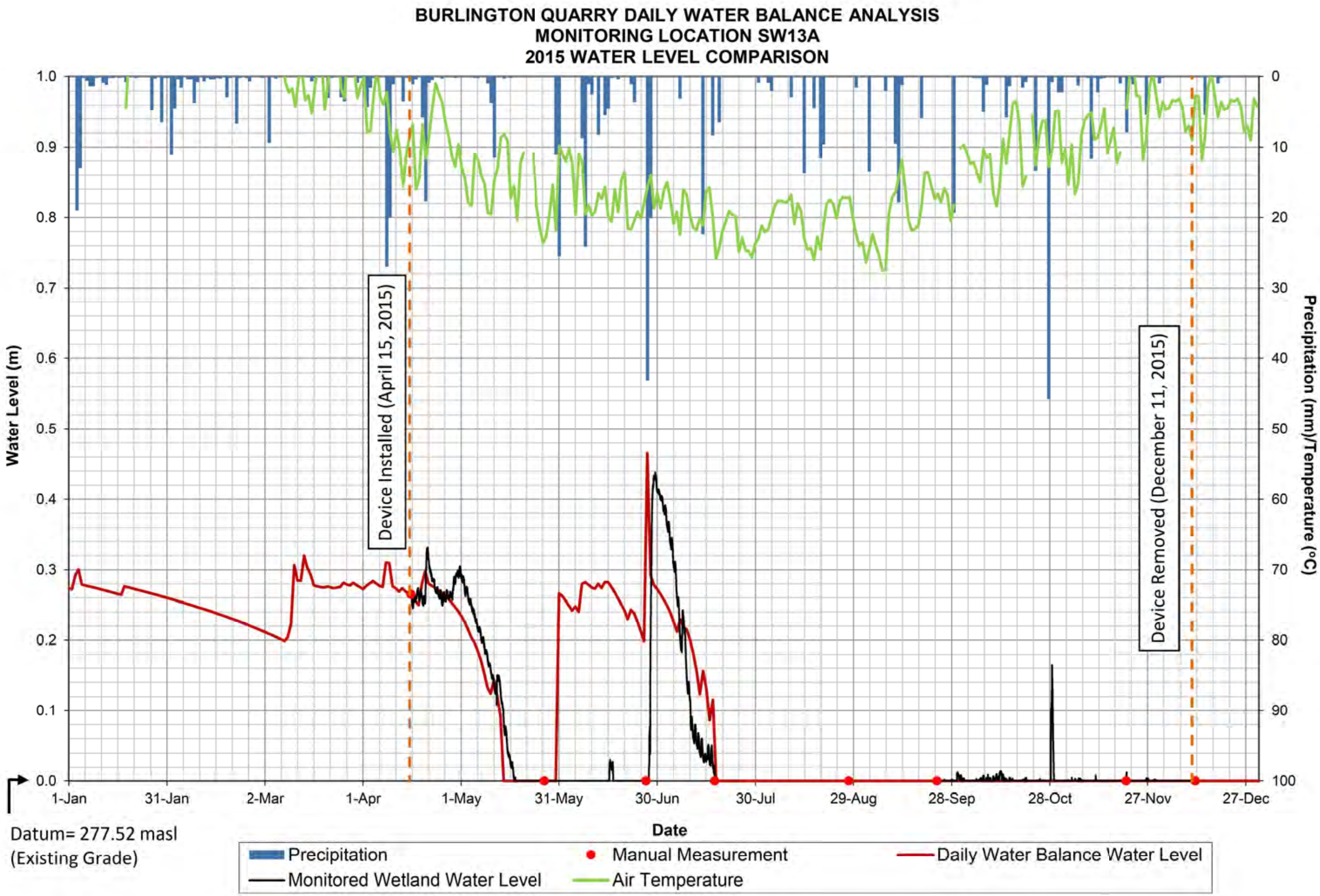
BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW12A
2017 WATER LEVEL COMPARISON
Water Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
Device Installed (May 17, 2017)
Device Removed (December 20, 2017)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Datum= 276.02 masl
(Existing Grade)
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature



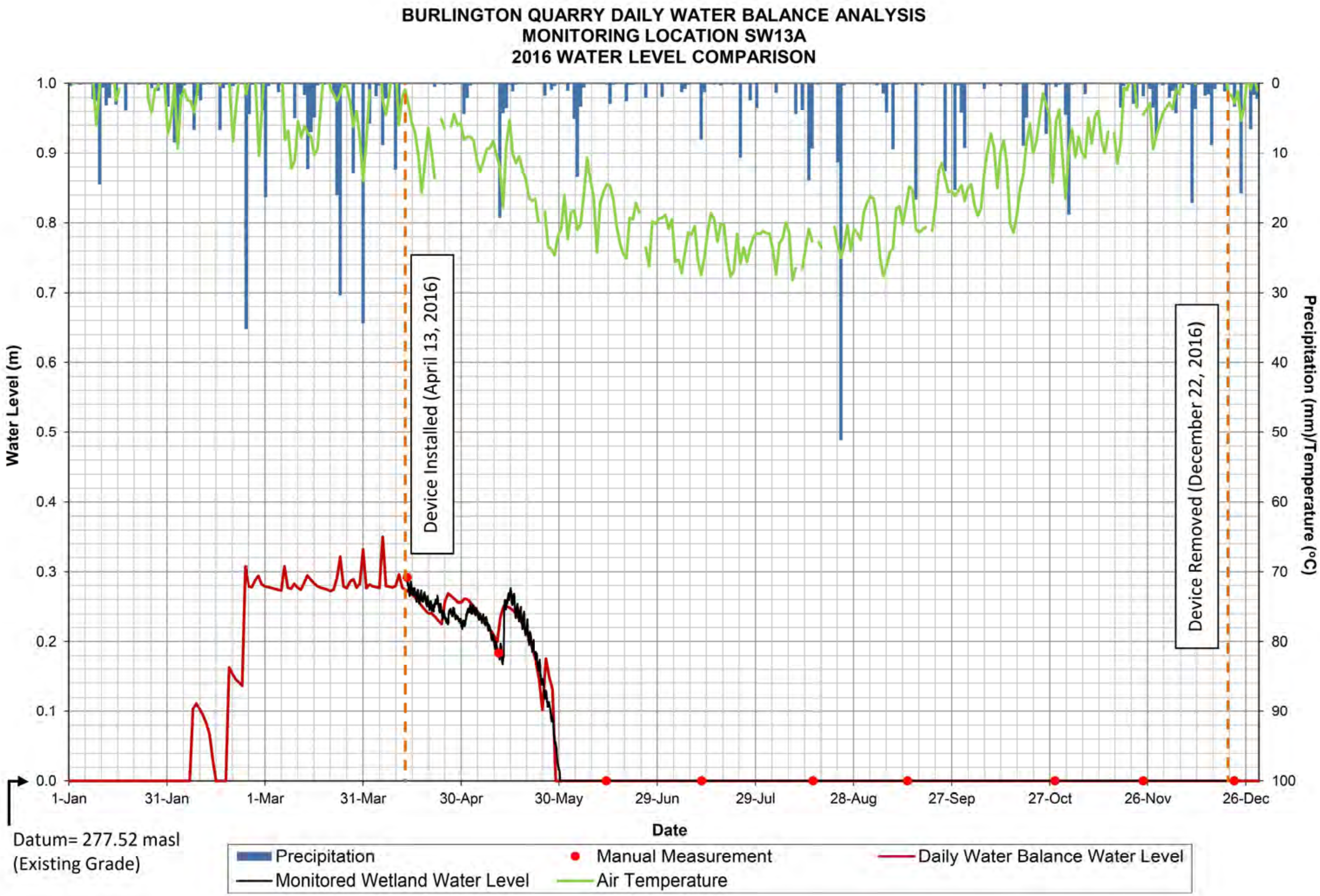
BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW12A
2018 WATER LEVEL COMPARISON
Water Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
Device Installed (April 19, 2018)
Device Removed (December 13, 2018)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Datum= 276.02 masl
(Existing Grade)
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature

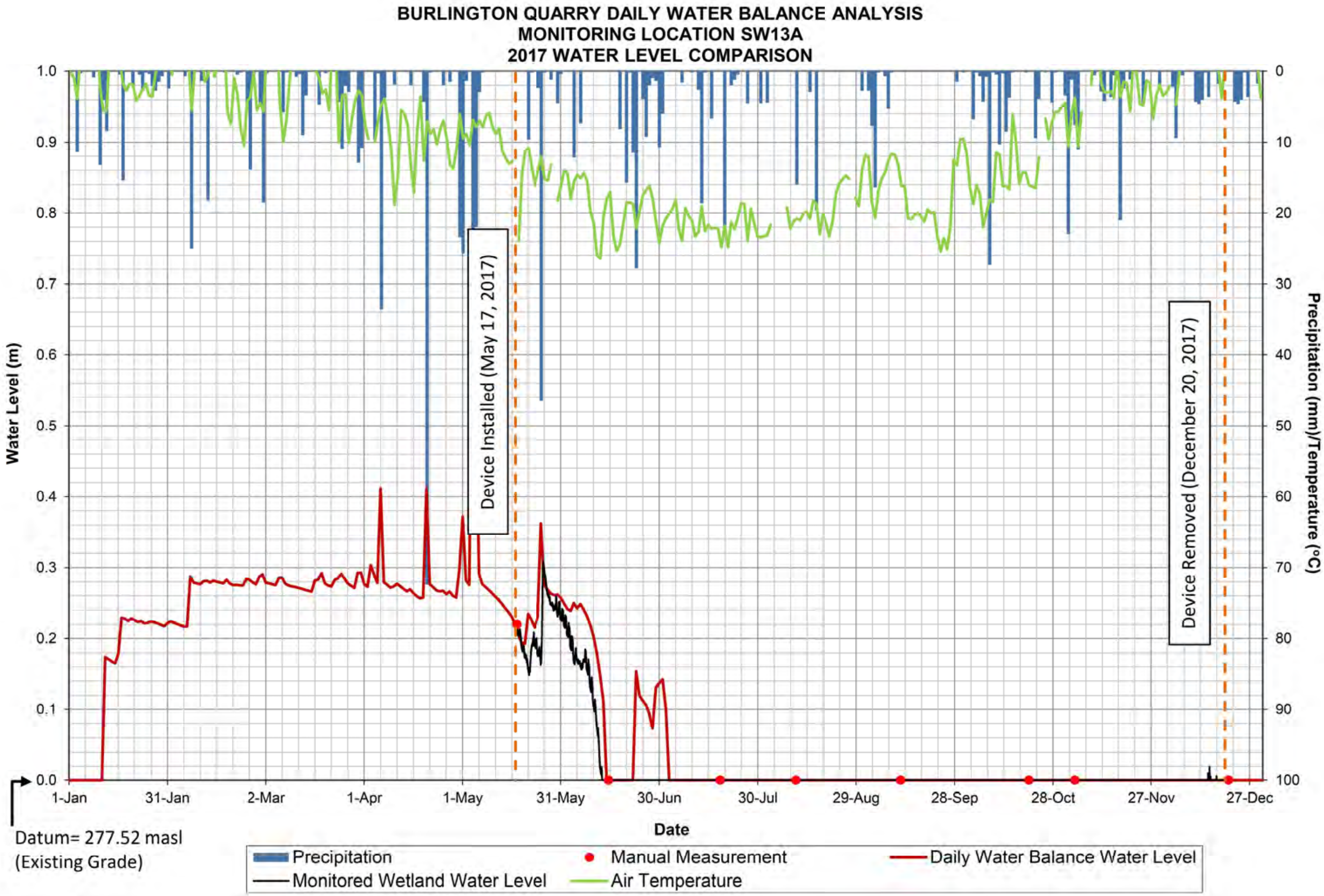

BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW12A
2019 WATER LEVEL COMPARISON
Water Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
Device Installed (March 15, 2019)
Device Malfunction
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Datum= 276.02 masl
(Existing Grade)
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature


BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW13A
2014-2019 WATER LEVEL COMPARISON
Water Level (m)
Precipitation (mm)/Temperature (ºC)
Date
01-Jan-14
30-Jun-14
27-Dec-14
25-Jun-15
22-Dec-15
19-Jun-16
16-Dec-16
14-Jun-17
11-Dec-17
09-Jun-18
06-Dec-18
04-Jun-19
01-Dec-19
Wetland Hydroperiod Monitoring Device Installed (October 2, 2014)
Device Removed During Winter Season
Device Malfunction
Monitoring Ongoing
End of Reporting Period (September 15, 2019)
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature

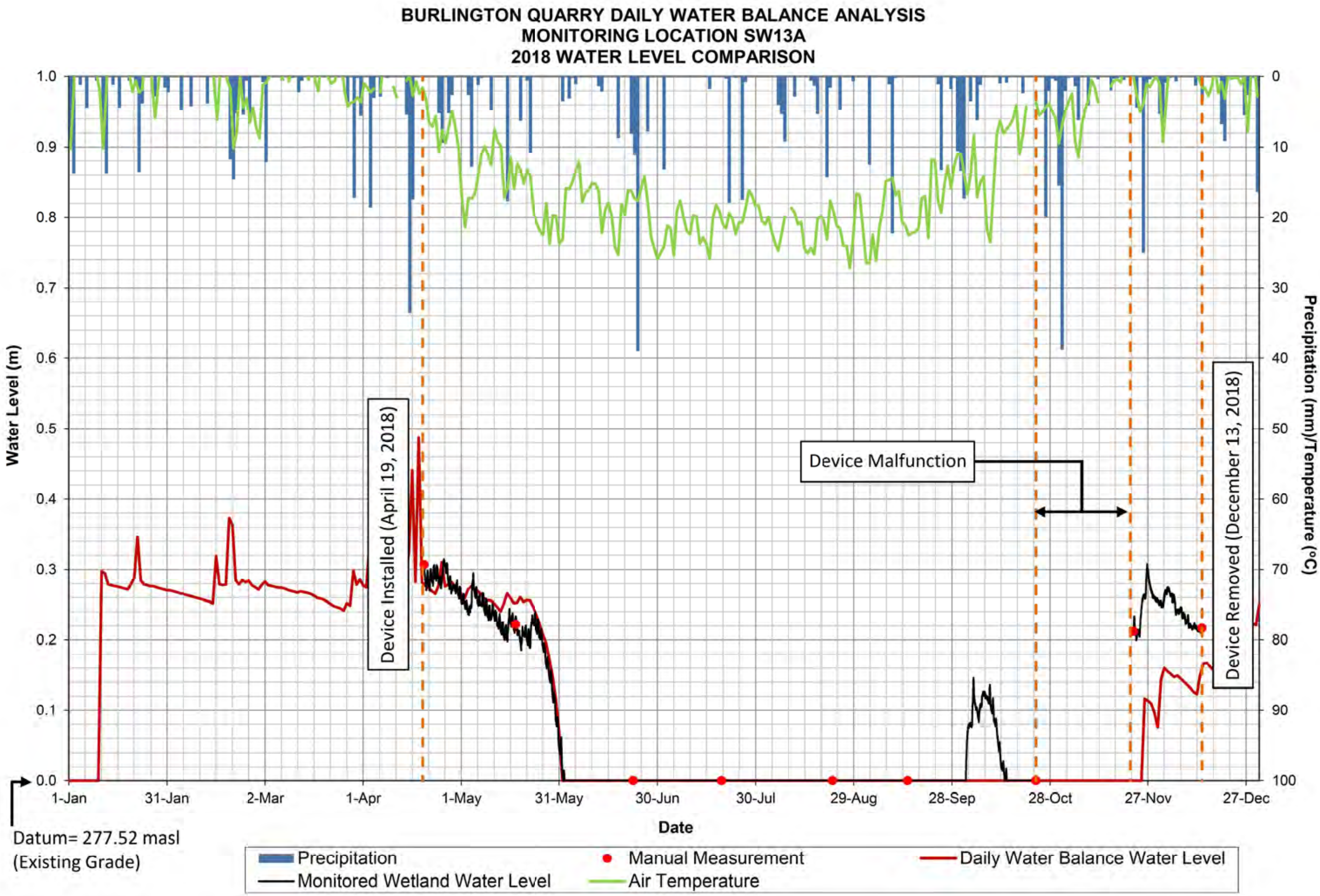


BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW13A
2015 WATER LEVEL COMPARISON
Water Level (m)
Precipitation (mm)/Temperature (°C)
Date
Device Installed (April 15, 2015)
Device Removed (December 11, 2015)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Datum= 277.52 masl
(Existing Grade)
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature

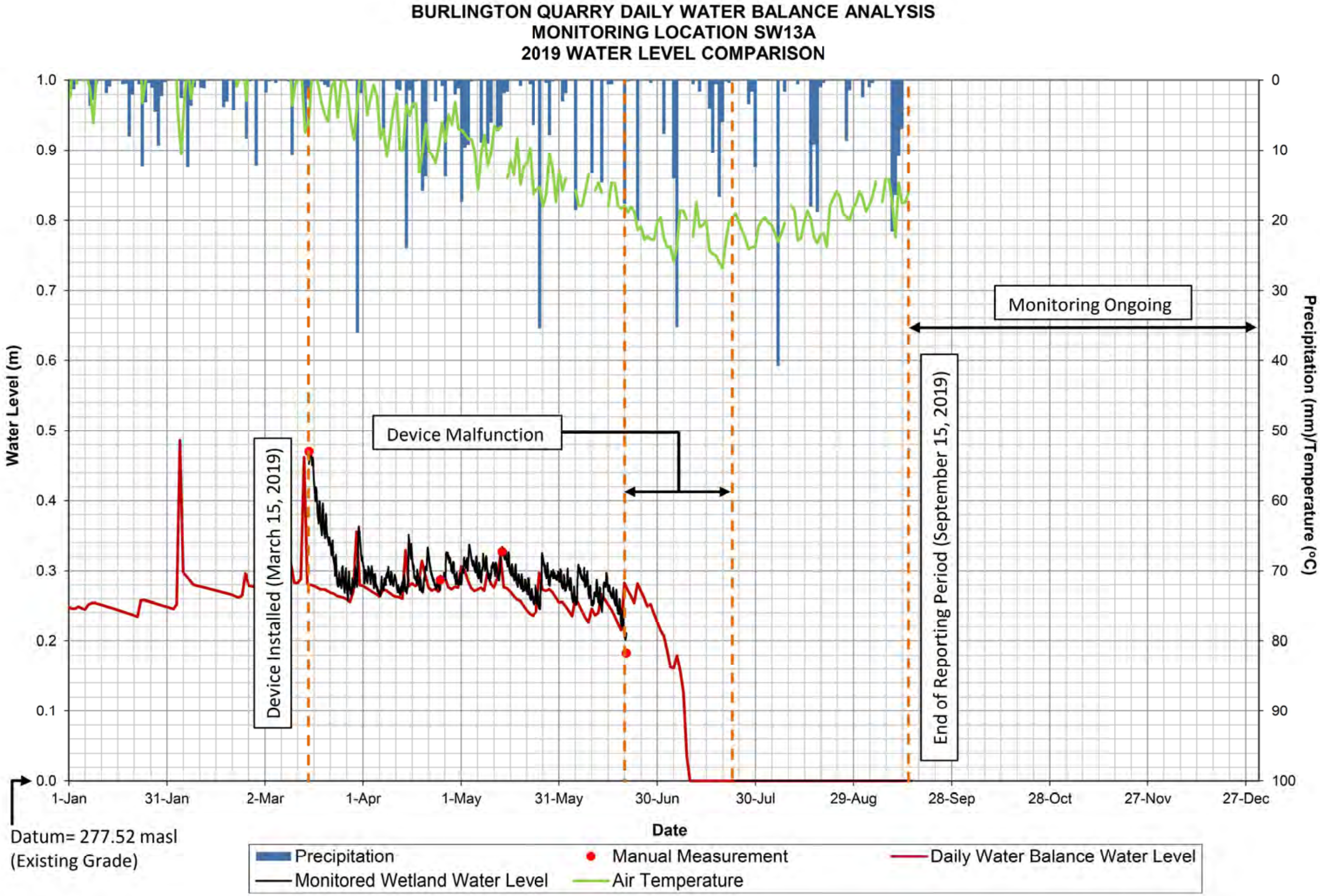

BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW13A
2016 WATER LEVEL COMPARISON
Water Level (m)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Device Installed (April 13, 2016)
Device Removed (December 22, 2016)
Datum= 277.52 masl
(Existing Grade)
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature



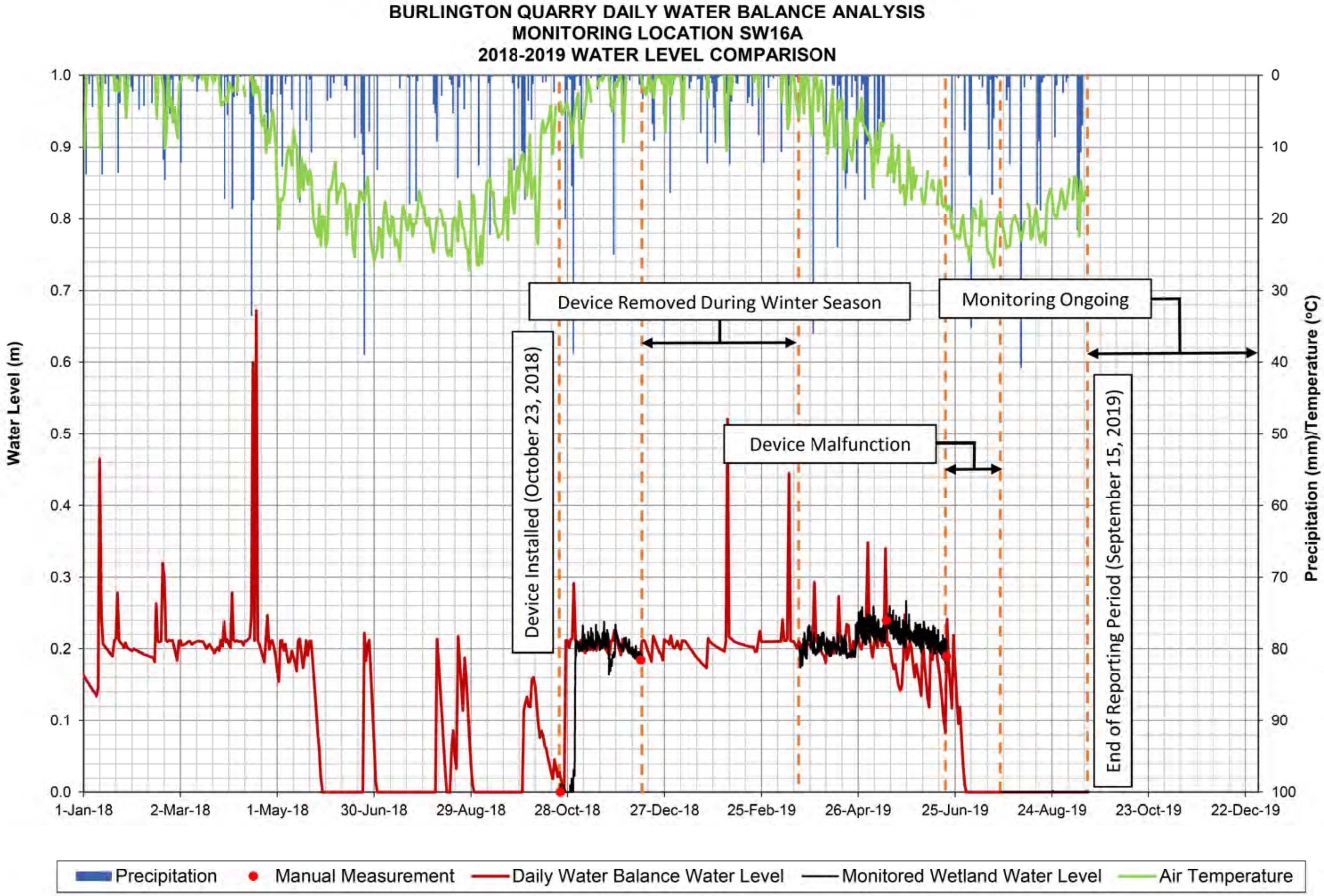
BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW13A
2017 WATER LEVEL COMPARISON
Water Level (m)
Precipitation (mm)/Temperature (°C)
Device Installed (May 17, 2017)
Device Removed (December 20, 2017)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Datum= 277.52 masl
(Existing Grade)
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature



BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW13A
2018 WATER LEVEL COMPARISON
Water Level (m)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Precipitation (mm)/Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Device Installed (April 19, 2018)
Device Malfunction
Device Removed (December 13, 2018)
Datum= 277.52 masl
(Existing Grade)
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature



BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW13A
2019 WATER LEVEL COMPARISON
Water Level (m)
Precipitation (mm)/Temperature (°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Device Installed (March 15, 2019)
Device Malfunction
End of Reporting Period (September 15, 2019)
Monitoring Ongoing
Datum= 277.52 masl
(Existing Grade)
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature


BURLINGTON QUARRY DAILY WATER BALANCE ANALYSIS
MONITORING LOCATION SW16A
2018-2019 WATER LEVEL COMPARISON
Water Level (m)
Precipitation (mm)/Temperature (°C)
Device Removed During Winter Season
Monitoring Ongoing
Device Installed (October 23, 2018)
Device Malfunction
End of Reporting Period (September 15, 2019)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
1-Jan-18
2-Mar-18
1-May-18
30-Jun-18
29-Aug-18
28-Oct-18
27-Dec-18
25-Feb-19
26-Apr-19
25-Jun-19
24-Aug-19
23-Oct-19
22-Dec-19
Precipitation
Manual Measurement
Daily Water Balance Water Level
Monitored Wetland Water Level
Air Temperature

Appendix J: Existing Conditions Outlet Water Balance Results

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	April 1, 2020
SUBJECT	Existing Daily Water Balance Outlet Volumes	NAME	John Gore
		PAGE	1 OF 5

WEST ARM OF THE WEST BRANCH OF THE MOUNT NEMO TRIBUTARY OF GRINDSTONE CREEK																						
Month	**Year**																					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	6.2	0.0	1.7	0.0	2.5	0.0	0.4	6.6	10.3	2.4	7.5	0.0	1.7	0.5	9.0	13.3	3.4	4.2	0.0	9.1	15.0	1.1
February	10.9	5.9	12.8	13.7	3.8	2.9	1.6	8.6	40.6	0.0	5.6	37.7	1.3	5.6	2.1	0.5	0.3	1.9	7.4	6.7	13.2	15.3
March	47.3	1.8	1.0	55.8	4.4	22.9	43.7	20.2	11.7	19.2	25.5	72.5	10.5	54.2	1.0	48.8	23.8	10.1	17.7	11.5	3.0	21.2
April	4.0	3.2	11.0	1.9	7.0	4.5	13.4	36.3	4.2	3.2	2.6	37.3	3.7	41.6	0.3	26.5	20.6	5.7	20.0	47.6	60.0	20.1
May	2.9	0.0	18.5	6.6	5.2	11.1	6.7	0.2	4.4	0.8	2.4	0.7	4.0	45.0	0.6	2.6	3.5	1.5	1.4	52.1	1.0	25.1
June	0.0	0.2	11.2	1.0	0.7	3.2	0.2	0.0	0.0	0.0	1.8	0.0	6.0	0.9	1.0	0.3	0.2	15.1	0.0	0.1	0.0	2.8
July	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	8.0	3.3	0.0	0.0	0.0	2.9	3.7	0.0	0.0	0.0	0.0	0.0
August	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
September	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	4.2	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0
October	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	1.8	0.0	0.0	2.0	0.0	5.4	3.4	0.0	0.0	0.0	0.0	0.0	0.0	
November	0.0	10.0	0.0	1.8	0.0	7.9	0.0	10.9	8.5	0.0	7.1	0.7	7.1	14.5	0.0	1.1	3.0	0.0	0.0	0.0	3.8	
December	0.0	2.0	0.0	2.3	0.0	4.7	5.1	2.2	7.8	0.0	13.2	7.2	3.5	5.4	2.2	3.7	1.6	0.0	0.0	0.0	3.0	
Total	**71.4**	**23.1**	**56.2**	**83.1**	**23.6**	**57.2**	**71.1**	**90.9**	**89.4**	**25.6**	**89.1**	**168.2**	**37.8**	**173.2**	**19.6**	**99.7**	**63.5**	**38.5**	**46.5**	**127.0**	**99.0**	**85.6**

* All volumes are in mm of runoff over drainage area

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	April 1, 2020
SUBJECT	Existing Daily Water Balance Outlet Volumes	NAME	John Gore
		PAGE	2 OF 5

EAST ARM OF THE WEST BRANCH OF THE MOUNT NEMO TRIBUTARY OF GRINDSTONE CREEK

Month	Year																					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	4.1	0.0	0.9	0.0	1.4	0.2	0.3	4.8	7.1	1.6	5.1	0.2	1.0	0.6	3.2	9.1	2.4	1.9	1.3	8.0	11.6	0.6
February	6.0	3.2	8.9	10.3	2.0	1.6	0.6	5.6	19.5	0.0	3.4	22.2	0.5	3.8	1.0	0.7	0.3	0.3	4.7	4.1	9.5	11.4
March	23.8	0.9	0.6	29.4	2.4	16.4	18.2	5.9	4.6	14.1	10.8	53.9	7.4	32.0	0.5	27.6	15.1	5.5	6.4	3.3	1.6	10.6
April	2.7	1.3	7.2	5.0	4.2	2.6	10.0	25.5	2.2	1.5	1.2	20.5	2.3	25.7	0.0	15.4	6.6	3.3	8.8	26.8	35.7	7.2
May	1.7	0.0	14.0	4.2	2.3	7.6	3.5	0.1	2.8	0.4	1.2	1.2	2.3	33.2	0.0	1.8	1.9	0.9	0.4	39.8	0.3	15.1
June	0.0	0.0	7.7	0.5	0.3	2.1	0.1	0.0	0.0	0.0	0.9	0.0	3.8	0.6	0.9	0.7	0.0	11.8	0.0	0.1	0.0	1.6
July	0.0	0.0	0.3	0.0	0.0	0.0	0.0	2.3	0.0	0.0	5.9	2.1	0.0	0.0	0.0	2.1	1.4	0.3	0.0	0.0	0.0	0.0
August	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	8.7	5.2	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
September	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.1	0.0	3.1	0.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0	0.0
October	0.0	2.8	0.0	0.0	0.0	1.9	0.0	1.2	2.2	0.0	0.1	1.9	1.9	6.3	3.6	1.3	0.1	0.0	0.0	0.0	0.0	
November	0.0	9.2	0.6	2.0	0.9	5.6	0.5	7.2	5.1	0.0	5.6	0.5	4.0	10.3	0.4	0.8	1.8	0.0	0.0	0.0	3.8	
December	0.0	1.3	0.1	1.4	1.1	3.4	3.7	1.6	6.4	0.0	8.6	5.2	2.4	4.7	1.3	2.6	0.8	0.8	0.0	0.4	1.6	
Total	**38.3**	**18.8**	**40.3**	**52.9**	**14.6**	**41.3**	**36.9**	**57.5**	**50.1**	**17.4**	**54.6**	**113.0**	**25.6**	**117.2**	**10.9**	**62.1**	**33.9**	**24.8**	**21.6**	**82.5**	**64.0**	**46.6**

* All volumes are in mm of runoff over drainage area

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	April 1, 2020
SUBJECT	Existing Daily Water Balance Outlet Volumes	NAME	John Gore
		PAGE	3 OF 5

WEIR POND (WETLAND 13202)																						
Month	**Year**																					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	1.8	0.4	1.5	0.0	0.3	0.0	0.5	6.9	10.0	2.7	2.4	0.0	1.8	0.5	5.5	10.6	3.7	4.2	0.2	3.1	10.1	1.1
February	7.0	2.3	11.8	10.3	3.4	0.6	1.1	8.9	9.7	0.0	3.7	25.3	0.9	5.1	1.8	0.2	0.3	1.0	5.6	4.8	12.6	14.3
March	16.1	0.1	0.6	22.5	4.2	15.3	20.7	7.6	4.8	17.1	11.6	50.0	10.0	22.6	0.9	20.8	19.4	9.1	9.8	4.7	2.3	16.3
April	3.6	1.0	9.6	1.4	6.5	3.7	3.5	14.2	3.6	2.4	2.0	23.7	3.4	22.5	0.1	12.2	8.8	4.7	5.6	17.2	25.0	7.1
May	1.9	0.2	16.4	5.2	4.0	10.2	5.4	0.1	3.6	0.3	1.7	0.1	2.7	38.7	0.0	1.3	3.4	1.2	0.9	39.7	0.4	7.5
June	0.0	0.0	10.1	0.9	0.4	2.9	0.1	0.0	0.0	0.0	0.8	0.1	5.0	0.6	0.8	0.6	0.3	11.6	0.0	0.1	0.4	2.0
July	0.0	0.3	0.4	0.0	0.0	0.0	0.3	2.5	0.4	0.0	6.1	1.4	0.5	0.0	0.2	1.5	1.6	0.0	0.0	0.0	0.0	0.0
August	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	10.8	6.5	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.6	0.0
September	0.0	1.0	0.3	0.0	0.4	1.0	0.2	1.0	0.7	0.0	4.2	0.0	1.0	0.3	0.5	0.5	2.3	0.0	0.0	0.0	0.0	0.0
October	0.0	1.5	0.0	1.1	0.1	0.7	0.0	0.3	0.7	0.0	0.0	1.8	0.4	3.4	1.7	0.5	0.1	0.8	0.0	0.0	0.3	
November	0.0	2.6	0.3	1.1	1.0	4.0	0.7	6.6	6.0	0.3	7.1	0.8	1.6	11.4	0.0	0.1	3.3	0.1	0.1	0.6	1.4	
December	0.0	0.5	0.0	0.2	0.3	5.4	1.5	2.7	8.1	0.8	11.8	7.7	3.3	6.2	0.2	3.9	2.2	0.3	0.8	0.1	2.4	
Total	**30.4**	**10.0**	**51.2**	**42.6**	**20.7**	**43.9**	**34.0**	**51.4**	**47.6**	**23.6**	**62.2**	**117.4**	**30.6**	**111.3**	**11.8**	**52.4**	**45.4**	**33.1**	**23.0**	**70.3**	**55.6**	**48.3**

* All volumes are in mm of runoff over drainage area

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	April 1, 2020
SUBJECT	Existing Daily Water Balance Outlet Volumes	NAME	John Gore
		PAGE	4 OF 5

BURLINGTON QUARRY																						
Month	**Year**																					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	54.4	33.8	18.0	11.2	25.1	11.1	10.7	46.1	69.3	28.7	66.4	9.1	18.9	7.5	48.1	79.8	31.1	27.1	30.4	77.9	68.2	15.2
February	59.1	84.6	53.4	56.9	35.4	23.9	31.2	55.7	59.4	6.2	40.9	94.6	20.5	33.4	22.0	11.3	14.8	7.0	51.8	59.0	67.6	64.4
March	82.6	18.9	15.4	117.9	36.2	81.0	103.4	62.1	40.2	72.4	74.2	91.7	54.6	125.0	10.8	89.1	90.7	51.3	72.5	41.1	22.6	76.2
April	28.8	24.9	46.6	23.1	60.4	40.0	30.9	62.7	31.1	22.5	20.4	87.6	23.1	76.0	14.6	66.9	62.7	37.1	43.8	92.1	102.9	60.9
May	13.1	9.8	64.2	36.8	31.9	45.9	40.8	3.4	25.7	7.7	20.6	13.2	24.5	77.3	15.6	17.3	28.2	14.0	9.1	68.5	11.4	43.7
June	8.3	7.5	61.1	8.0	6.6	17.9	8.7	3.4	3.7	3.0	18.3	9.6	39.3	6.5	2.6	14.2	8.5	43.1	3.5	9.6	11.0	19.2
July	4.0	9.0	11.6	2.6	8.5	6.5	12.5	24.8	18.9	2.7	42.3	27.1	12.4	2.2	10.5	14.2	20.6	2.8	3.9	7.6	6.0	6.0
August	2.5	5.8	4.4	6.6	1.5	5.0	4.1	12.9	4.6	2.7	50.0	37.0	3.1	11.4	5.9	6.1	6.0	8.1	9.7	7.3	17.8	8.3
September	2.4	19.9	14.6	9.2	13.3	31.8	6.8	27.8	29.1	3.9	33.7	4.7	19.7	19.5	19.6	14.2	25.3	9.6	12.5	2.7	12.8	4.6
October	3.8	37.4	4.8	54.4	17.8	32.8	13.7	25.7	42.1	8.8	11.9	34.6	32.3	67.5	78.5	45.6	17.4	28.7	11.9	15.6	43.7	
November	12.4	48.0	25.7	41.8	35.9	67.5	44.1	64.9	65.1	37.2	49.3	16.8	47.2	60.1	13.5	19.9	30.7	16.0	26.7	36.1	38.3	
December	19.6	27.0	10.6	29.9	26.4	48.2	52.1	28.7	33.5	41.6	67.4	47.4	30.5	57.9	28.7	31.9	18.8	25.4	34.6	15.7	30.1	
Total	**291.1**	**326.5**	**330.5**	**398.3**	**299.0**	**411.6**	**359.0**	**418.1**	**422.6**	**237.5**	**495.5**	**473.4**	**326.1**	**544.2**	**270.5**	**410.4**	**354.9**	**270.1**	**310.3**	**433.3**	**432.4**	**298.5**

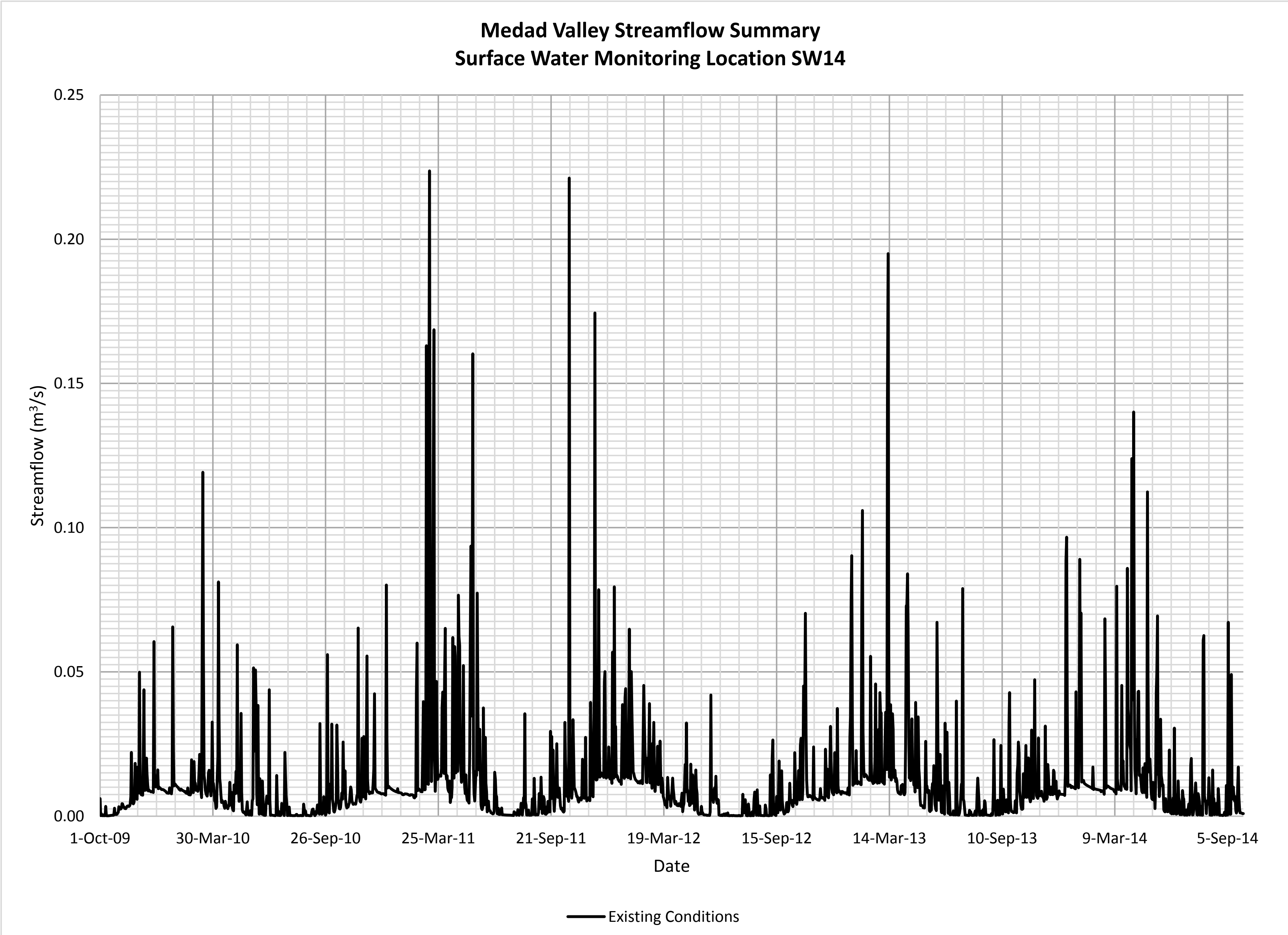
* All volumes are in mm of runoff over drainage area

WETLAND 13021

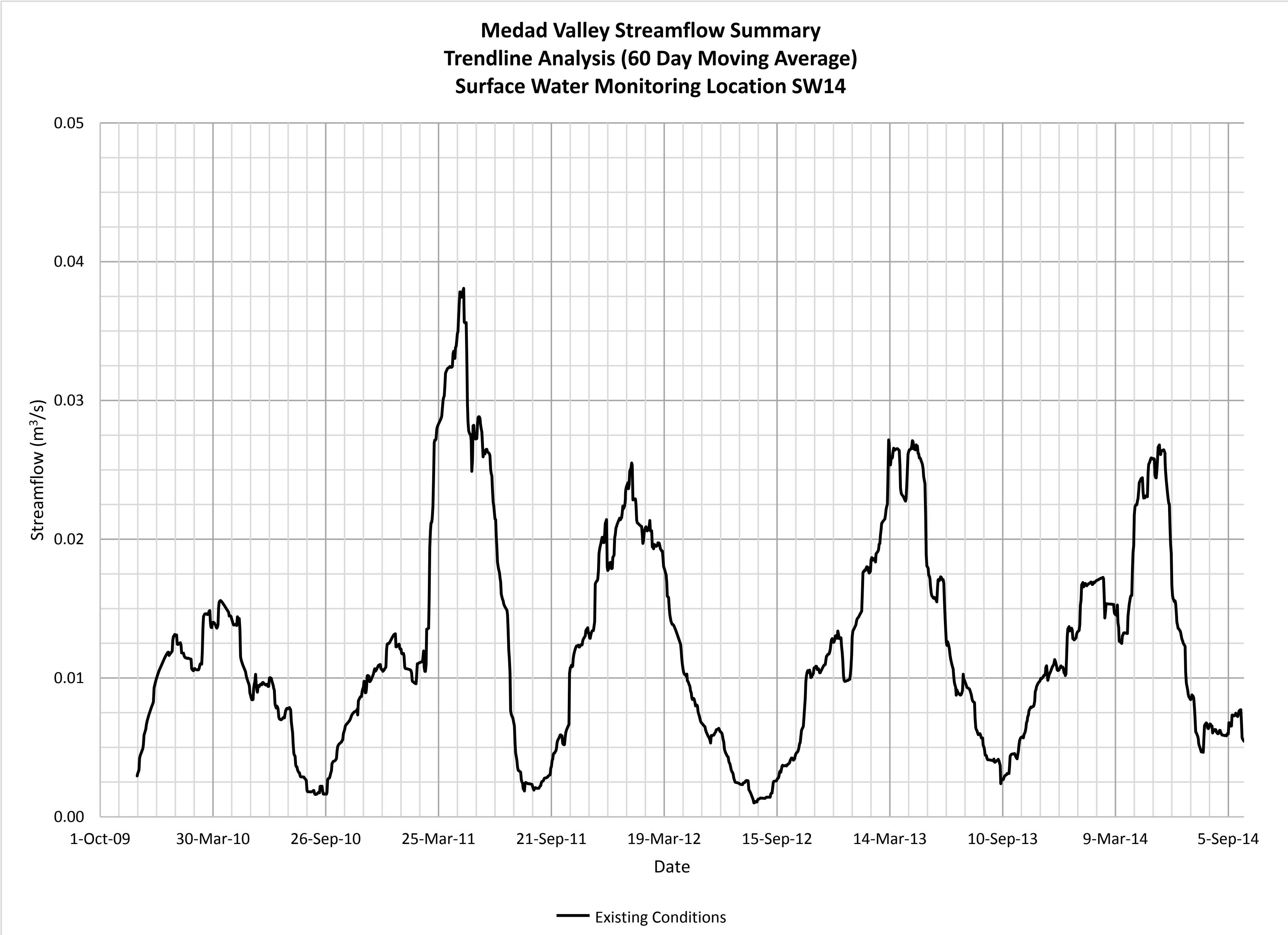
Month	Year																					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	5.5	0.0	3.3	0.0	4.3	0.0	2.2	12.1	31.6	5.2	8.6	0.0	2.7	1.0	28.3	29.5	6.5	5.1	0.0	10.5	12.1	1.6
February	28.2	5.2	16.9	13.0	6.4	1.3	0.2	25.3	46.0	0.0	9.0	52.9	0.8	6.6	2.7	0.4	0.5	0.0	8.0	20.1	25.2	21.0
March	58.9	3.0	0.5	78.1	7.6	29.6	71.2	30.7	18.6	21.2	44.7	75.4	15.8	77.9	1.3	62.2	47.3	12.2	37.6	26.2	3.0	43.9
April	5.2	2.2	13.4	2.2	26.2	6.8	14.6	38.4	5.0	3.1	3.6	51.5	5.3	51.9	0.0	35.2	30.2	8.1	22.2	53.9	78.2	27.5
May	1.1	0.0	14.2	5.3	14.0	14.6	13.7	0.0	4.4	0.0	1.7	0.0	2.1	51.7	0.0	1.3	5.5	0.0	0.0	56.5	0.0	30.2
June	0.0	0.0	21.7	1.3	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	6.1	0.4	0.0	0.1	0.0	15.6	0.0	0.0	0.0	1.7
July	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0
August	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.6	8.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
September	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
October	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
November	0.0	9.2	0.0	0.0	0.0	11.2	0.0	8.7	8.1	0.0	11.6	1.4	2.7	20.3	0.0	0.5	2.4	0.0	0.0	0.0	0.0	
December	0.0	4.2	0.0	4.8	0.0	11.7	0.3	4.7	13.0	0.0	34.8	12.7	5.8	12.5	2.2	6.9	2.7	0.0	0.0	0.0	2.0	
Total	**98.9**	**23.8**	**70.0**	**104.8**	**58.5**	**80.0**	**102.1**	**119.9**	**126.7**	**29.5**	**143.9**	**204.7**	**41.3**	**222.3**	**34.6**	**137.9**	**95.1**	**40.9**	**67.8**	**167.3**	**120.4**	**125.9**

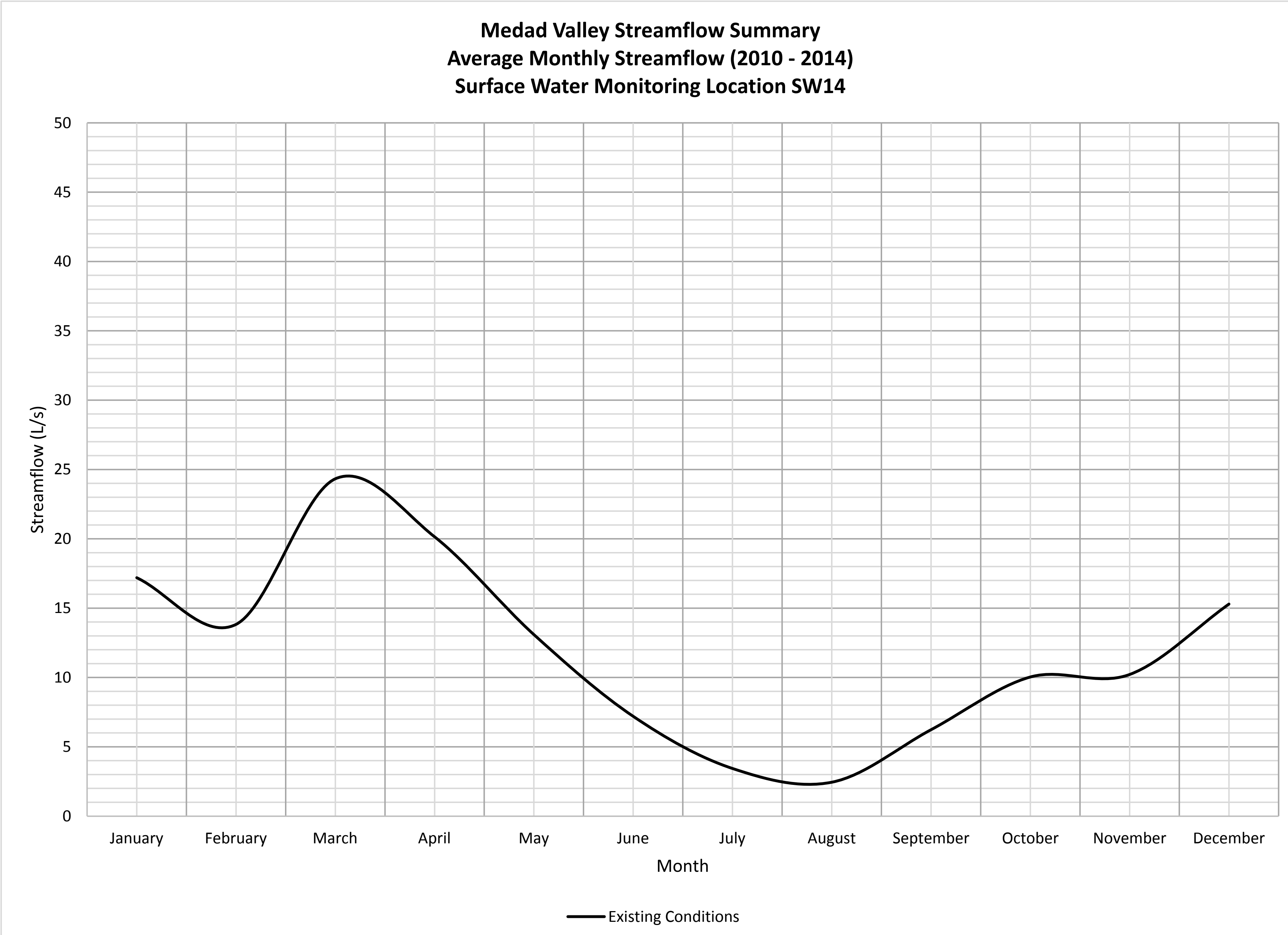
* All volumes are in mm of runoff over drainage area

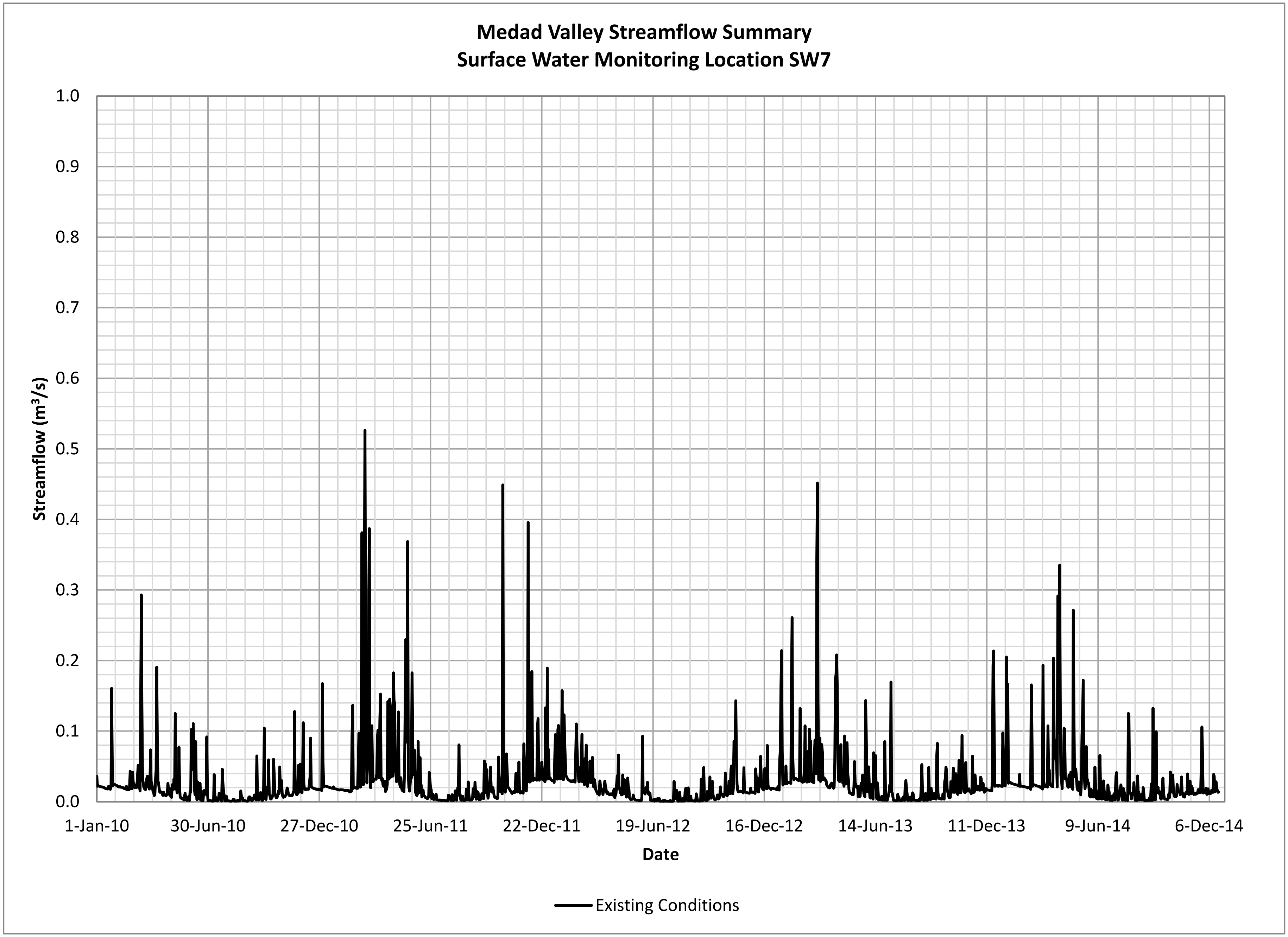
Appendix K:
Existing Conditions Integrated Surface Water Groundwater Model Results

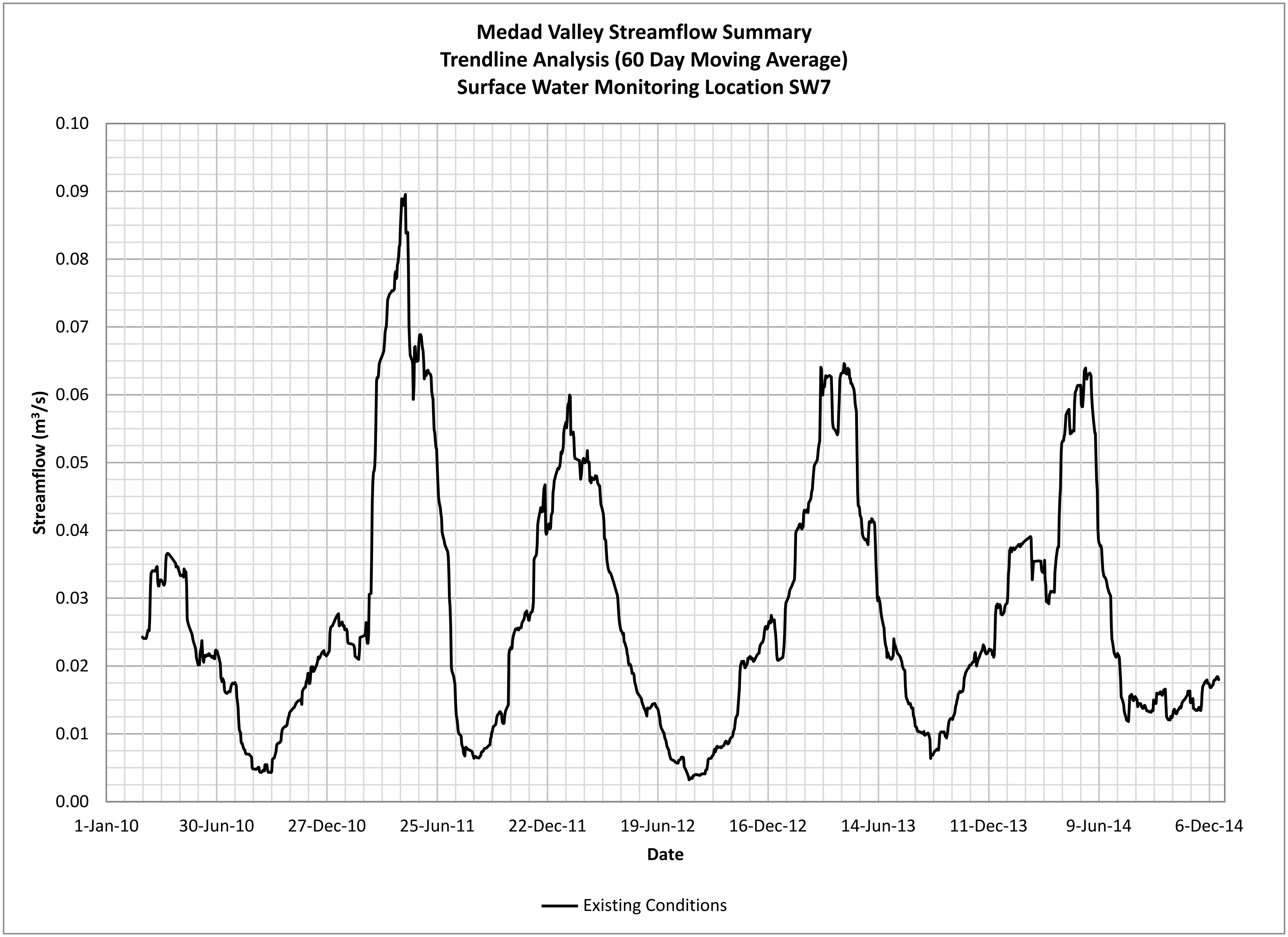


Medad Valley Streamflow Summary
Surface Water Monitoring Location SW14
Streamflow (m³/s)
0.25
0.20
0.15
0.10
0.05
0.00
1-Oct-09
30-Mar-10
26-Sep-10
25-Mar-11
21-Sep-11
19-Mar-12
15-Sep-12
14-Mar-13
10-Sep-13
9-Mar-14
5-Sep-14
Date
Existing Conditions

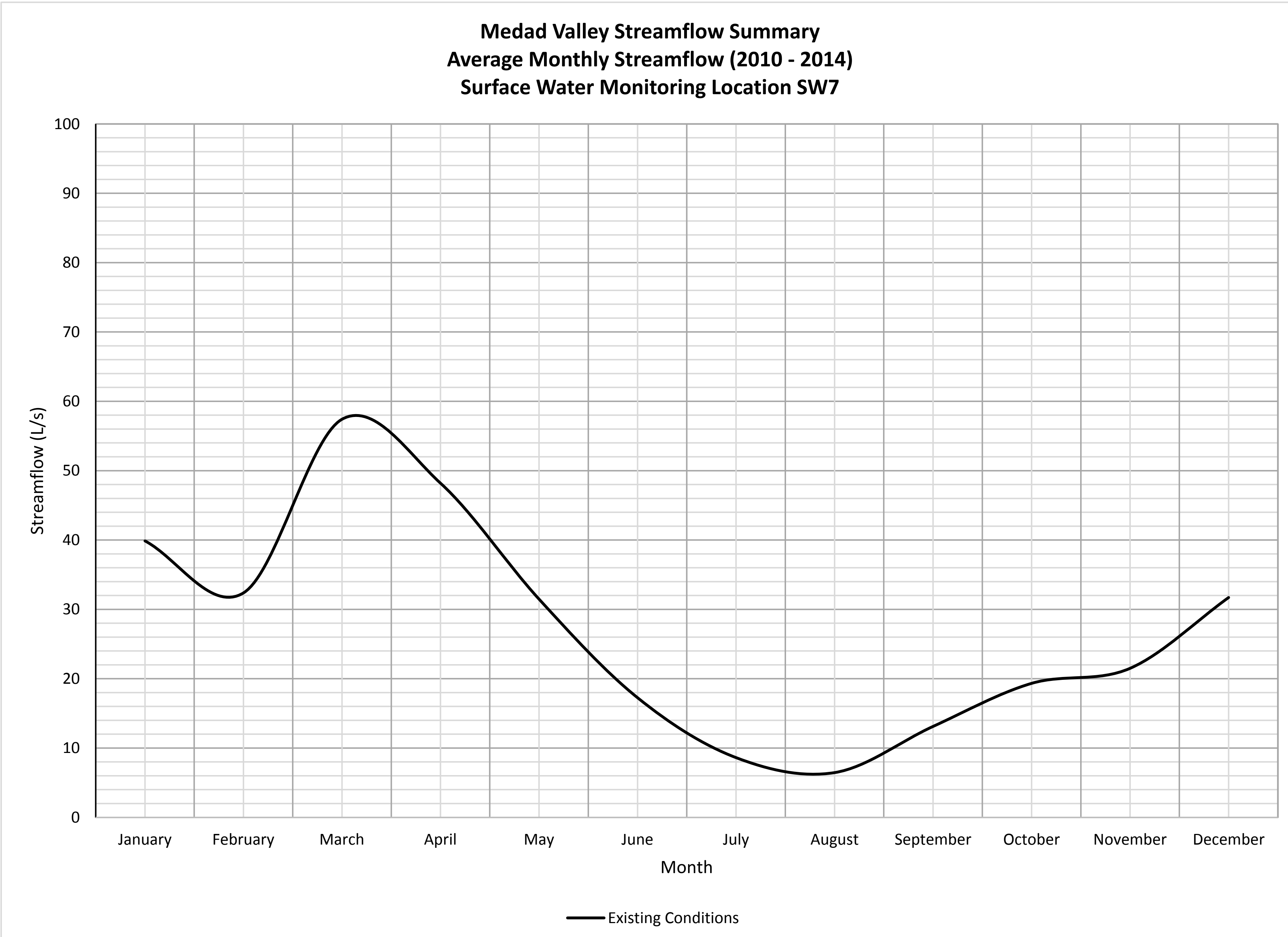

Medad Valley Streamflow Summary
Trendline Analysis (60 Day Moving Average)
Surface Water Monitoring Location SW14
0.05
0.04
0.03
0.02
0.01
0.00
Streamflow (m³/s)
1-Oct-09
30-Mar-10
26-Sep-10
25-Mar-11
21-Sep-11
19-Mar-12
15-Sep-12
14-Mar-13
10-Sep-13
9-Mar-14
5-Sep-14
Date
Existing Conditions


Medad Valley Streamflow Summary
Average Monthly Streamflow (2010 - 2014)
Surface Water Monitoring Location SW14
Streamflow (L/s)
0
5
10
15
20
25
30
35
40
45
50
January
February
March
April
May
June
July
August
September
October
November
December
Month
Existing Conditions

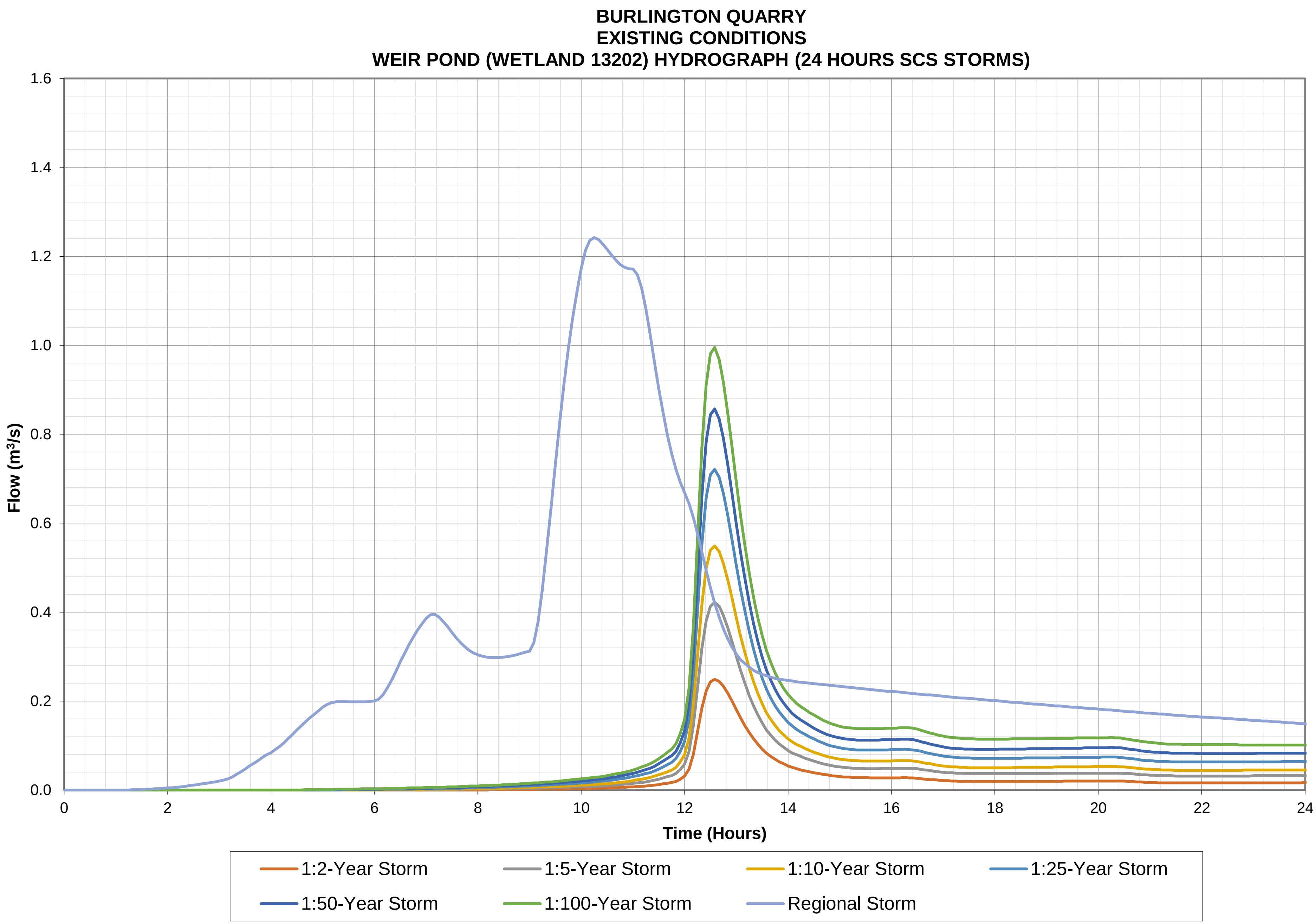

Medad Valley Streamflow Summary
Surface Water Monitoring Location SW7
Streamflow (m³/s)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1-Jan-10
30-Jun-10
27-Dec-10
25-Jun-11
22-Dec-11
19-Jun-12
16-Dec-12
14-Jun-13
11-Dec-13
9-Jun-14
6-Dec-14
Date
Existing Conditions

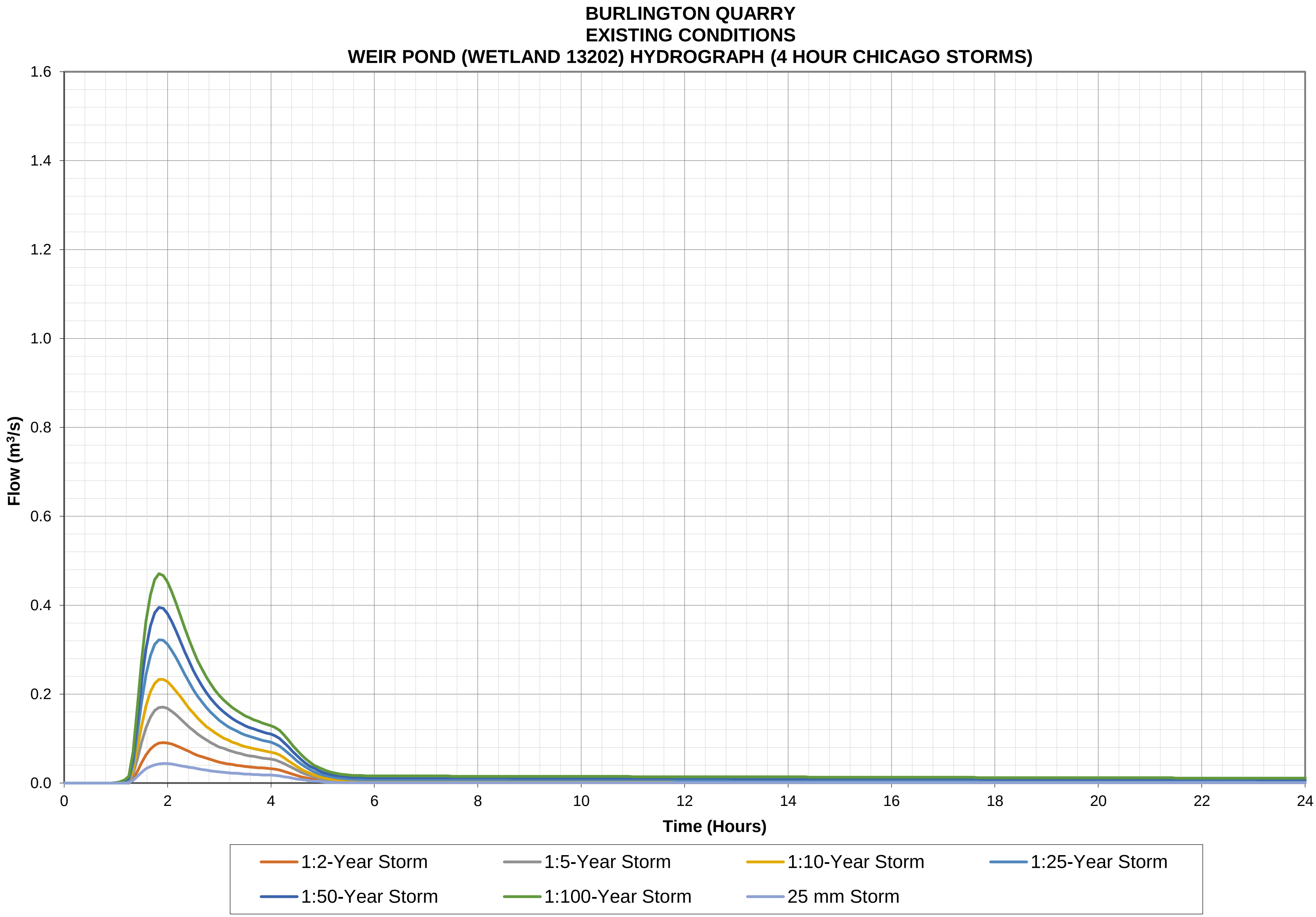


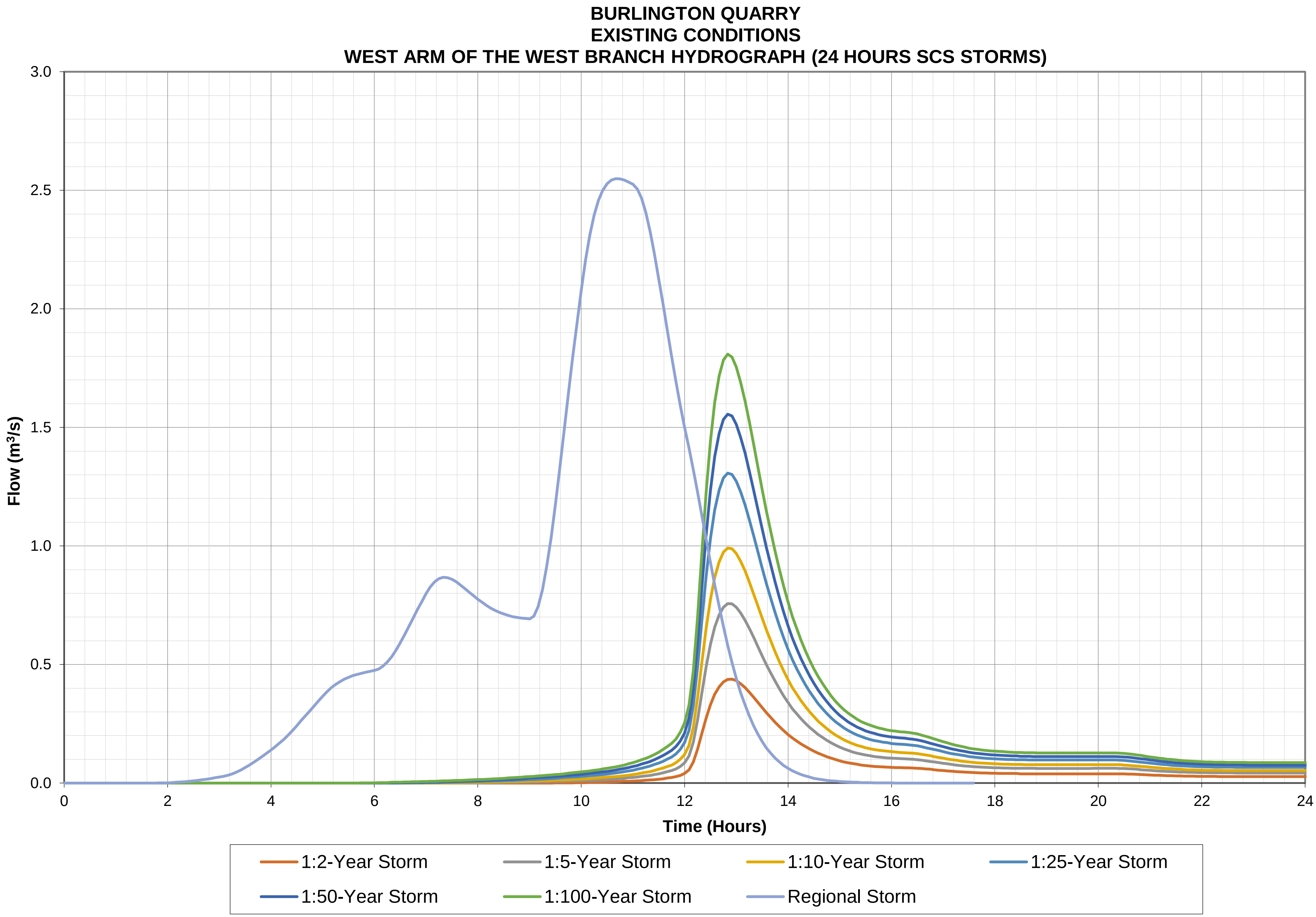
Medad Valley Streamflow Summary
Trendline Analysis (60 Day Moving Average)
Surface Water Monitoring Location SW7
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Streamflow (m³/s)
1-Jan-10
30-Jun-10
27-Dec-10
25-Jun-11
22-Dec-11
19-Jun-12
16-Dec-12
14-Jun-13
11-Dec-13
9-Jun-14
6-Dec-14
Date
Existing Conditions

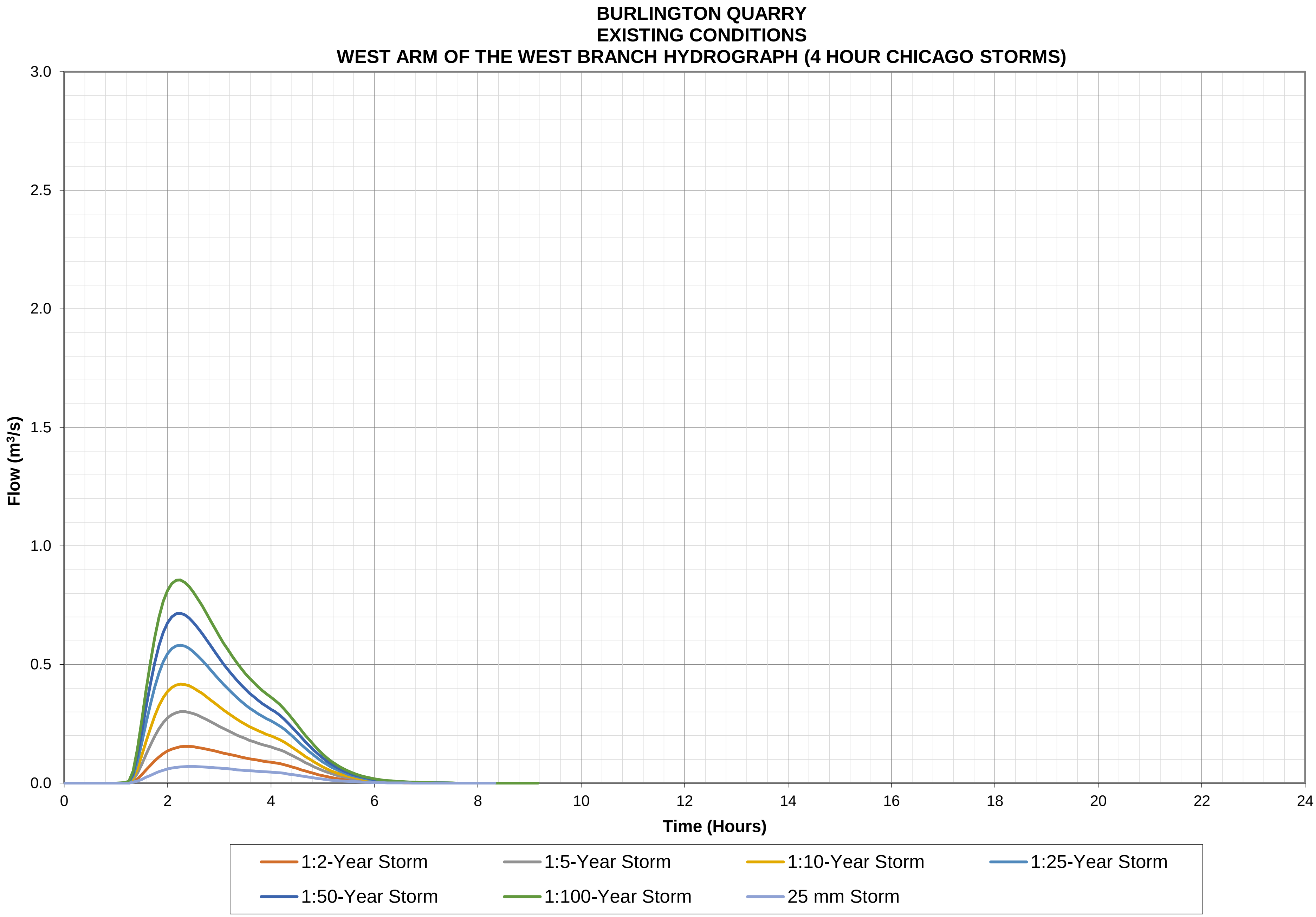

Medad Valley Streamflow Summary
Average Monthly Streamflow (2010 - 2014)
Surface Water Monitoring Location SW7
100
90
80
70
60
50
40
30
20
10
0
Streamflow (L/s)
January
February
March
April
May
June
July
August
September
October
November
December
Month
Existing Conditions

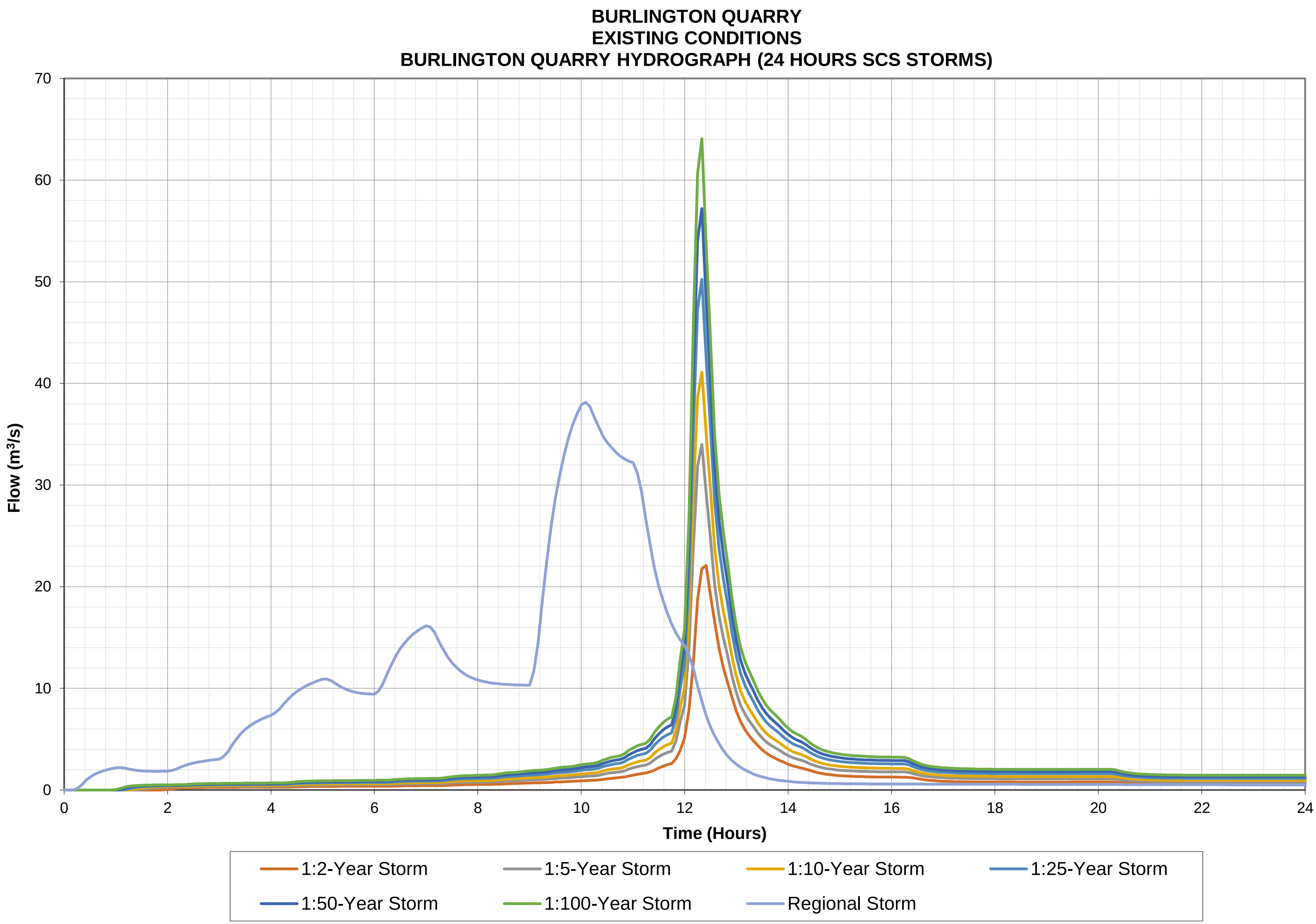
Appendix L:
Existing Conditions Event Based Hydrologic Model Results


BURLINGTON QUARRY
EXISTING CONDITIONS
WEIR POND (WETLAND 13202) HYDROGRAPH (24 HOURS SCS STORMS)
Flow (m³/s)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
Regional Storm

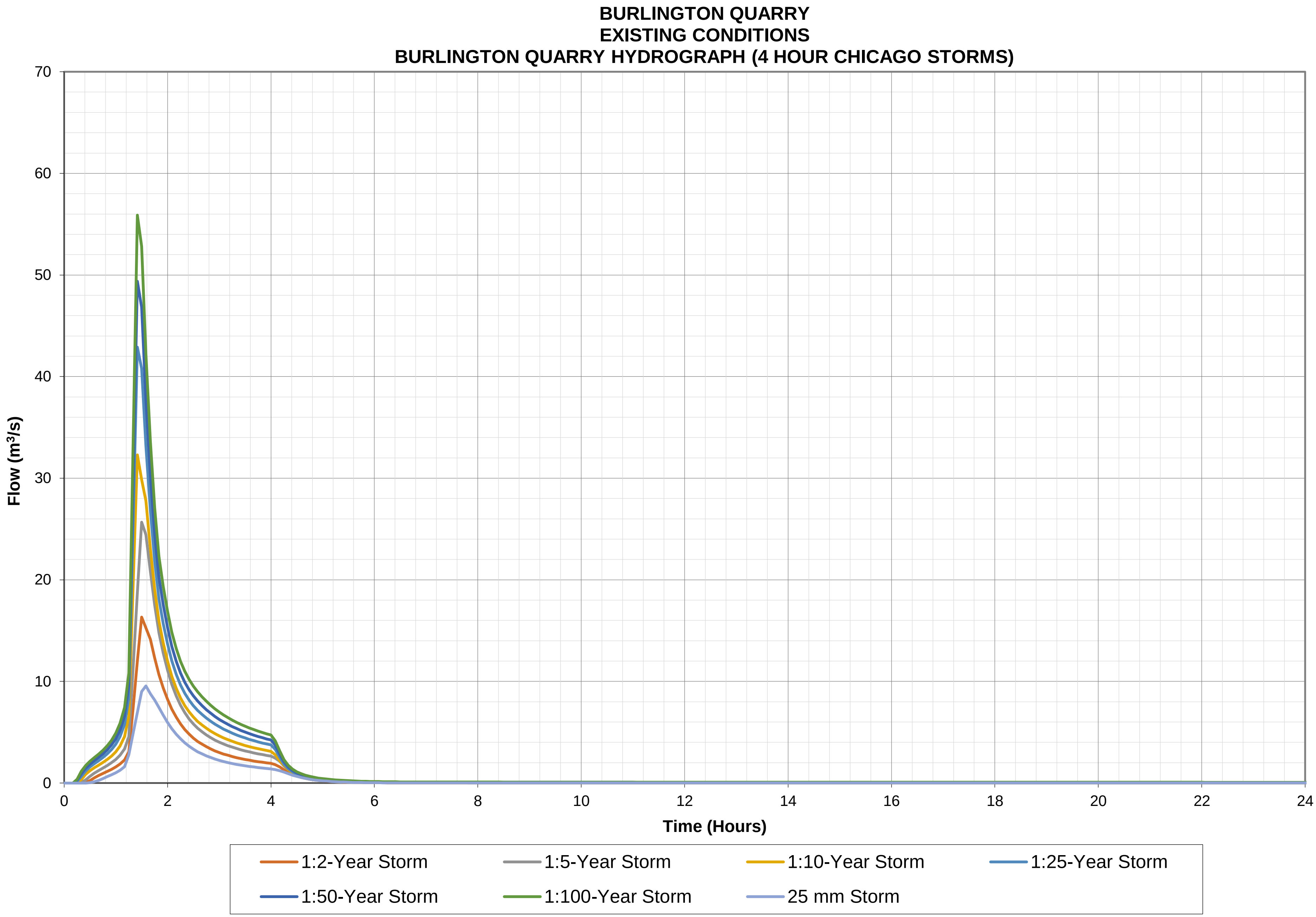

BURLINGTON QUARRY
EXISTING CONDITIONS
WEIR POND (WETLAND 13202) HYDROGRAPH (4 HOUR CHICAGO STORMS)
Flow (m³/s)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
25 mm Storm

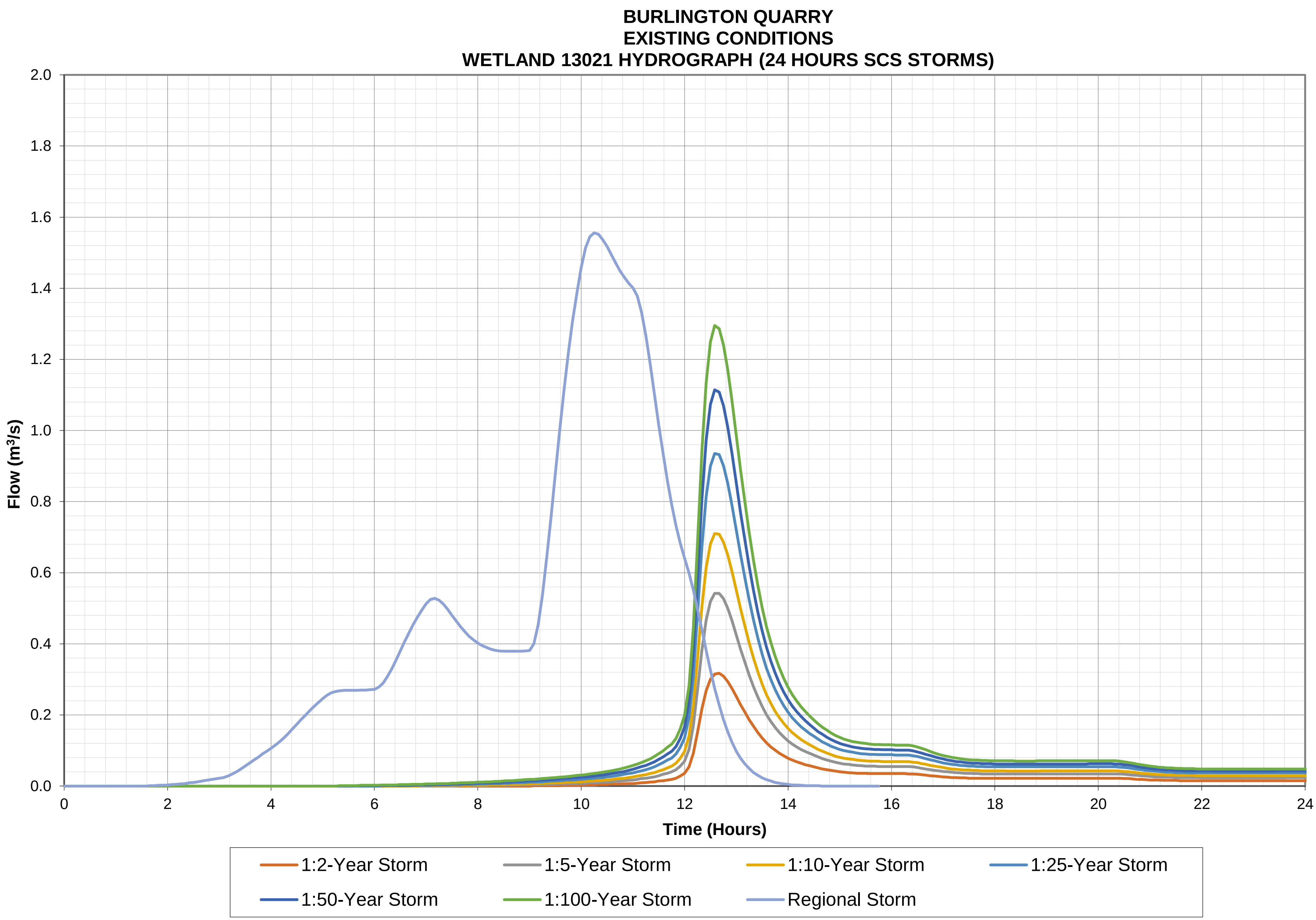

BURLINGTON QUARRY
EXISTING CONDITIONS
WEST ARM OF THE WEST BRANCH HYDROGRAPH (24 HOURS SCS STORMS)
Flow (m³/s)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
Regional Storm

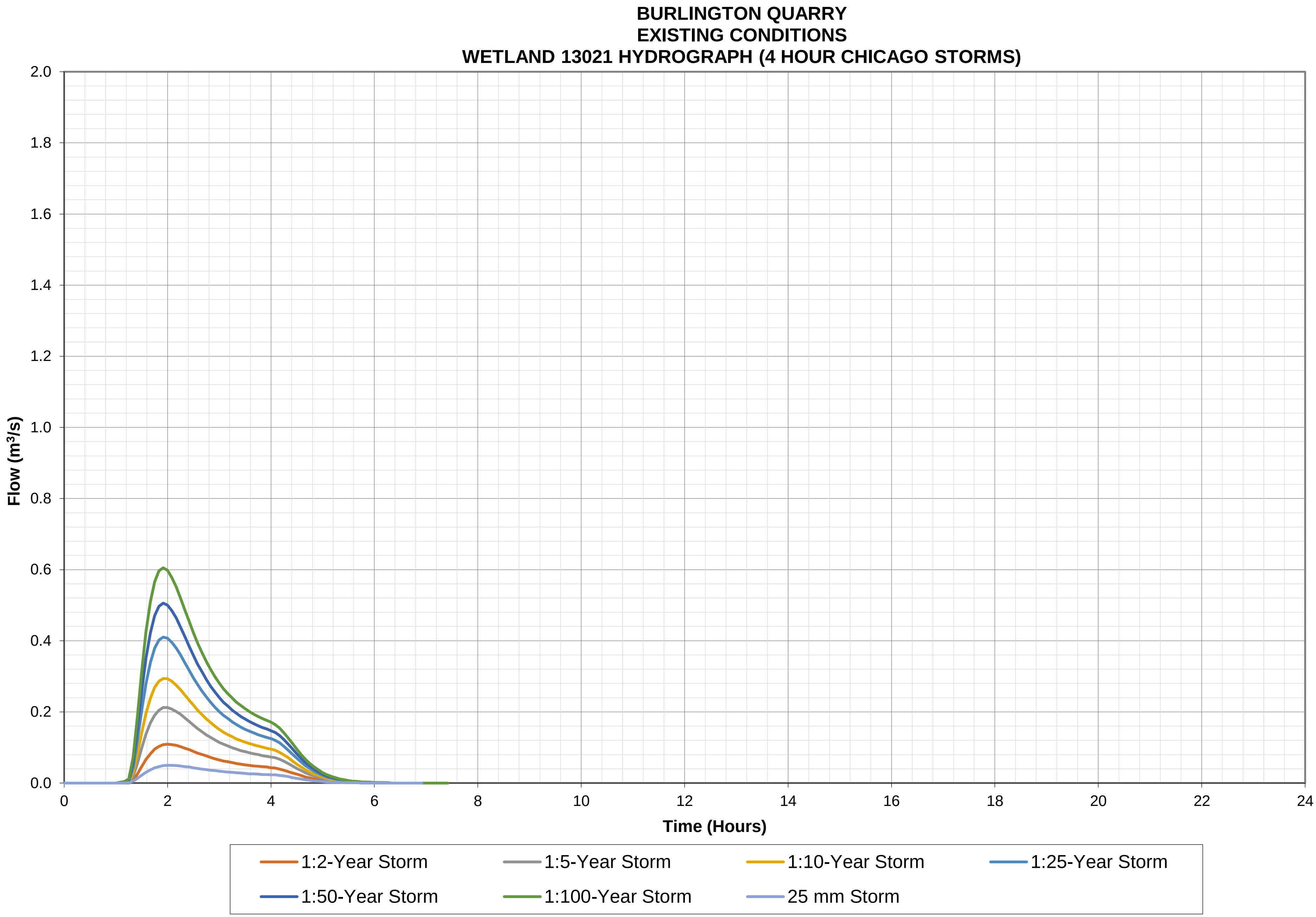

BURLINGTON QUARRY
EXISTING CONDITIONS
WEST ARM OF THE WEST BRANCH HYDROGRAPH (4 HOUR CHICAGO STORMS)
Flow (m³/s)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
25 mm Storm



BURLINGTON QUARRY
EXISTING CONDITIONS
BURLINGTON QUARRY HYDROGRAPH (24 HOURS SCS STORMS)
Flow (m³/s)
70
60
50
40
30
20
10
0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
Regional Storm


BURLINGTON QUARRY
EXISTING CONDITIONS
BURLINGTON QUARRY HYDROGRAPH (4 HOUR CHICAGO STORMS)
Flow (m³/s)
Time (Hours)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
16
18
20
22
24
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
25 mm Storm


BURLINGTON QUARRY
EXISTING CONDITIONS
WETLAND 13021 HYDROGRAPH (24 HOURS SCS STORMS)
Flow (m³/s)
Time (Hours)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
0
2
4
6
8
10
12
14
16
18
20
22
24
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
Regional Storm


BURLINGTON QUARRY
EXISTING CONDITIONS
WETLAND 13021 HYDROGRAPH (4 HOUR CHICAGO STORMS)
Flow (m³/s)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
25 mm Storm

Appendix M: Natural Hazard Assessment Results

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********************************
** SIMULATION:Hazel           **
********************************

--------------------
|    READ STORM    |    Filename: C:\Users\jgore\AppD
|                  |              ata\Local\Temp\
|                  |              cbe45063-35f0-4328-8ce6-b91cd11a7685\e8cd024b
| Ptotal=212.00 mm |    Comments: Hazel
--------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 1.00    6.00 |  4.00   13.00 |  7.00   23.00 | 10.00   53.00
                 2.00    4.00 |  5.00   17.00 |  8.00   13.00 | 11.00   38.00
                 3.00    6.00 |  6.00   13.00 |  9.00   13.00 | 12.00   13.00

-------------------------------------------------------------------------------

--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=  25.70   Curve Number   (CN)= 64.4
|ID= 1 DT= 5.0 min |   Ia      (mm)=   7.35   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   1.15

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                                  ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    6.00 | 3.083   13.00 | 6.083   23.00 |  9.08   53.00
                0.167    6.00 | 3.167   13.00 | 6.167   23.00 |  9.17   53.00
                0.250    6.00 | 3.250   13.00 | 6.250   23.00 |  9.25   53.00
                0.333    6.00 | 3.333   13.00 | 6.333   23.00 |  9.33   53.00
                0.417    6.00 | 3.417   13.00 | 6.417   23.00 |  9.42   53.00
                0.500    6.00 | 3.500   13.00 | 6.500   23.00 |  9.50   53.00
                0.583    6.00 | 3.583   13.00 | 6.583   23.00 |  9.58   53.00
                0.667    6.00 | 3.667   13.00 | 6.667   23.00 |  9.67   53.00
                0.750    6.00 | 3.750   13.00 | 6.750   23.00 |  9.75   53.00
                0.833    6.00 | 3.833   13.00 | 6.833   23.00 |  9.83   53.00
                0.917    6.00 | 3.917   13.00 | 6.917   23.00 |  9.92   53.00
                1.000    6.00 | 4.000   13.00 | 7.000   23.00 | 10.00   53.00
                1.083    4.00 | 4.083   17.00 | 7.083   13.00 | 10.08   38.00
                1.167    4.00 | 4.167   17.00 | 7.167   13.00 | 10.17   38.00
                1.250    4.00 | 4.250   17.00 | 7.250   13.00 | 10.25   38.00
                1.333    4.00 | 4.333   17.00 | 7.333   13.00 | 10.33   38.00
                1.417    4.00 | 4.417   17.00 | 7.417   13.00 | 10.42   38.00
                1.500    4.00 | 4.500   17.00 | 7.500   13.00 | 10.50   38.00
                1.583    4.00 | 4.583   17.00 | 7.583   13.00 | 10.58   38.00
                1.667    4.00 | 4.667   17.00 | 7.667   13.00 | 10.67   38.00
                1.750    4.00 | 4.750   17.00 | 7.750   13.00 | 10.75   38.00
                1.833    4.00 | 4.833   17.00 | 7.833   13.00 | 10.83   38.00
                1.917    4.00 | 4.917   17.00 | 7.917   13.00 | 10.92   38.00
                2.000    4.00 | 5.000   17.00 | 8.000   13.00 | 11.00   38.00
                2.083    6.00 | 5.083   13.00 | 8.083   13.00 | 11.08   13.00
                2.167    6.00 | 5.167   13.00 | 8.167   13.00 | 11.17   13.00
                2.250    6.00 | 5.250   13.00 | 8.250   13.00 | 11.25   13.00
                2.333    6.00 | 5.333   13.00 | 8.333   13.00 | 11.33   13.00
                2.417    6.00 | 5.417   13.00 | 8.417   13.00 | 11.42   13.00
                2.500    6.00 | 5.500   13.00 | 8.500   13.00 | 11.50   13.00
                2.583    6.00 | 5.583   13.00 | 8.583   13.00 | 11.58   13.00
                2.667    6.00 | 5.667   13.00 | 8.667   13.00 | 11.67   13.00
                2.750    6.00 | 5.750   13.00 | 8.750   13.00 | 11.75   13.00
                2.833    6.00 | 5.833   13.00 | 8.833   13.00 | 11.83   13.00
                2.917    6.00 | 5.917   13.00 | 8.917   13.00 | 11.92   13.00
                3.000    6.00 | 6.000   13.00 | 9.000   13.00 | 12.00   13.00

     Unit Hyd Qpeak  (cms)=   0.854

     PEAK FLOW       (cms)=   1.988 (i)
     TIME TO PEAK    (hrs)=  11.333
     RUNOFF VOLUME    (mm)= 121.482
     TOTAL RAINFALL   (mm)= 212.000
     RUNOFF COEFFICIENT   =   0.573

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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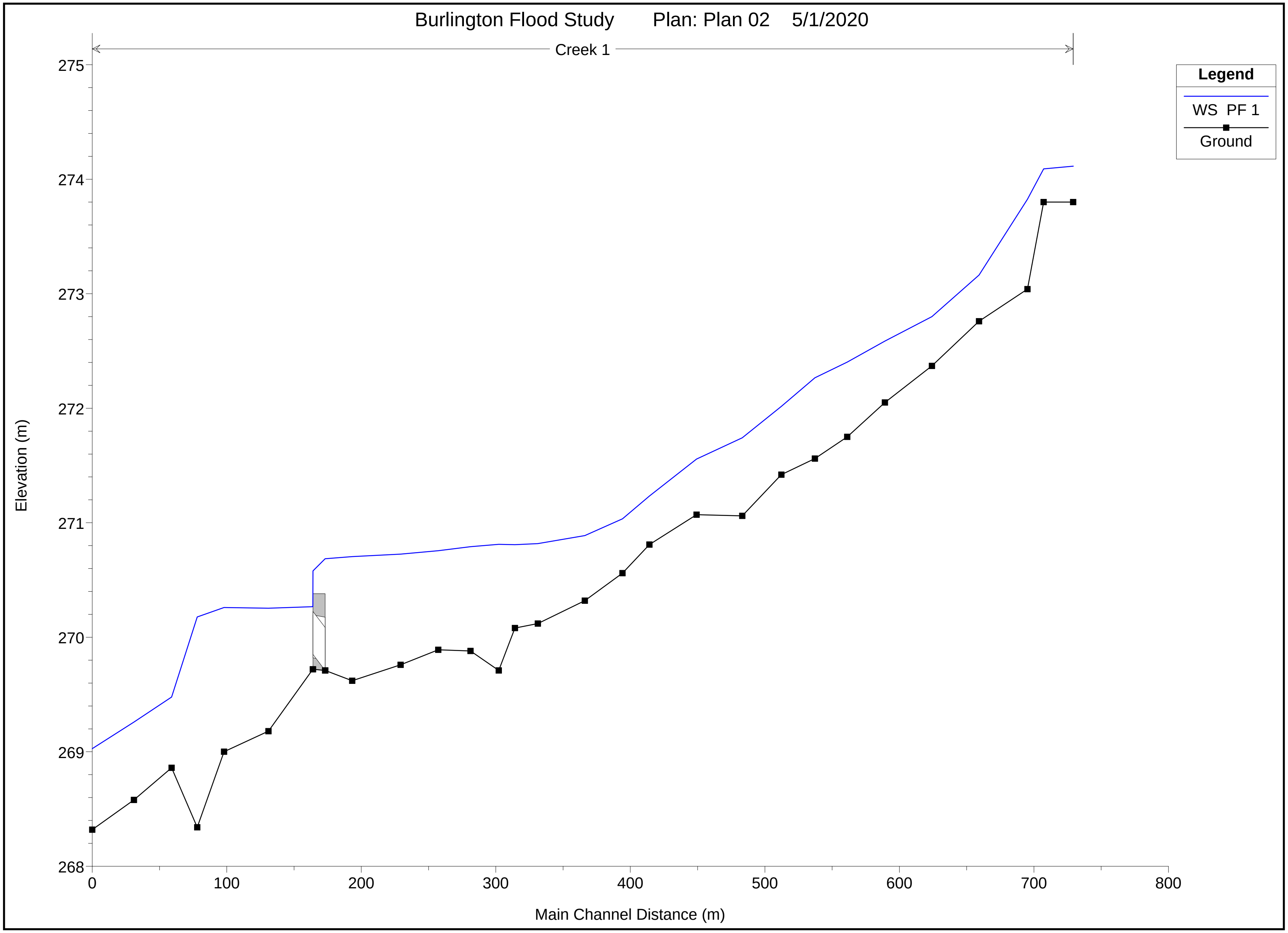
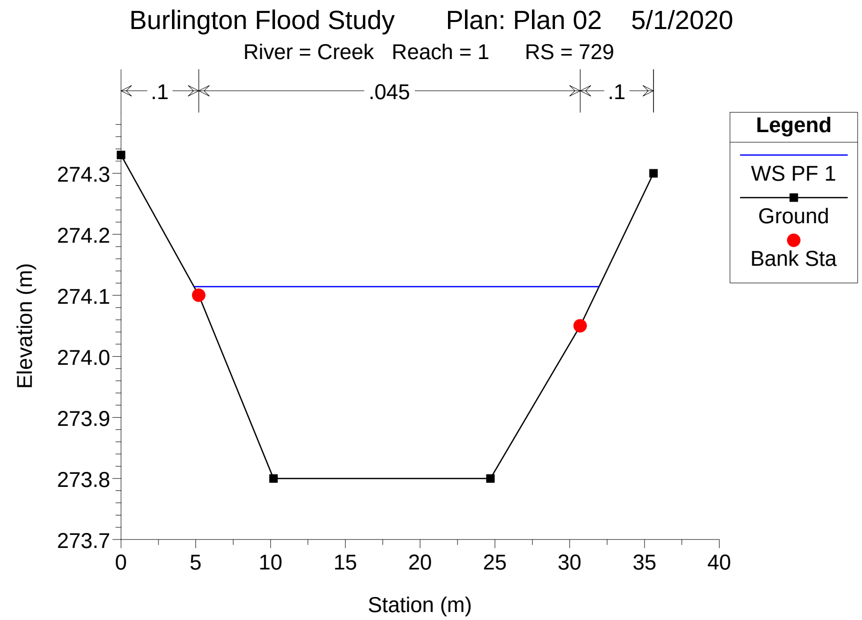
HEC-RAS Plan: Plan 02 River: Creek Reach: 1 Profile: PF 1

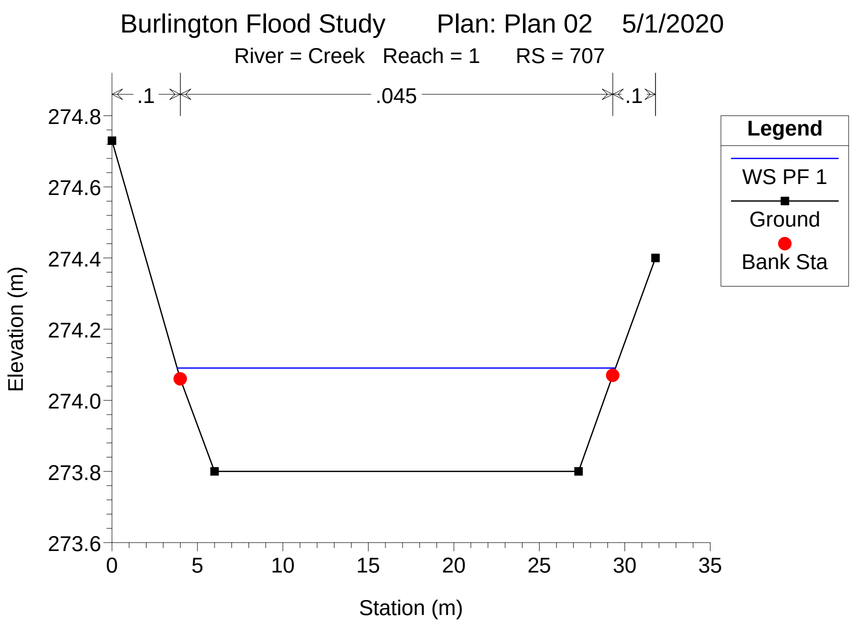
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
1	729	PF 1	2.00	273.80	274.11		274.12	0.001181	0.31	6.56	27.09	0.19
1	707	PF 1	2.00	273.80	274.09		274.10	0.001005	0.29	6.83	25.64	0.18
1	695	PF 1	2.00	273.04	273.83	273.83	274.04	0.032736	2.05	0.99	2.39	1.00
1	659	PF 1	2.00	272.76	273.16		273.20	0.009823	0.94	2.96	17.88	0.57
1	624	PF 1	2.00	272.37	272.80		272.85	0.010122	1.02	2.23	11.15	0.59
1	589	PF 1	2.00	272.05	272.59		272.61	0.004763	0.75	4.66	30.67	0.41
1	561	PF 1	2.00	271.75	272.40		272.46	0.006041	1.12	2.76	8.65	0.49
1	537	PF 1	2.00	271.56	272.27		272.32	0.005528	1.14	3.11	11.21	0.47
1	512	PF 1	2.00	271.42	272.02	271.94	272.12	0.012128	1.49	2.02	8.66	0.68
1	483	PF 1	2.00	271.06	271.74		271.81	0.008656	1.21	2.01	7.76	0.57
1	449	PF 1	2.00	271.07	271.56		271.58	0.004845	0.76	3.17	12.95	0.41
1	414	PF 1	2.00	270.81	271.23		271.32	0.013570	1.29	1.76	7.11	0.69
1	394	PF 1	2.00	270.56	271.03		271.09	0.008775	1.12	2.33	8.93	0.57
1	366	PF 1	2.00	270.32	270.89		270.92	0.004167	0.89	3.35	11.40	0.41
1	331	PF 1	2.00	270.12	270.82		270.83	0.001505	0.61	5.21	17.13	0.25
1	314	PF 1	2.00	270.08	270.81		270.82	0.000647	0.40	7.00	18.35	0.17
1	302	PF 1	2.00	269.71	270.81		270.81	0.000035	0.12	17.00	21.38	0.04
1	281	PF 1	2.00	269.88	270.79		270.81	0.001803	0.59	3.66	9.11	0.26
1	257	PF 1	2.00	269.89	270.76		270.77	0.001198	0.62	4.45	9.73	0.23
1	229	PF 1	2.00	269.76	270.73		270.74	0.001054	0.57	5.23	13.40	0.21
1	193	PF 1	2.00	269.62	270.70		270.71	0.000532	0.44	6.63	16.12	0.15
1	173	PF 1	2.00	269.71	270.69	270.15	270.70	0.000908	0.51	5.10	16.29	0.19
1	172.9		Culvert									
1	164	PF 1	2.00	269.72	270.27	270.27	270.50	0.027699	2.16	0.93	4.16	1.01
1	131	PF 1	2.00	269.18	270.25		270.27	0.000876	0.52	5.37	13.34	0.19
1	98	PF 1	2.00	269.00	270.26		270.26	0.000024	0.11	19.75	25.92	0.03
1	78	PF 1	2.00	270.00	270.18	270.18	270.25	0.041507	1.43	2.31	17.19	1.08
1	59	PF 1	2.00	268.86	269.48	269.47	269.59	0.017199	1.52	1.95	13.24	0.76
1	31	PF 1	2.00	268.58	269.26		269.30	0.005855	0.99	2.92	13.79	0.47
1	0	PF 1	2.00	268.32	269.03	268.95	269.09	0.008411	1.23	3.05	14.47	0.56

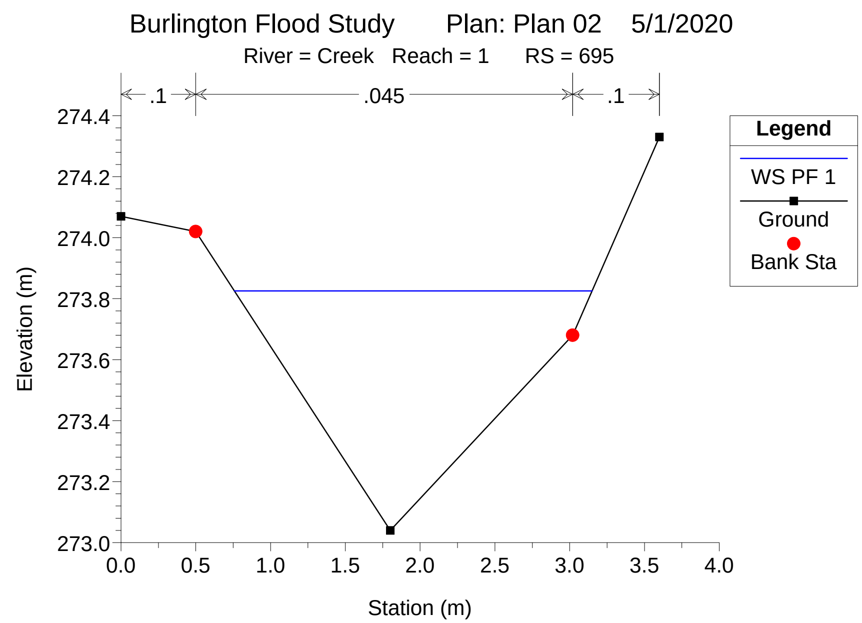


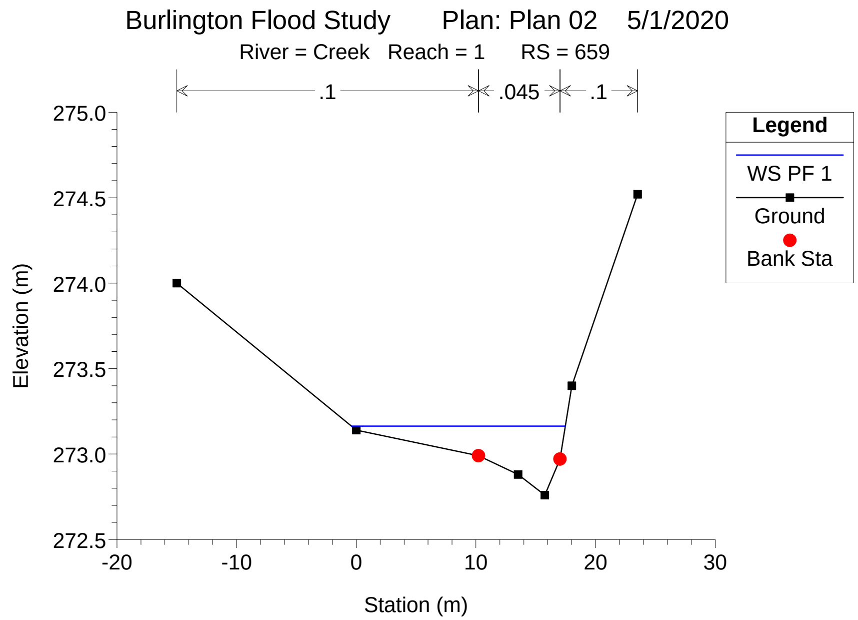
Burlington Flood Study Plan: Plan 02 5/1/2020
Creek 1
Legend
WS PF 1
Ground
Elevation (m)
275
274
273
272
271
270
269
268
0
100
200
300
400
500
600
700
800
Main Channel Distance (m)

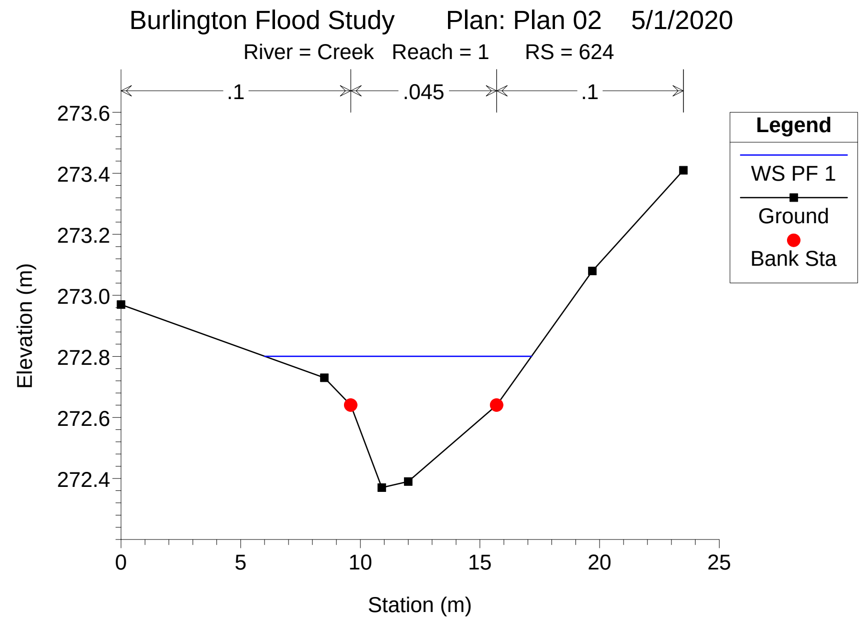
No Data for Plot

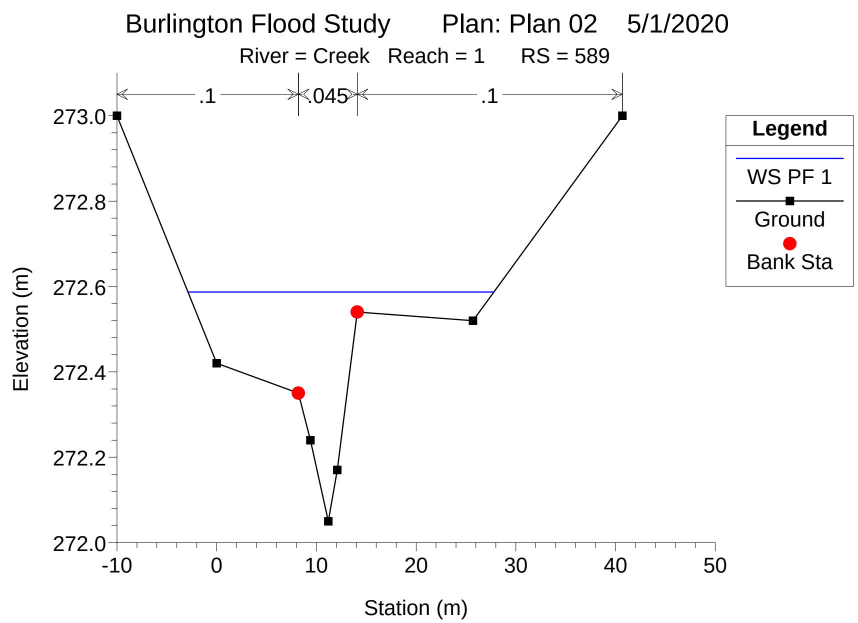


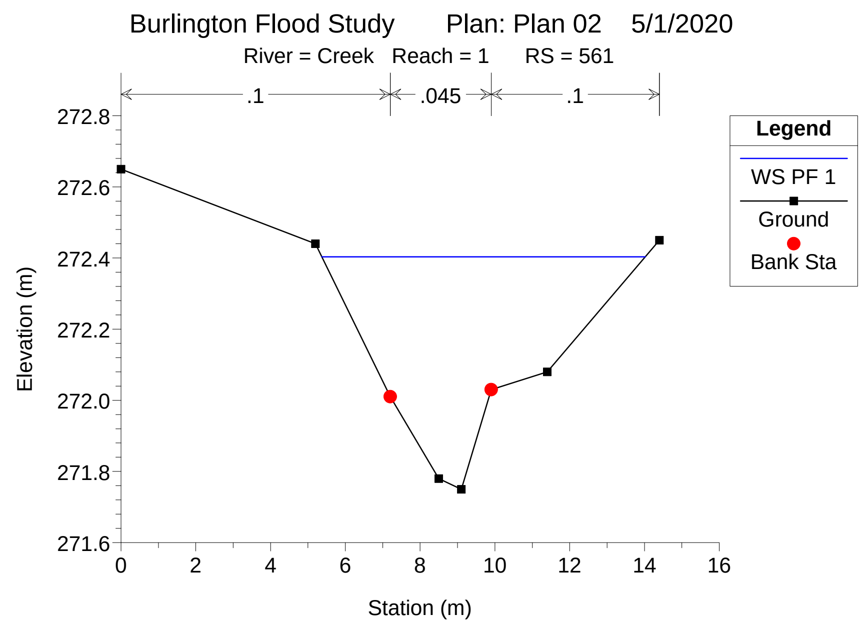


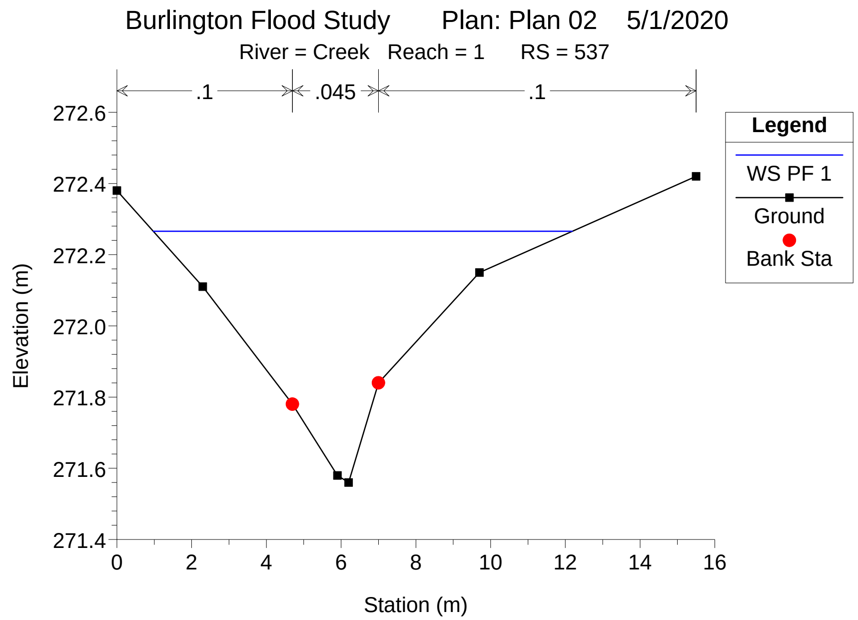


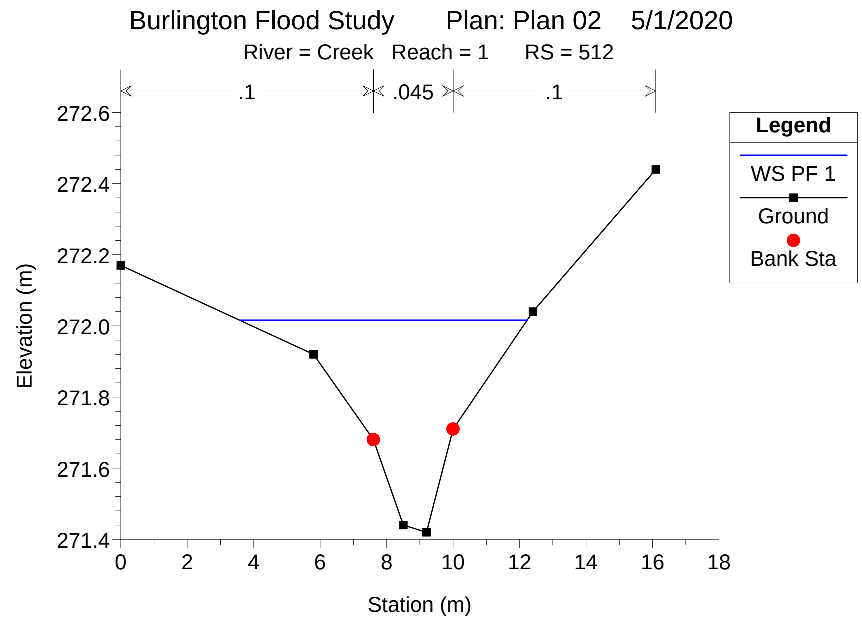

Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 659
.1
.045
.1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
275.0
274.5
274.0
273.5
273.0
272.5
-20
-10
0
10
20
30
Station (m)

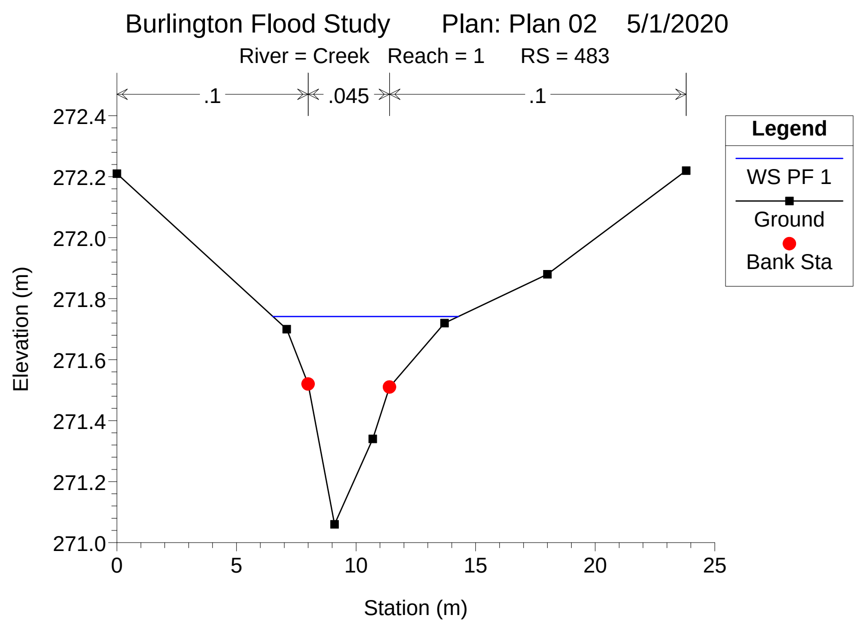

Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 624
.1
.045
.1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
273.6
273.4
273.2
273.0
272.8
272.6
272.4
0
5
10
15
20
25
Station (m)

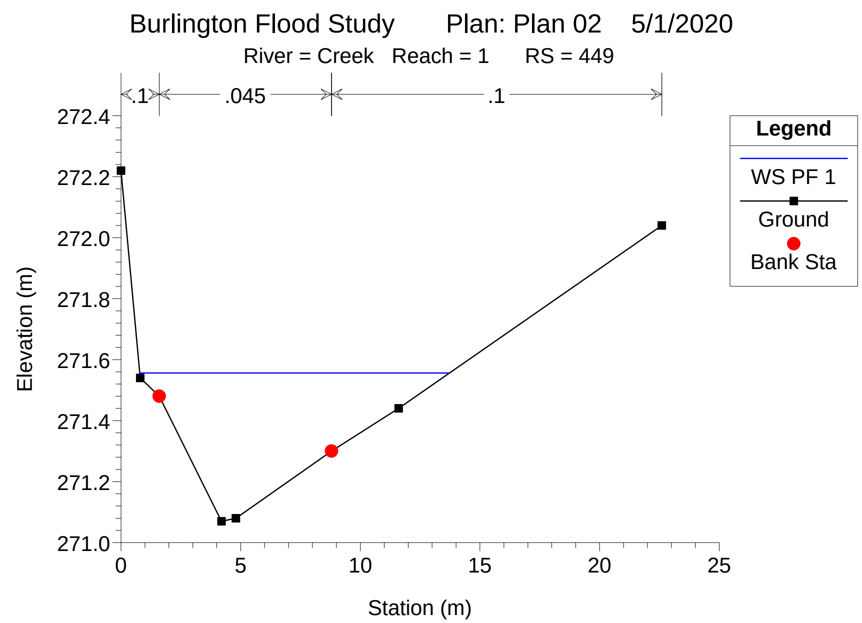

Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 589
.1
.045
.1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
273.0
272.8
272.6
272.4
272.2
272.0
-10
0
10
20
30
40
50
Station (m)

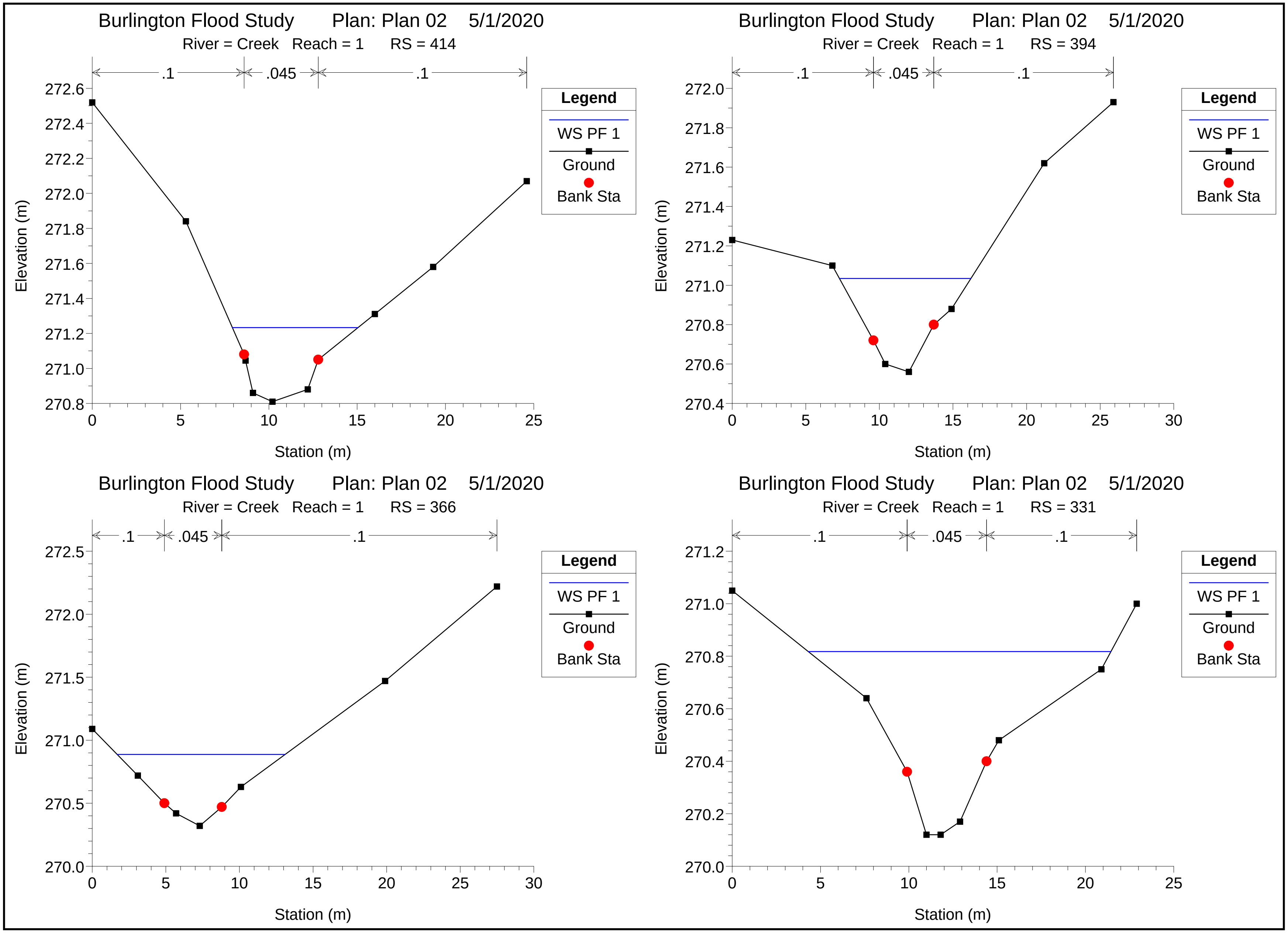

Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 561
.1
.045
.1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
272.8
272.6
272.4
272.2
272.0
271.8
271.6
0
2
4
6
8
10
12
14
16
Station (m)

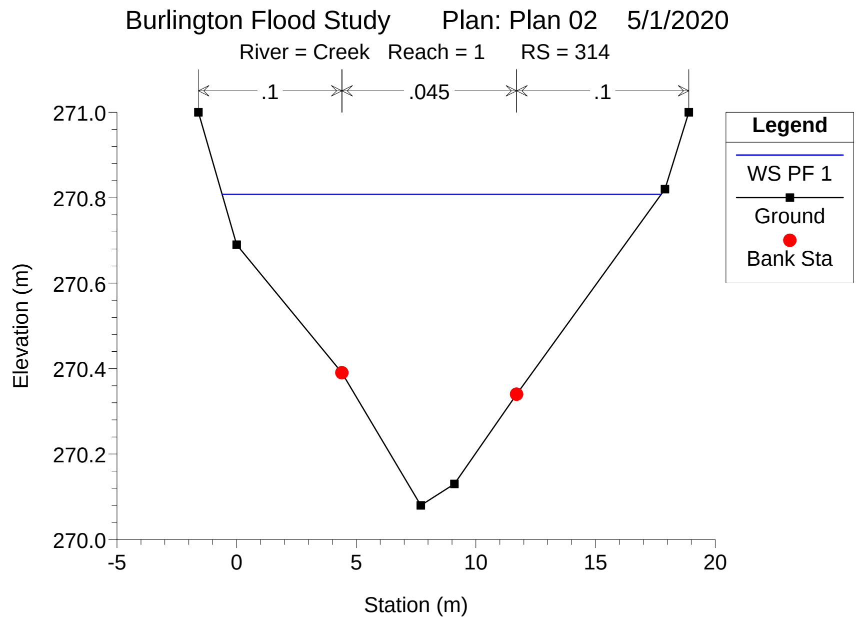

Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 537
.1 .045 .1
Elevation (m)
Station (m)
Legend
WS PF 1
Ground
Bank Sta

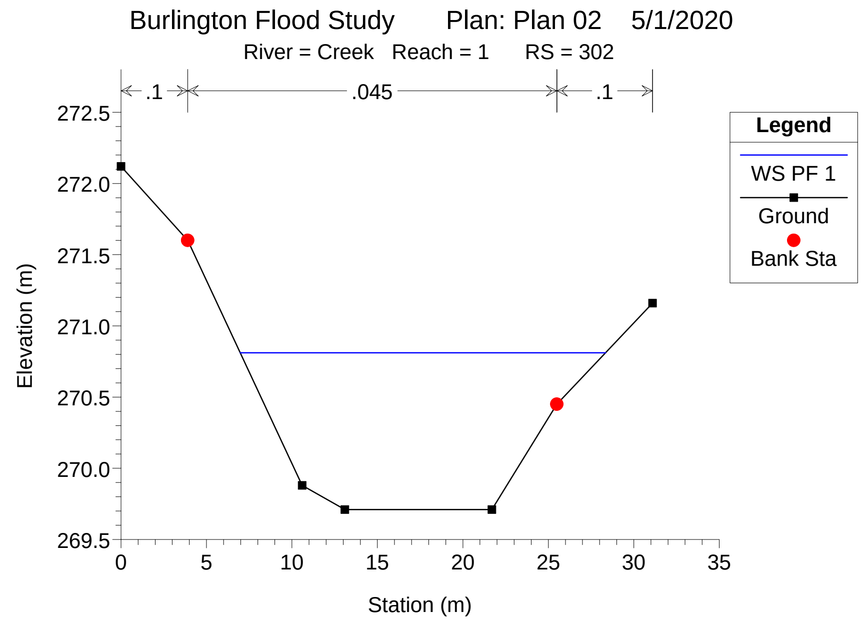

Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 512
.1 .045 .1
Elevation (m)
Station (m)
Legend
WS PF 1
Ground
Bank Sta

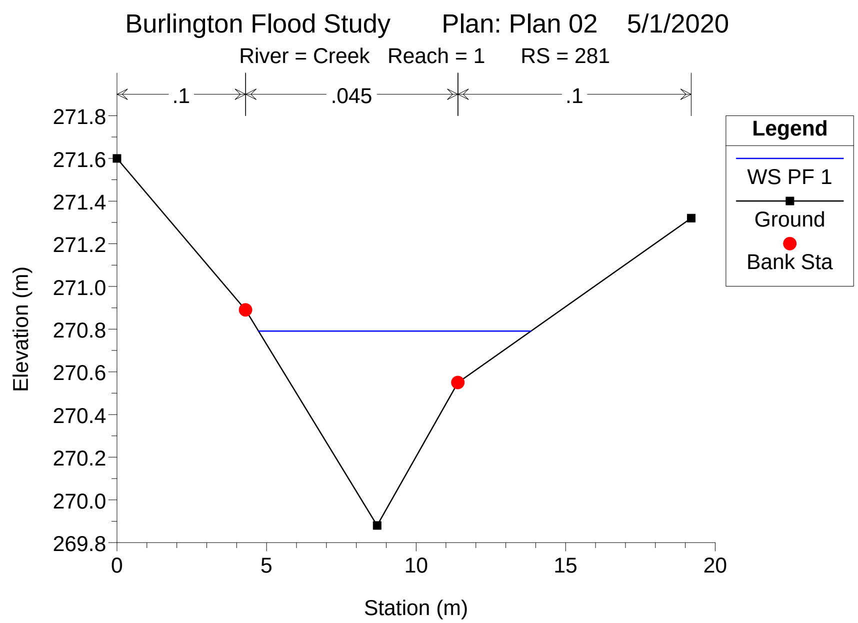

Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 483
.1 .045 .1
Elevation (m)
Station (m)
Legend
WS PF 1
Ground
Bank Sta

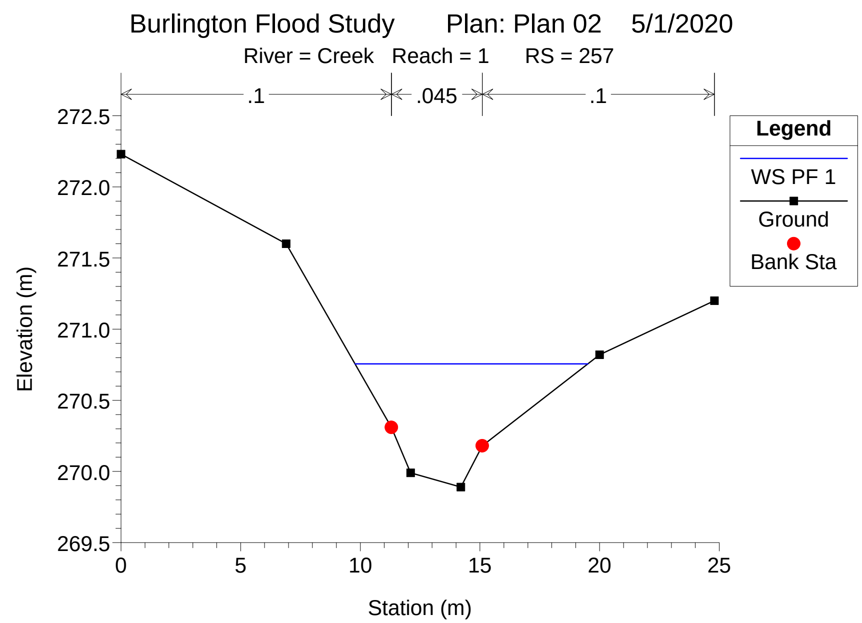

Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 449
.1 .045 .1
Elevation (m)
Station (m)
Legend
WS PF 1
Ground
Bank Sta

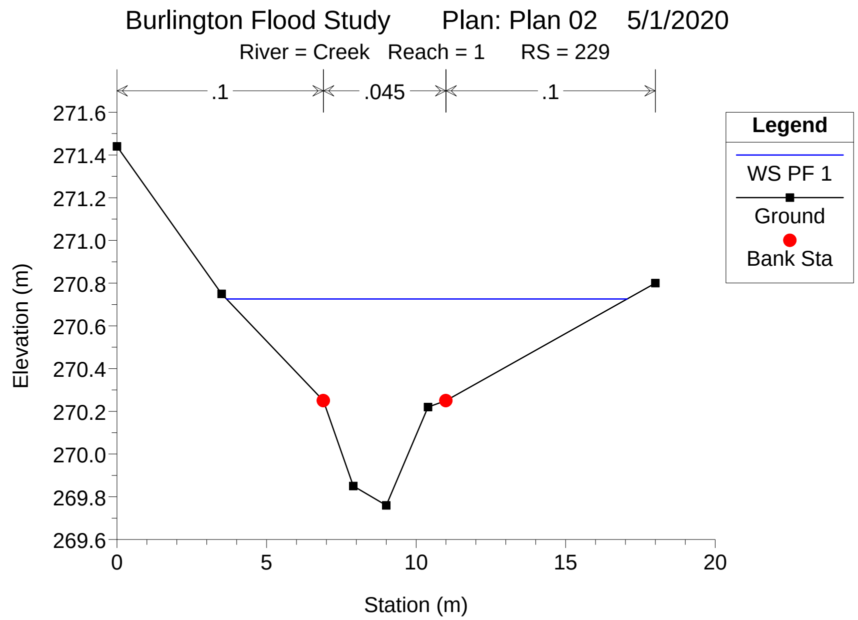

Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 414
.1 .045 .1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
272.6 272.4 272.2 272.0 271.8 271.6 271.4 271.2 271.0 270.8
0 5 10 15 20 25
Station (m)
Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 394
.1 .045 .1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
272.0 271.8 271.6 271.4 271.2 271.0 270.8 270.6 270.4
0 5 10 15 20 25 30
Station (m)
Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 366
.1 .045 .1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
272.5 272.0 271.5 271.0 270.5 270.0
0 5 10 15 20 25 30
Station (m)
Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 331
.1 .045 .1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
271.2 271.0 270.8 270.6 270.4 270.2 270.0
0 5 10 15 20 25
Station (m)

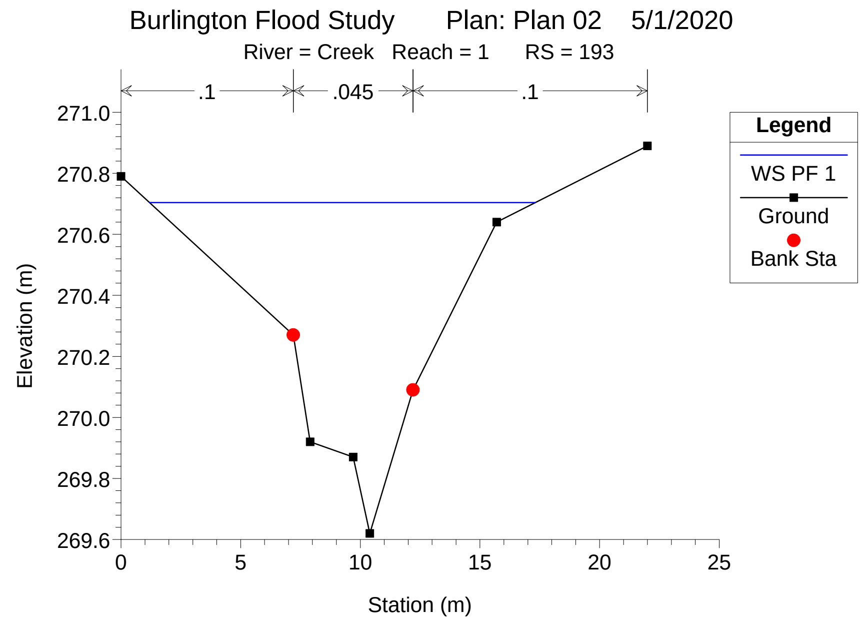

Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 314
.1
.045
.1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
271.0
270.8
270.6
270.4
270.2
270.0
-5
0
5
10
15
20
Station (m)

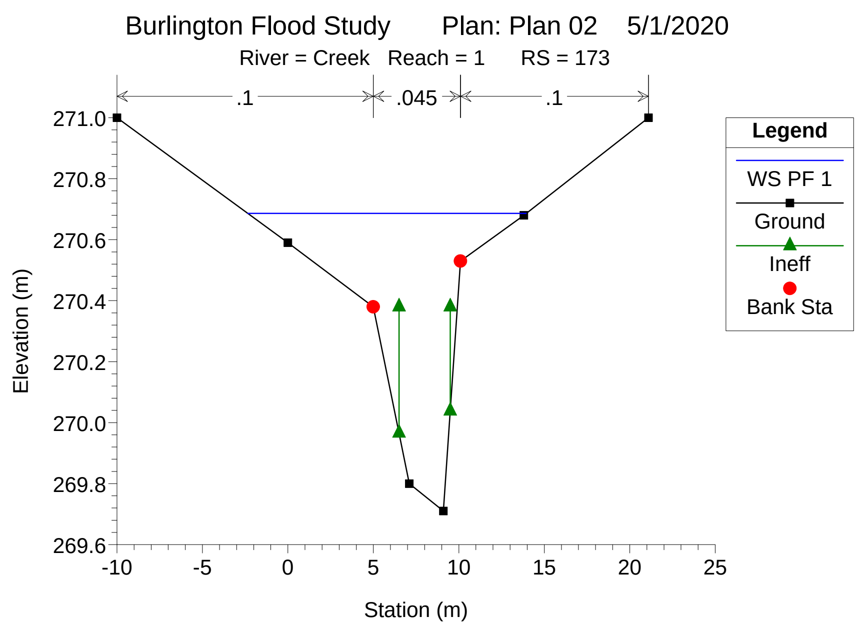

Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 302
.1
.045
.1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
272.5
272.0
271.5
271.0
270.5
270.0
269.5
0
5
10
15
20
25
30
35
Station (m)

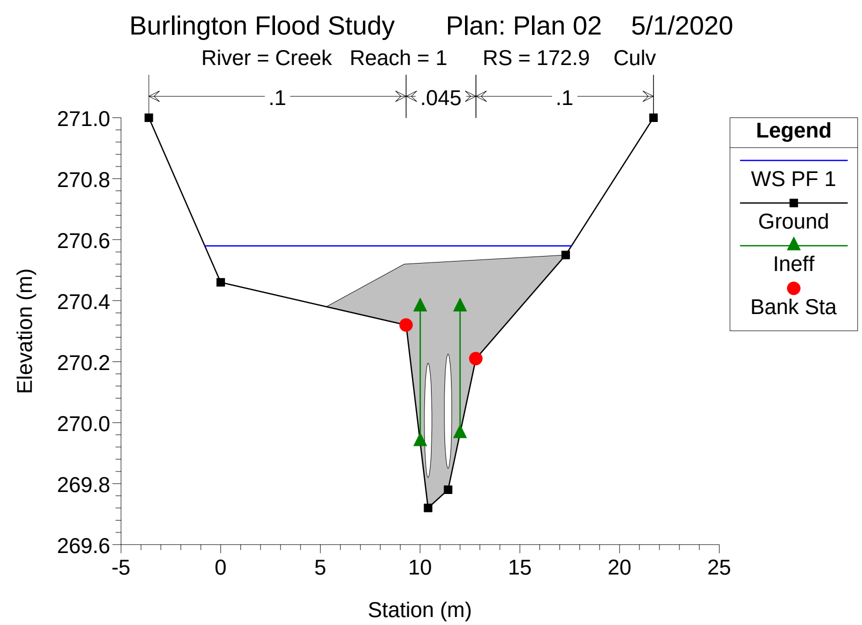

Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 281
.1
.045
.1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
271.8
271.6
271.4
271.2
271.0
270.8
270.6
270.4
270.2
270.0
269.8
0
5
10
15
20
Station (m)

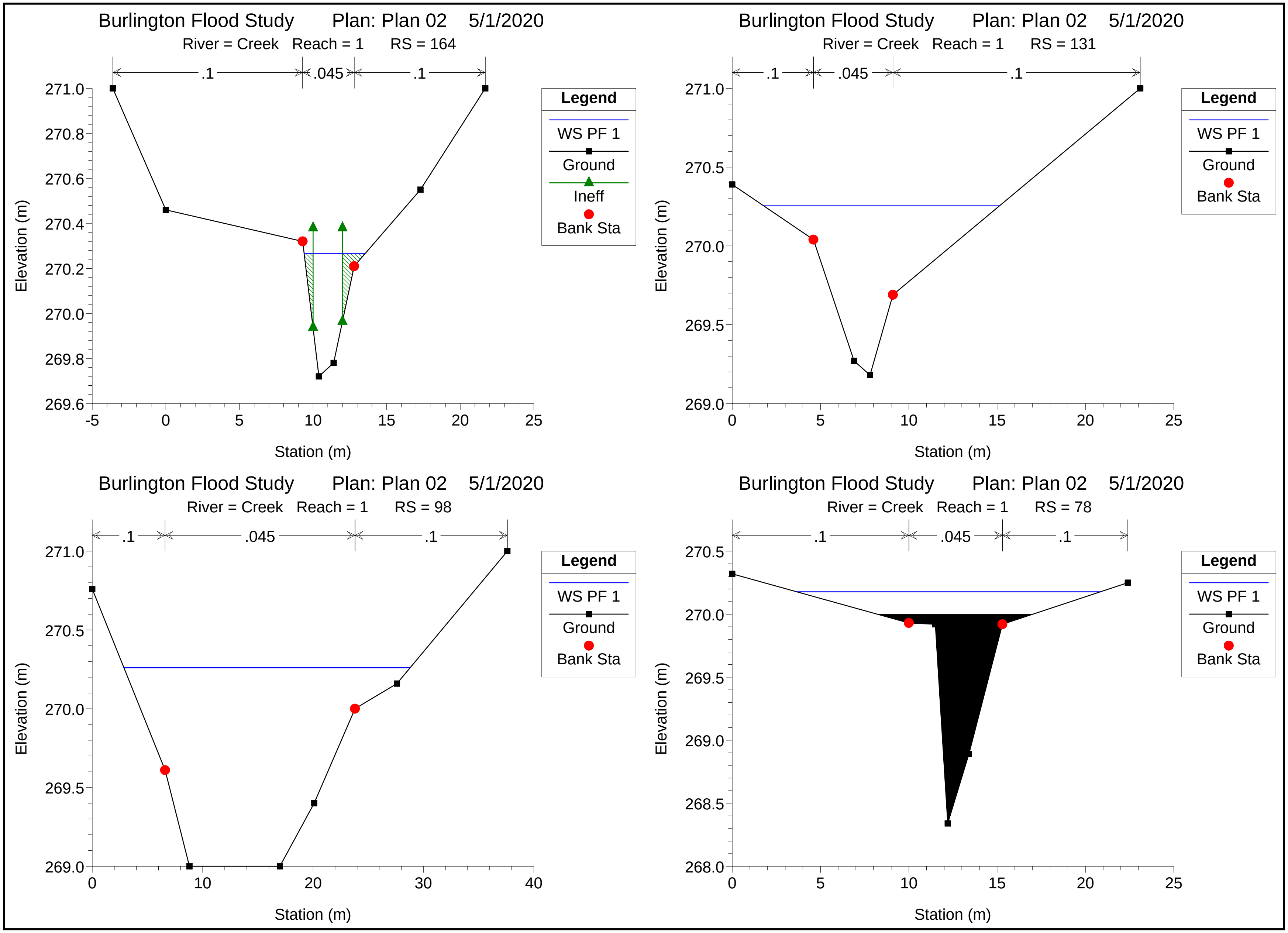

Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 257
.1
.045
.1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
272.5
272.0
271.5
271.0
270.5
270.0
269.5
0
5
10
15
20
25
Station (m)


Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 229
.1
.045
.1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
Station (m)
271.6
271.4
271.2
271.0
270.8
270.6
270.4
270.2
270.0
269.8
269.6
0
5
10
15
20


Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 193
.1
.045
.1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
Station (m)
271.0
270.8
270.6
270.4
270.2
270.0
269.8
269.6
0
5
10
15
20
25


Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 173
.1
.045
.1
Legend
WS PF 1
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
271.0
270.8
270.6
270.4
270.2
270.0
269.8
269.6
-10
-5
0
5
10
15
20
25


Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 172.9 Culv
.1
.045
.1
Legend
WS PF 1
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
271.0
270.8
270.6
270.4
270.2
270.0
269.8
269.6
-5
0
5
10
15
20
25



Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 164
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.045
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Legend
WS PF 1
Ground
Ineff
Bank Sta
Elevation (m)
271.0
270.8
270.6
270.4
270.2
270.0
269.8
269.6
-5
0
5
10
15
20
25
Station (m)
Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 131
.1
.045
.1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
271.0
270.5
270.0
269.5
269.0
0
5
10
15
20
25
Station (m)
Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 98
.1
.045
.1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
271.0
270.5
270.0
269.5
269.0
0
10
20
30
40
Station (m)
Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 78
.1
.045
.1
Legend
WS PF 1
Ground
Bank Sta
Elevation (m)
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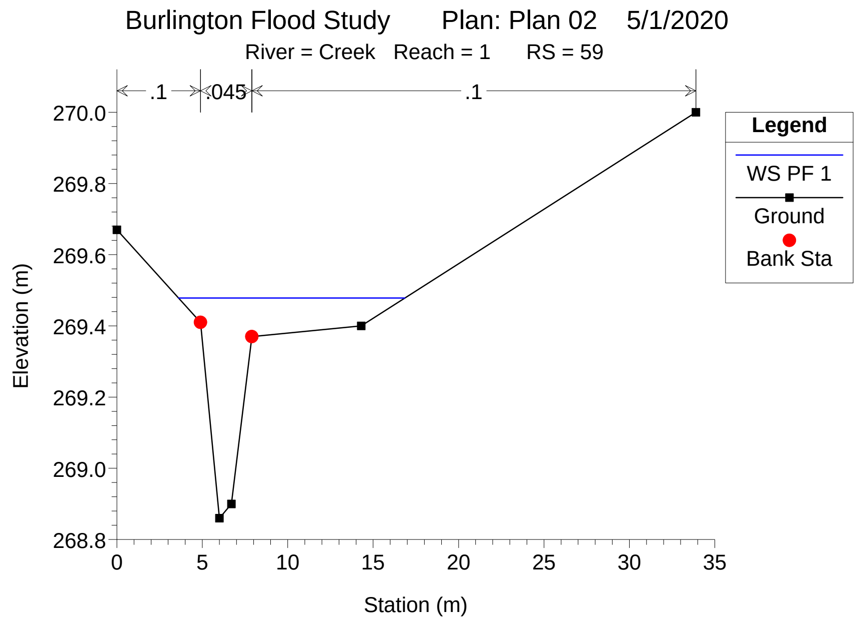
270.0
269.5
269.0
268.5
268.0
0
5
10
15
20
25
Station (m)


Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 59
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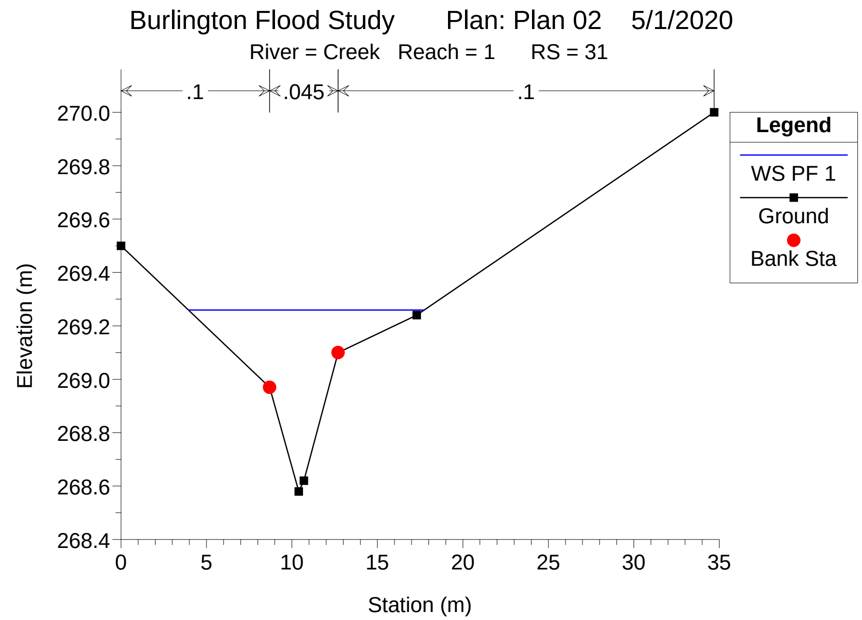
Elevation (m)
Station (m)
Legend
WS PF 1
Ground
Bank Sta


Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 31
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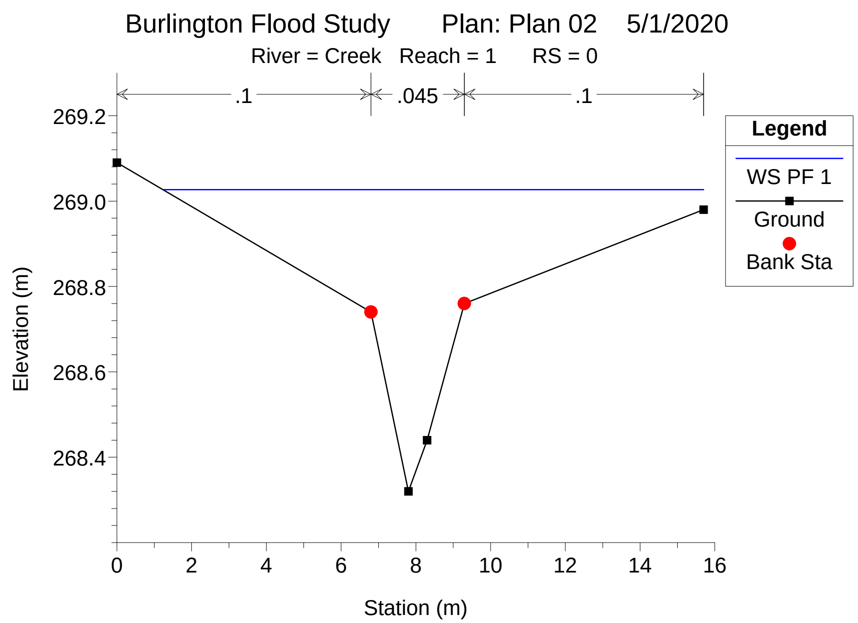
Elevation (m)
Station (m)
Legend
WS PF 1
Ground
Bank Sta


Burlington Flood Study Plan: Plan 02 5/1/2020
River = Creek Reach = 1 RS = 0
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.045
.1
Elevation (m)
Station (m)
Legend
WS PF 1
Ground
Bank Sta

Burlington Quarry

West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek

Geomorphic Parameters Summary

Parameter	Cross-section					
	A-A	B-B	C-C	D-D	E-E	Average
Bankfull Width (m)	3.1	6.7	6.2	7.2	3.3	5.3
Bankfull Depth (m)	0.19	0.54	0.31	0.72	0.43	0.44
Bankfull Area (m^2)	0.35	1.55	1.23	2.76	0.77	1.33
Wetted Perimeter (m)	5.26	12.92	9.52	16.29	9.31	10.66
Hydraulic Radius (m)	0.07	0.12	0.13	0.17	0.08	0.11
Floodprone Width (m)	12.6	22.9	15.2	22.9	31.5	21.0
Width - Depth Ratio	16.3	12.4	20.0	10.0	7.7	13.3
Entrenchment Ratio	4.1	3.4	2.4	3.2	9.5	4.5
Channel Slope (m/m)	0.011	0.006	0.006	0.004	0.010	0.007

Burlington Quarry
West Arm of the West Branch of the Mount Nemo Tributary of Grindstone Creek
Erosion Threshold Assessment

Cross-section C-C

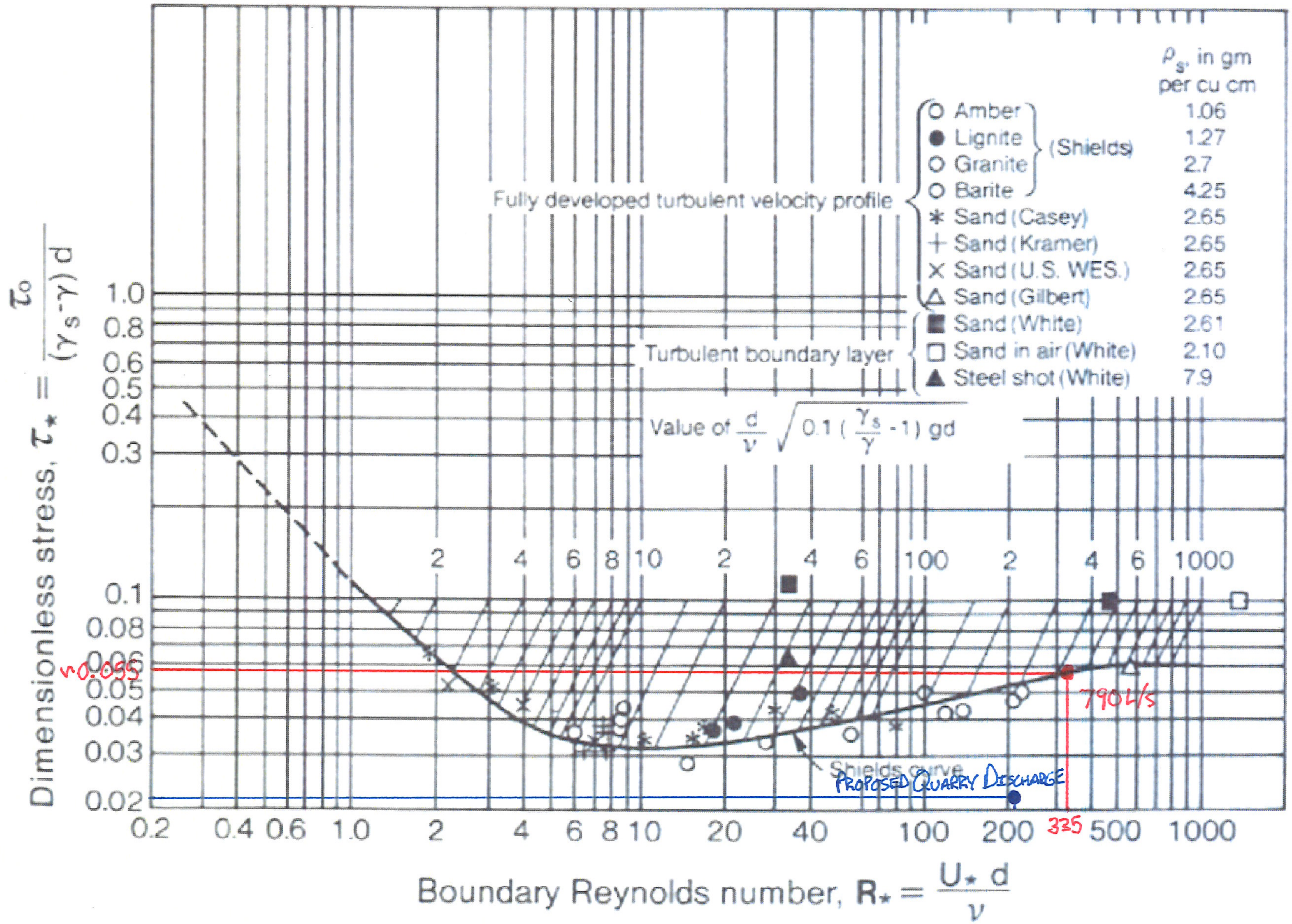
Parameter	Current Quarry Discharge (15 L/s)	Proposed Quarry Discharge (66 L/s)	25 mm Storm Peak Flow (70 L/s)	1:2-Year Design Storm Peak Flow		Critical Flow (790 L/s)
				Chicago Storm (150 L/s)	SCS Storm (440 L/s)	
Shear Stress (N/m^2)	0.7	1.8	1.85	3.5	2.71	4.4
Density (kg/m^3)	980	980	980	980	980	980
Shear Velocity (m/s)	0.026	0.043	0.043	0.060	0.053	0.067
Substrate D_{50} (mm)	5	5	5	5	5	5
Viscosity (m^2/s)	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06
Reynolds Number	130	213	217	299	263	335
Specific Weight (	2.65	2.65	2.65	2.65	2.65	2.65
Gravitational Constant (m/s^2)	9.81	9.81	9.81	9.81	9.81	9.81
Entrainment Function	0.008	0.022	0.023	0.044	0.034	0.055
Shields Method (Diagram)	**Stable**	**Stable**	**Stable**	**Stable**	**Stable**	**Erosion Threshold**

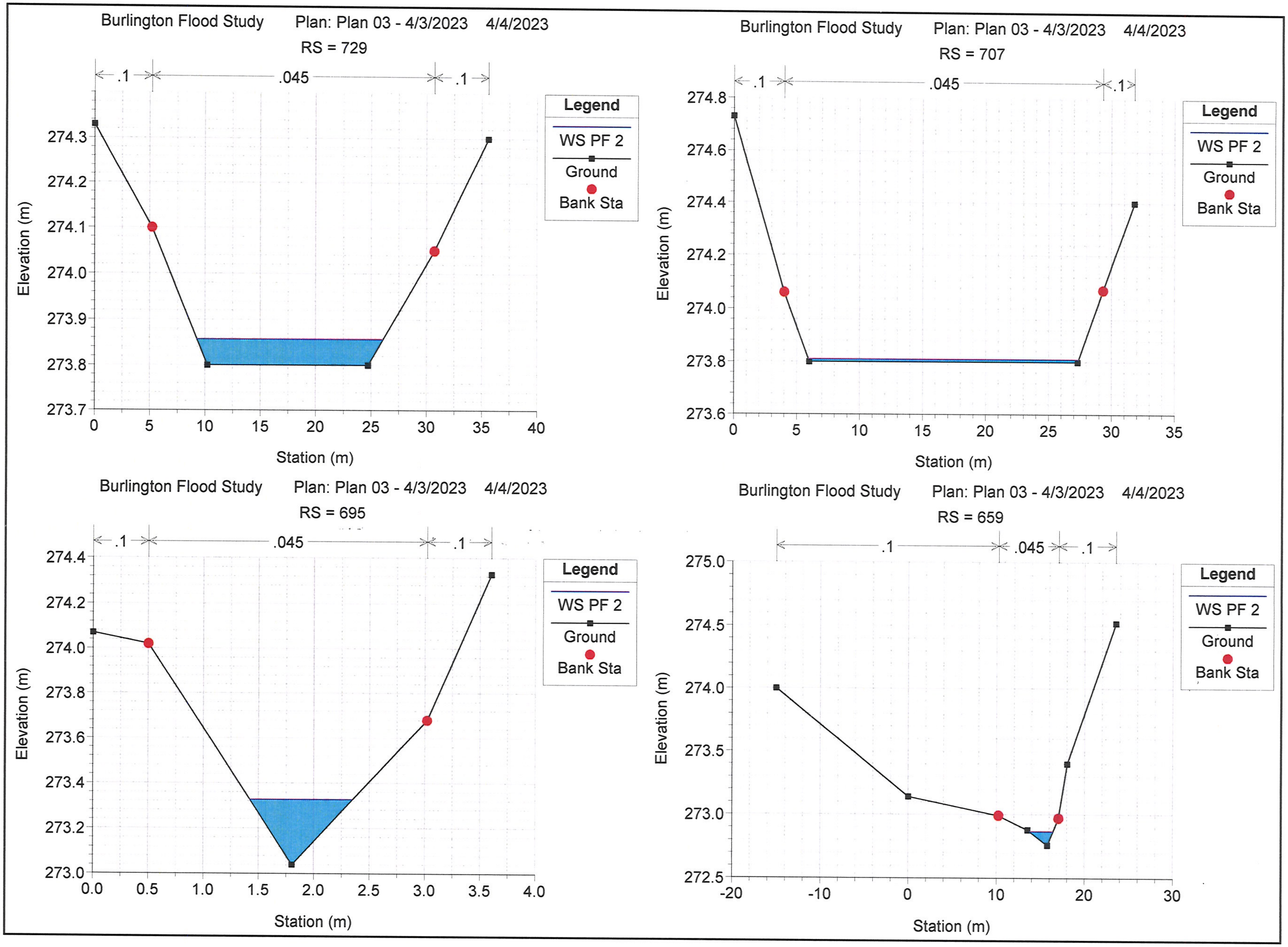
Cross-Section D-D

Parameter	Current Quarry Discharge (15 L/s)	Proposed Quarry Discharge (66 L/s)	25 mm Storm Peak Flow (70 L/s)	1:2-Year Design Storm Peak Flow		Critical Flow (790 L/s)
				Chicago Storm (150 L/s)	SCS Storm (440 L/s)	
Shear Stress (N/m^2)	0.1	0.6	0.65	1.05	1.01	2.2
Density (kg/m^3)	980	980	980	980	980	980
Shear Velocity (m/s)	0.008	0.025	0.026	0.033	0.032	0.047
Substrate D_{50} (mm)	5	5	5	5	5	5
Viscosity (m^2/s)	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06
Reynolds Number	42	125	129	164	161	237
Specific Weight (	2.65	2.65	2.65	2.65	2.65	2.65
Gravitational Constant (m/s^2)	9.81	9.81	9.81	9.81	9.81	9.81
Entrainment Function	0.001	0.008	0.008	0.013	0.013	0.028
Shields Method (Diagram)	**Stable**	**Stable**	**Stable**	**Stable**	**Stable**	**Stable**

SHIELDS DIAGRAM

CROSS-SECTION C-C

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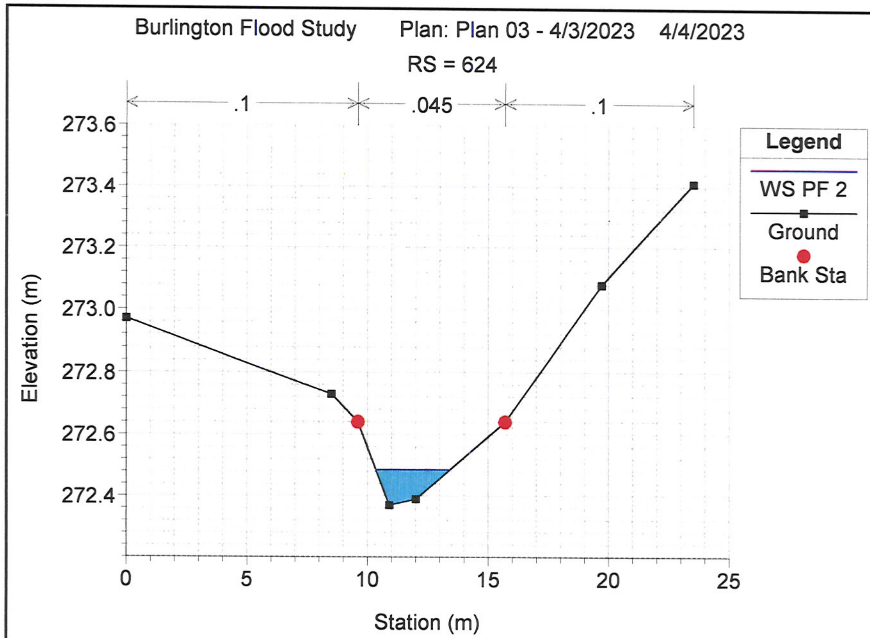
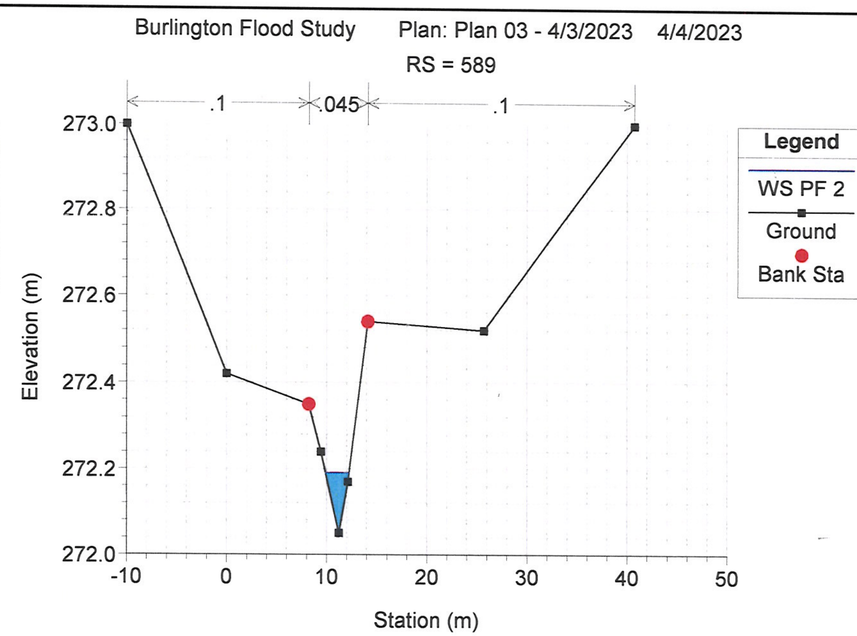
RS = 729
.1
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
Station (m)
Burlington Flood Study Plan: Plan 03 - 4/3/2023 4/4/2023
RS = 707
.1
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
Station (m)
Burlington Flood Study Plan: Plan 03 - 4/3/2023 4/4/2023
RS = 695
.1
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
Station (m)
Burlington Flood Study Plan: Plan 03 - 4/3/2023 4/4/2023
RS = 659
.1
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
Station (m)



Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
RS = 624
.1
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
273.6
273.4
273.2
273.0
272.8
272.6
272.4
0
5
10
15
20
25
Station (m)



Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
RS = 589
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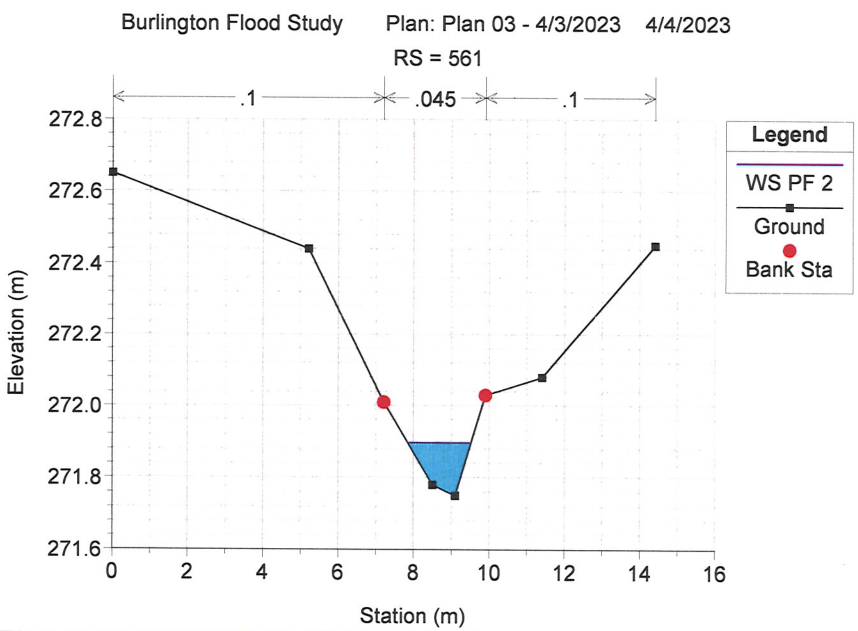
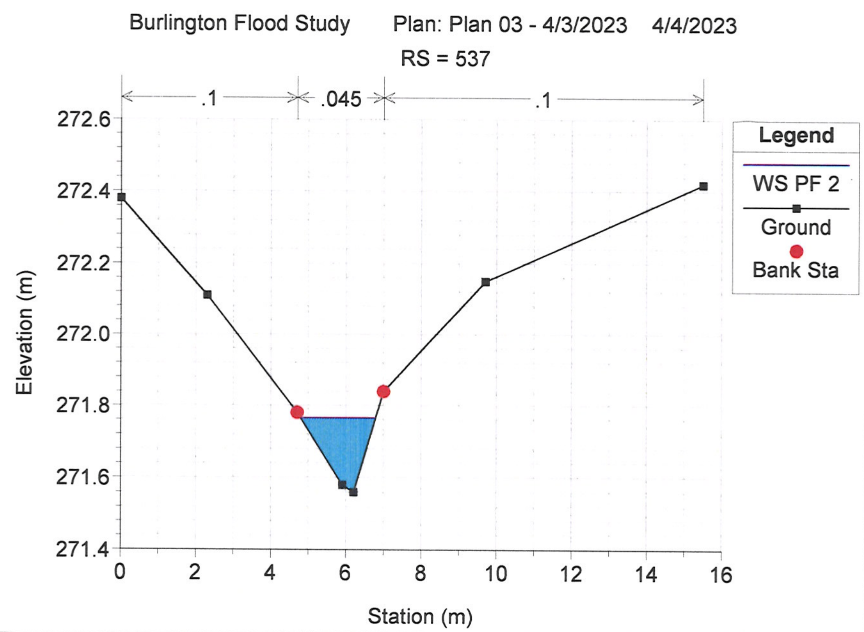
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
273.0
272.8
272.6
272.4
272.2
272.0
-10
0
10
20
30
40
50
Station (m)



Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
RS = 561
.1
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
272.8
272.6
272.4
272.2
272.0
271.8
271.6
0
2
4
6
8
10
12
14
16
Station (m)



Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
RS = 537
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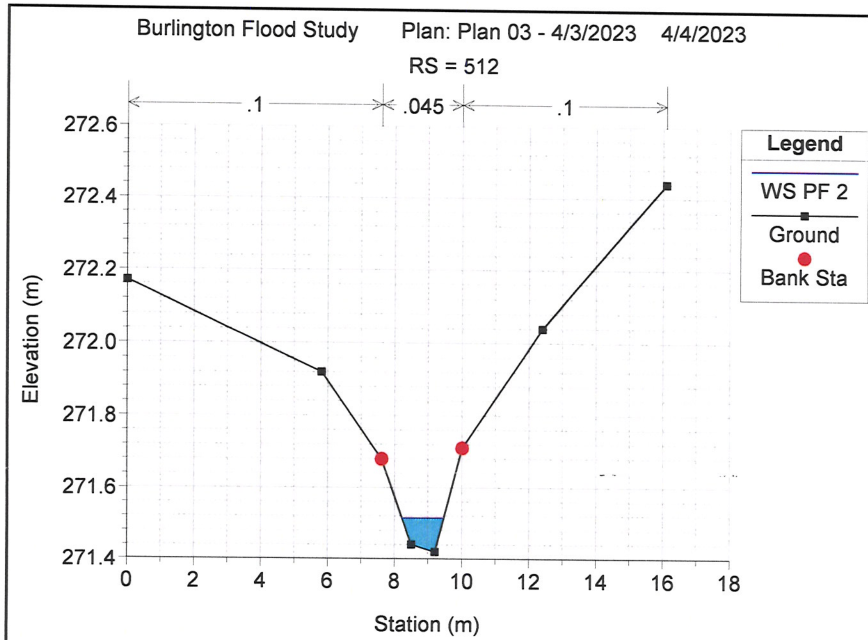
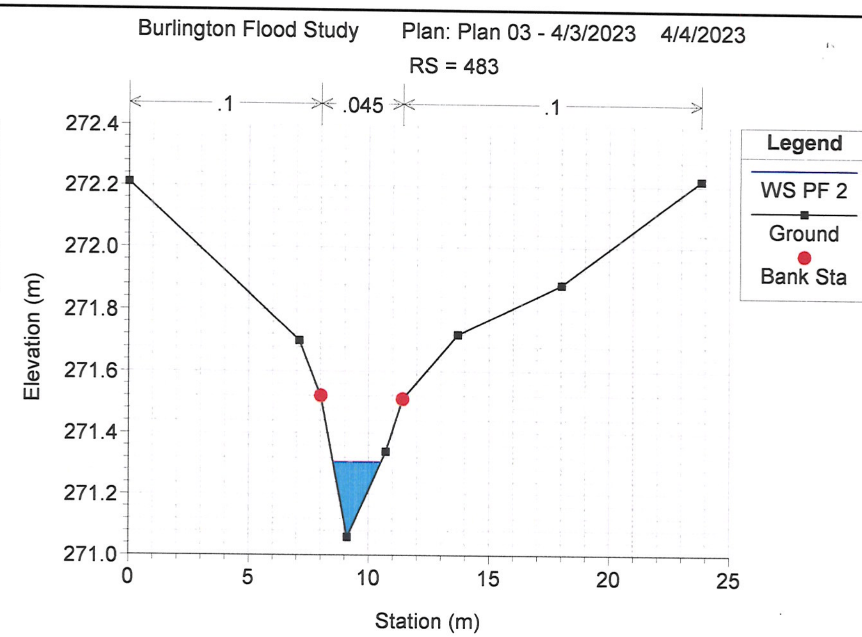
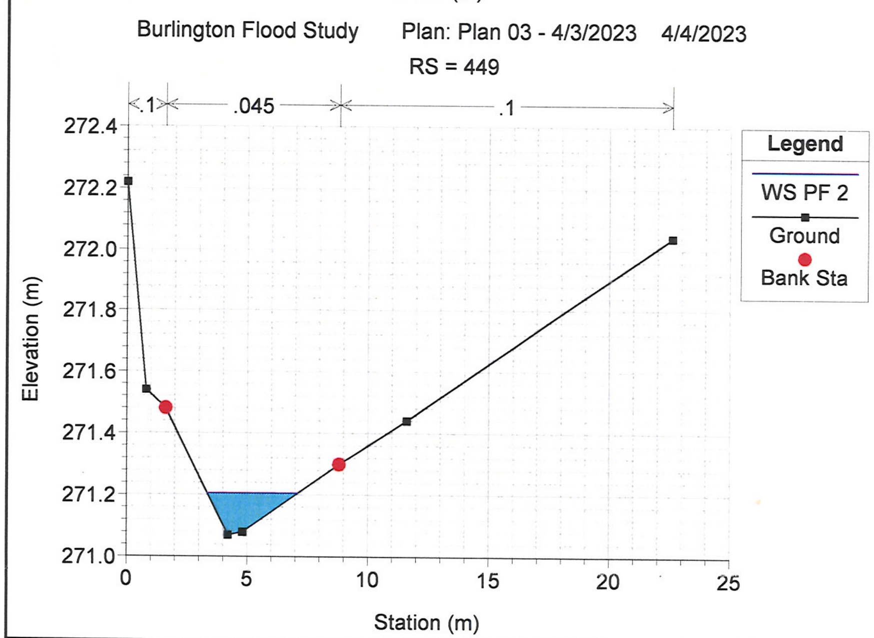
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
272.6
272.4
272.2
272.0
271.8
271.6
271.4
0
2
4
6
8
10
12
14
16
Station (m)


Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
RS = 512
.1
.045
.1
Legend
WS PF 2
Ground
Bank Sta
272.6
272.4
272.2
272.0
271.8
271.6
271.4
Elevation (m)
0
2
4
6
8
10
12
14
16
18
Station (m)


Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
RS = 483
.1
.045
.1
Legend
WS PF 2
Ground
Bank Sta
272.4
272.2
272.0
271.8
271.6
271.4
271.2
271.0
Elevation (m)
0
5
10
15
20
25
Station (m)


Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
RS = 449
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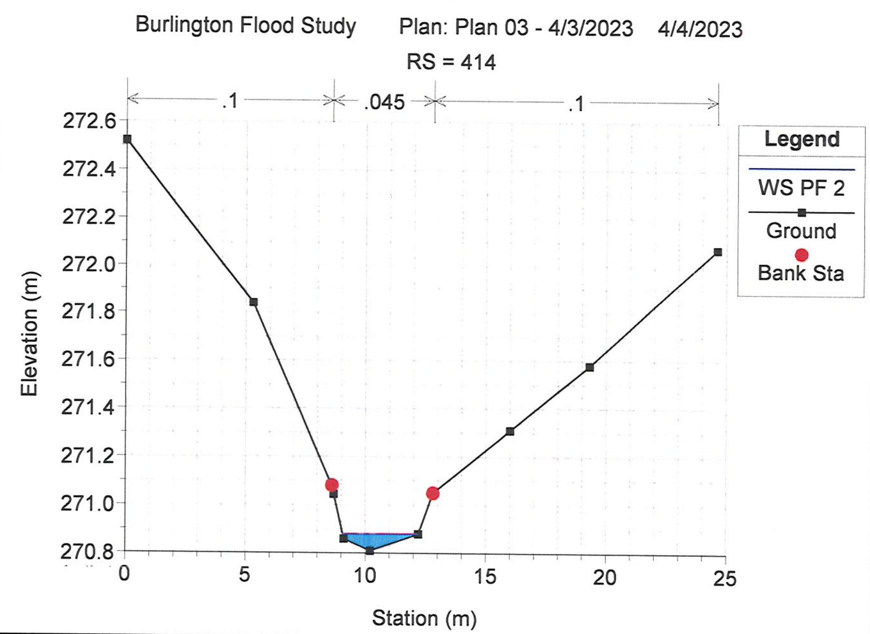
.045
.1
Legend
WS PF 2
Ground
Bank Sta
272.4
272.2
272.0
271.8
271.6
271.4
271.2
271.0
Elevation (m)
0
5
10
15
20
25
Station (m)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Plan: Plan 03 - 4/3/2023
4/4/2023
RS = 414
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Legend
WS PF 2
Ground
Bank Sta
272.6
272.4
272.2
272.0
271.8
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271.2
271.0
270.8
Elevation (m)
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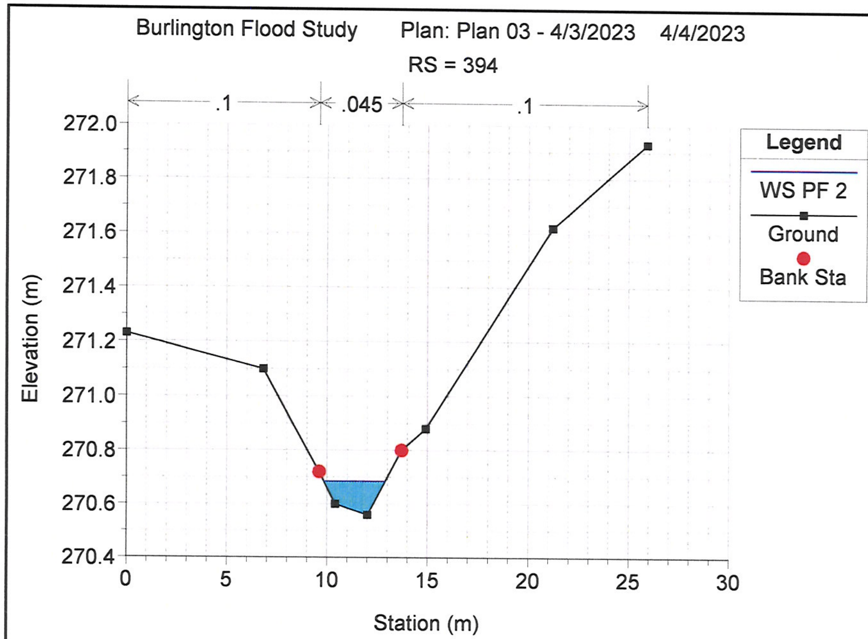
5
10
15
20
25
Station (m)


Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
RS = 394
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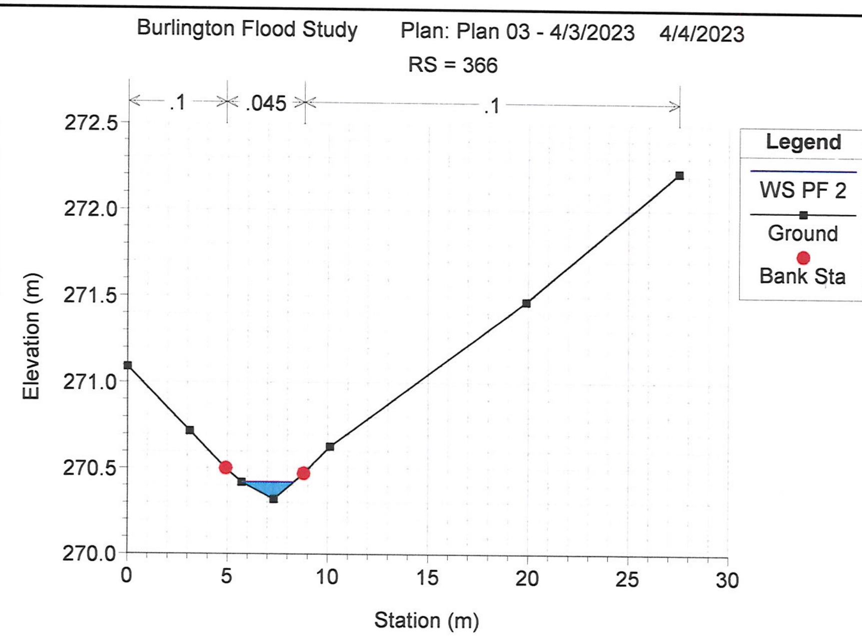
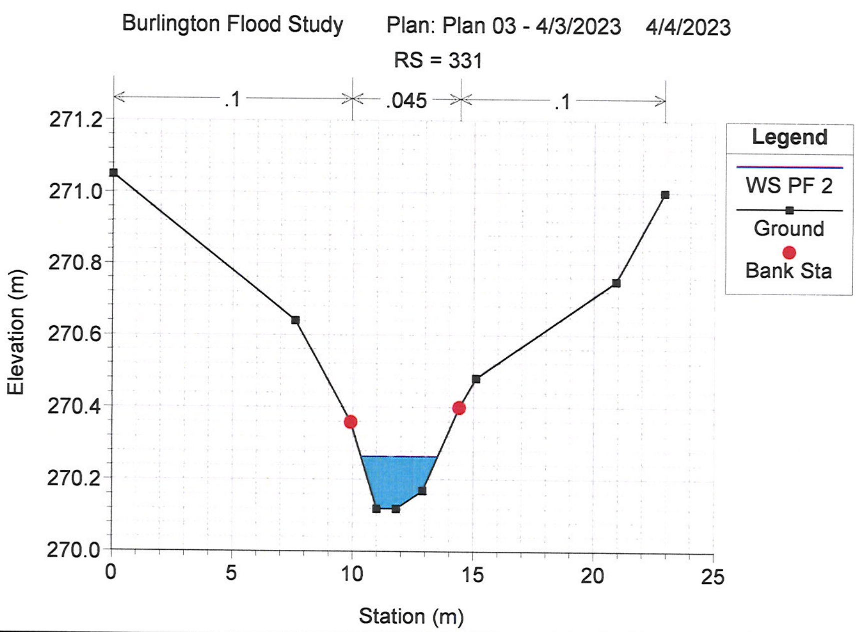
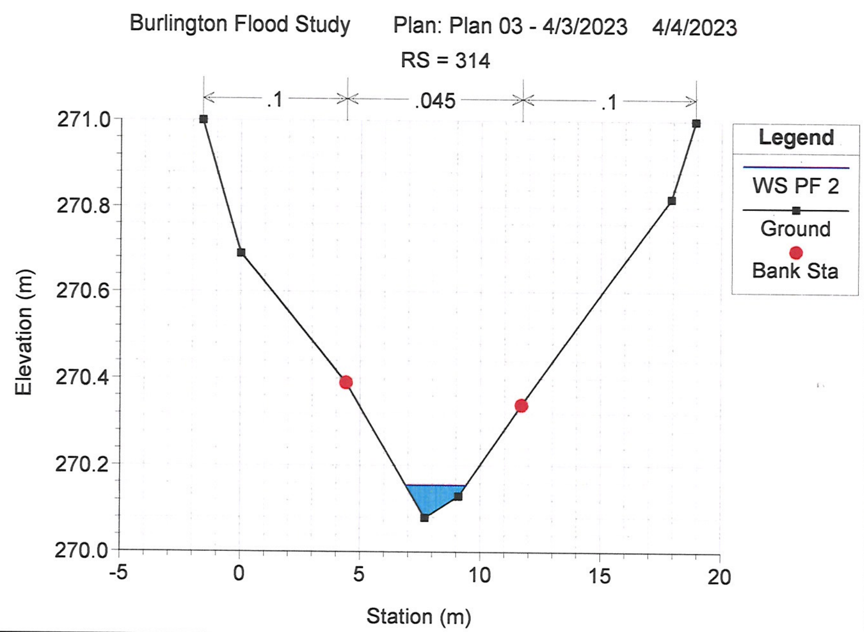
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
Station (m)


Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
RS = 366
.1
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
Station (m)


Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
RS = 331
.1
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
Station (m)


Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
RS = 314
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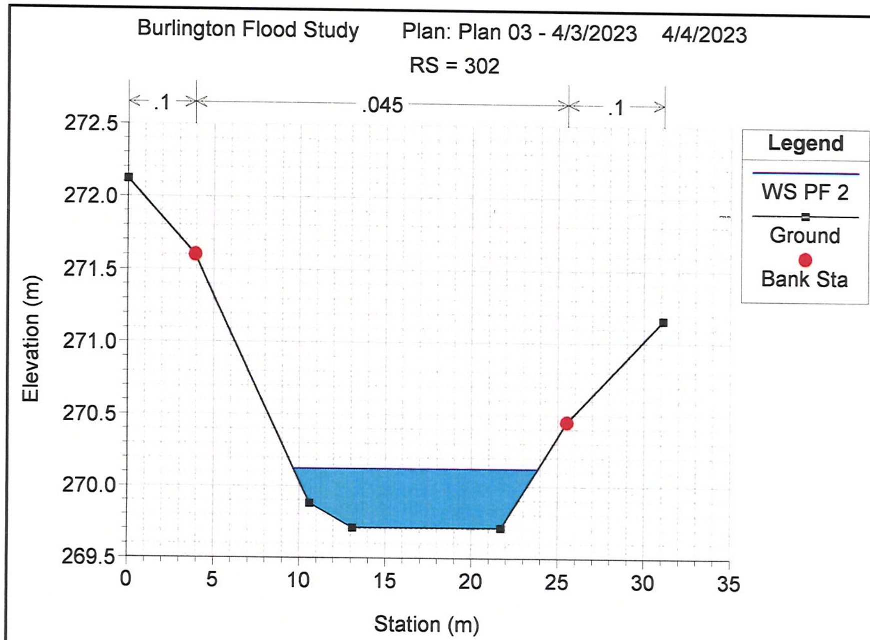
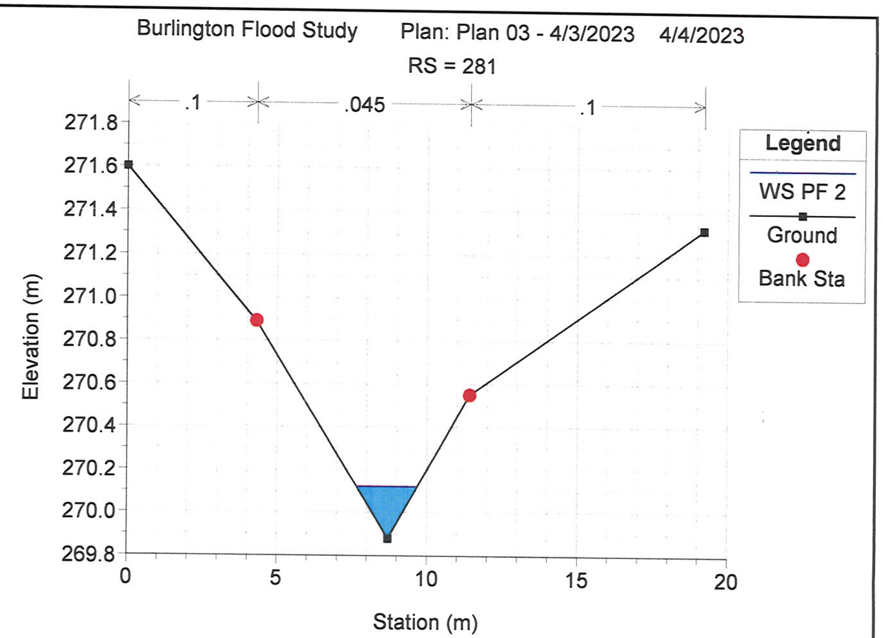
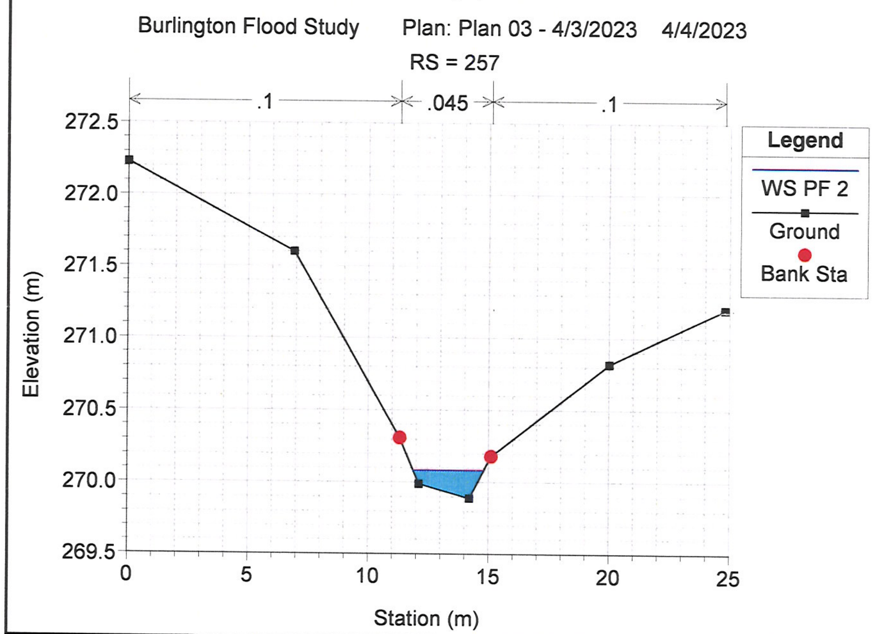
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
Station (m)


Burlington Flood Study
Plan: Plan 03 - 4/3/2023 4/4/2023
RS = 302
.1
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
272.5
272.0
271.5
271.0
270.5
270.0
269.5
0
5
10
15
20
25
30
35
Station (m)


Burlington Flood Study
Plan: Plan 03 - 4/3/2023 4/4/2023
RS = 281
.1
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
271.8
271.6
271.4
271.2
271.0
270.8
270.6
270.4
270.2
270.0
269.8
0
5
10
15
20
Station (m)


Burlington Flood Study
Plan: Plan 03 - 4/3/2023 4/4/2023
RS = 257
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.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
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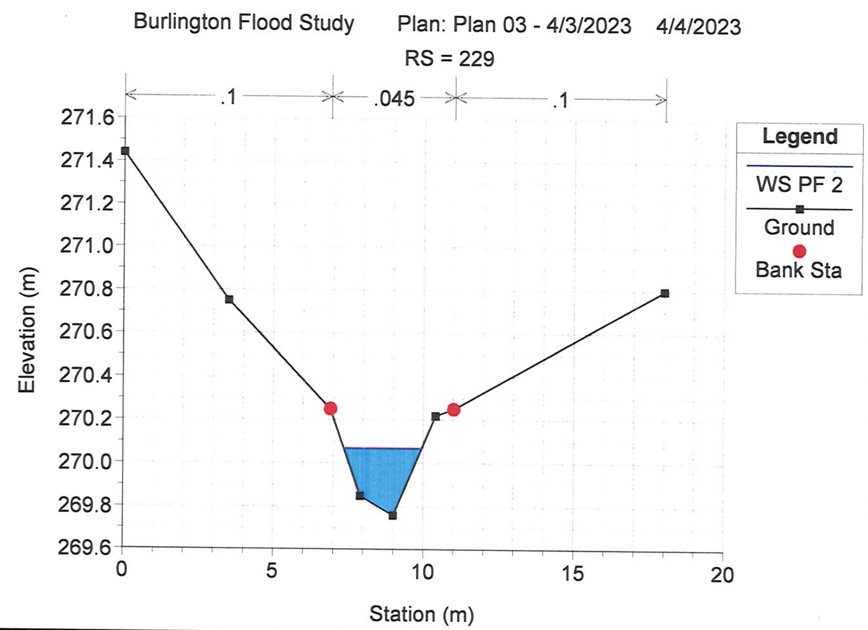
272.0
271.5
271.0
270.5
270.0
269.5
0
5
10
15
20
25
Station (m)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Plan: Plan 03 - 4/3/2023 4/4/2023
RS = 229
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.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
271.6
271.4
271.2
271.0
270.8
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270.2
270.0
269.8
269.6
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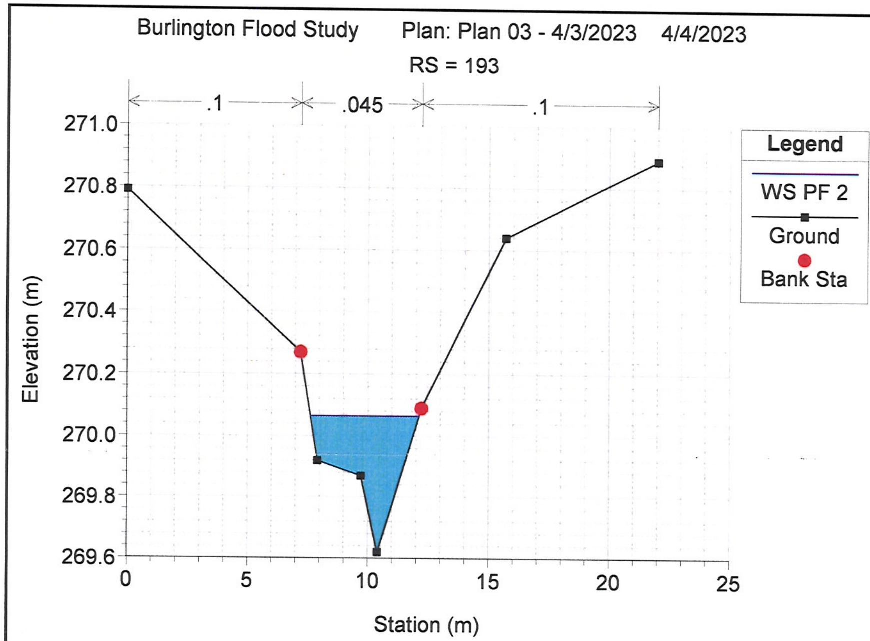
5
10
15
20
Station (m)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Plan: Plan 03 - 4/3/2023
4/4/2023
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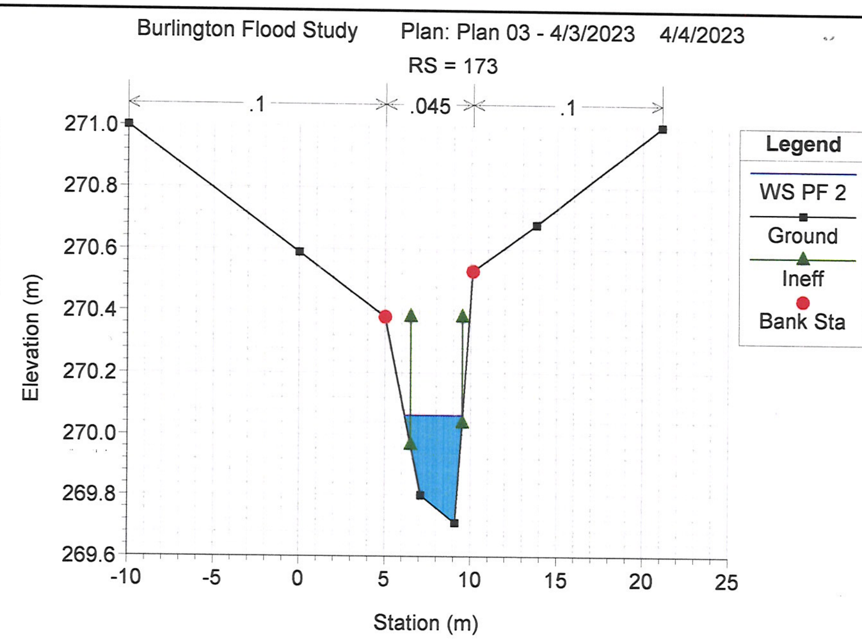
.1
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
Station (m)


Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
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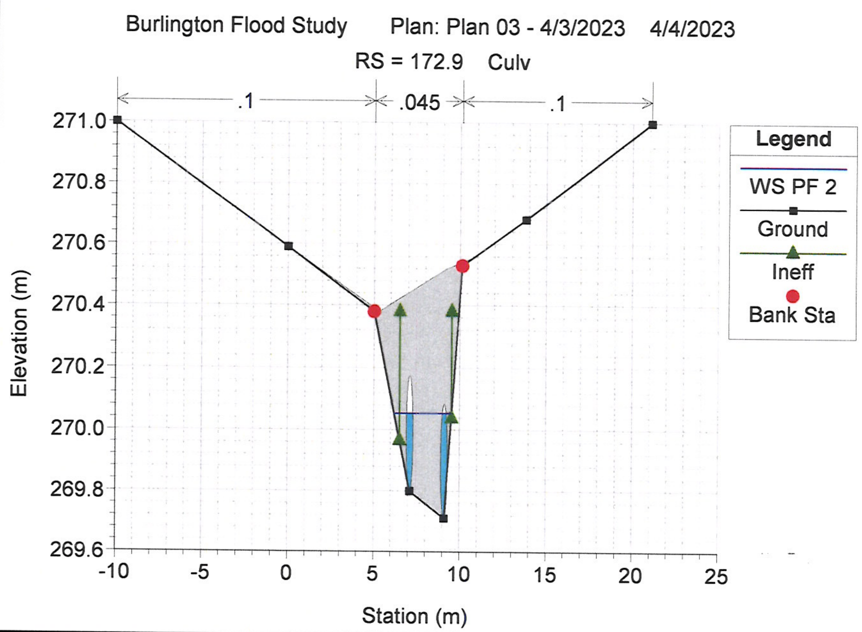
.1
.045
.1
Legend
WS PF 2
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)


Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
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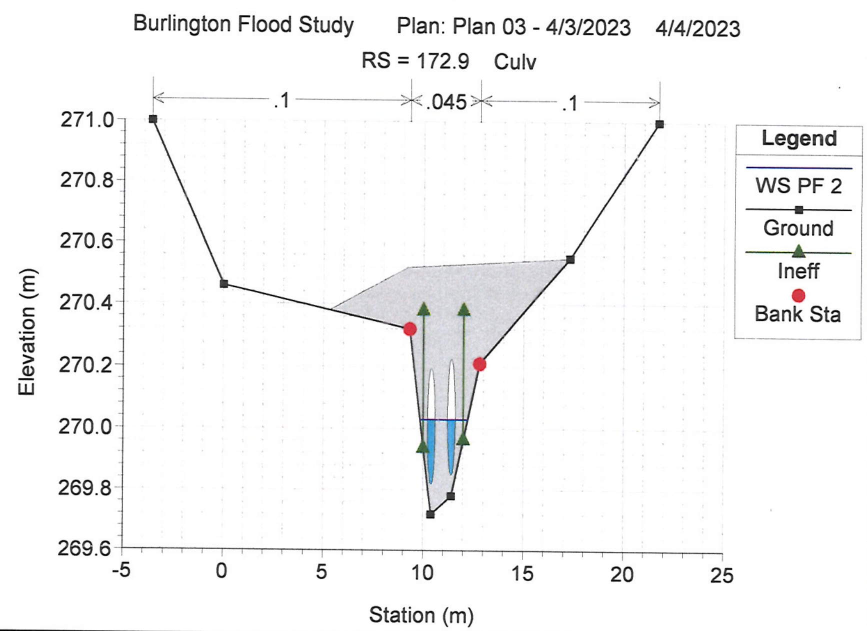
.1
.045
.1
Legend
WS PF 2
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)


Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
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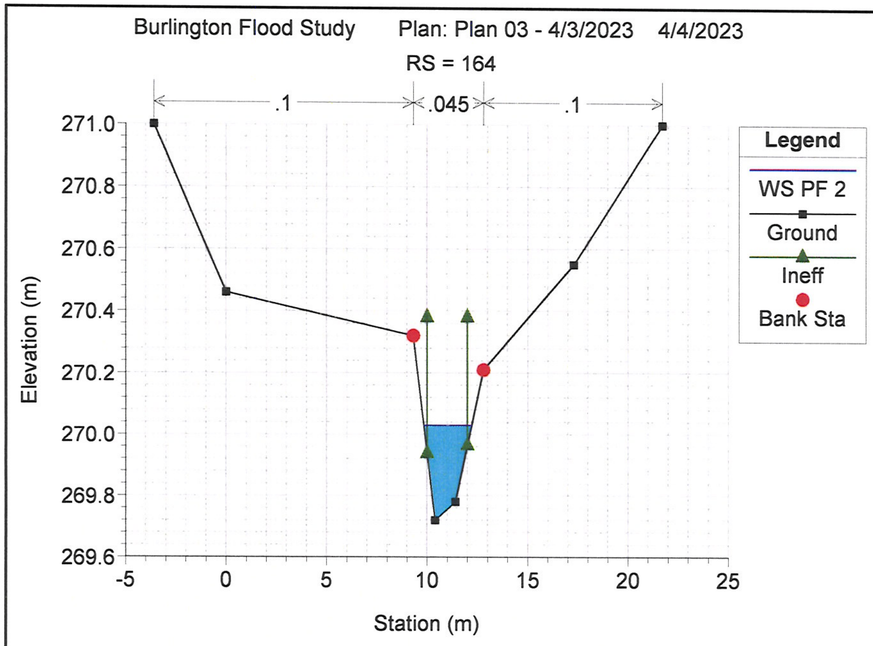
.1
.045
.1
Legend
WS PF 2
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)


Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
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.045
.1
Legend
WS PF 2
Ground
Ineff
Bank Sta
Elevation (m)
Station (m)
271.0
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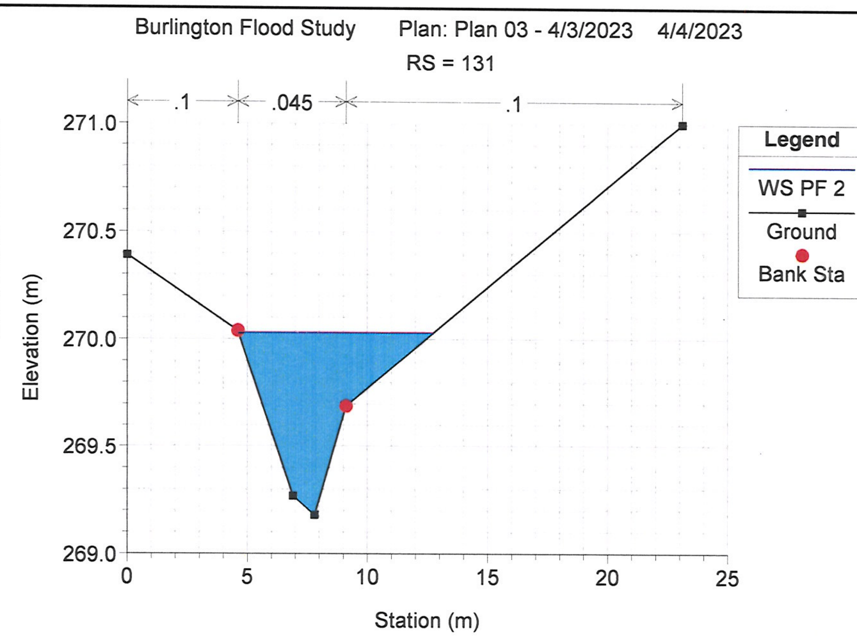
270.4
270.2
270.0
269.8
269.6
-5
0
5
10
15
20
25


Burlington Flood Study
Plan: Plan 03 - 4/3/2023
4/4/2023
RS = 131
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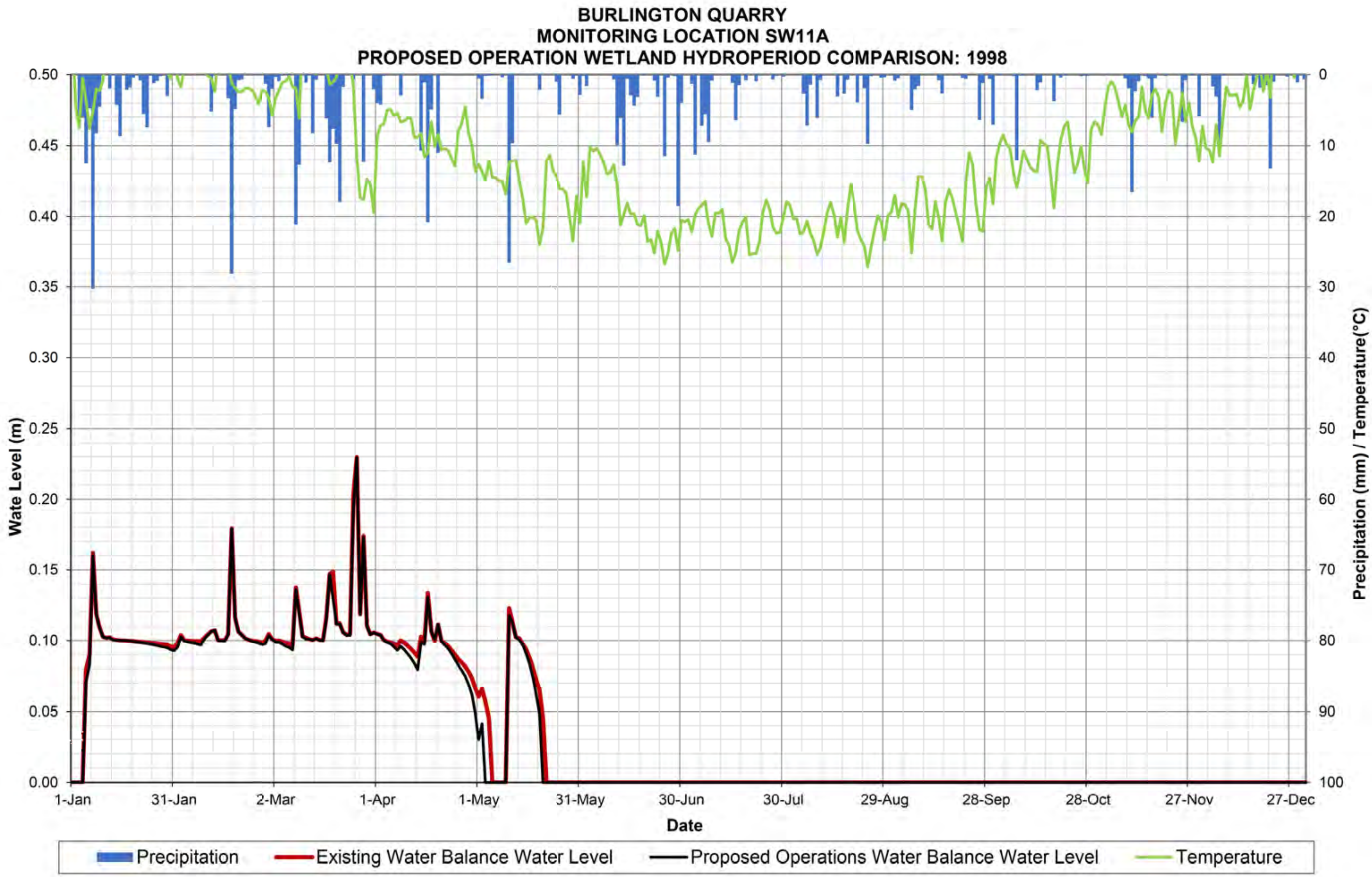
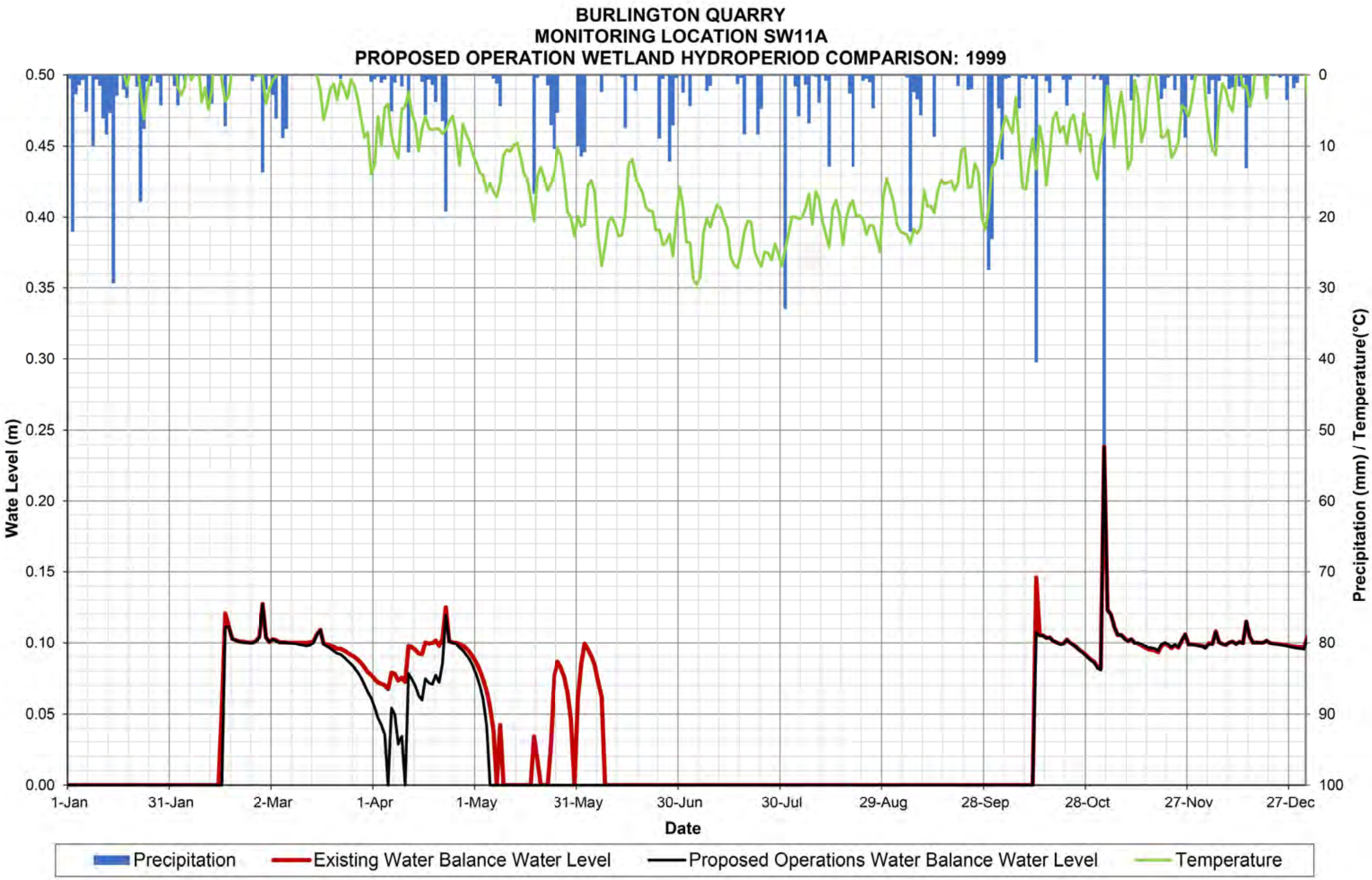
.045
.1
Legend
WS PF 2
Ground
Bank Sta
Elevation (m)
Station (m)
271.0
270.5
270.0
269.5
269.0
0
5
10
15
20
25

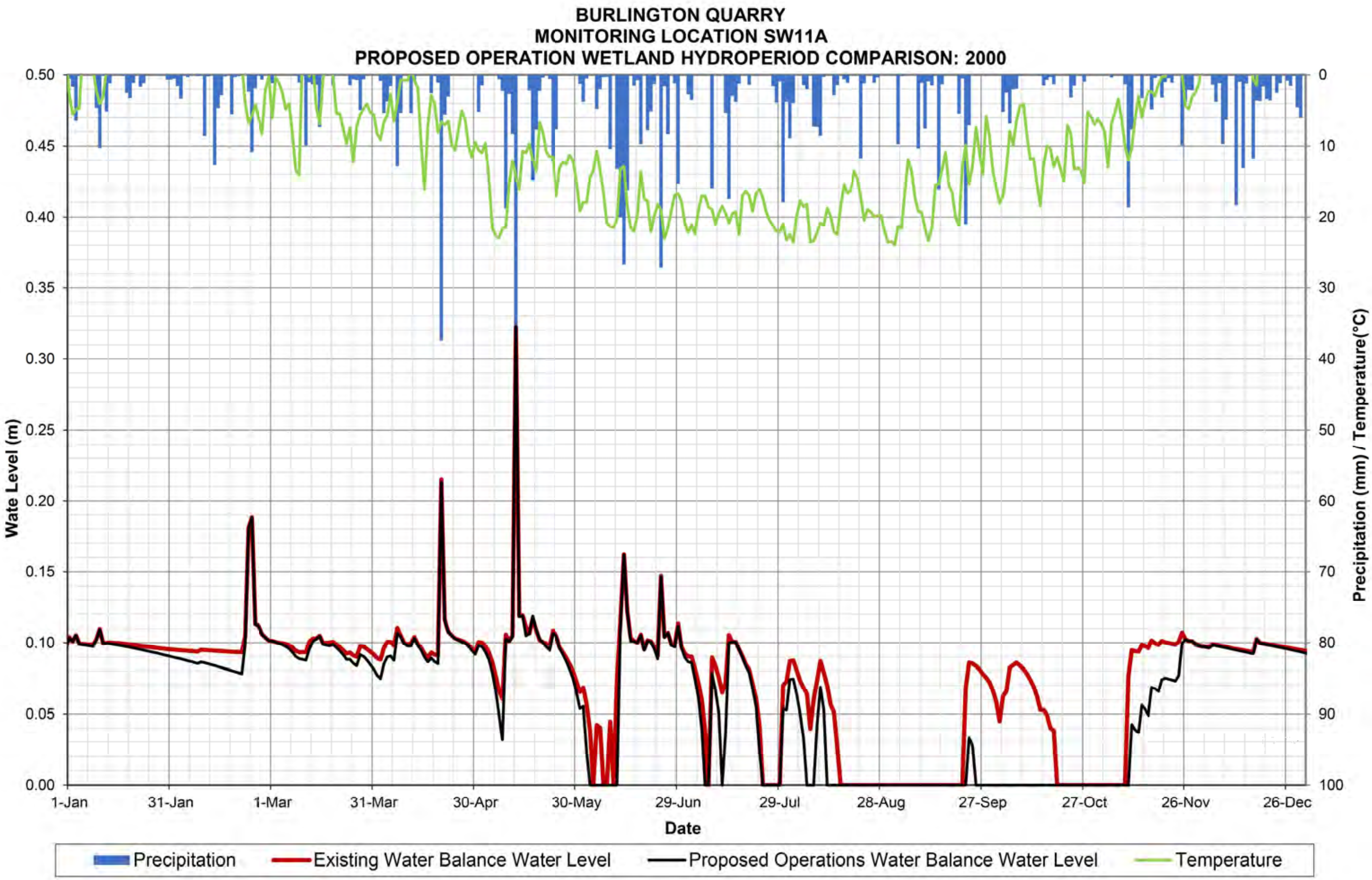
Appendix N:
Proposed Conditions (Operations) Wetland Water Balance Results

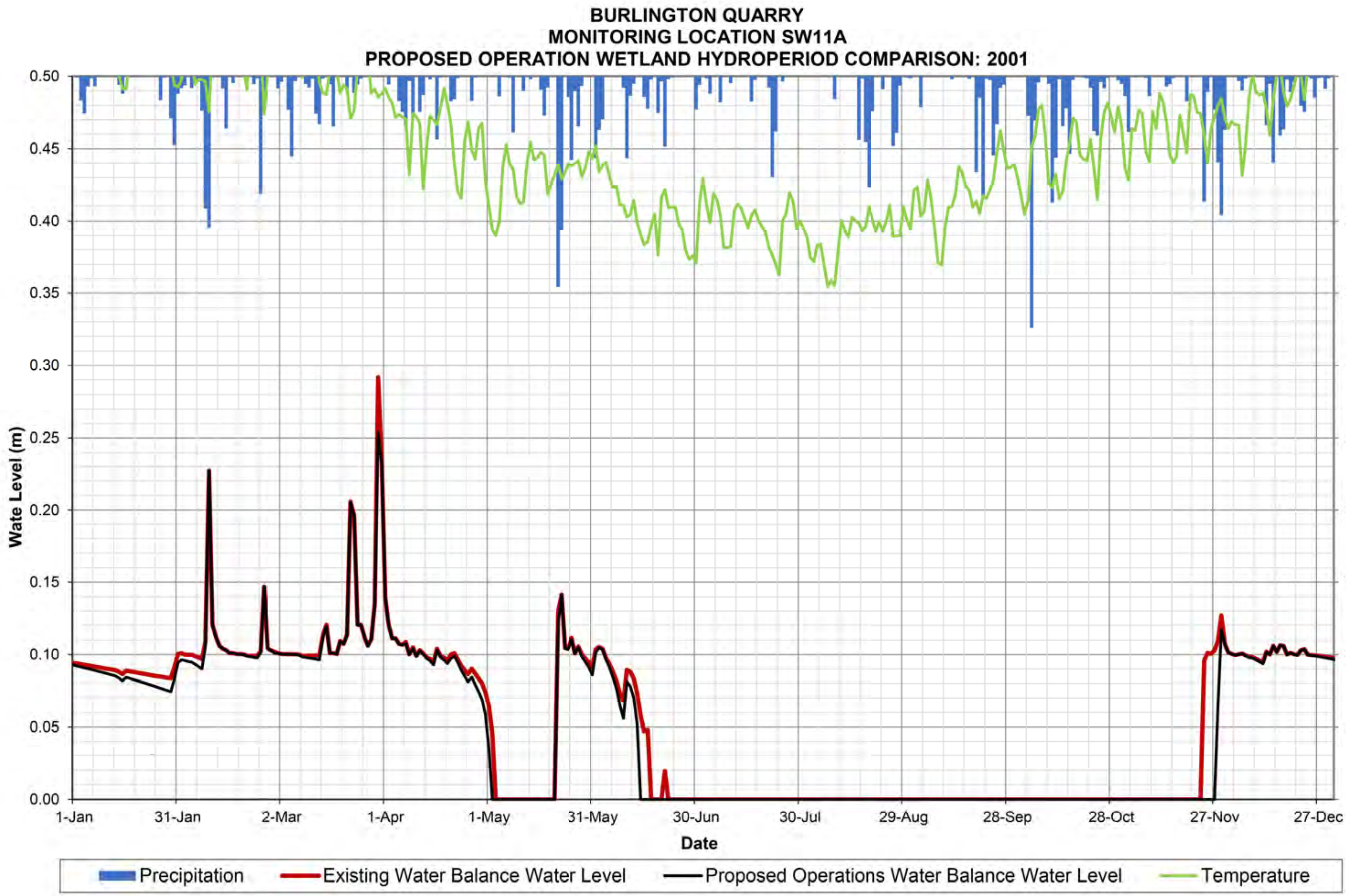


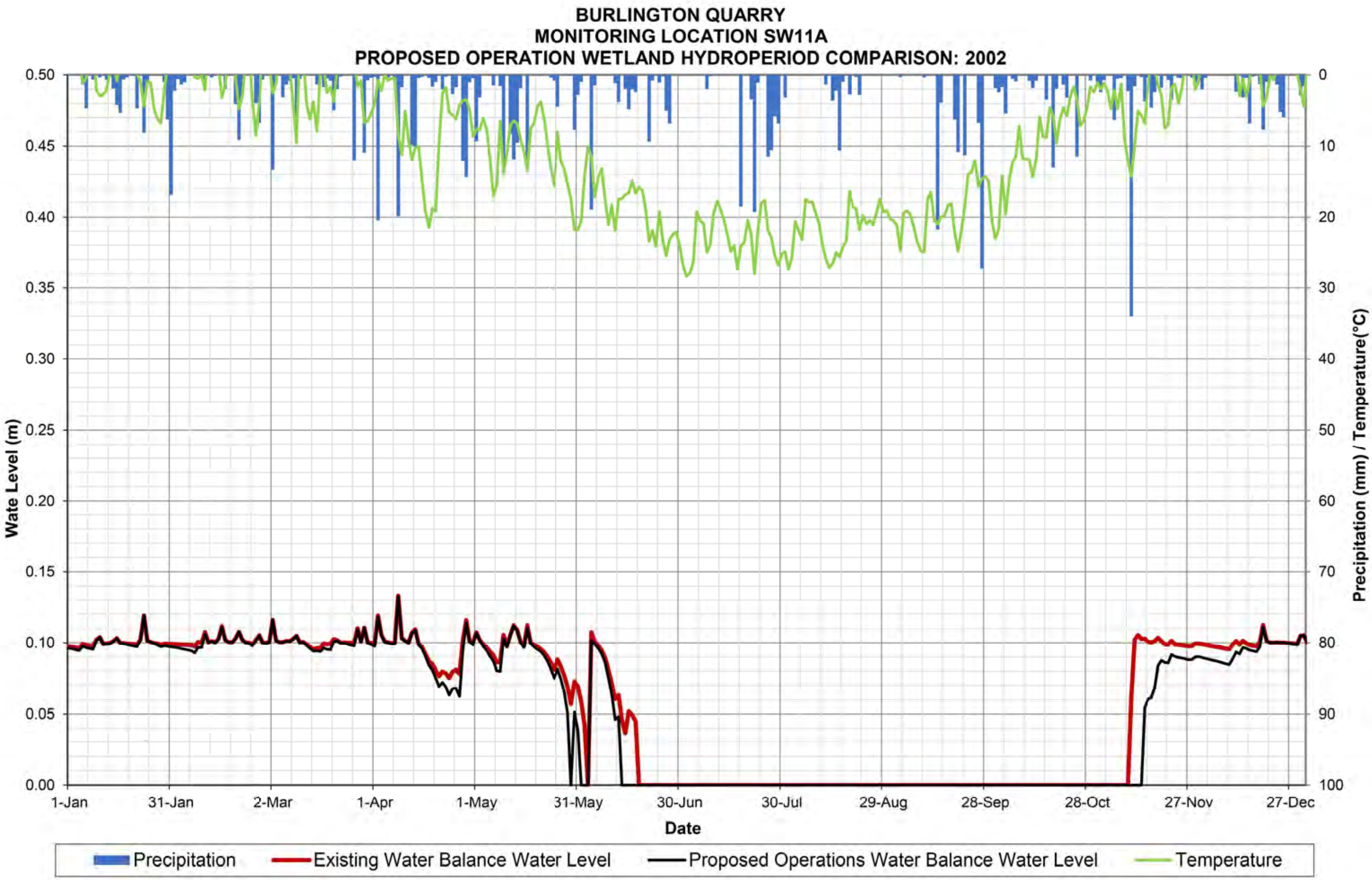
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 1998
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature



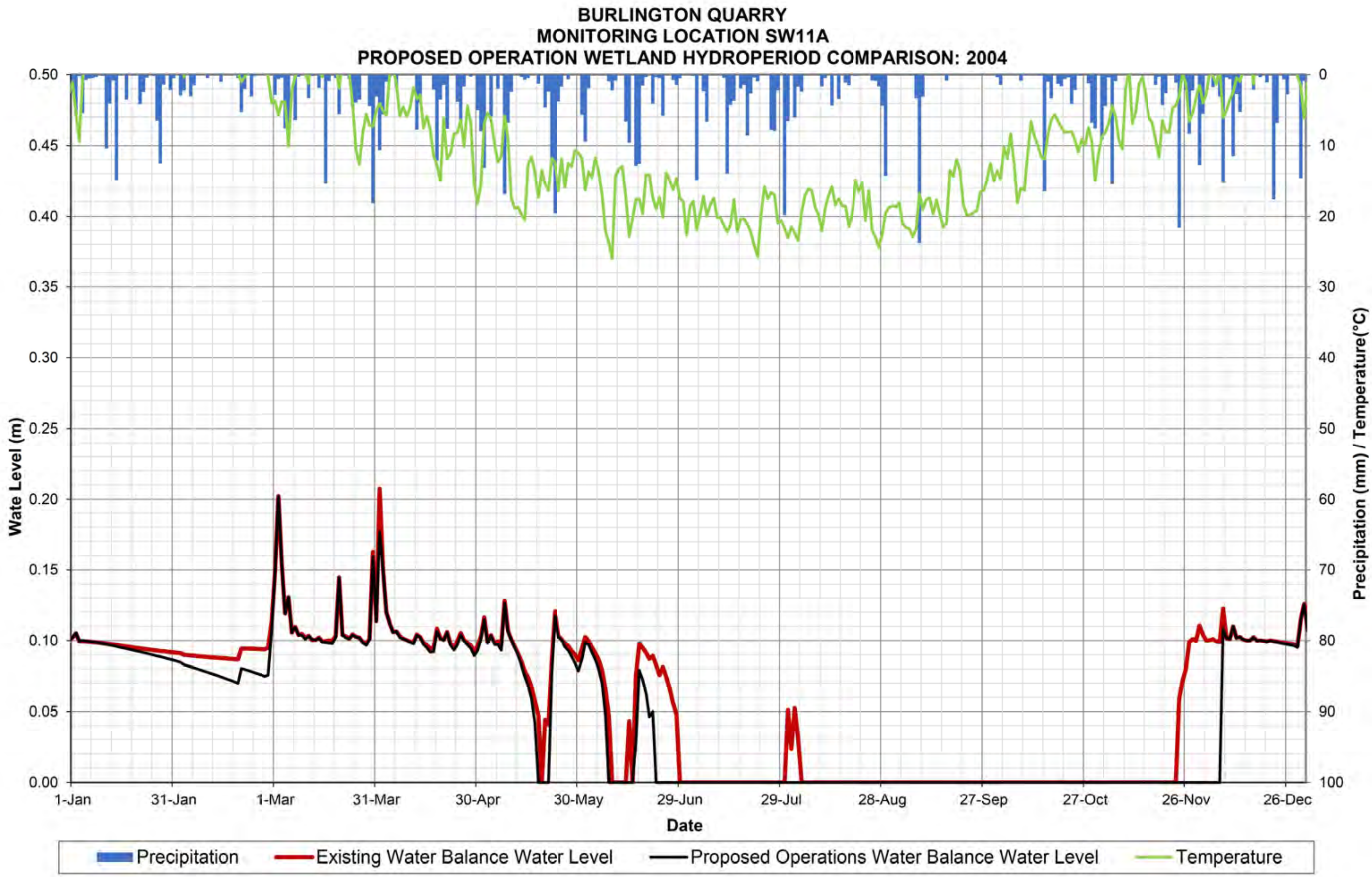
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 1999
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2000
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

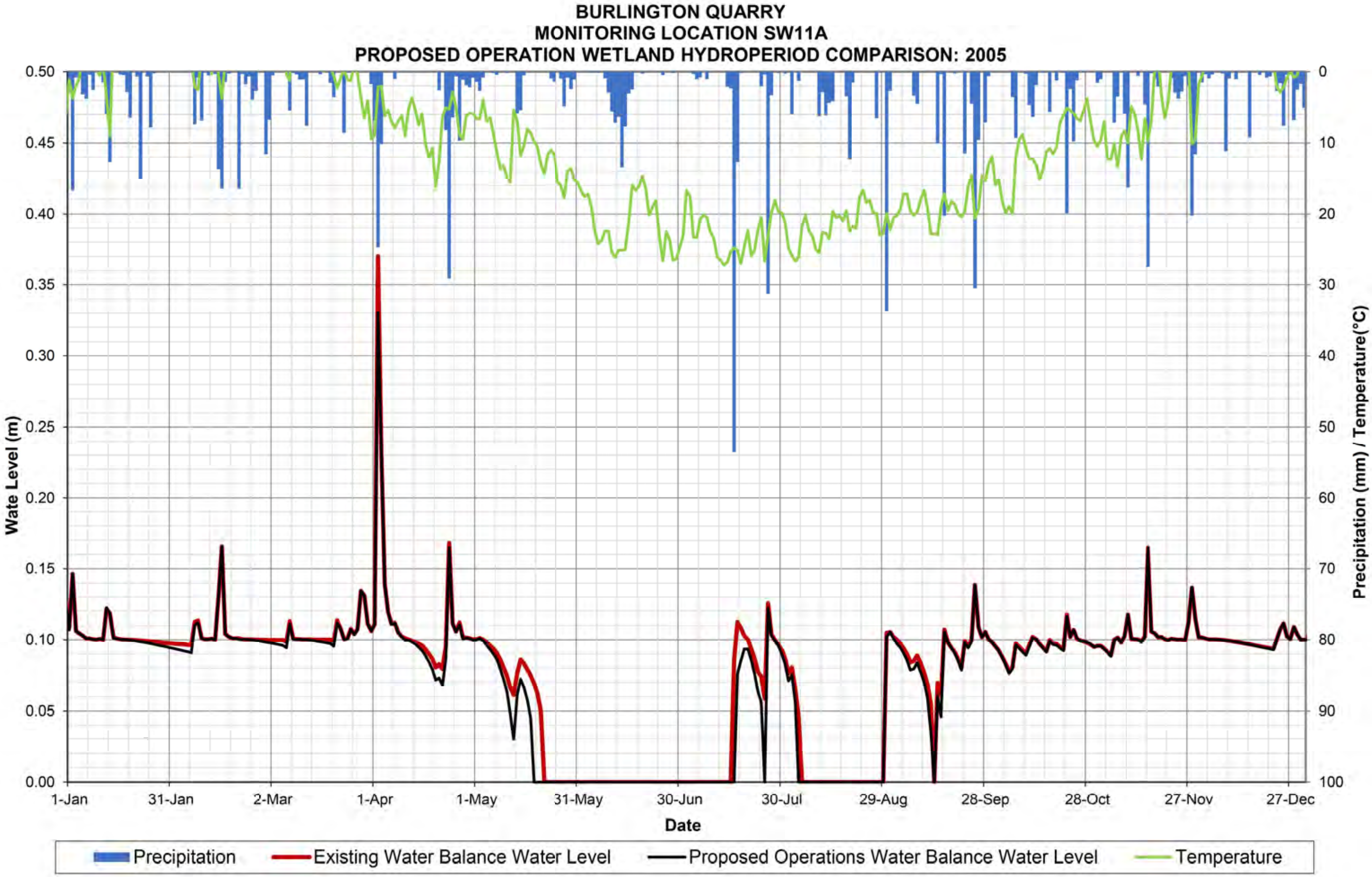

BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2001
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2002
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

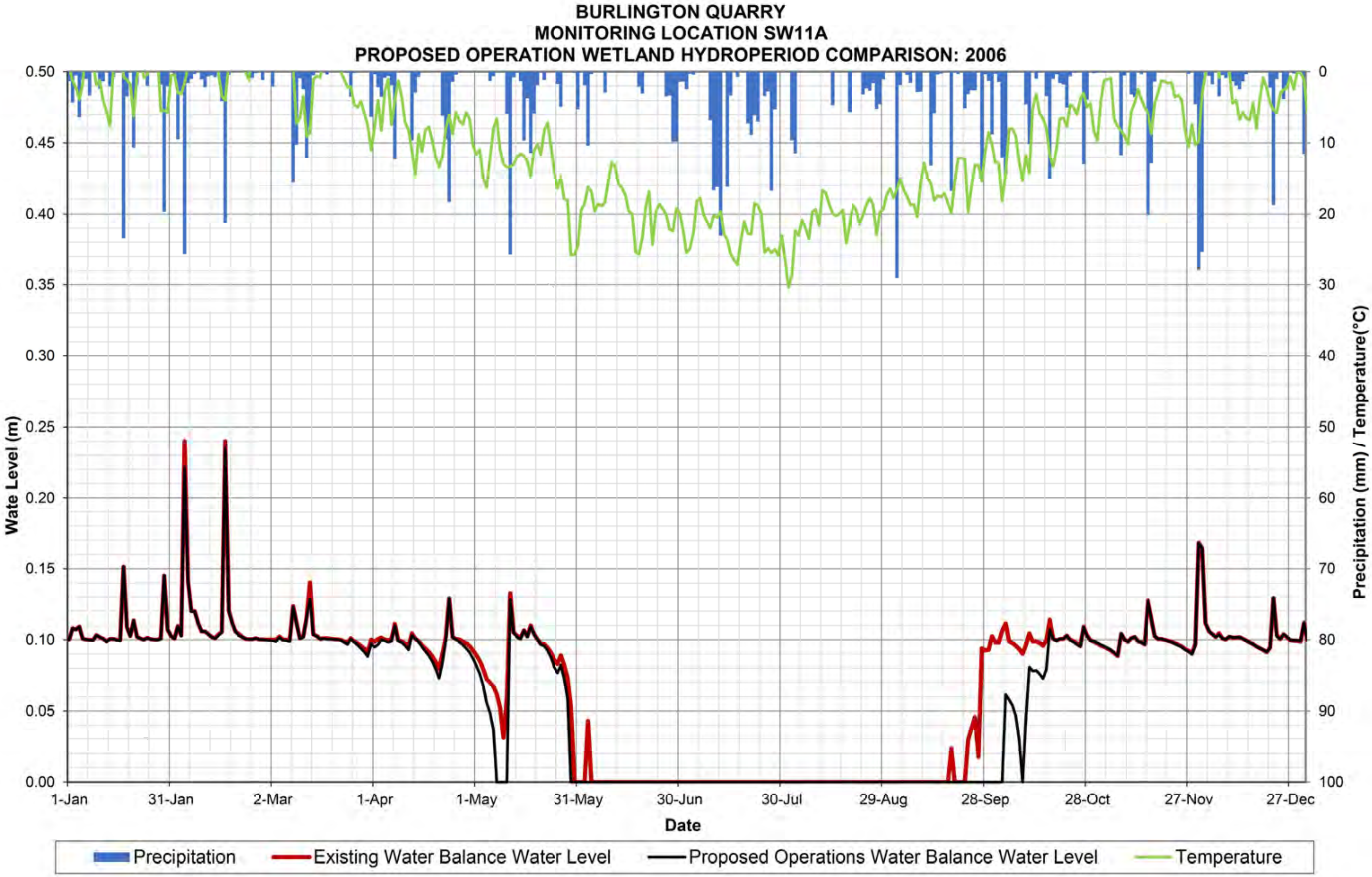

BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2003
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature



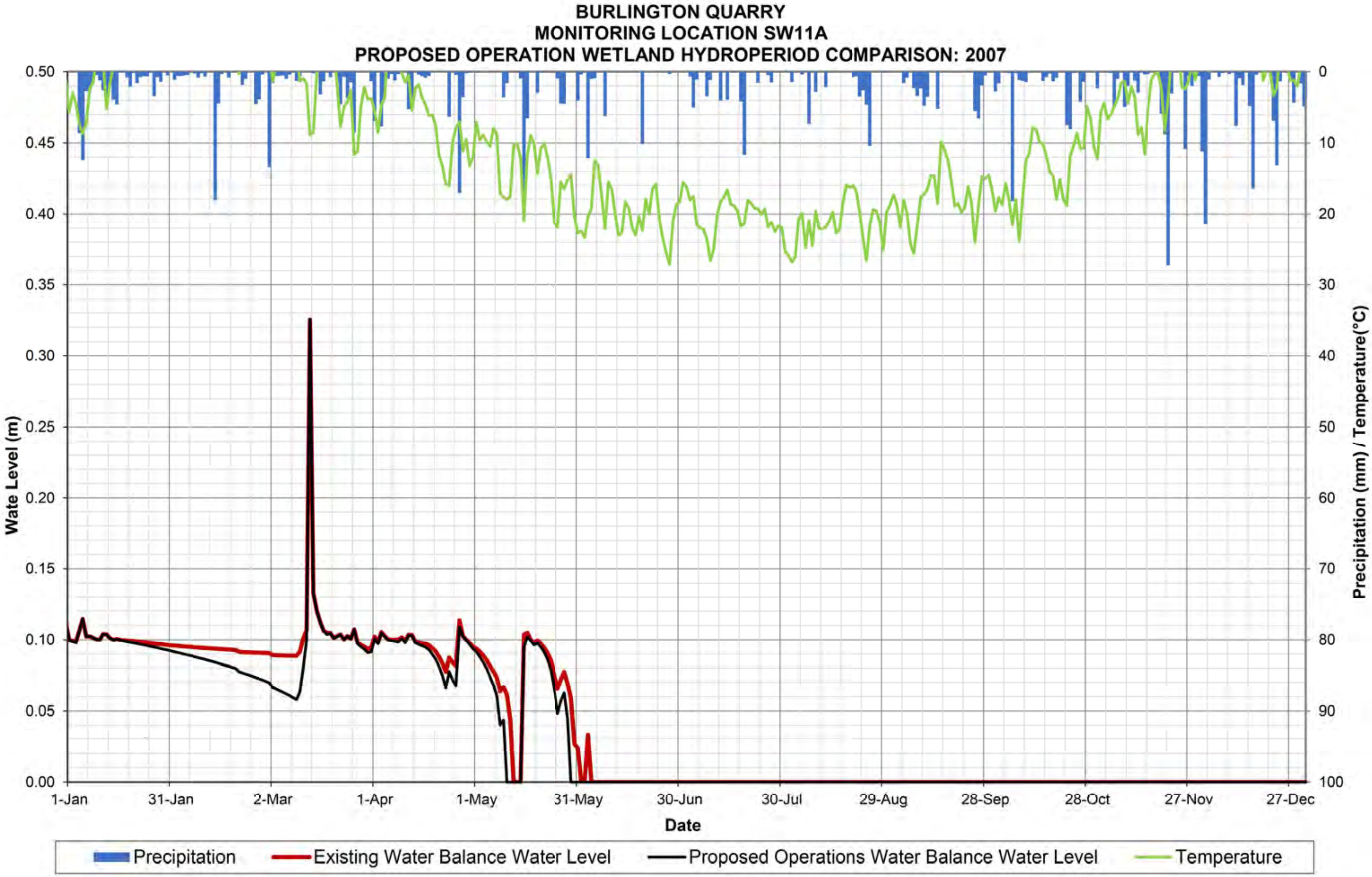
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2004
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

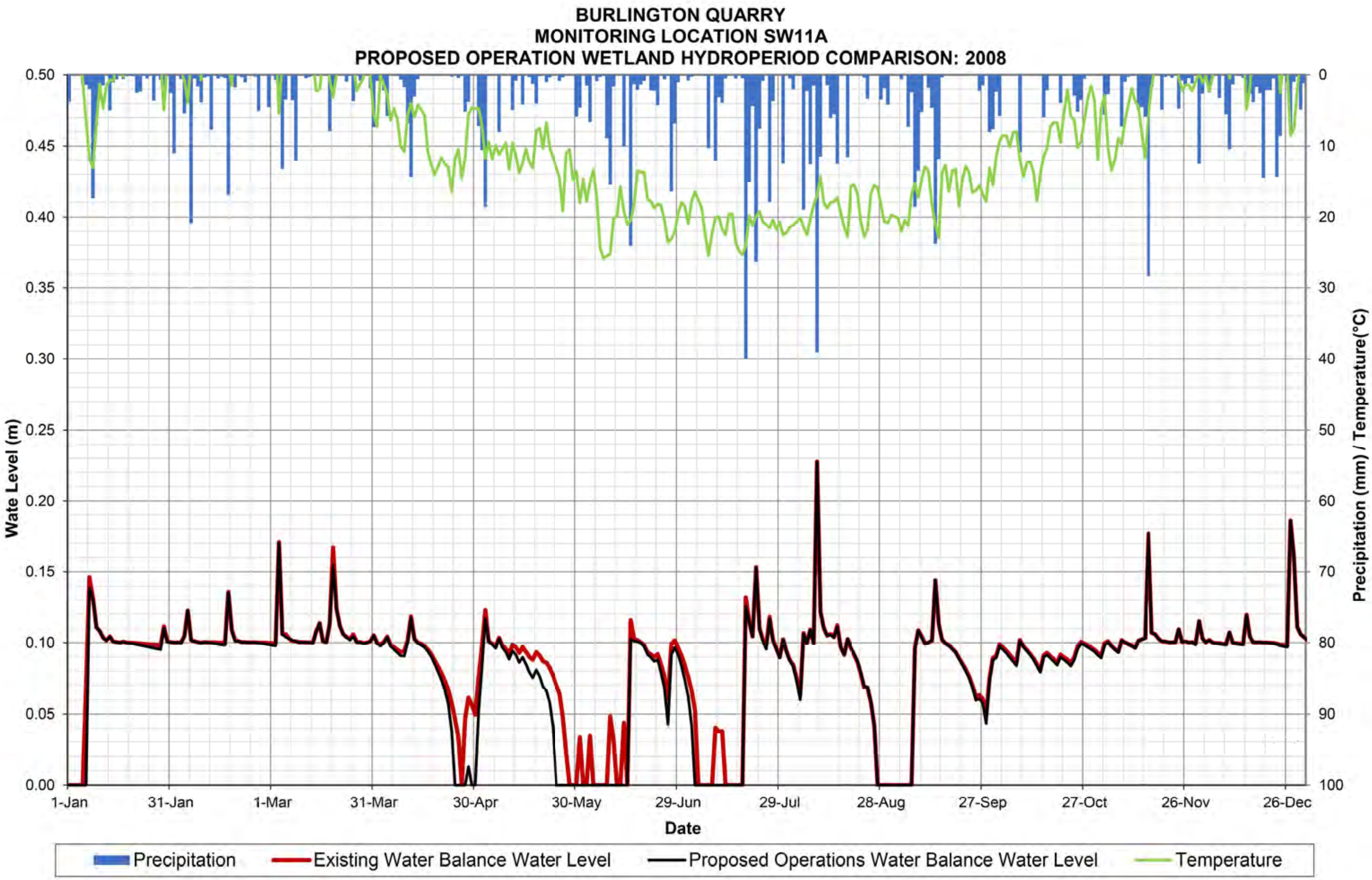


BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2005
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

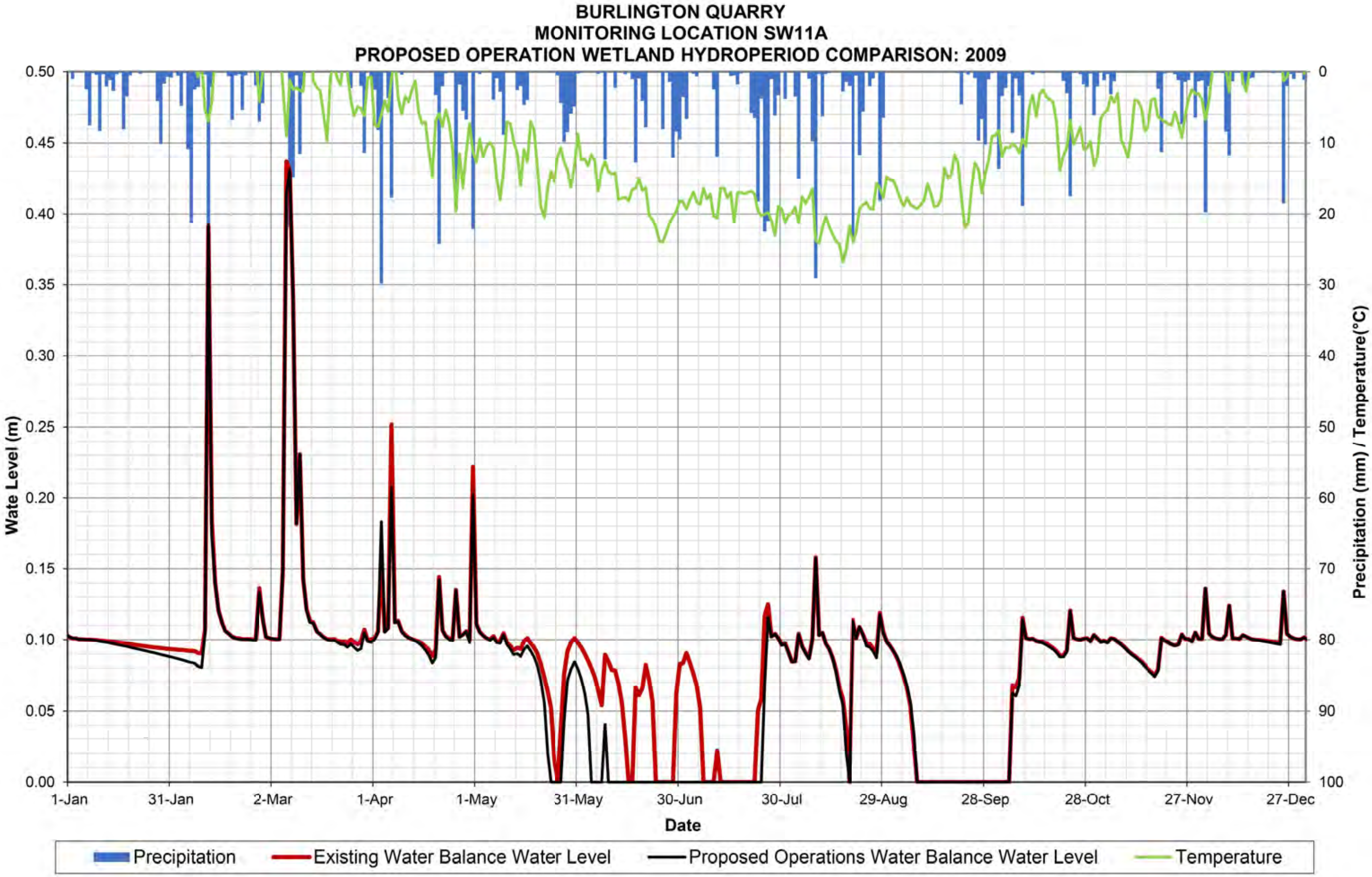


BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2006
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

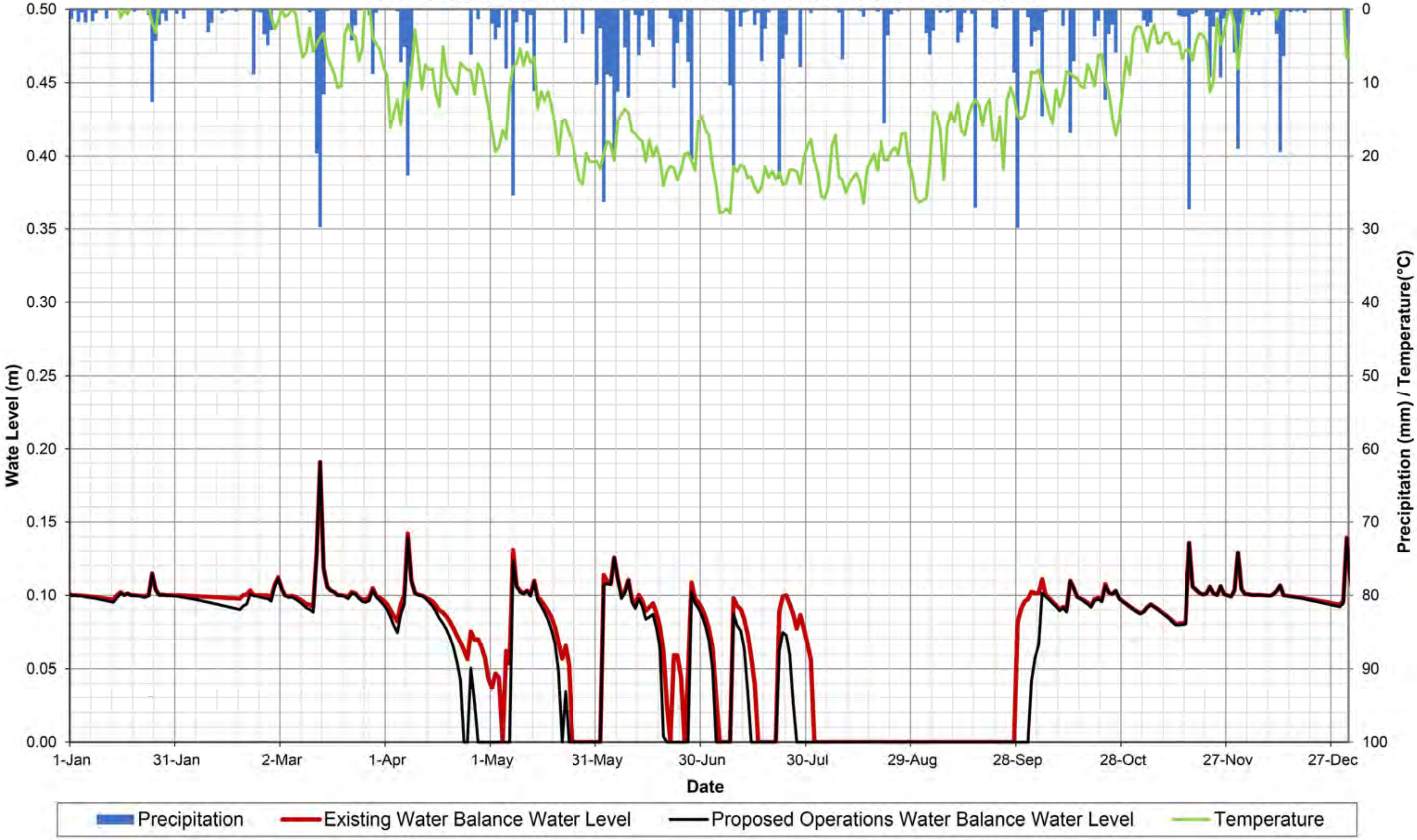

BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2007
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

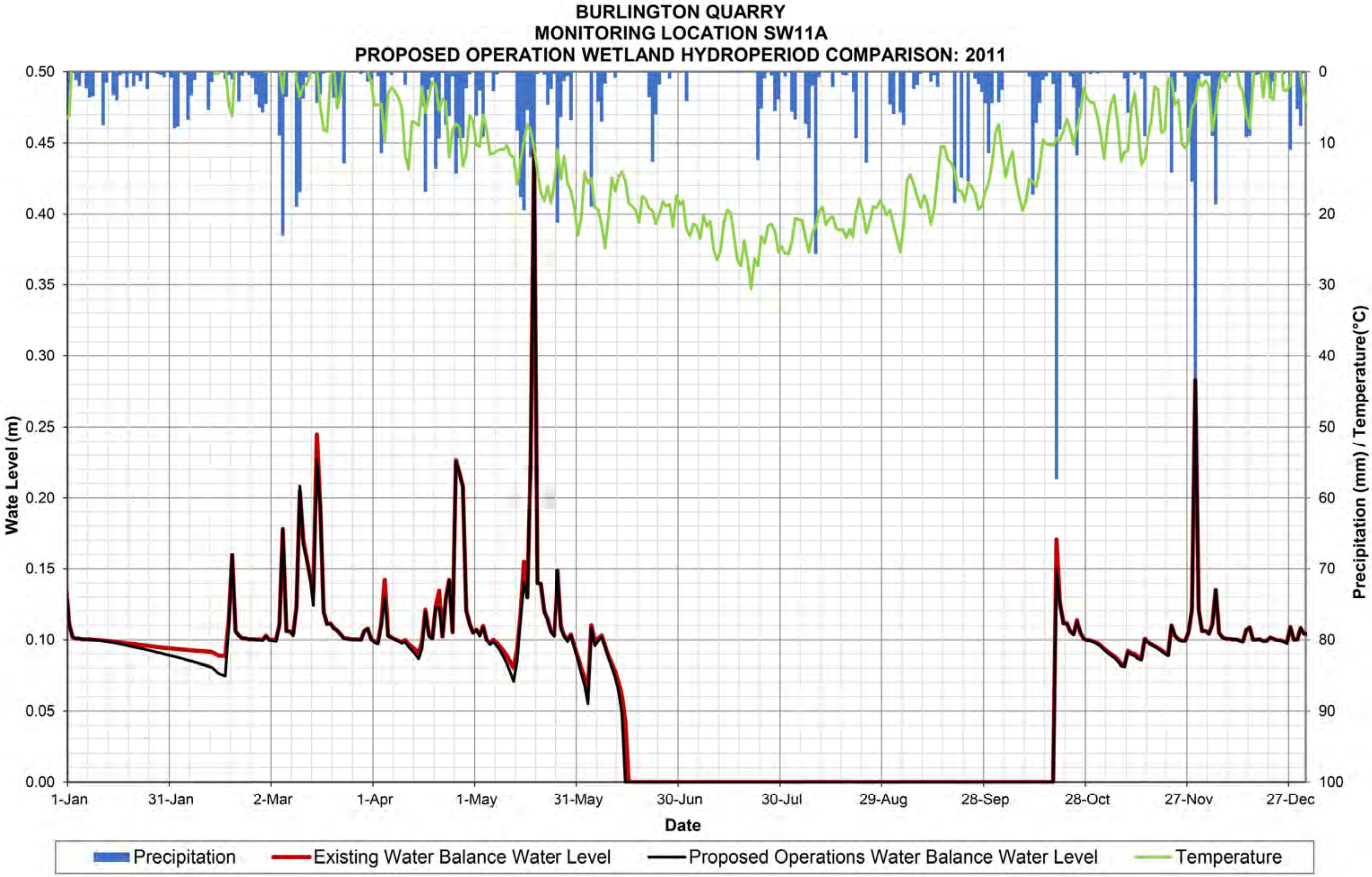


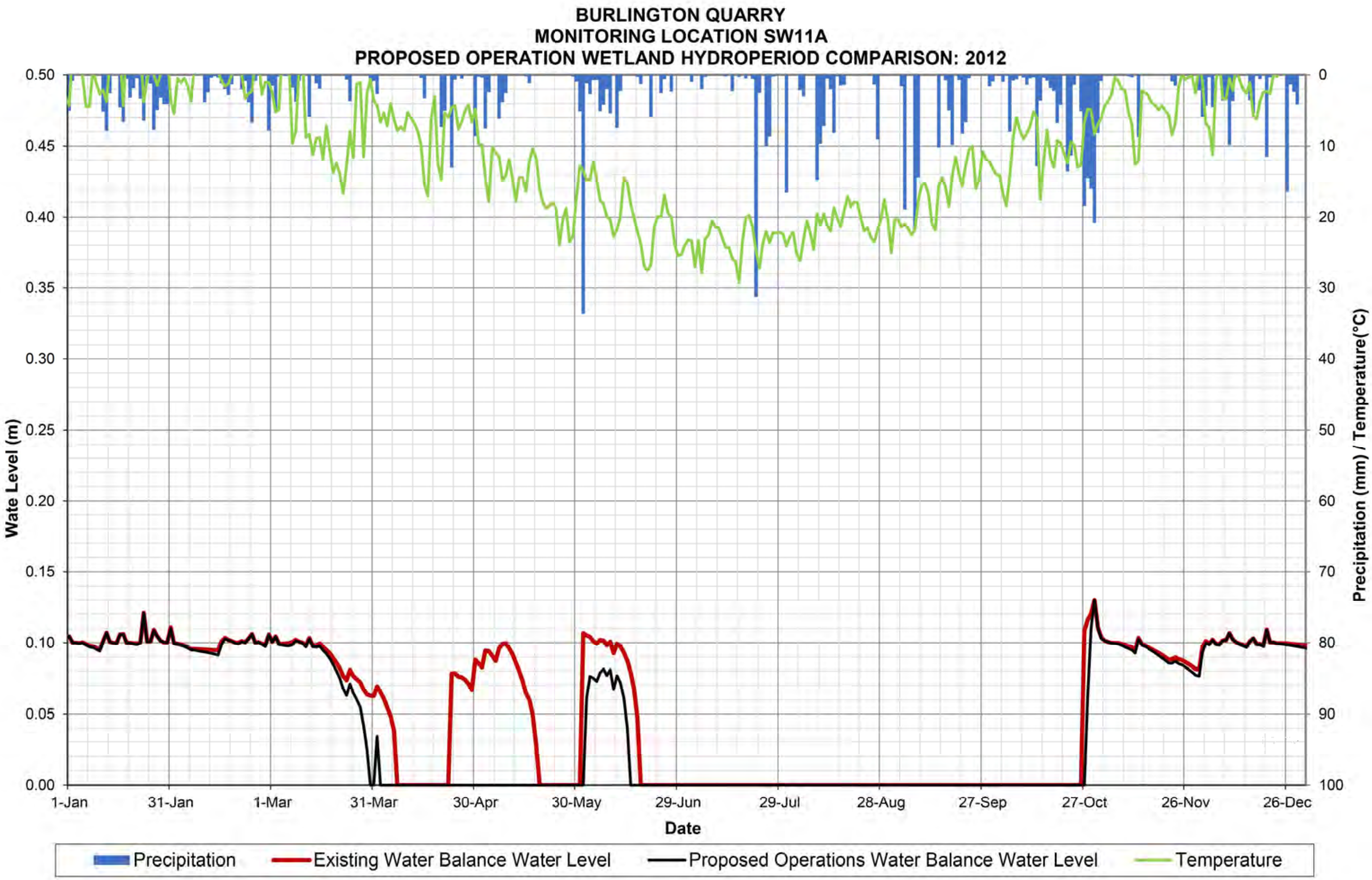
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2008
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2009
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

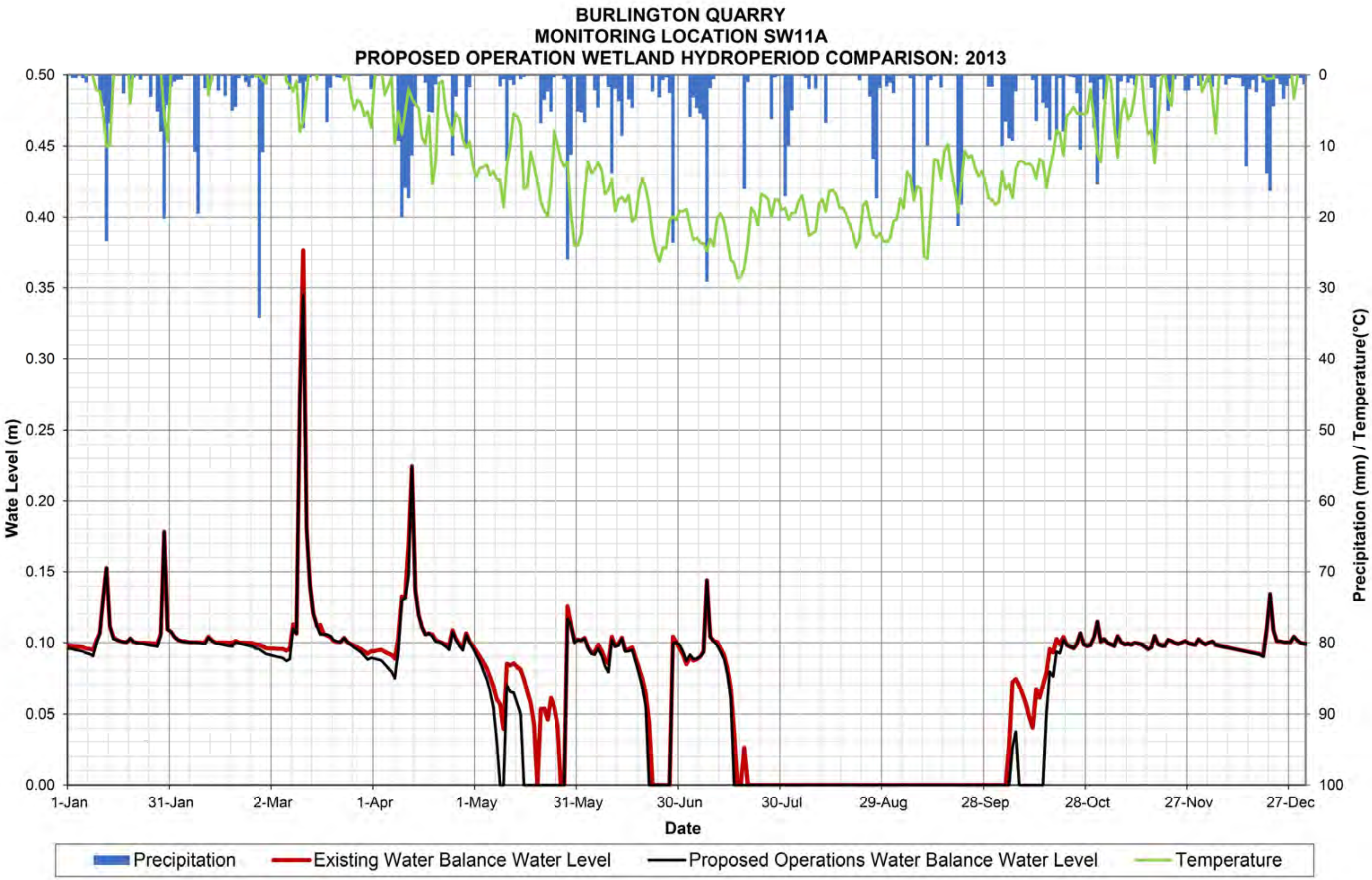
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2010



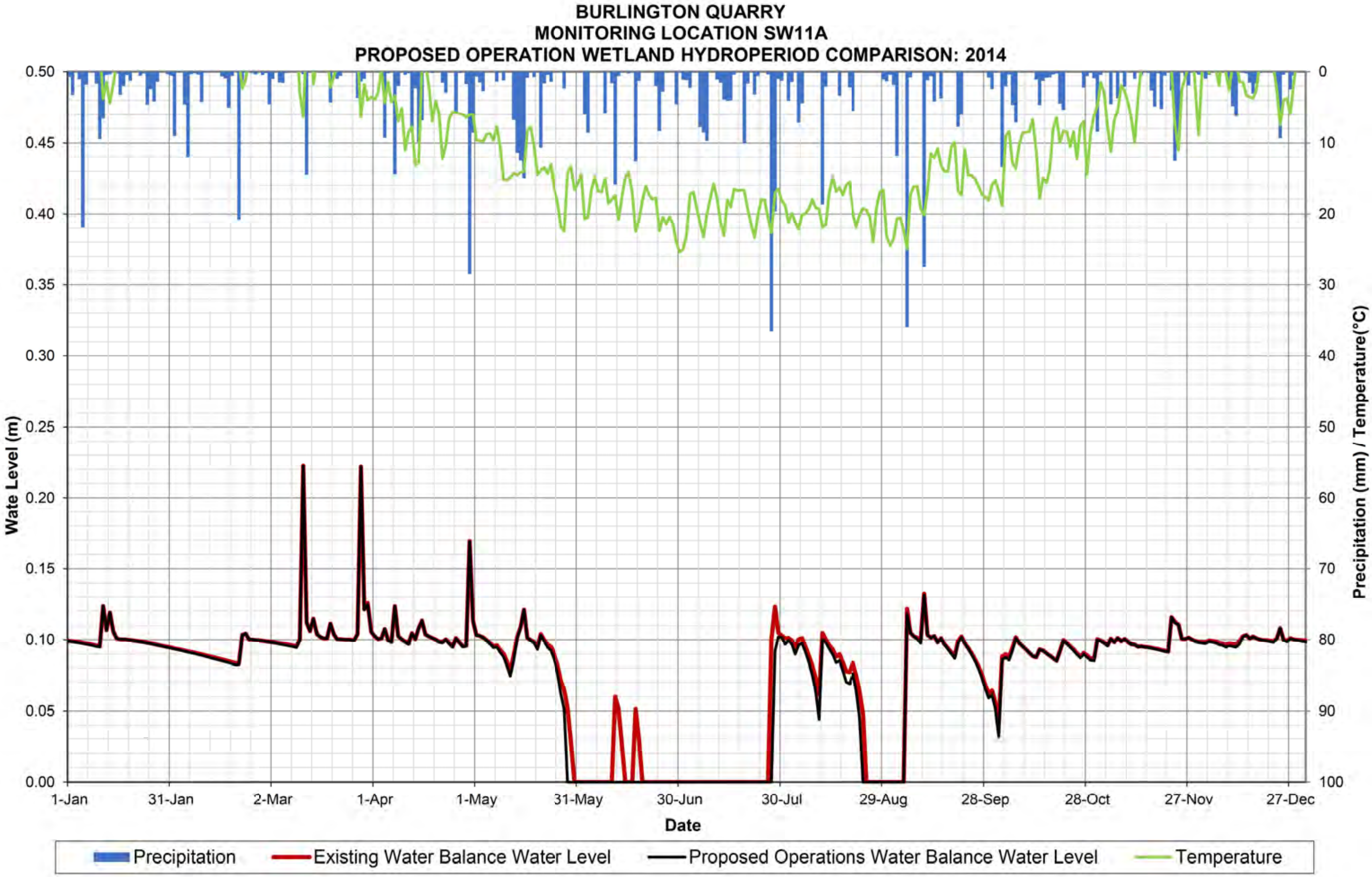

BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2011
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature



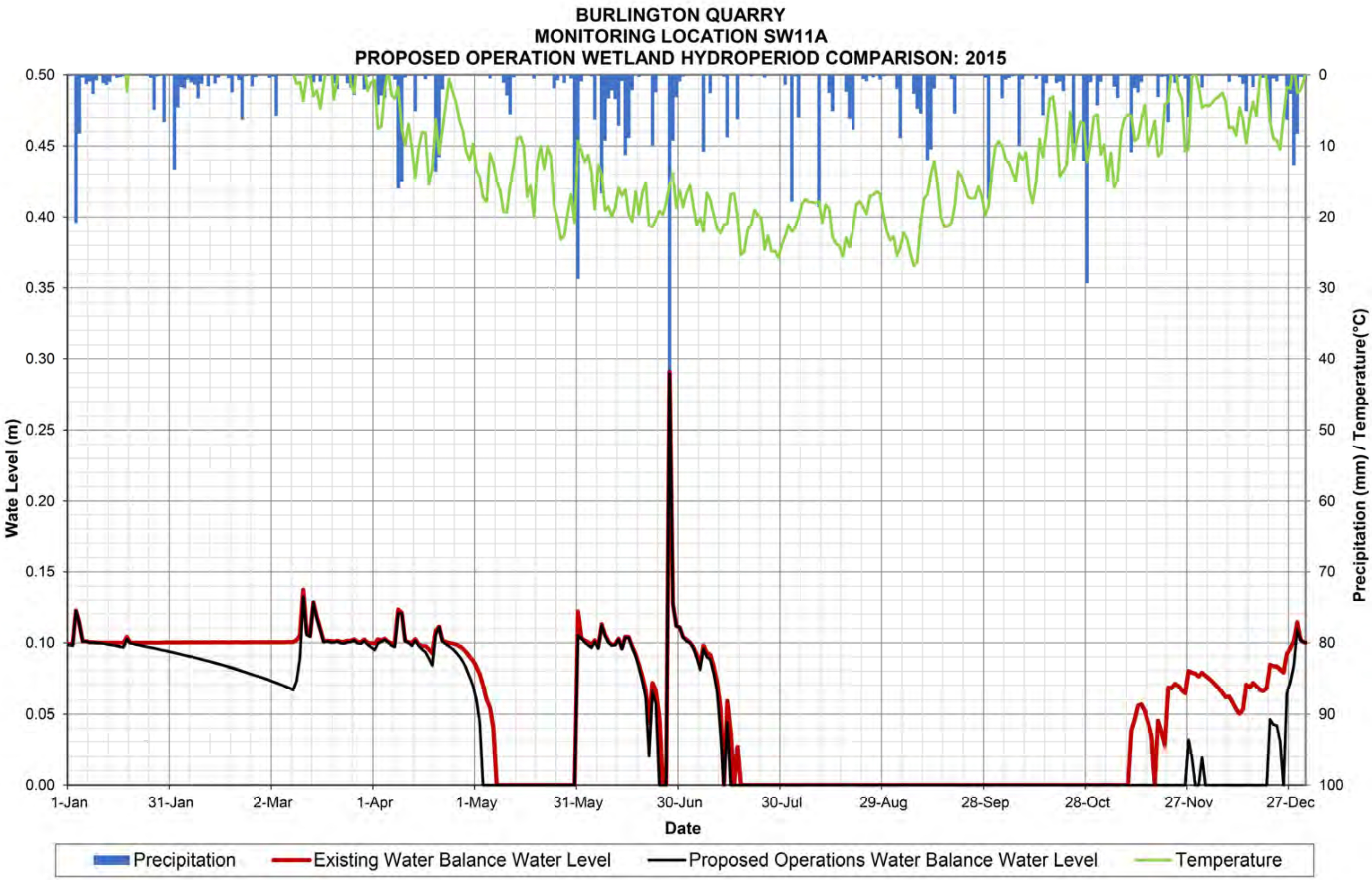
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2012
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature



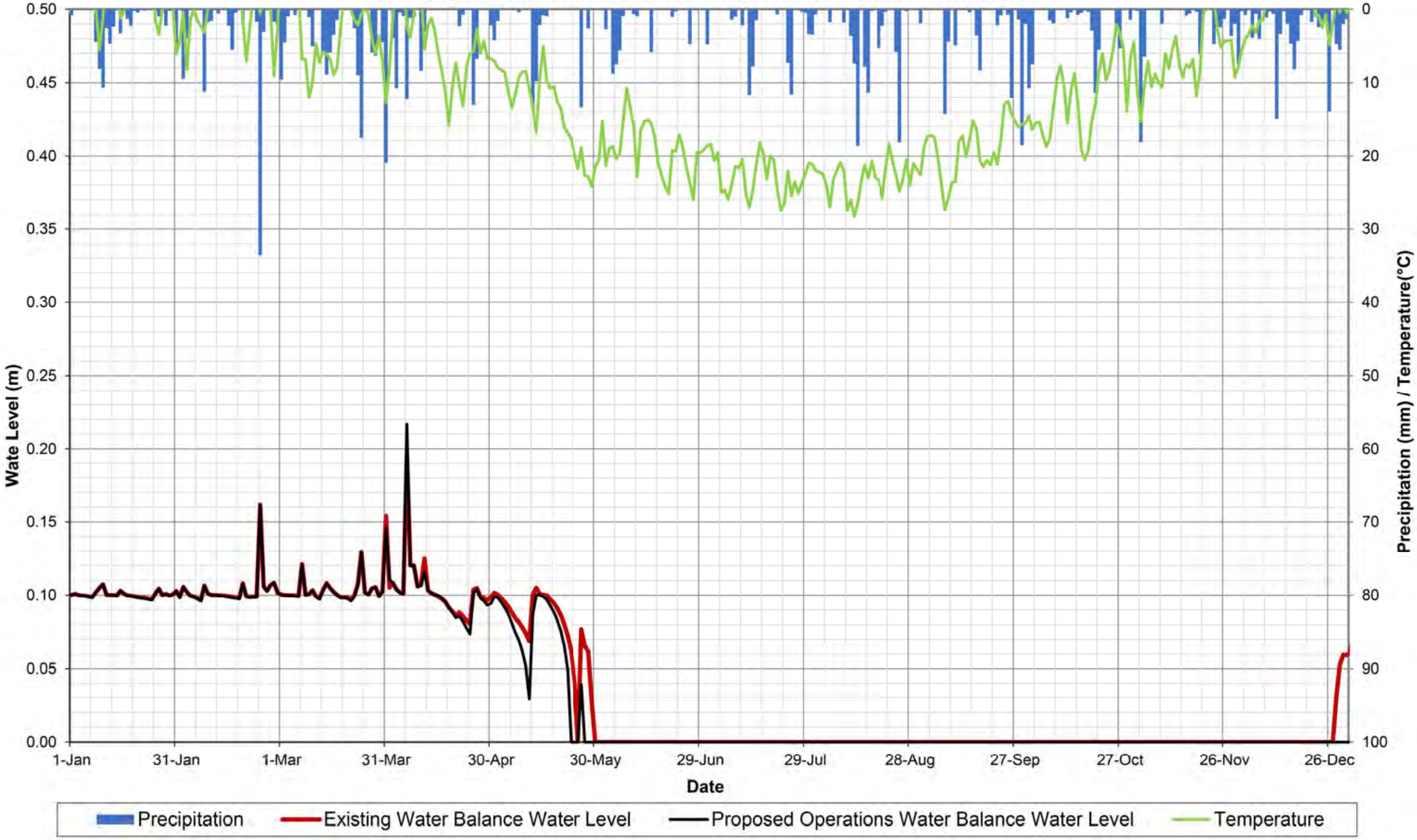
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2013
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

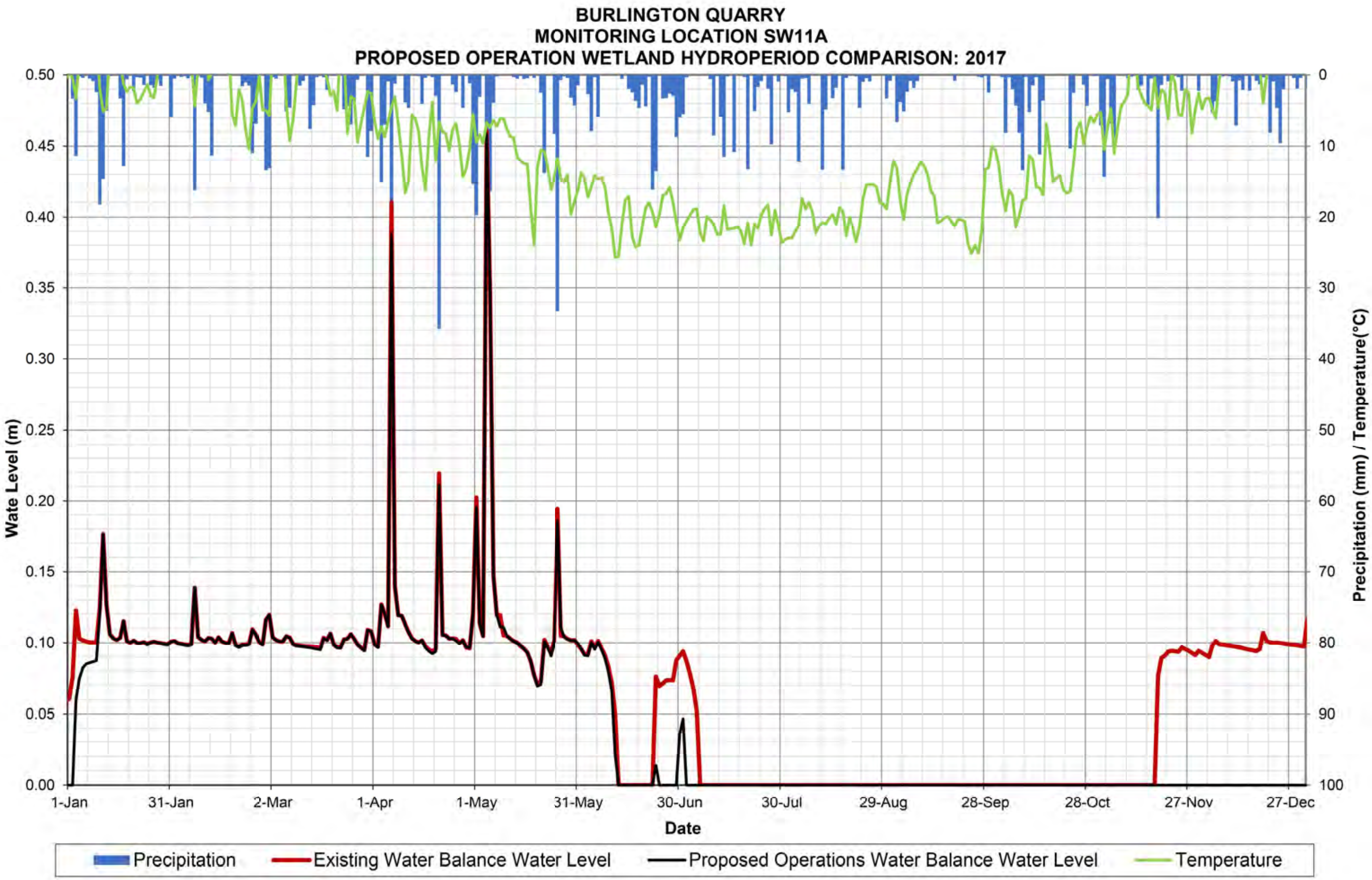


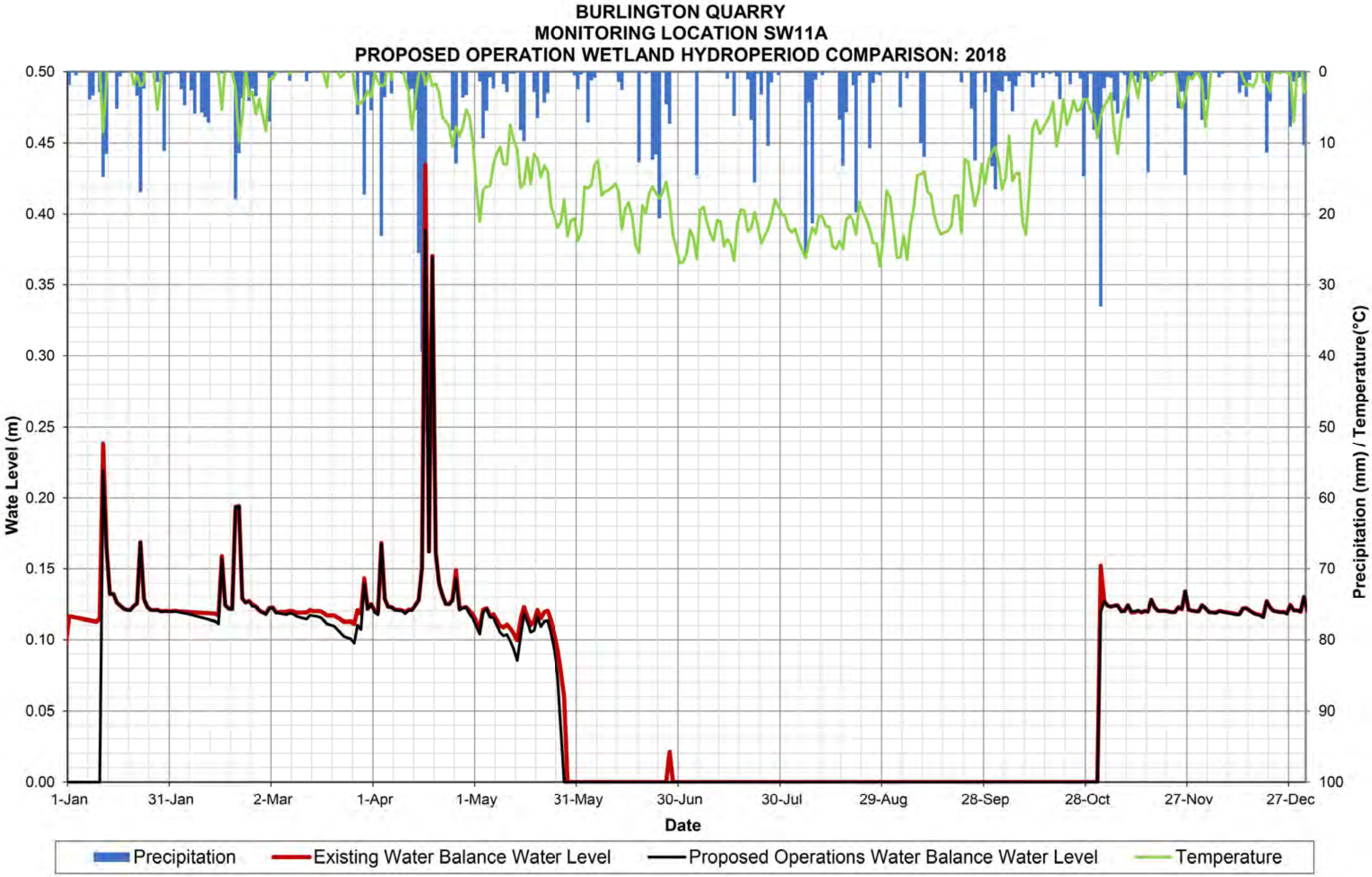
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2014
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2015
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

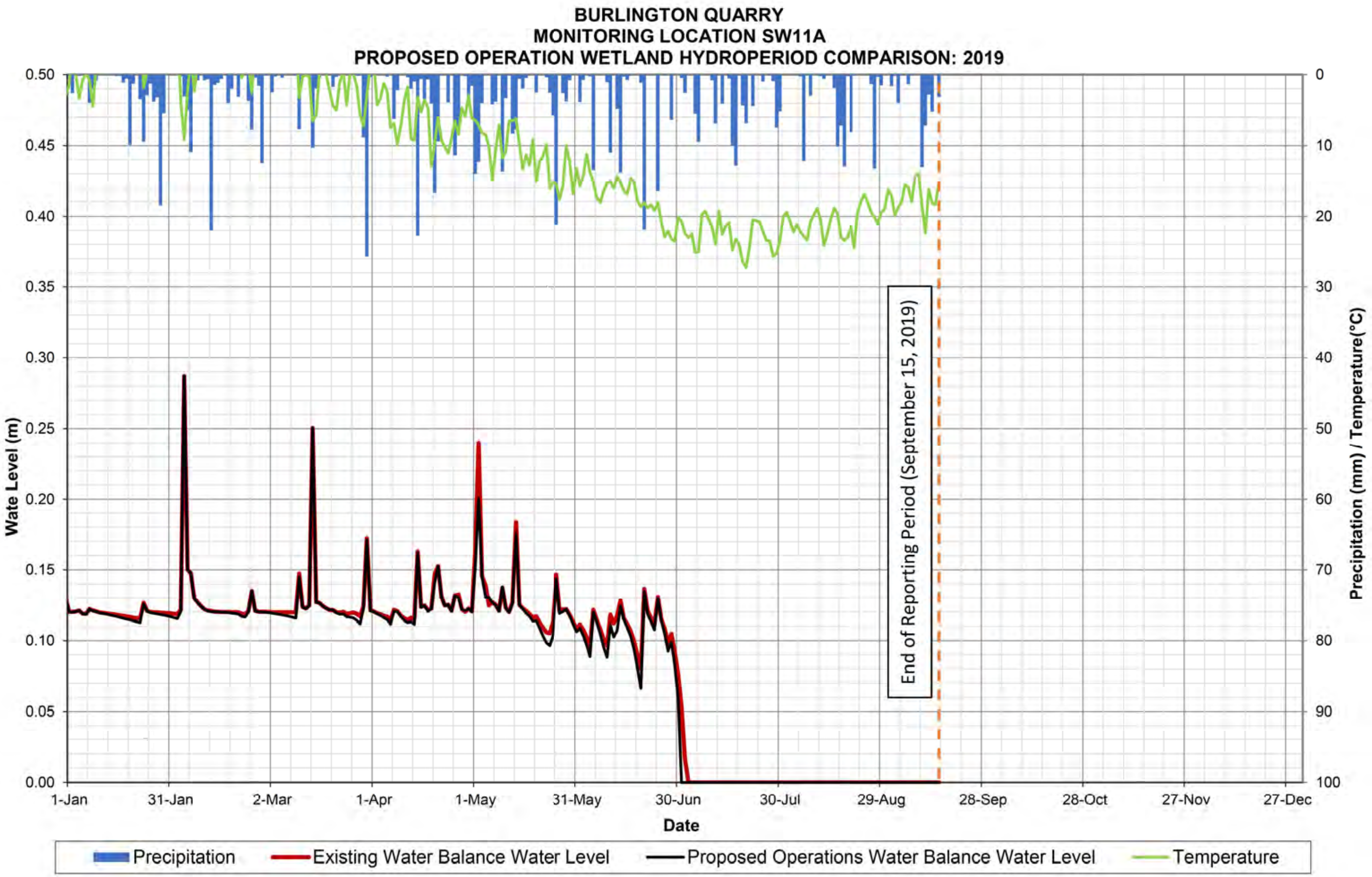
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2016



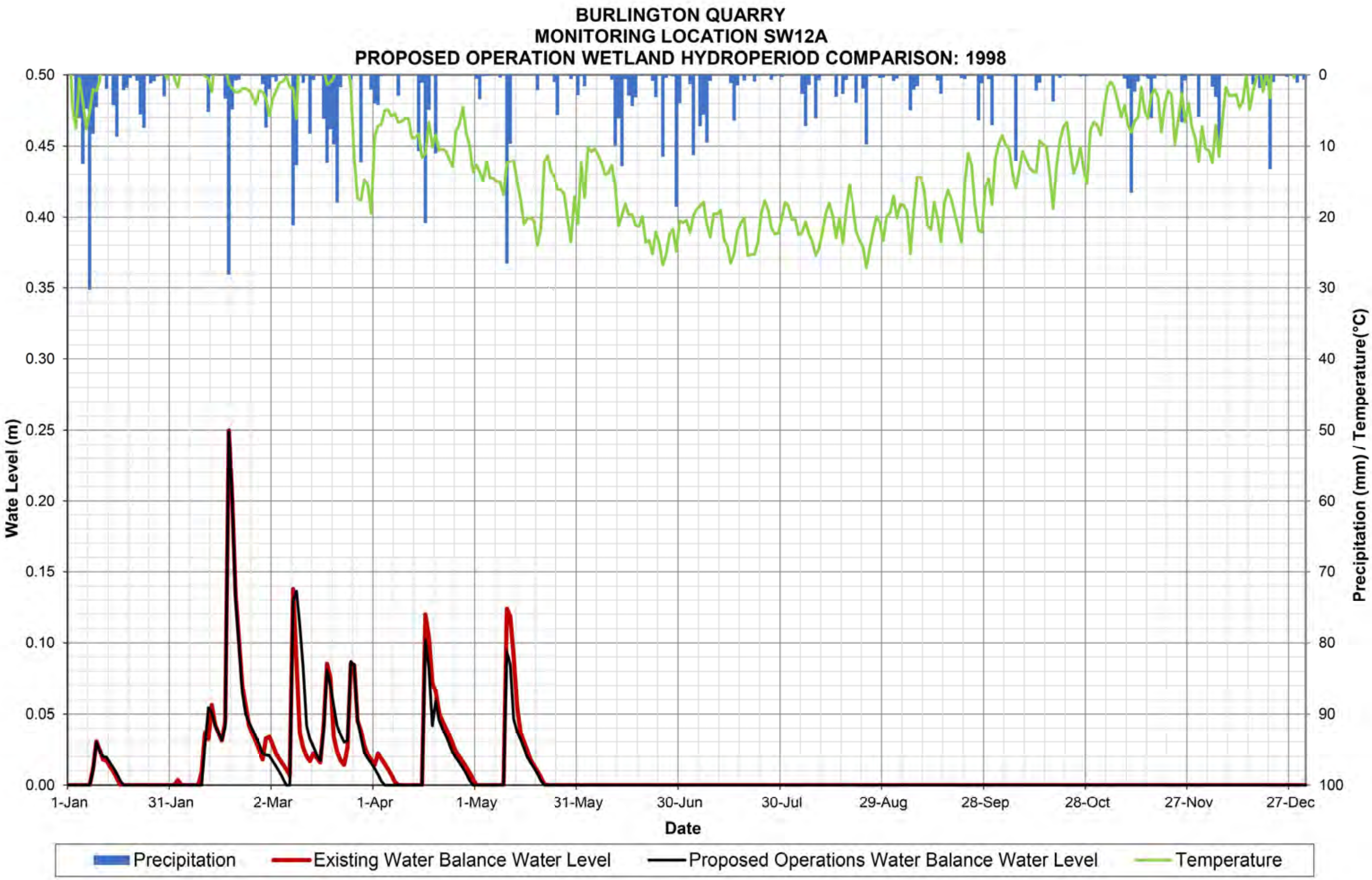

BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2017
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

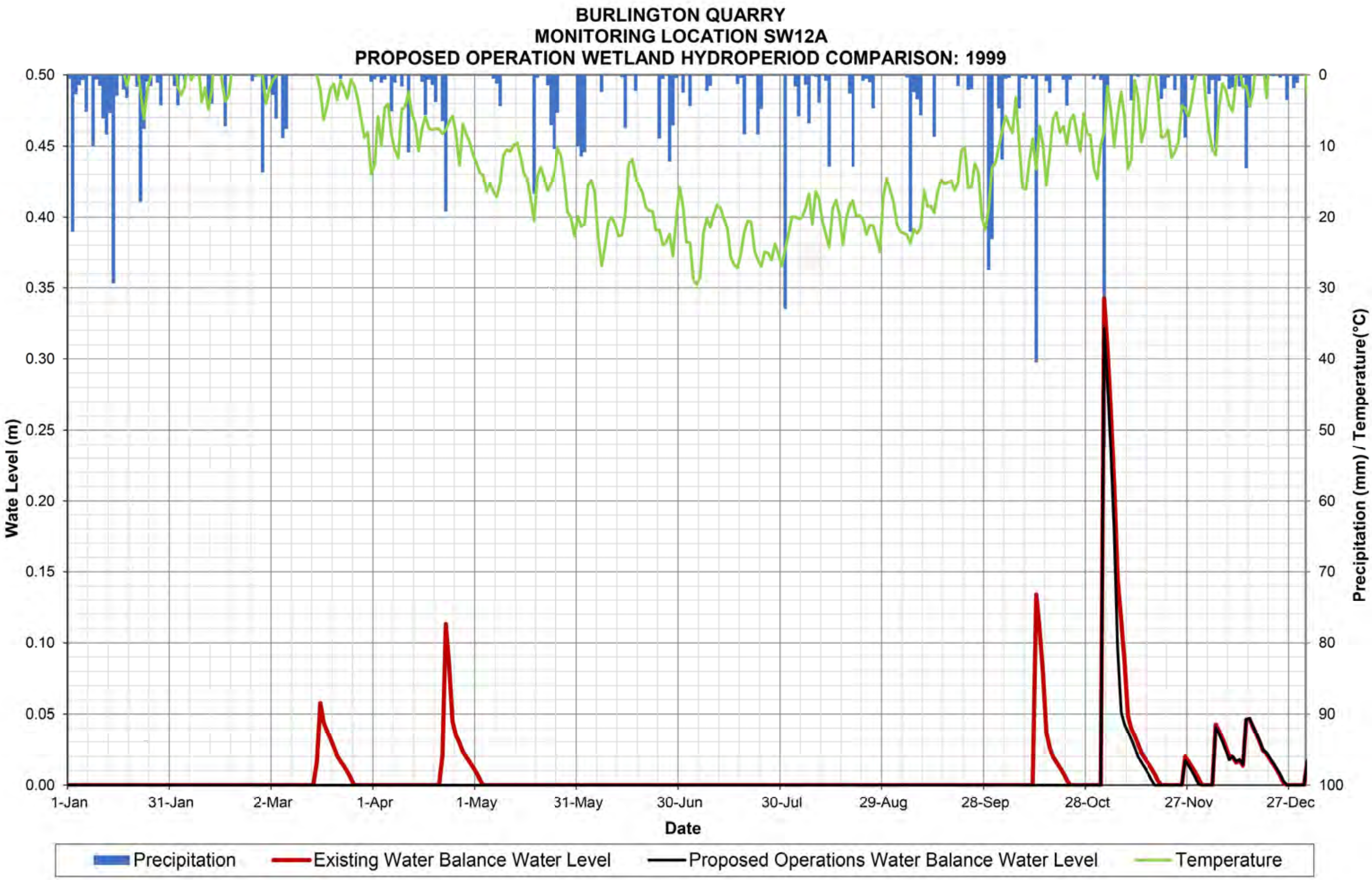


BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2018
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

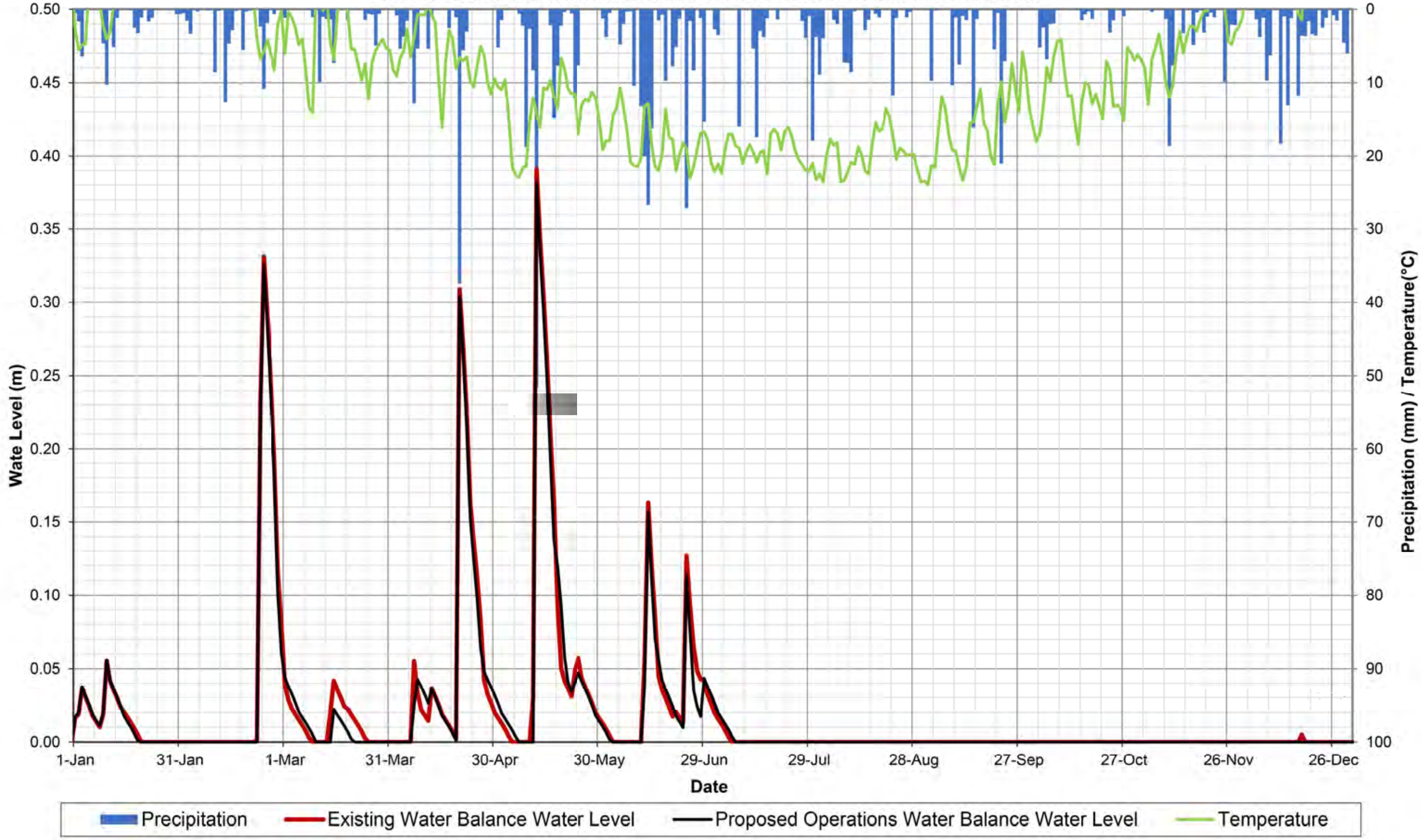


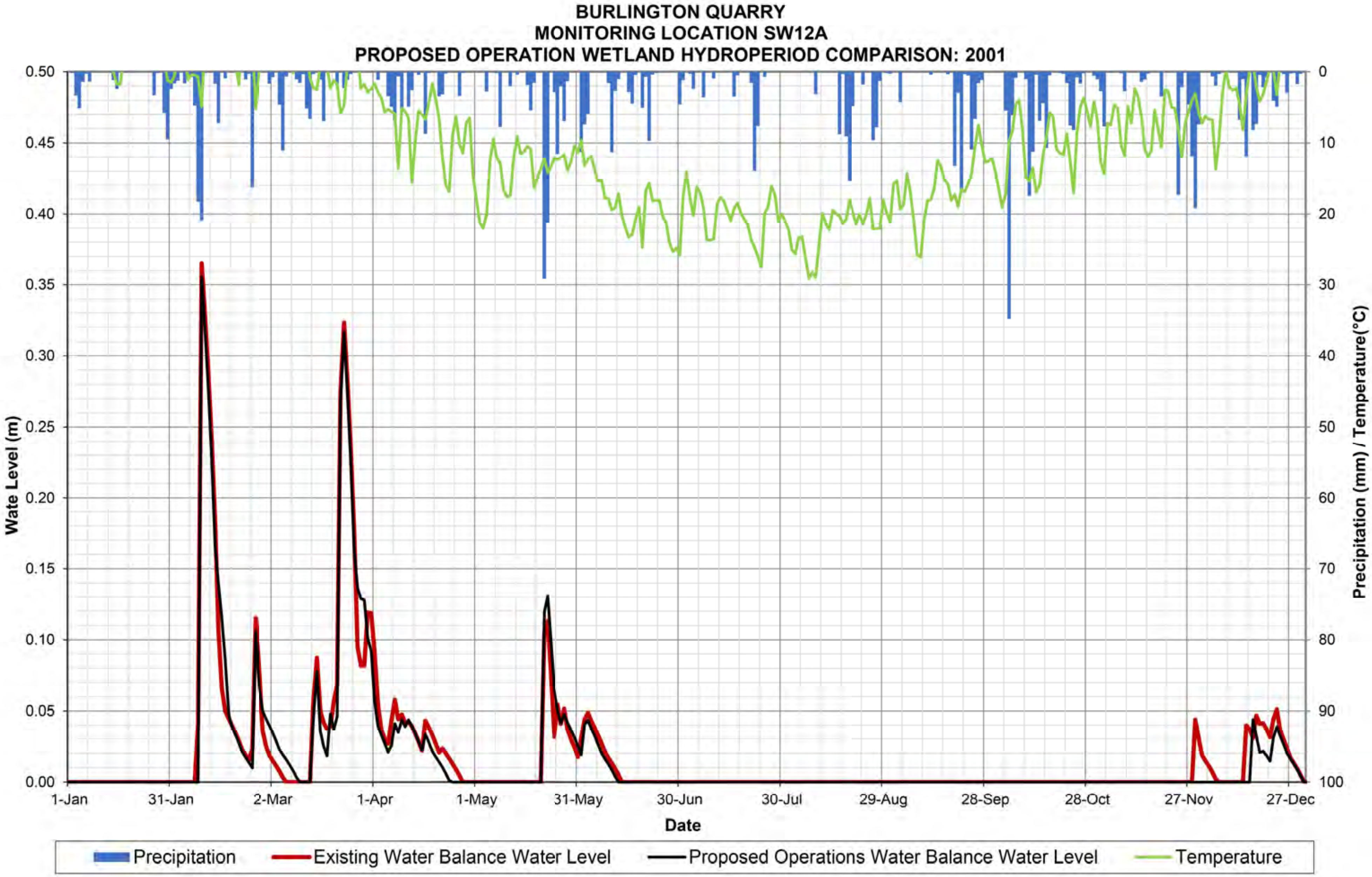
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2019
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
End of Reporting Period (September 15, 2019)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

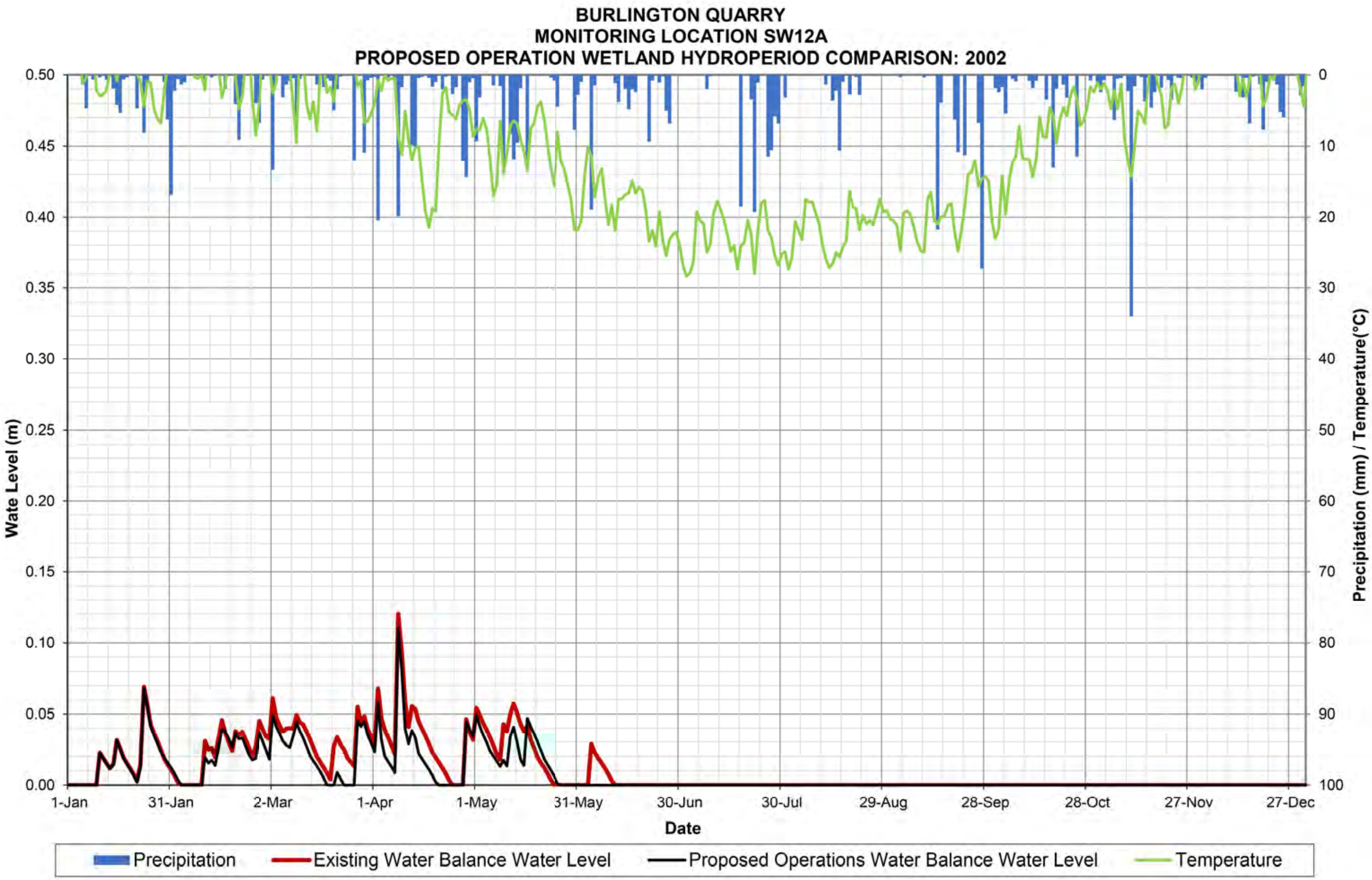

BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 1998
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 1999
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

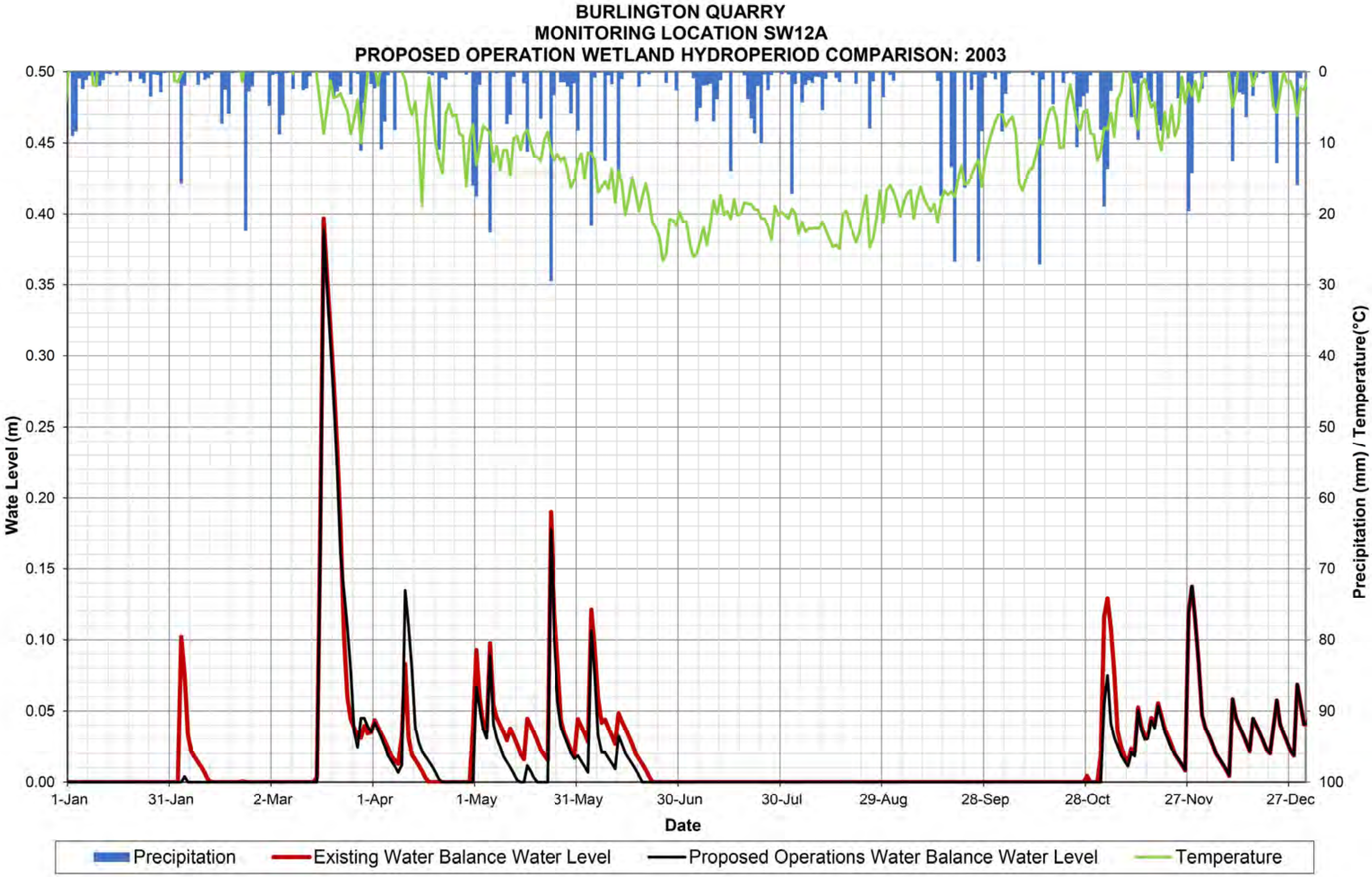
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2000



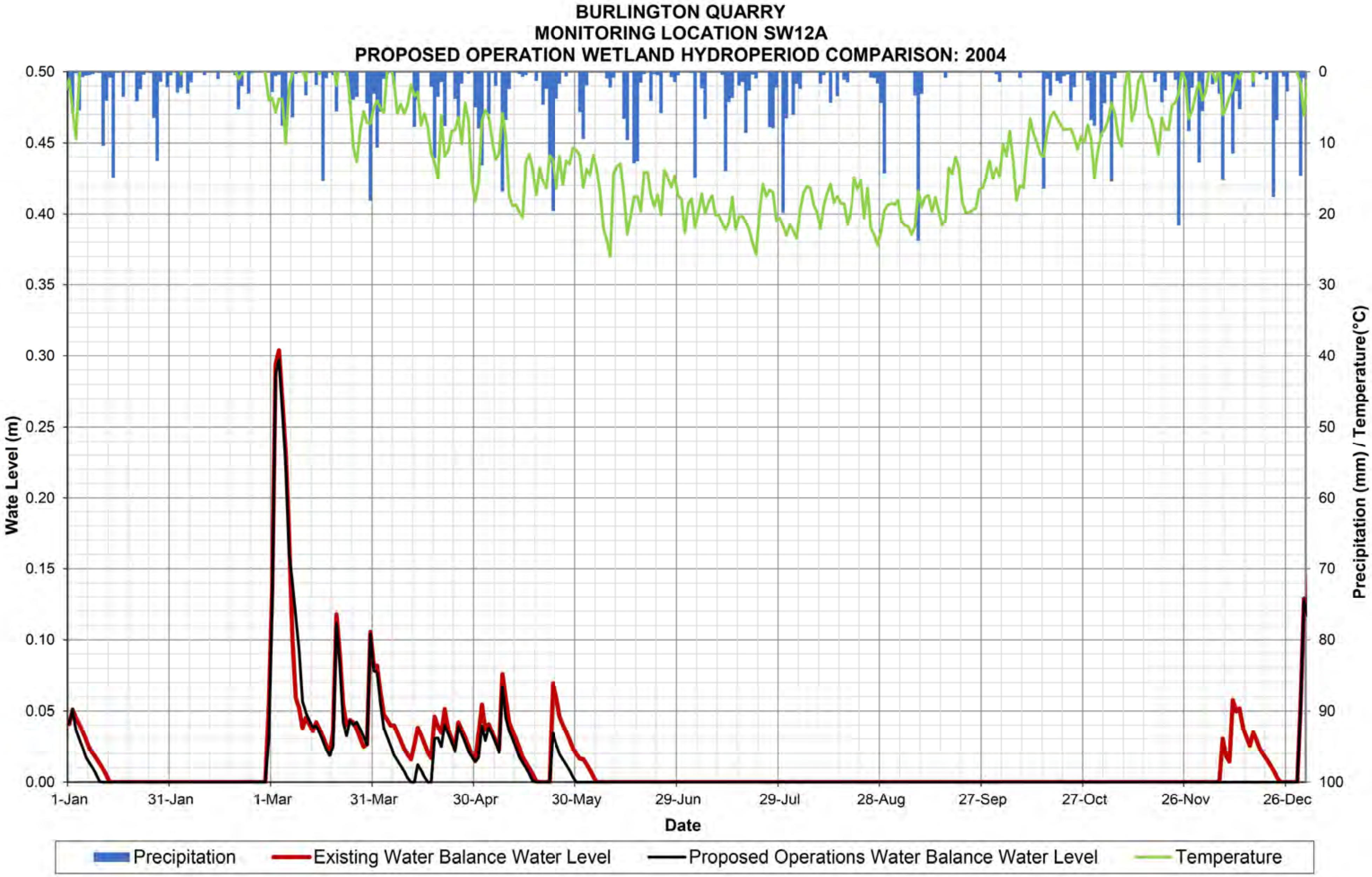

BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2001
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

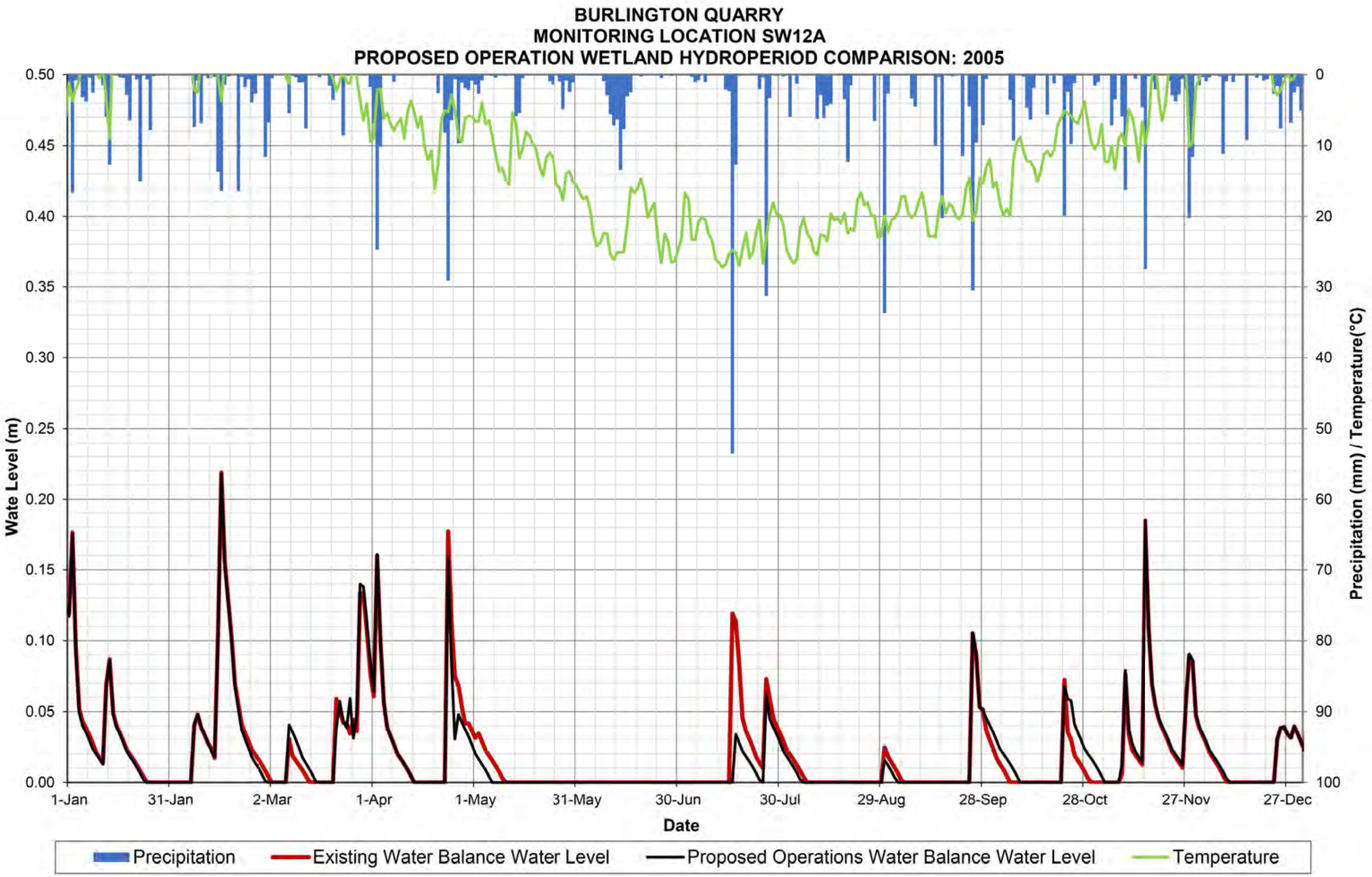


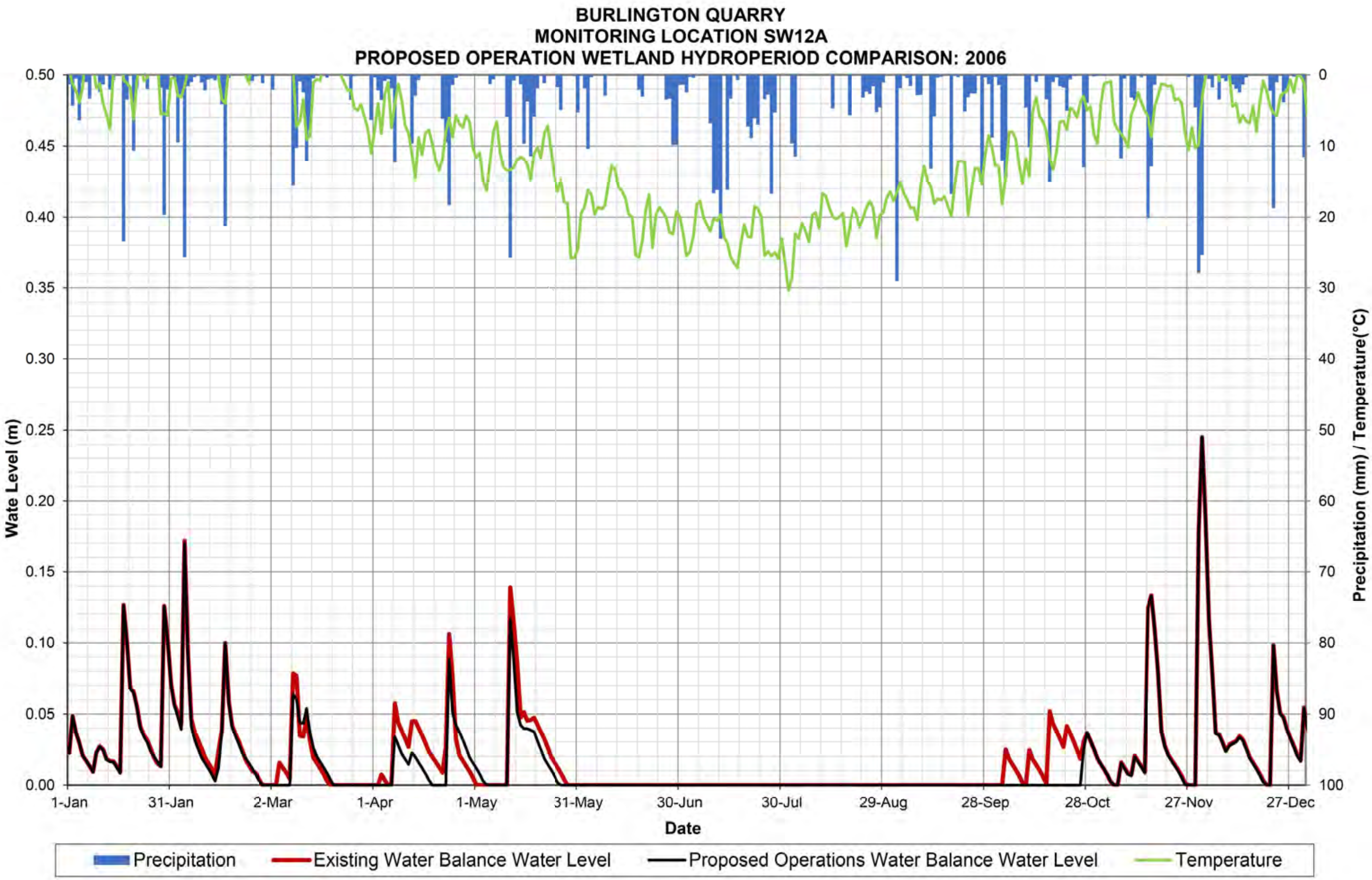
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2002
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature



BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2003
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2004
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2005
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature



BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2006
Wate Level (m)
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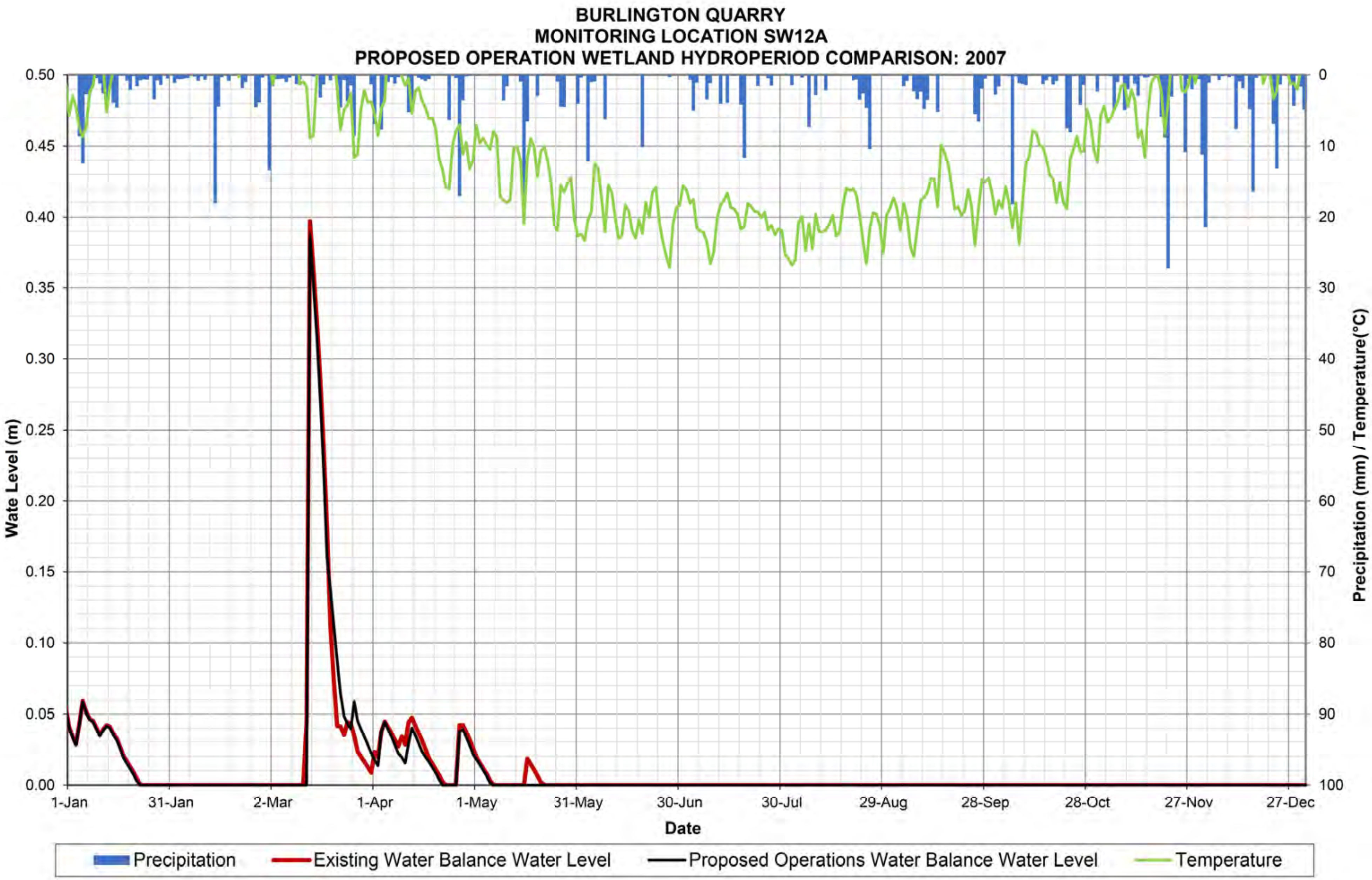
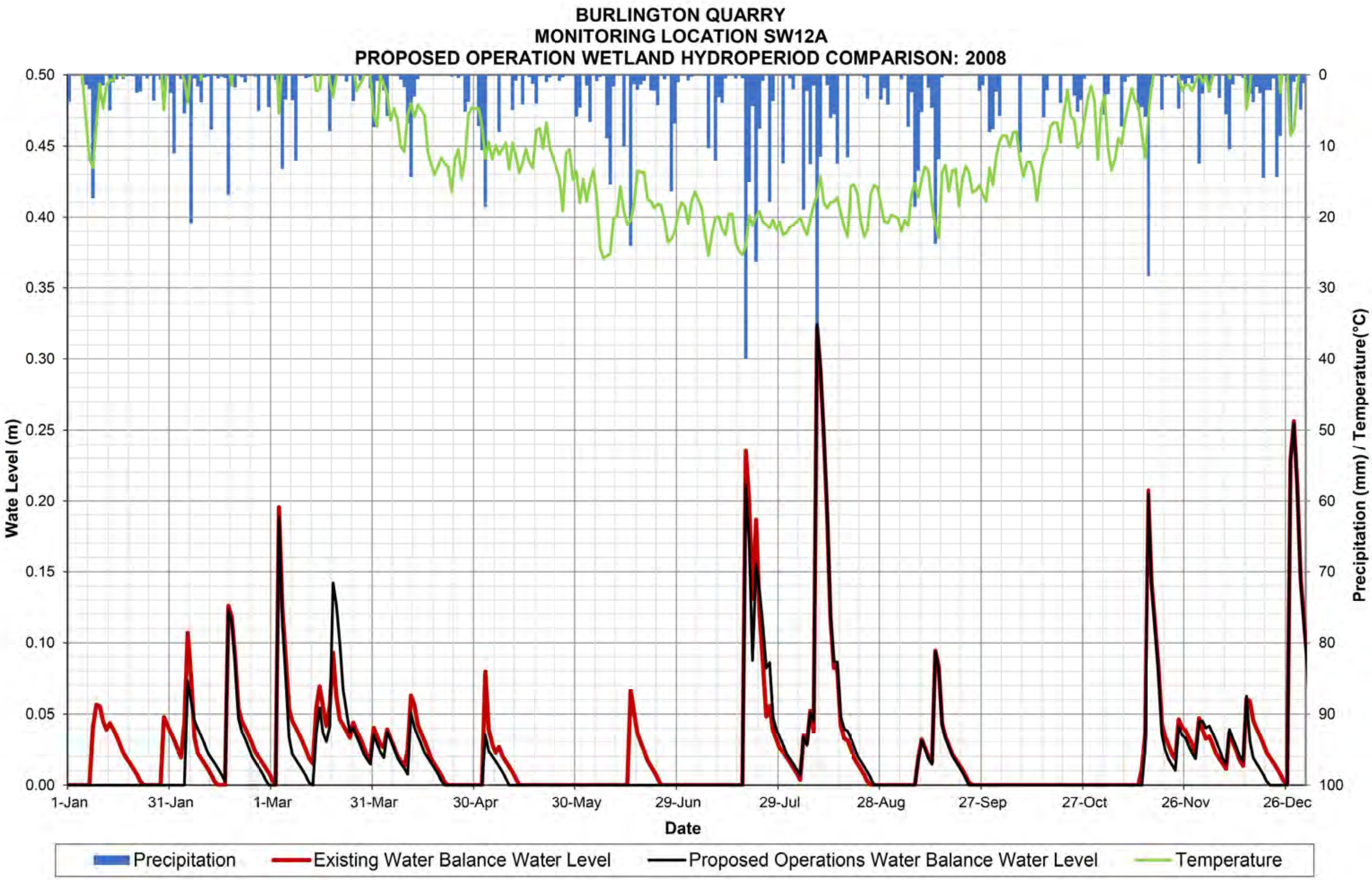
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2007
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2008
Wate Level (m)
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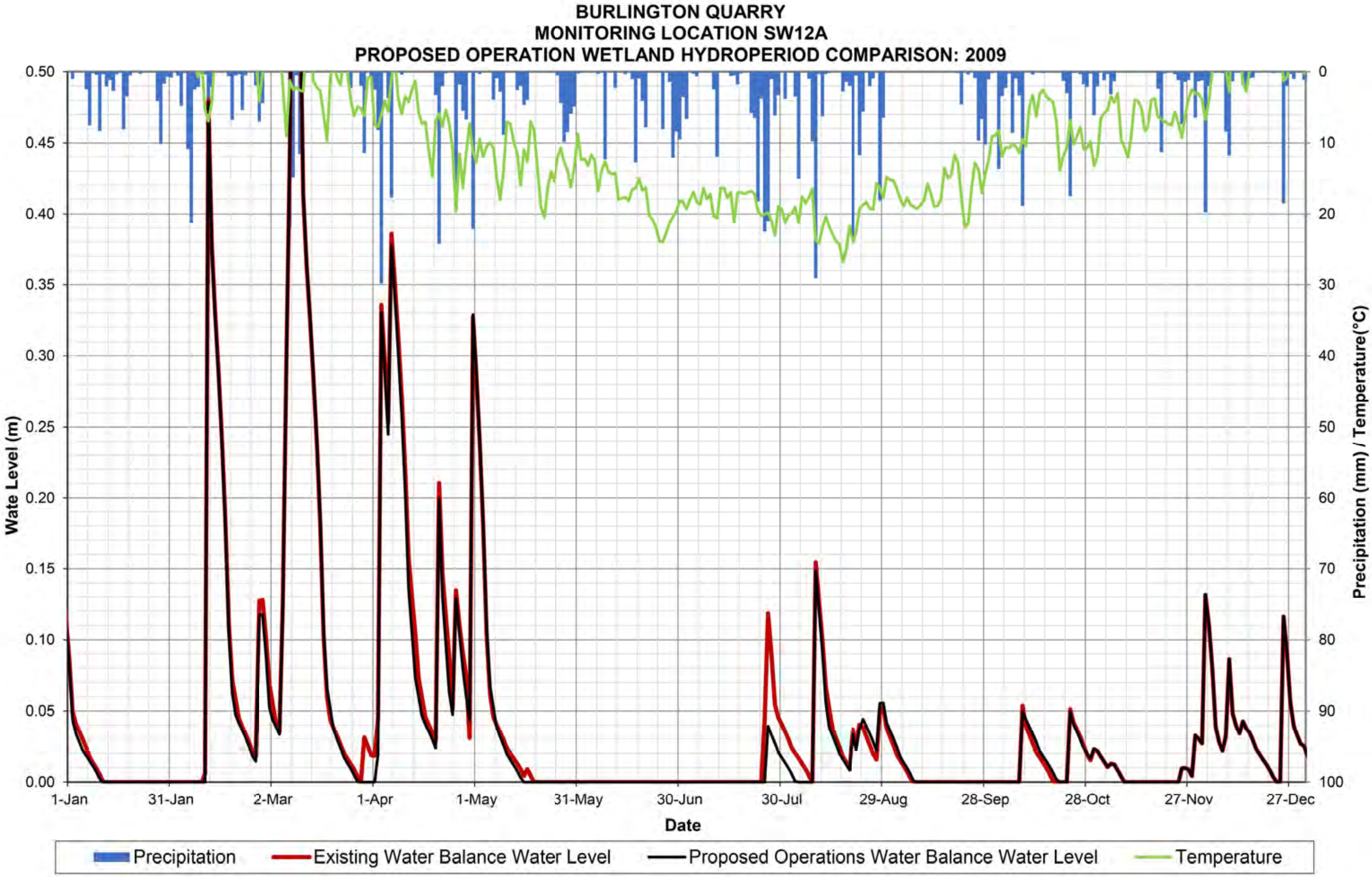
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2009
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
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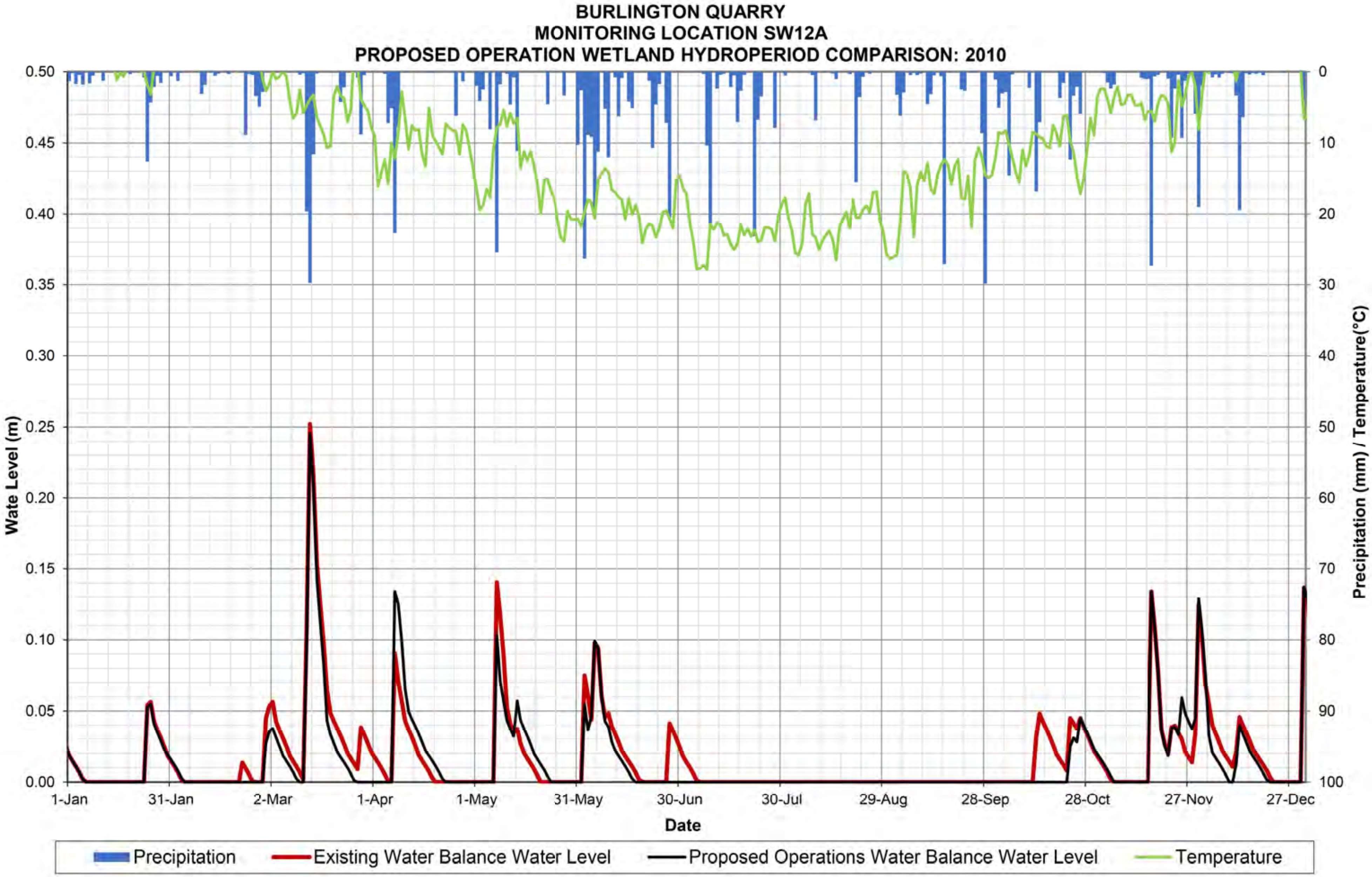
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2010
Wate Level (m)
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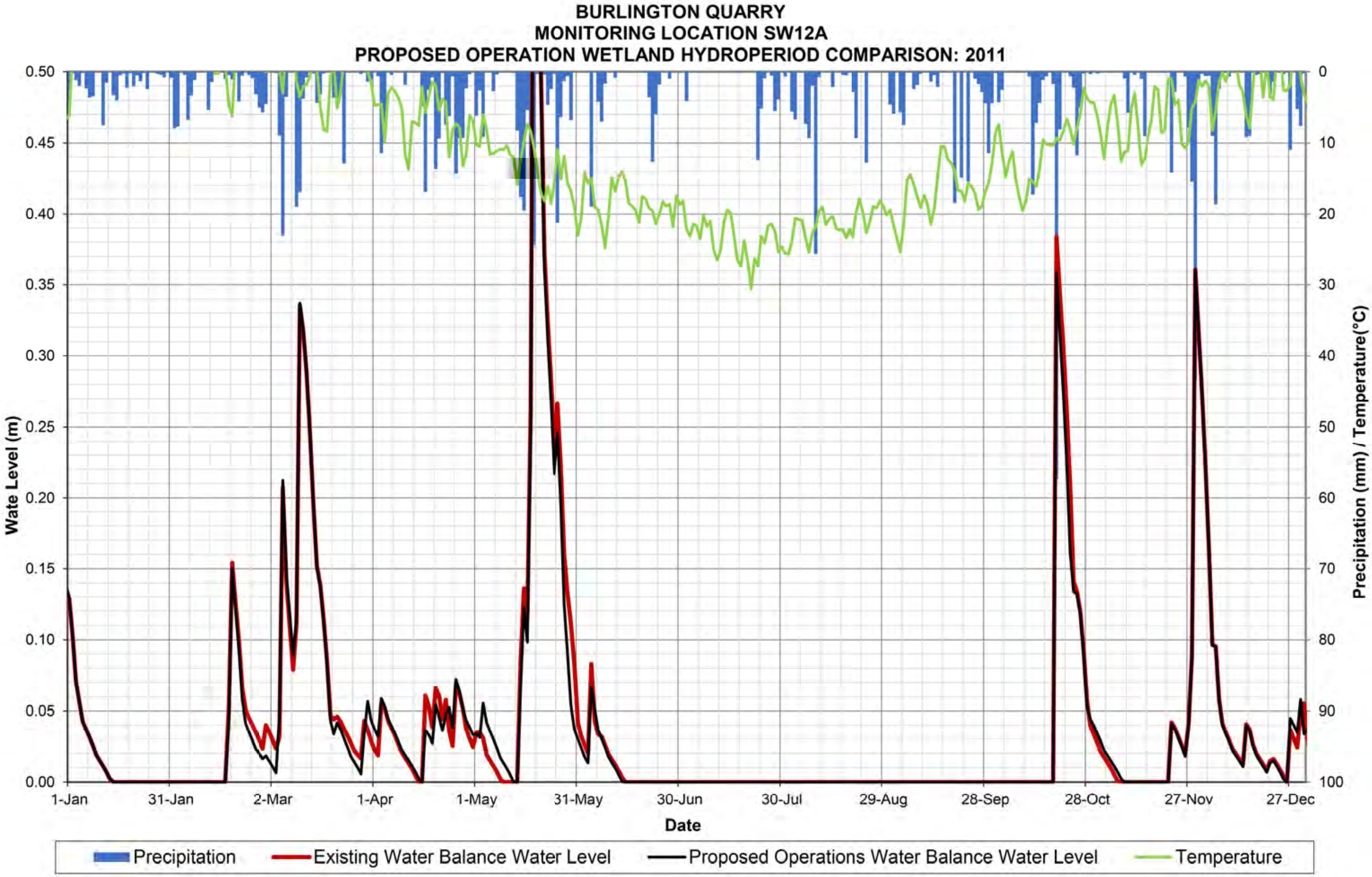
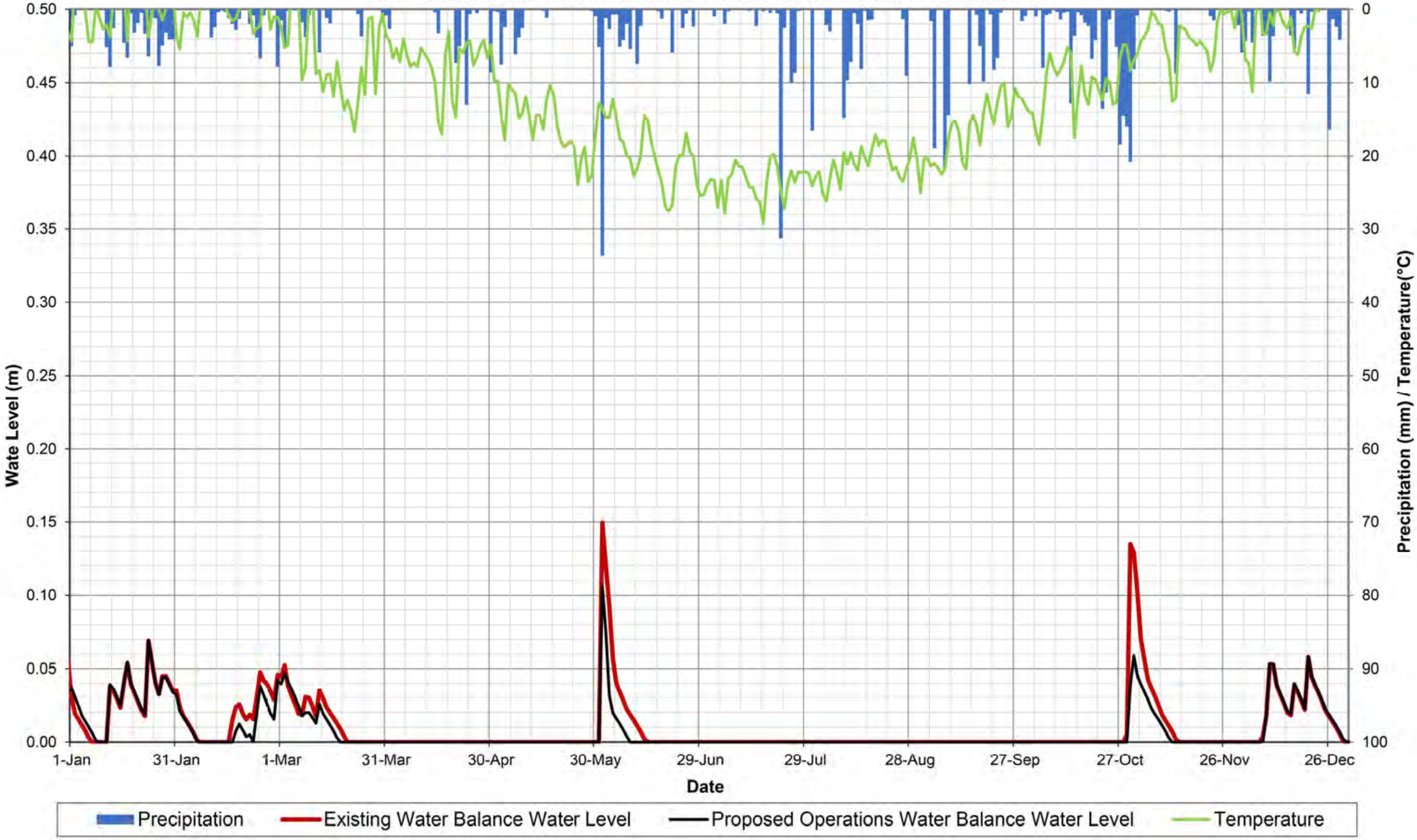
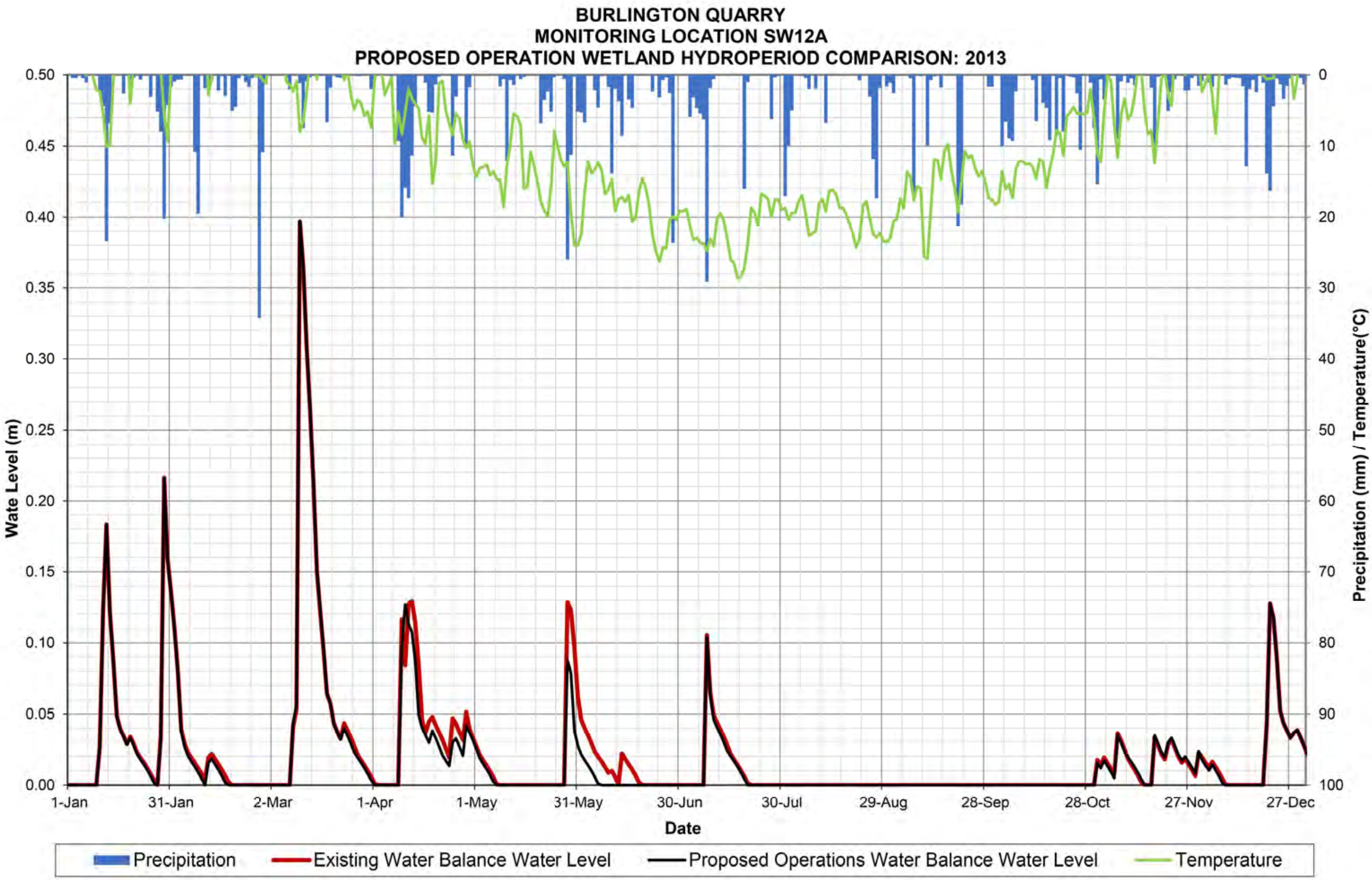
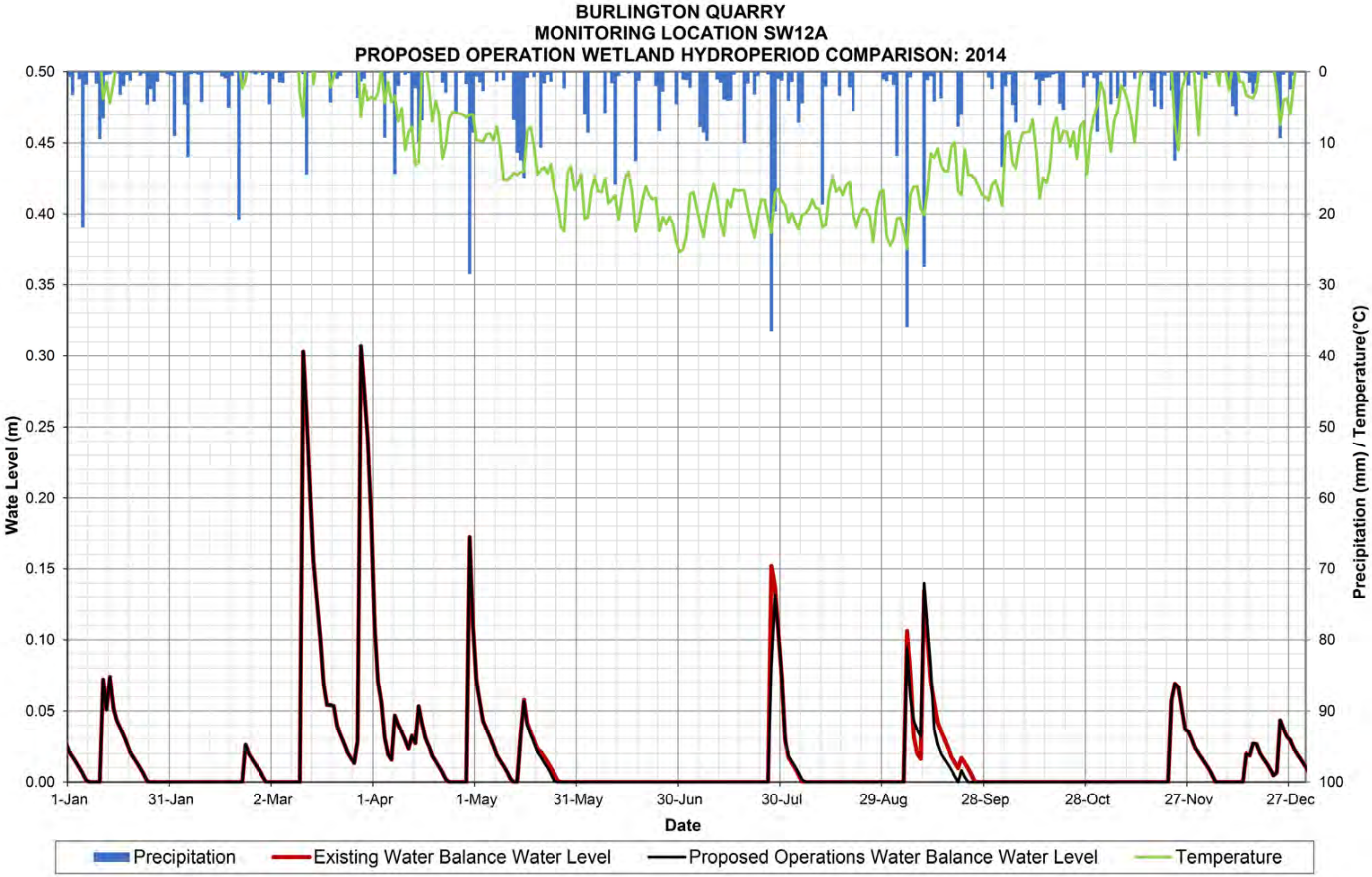
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2011
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

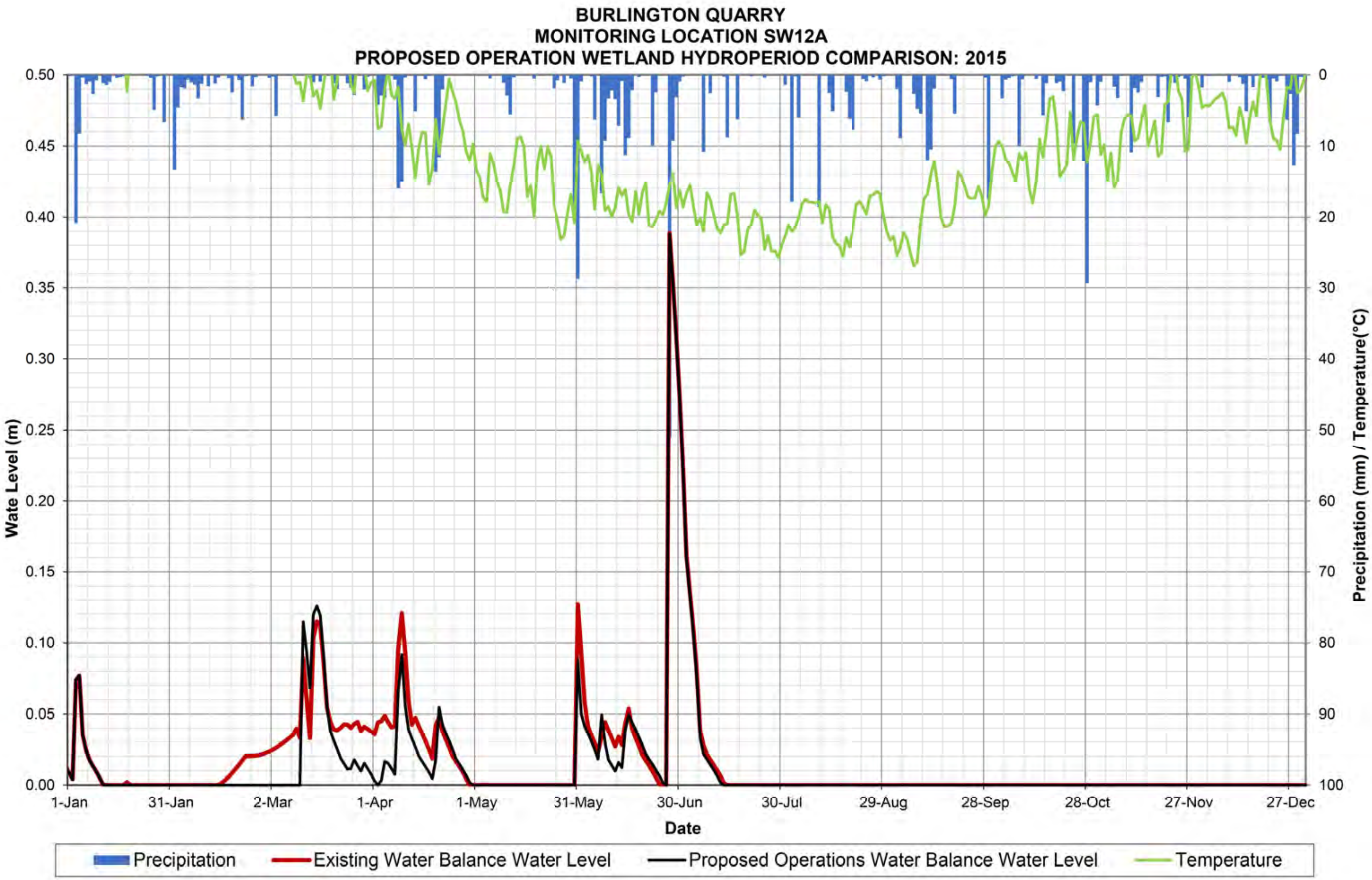
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2012



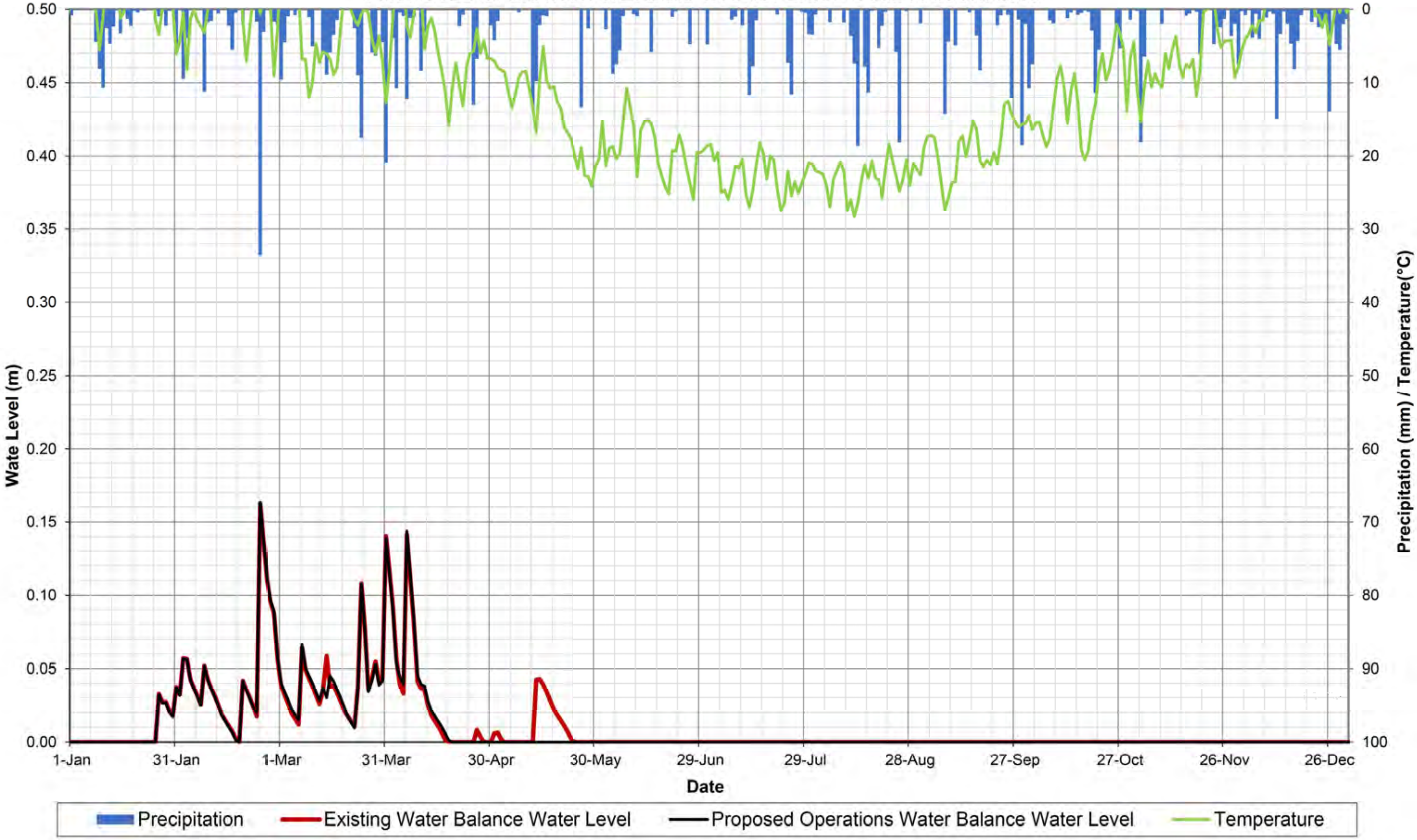

BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2013
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

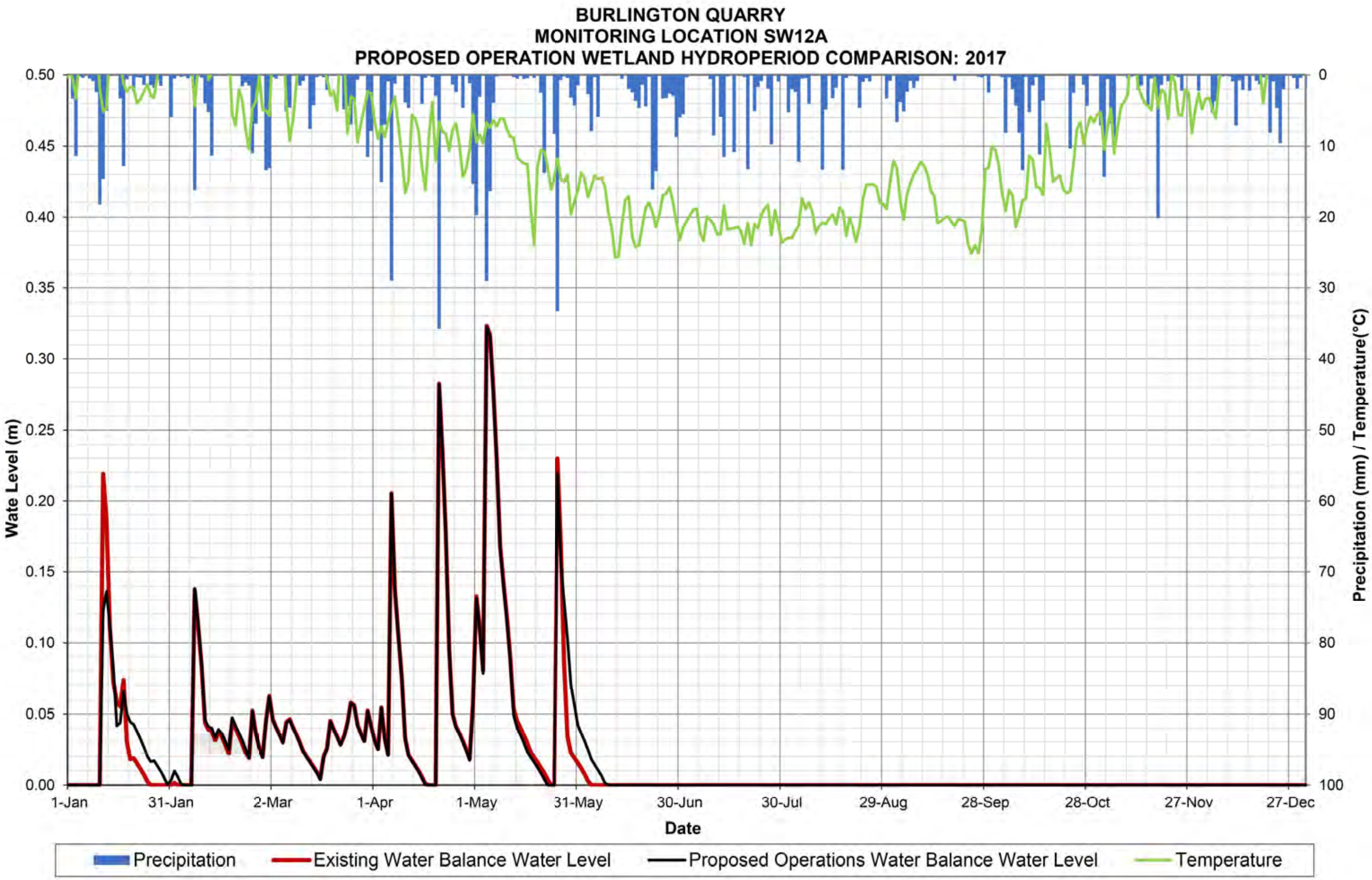


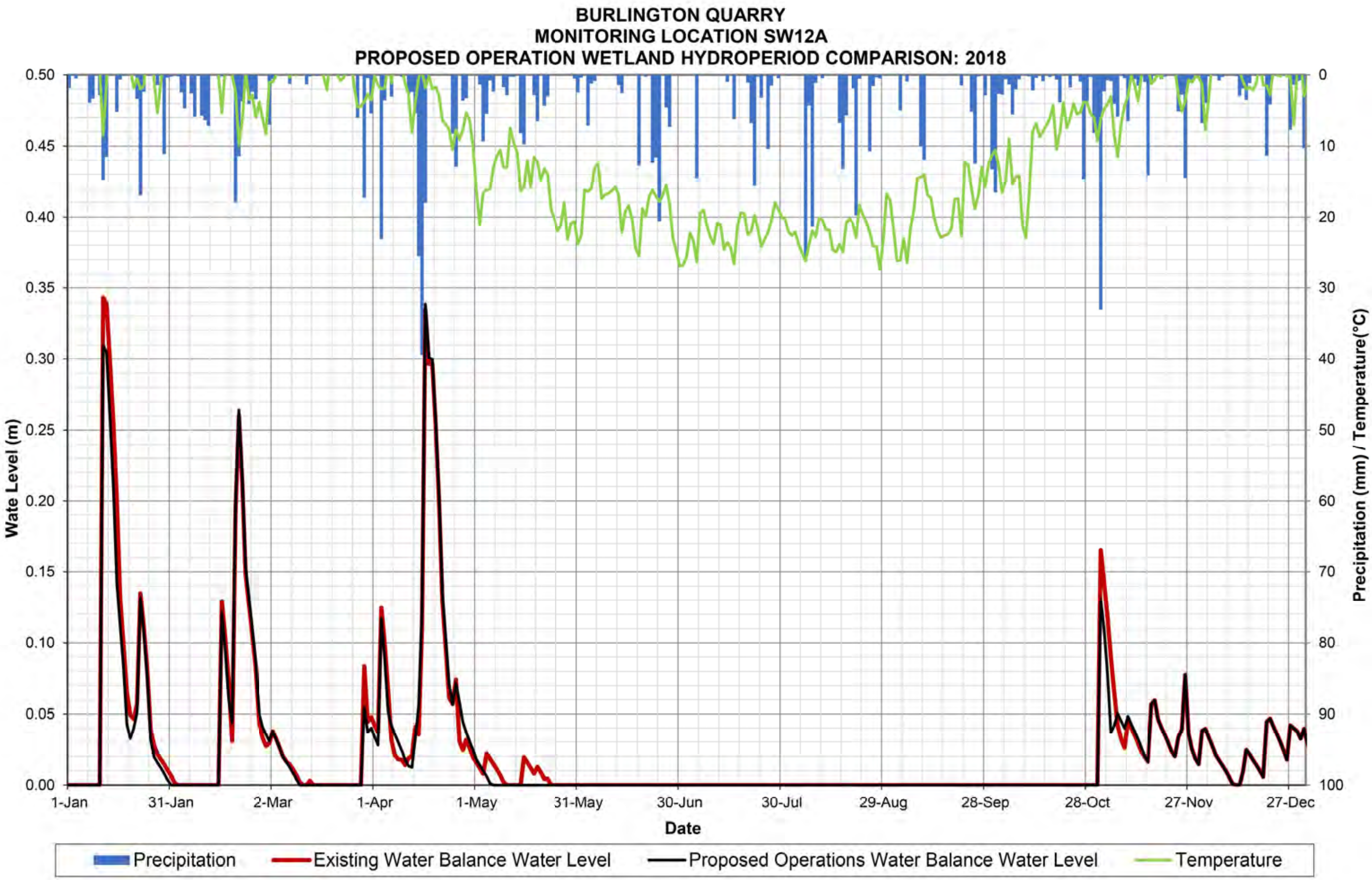
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2014
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2015
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

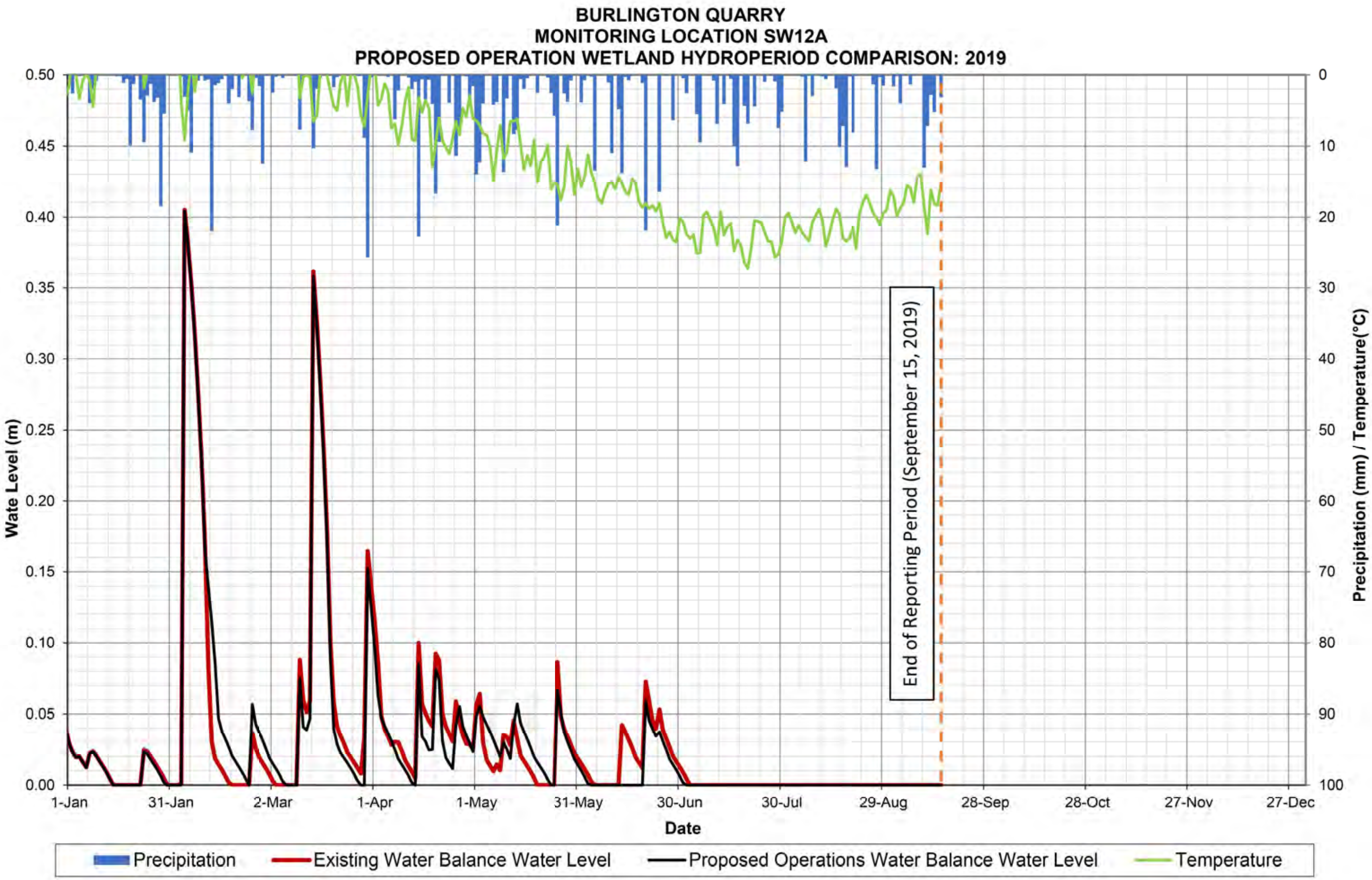
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2016



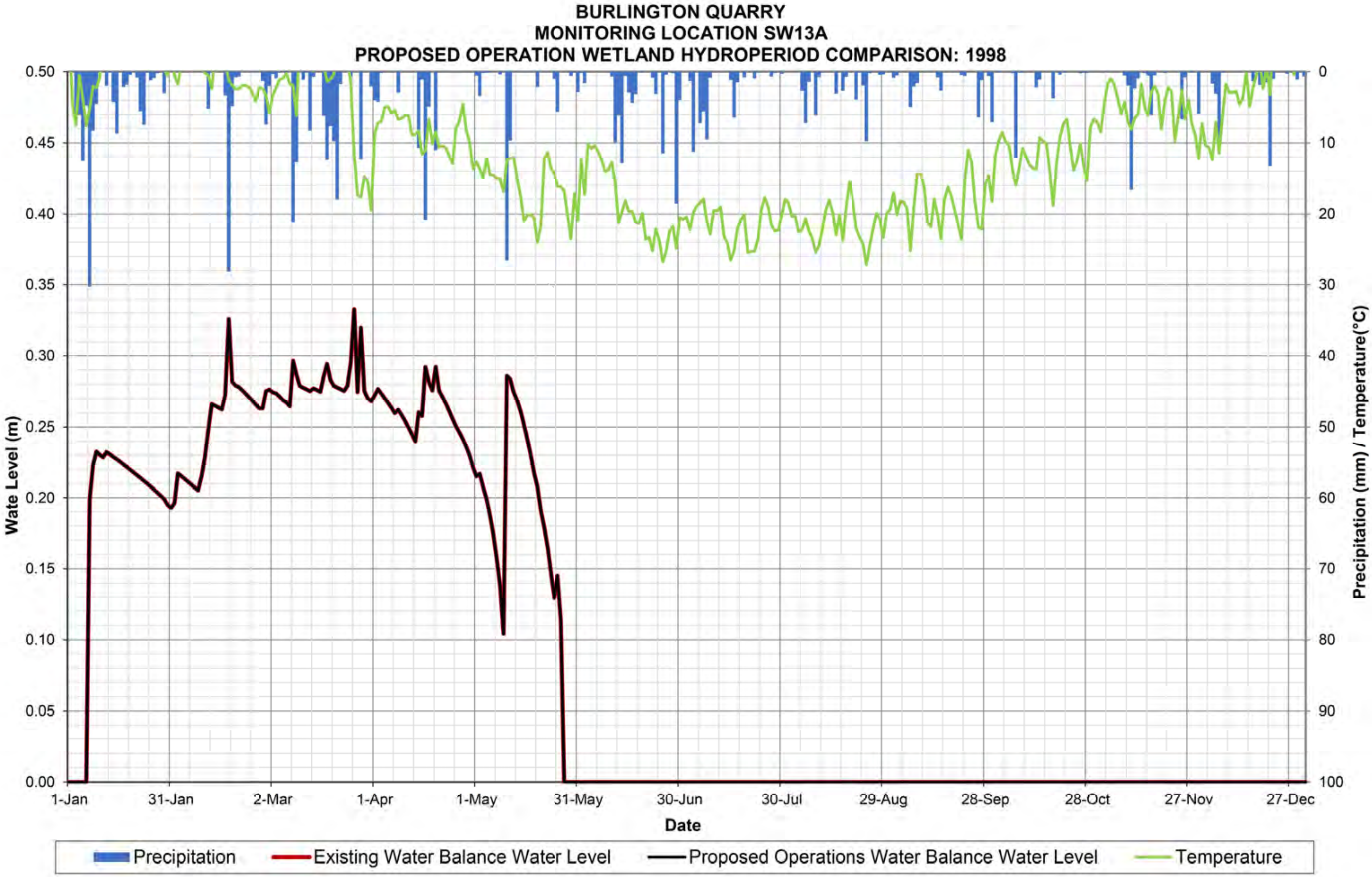

BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2017
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature



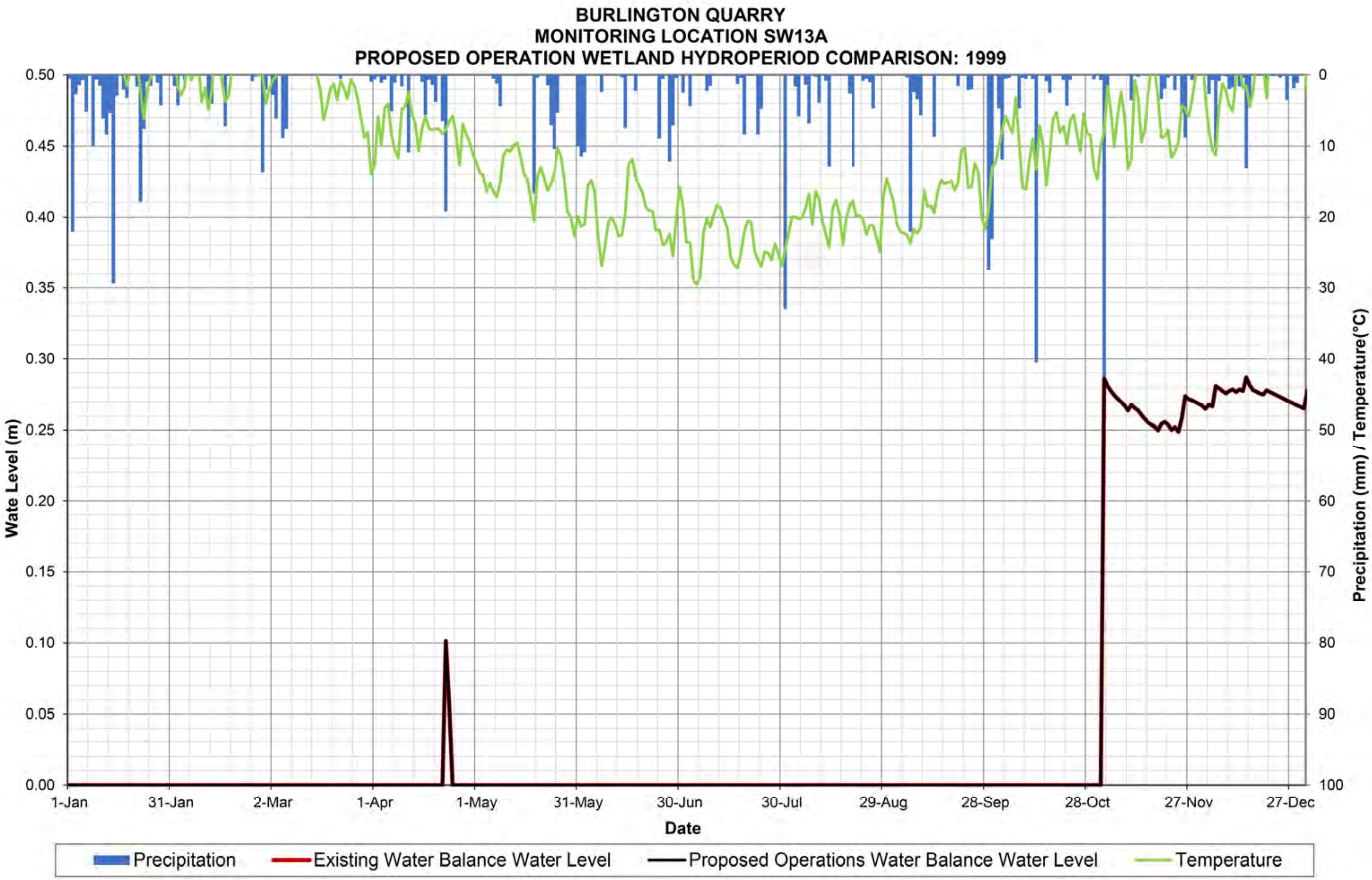
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2018
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

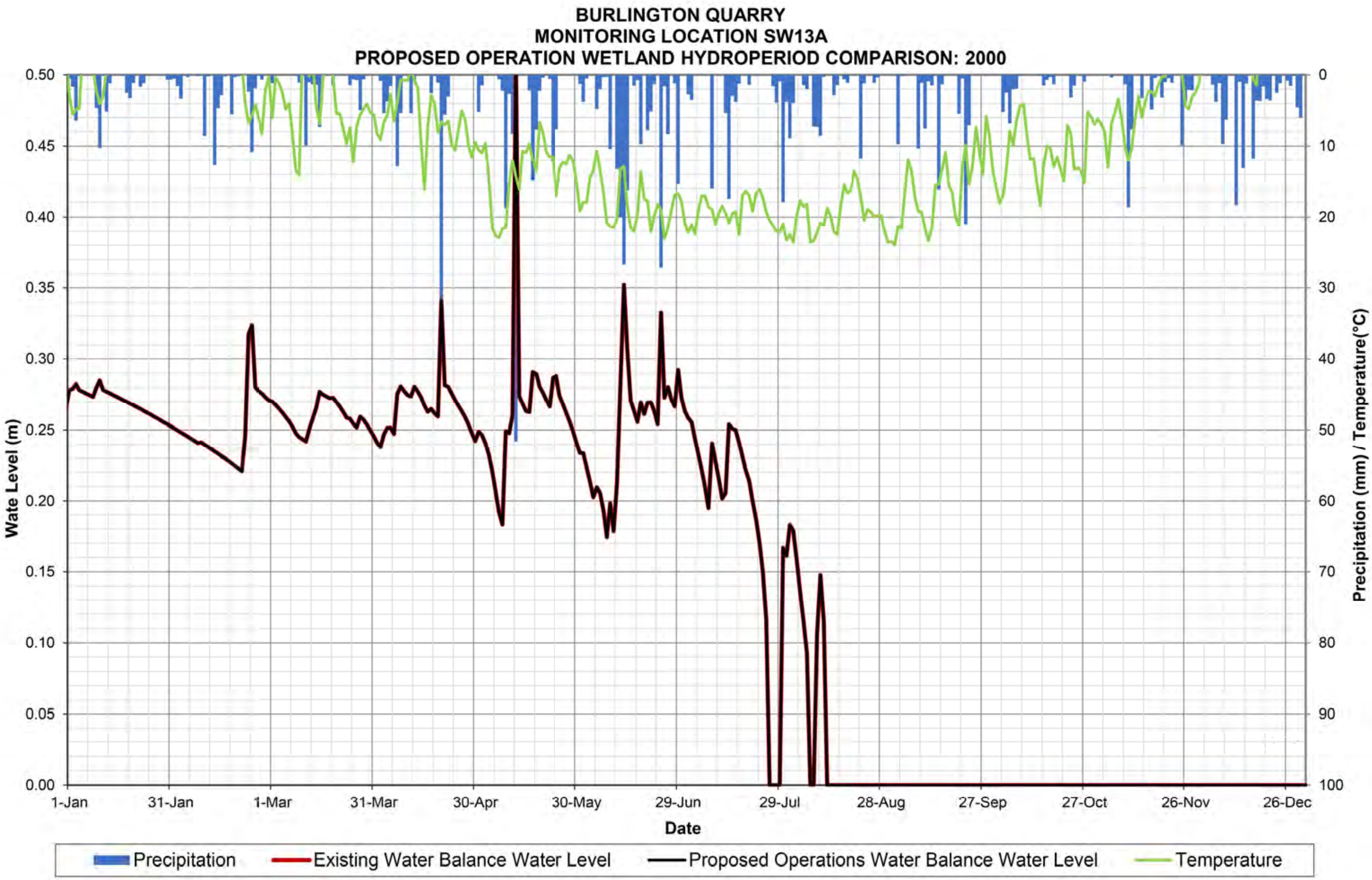


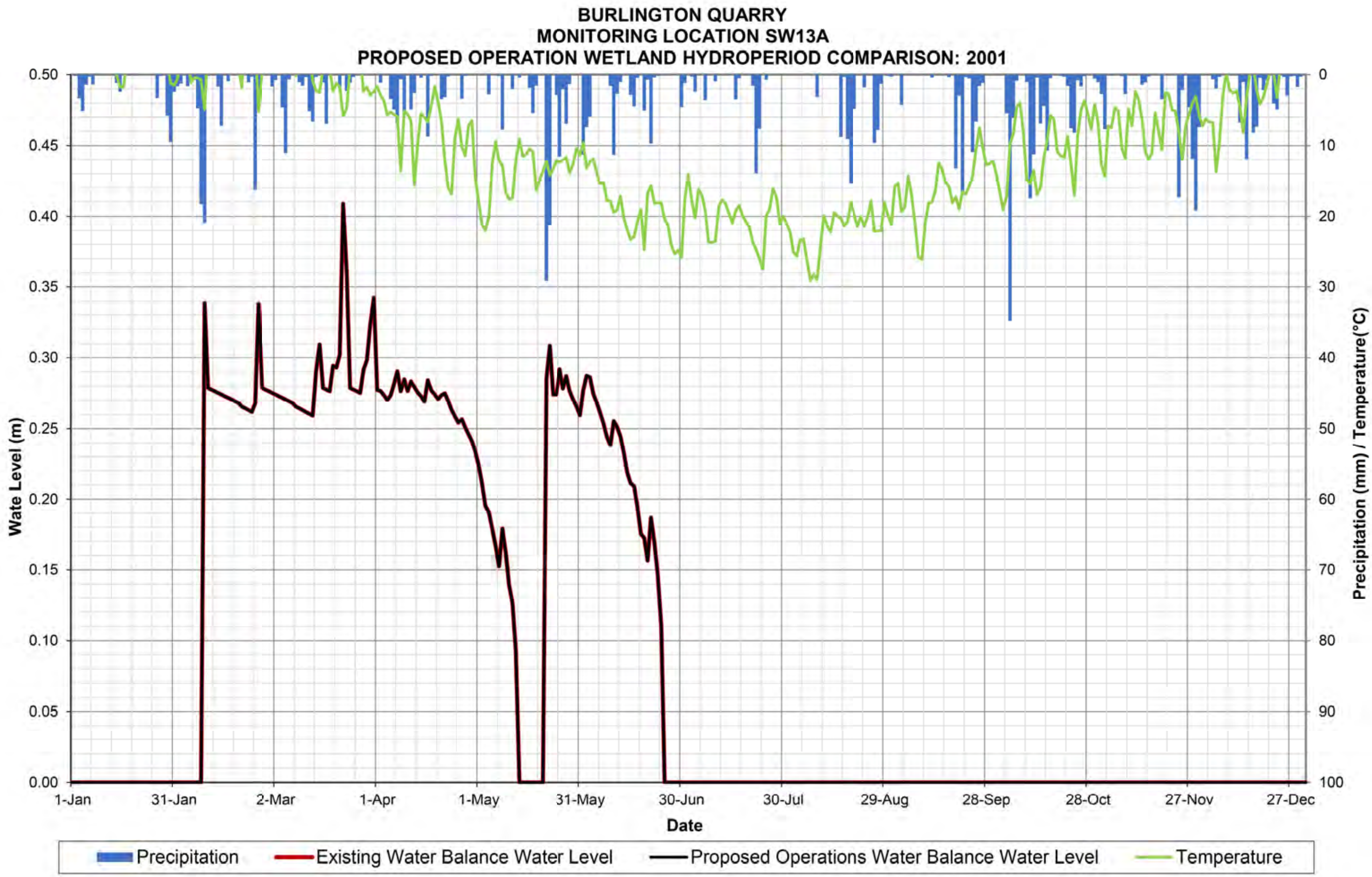
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2019
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0
10
20
30
40
50
60
70
80
90
100
End of Reporting Period (September 15, 2019)
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

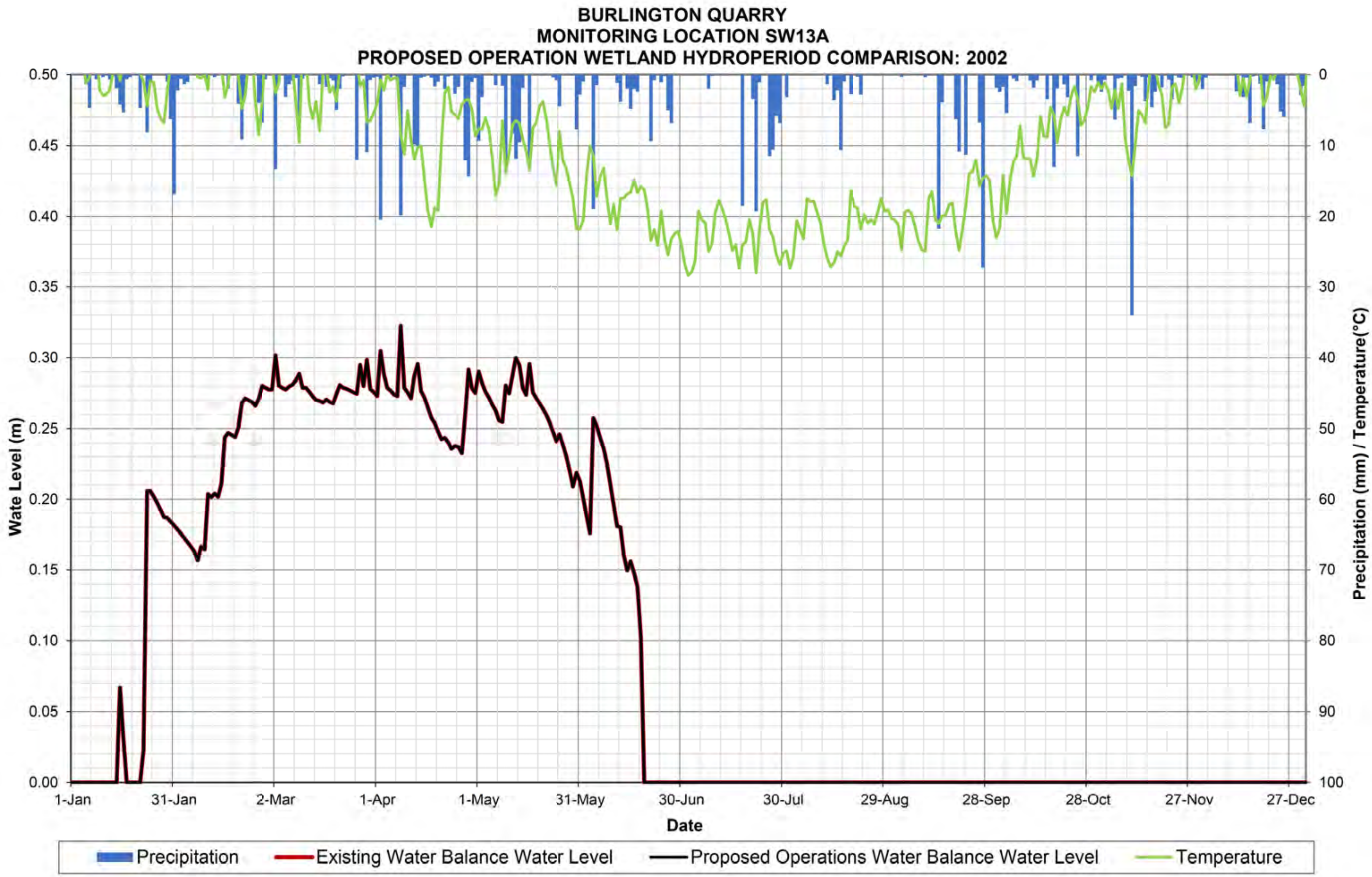


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 1998
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 1999
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

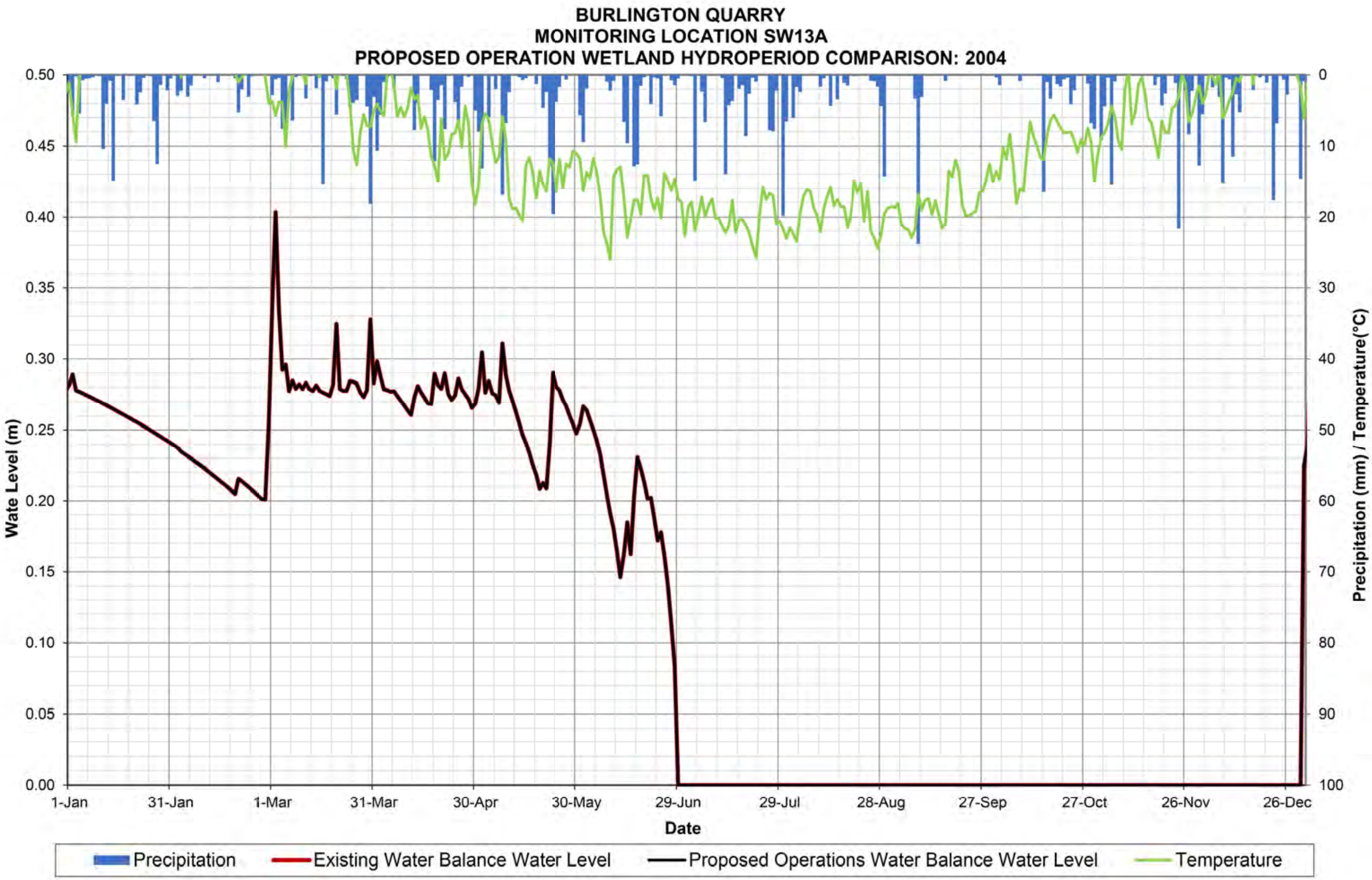

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2000
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

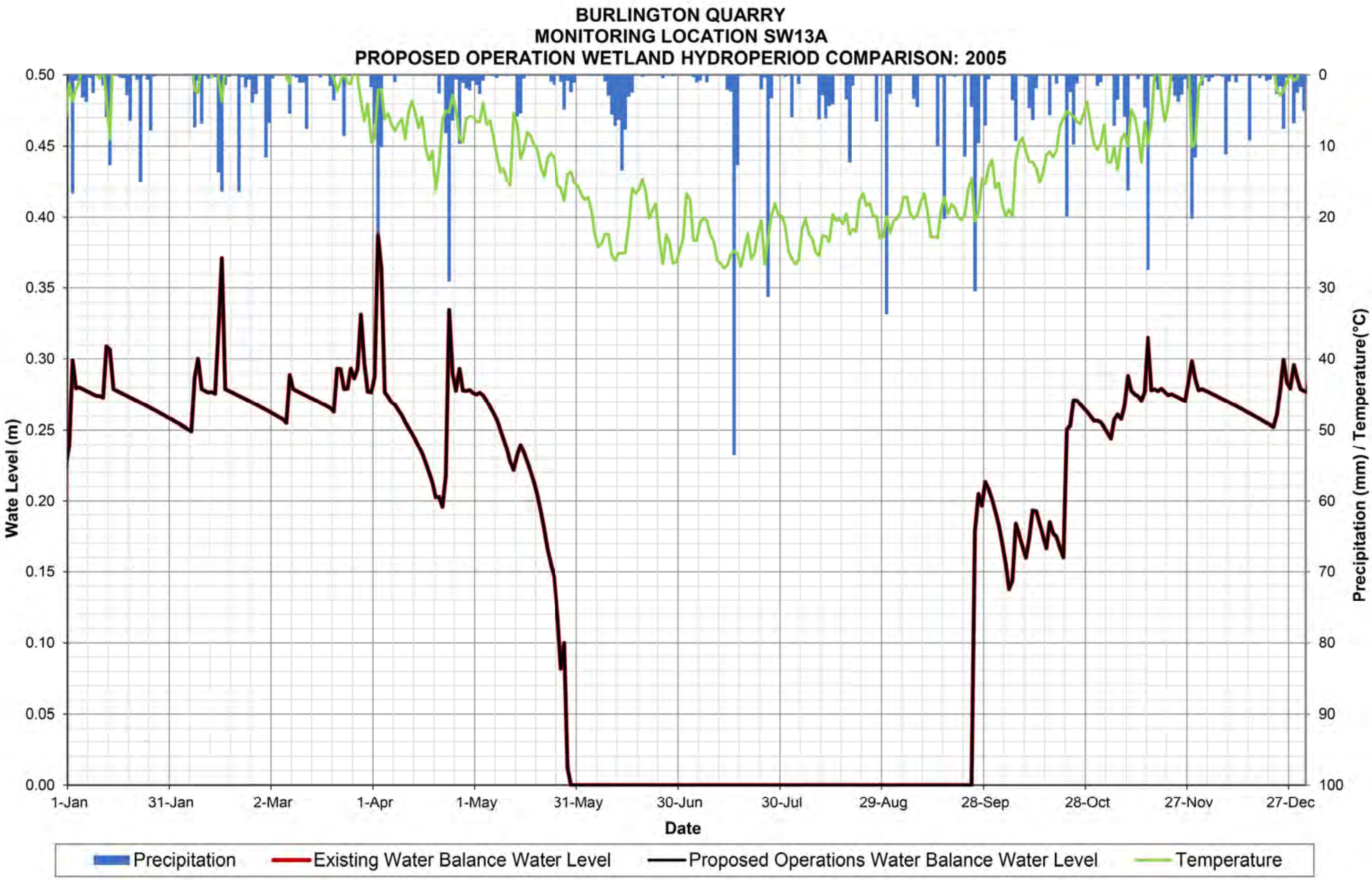

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2001
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

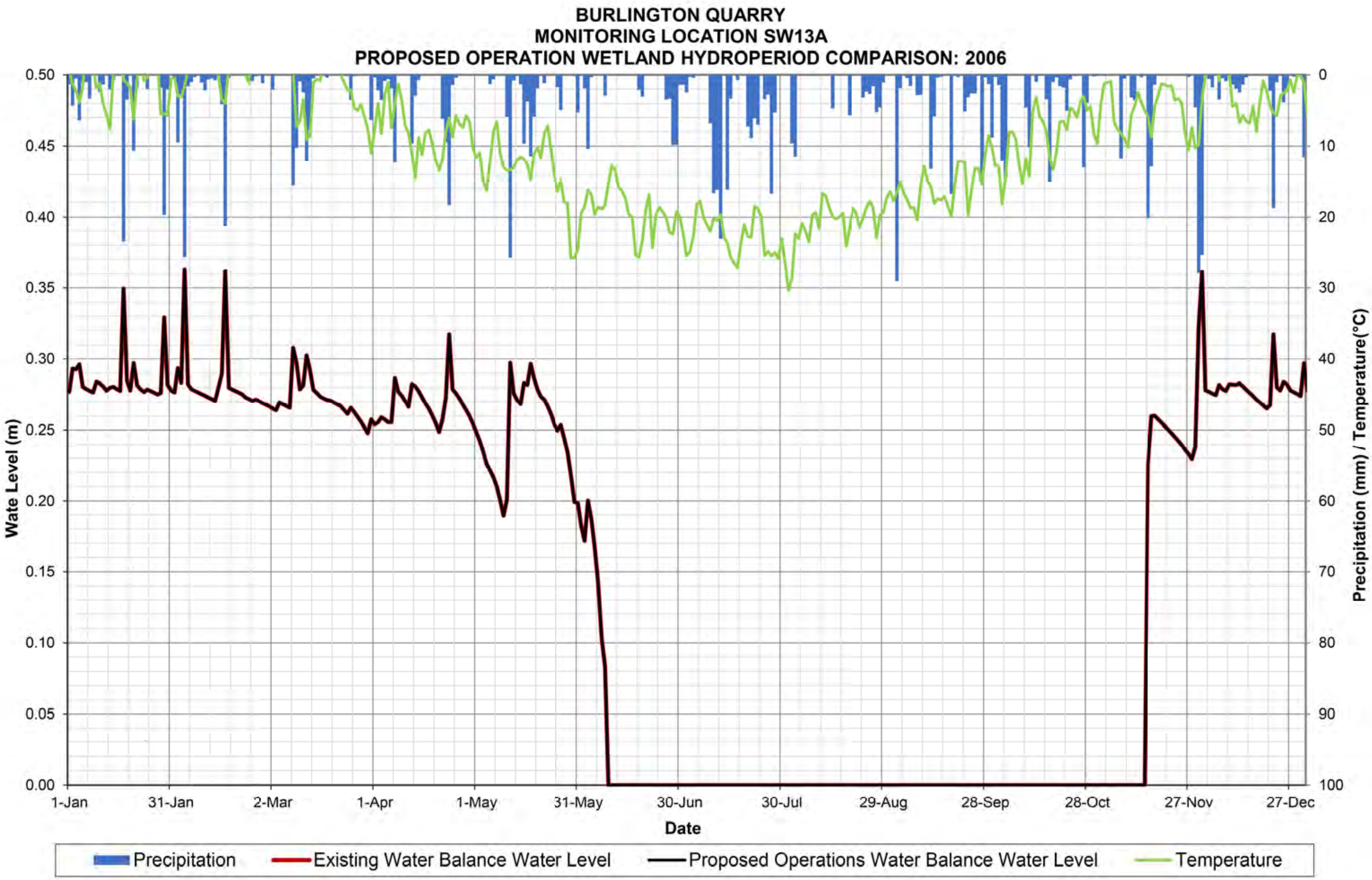


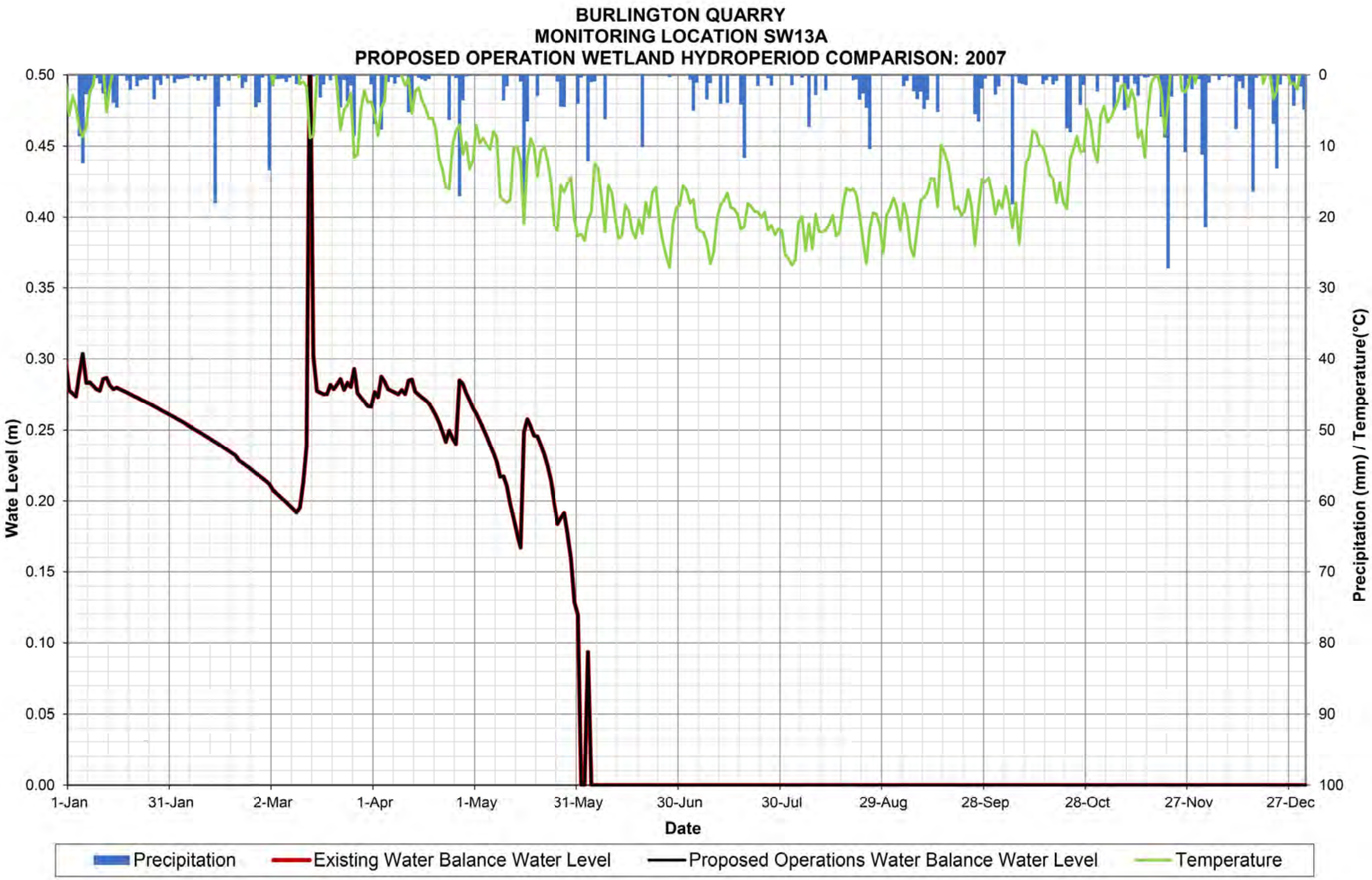
BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2002
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2003
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

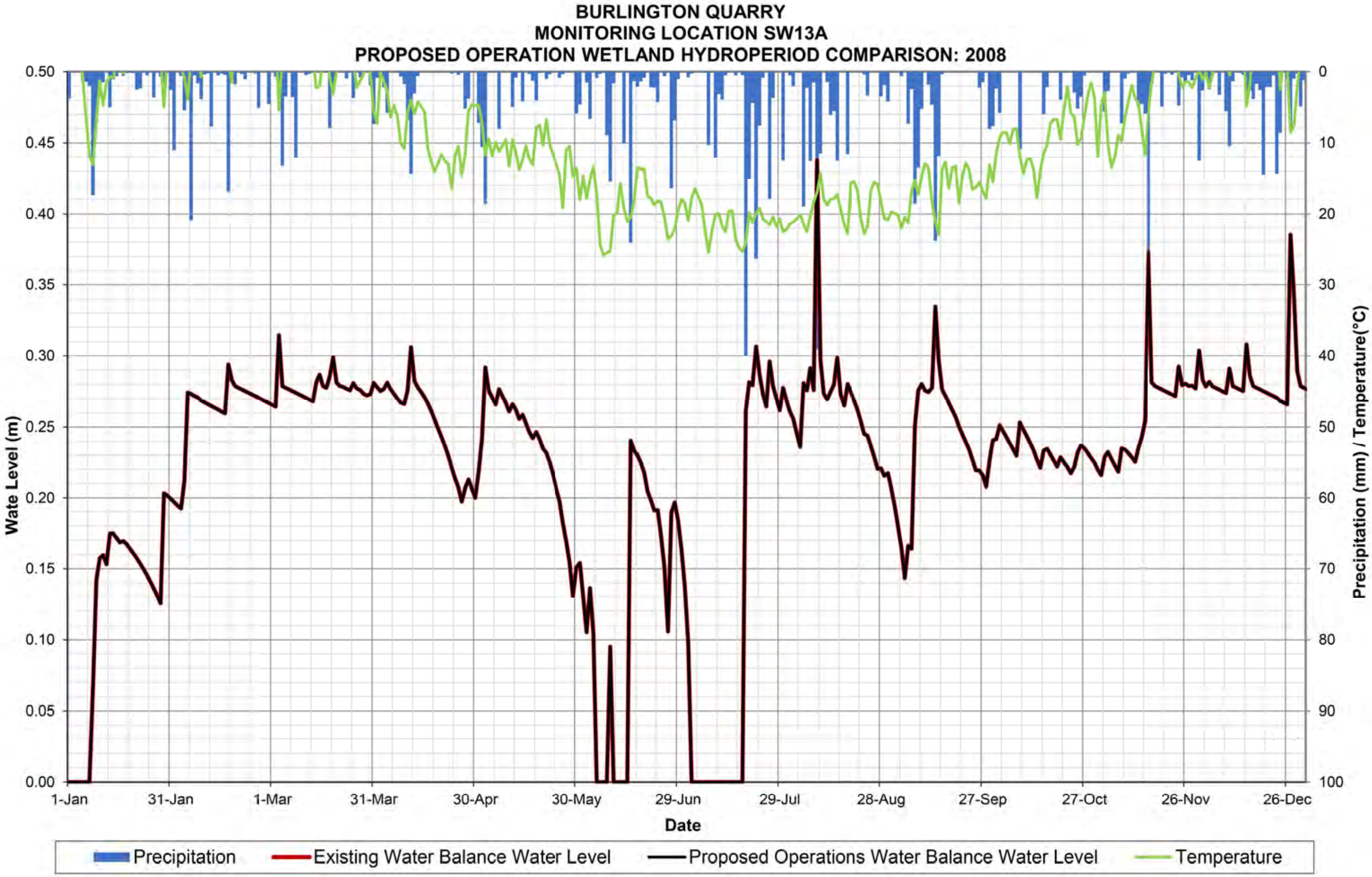

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2004
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2005
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

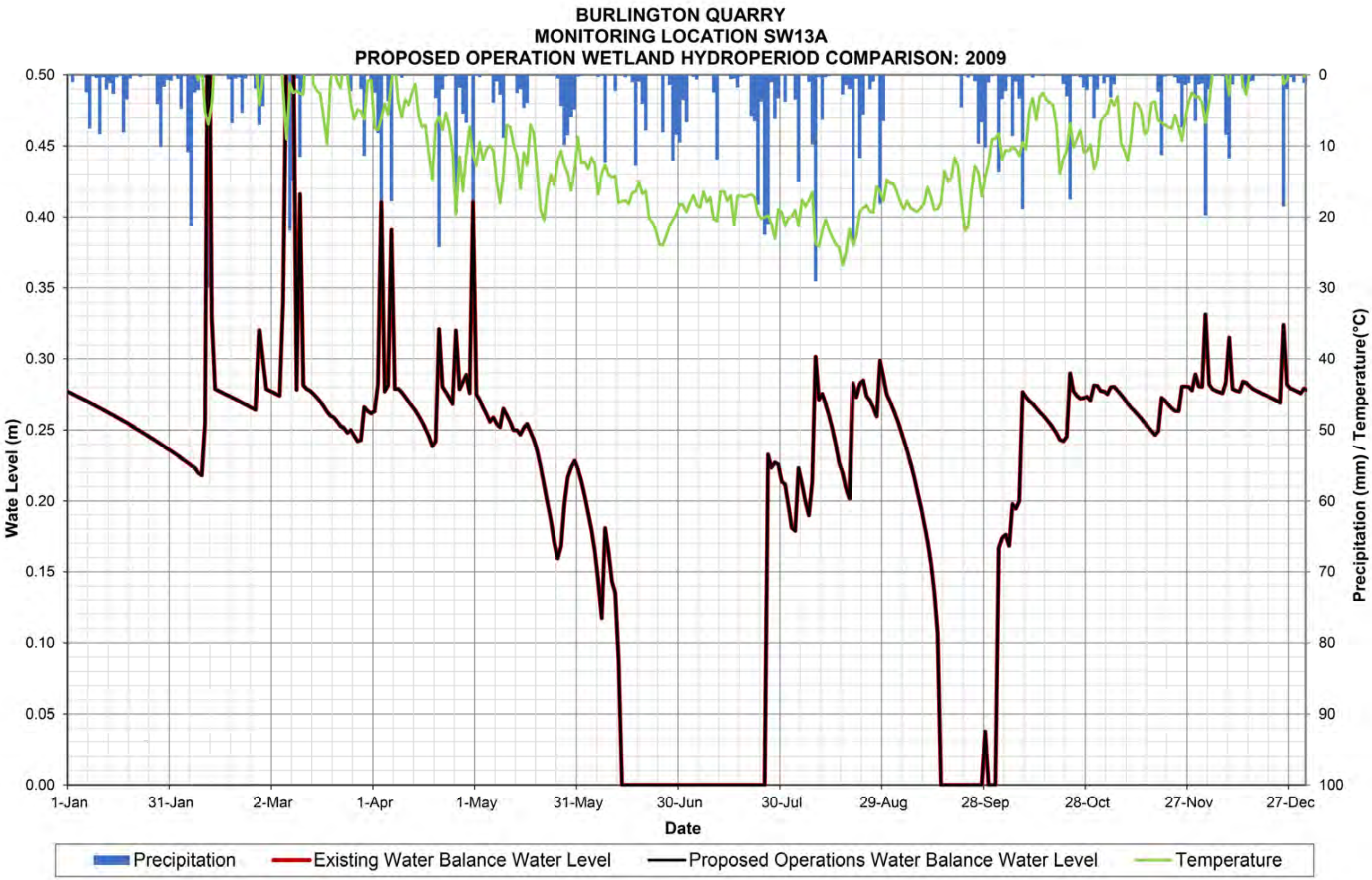

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2006
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature



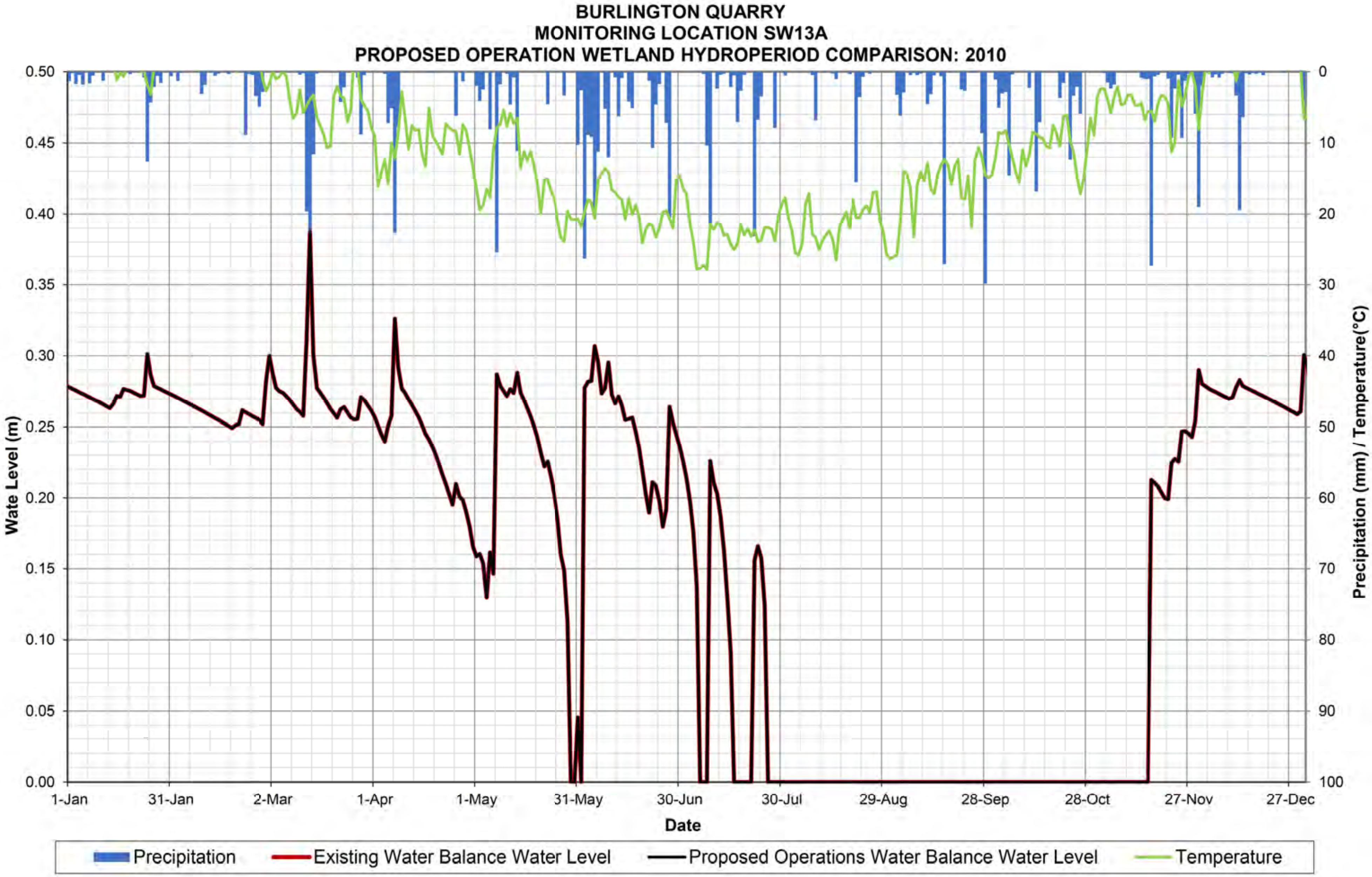
BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2007
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

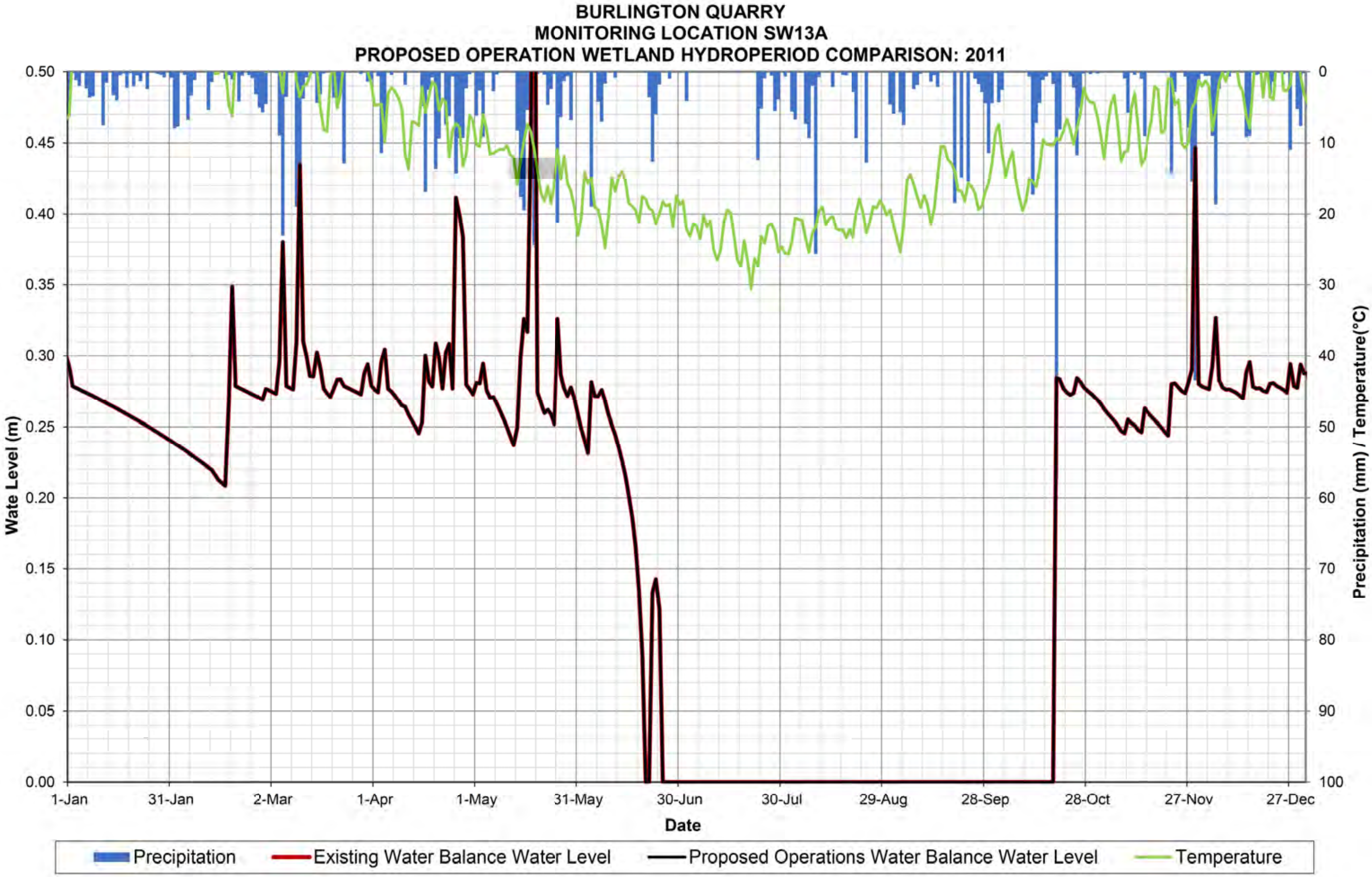


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2008
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

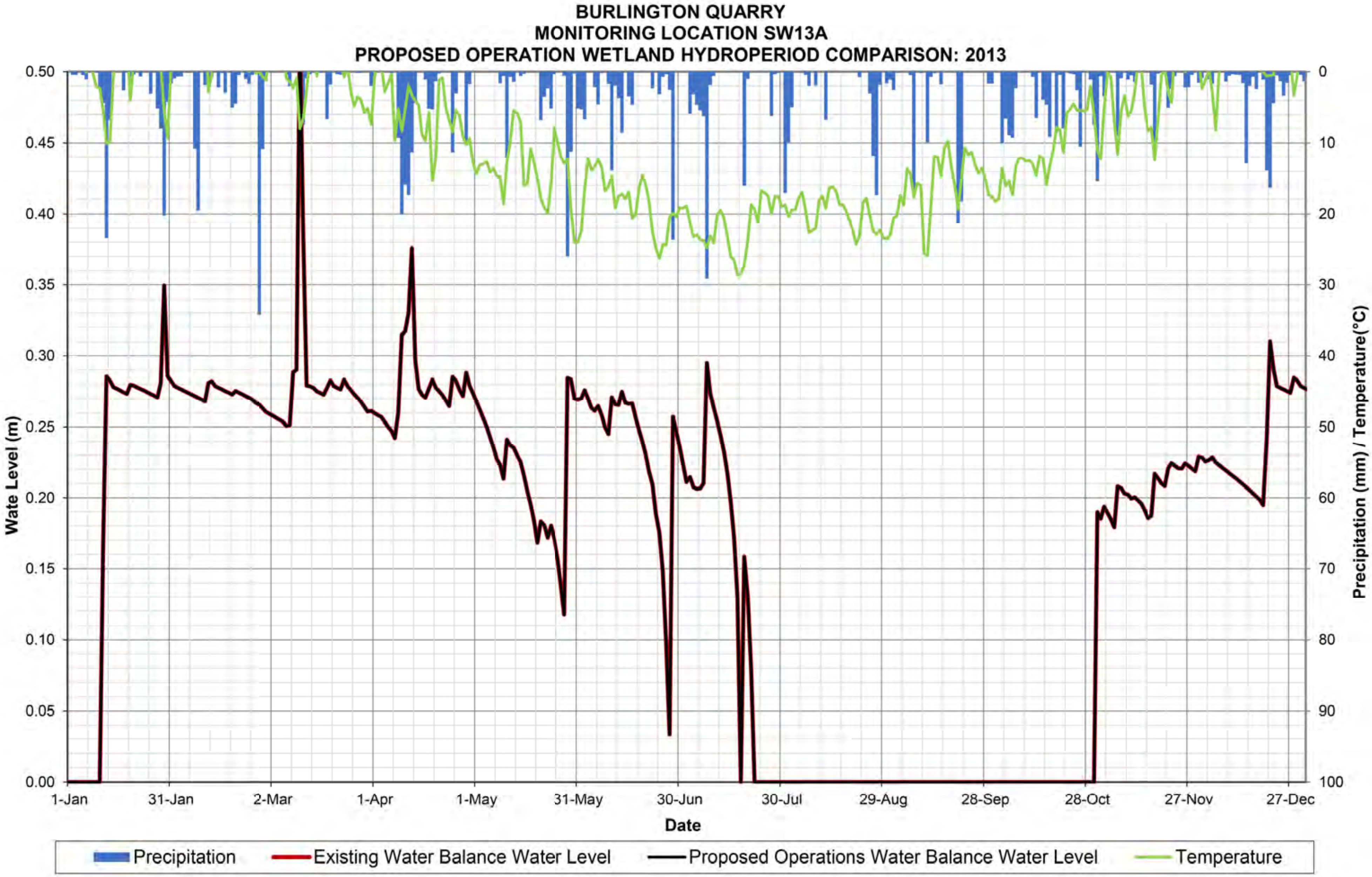


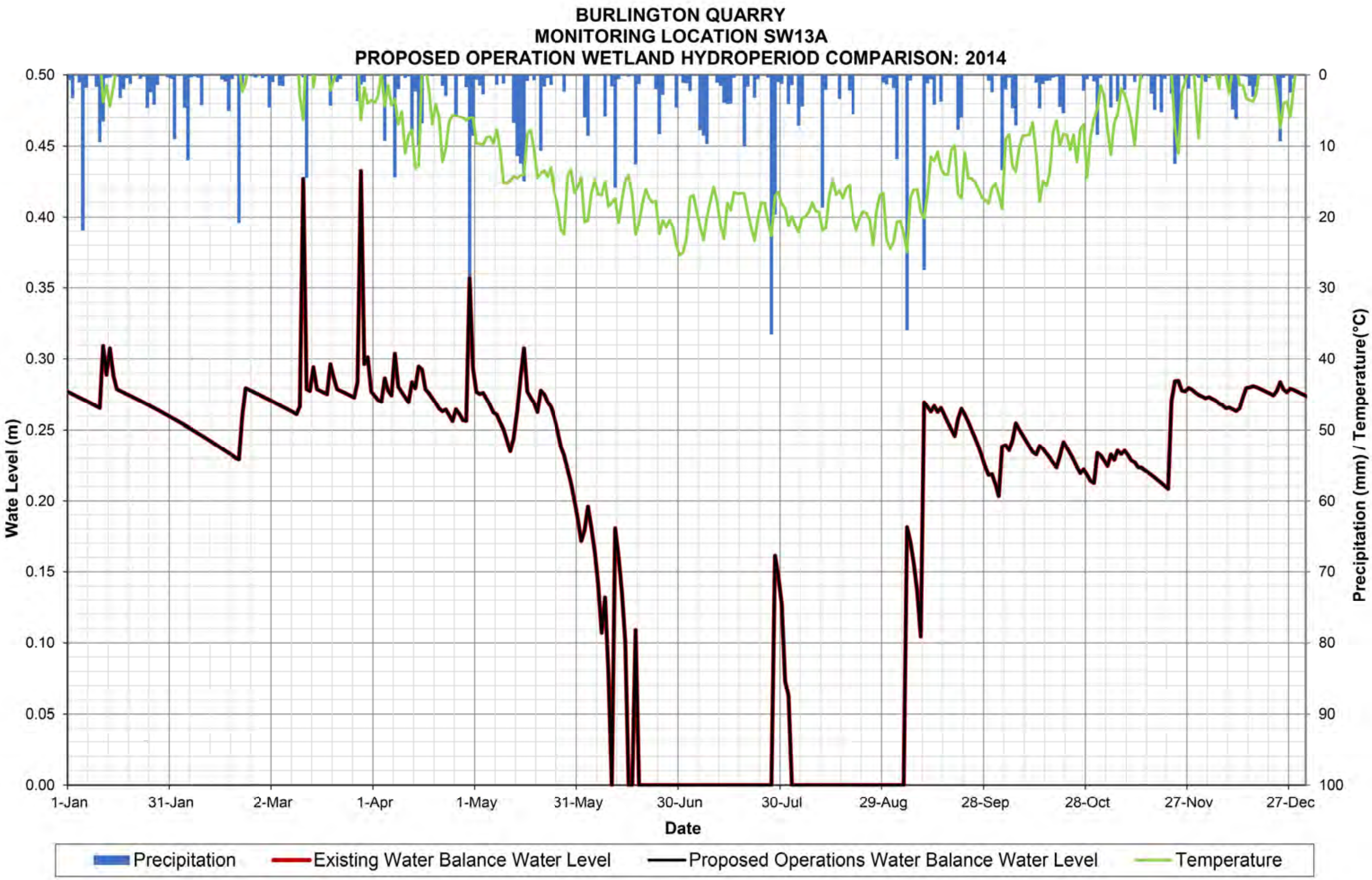
BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2009
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2010
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

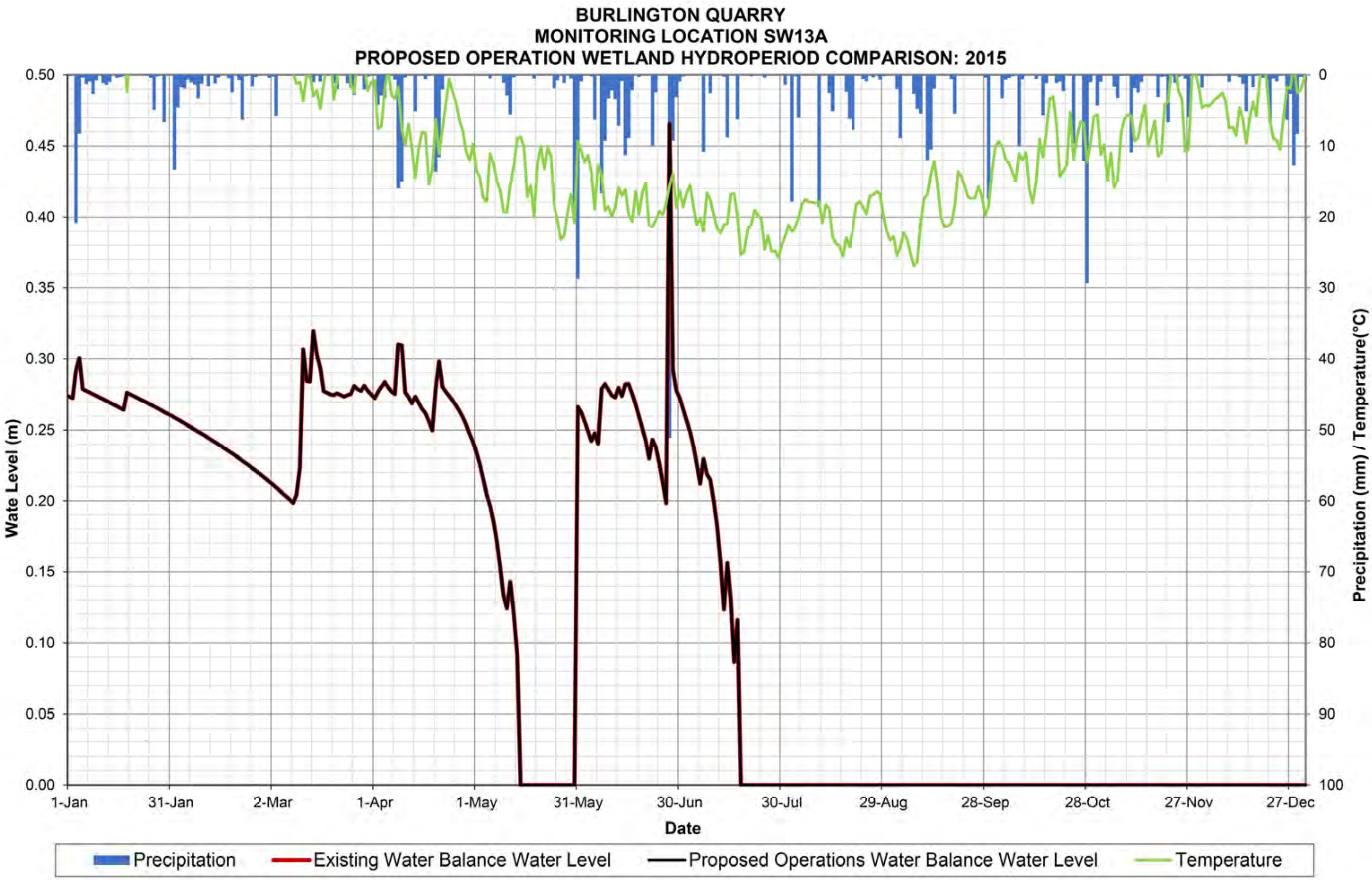

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2011
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2012

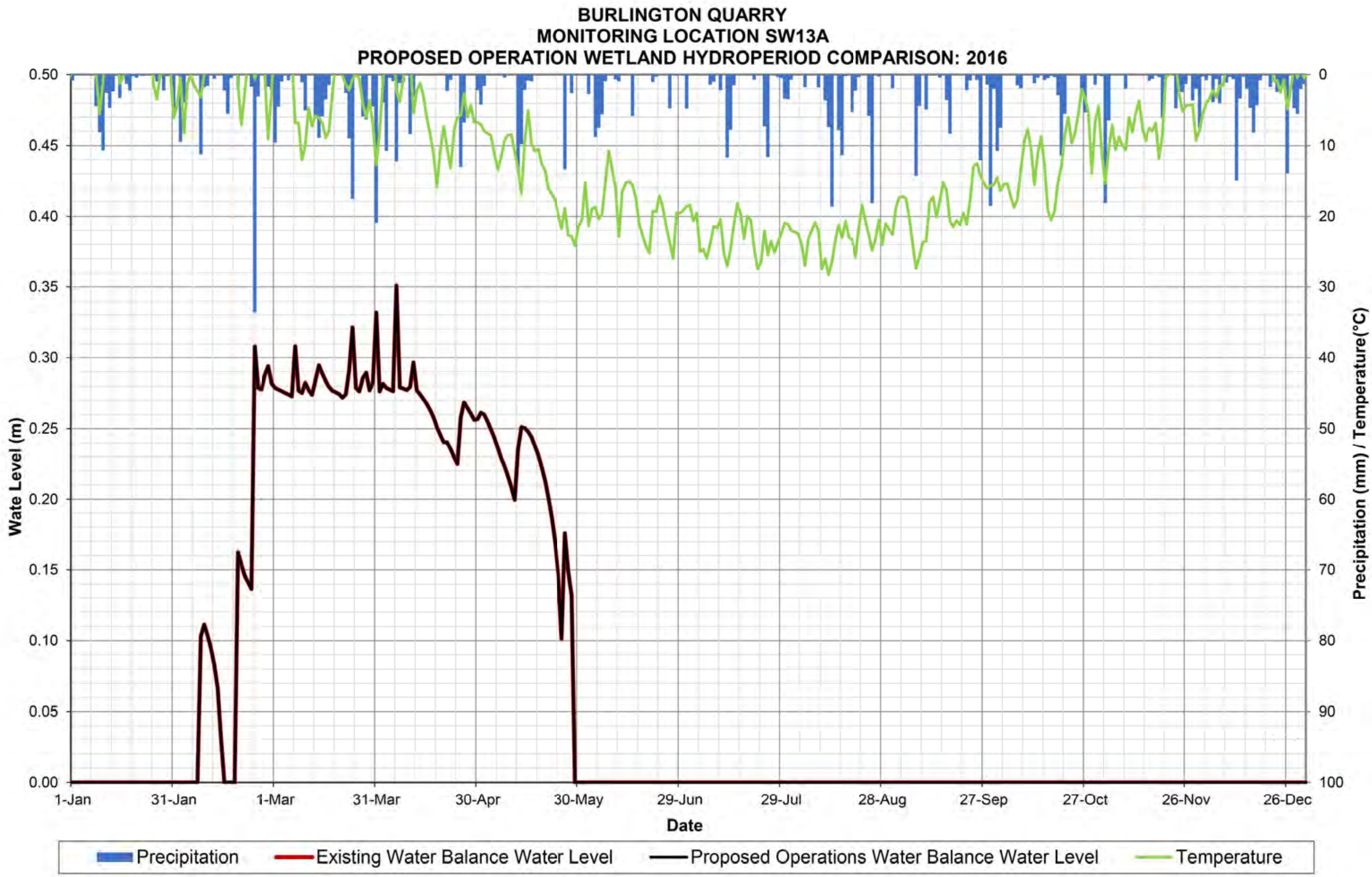

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2013
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

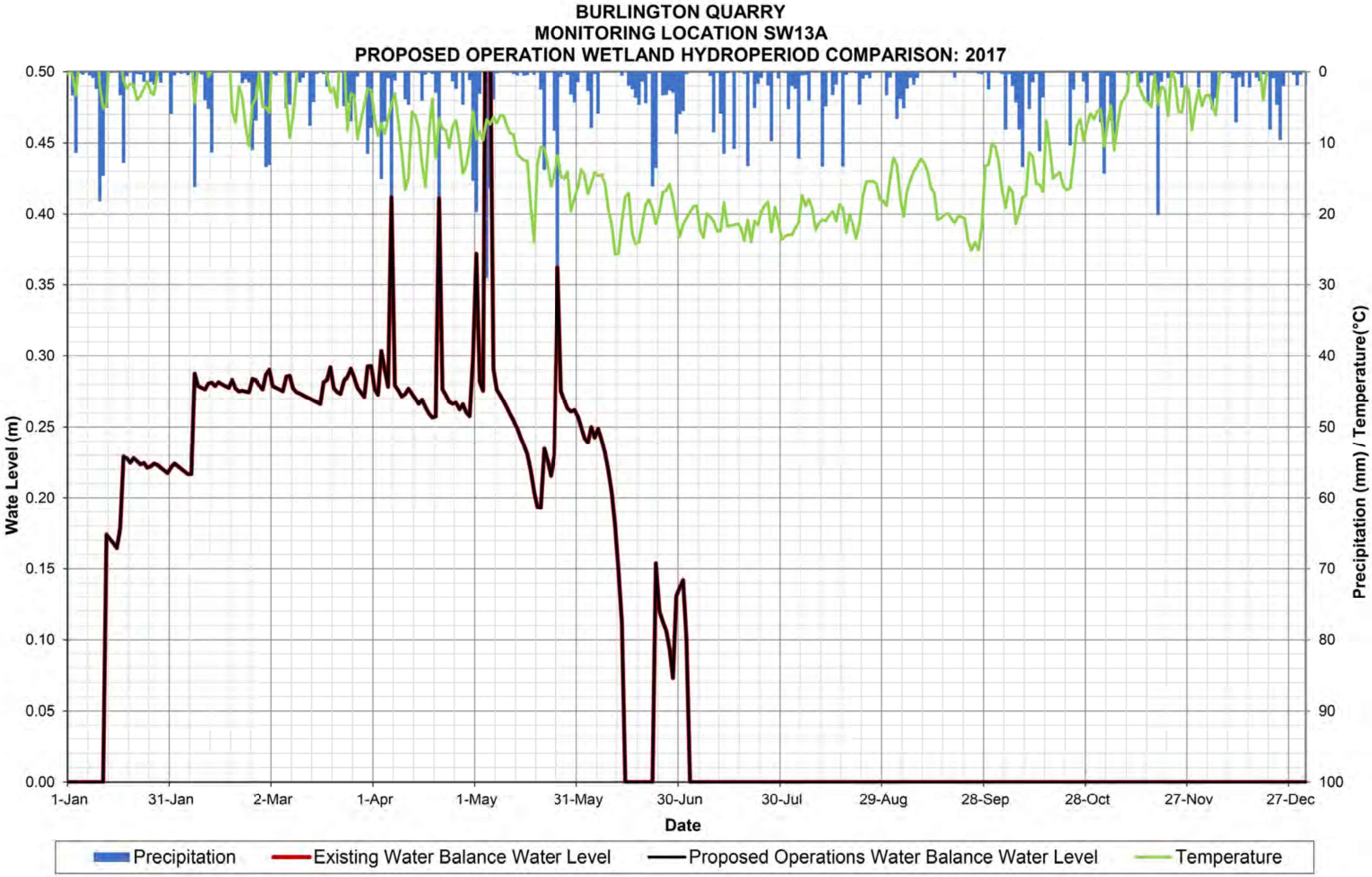


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2014
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

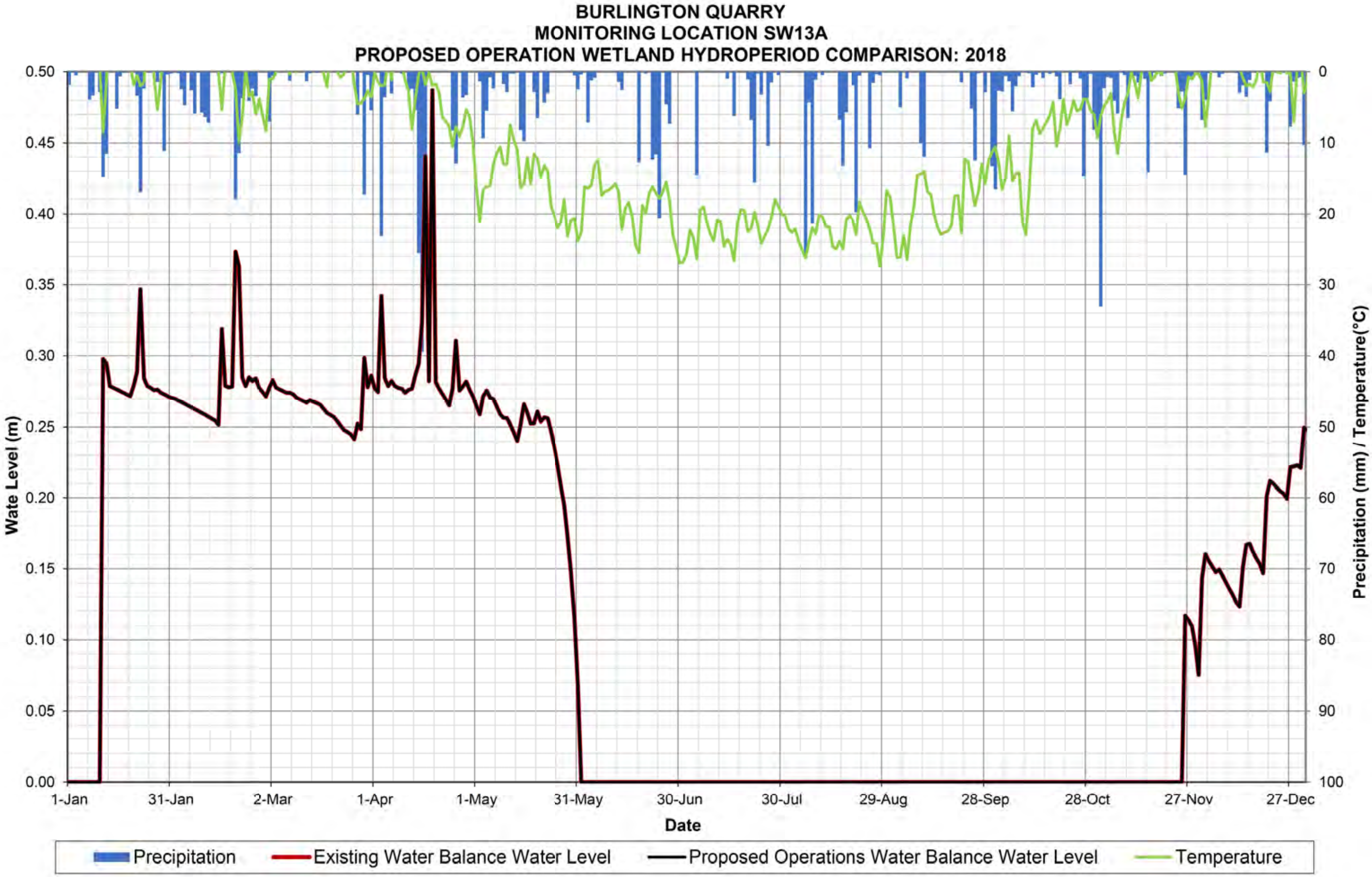


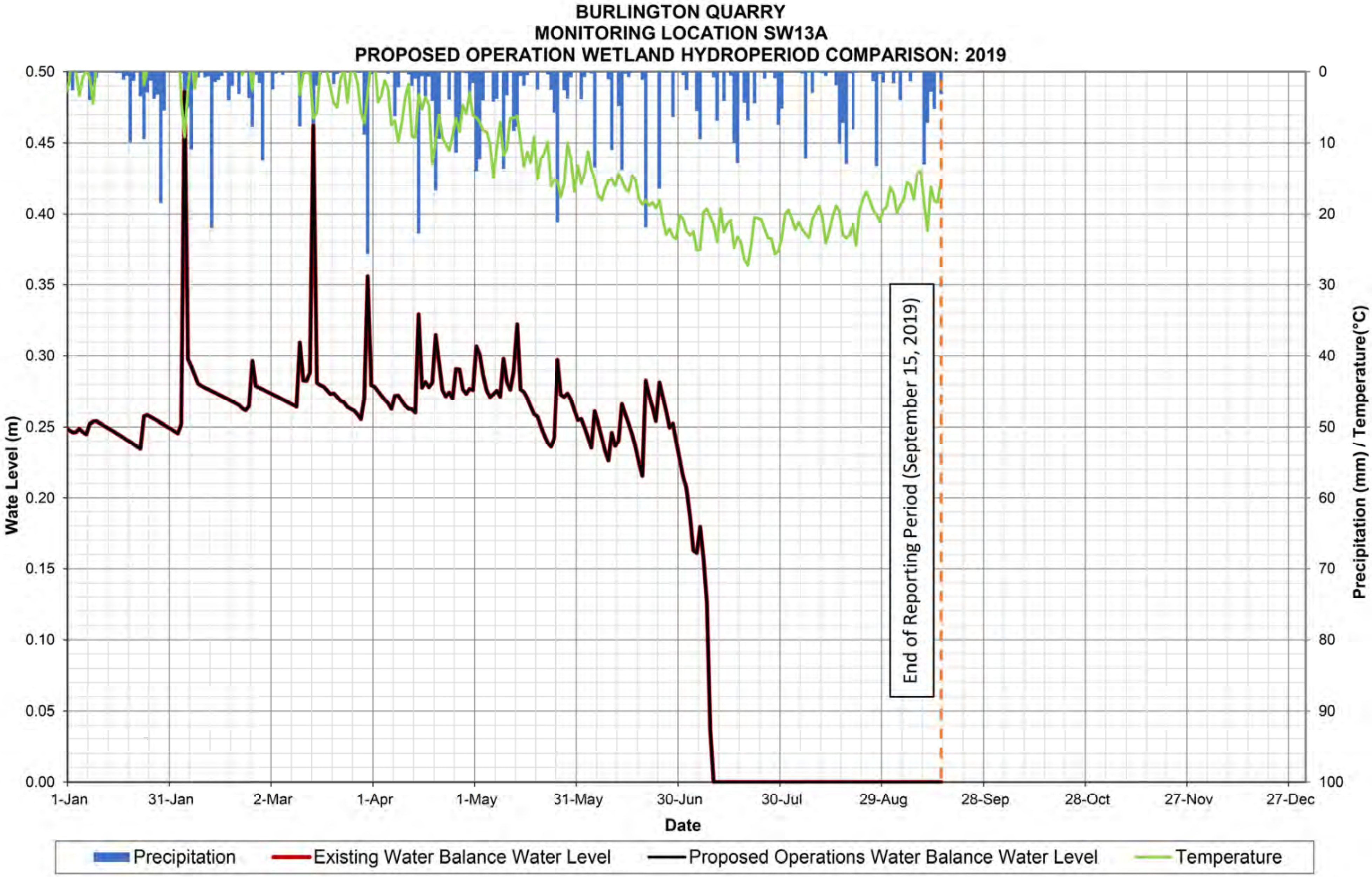
BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2015
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

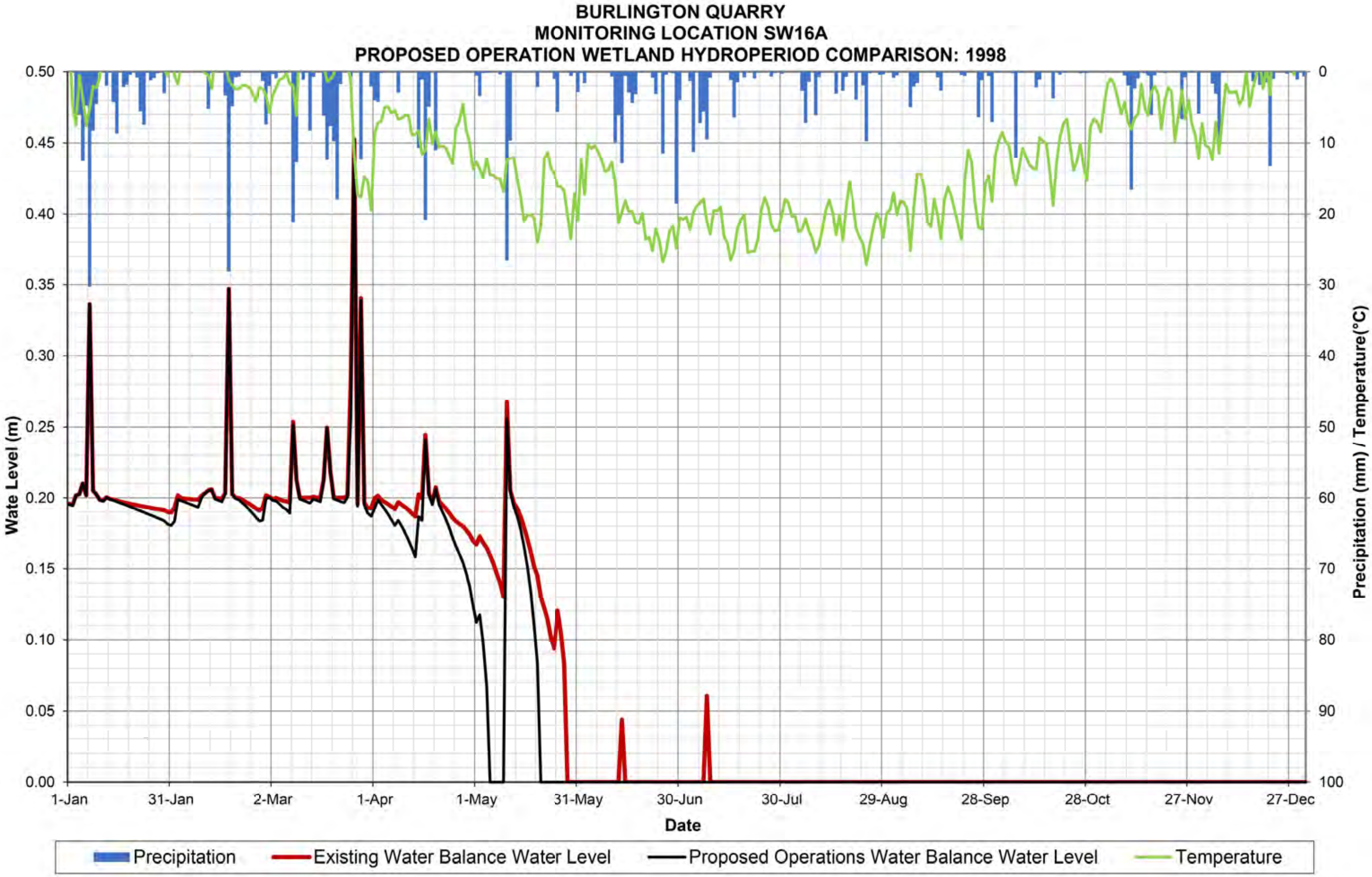

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2016
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

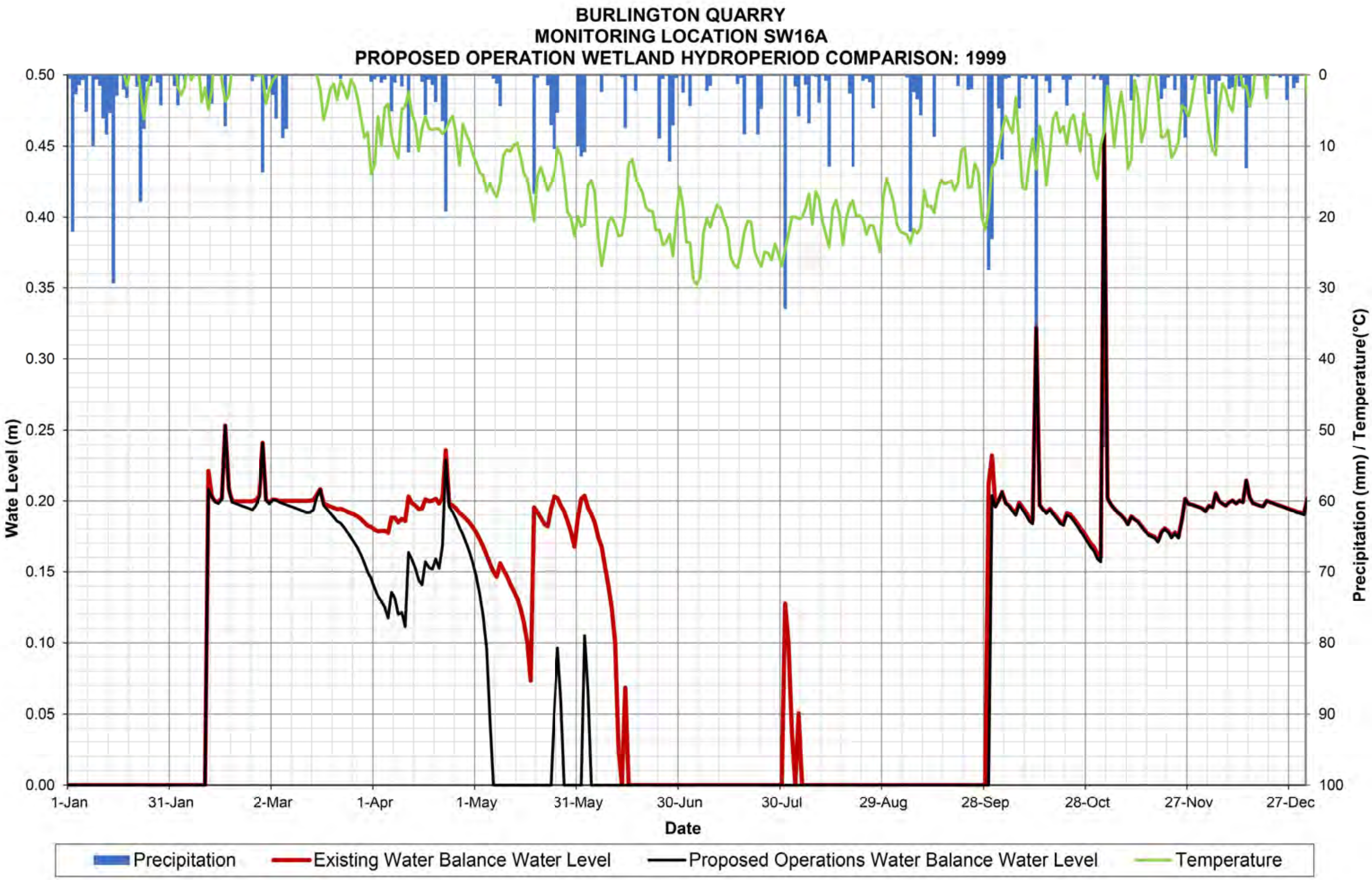


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2017
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

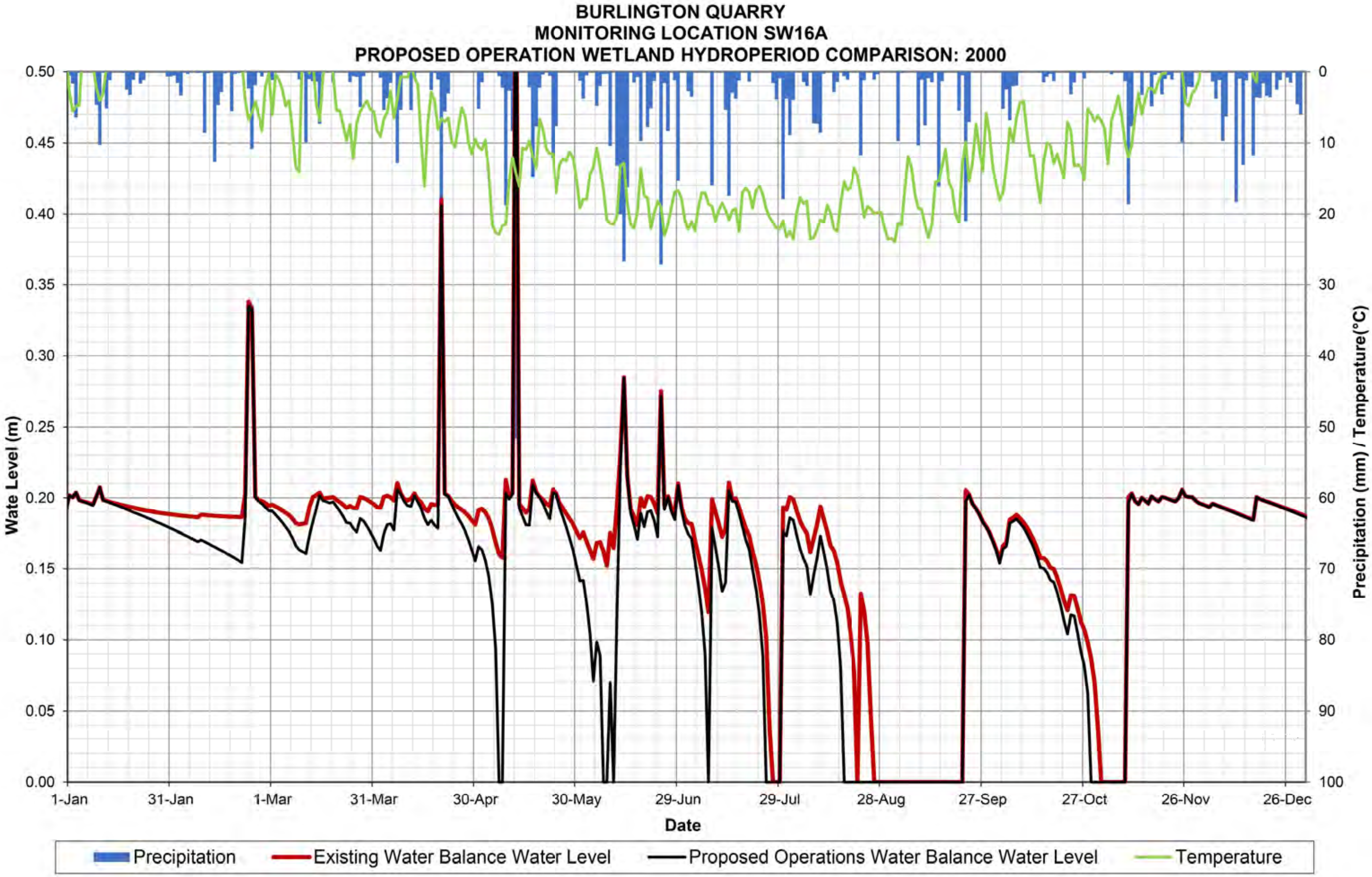

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2018
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2019
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
End of Reporting Period (September 15, 2019)
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

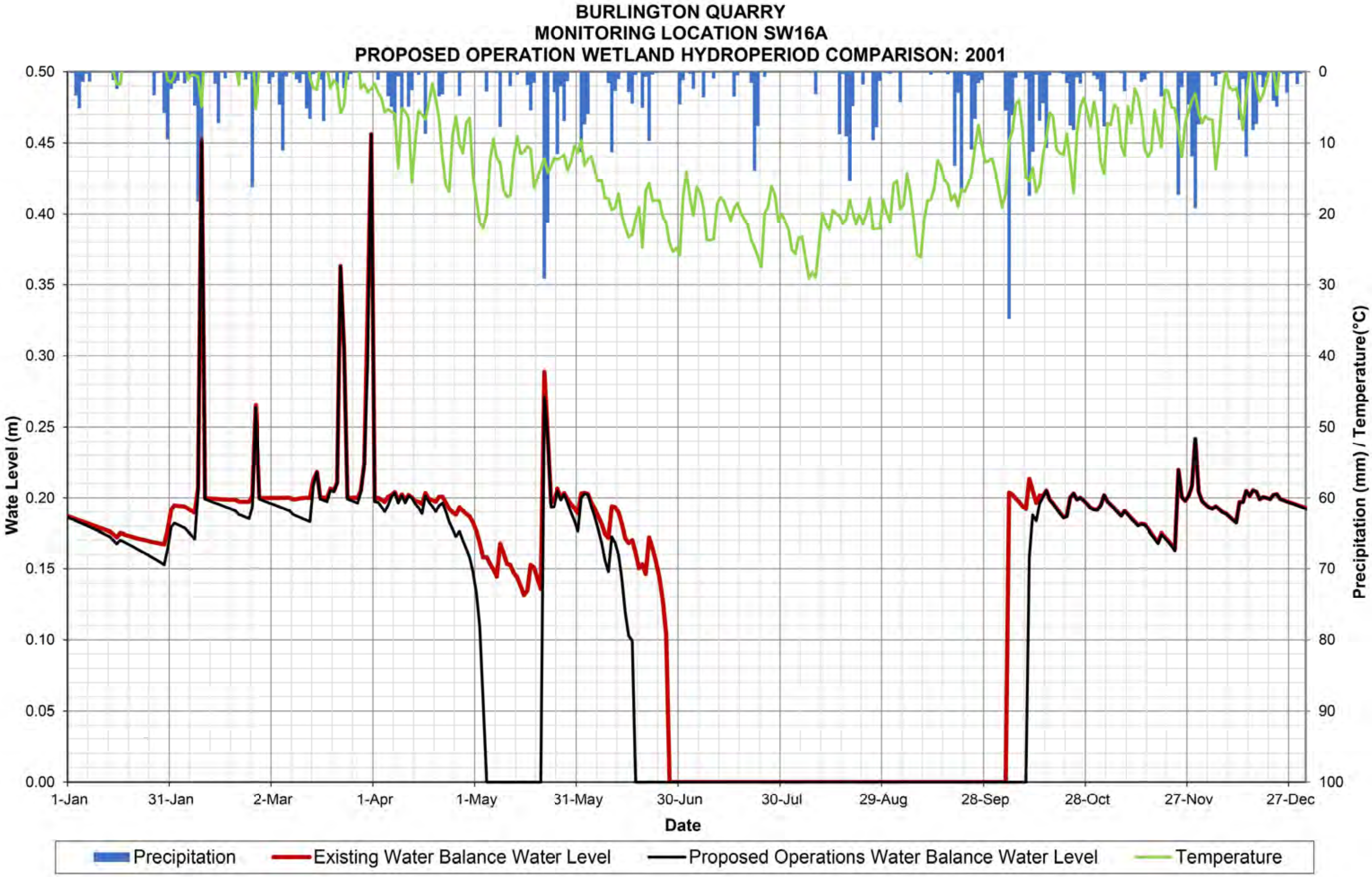

BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 1998
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

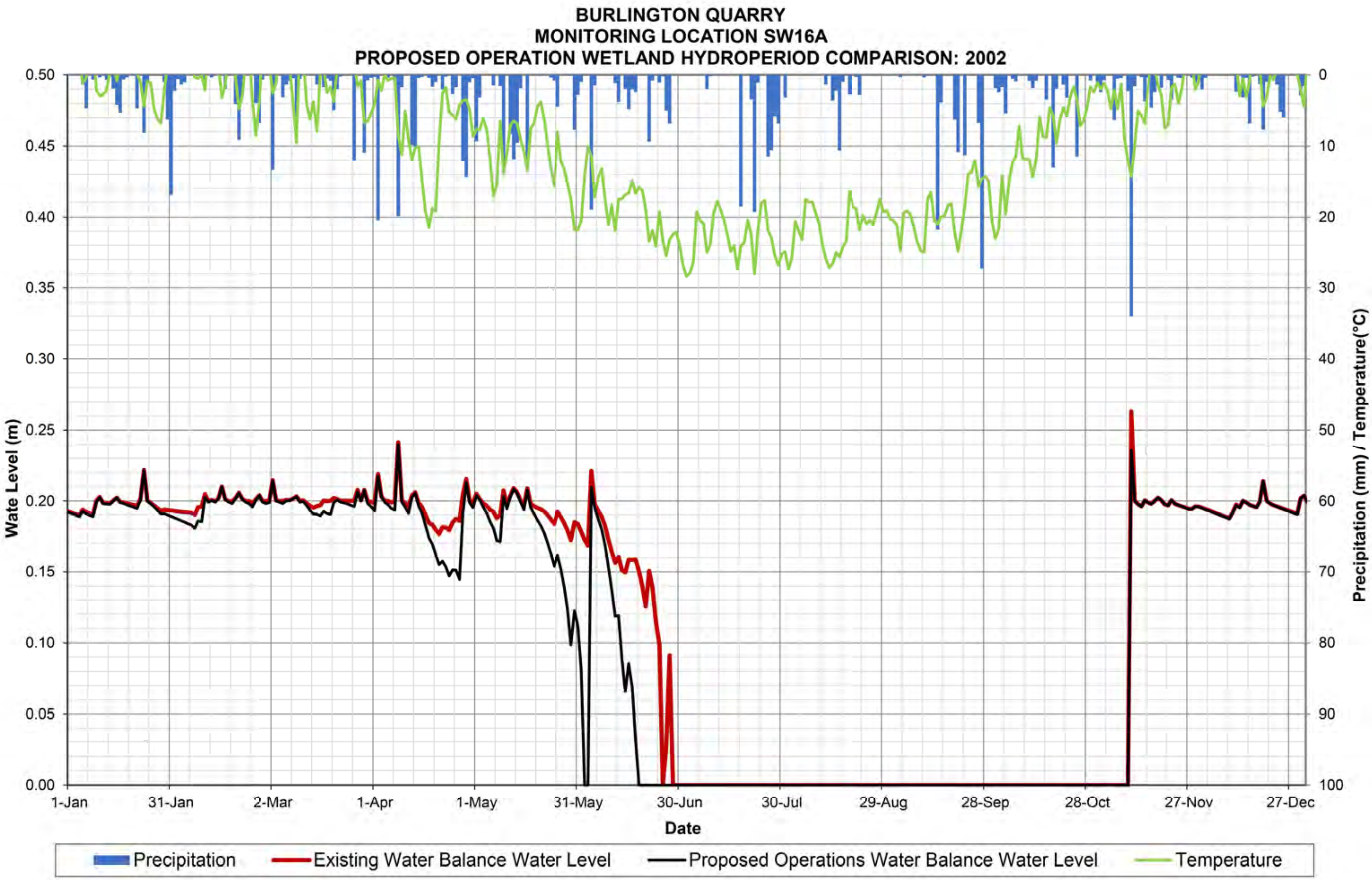


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 1999
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

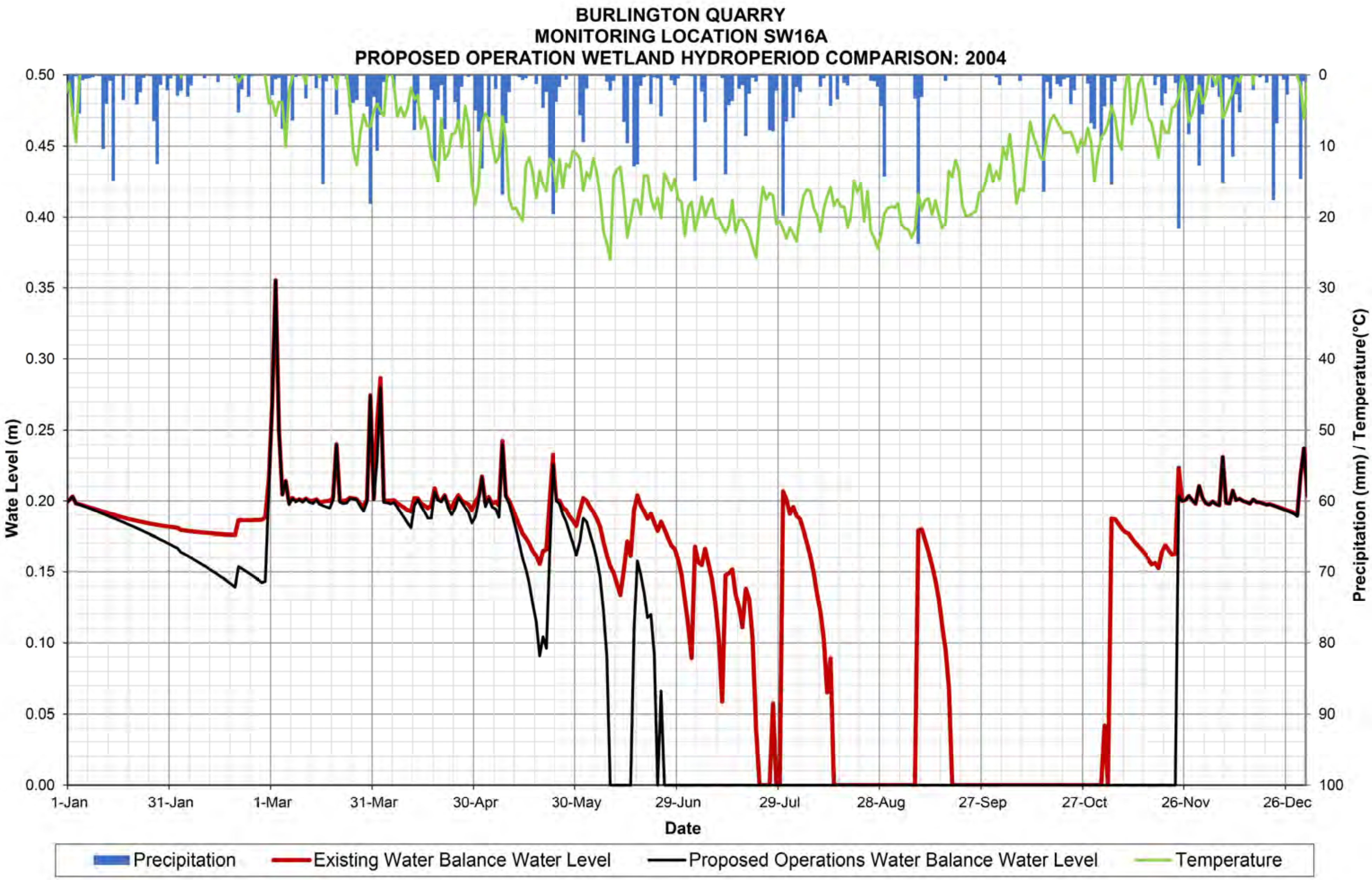


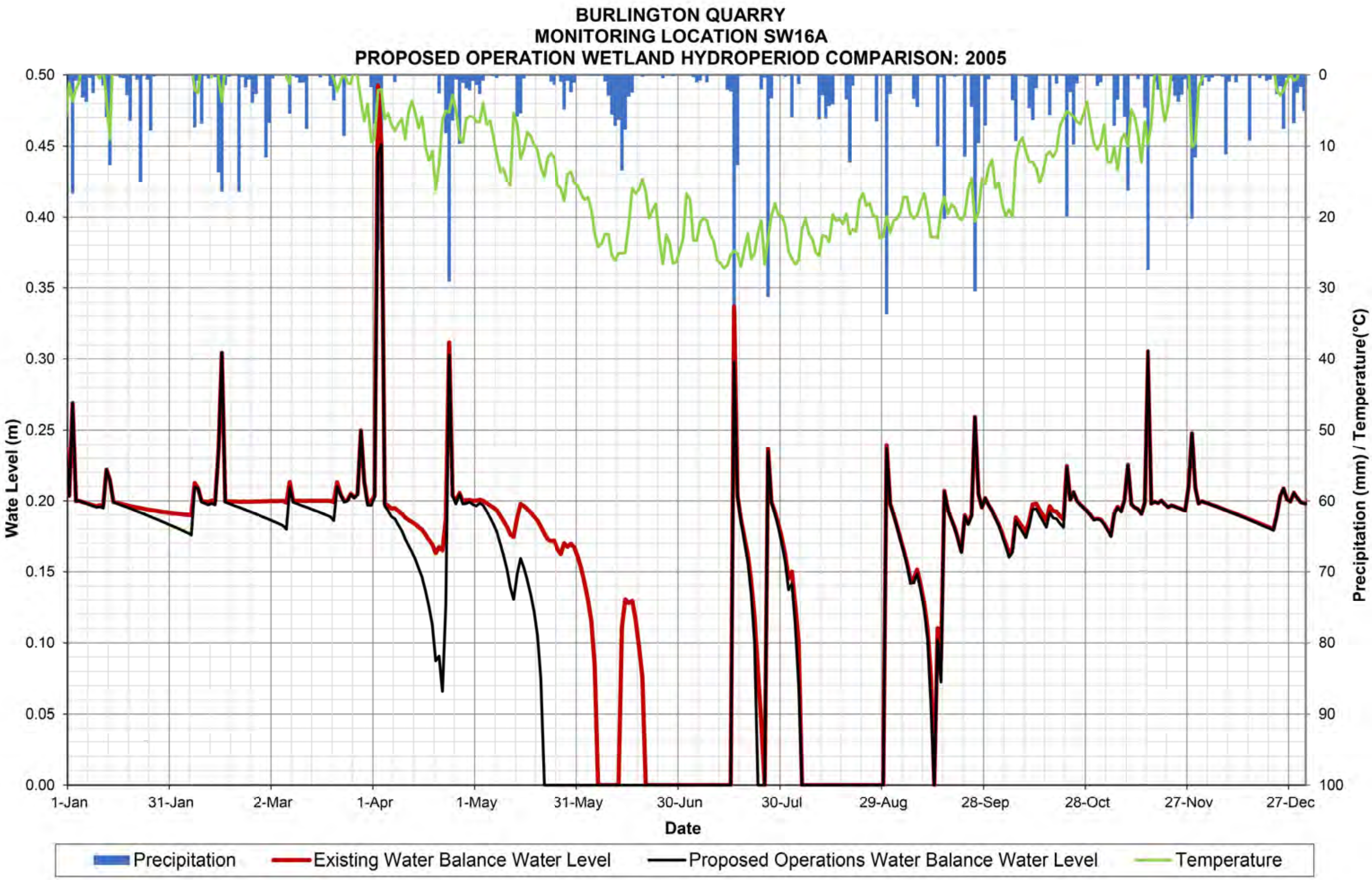
BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2000
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

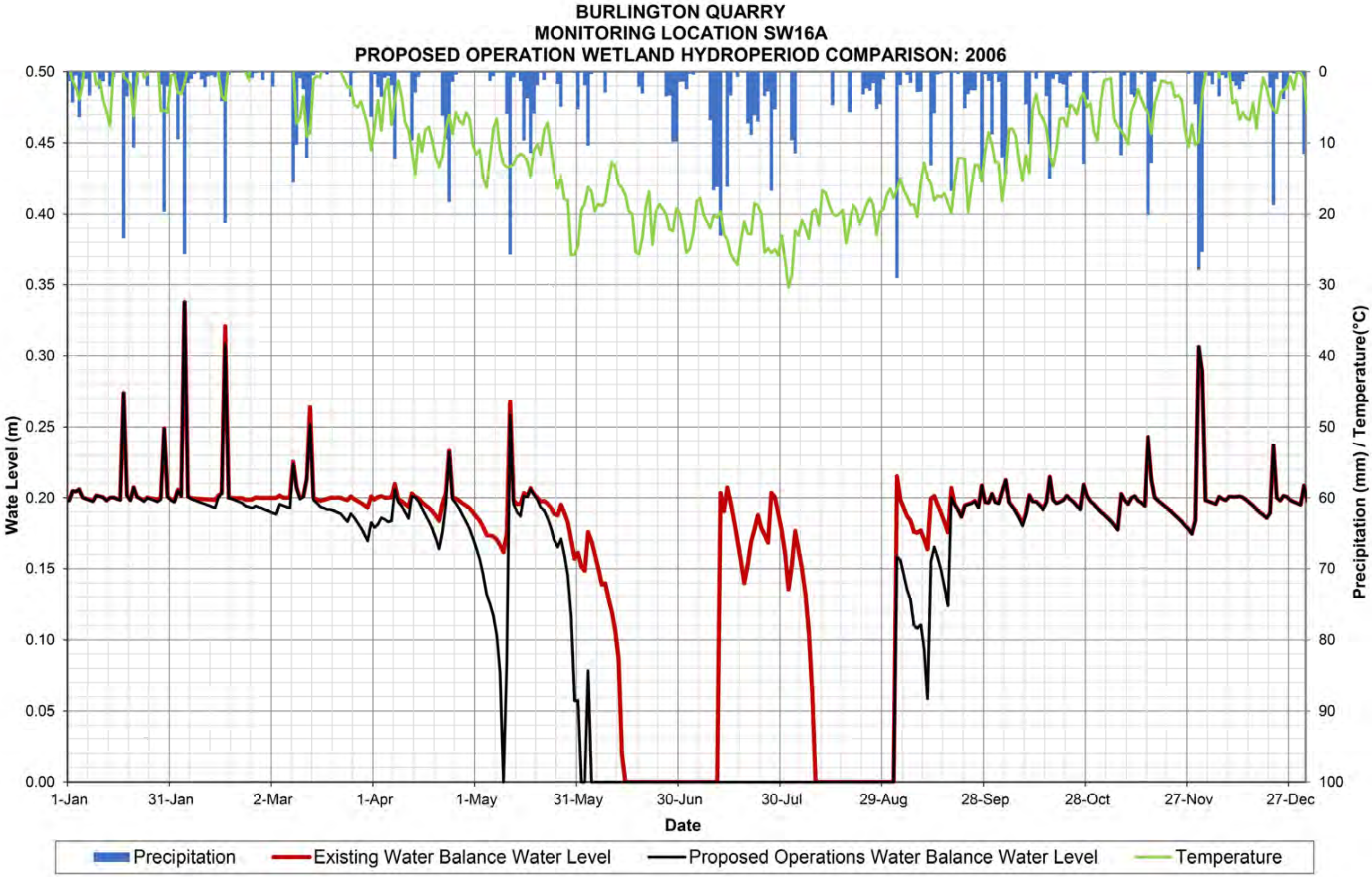

BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2001
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2002
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

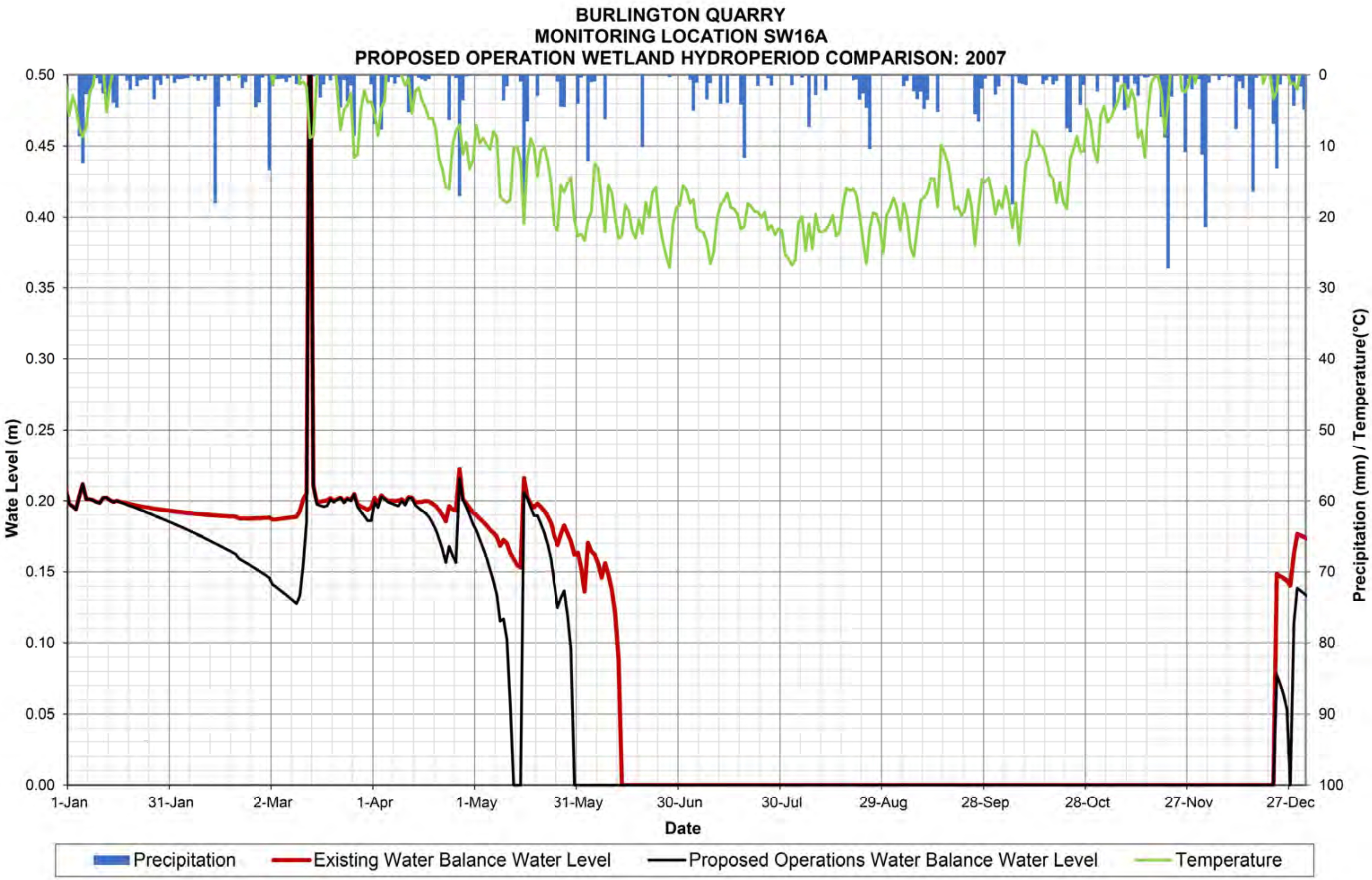

BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2003
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

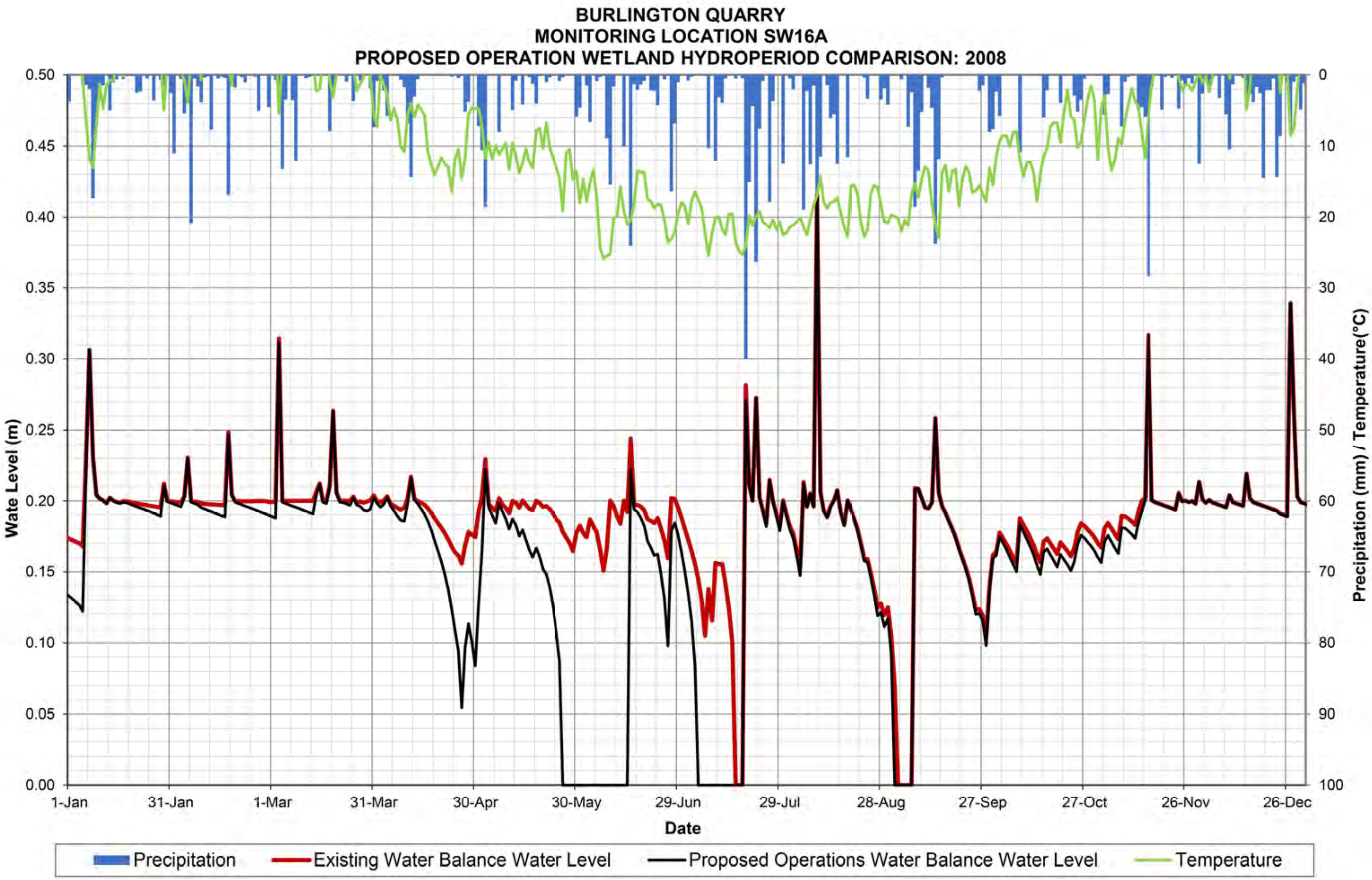

BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2004
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

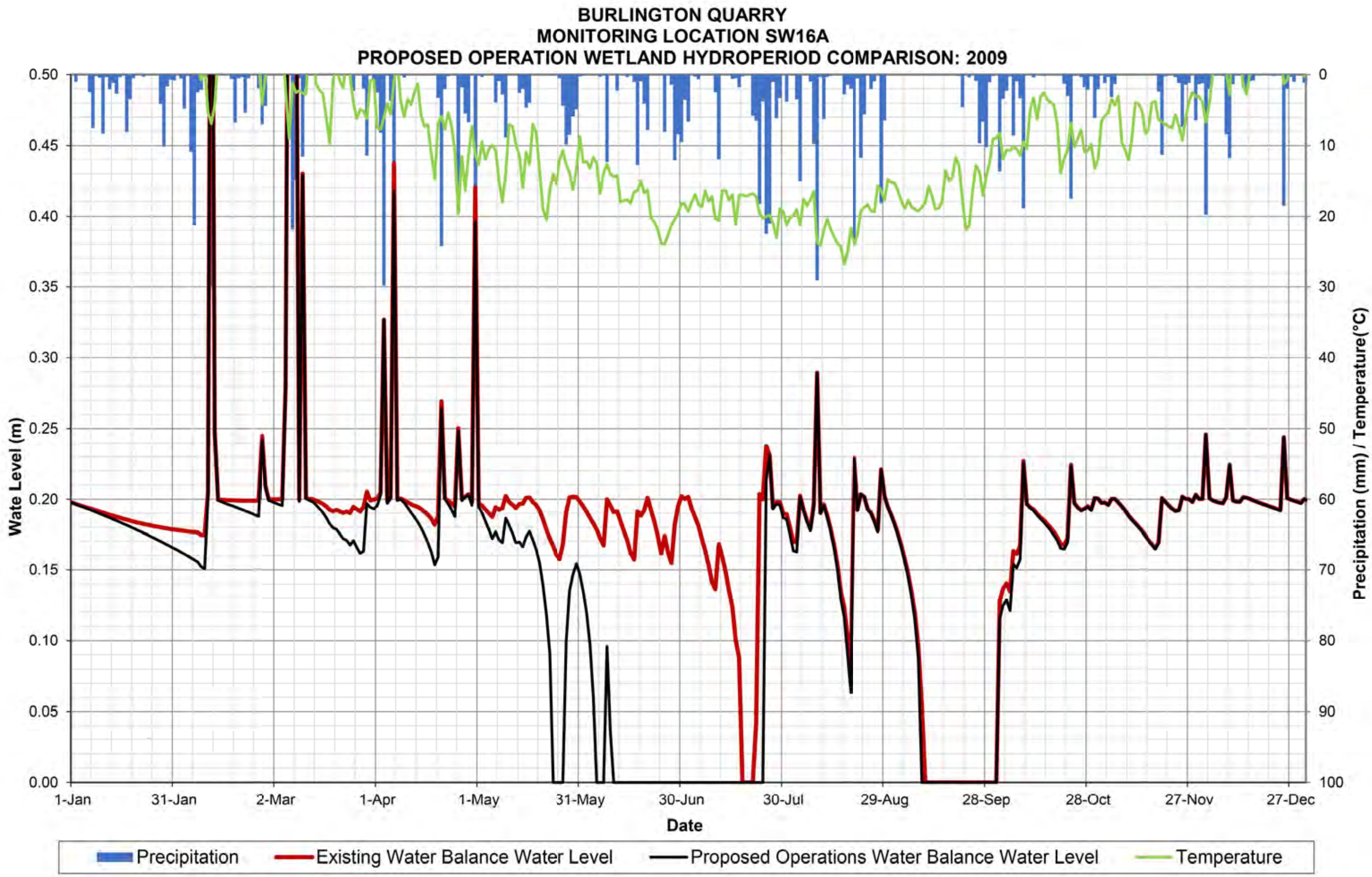

BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2005
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

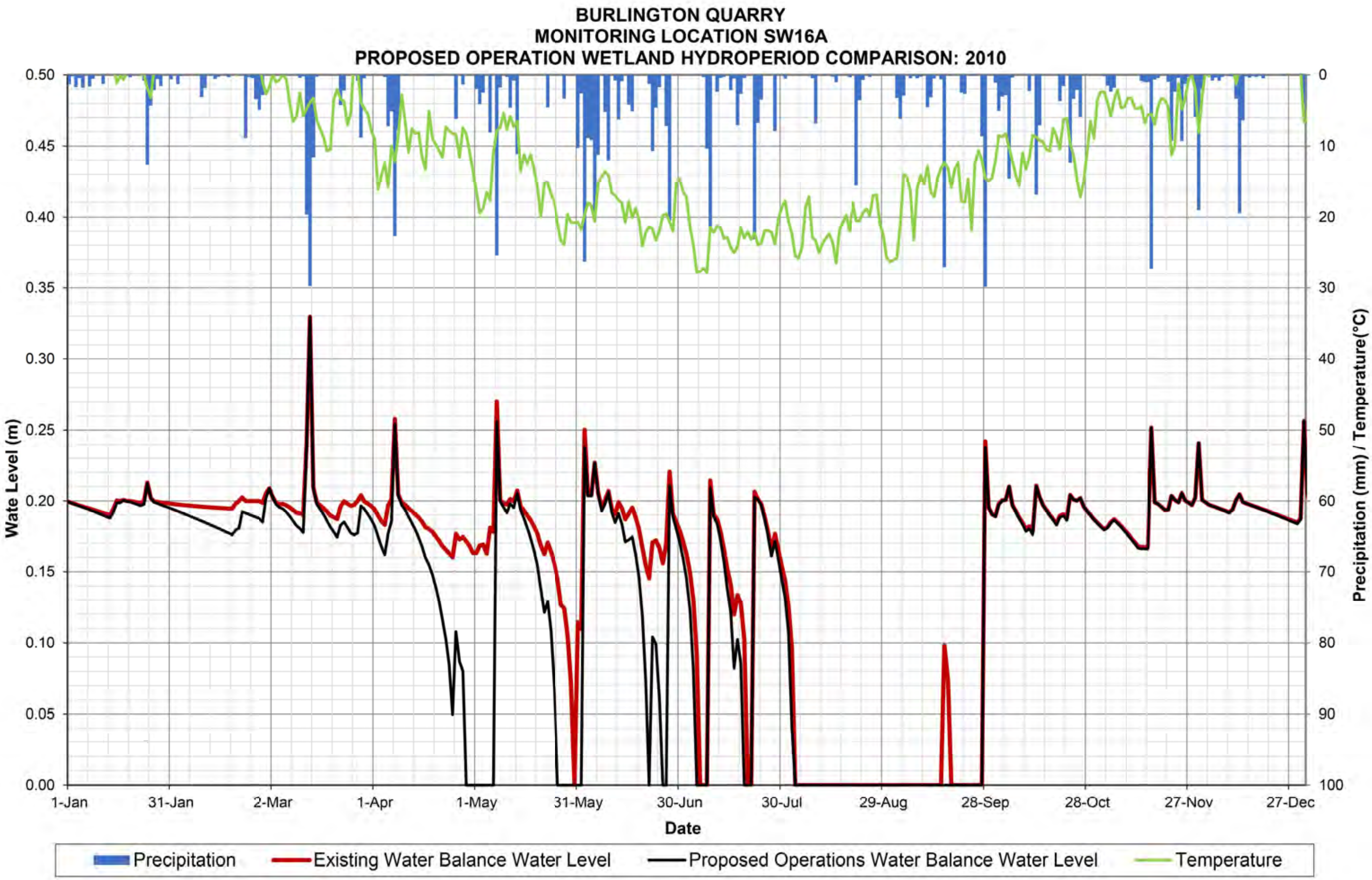


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2006
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

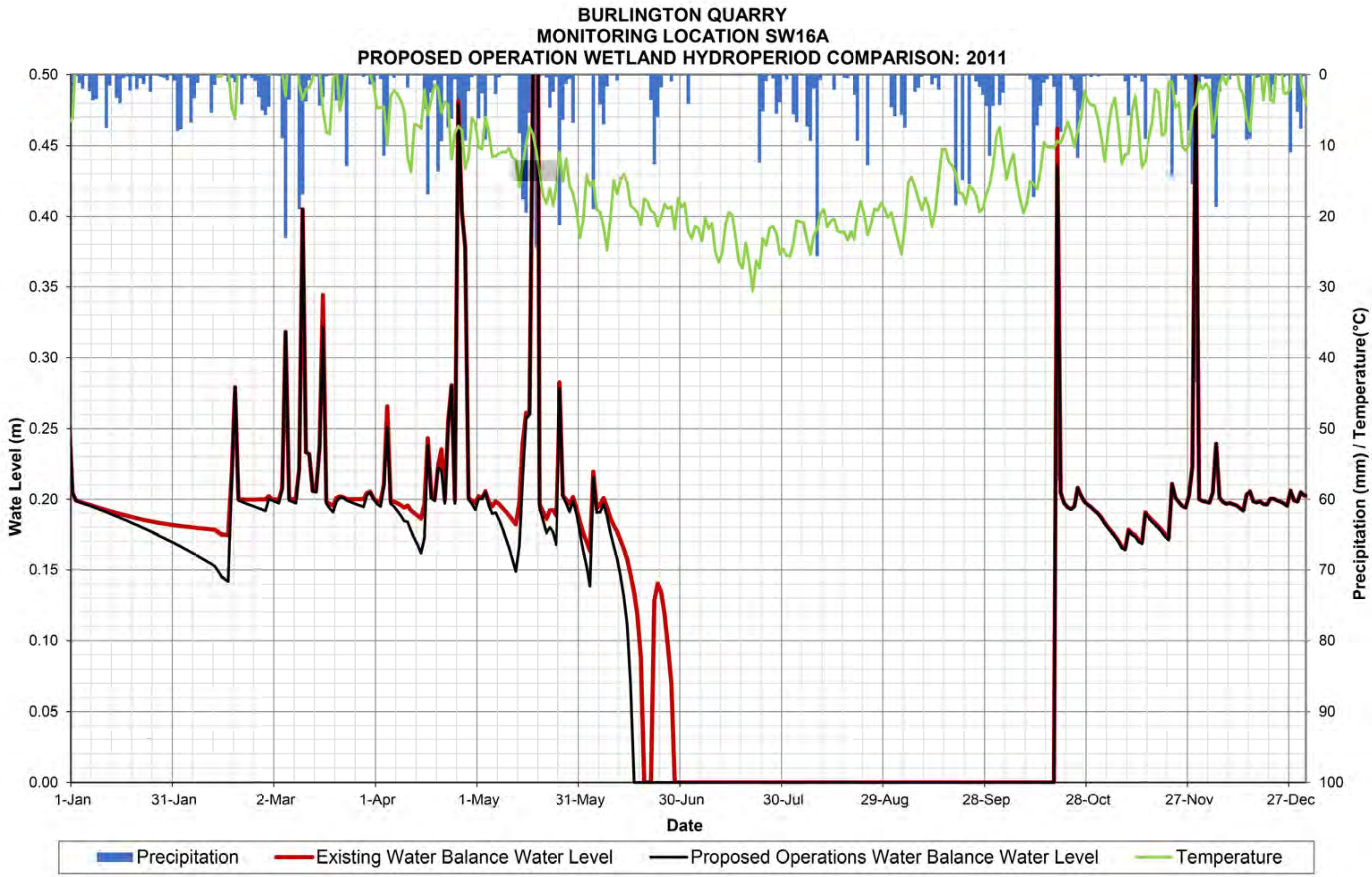

BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2007
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2008
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

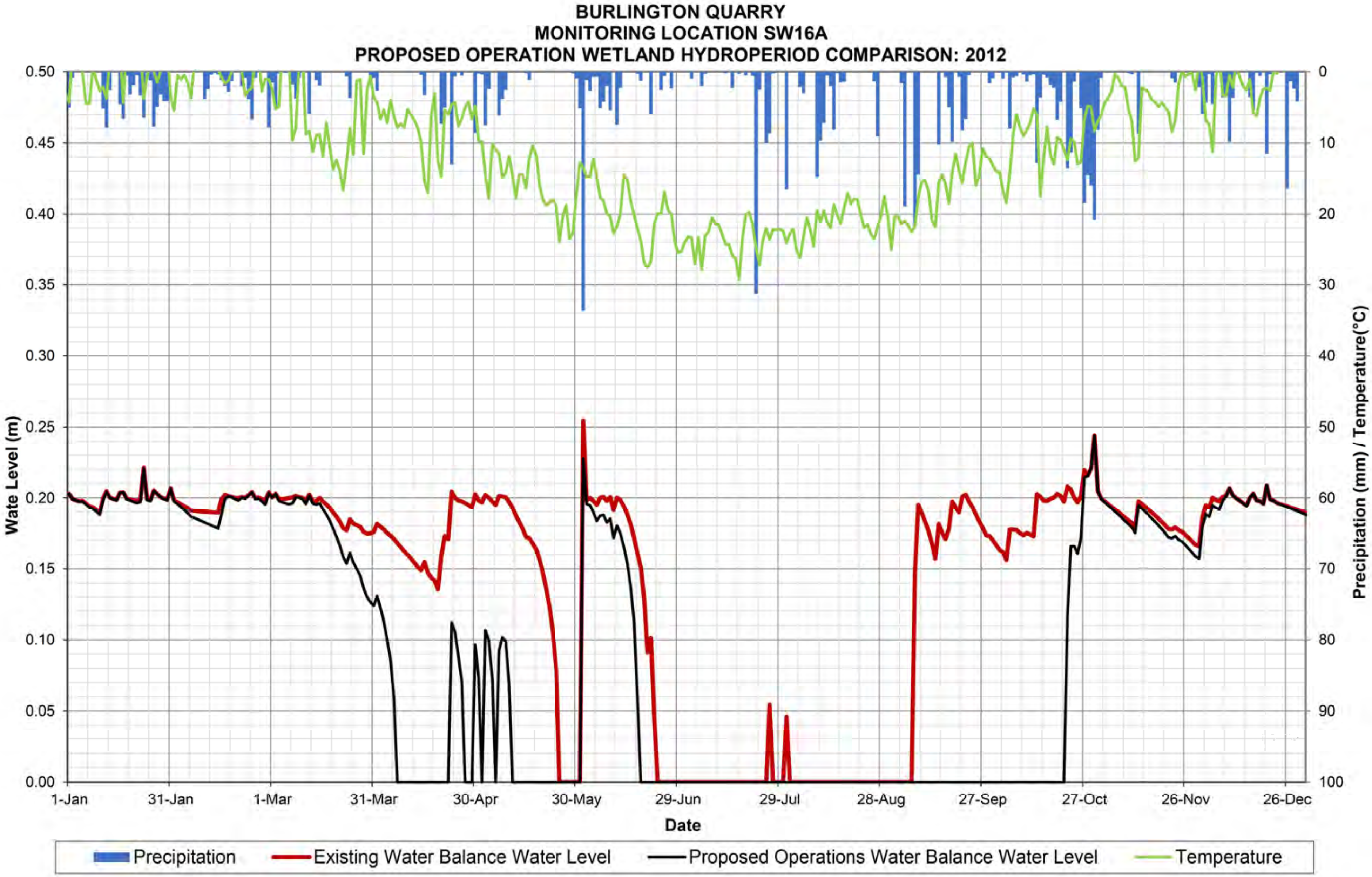

BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2009
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature



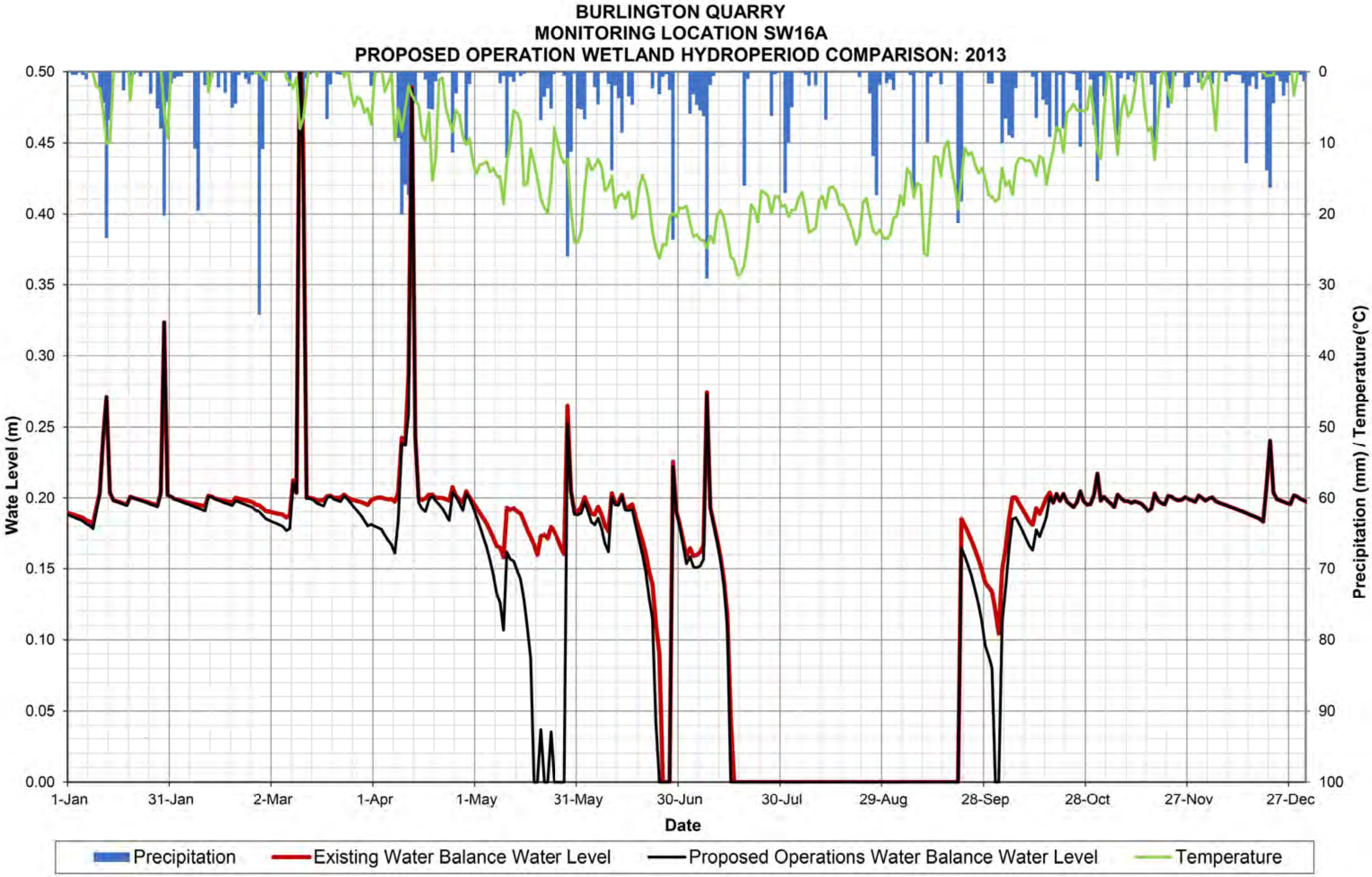
BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2010
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature



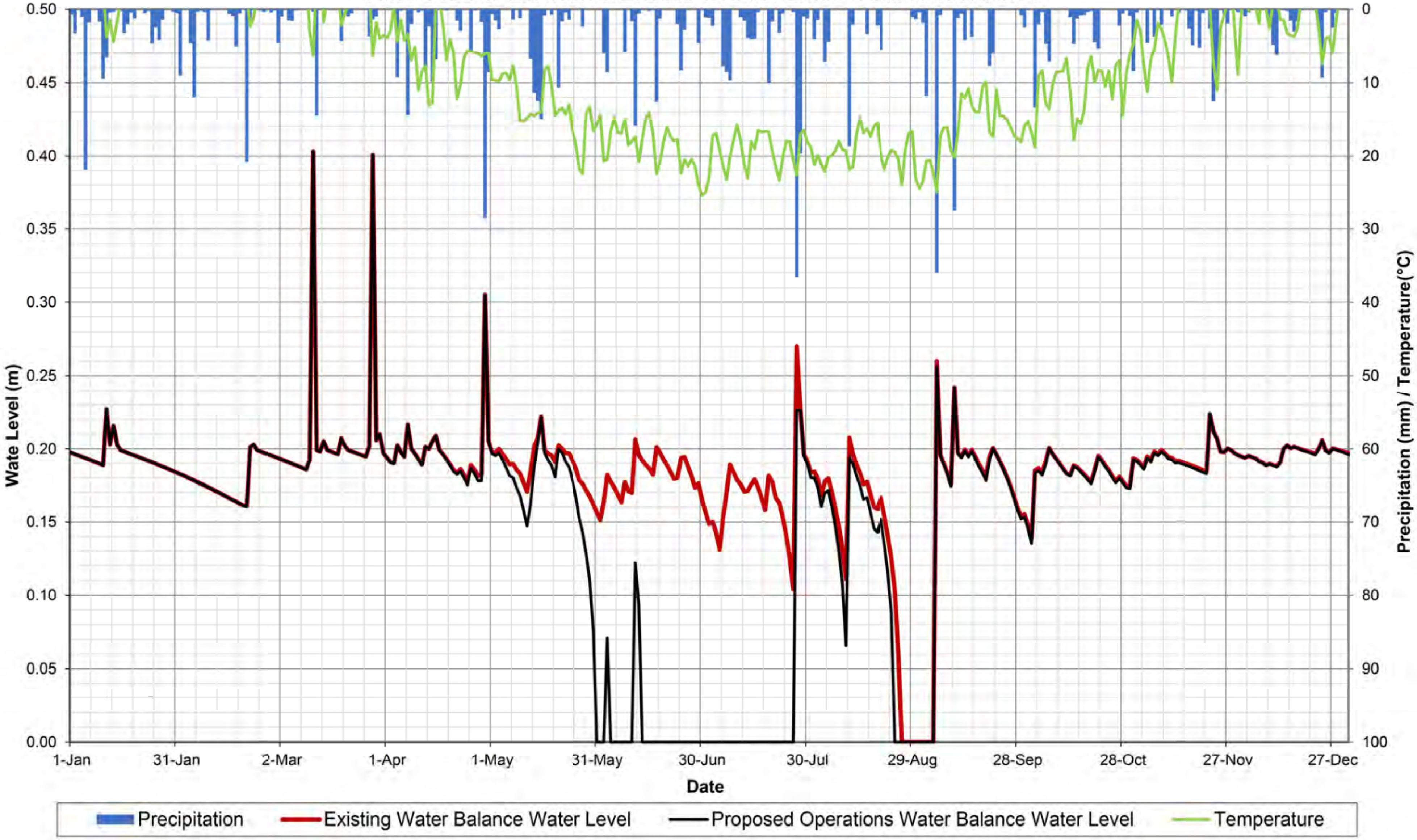
BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2011
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

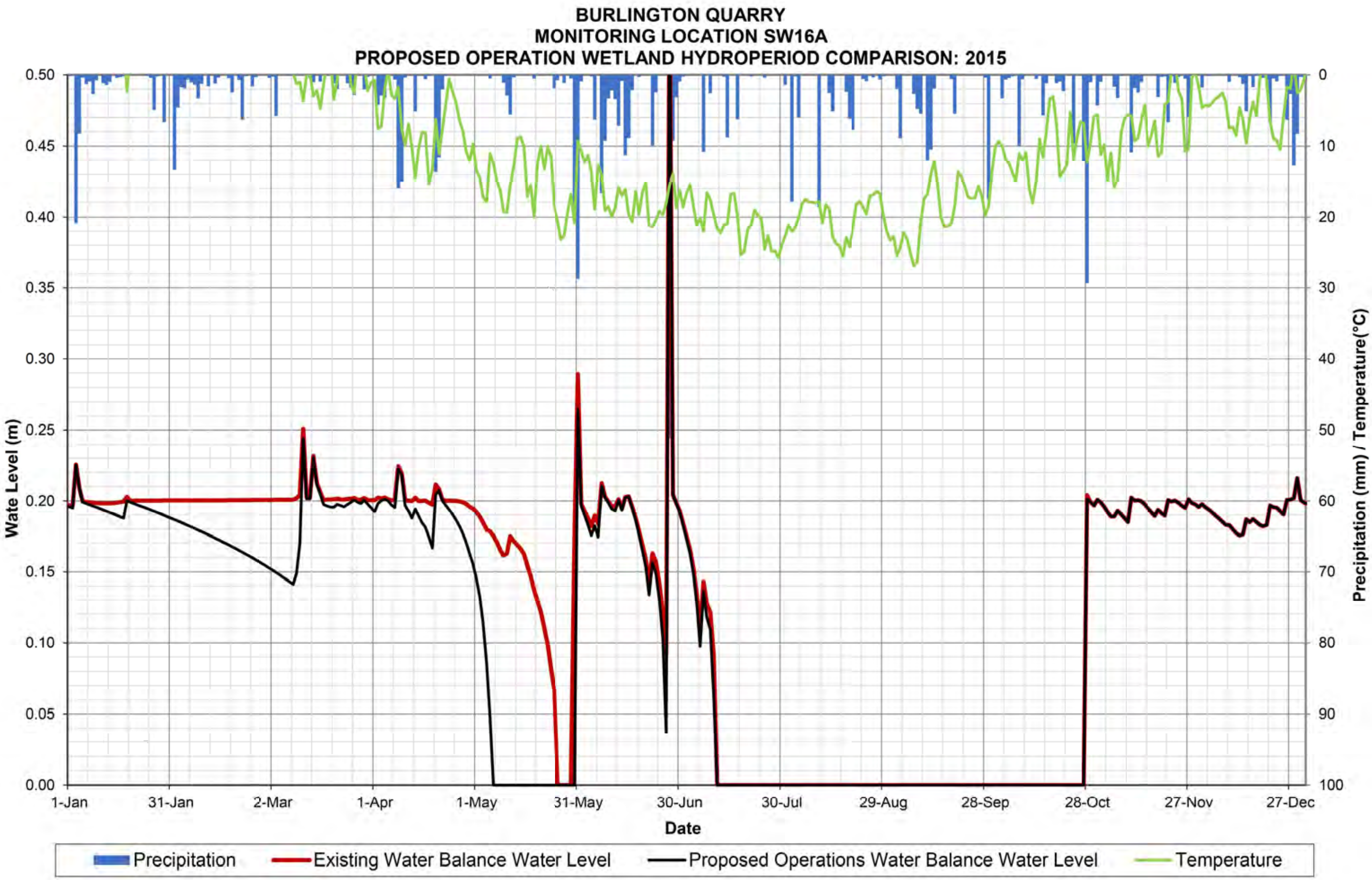


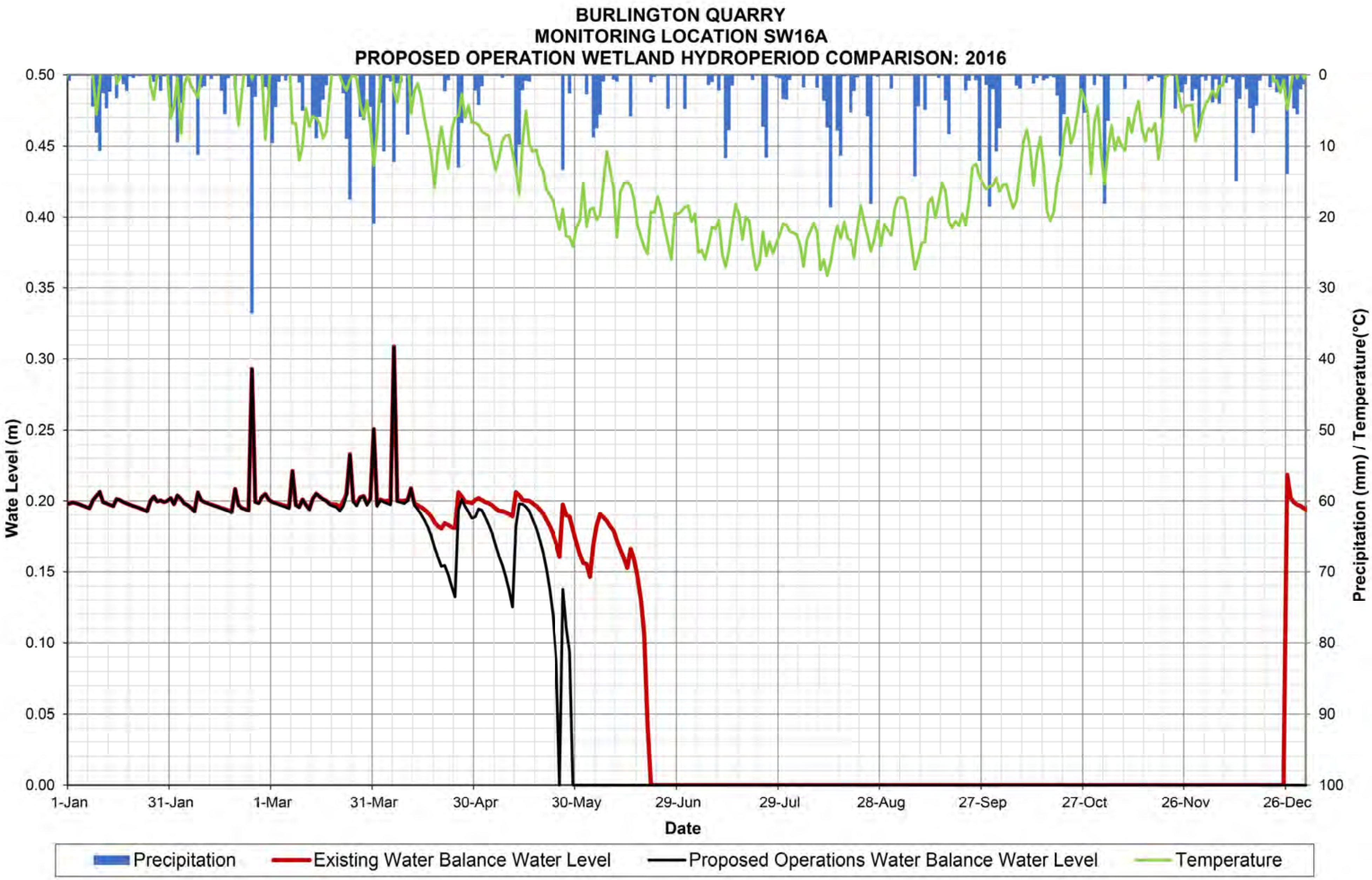
BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2012
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2013
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

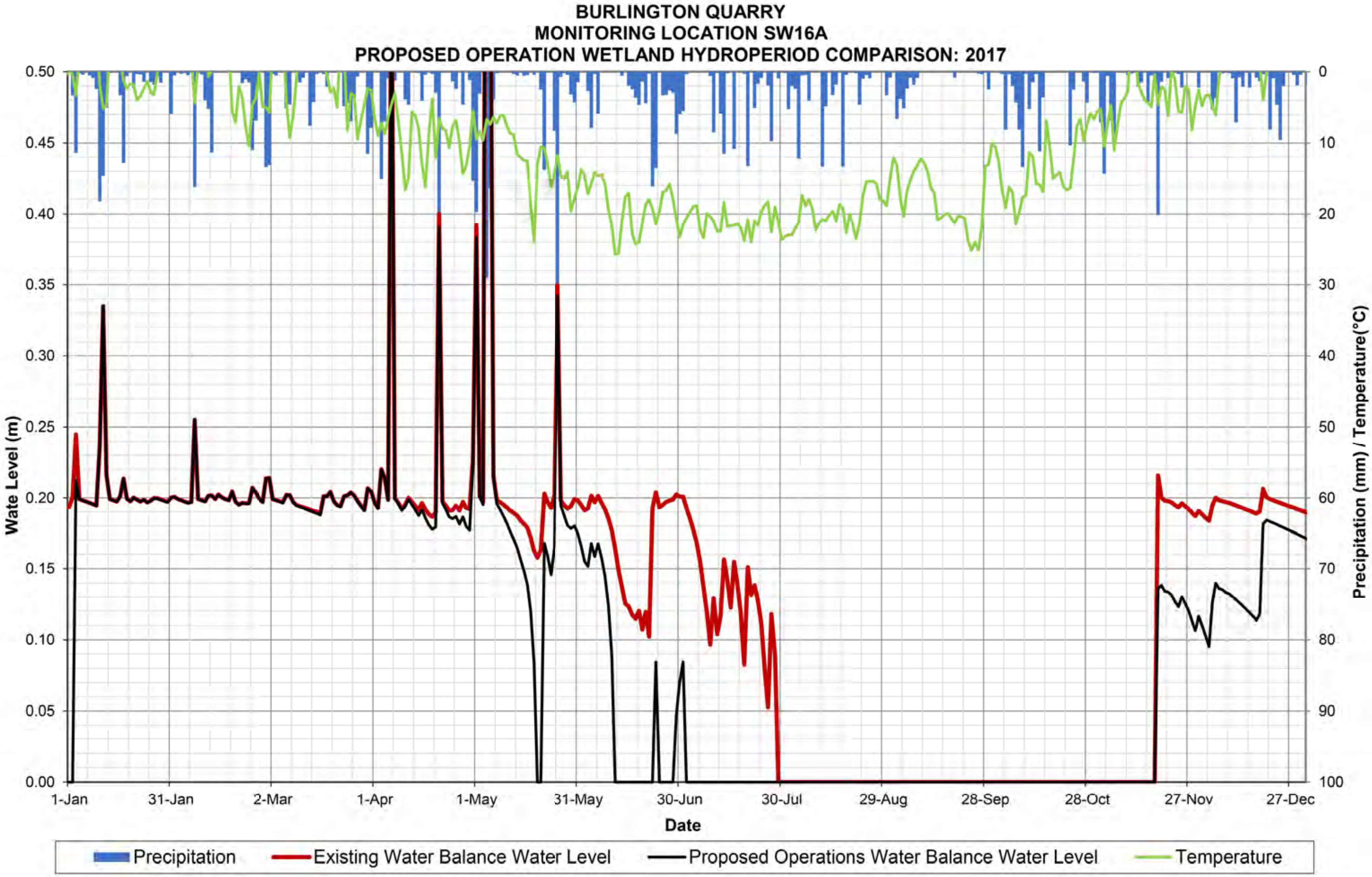
BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2014



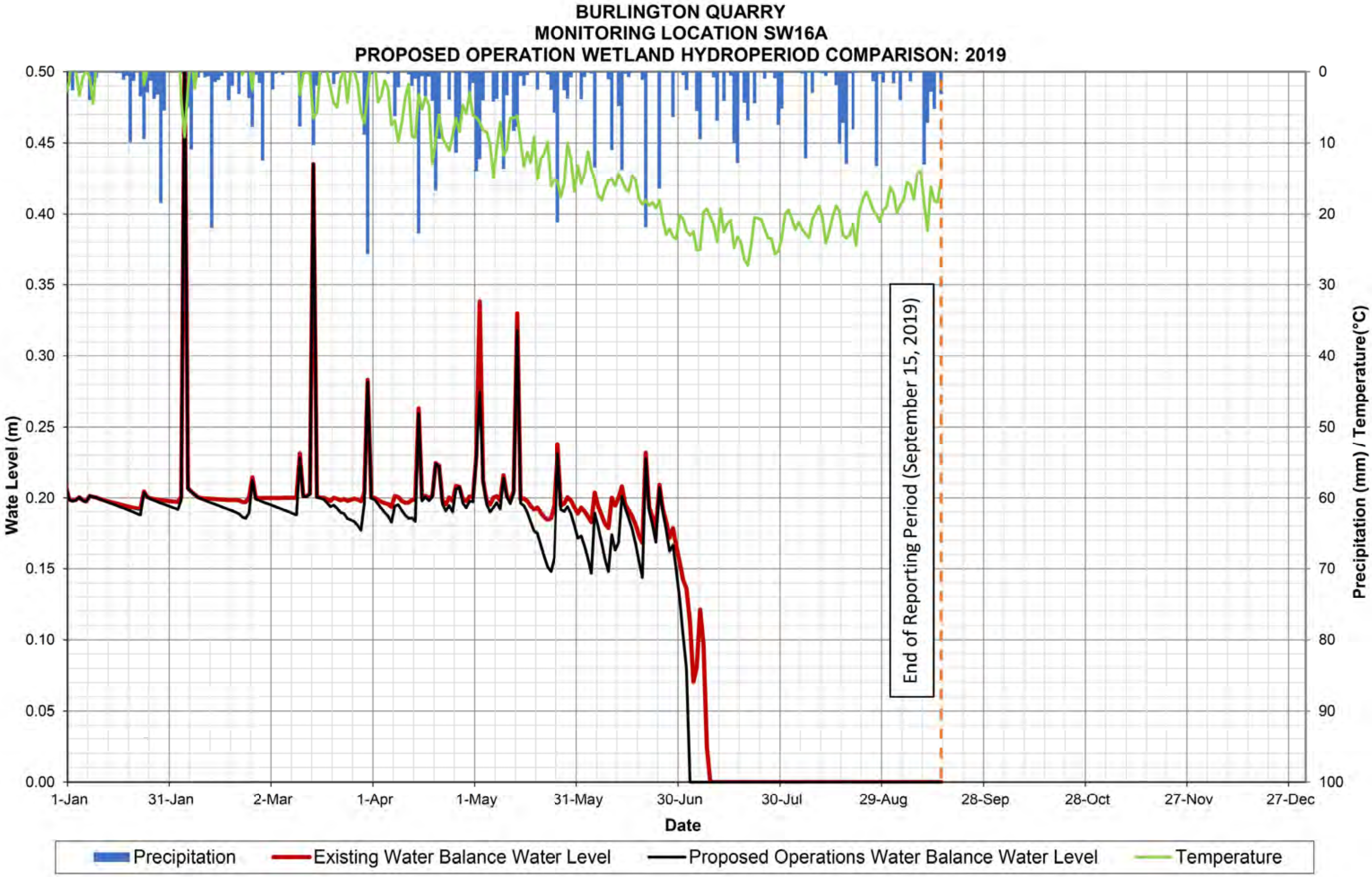

BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2015
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature



BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2016
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2017
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2018


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED OPERATION WETLAND HYDROPERIOD COMPARISON: 2019
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
End of Reporting Period (September 15, 2019)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Operations Water Balance Water Level
Temperature

Appendix O:
Proposed Conditions (Operations) Outlet Water Balance Results

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	June 23, 2023
SUBJECT	Proposed (Operations) Daily Water Balance Outlet Volumes	NAME	John Gore
		PAGE	1 OF 5

WEST ARM OF THE WEST BRANCH OF THE MOUNT NEMO TRIBUTARY OF GRINDSTONE CREEK																						
Month	**Year**																					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	1.5	0.0	1.4	0.0	1.9	0.0	0.8	4.3	8.6	2.5	3.2	1.3	1.3	1.7	5.9	8.5	3.0	2.1	0.0	4.2	5.4	0.6
February	7.9	0.7	7.4	4.9	2.5	0.0	0.0	7.6	23.0	0.0	4.3	19.7	0.1	2.9	3.0	1.4	0.2	0.0	2.5	4.4	8.7	9.8
March	25.3	2.2	0.7	25.4	2.7	12.8	24.3	9.8	6.5	11.0	15.6	40.4	7.3	32.8	0.8	28.1	13.9	4.7	9.5	8.5	1.0	11.8
April	3.1	0.8	6.2	9.3	4.6	2.5	9.2	20.6	2.0	1.2	1.8	15.9	2.3	21.5	0.0	14.2	11.9	3.3	13.7	26.5	33.7	12.3
May	0.3	0.0	10.5	2.0	3.6	6.2	3.6	0.2	1.9	0.1	0.6	4.6	0.8	25.0	0.0	0.4	4.0	0.0	0.0	27.9	0.5	13.6
June	0.0	0.0	6.1	0.6	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.3	0.0	0.2	0.0	6.0	0.0	0.2	0.0	0.5
July	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.8	0.0	1.5	0.0	0.0	0.0	0.0
August	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
September	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
October	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
November	0.0	4.9	0.0	0.0	0.0	3.7	0.0	2.6	0.7	0.0	4.7	0.4	0.1	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
December	0.0	1.8	0.0	1.6	0.0	4.5	0.0	2.9	7.7	0.0	9.2	5.8	1.9	7.9	0.4	2.9	0.8	0.0	0.0	0.0	0.0	
Total	**38.1**	**10.4**	**32.7**	**44.0**	**15.3**	**31.7**	**38.0**	**48.0**	**50.5**	**14.8**	**52.6**	**92.0**	**16.3**	**98.0**	**10.1**	**56.6**	**33.8**	**17.6**	**25.6**	**71.7**	**49.3**	**48.7**

* All volumes are in mm of runoff over drainage area

EAST ARM OF THE WEST BRANCH OF THE MOUNT NEMO TRIBUTARY OF GRINDSTONE CREEK

Month	Year																					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	4.0	0.0	0.9	0.0	1.3	0.2	0.3	4.8	7.0	1.5	4.7	0.2	0.9	0.6	3.0	8.9	2.4	1.7	1.2	6.5	10.7	0.5
February	5.8	2.7	8.6	10.0	1.8	1.4	0.3	5.4	18.3	0.0	3.2	21.4	0.3	3.5	0.9	0.5	0.3	0.0	4.7	4.0	9.3	11.2
March	22.2	0.8	0.4	27.6	2.1	16.0	17.7	5.6	3.8	13.6	9.9	52.7	7.1	30.5	0.4	26.0	15.0	4.3	5.9	3.2	1.3	10.3
April	2.4	0.9	6.8	4.8	3.8	2.3	8.4	23.4	1.9	1.1	1.0	18.7	2.2	24.3	0.0	14.0	6.5	2.7	9.3	25.4	33.1	6.6
May	1.4	0.0	13.5	3.6	2.0	7.1	3.0	0.0	2.4	0.1	0.9	1.0	1.9	32.0	0.0	1.3	1.8	0.2	0.0	39.0	0.1	12.2
June	0.0	0.0	7.2	0.4	0.1	1.9	0.0	0.0	0.0	0.0	0.2	0.0	3.1	0.4	0.0	0.4	0.0	11.4	0.0	0.0	0.0	1.2
July	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	5.4	1.0	0.0	0.0	0.0	2.0	0.1	0.2	0.0	0.0	0.0	0.0
August	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	8.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
September	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	3.1	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0
October	0.0	1.2	0.0	0.0	0.0	1.0	0.0	1.2	1.0	0.0	0.0	1.8	1.2	5.3	2.2	1.1	0.0	0.0	0.0	0.0	0.0	
November	0.0	9.2	0.2	1.0	0.0	5.5	0.0	7.2	5.1	0.0	5.5	0.5	4.0	10.3	0.3	0.8	1.8	0.0	0.0	0.0	2.4	
December	0.0	1.3	0.1	1.4	1.0	3.3	2.9	1.6	6.4	0.0	8.6	5.2	2.3	4.6	1.1	2.6	0.8	0.5	0.0	0.0	1.5	
Total	**35.7**	**16.0**	**37.7**	**48.8**	**12.0**	**38.7**	**32.6**	**53.2**	**45.9**	**16.2**	**51.1**	**107.5**	**23.0**	**111.6**	**7.9**	**57.6**	**31.6**	**21.0**	**21.2**	**78.2**	**58.4**	**42.0**

* All volumes are in mm of runoff over drainage area

WEIR POND (WETLAND 13202)																						
Month	**Year**																					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	3.6	2.4	1.2	0.3	4.4	0.3	1.6	15.9	24.6	8.5	4.8	0.0	5.7	1.8	17.7	22.0	10.4	8.5	3.4	5.6	19.2	4.2
February	12.0	6.4	16.7	19.3	12.4	1.5	4.1	18.9	19.0	0.0	7.4	34.7	3.6	10.4	7.2	2.1	3.8	0.0	19.4	15.2	23.4	23.1
March	29.1	0.9	2.8	43.1	12.8	18.3	41.2	21.0	12.9	26.5	25.9	32.8	20.6	43.6	3.3	30.4	34.5	19.7	25.0	16.9	6.7	27.0
April	9.1	3.8	16.4	5.2	17.2	8.5	10.5	20.5	10.6	7.4	5.9	31.9	7.9	26.6	1.2	24.1	19.5	13.3	11.2	25.9	37.1	17.0
May	1.7	1.3	22.1	7.8	12.3	19.9	12.9	0.4	7.0	1.0	4.7	1.0	4.1	29.4	0.3	3.5	7.6	2.3	1.7	30.0	1.7	16.4
June	0.8	0.7	20.4	3.4	0.9	6.6	1.4	0.3	0.3	0.3	2.3	1.7	10.3	1.2	0.4	2.6	1.0	12.0	0.3	1.4	1.5	4.7
July	0.2	0.0	0.6	0.0	0.0	0.0	0.9	0.8	3.0	0.0	8.7	2.8	0.1	0.0	0.0	1.4	2.7	0.0	0.0	0.1	0.0	0.1
August	0.0	0.0	0.5	0.0	0.0	0.1	0.0	1.2	0.0	0.0	19.1	12.5	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.7	1.6	0.3
September	0.0	2.6	2.2	0.6	1.5	4.0	0.6	3.6	3.1	0.0	10.7	0.8	0.8	3.0	0.4	2.4	3.1	1.0	1.2	0.0	1.2	0.6
October	0.0	3.2	0.3	5.1	1.3	2.7	1.3	2.3	3.4	1.0	1.0	7.2	2.8	5.7	6.6	4.1	1.5	3.4	1.5	1.9	2.6	
November	1.0	3.9	2.1	3.4	2.6	12.7	3.7	5.5	13.9	3.0	18.5	4.6	3.7	12.8	0.4	6.7	2.9	1.0	1.9	2.9	4.1	
December	1.2	1.3	0.4	1.8	1.6	15.8	8.0	9.6	18.0	3.0	23.7	18.3	6.8	18.7	2.1	11.4	6.0	1.6	2.4	0.8	9.3	
Total	**58.7**	**26.4**	**85.6**	**89.9**	**67.1**	**90.4**	**86.2**	**99.8**	**115.6**	**50.6**	**132.7**	**148.1**	**66.5**	**153.3**	**39.4**	**110.6**	**93.2**	**62.7**	**68.1**	**101.5**	**108.4**	**93.4**

* All volumes are in mm of runoff over drainage area

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	June 23, 2023
SUBJECT	Proposed (Operations) Daily Water Balance Outlet Volumes	NAME	John Gore
		PAGE	4 OF 5

BURLINGTON QUARRY																						
Month	**Year**																					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	72.8	46.1	34.5	21.8	38.6	21.6	23.0	64.9	87.6	42.2	85.3	21.3	30.3	20.2	69.8	98.4	44.5	39.2	44.3	98.0	87.1	26.9
February	75.1	103.0	68.8	71.2	48.2	35.6	27.3	70.6	76.6	14.6	54.7	114.8	23.0	43.4	36.9	24.5	24.6	14.6	66.1	65.9	81.9	81.1
March	102.3	31.3	27.2	142.5	51.1	100.7	135.0	74.7	55.3	88.8	93.1	116.3	76.5	151.7	21.4	111.8	110.6	67.2	89.5	66.8	38.1	94.9
April	42.6	36.8	60.6	35.9	71.9	44.6	49.9	85.6	43.9	38.1	30.1	108.2	31.3	94.7	20.1	90.3	80.7	51.4	57.2	100.3	126.0	69.2
May	18.3	14.5	79.8	43.4	47.2	70.5	54.0	8.9	35.1	13.4	30.9	22.7	28.5	106.3	7.3	29.6	38.3	18.2	16.7	100.0	19.4	66.2
June	13.8	13.1	76.1	15.7	10.5	23.1	15.2	6.2	6.6	5.3	25.7	15.3	50.2	12.7	18.8	23.1	12.7	61.0	5.6	15.1	17.7	27.7
July	6.7	13.3	16.1	4.3	13.7	10.9	19.5	32.4	28.8	4.6	52.7	35.1	18.3	4.1	15.7	21.9	27.9	5.0	7.1	12.4	9.6	9.9
August	4.3	9.2	8.8	10.9	2.6	7.7	6.5	19.1	7.8	4.7	60.6	46.8	5.1	17.9	10.0	11.7	9.7	13.1	15.0	12.5	26.1	13.3
September	4.7	28.2	21.9	15.0	25.0	39.8	9.5	35.7	38.8	6.7	43.5	8.1	27.6	30.4	27.8	21.2	32.7	15.5	17.2	4.9	15.0	7.9
October	9.7	46.5	11.2	66.5	23.8	40.2	18.0	35.1	52.9	16.4	20.2	49.0	39.5	81.6	89.7	60.0	25.1	42.8	21.1	23.2	37.0	
November	22.7	62.5	37.6	55.2	48.3	87.1	58.9	81.7	62.6	50.2	63.5	26.7	58.2	77.1	16.5	31.4	41.5	25.5	37.2	50.8	69.3	
December	31.6	36.0	21.0	43.9	39.6	64.0	67.3	42.5	66.5	55.4	84.4	63.5	39.4	76.2	45.0	44.7	30.6	38.2	47.2	27.5	47.9	
Total	**404.6**	**440.6**	**463.6**	**526.2**	**420.5**	**545.7**	**484.2**	**557.6**	**562.3**	**340.3**	**644.6**	**627.9**	**428.0**	**716.3**	**378.9**	**568.6**	**478.9**	**391.7**	**424.3**	**577.3**	**575.2**	**397.1**

* All volumes are in mm of runoff over drainage area

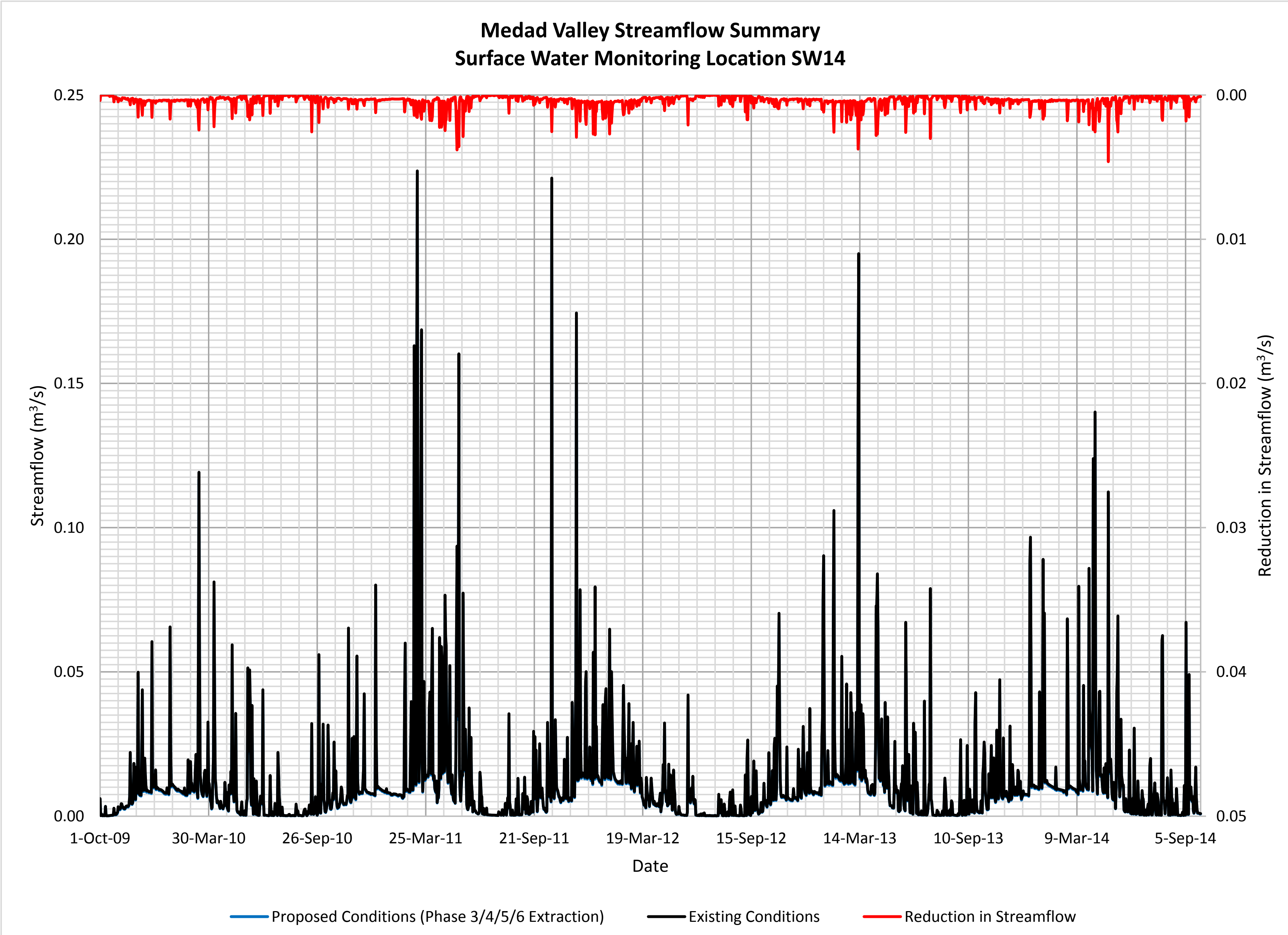
TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	June 23, 2023
SUBJECT	Proposed (Operations) Daily Water Balance Outlet Volumes	NAME	John Gore
		PAGE	5 OF 5

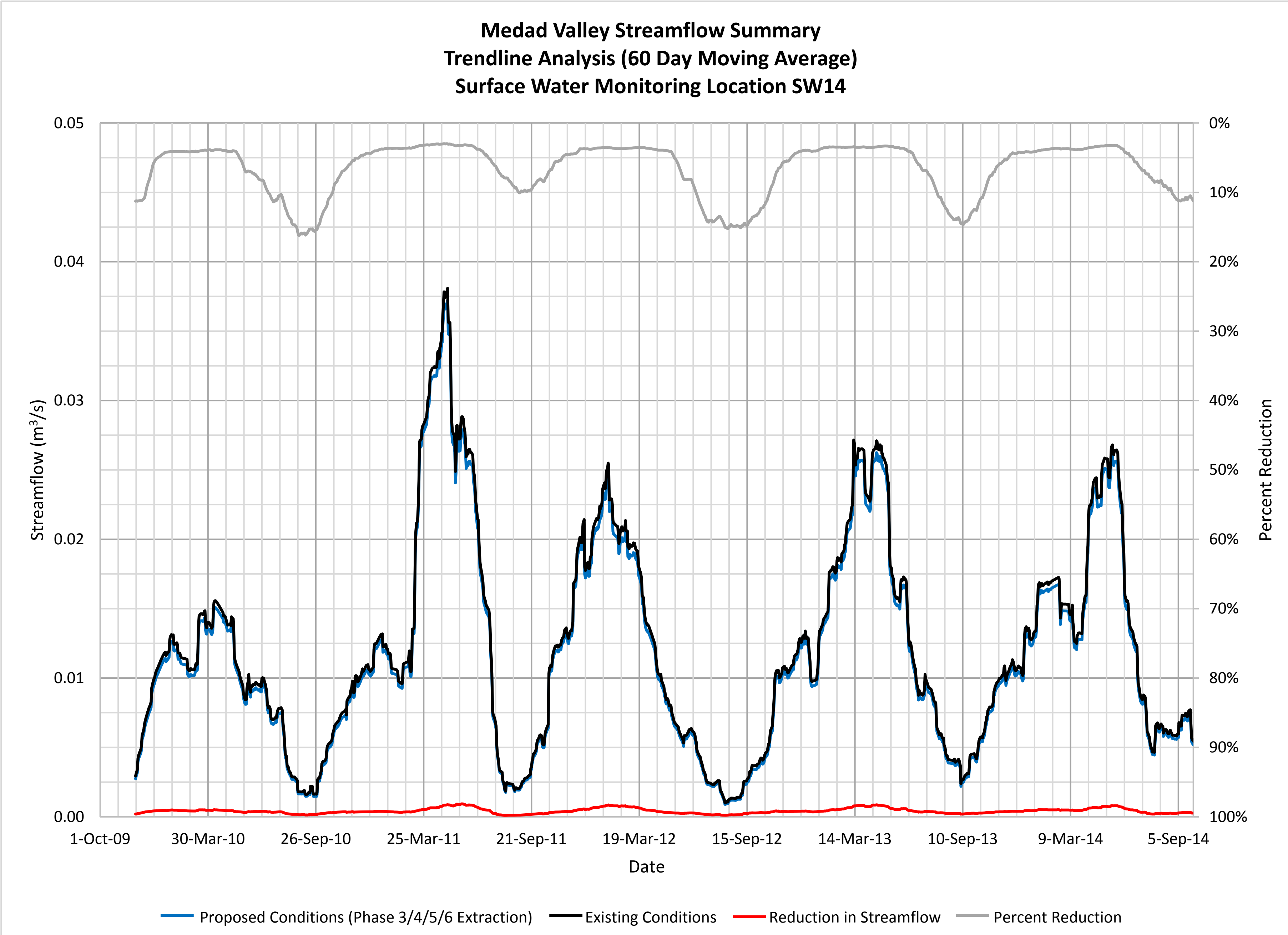
WETLAND 13021																						
Month	**Year**																					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	9.3	0.0	3.1	0.0	3.8	0.0	1.4	4.2	20.3	4.7	1.8	0.0	2.4	0.5	16.5	18.0	5.6	0.3	0.0	2.2	2.6	0.0
February	16.8	0.0	11.5	3.6	5.9	0.0	0.0	15.4	24.3	0.0	7.3	30.0	0.5	4.3	2.5	0.4	0.3	0.0	3.1	13.8	16.6	12.3
March	32.1	2.1	0.4	44.3	6.4	14.6	40.7	17.9	10.9	15.5	25.1	38.7	12.1	44.9	1.2	33.9	29.2	8.7	22.4	15.5	2.2	25.0
April	4.1	1.0	9.0	2.0	14.6	4.7	8.4	20.4	3.7	2.3	2.8	28.6	3.9	27.8	0.0	20.1	17.1	6.5	11.8	28.5	42.1	15.4
May	0.0	0.0	13.6	1.9	8.6	9.7	7.8	0.0	2.5	0.0	0.8	0.0	0.1	27.5	0.0	0.0	3.3	0.0	0.0	29.3	0.0	16.2
June	0.0	0.0	10.3	1.2	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0
July	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
August	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.8	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
September	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
October	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
November	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.5	0.0	8.9	1.3	0.0	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
December	0.0	0.8	0.0	0.1	0.0	9.4	0.0	1.8	10.4	0.0	21.1	10.5	0.0	10.7	0.0	2.8	0.0	0.0	0.0	0.0	0.0	
Total	**62.3**	**3.9**	**48.0**	**53.2**	**39.3**	**45.6**	**58.3**	**59.7**	**72.7**	**22.5**	**85.0**	**111.4**	**22.7**	**123.0**	**20.2**	**75.1**	**55.6**	**21.2**	**37.3**	**89.3**	**63.4**	**68.9**

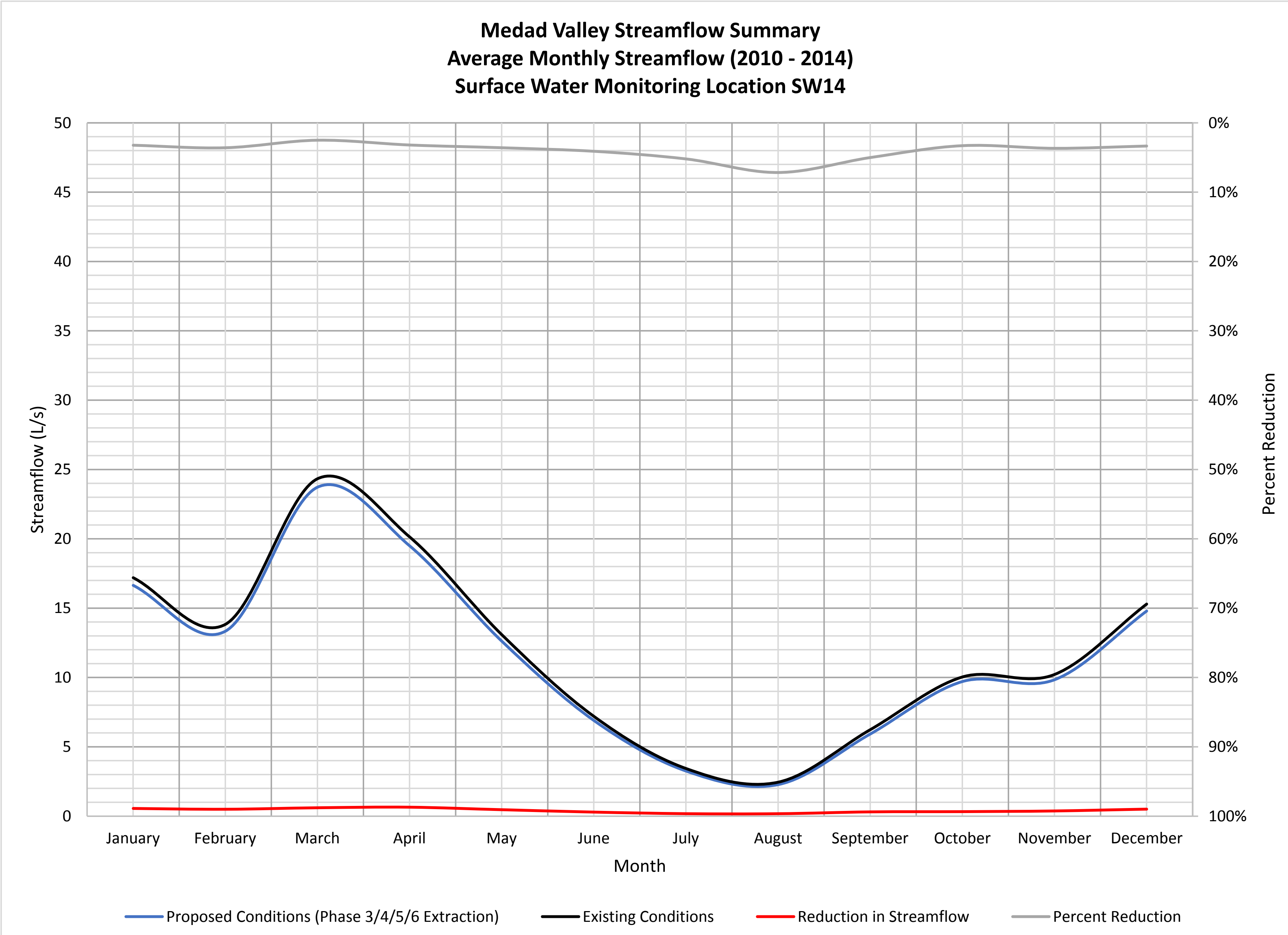
* All volumes are in mm of runoff over drainage area

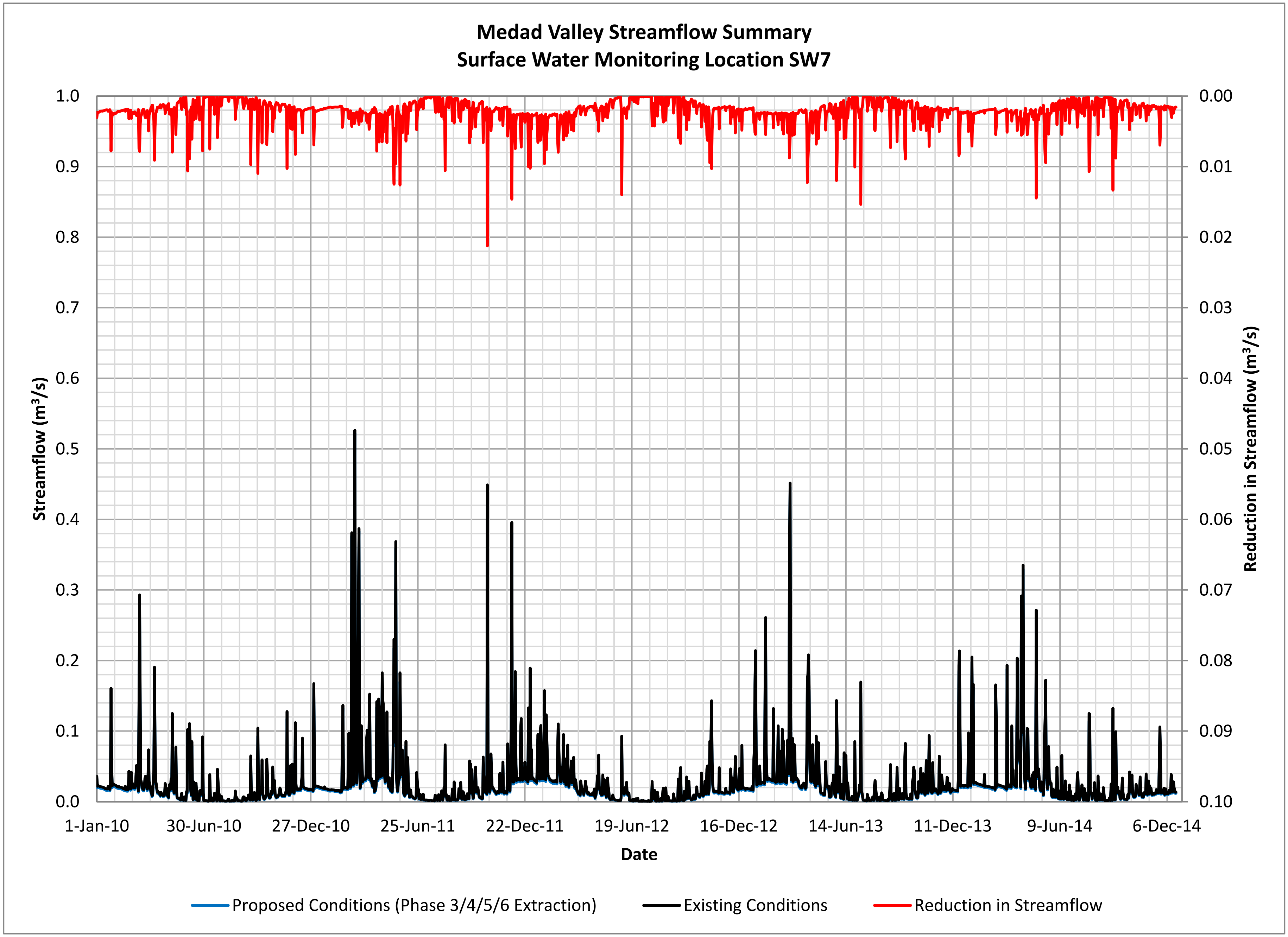
Appendix P:
Proposed Conditions Integrated Surface Water Groundwater Model Results



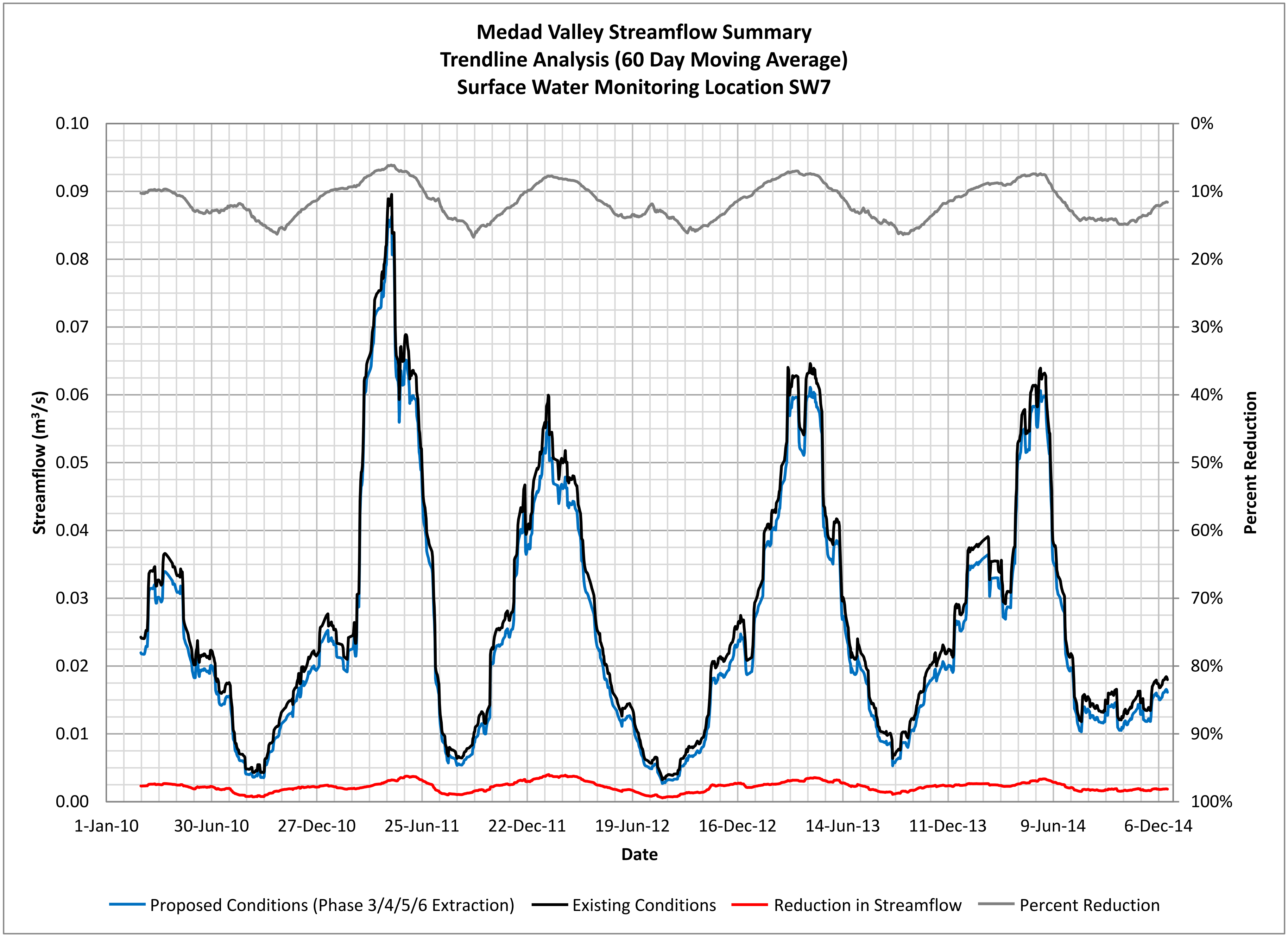
Medad Valley Streamflow Summary
Surface Water Monitoring Location SW14
Streamflow (m³/s)
Reduction in Streamflow (m³/s)
0.25
0.20
0.15
0.10
0.05
0.00
0.00
0.01
0.02
0.03
0.04
0.05
1-Oct-09
30-Mar-10
26-Sep-10
25-Mar-11
21-Sep-11
19-Mar-12
15-Sep-12
14-Mar-13
10-Sep-13
9-Mar-14
5-Sep-14
Date
Proposed Conditions (Phase 3/4/5/6 Extraction)
Existing Conditions
Reduction in Streamflow

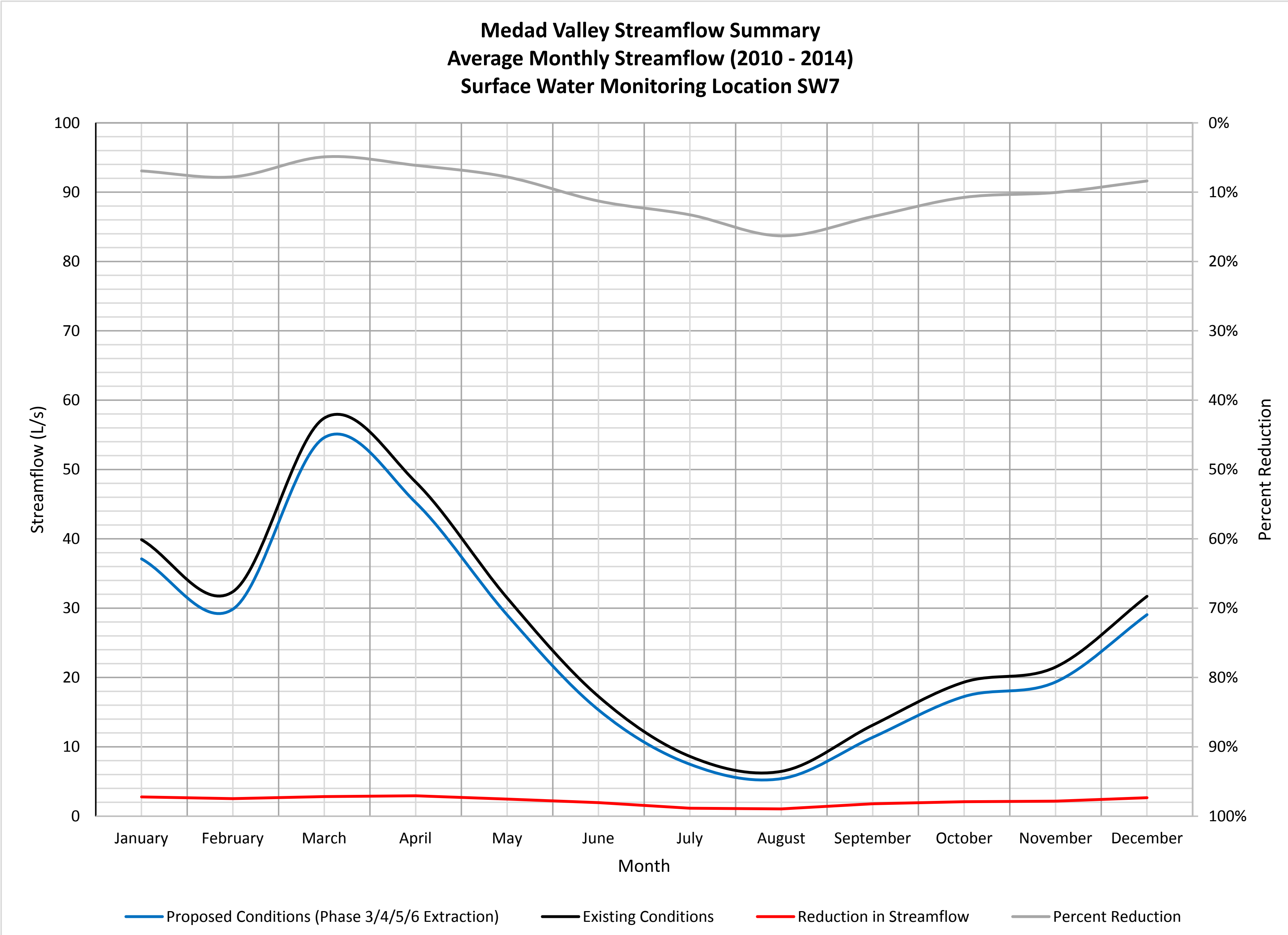

Medad Valley Streamflow Summary
Trendline Analysis (60 Day Moving Average)
Surface Water Monitoring Location SW14
0.05
0.04
0.03
0.02
0.01
0.00
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Streamflow (m³/s)
Percent Reduction
1-Oct-09
30-Mar-10
26-Sep-10
25-Mar-11
21-Sep-11
19-Mar-12
15-Sep-12
14-Mar-13
10-Sep-13
9-Mar-14
5-Sep-14
Date
Proposed Conditions (Phase 3/4/5/6 Extraction)
Existing Conditions
Reduction in Streamflow
Percent Reduction


Medad Valley Streamflow Summary
Average Monthly Streamflow (2010 - 2014)
Surface Water Monitoring Location SW14
Streamflow (L/s)
Percent Reduction
50
45
40
35
30
25
20
15
10
5
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
January
February
March
April
May
June
July
August
September
October
November
December
Month
Proposed Conditions (Phase 3/4/5/6 Extraction)
Existing Conditions
Reduction in Streamflow
Percent Reduction



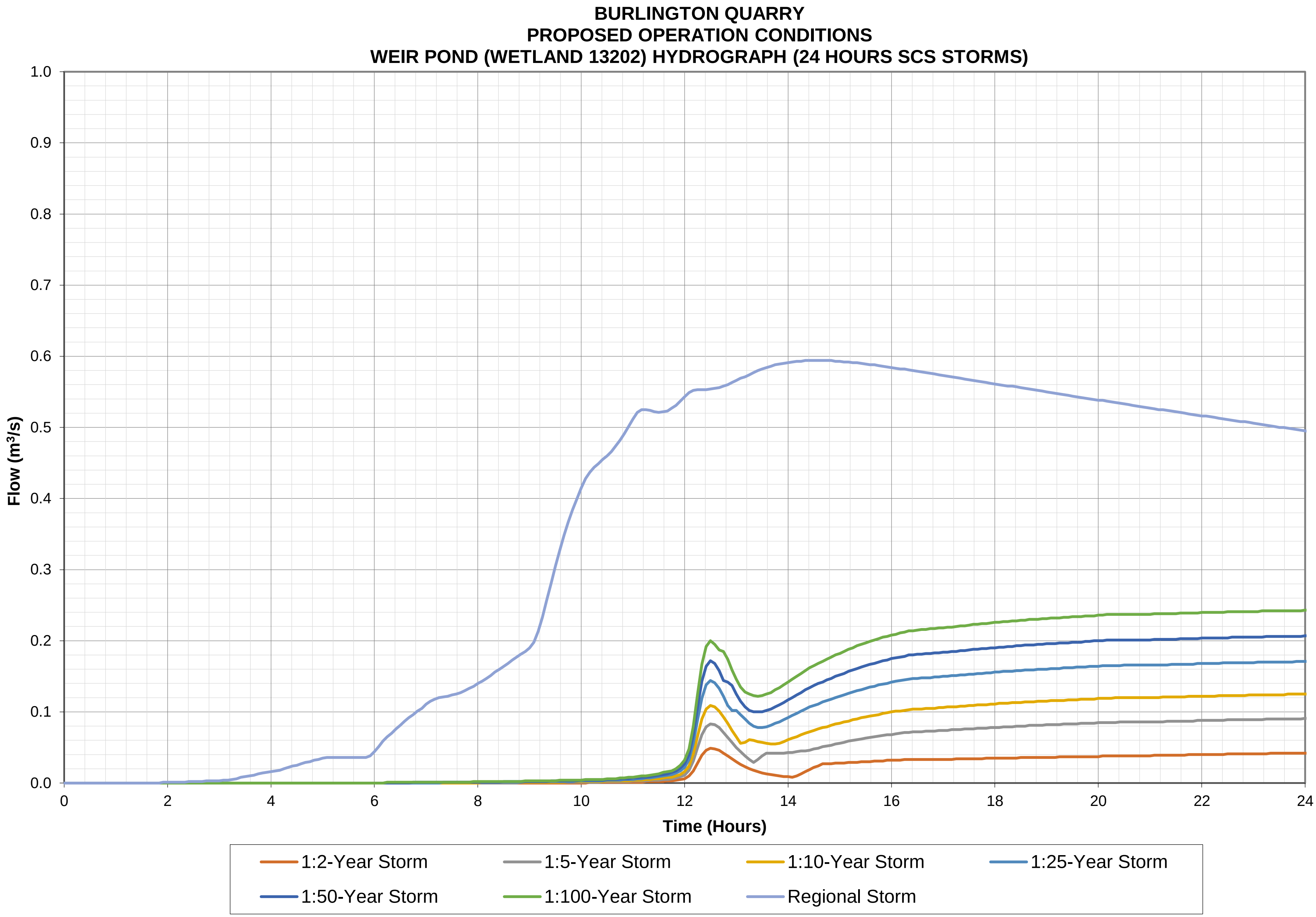
Medad Valley Streamflow Summary
Surface Water Monitoring Location SW7
Streamflow (m3/s)
Reduction in Streamflow (m3/s)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
1-Jan-10
30-Jun-10
27-Dec-10
25-Jun-11
22-Dec-11
19-Jun-12
16-Dec-12
14-Jun-13
11-Dec-13
9-Jun-14
6-Dec-14
Date
Proposed Conditions (Phase 3/4/5/6 Extraction)
Existing Conditions
Reduction in Streamflow

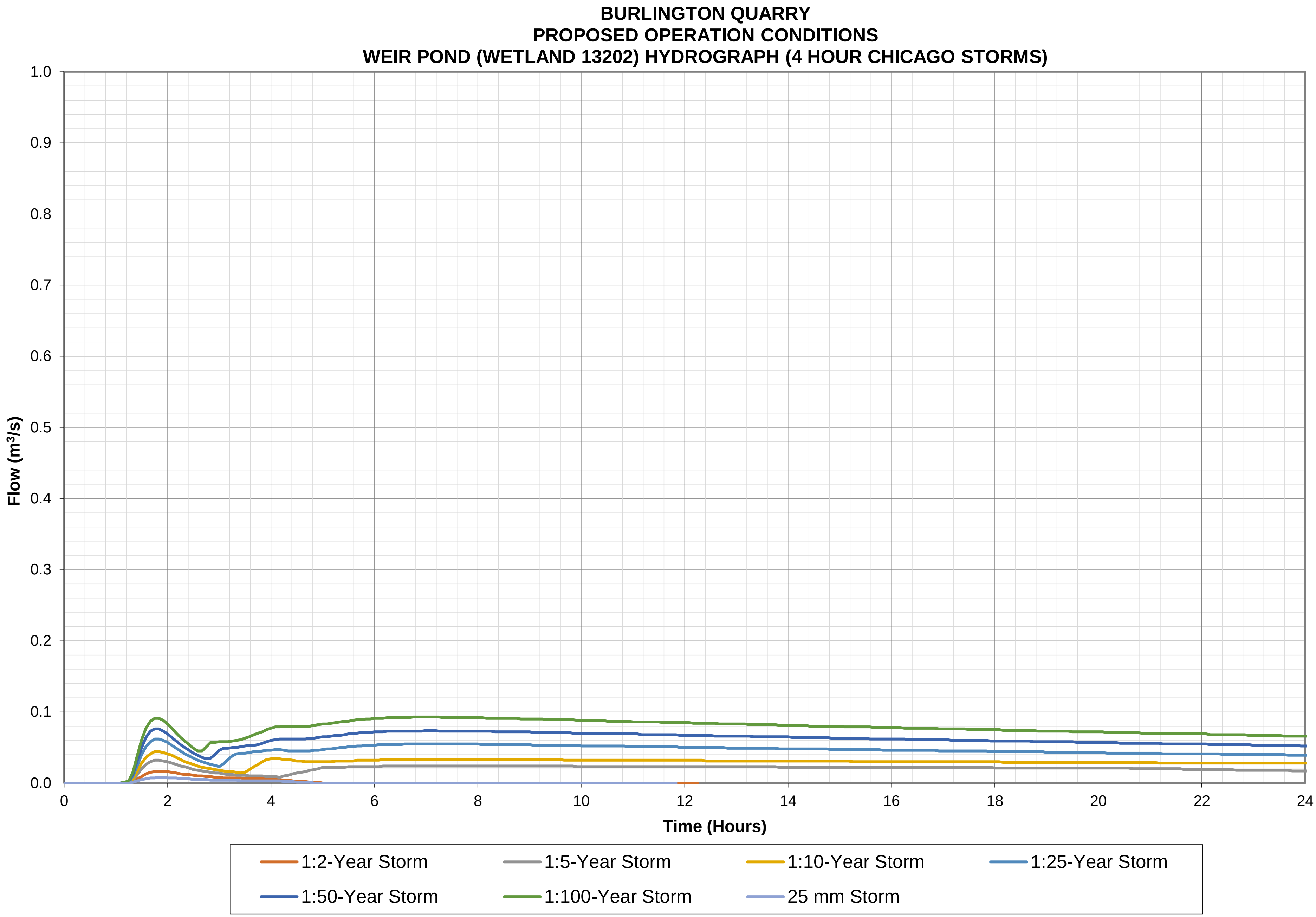

Medad Valley Streamflow Summary
Trendline Analysis (60 Day Moving Average)
Surface Water Monitoring Location SW7
Streamflow (m³/s)
Percent Reduction
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
1-Jan-10
30-Jun-10
27-Dec-10
25-Jun-11
22-Dec-11
19-Jun-12
16-Dec-12
14-Jun-13
11-Dec-13
9-Jun-14
6-Dec-14
Date
Proposed Conditions (Phase 3/4/5/6 Extraction)
Existing Conditions
Reduction in Streamflow
Percent Reduction

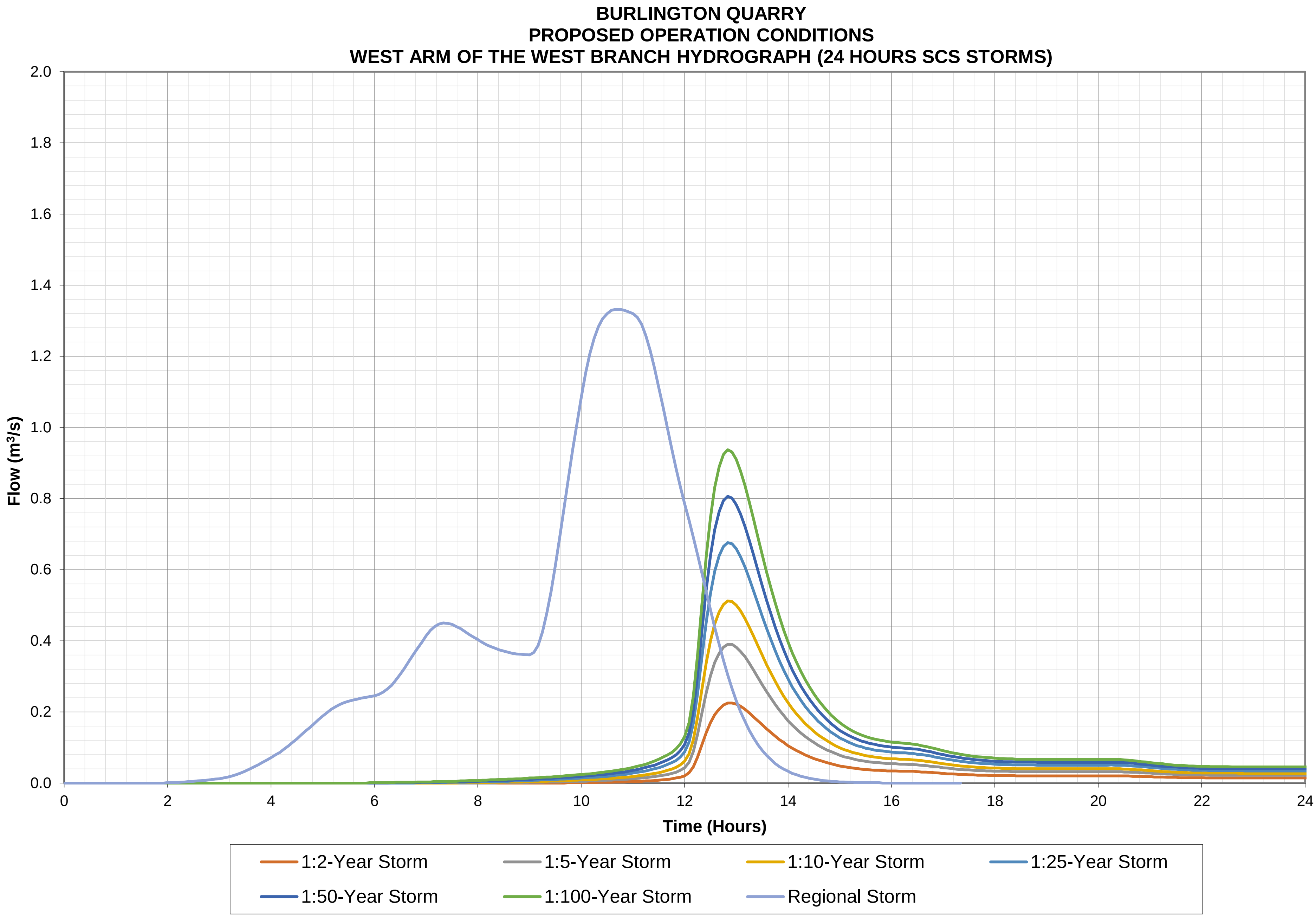


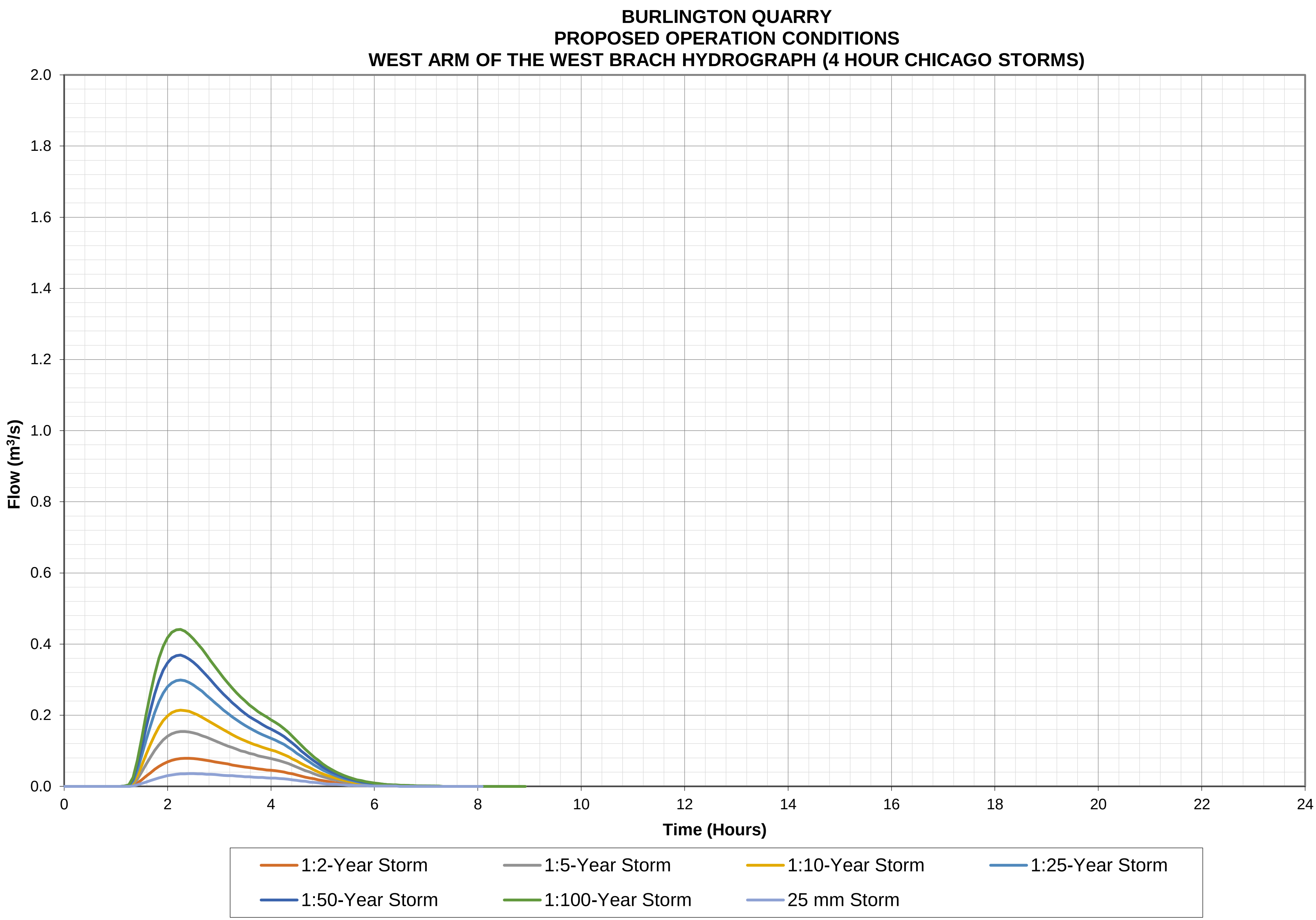
Medad Valley Streamflow Summary
Average Monthly Streamflow (2010 - 2014)
Surface Water Monitoring Location SW7
Streamflow (L/s)
100
90
80
70
60
50
40
30
20
10
0
Percent Reduction
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
January
February
March
April
May
June
July
August
September
October
November
December
Month
Proposed Conditions (Phase 3/4/5/6 Extraction)
Existing Conditions
Reduction in Streamflow
Percent Reduction

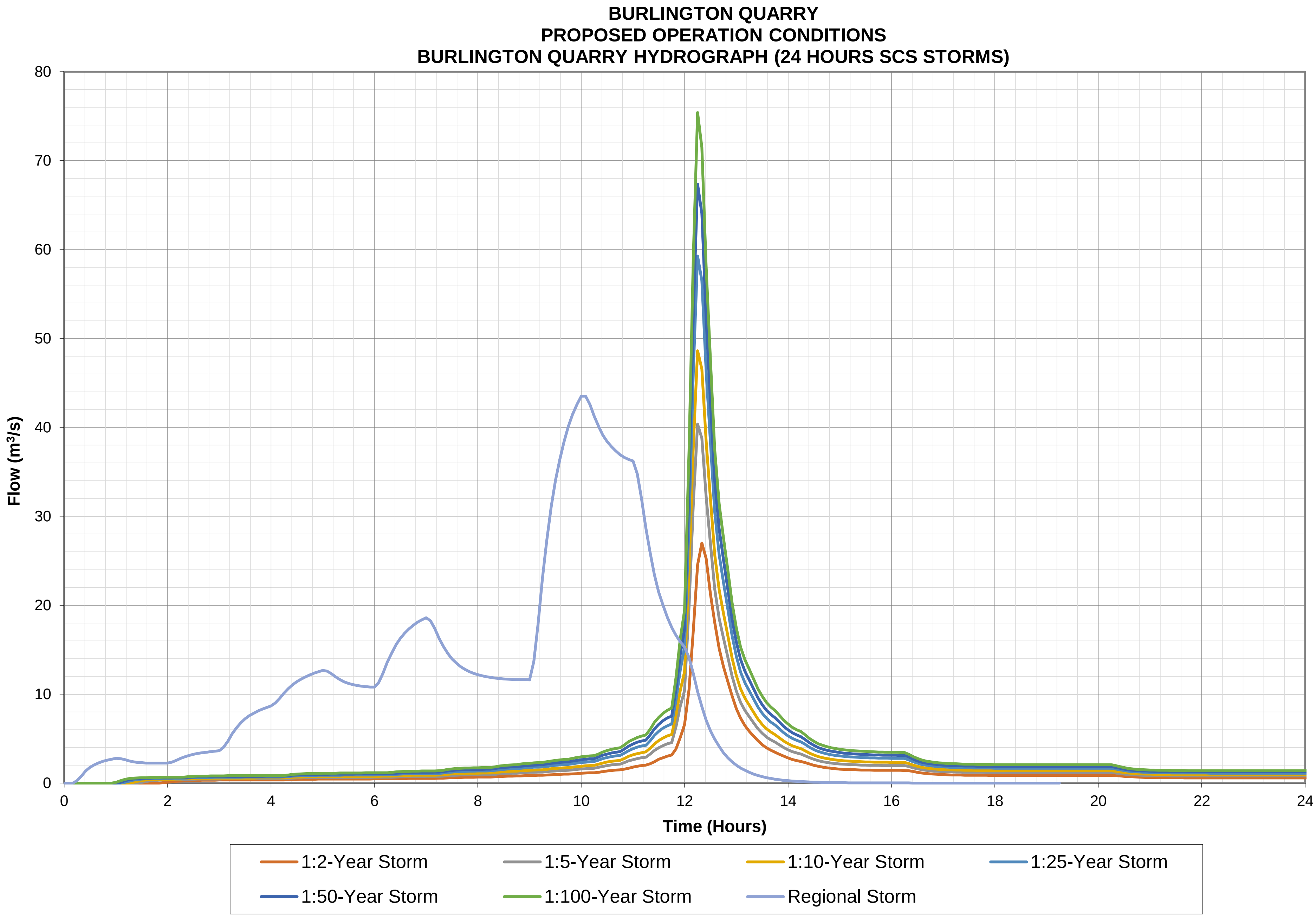
Appendix Q:
Proposed Conditions (Operations) Event Based Hydrologic Model Results

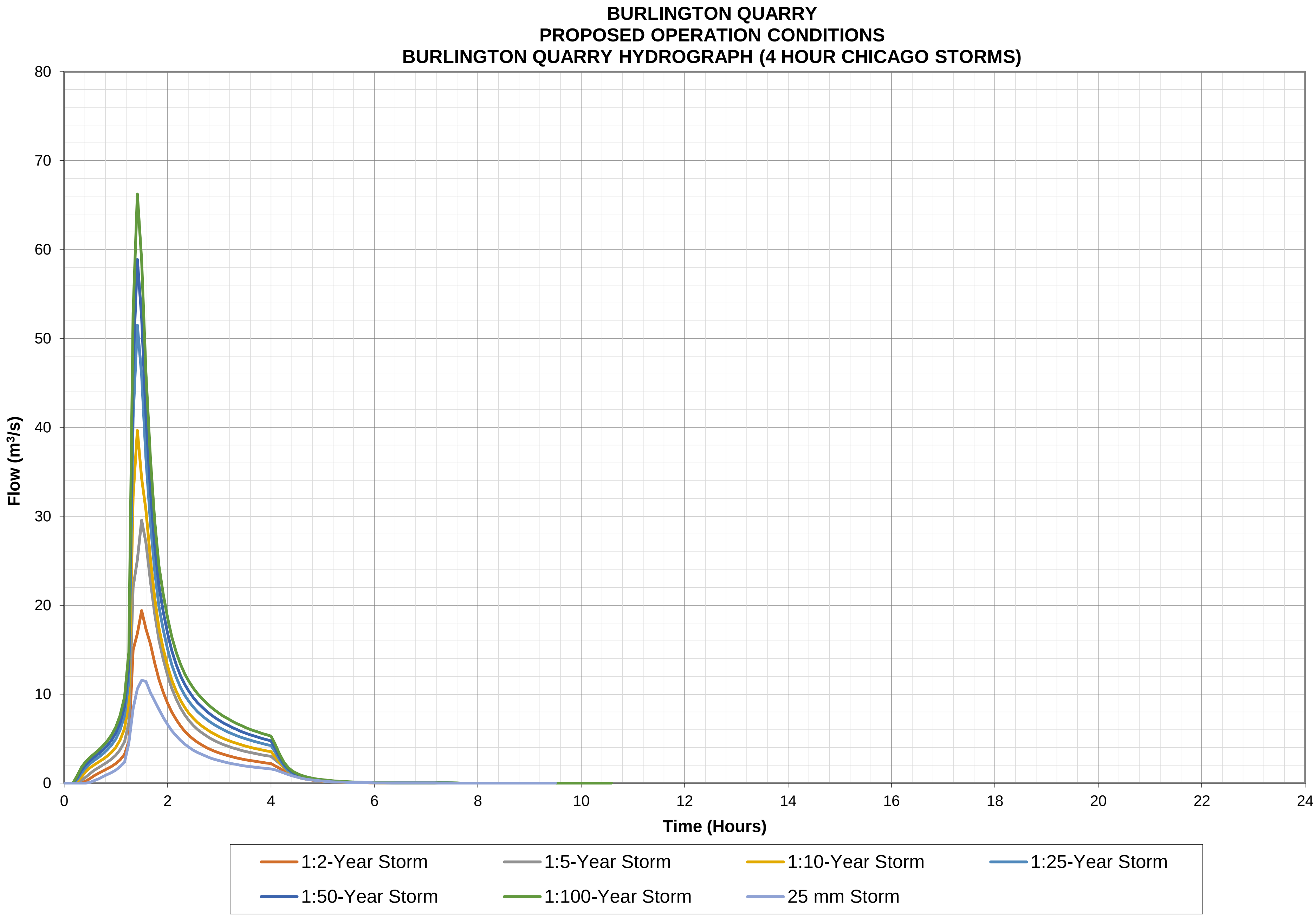

BURLINGTON QUARRY
PROPOSED OPERATION CONDITIONS
WEIR POND (WETLAND 13202) HYDROGRAPH (24 HOURS SCS STORMS)
Flow (m³/s)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
Regional Storm

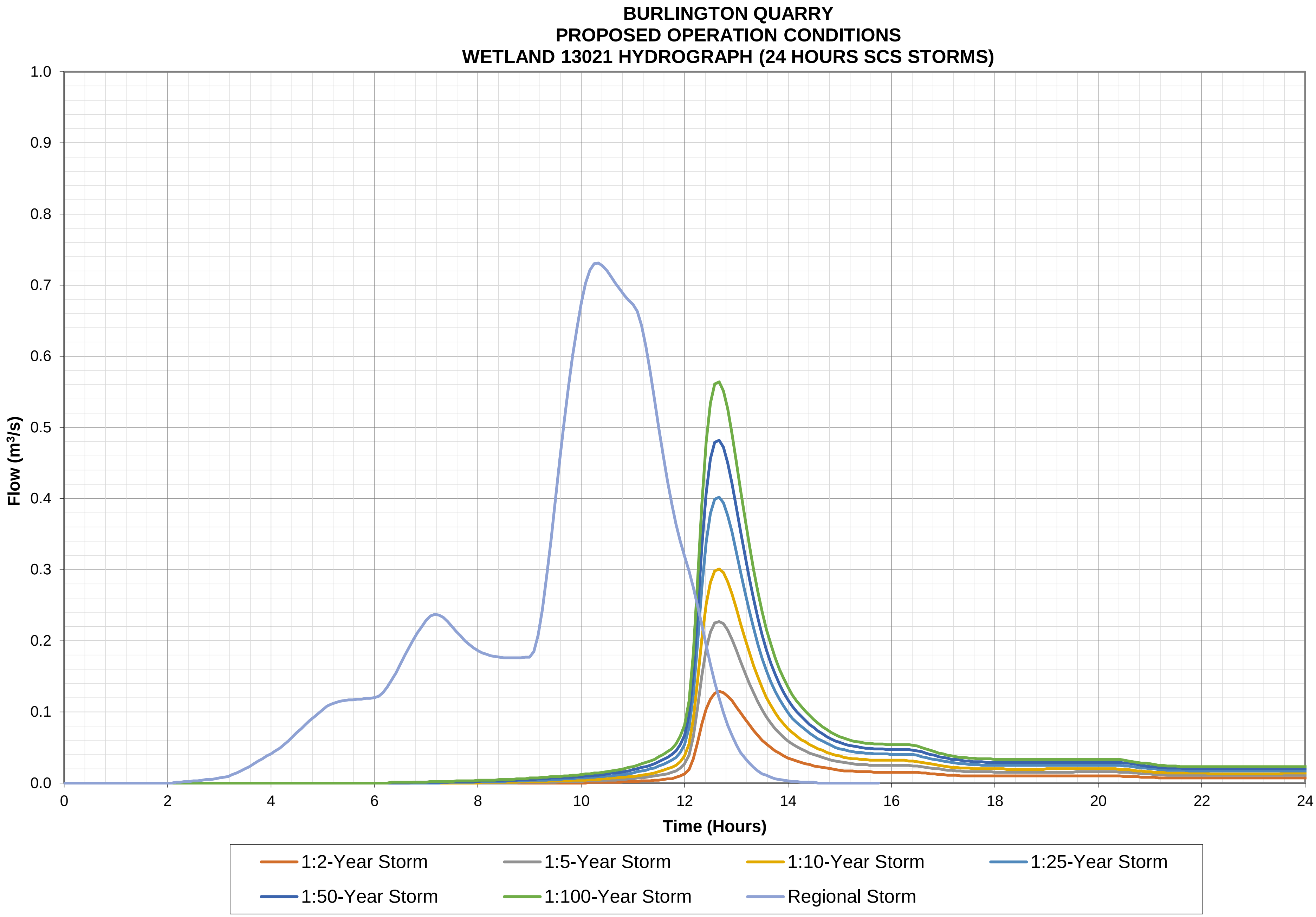

BURLINGTON QUARRY
PROPOSED OPERATION CONDITIONS
WEIR POND (WETLAND 13202) HYDROGRAPH (4 HOUR CHICAGO STORMS)
Flow (m³/s)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
25 mm Storm

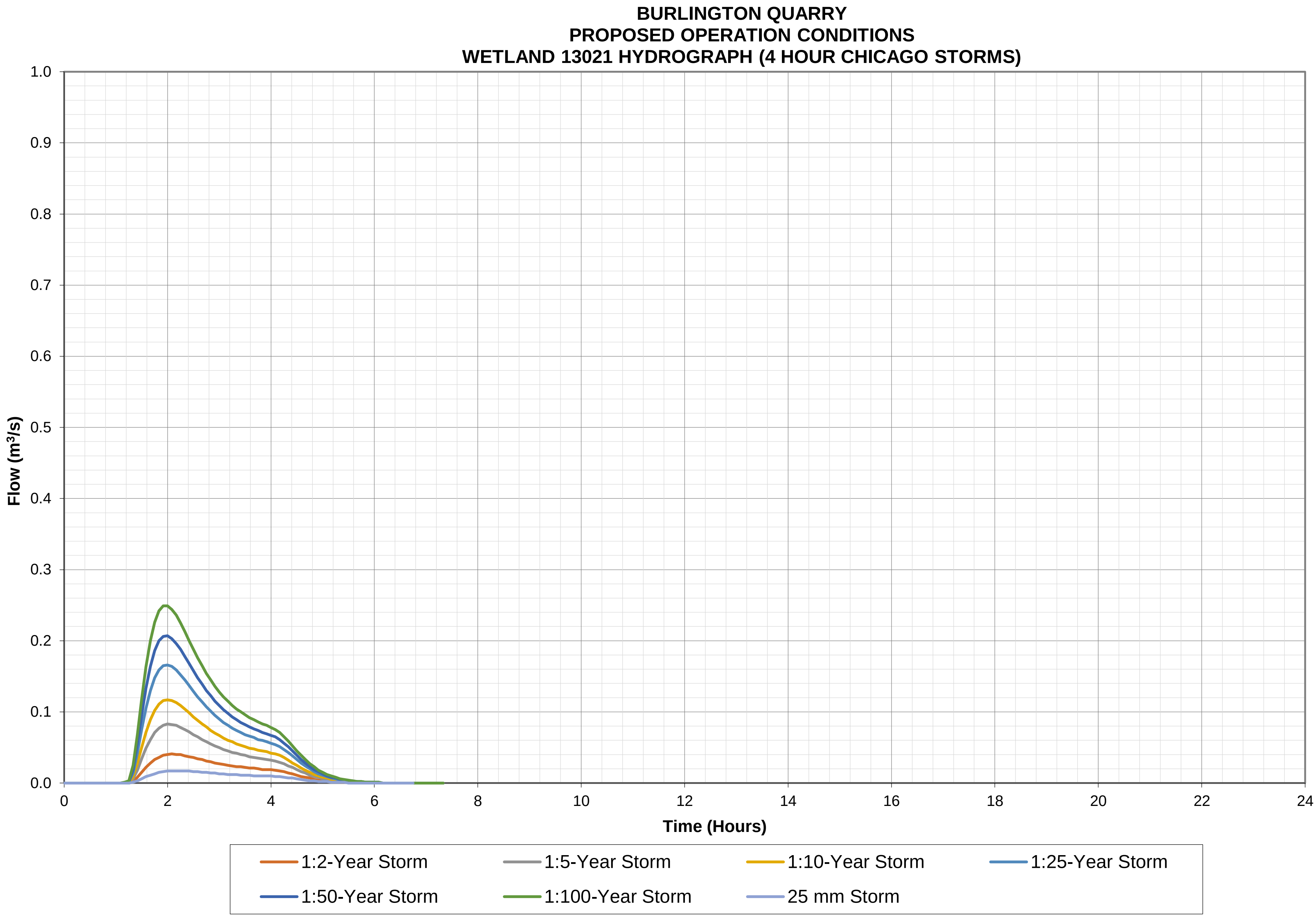

BURLINGTON QUARRY
PROPOSED OPERATION CONDITIONS
WEST ARM OF THE WEST BRANCH HYDROGRAPH (24 HOURS SCS STORMS)
Flow (m³/s)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
Regional Storm


BURLINGTON QUARRY
PROPOSED OPERATION CONDITIONS
WEST ARM OF THE WEST BRACH HYDROGRAPH (4 HOUR CHICAGO STORMS)
Flow (m³/s)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
25 mm Storm

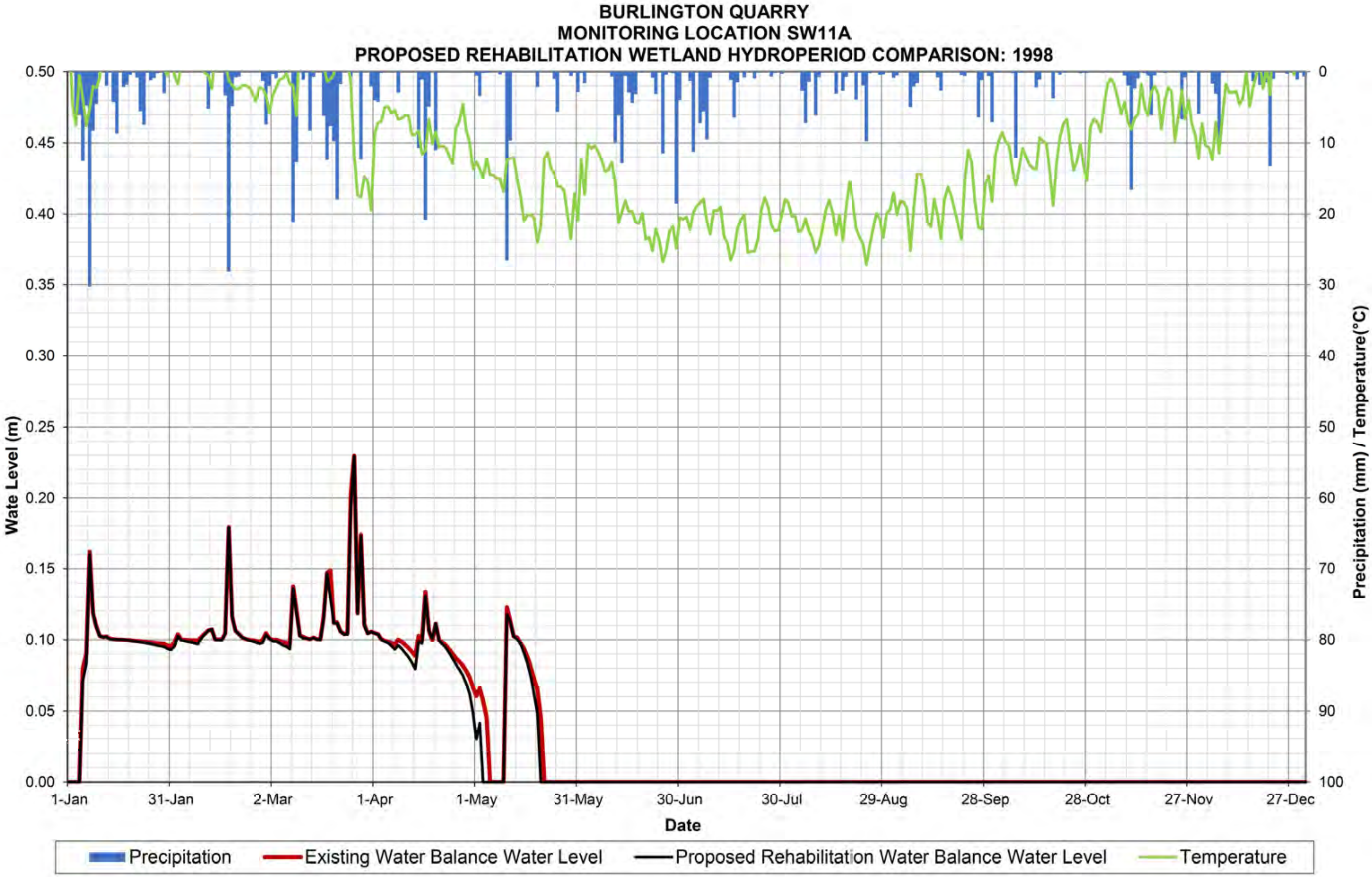

BURLINGTON QUARRY
PROPOSED OPERATION CONDITIONS
BURLINGTON QUARRY HYDROGRAPH (24 HOURS SCS STORMS)
Flow (m³/s)
0
10
20
30
40
50
60
70
80
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
Regional Storm

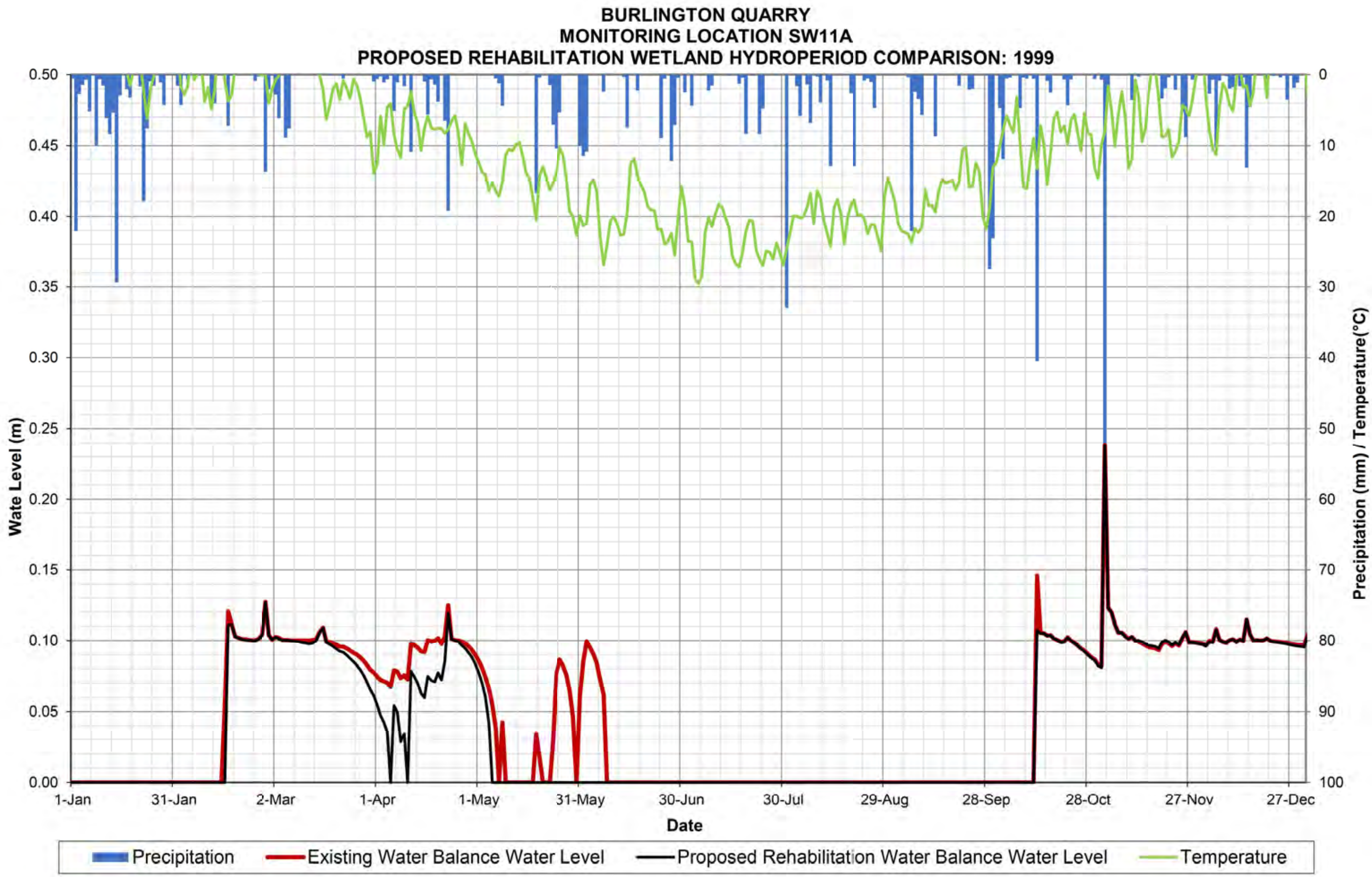

BURLINGTON QUARRY
PROPOSED OPERATION CONDITIONS
BURLINGTON QUARRY HYDROGRAPH (4 HOUR CHICAGO STORMS)
Flow (m³/s)
0
10
20
30
40
50
60
70
80
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
25 mm Storm

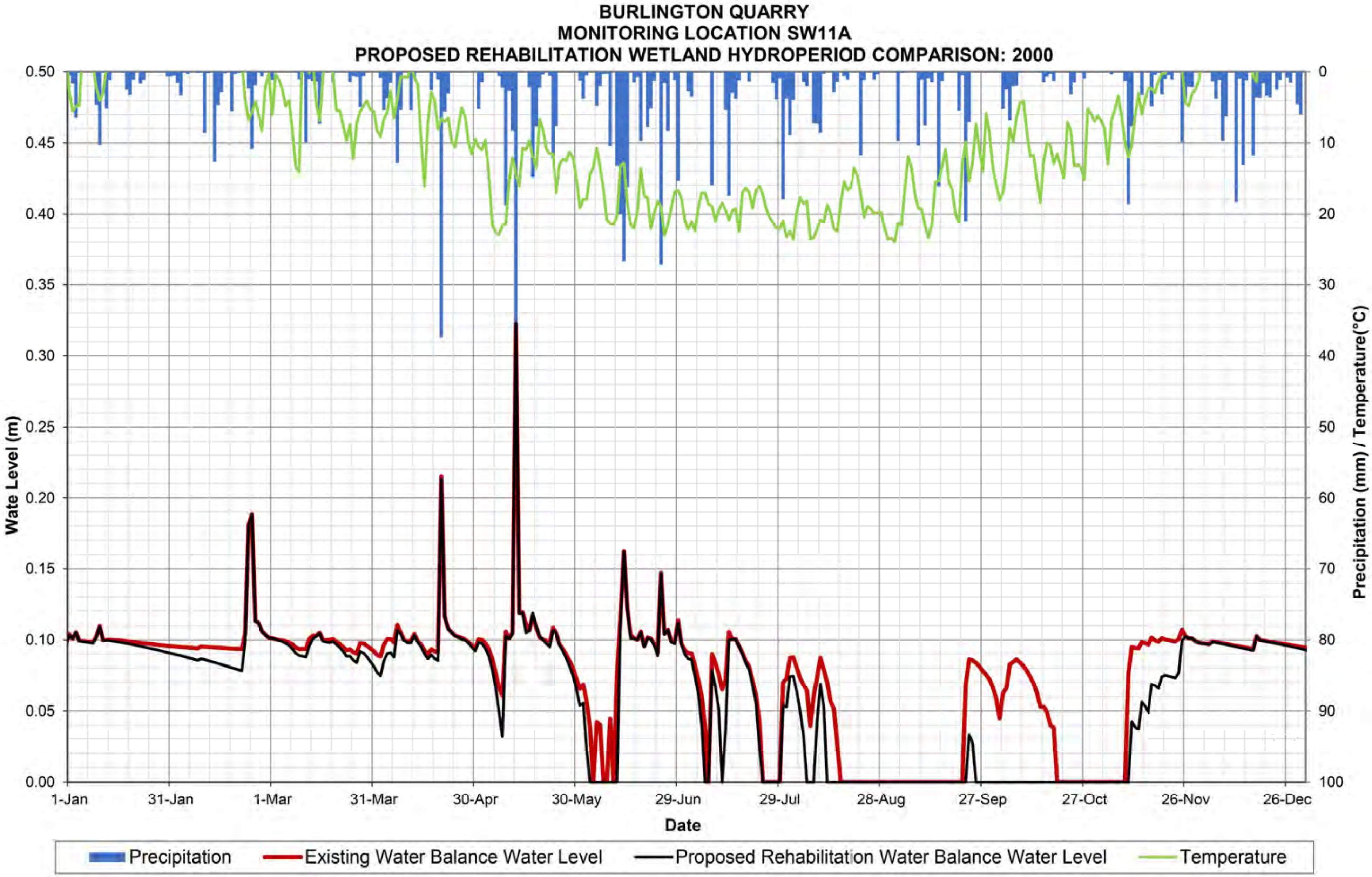

BURLINGTON QUARRY
PROPOSED OPERATION CONDITIONS
WETLAND 13021 HYDROGRAPH (24 HOURS SCS STORMS)
Flow (m³/s)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
Regional Storm


BURLINGTON QUARRY
PROPOSED OPERATION CONDITIONS
WETLAND 13021 HYDROGRAPH (4 HOUR CHICAGO STORMS)
Flow (m³/s)
Time (Hours)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
25 mm Storm

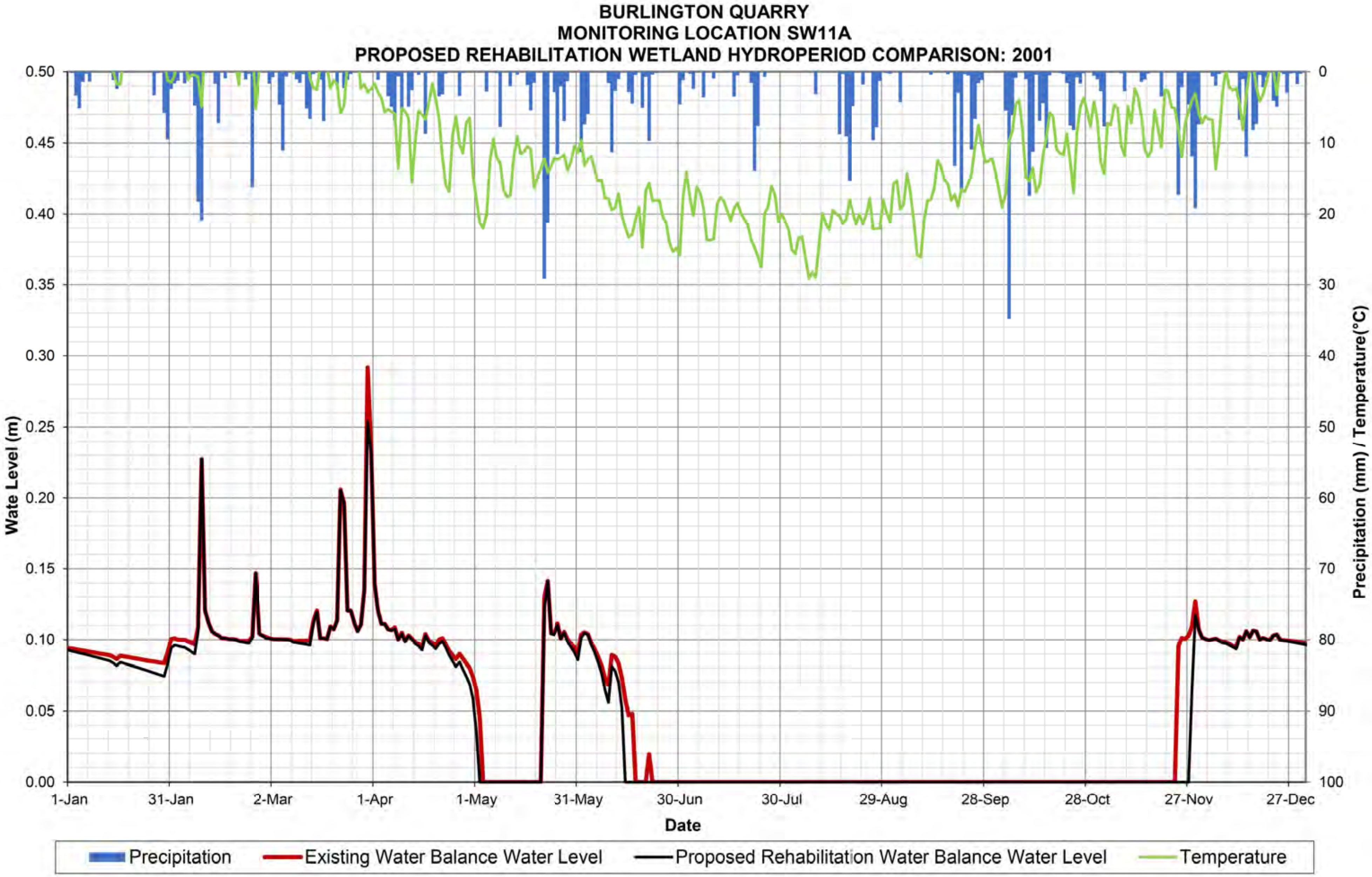
Appendix R: Proposed Conditions (Rehabilitation) Wetland Water Balance Results


BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 1998
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

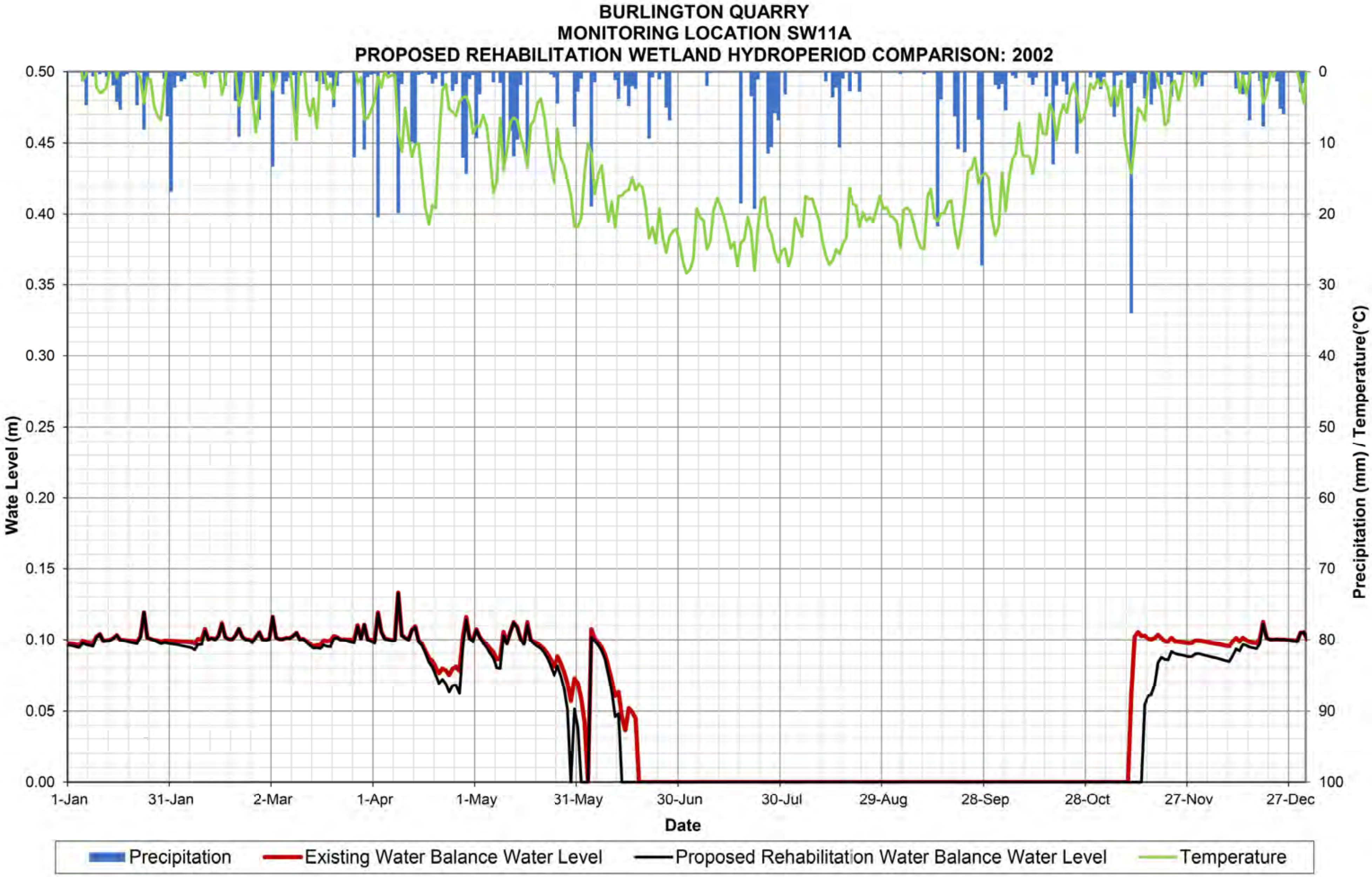

BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 1999
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2000
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

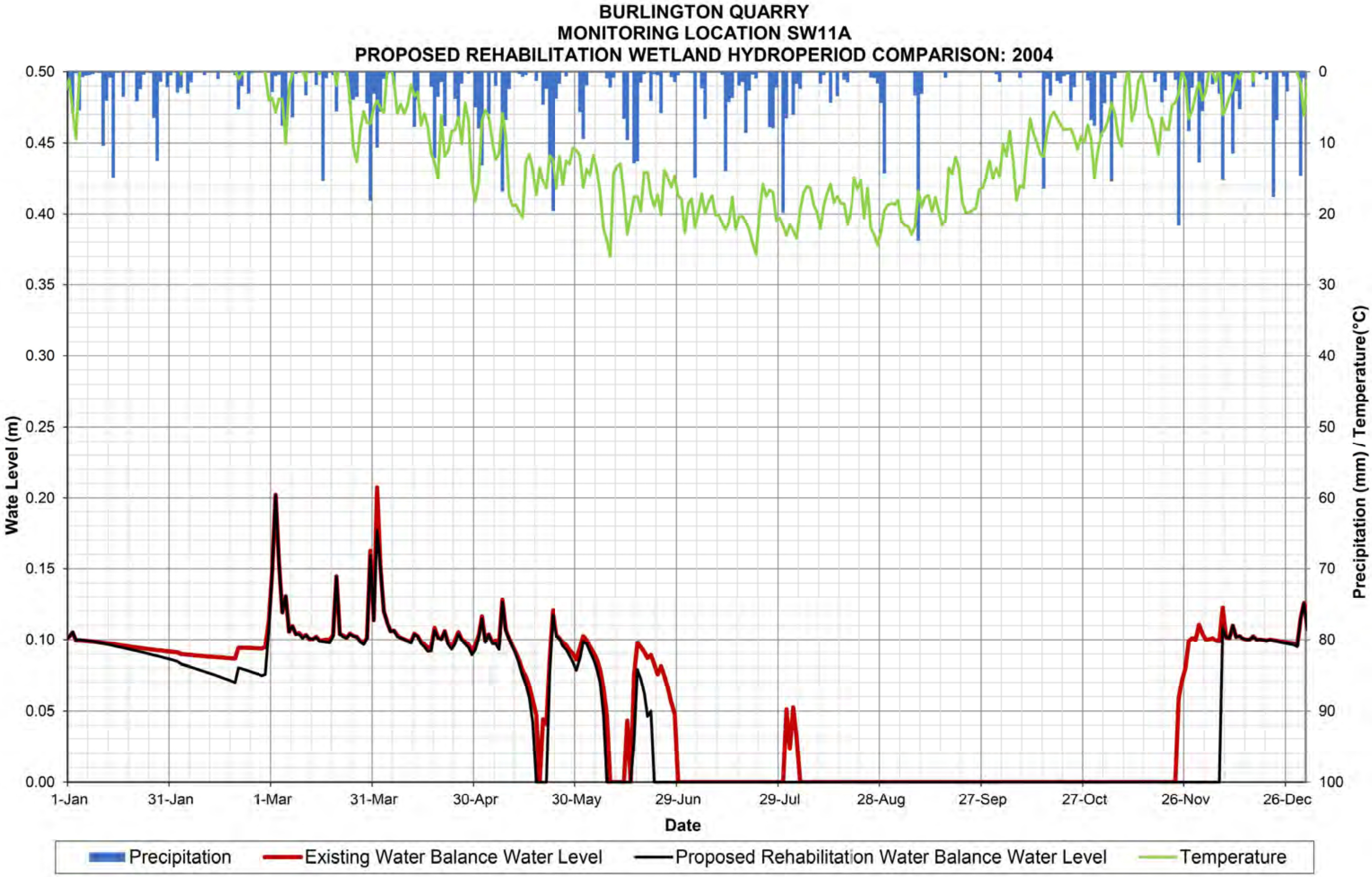


BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2001
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

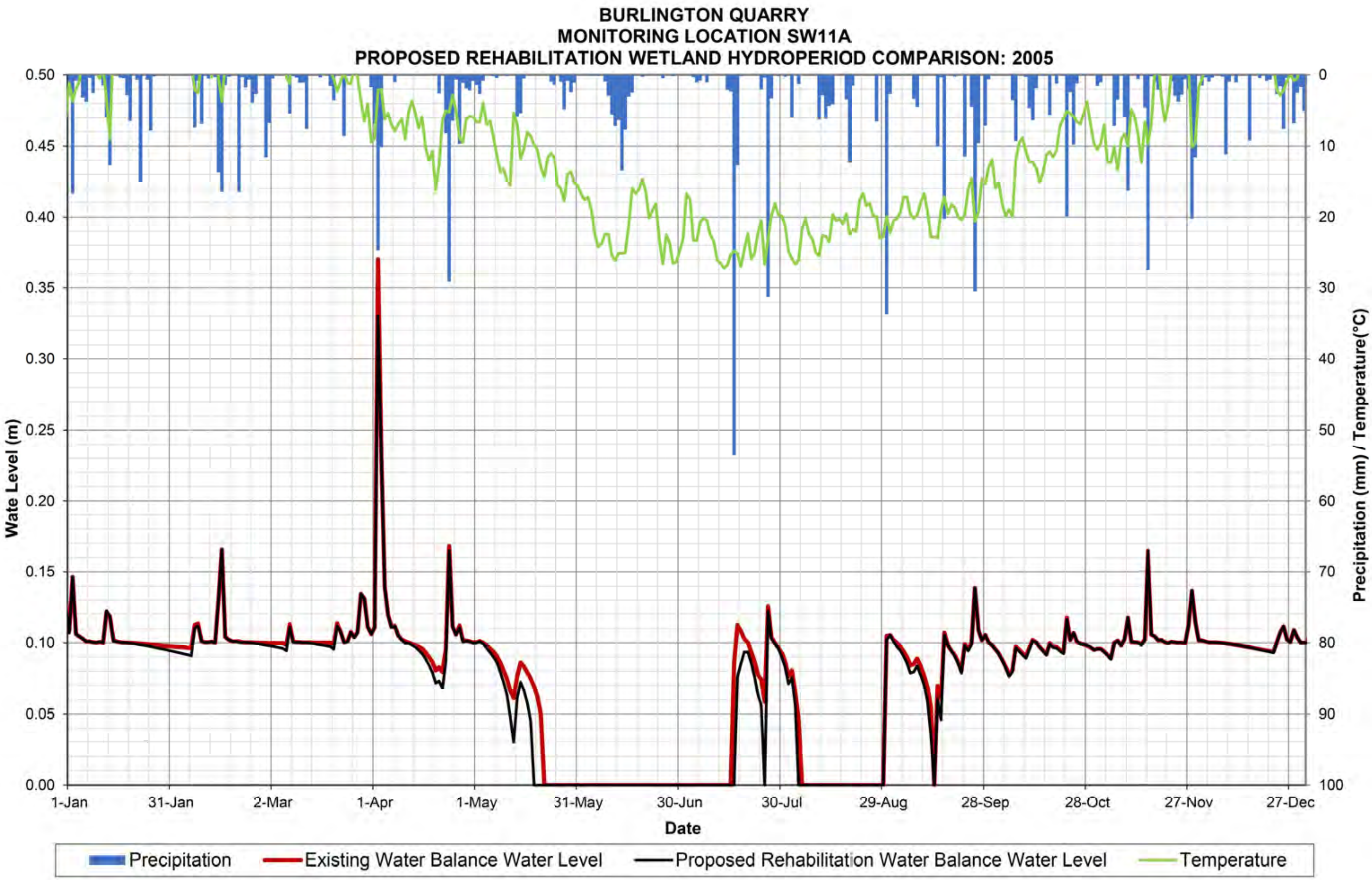


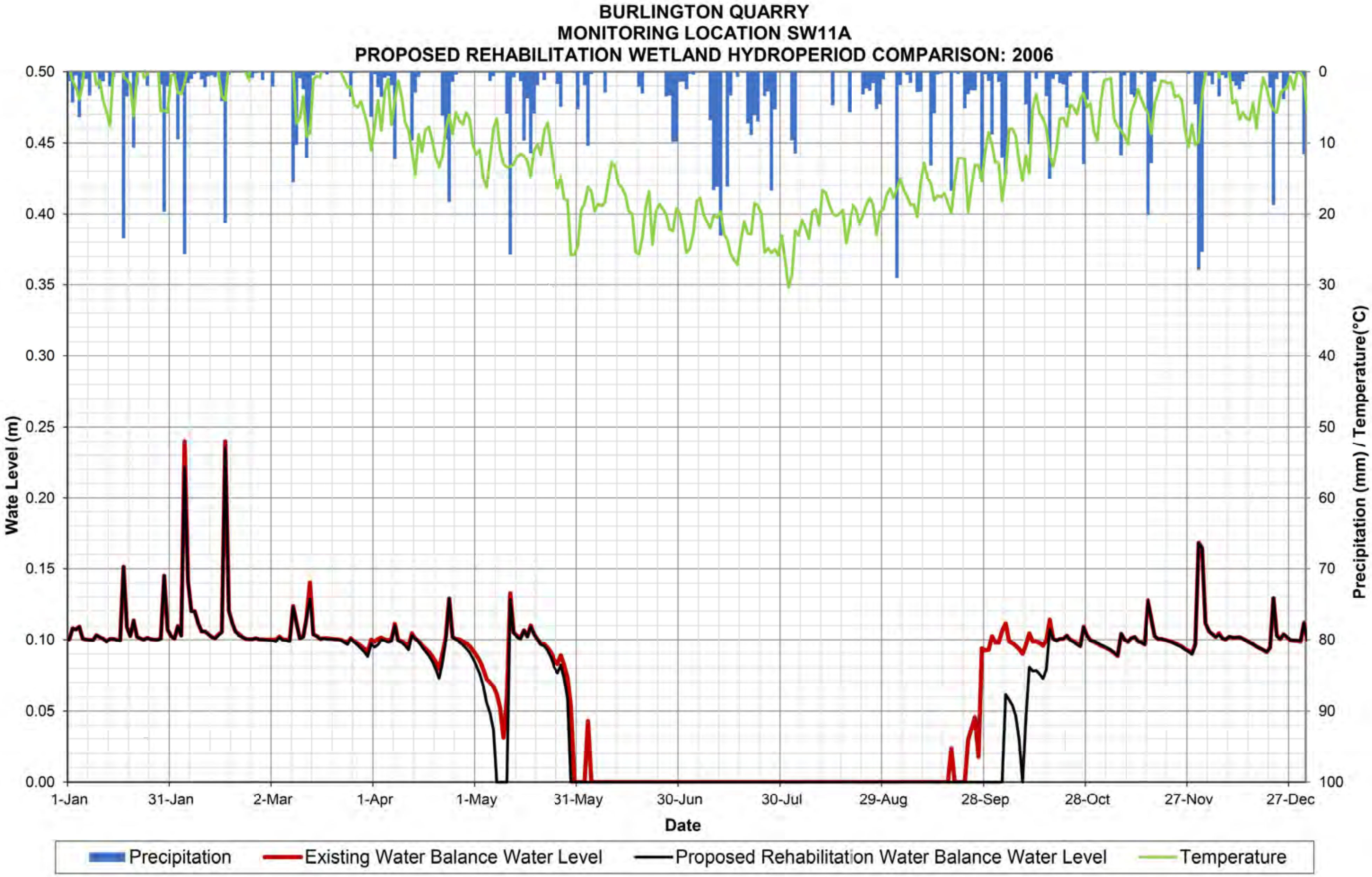
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2002
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2003
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

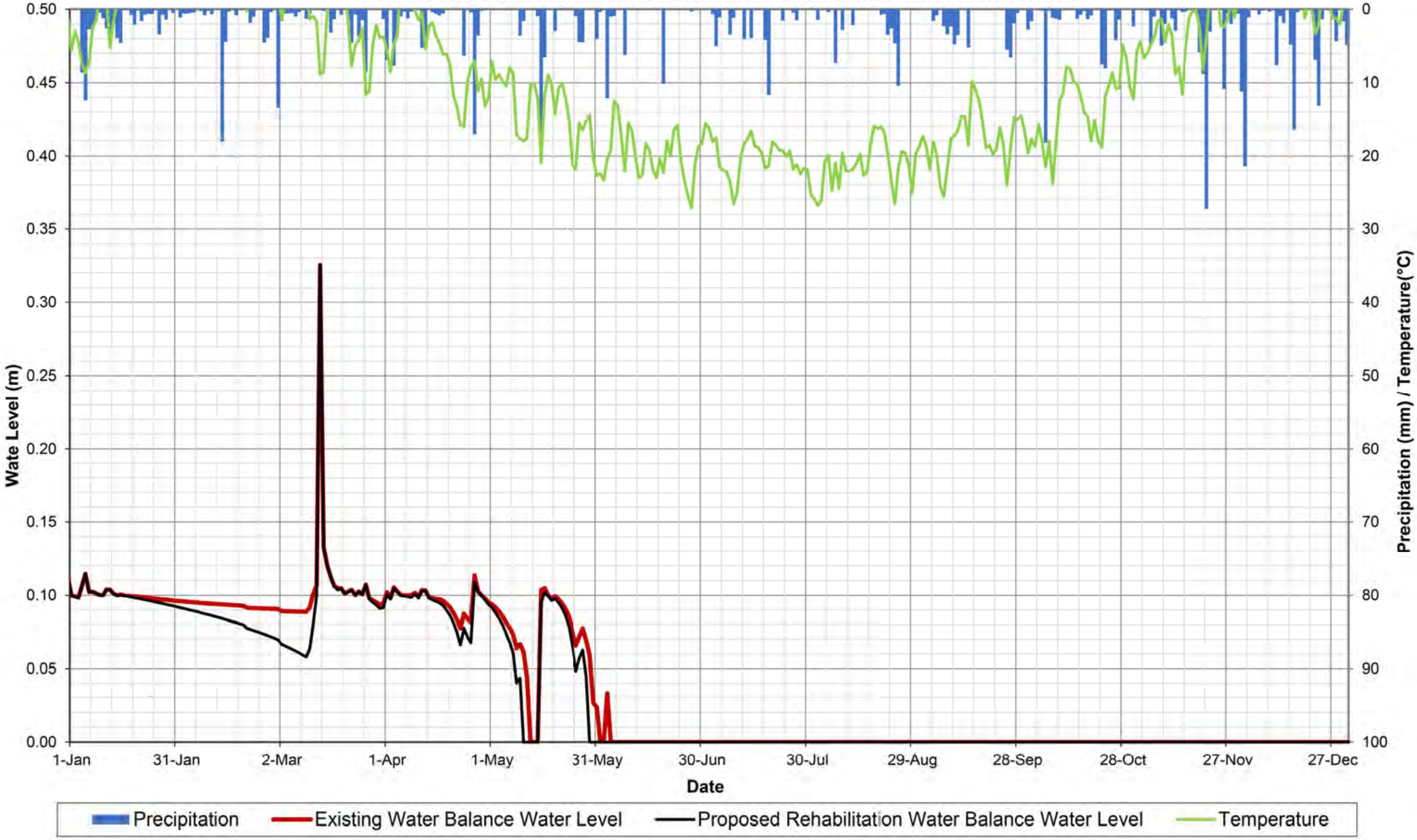


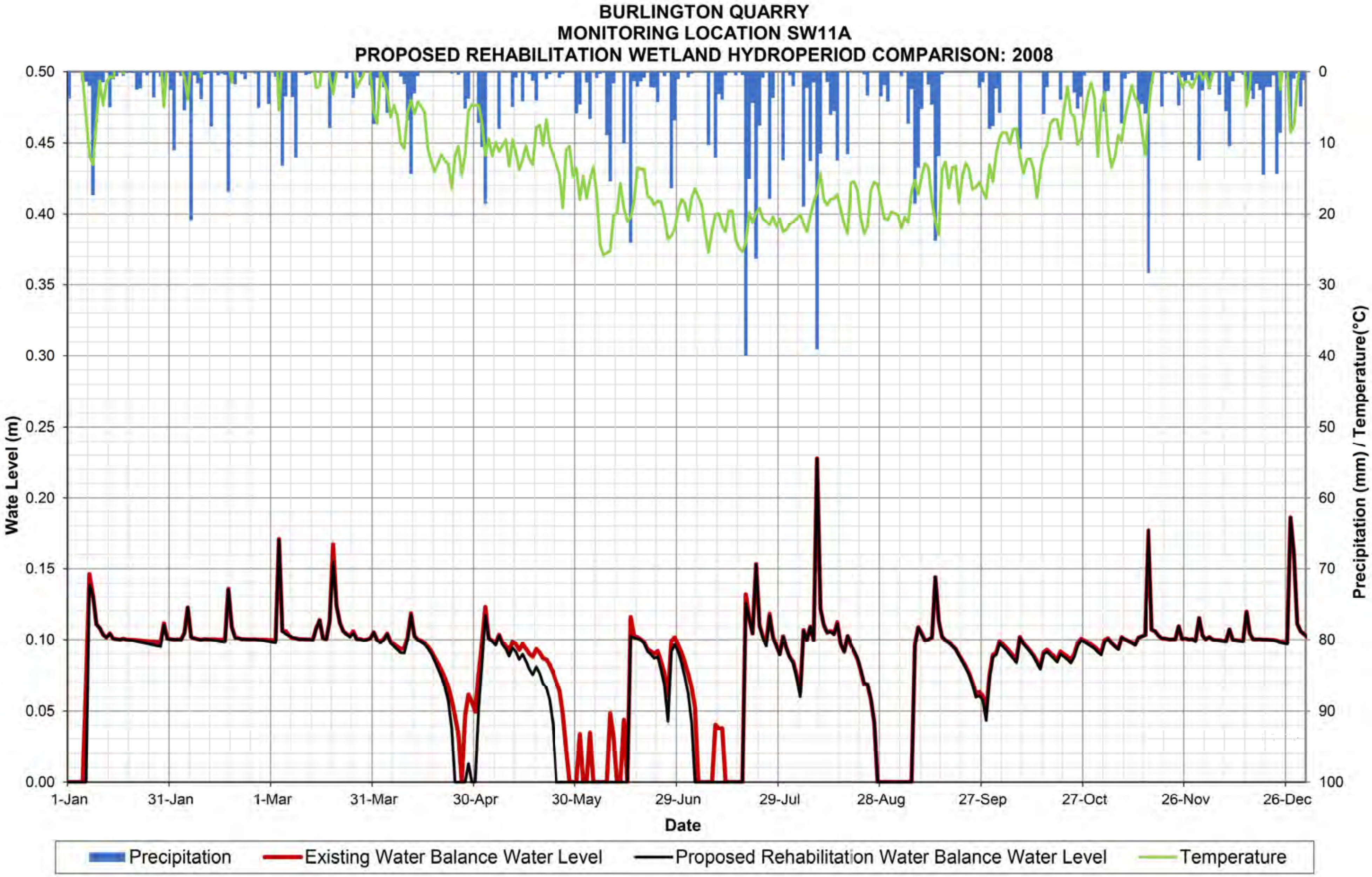
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2004
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

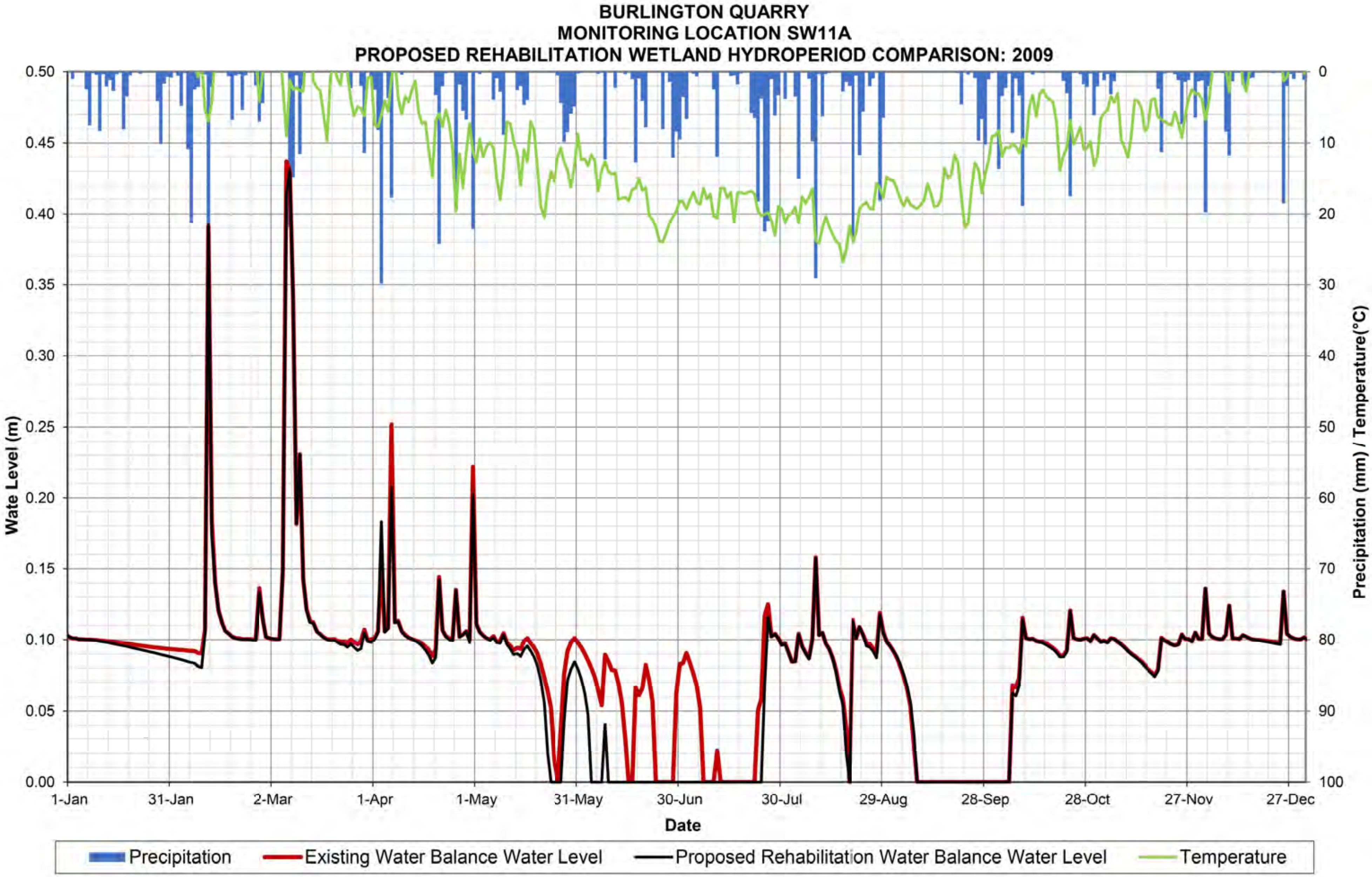

BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2005
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0
10
20
30
40
50
60
70
80
90
100
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2006
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2007

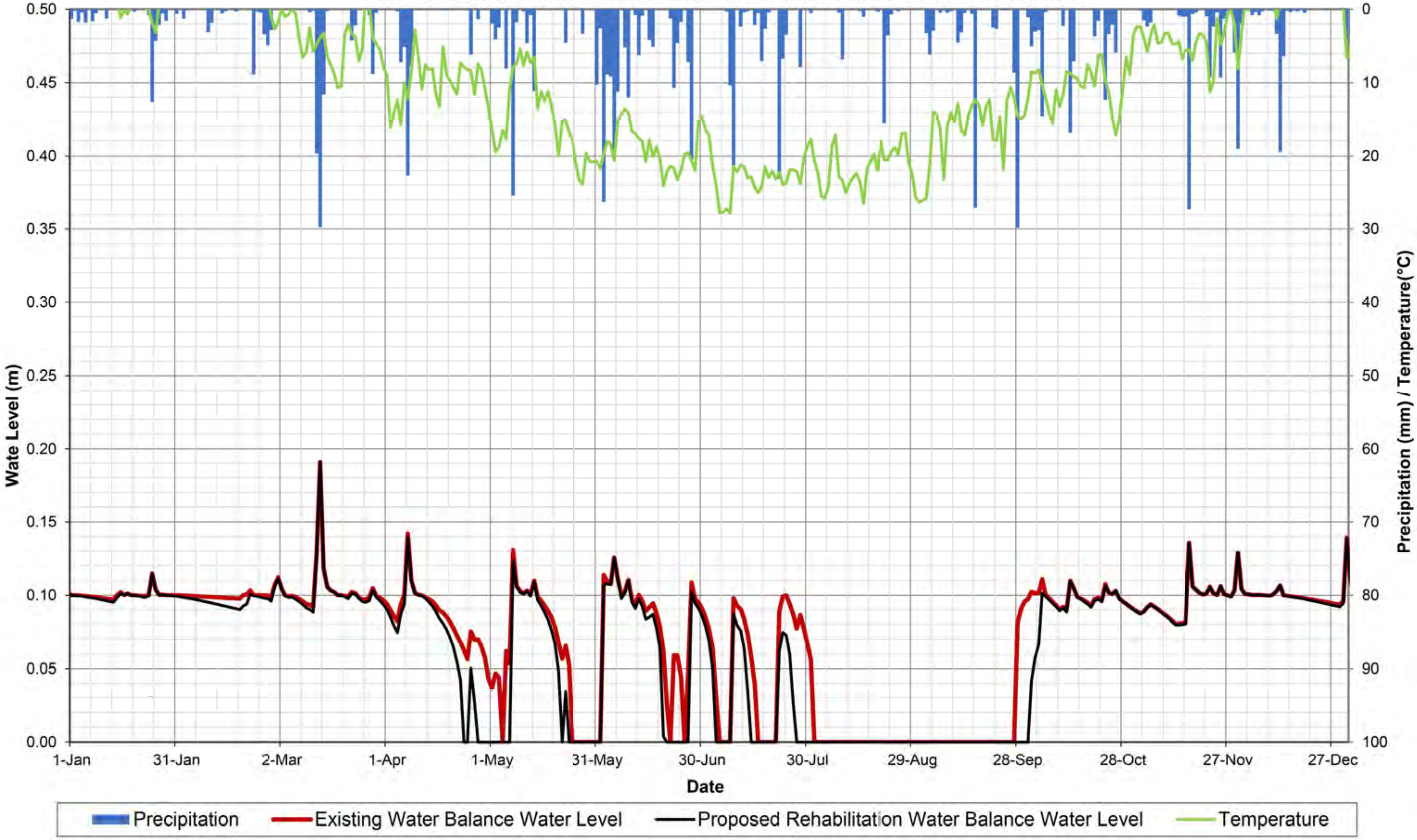


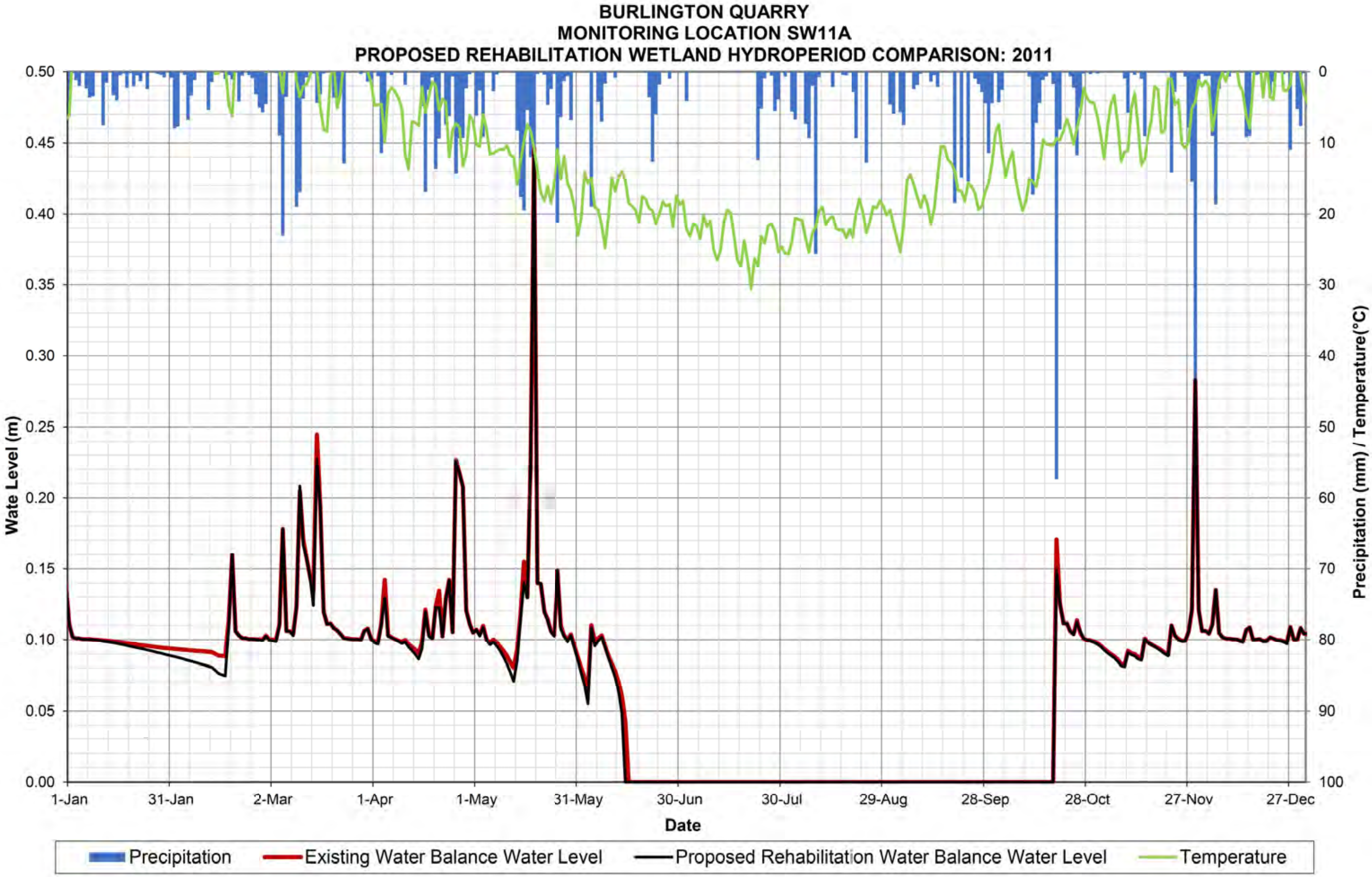

BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2008
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



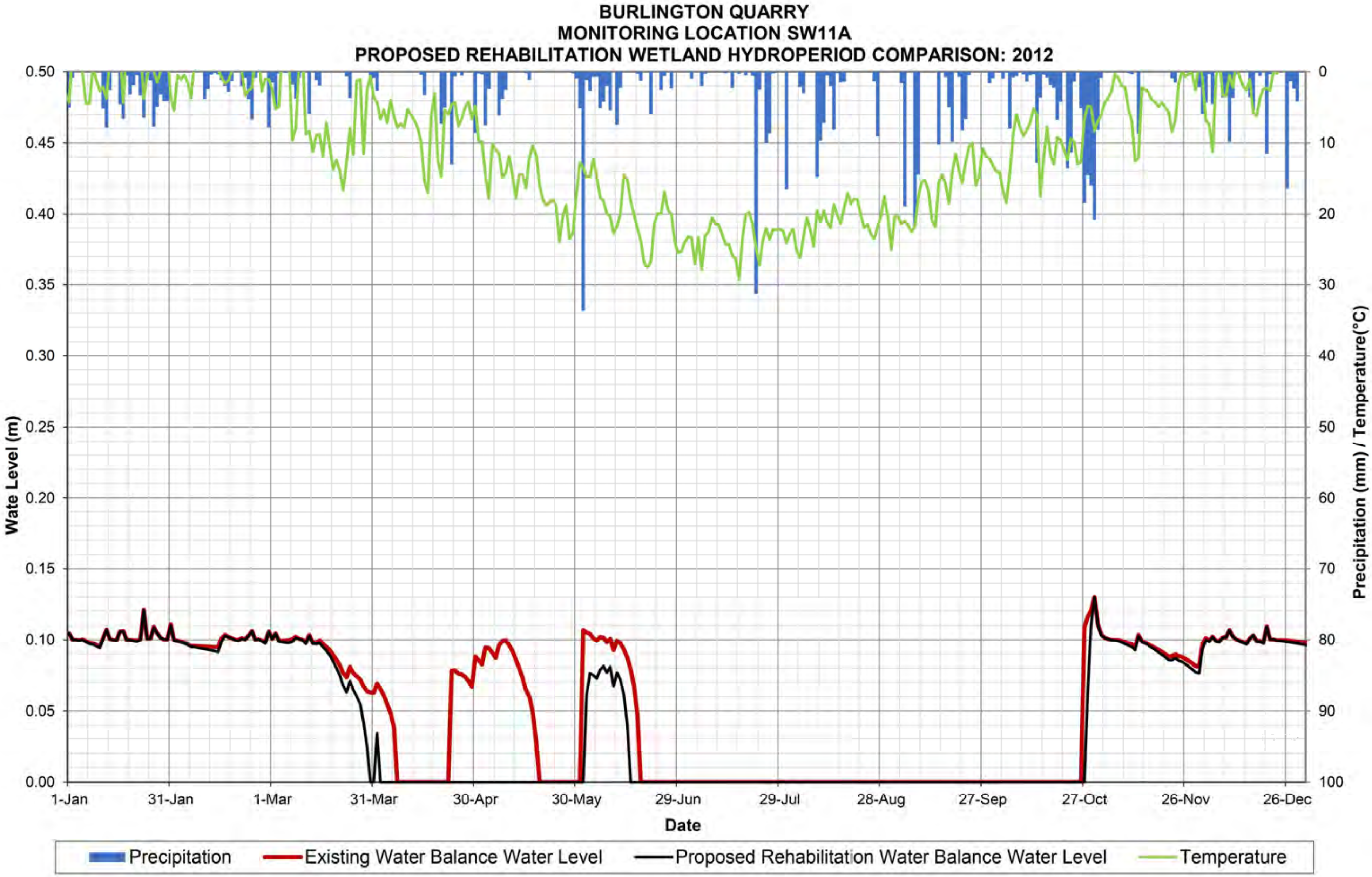
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2009
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2010

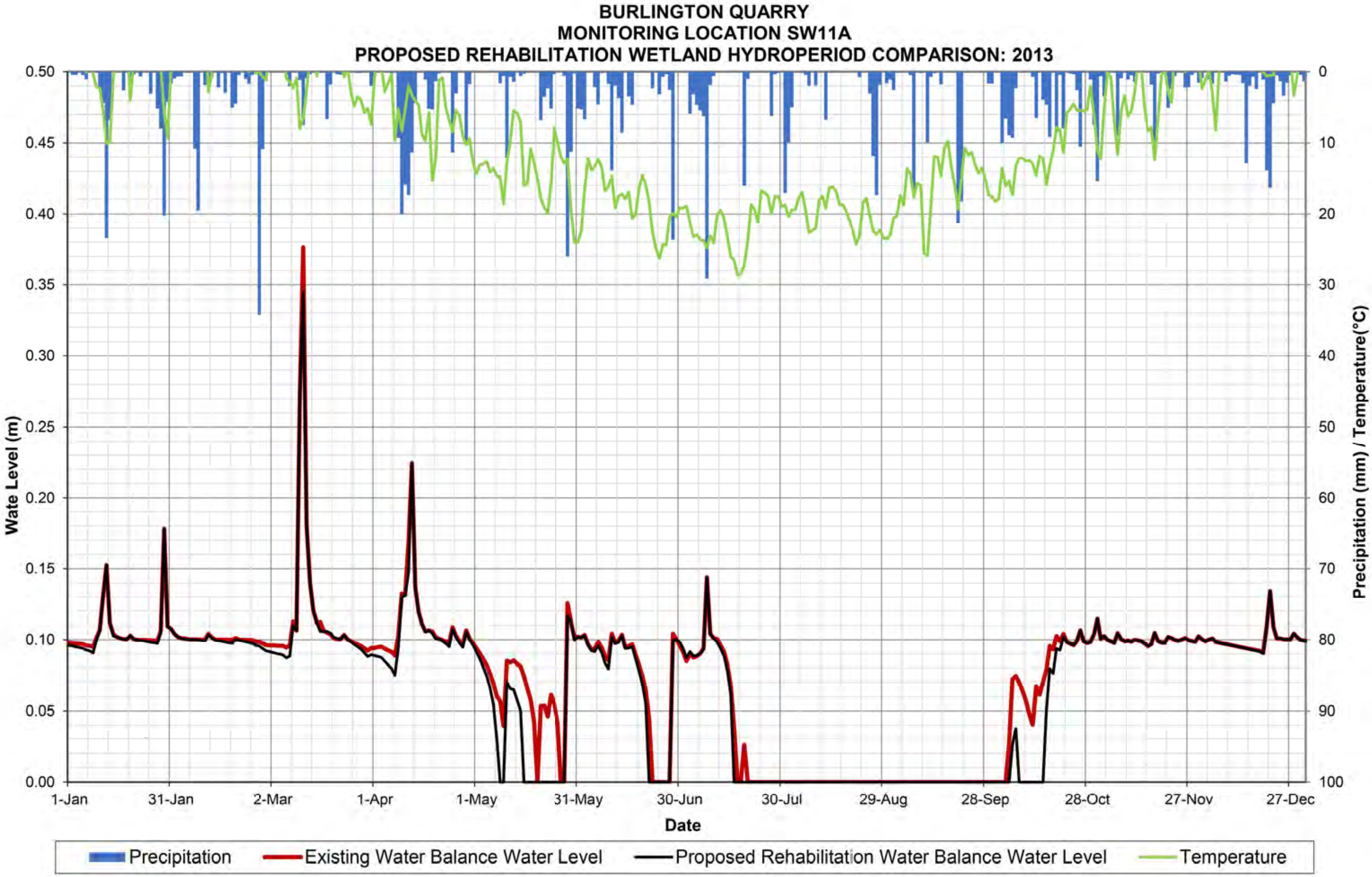


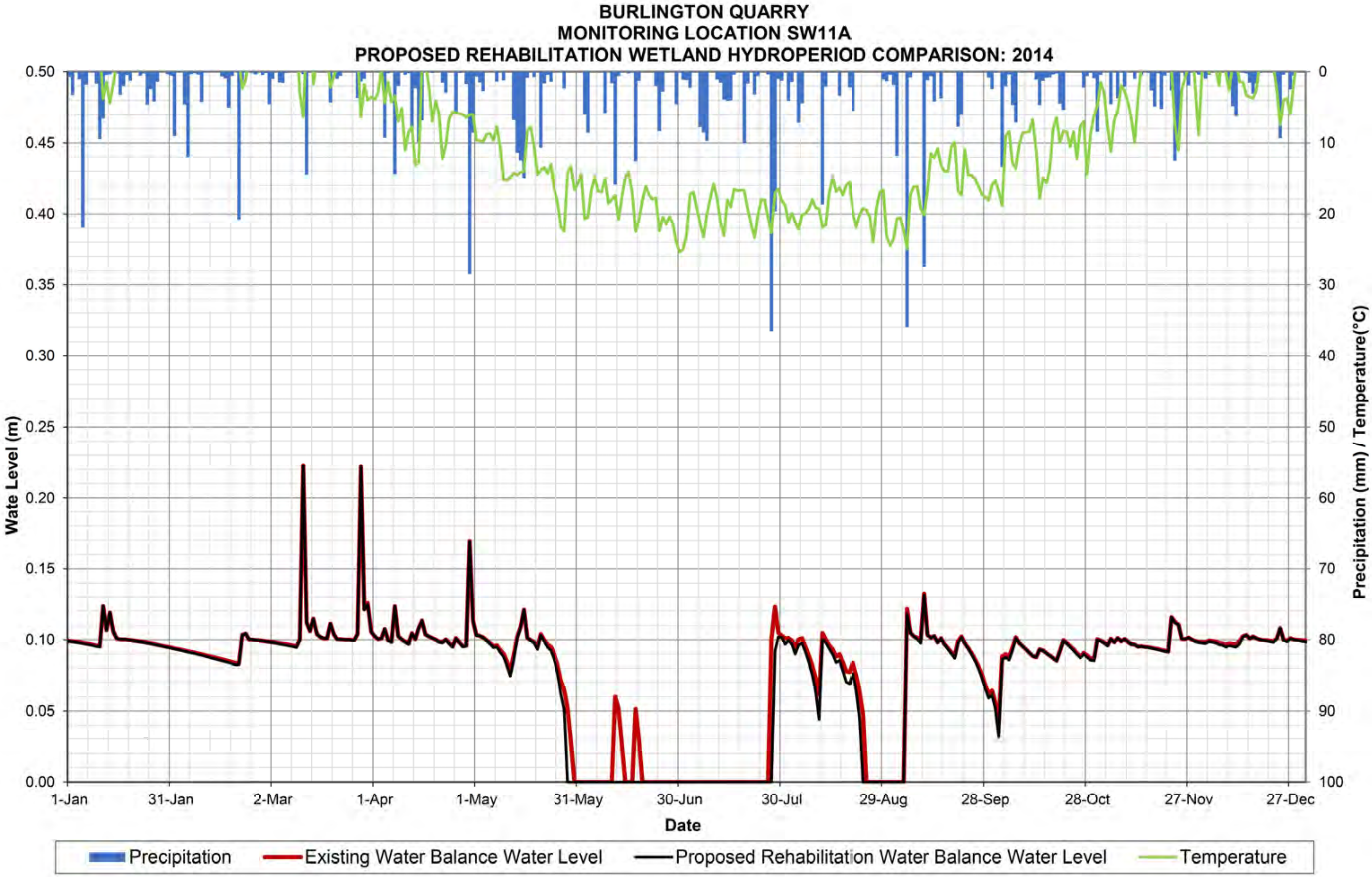


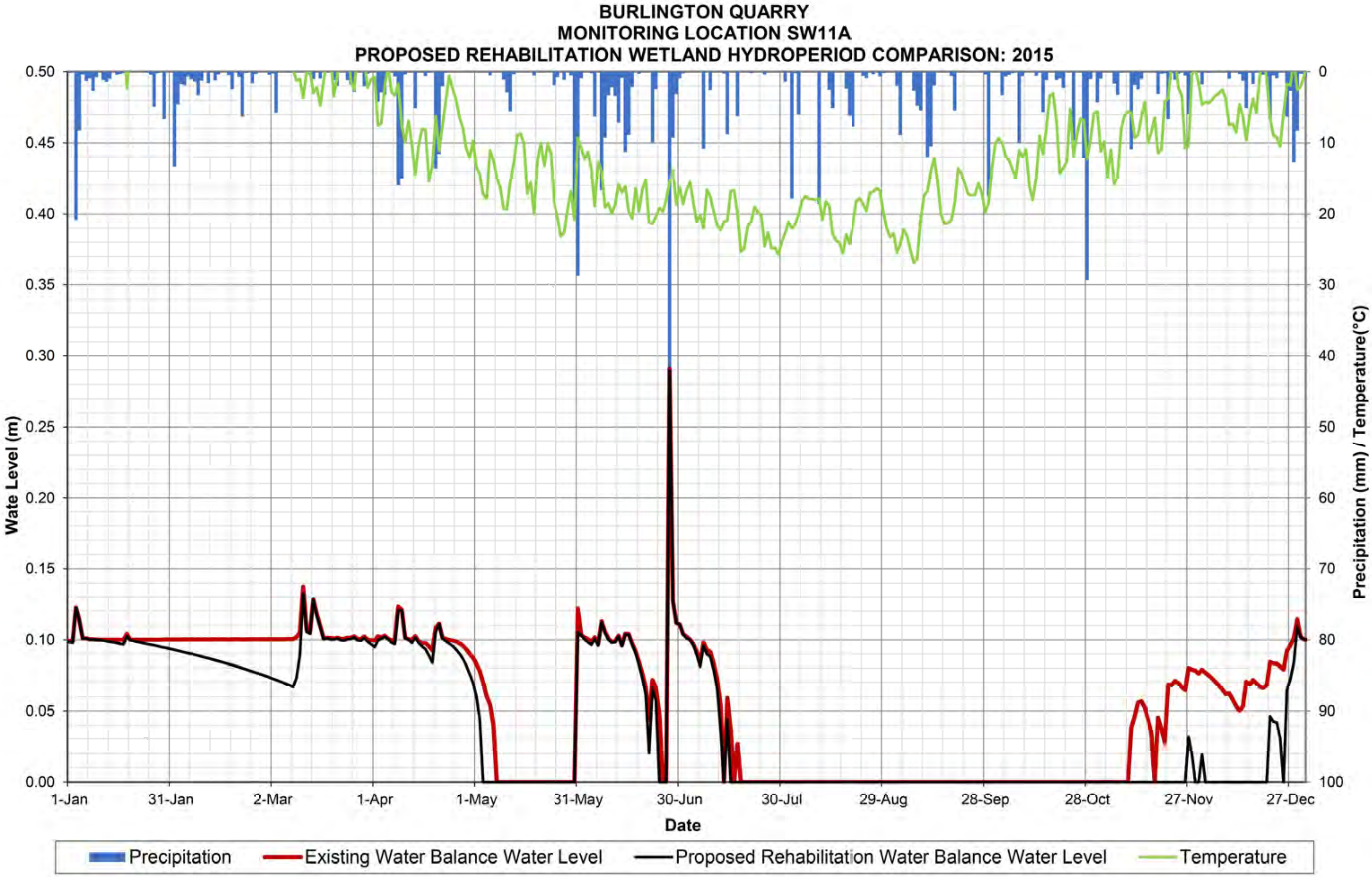
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2011
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



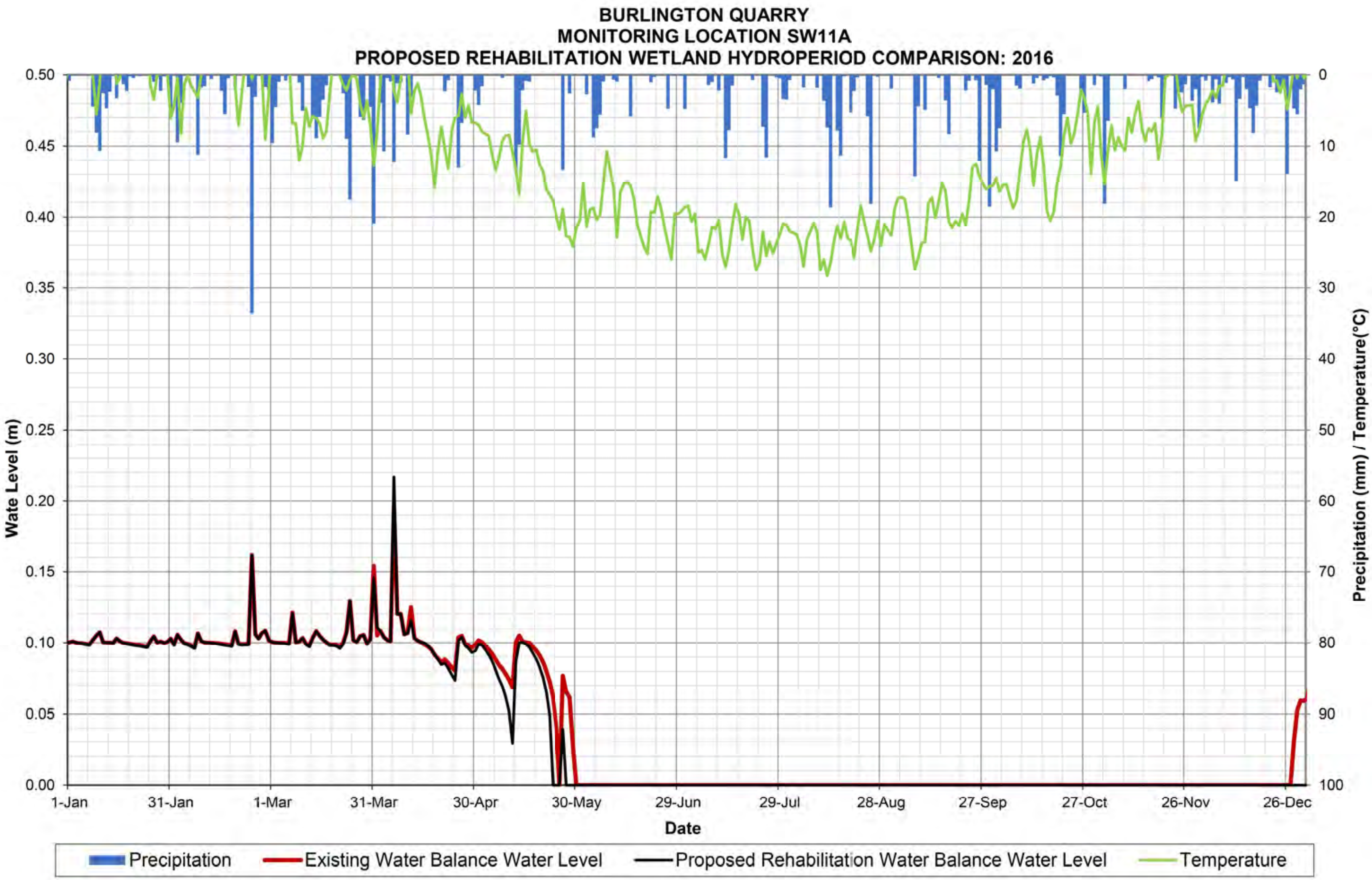
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2012
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

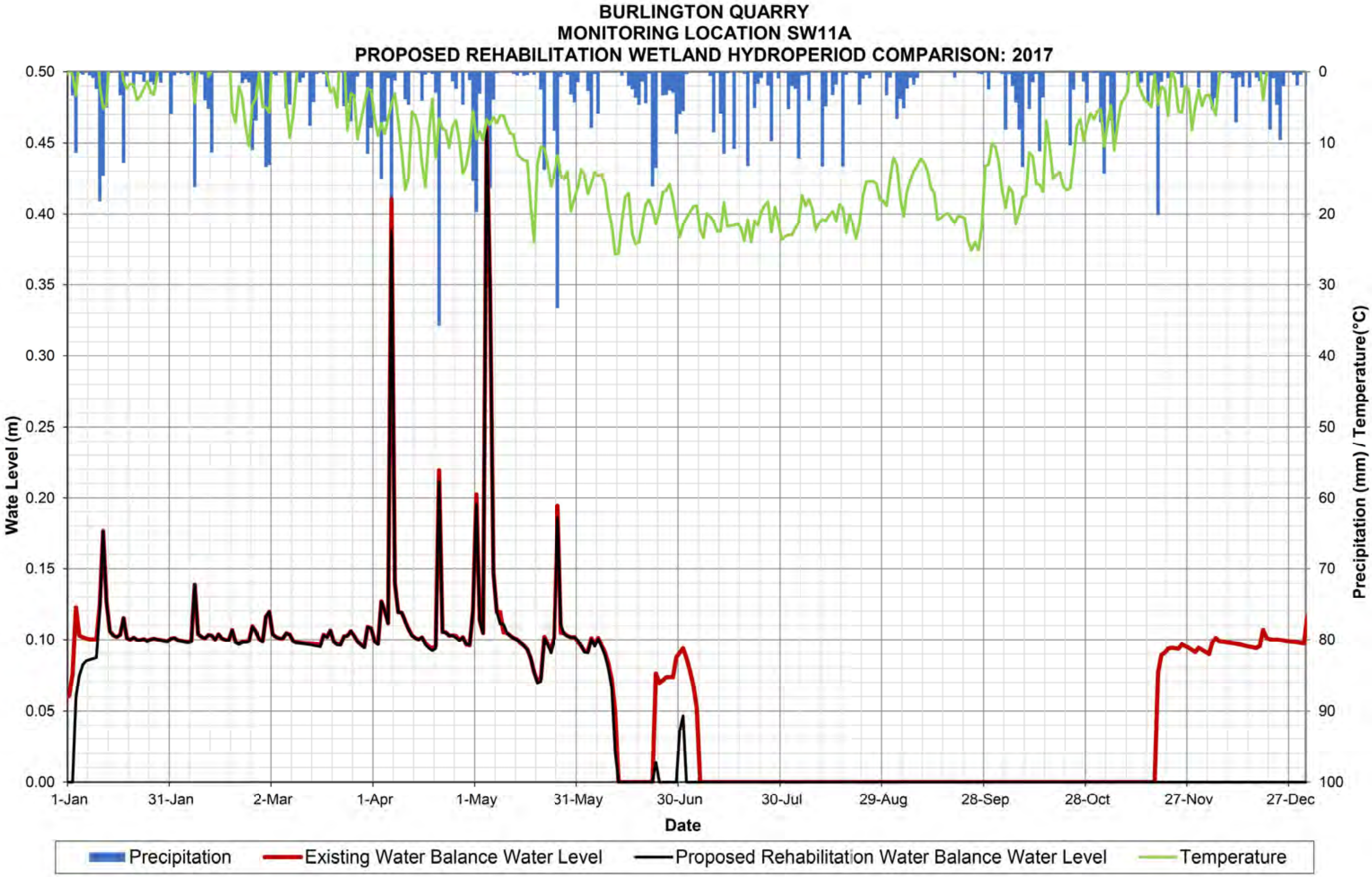

BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2013
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2014
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

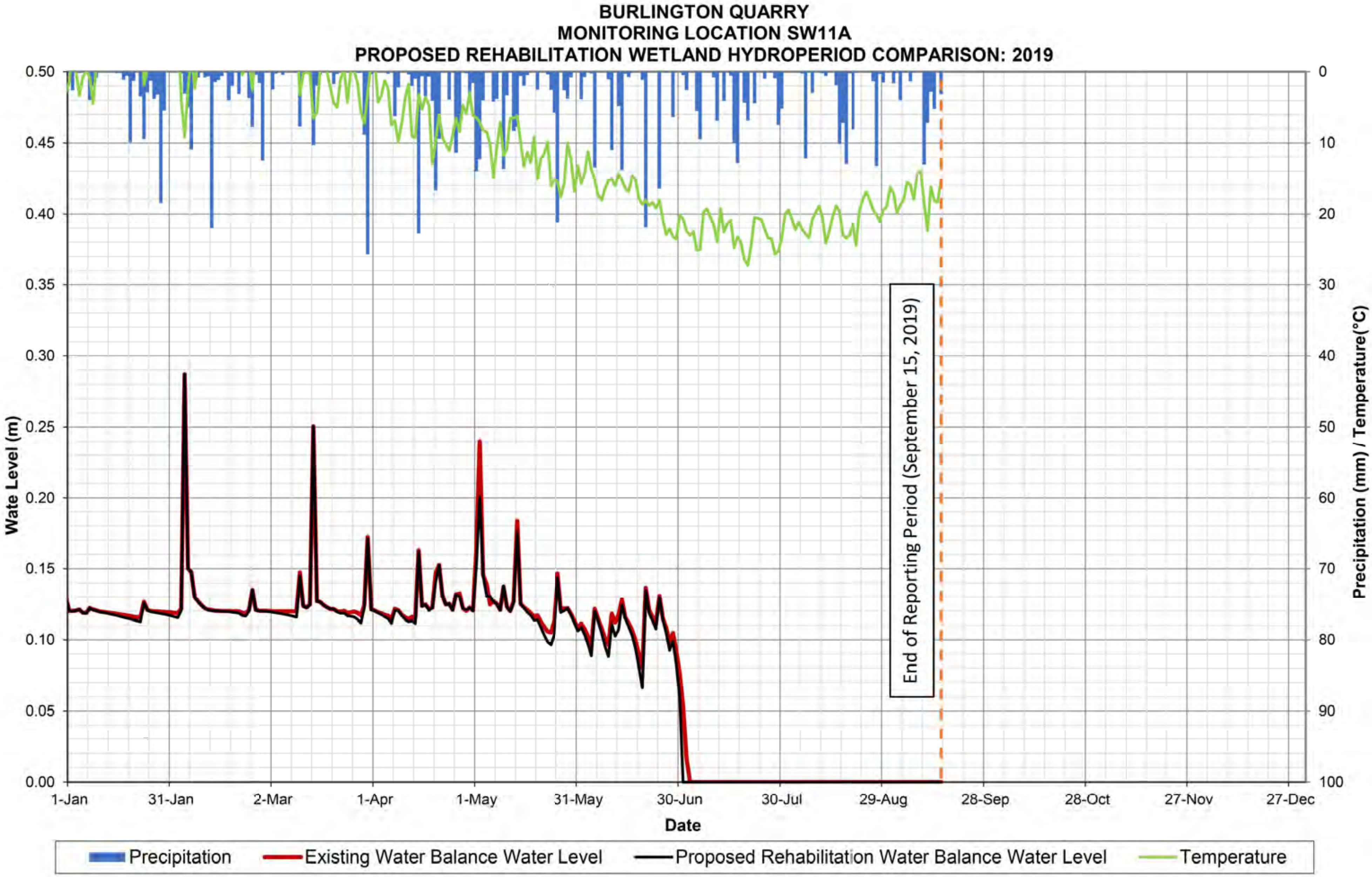


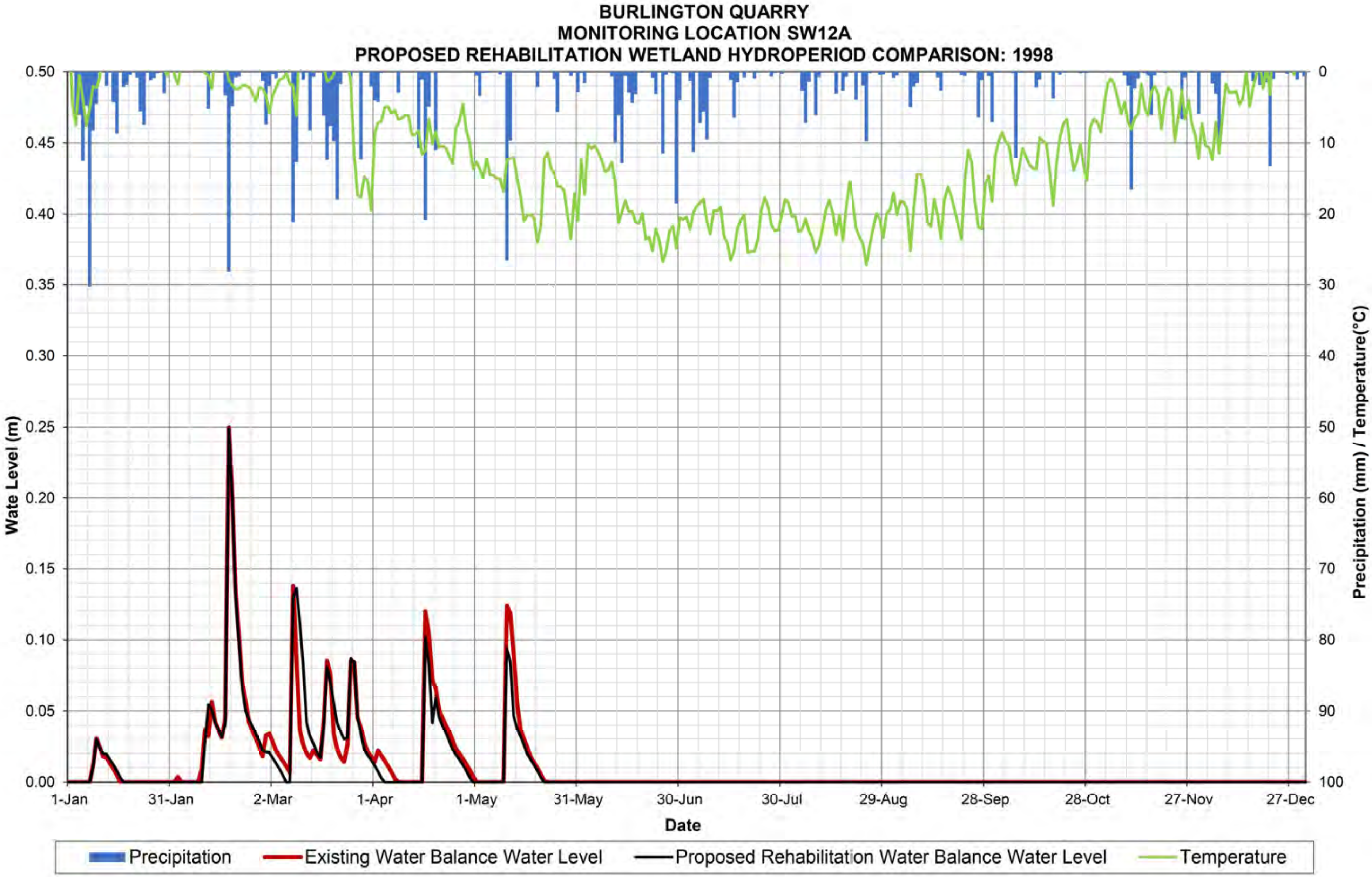
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2015
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

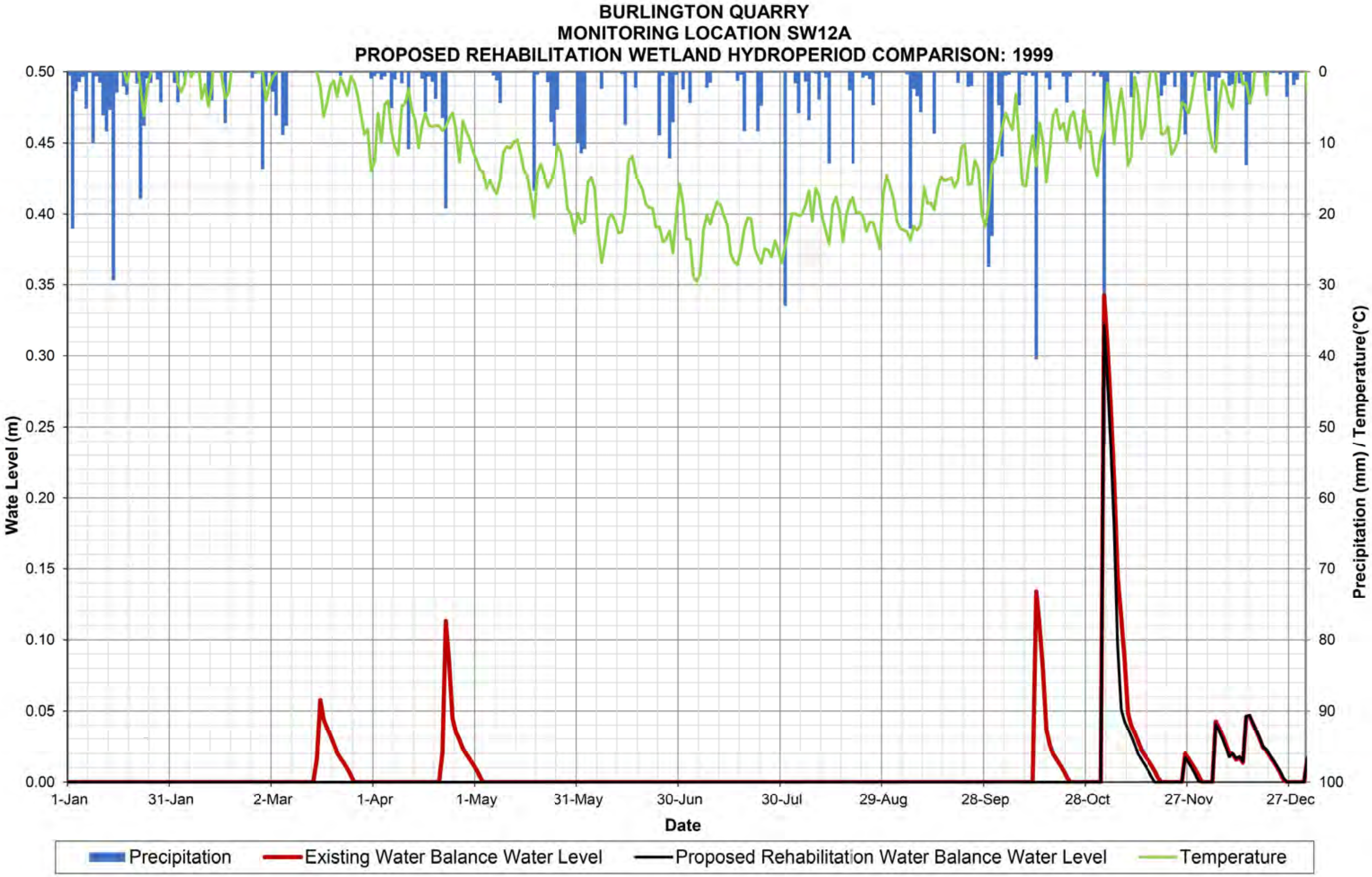

BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2016
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2017
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

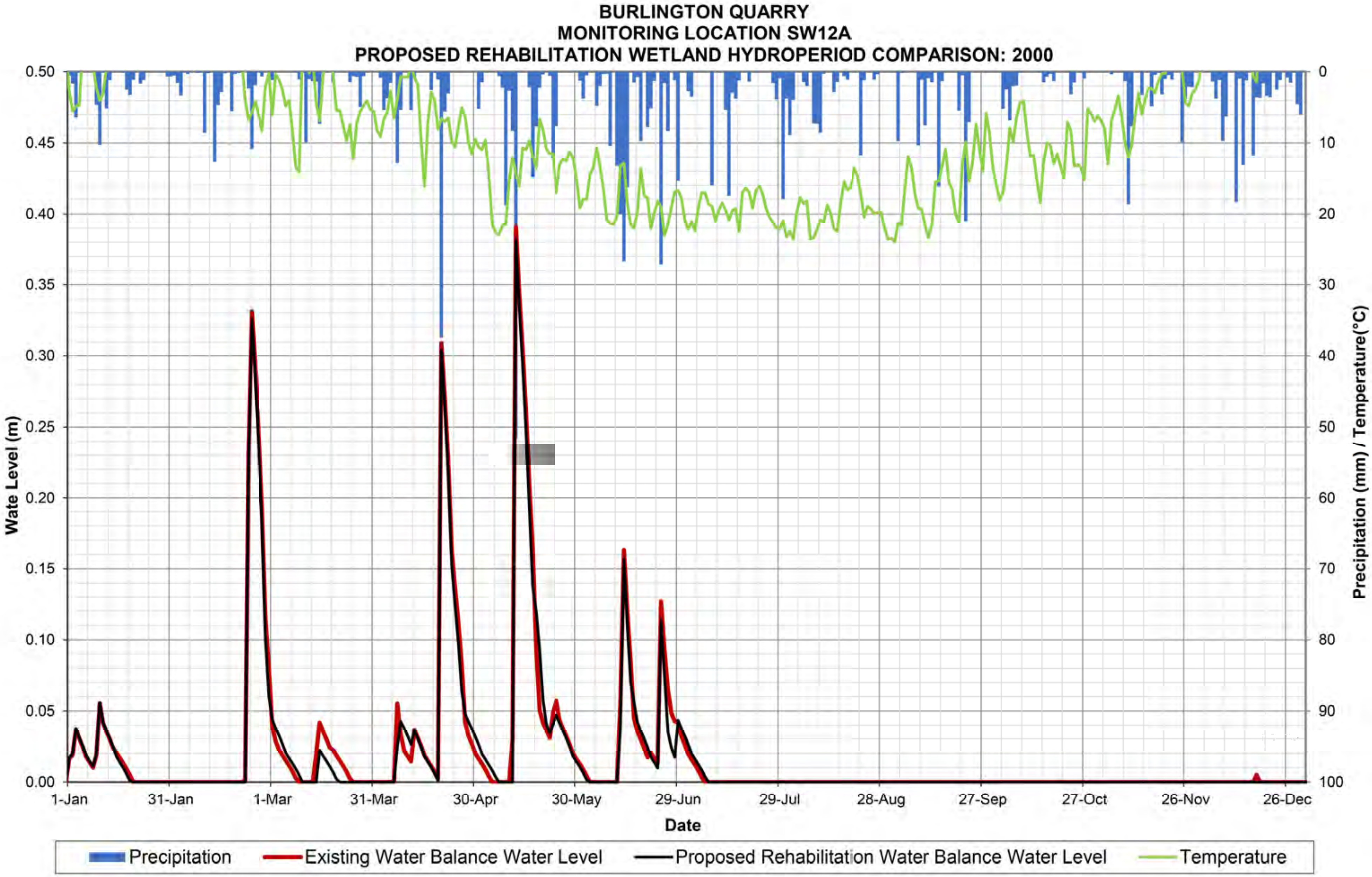
BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2018


BURLINGTON QUARRY
MONITORING LOCATION SW11A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2019
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
End of Reporting Period (September 15, 2019)
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

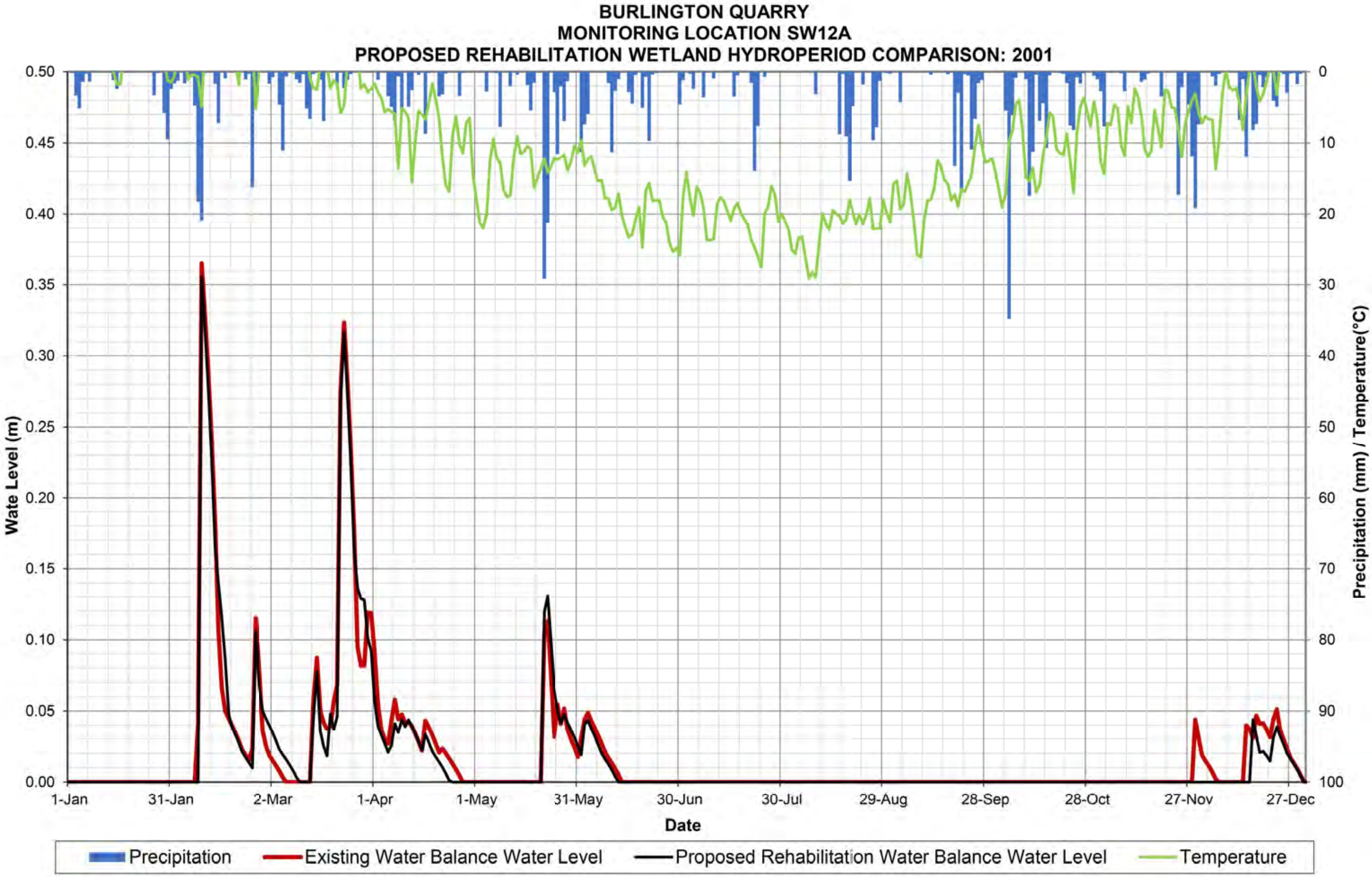

BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 1998
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



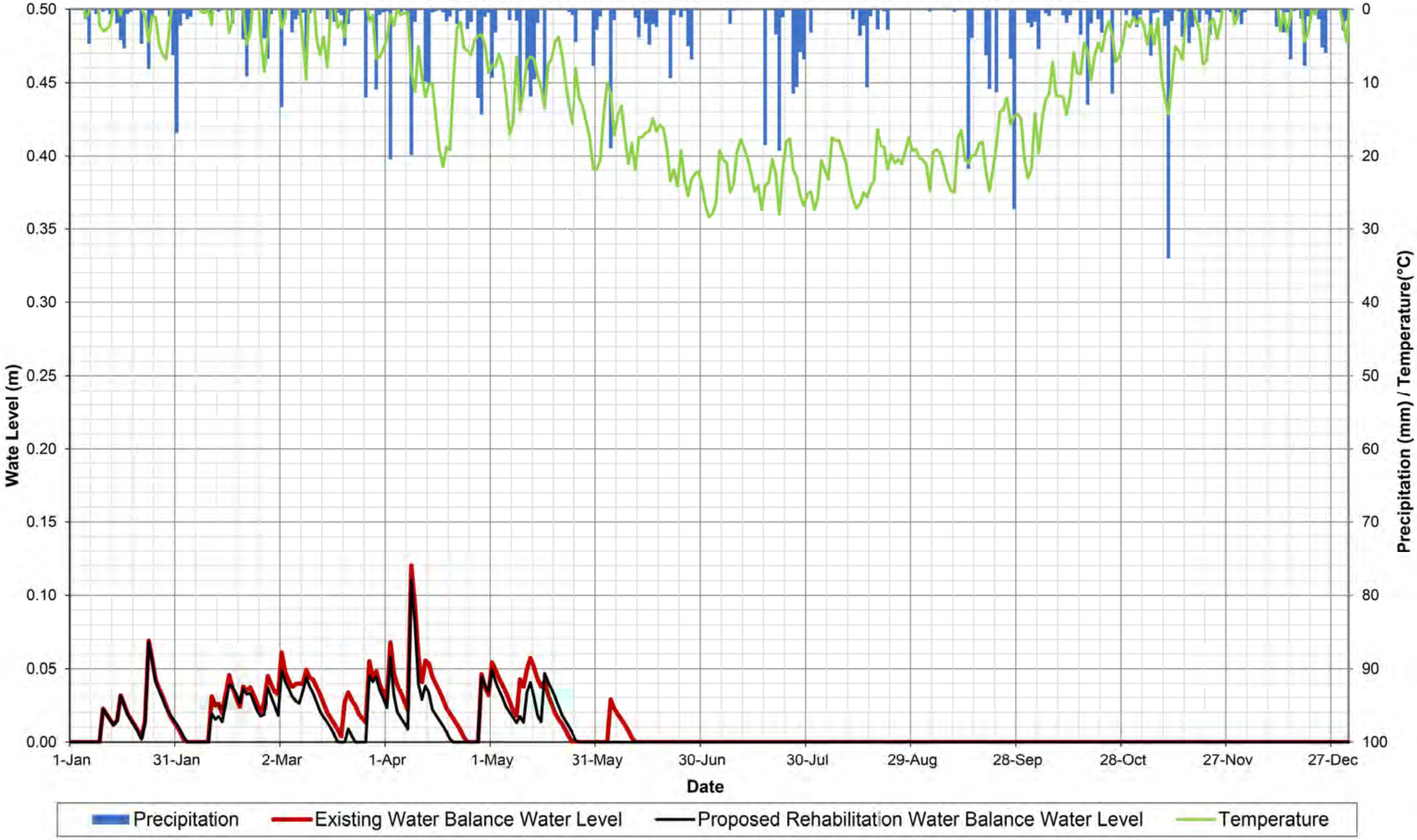
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 1999
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

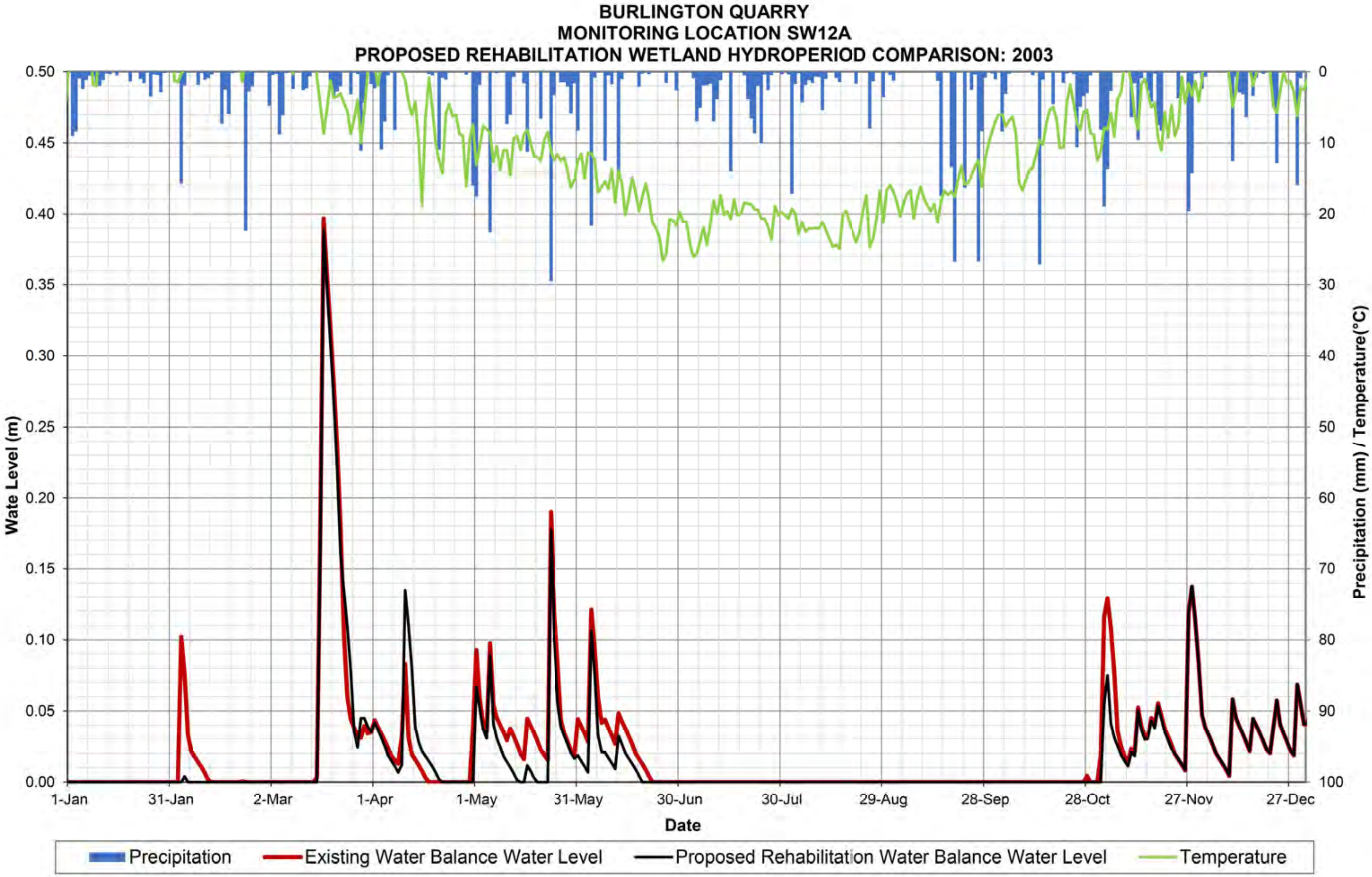


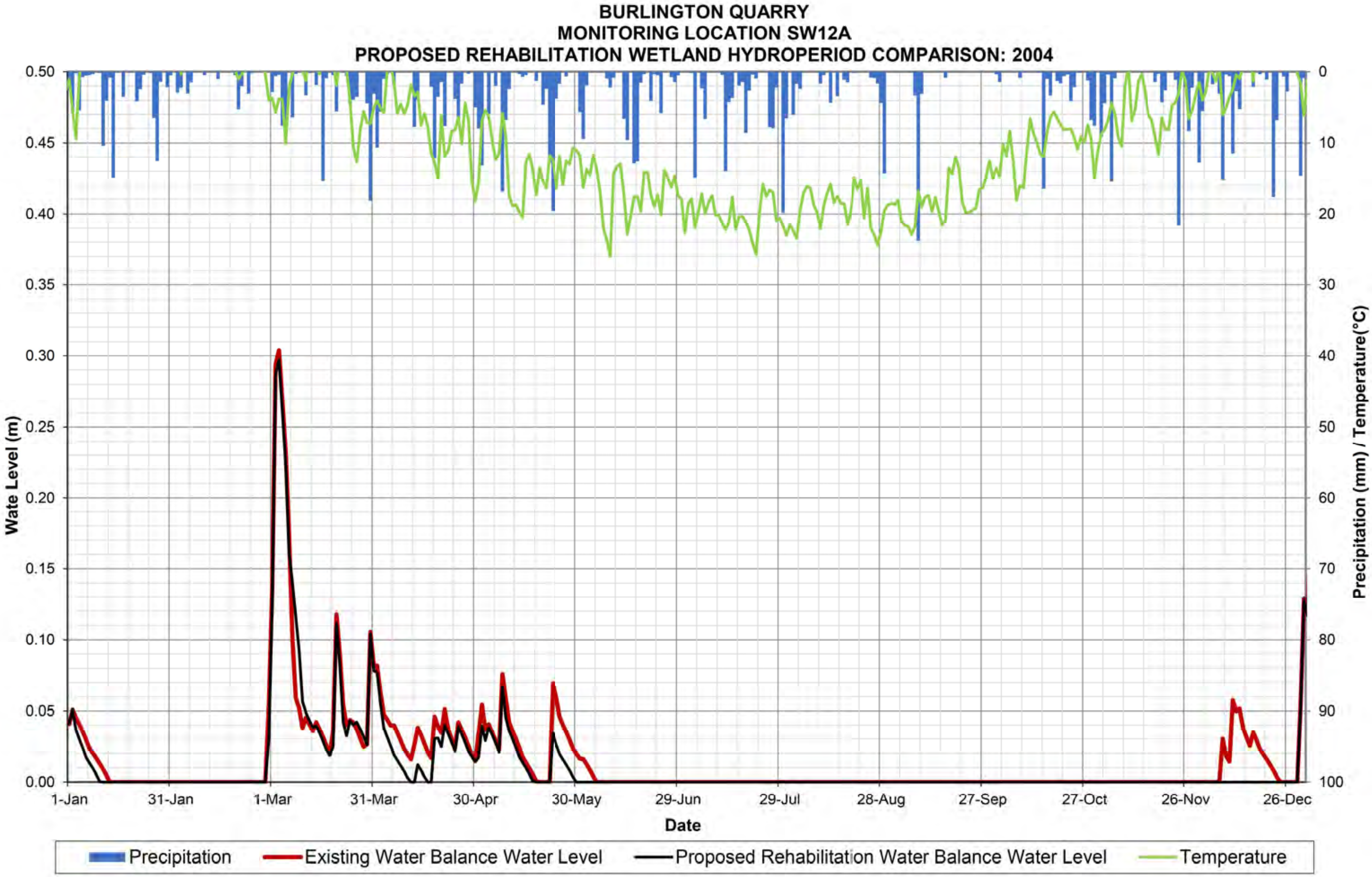
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2000
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2001
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

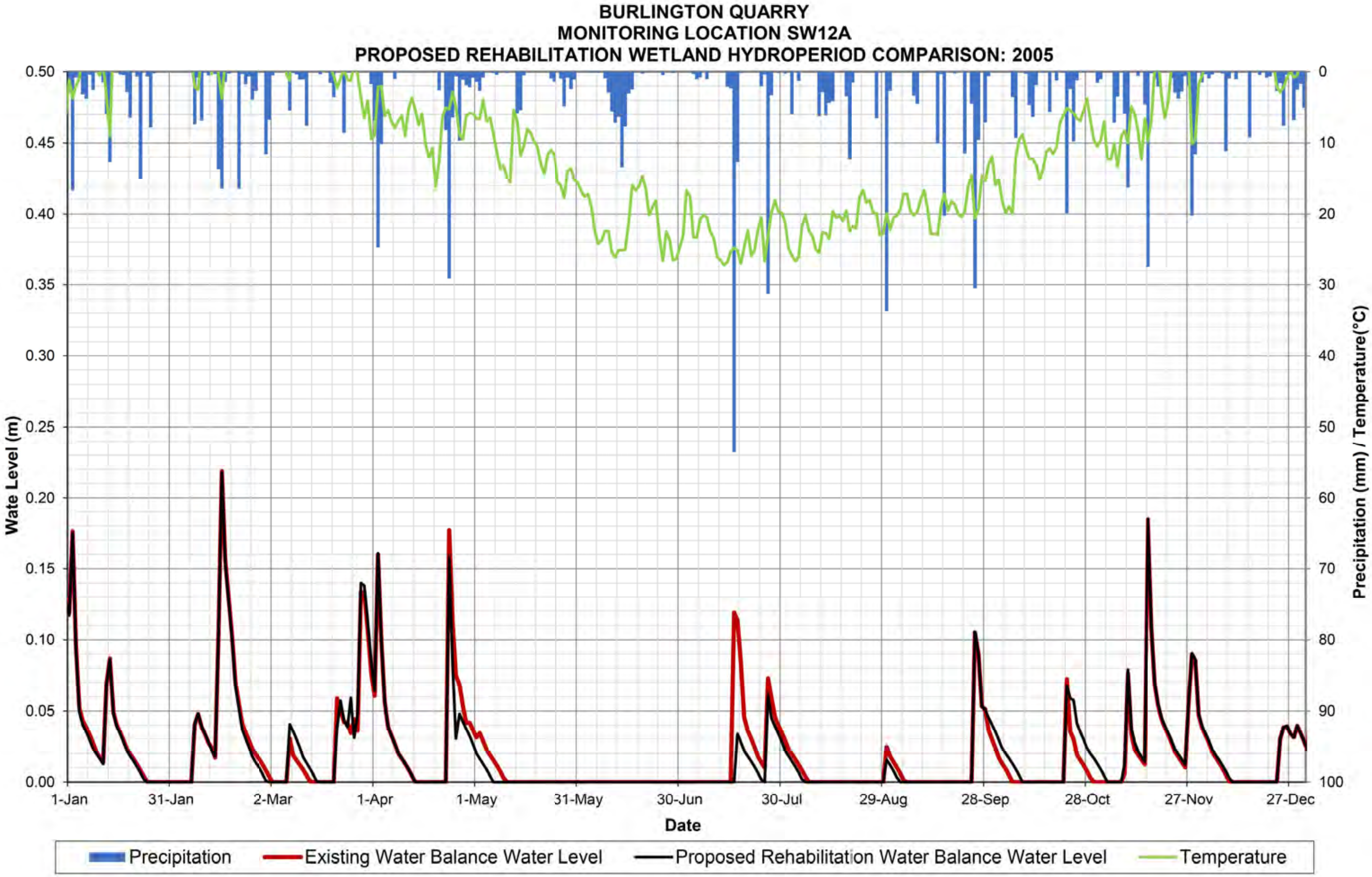
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2002

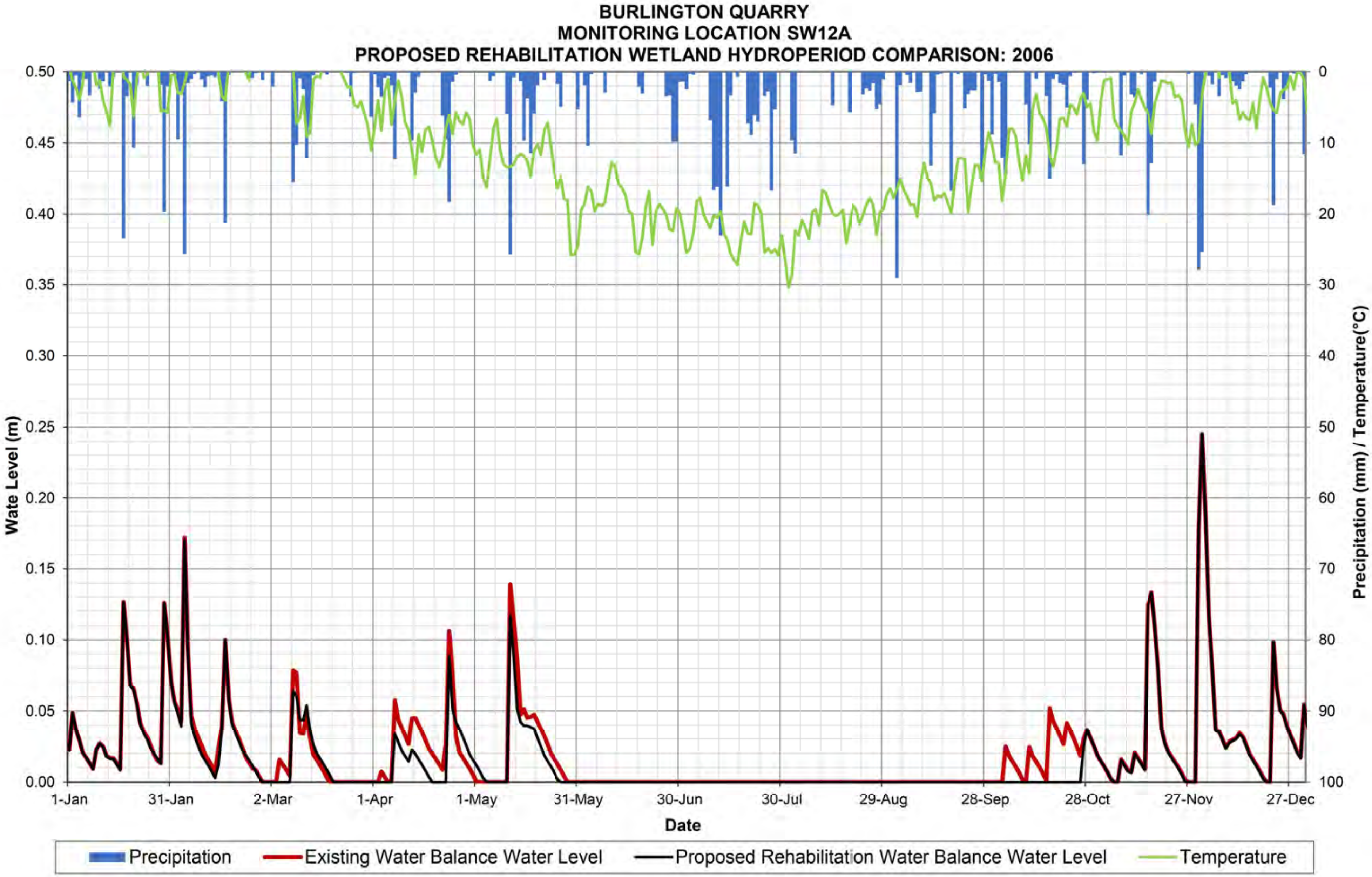


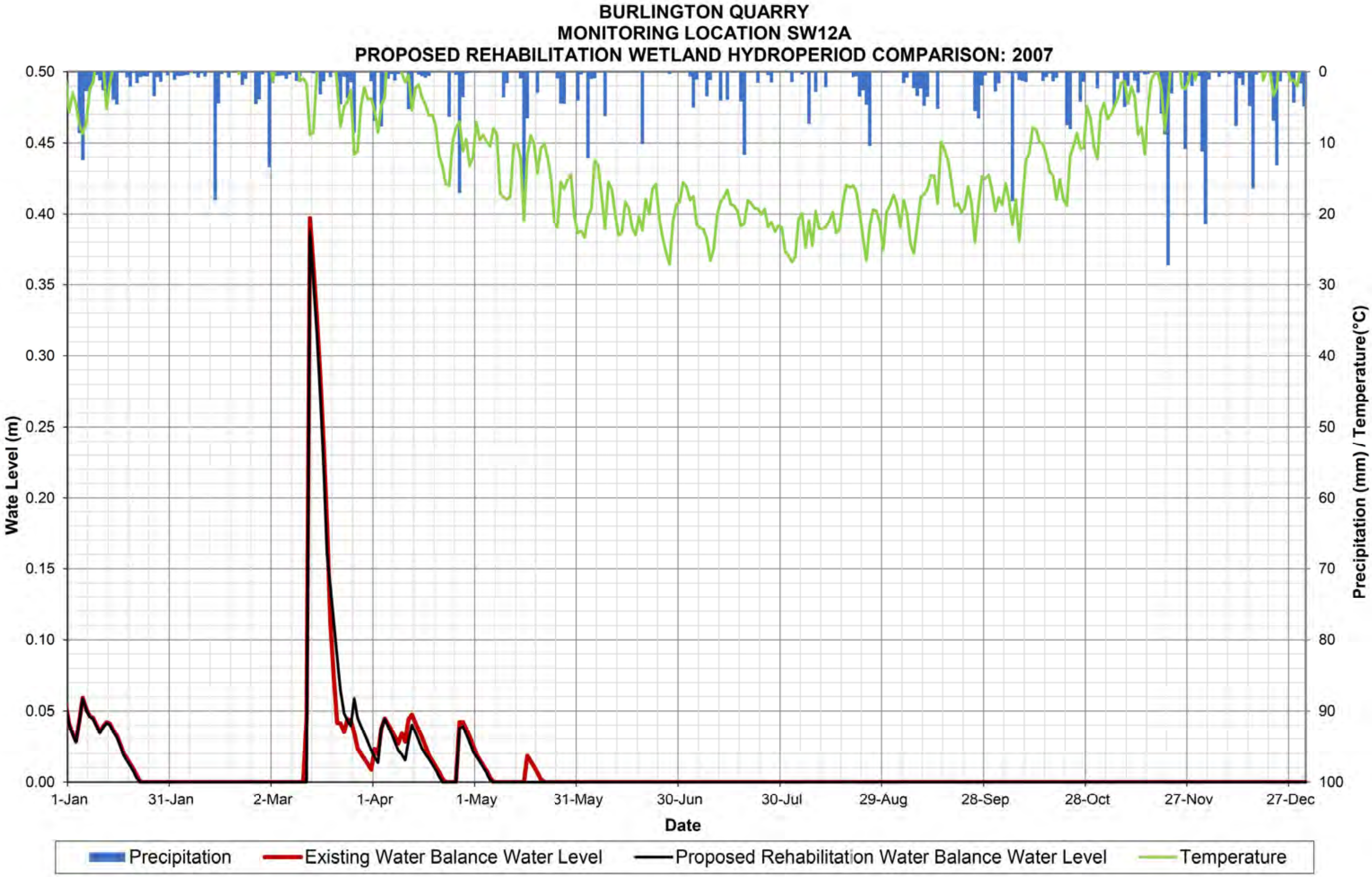

BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2003
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



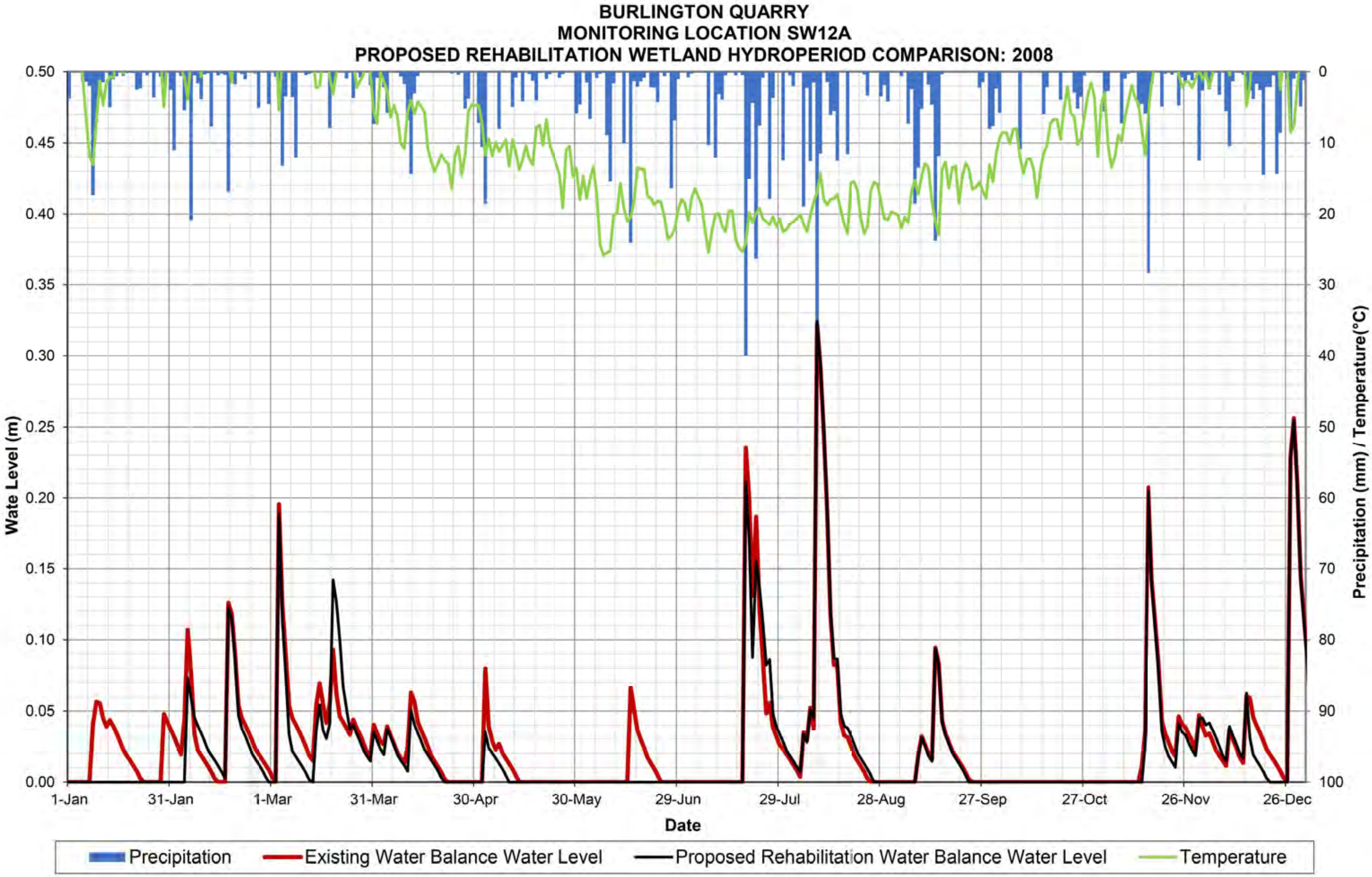
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2004
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2005
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

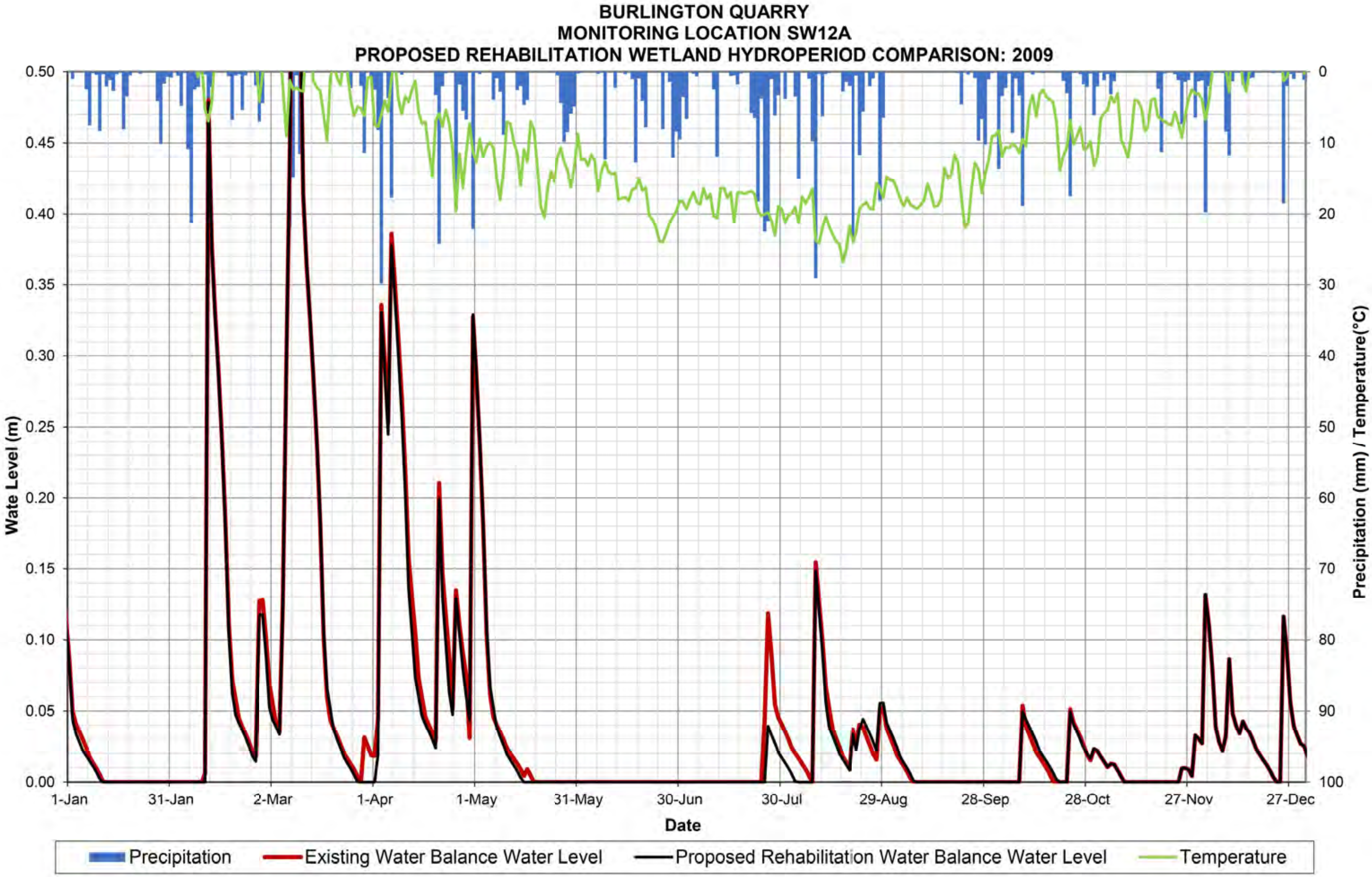

BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2006
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



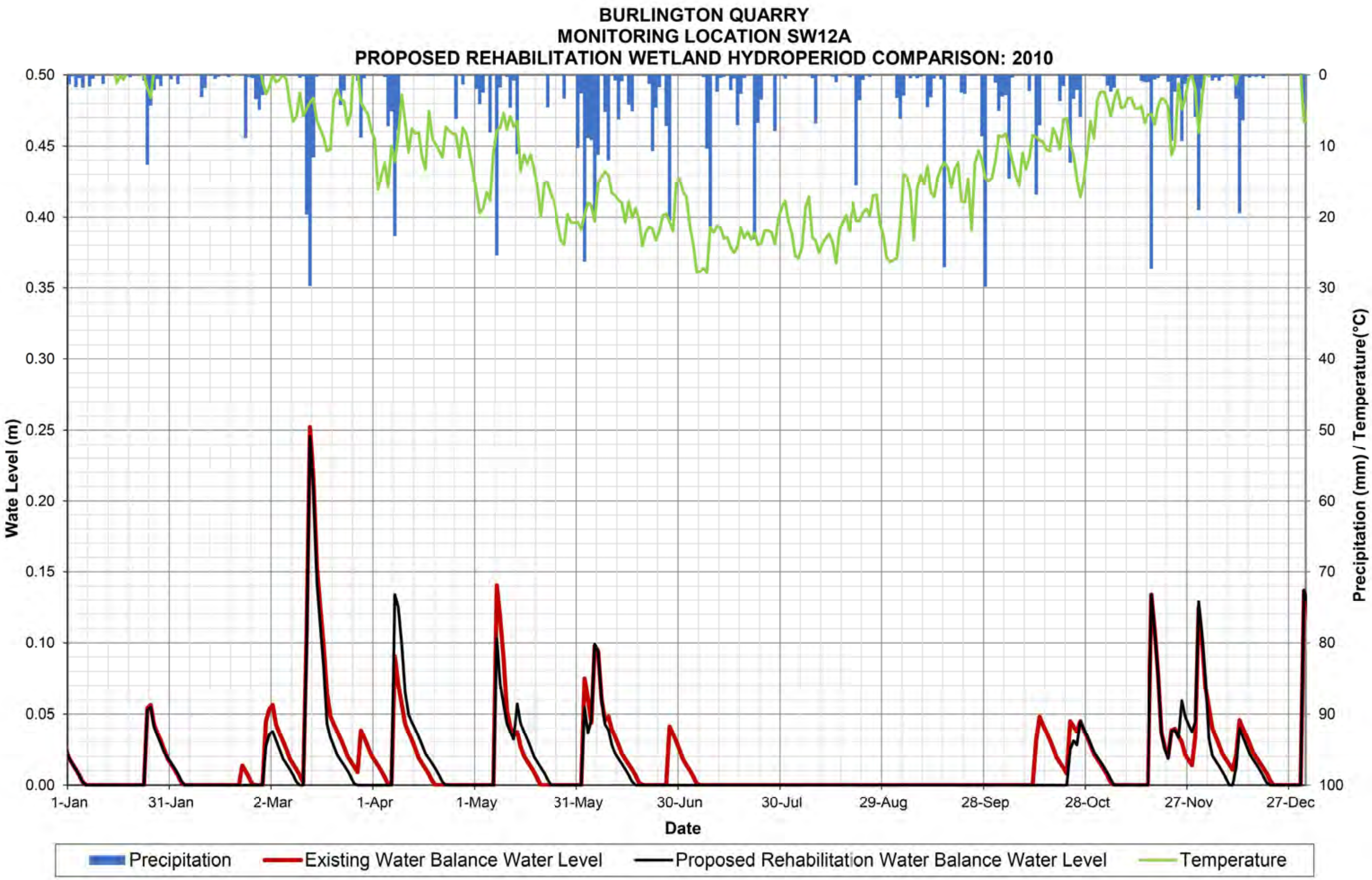
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2007
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



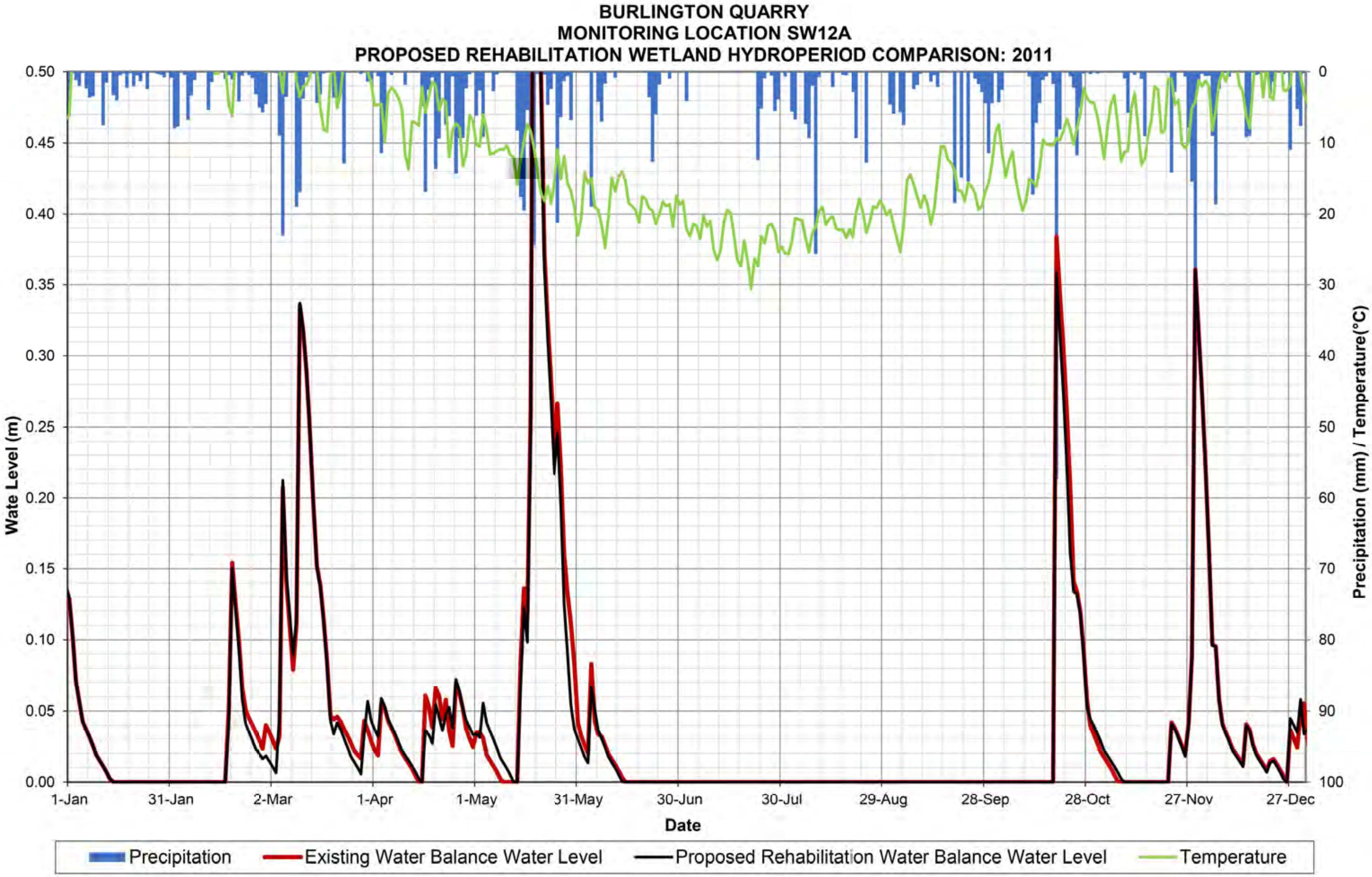
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2008
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



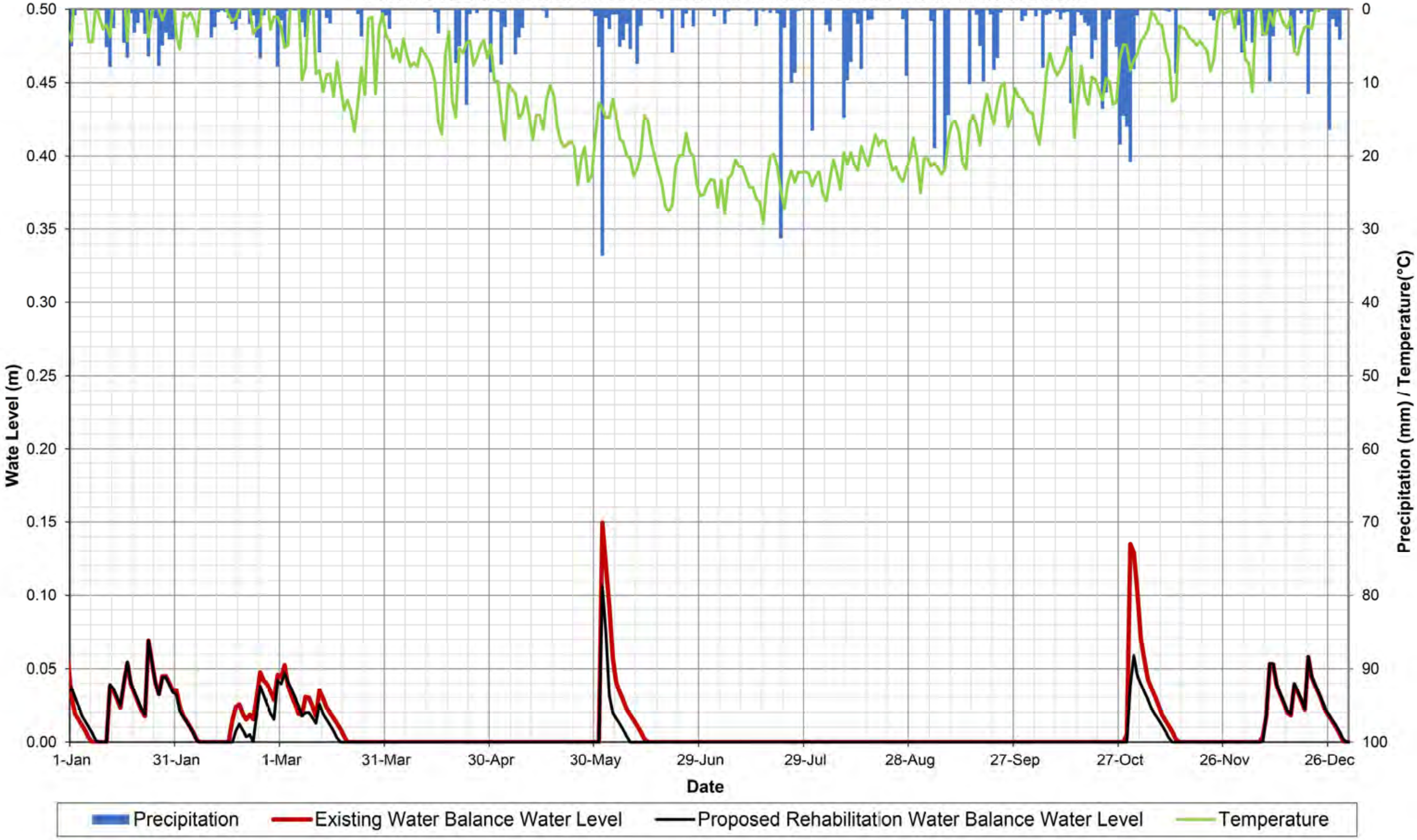
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2009
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

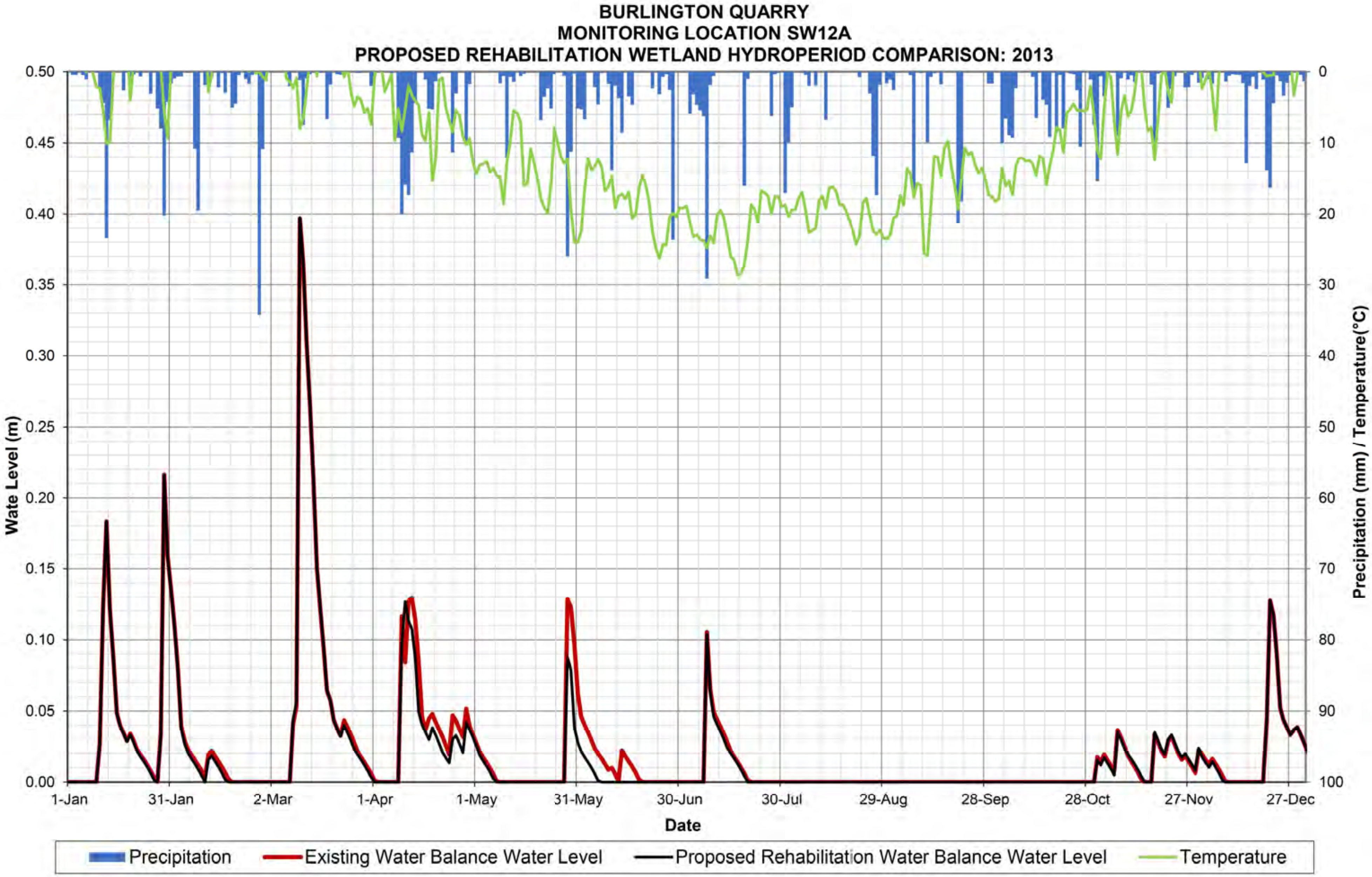


BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2010
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

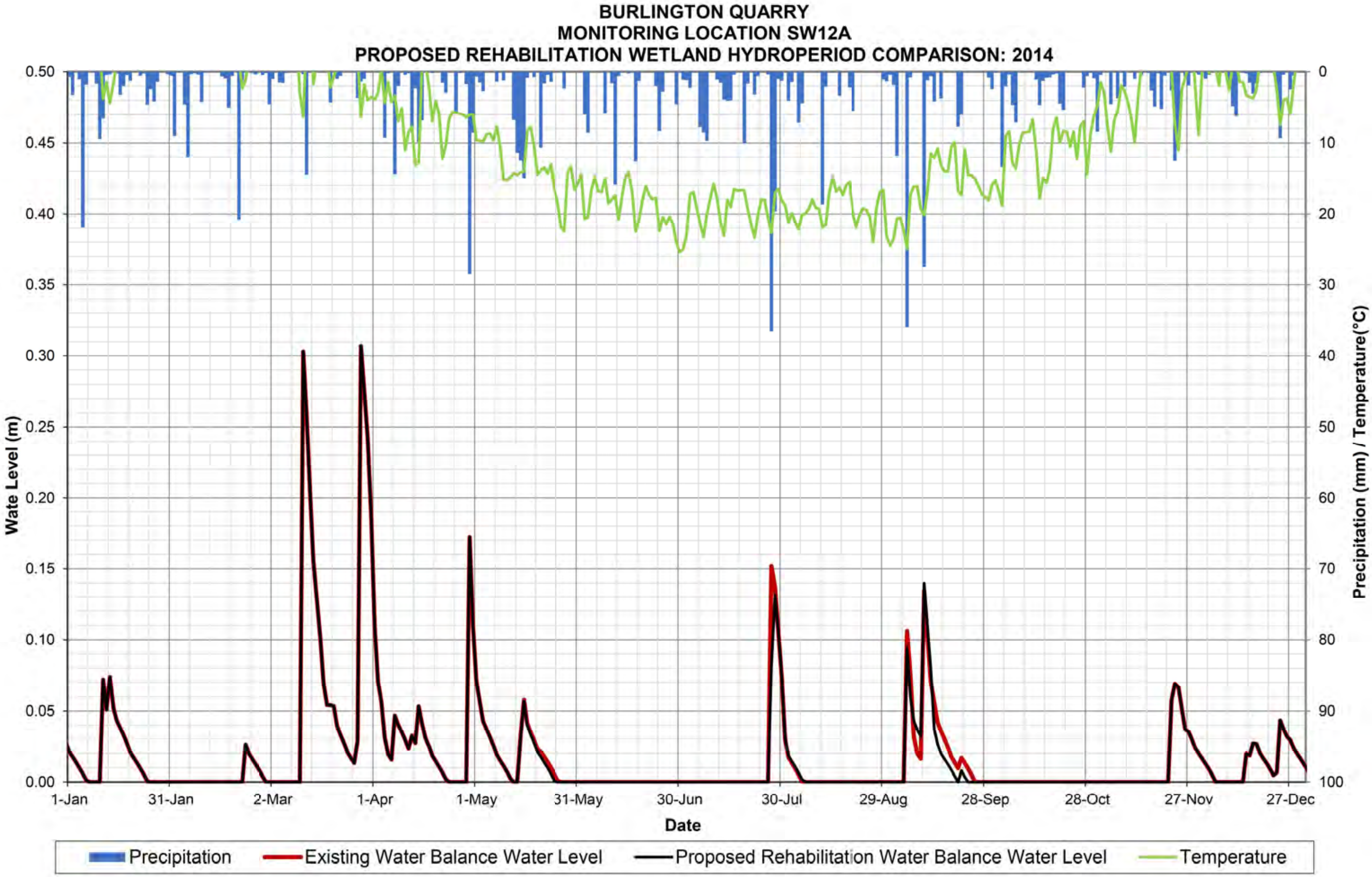

BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2011
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2012

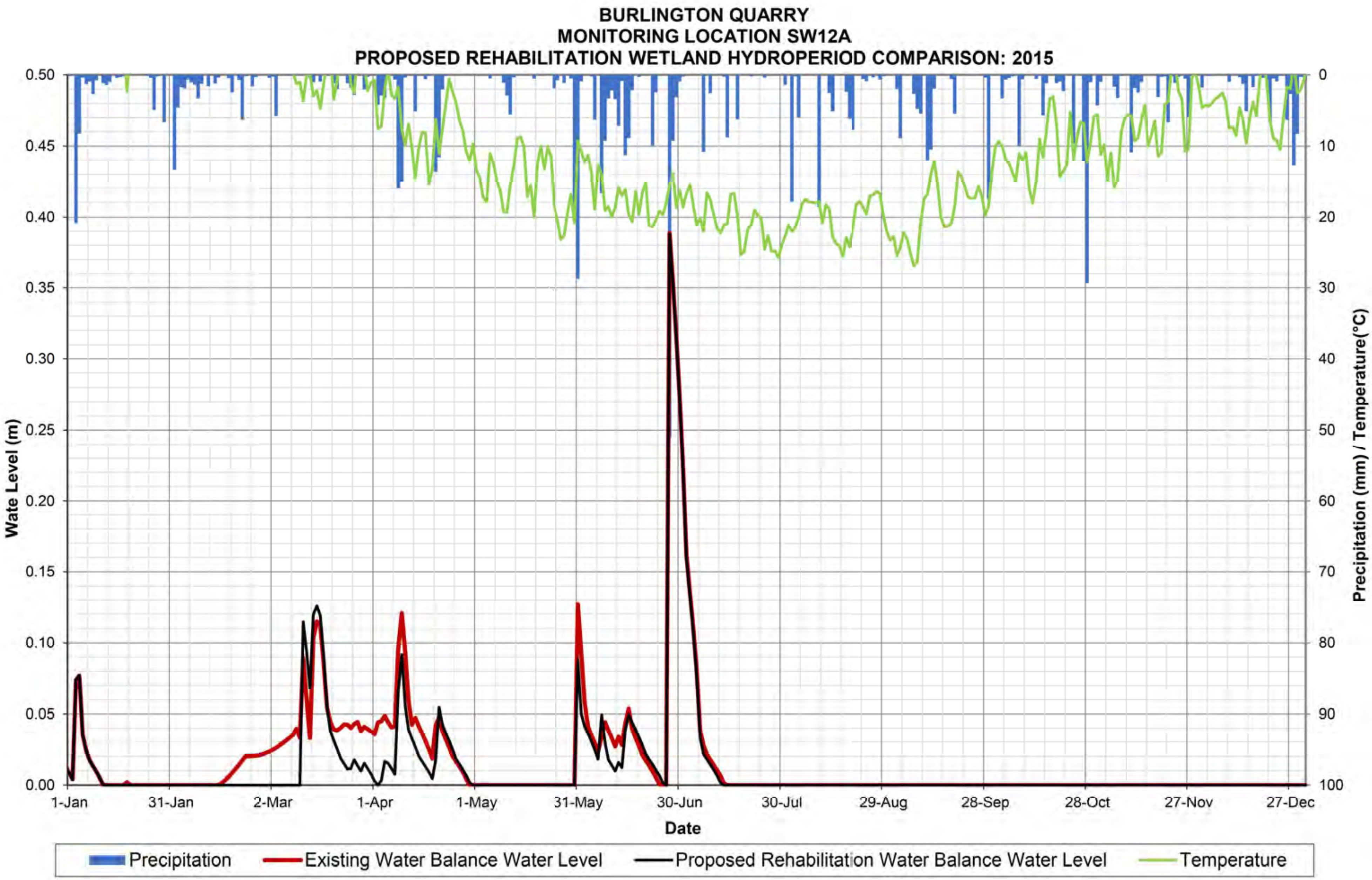


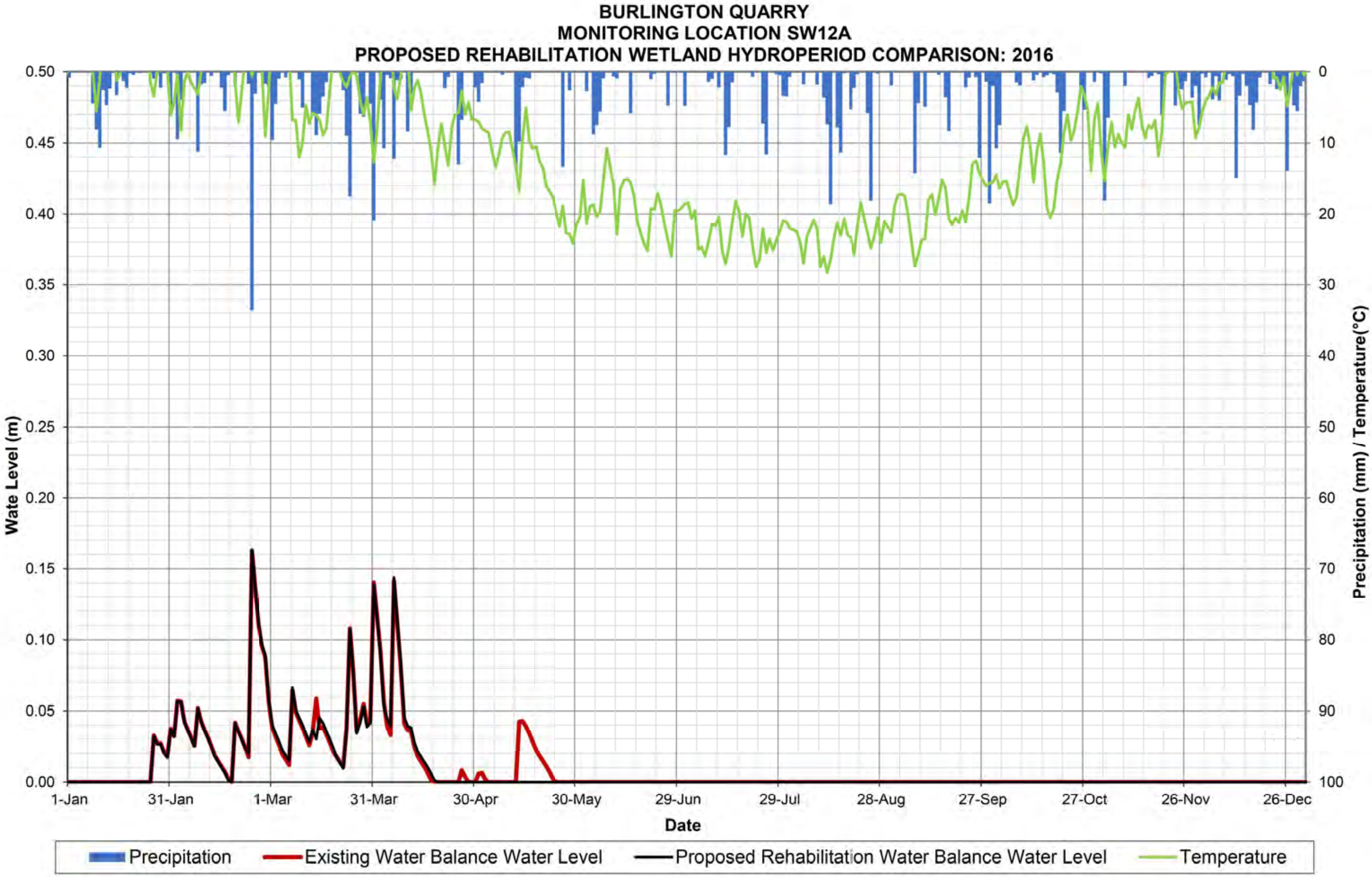


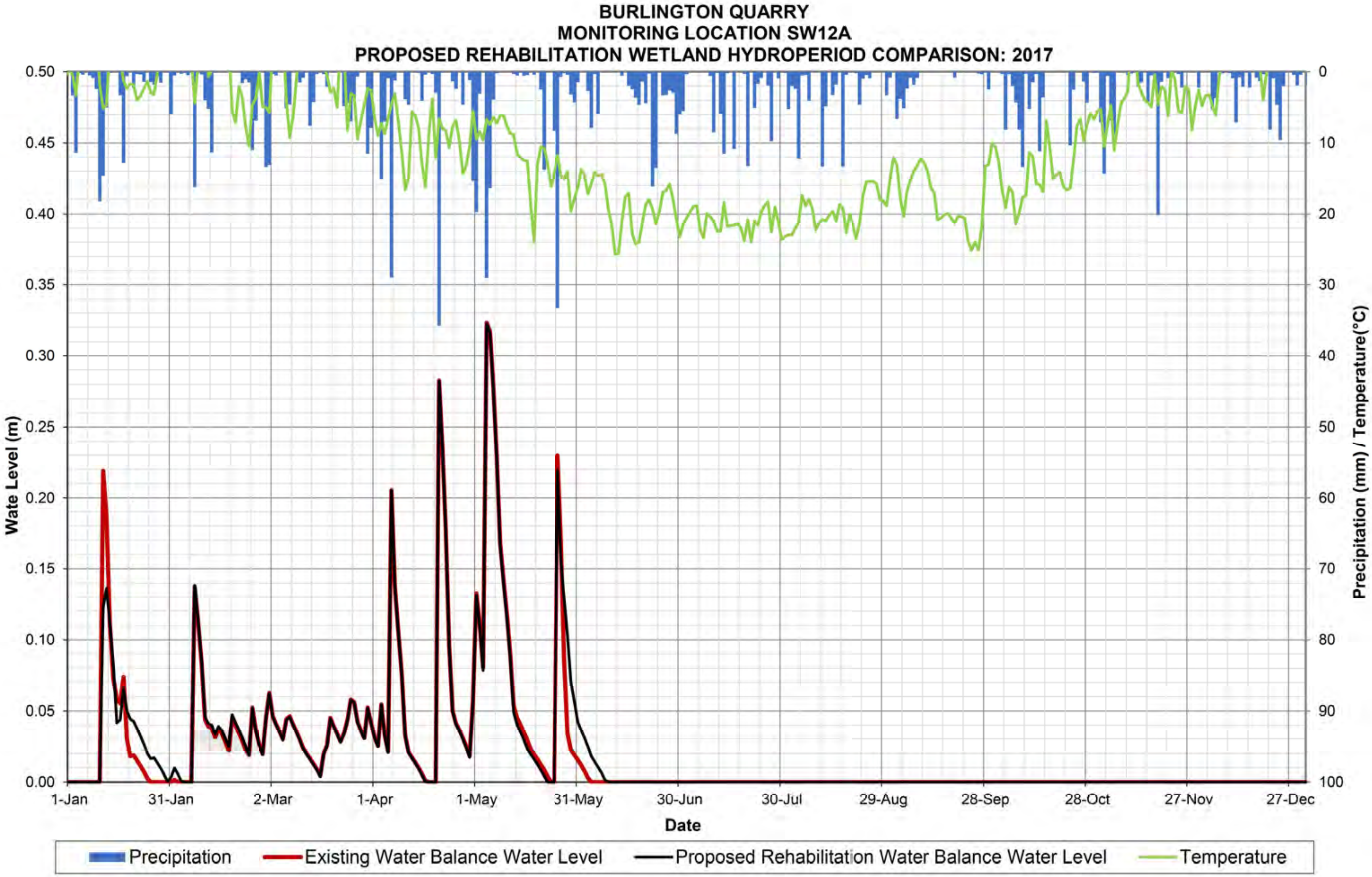
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2013
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



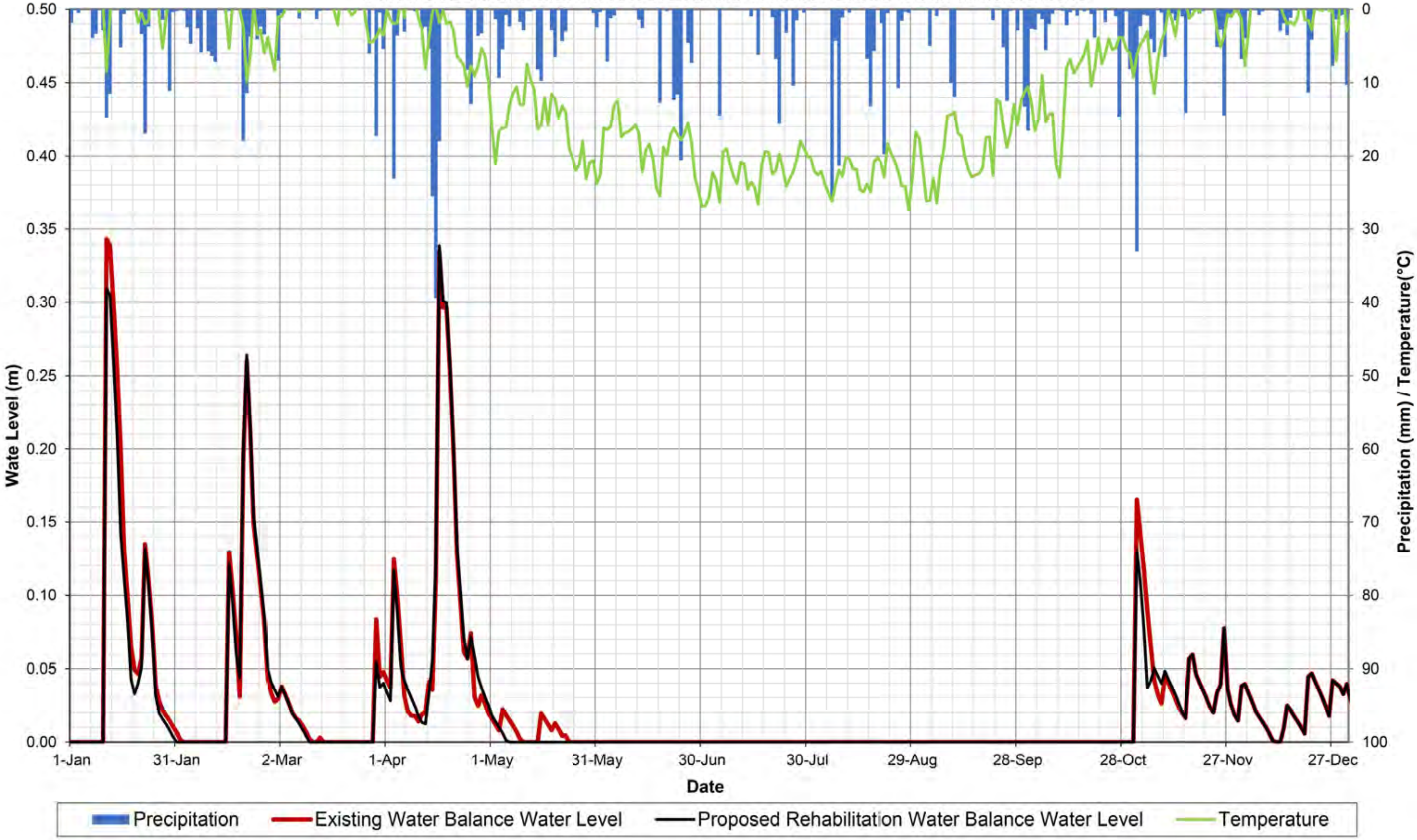
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2014
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

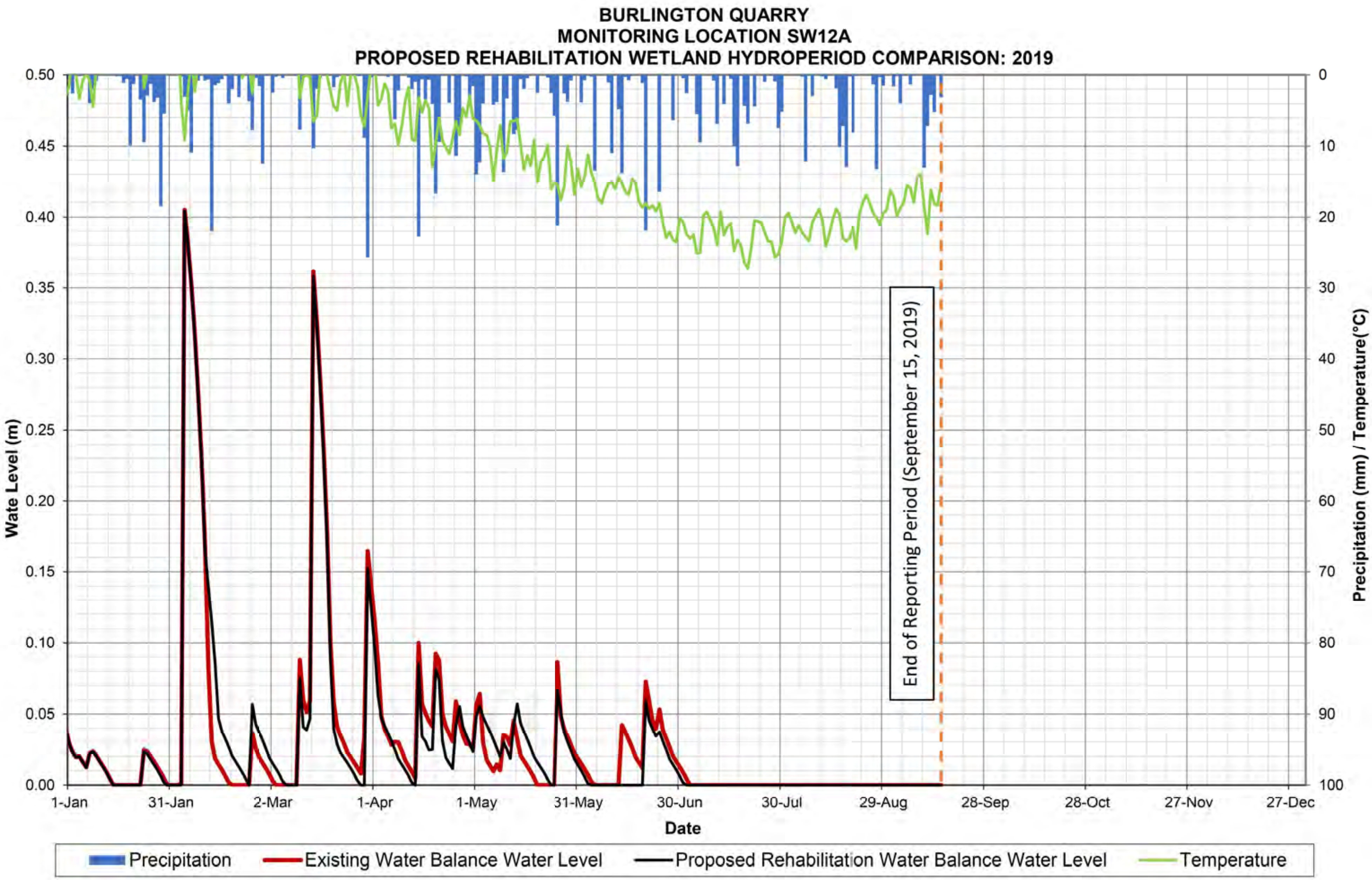

BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2015
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

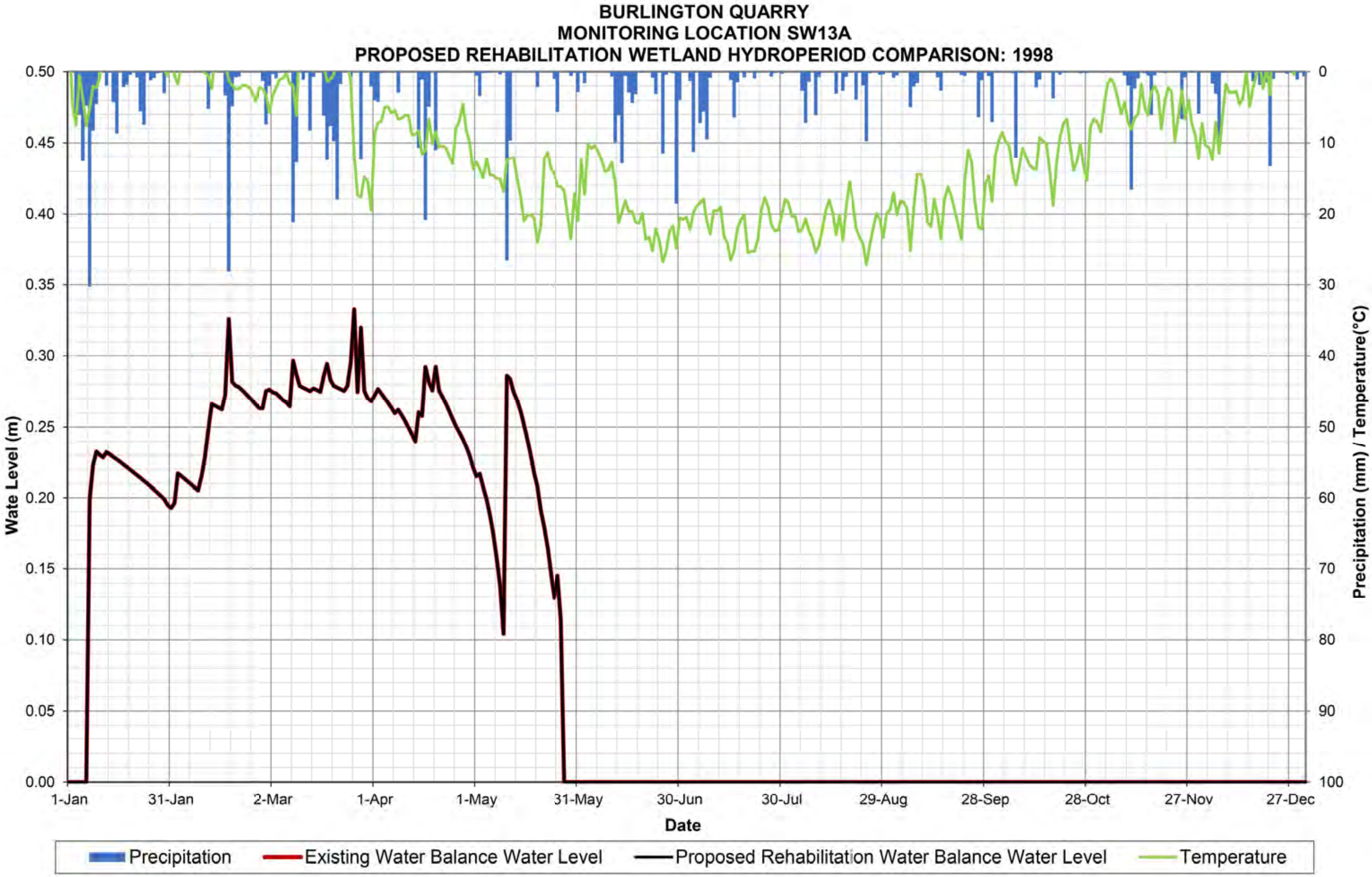

BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2016
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2017
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

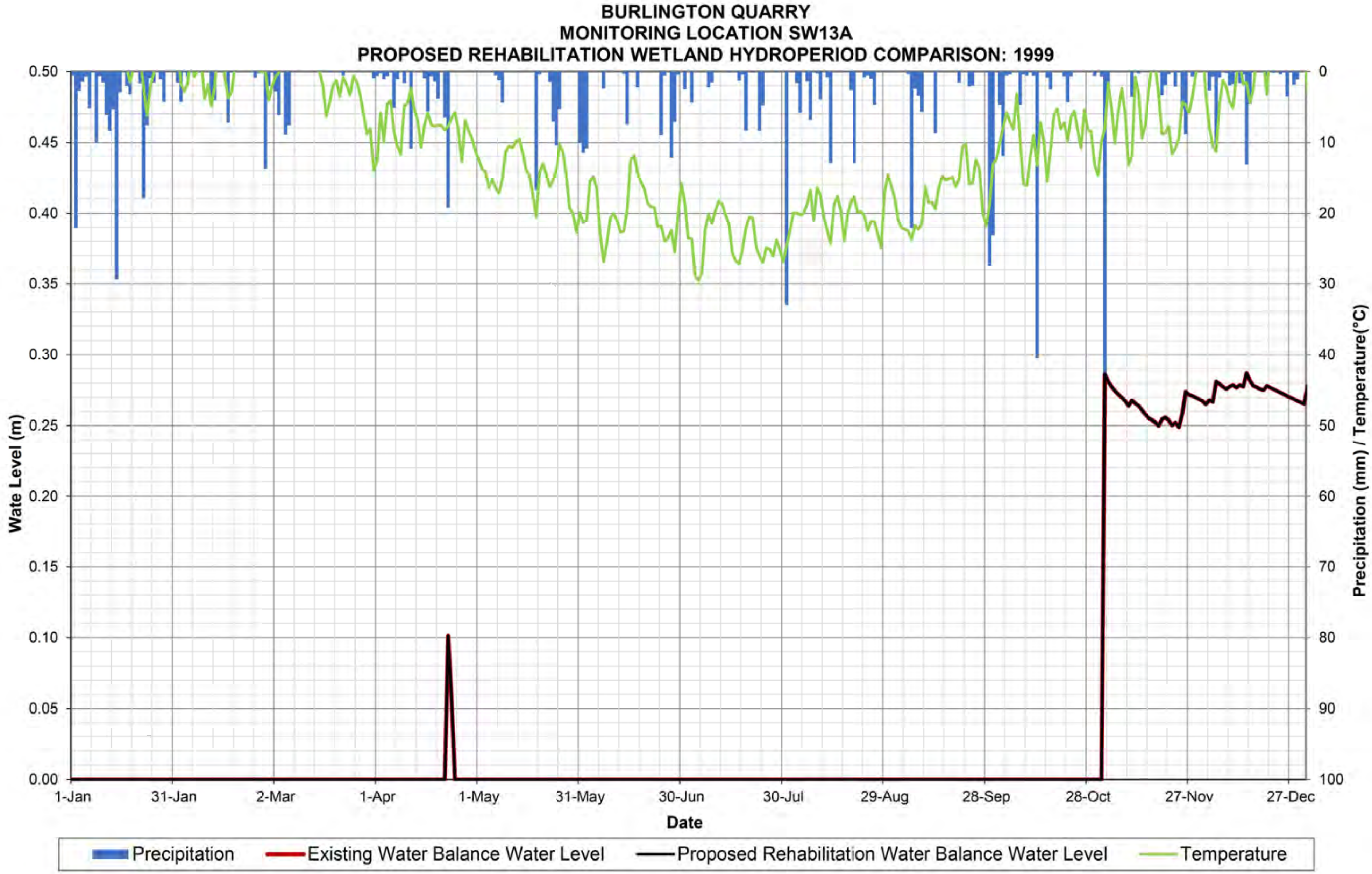
BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2018



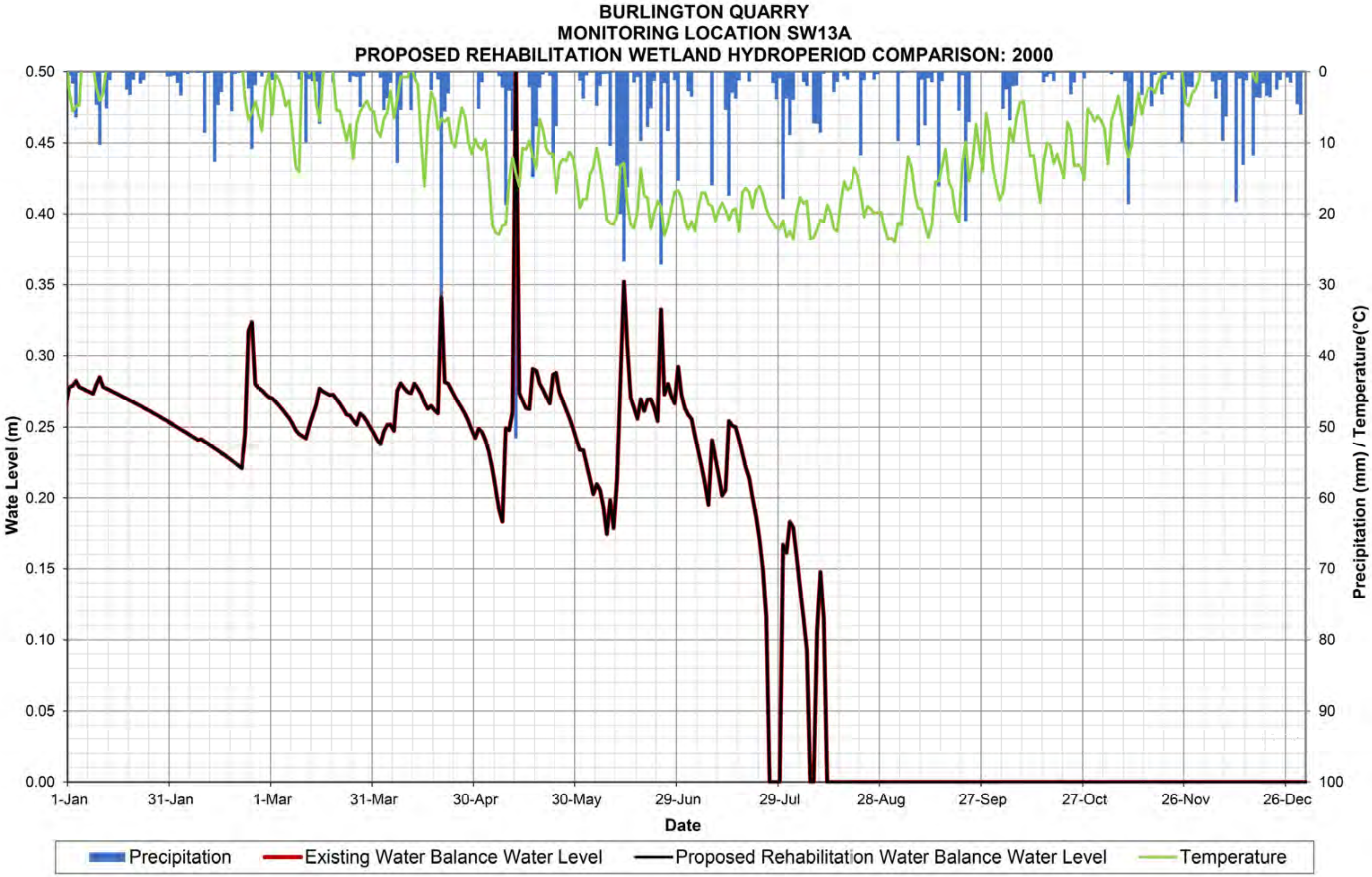

BURLINGTON QUARRY
MONITORING LOCATION SW12A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2019
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
End of Reporting Period (September 15, 2019)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

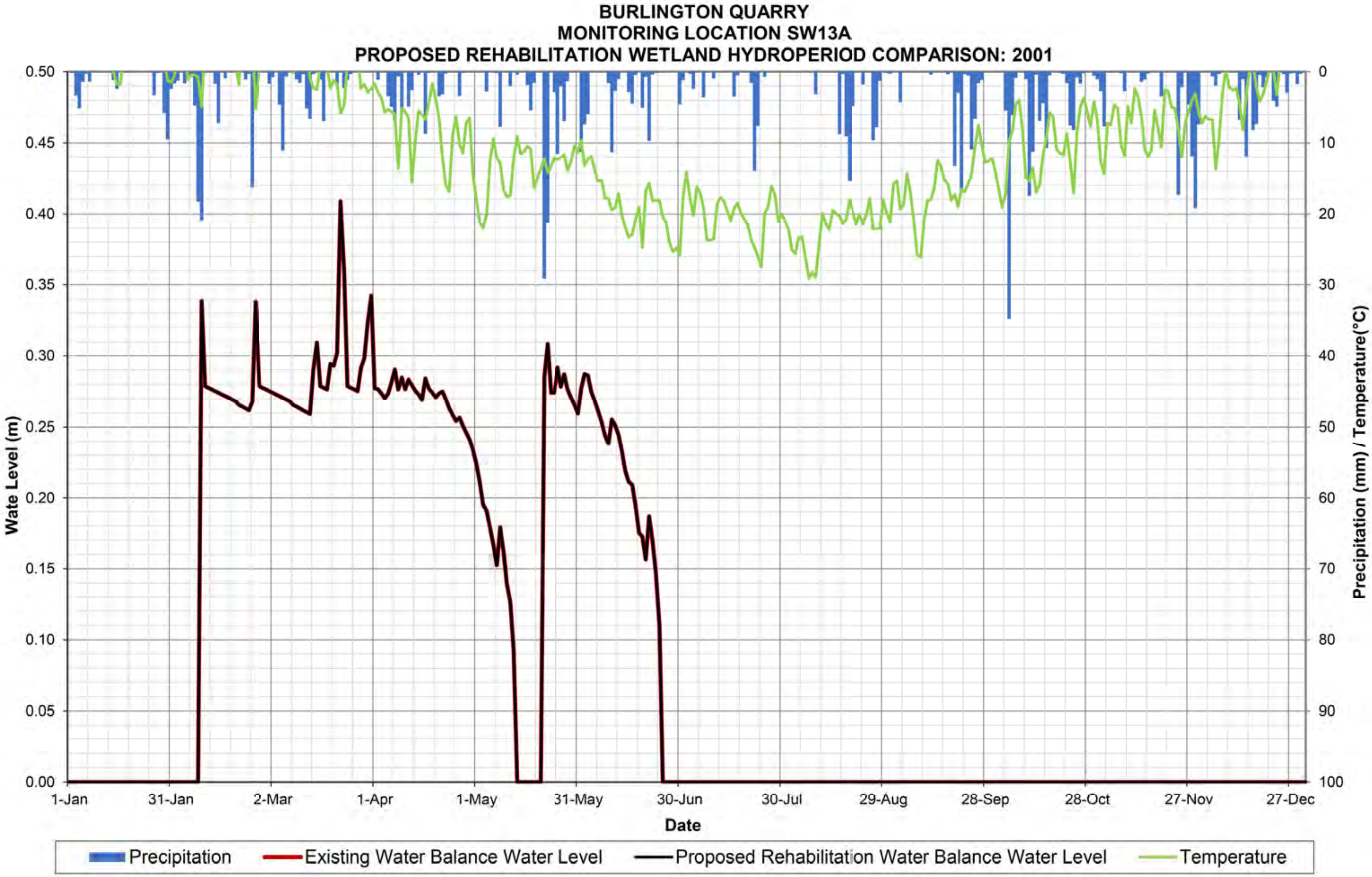


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 1998
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

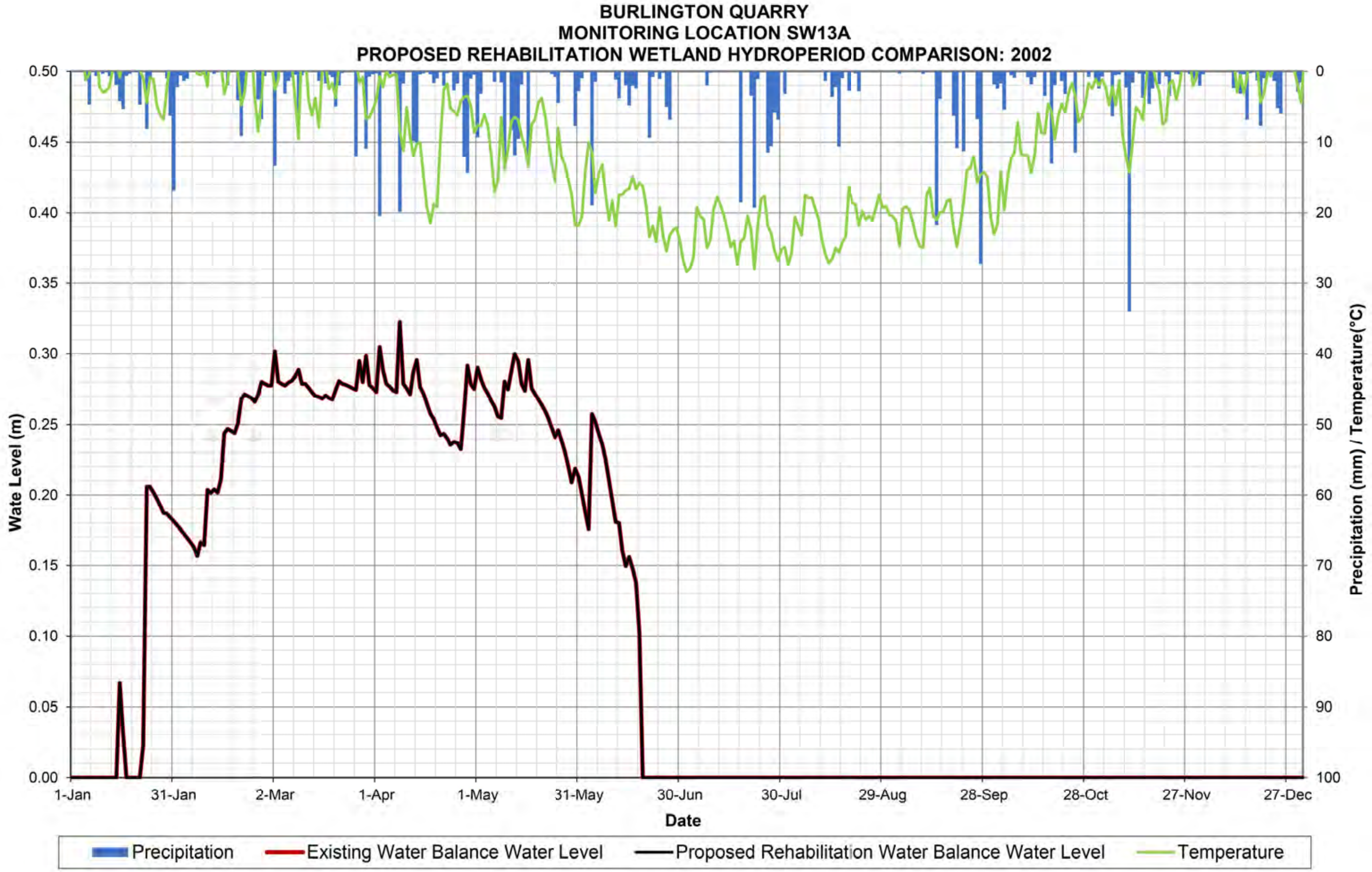


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 1999
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

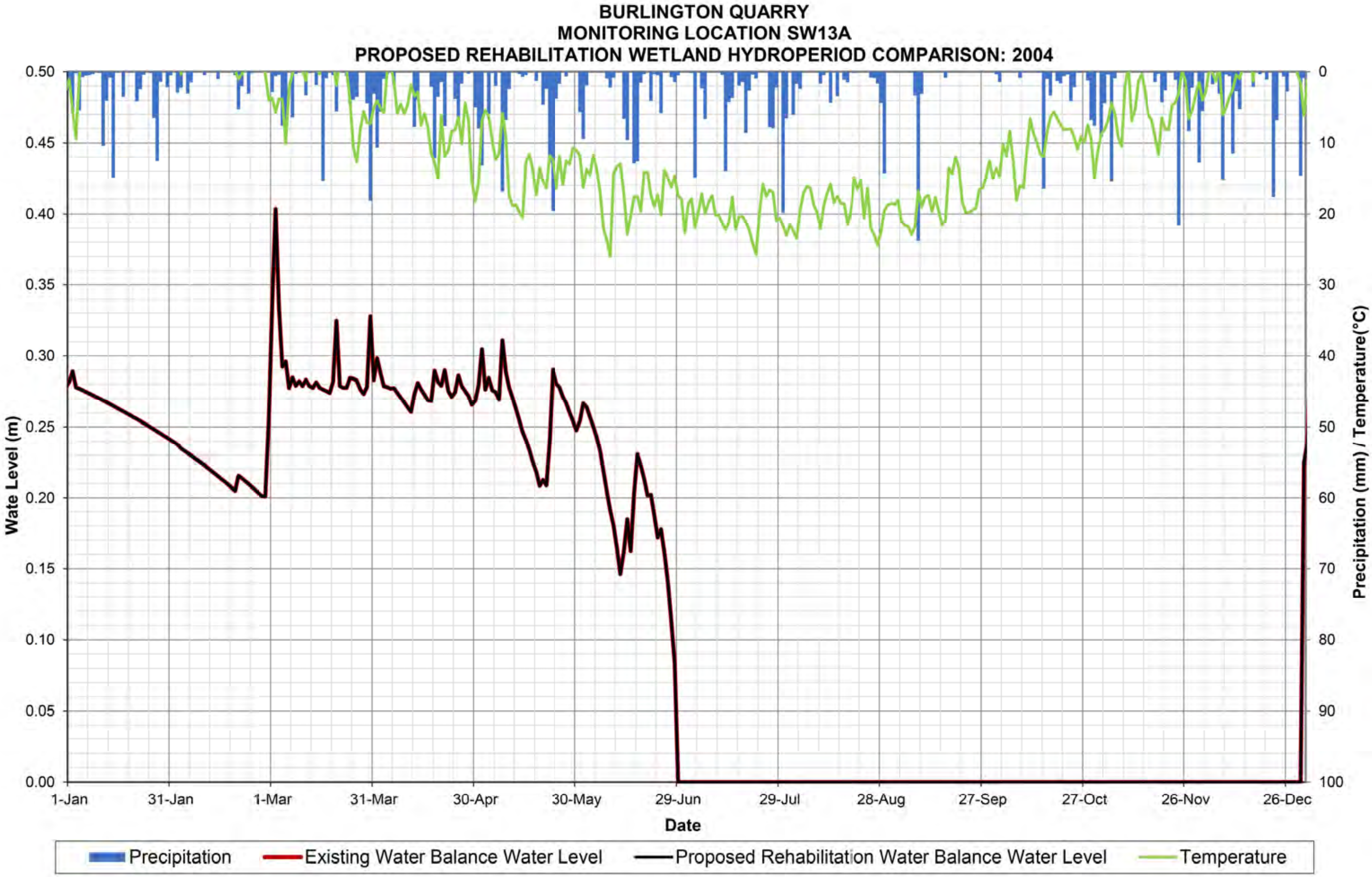

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2000
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

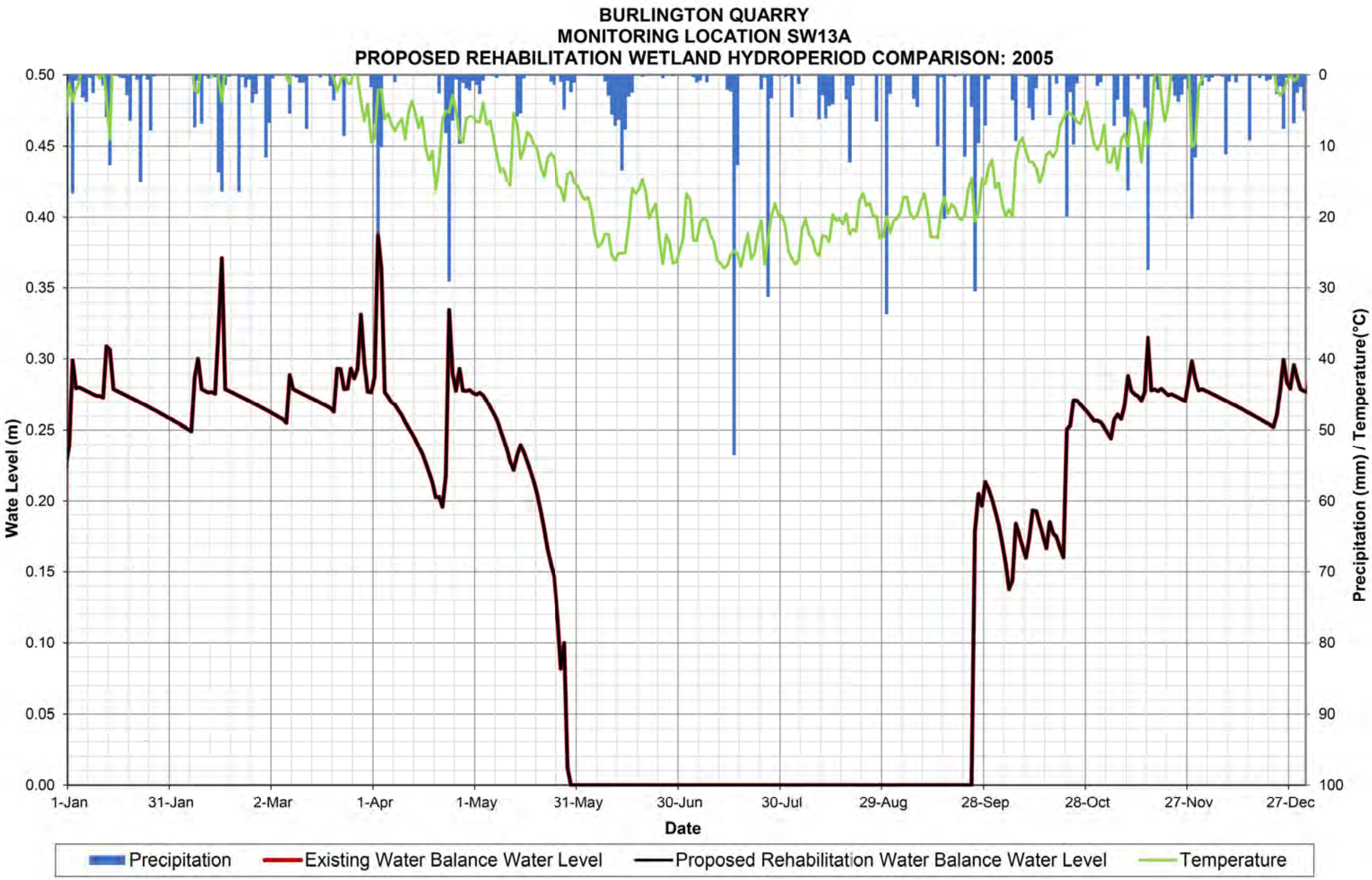


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2001
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

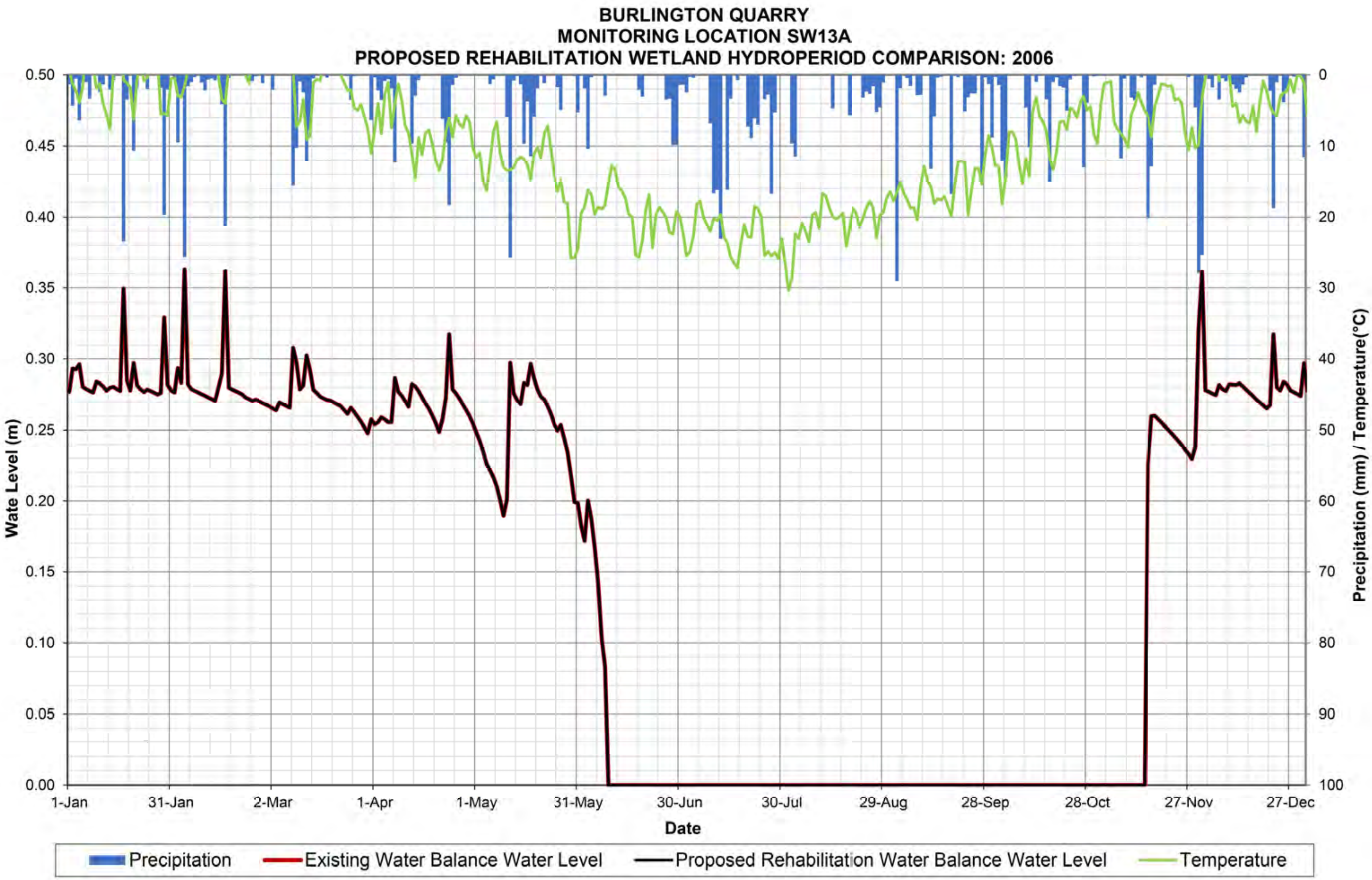

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2002
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2003
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

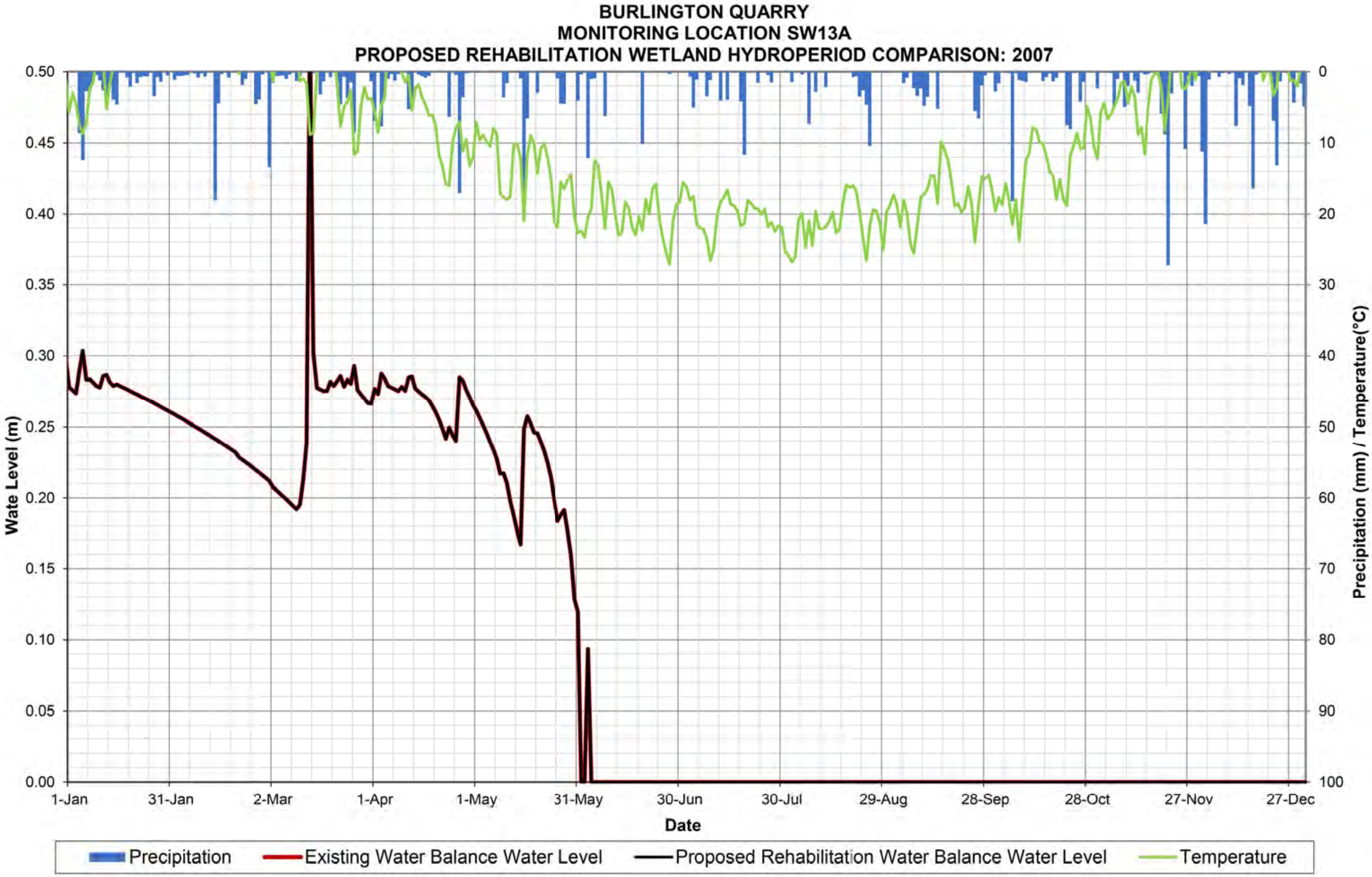

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2004
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



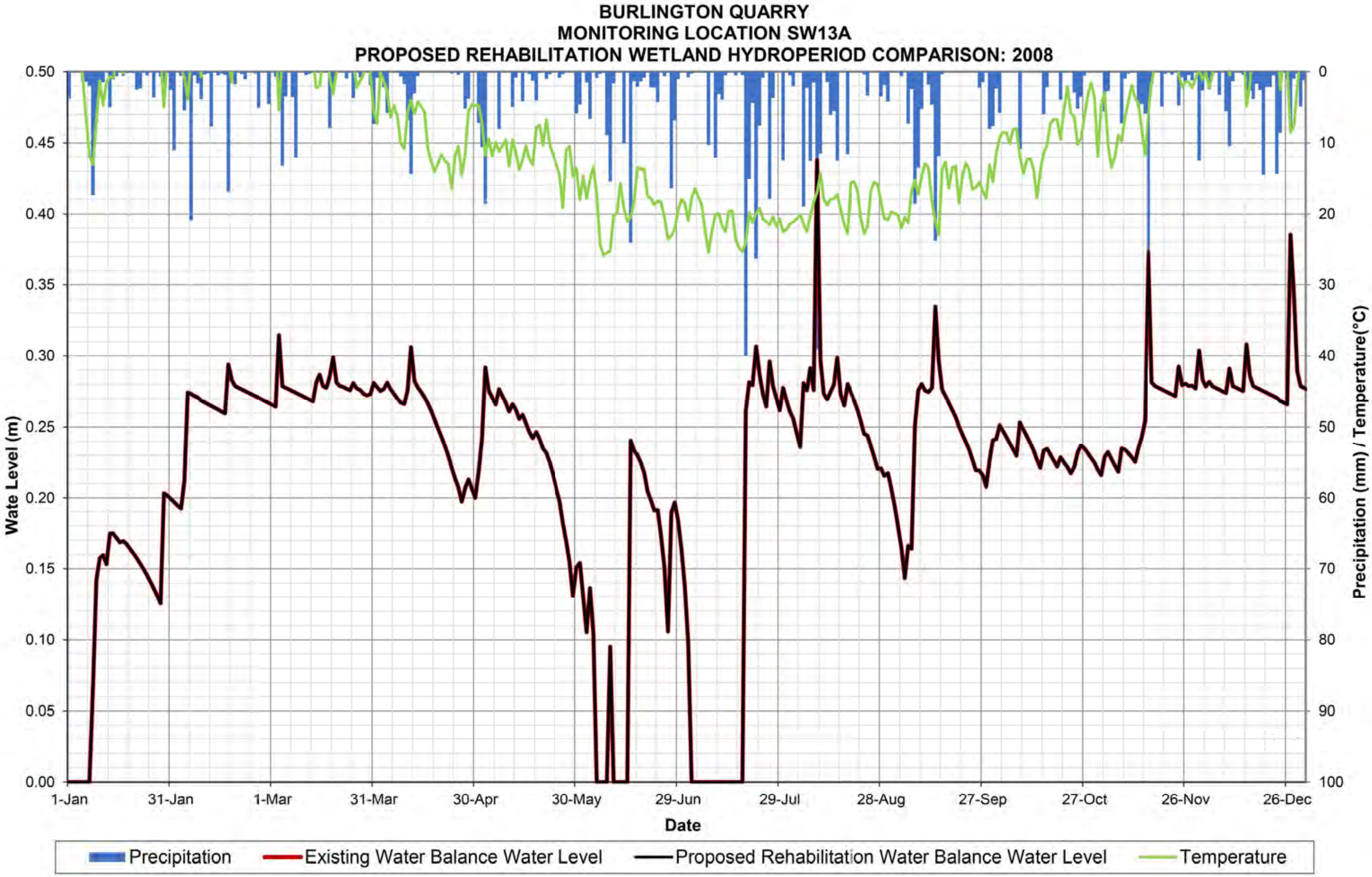
BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2005
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

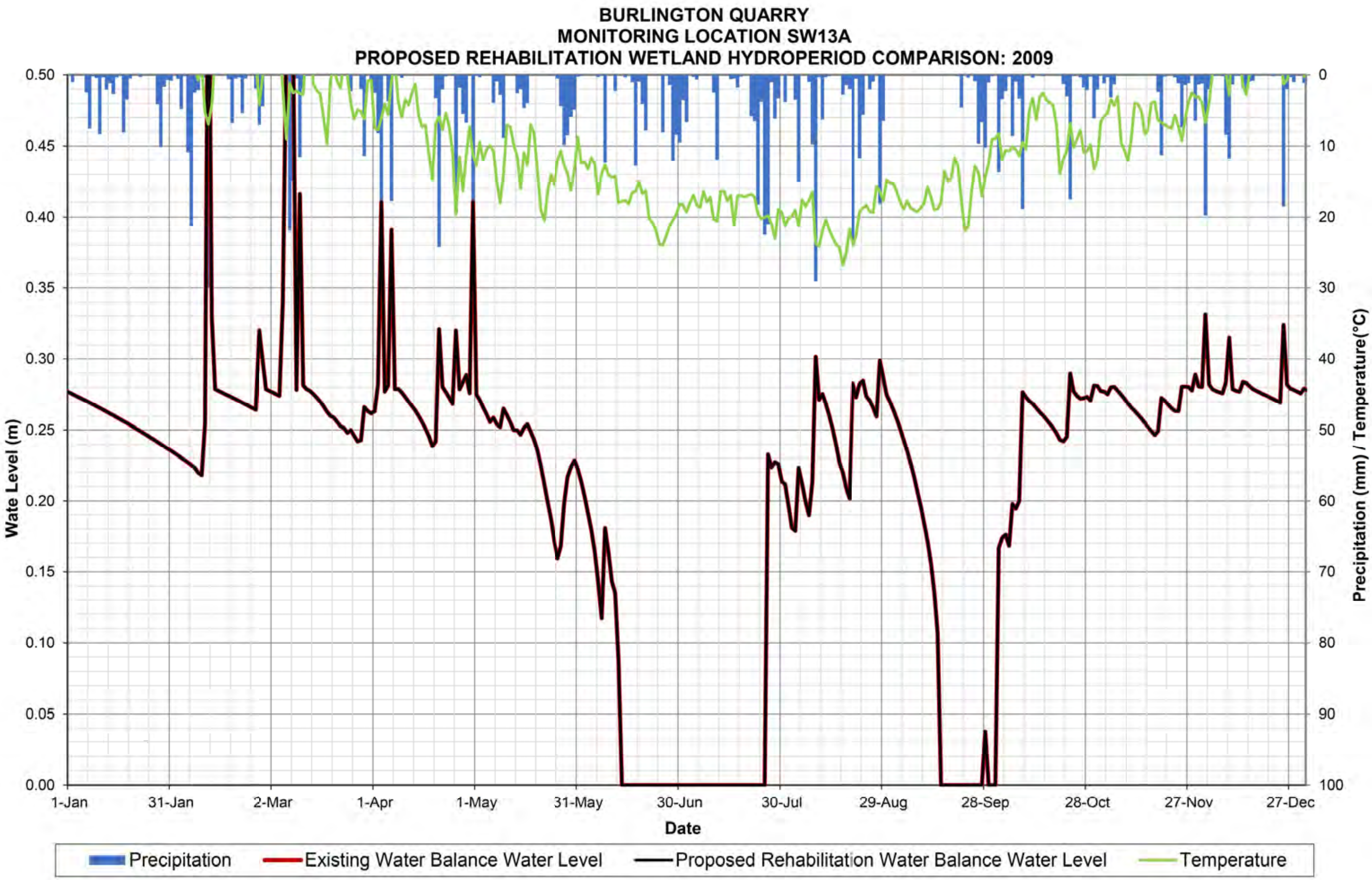


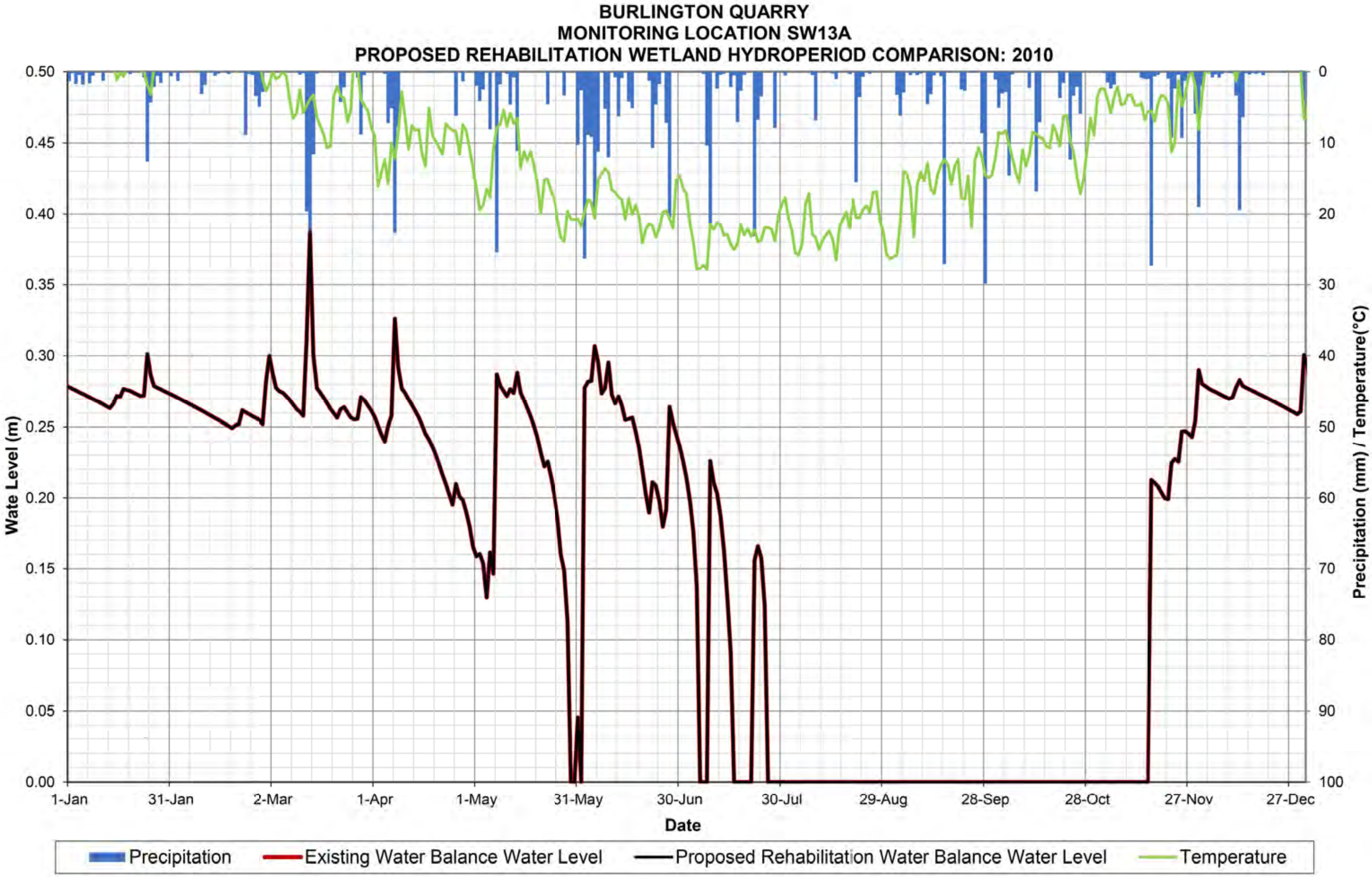
BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2006
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



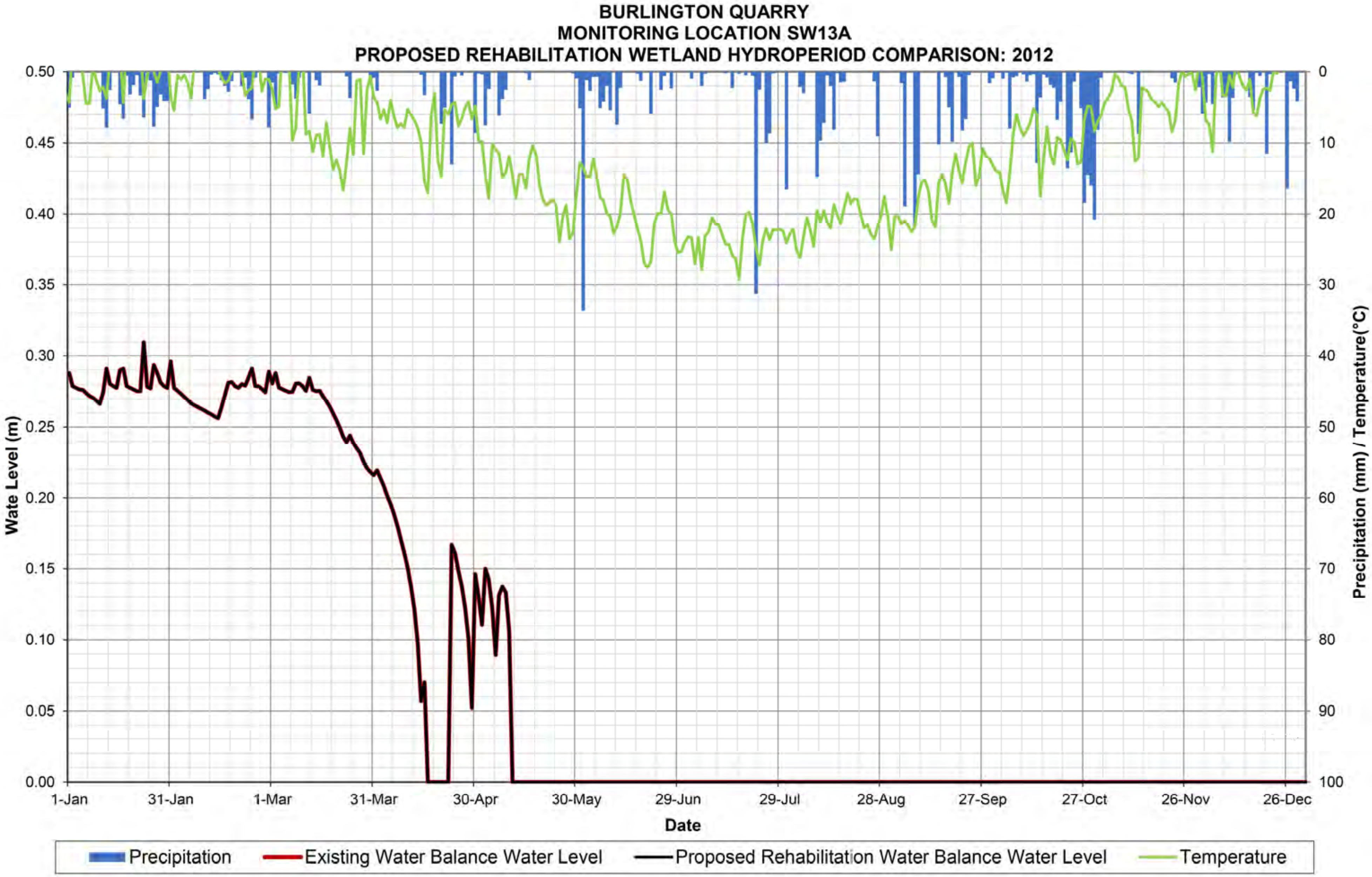
BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2007
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2008
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

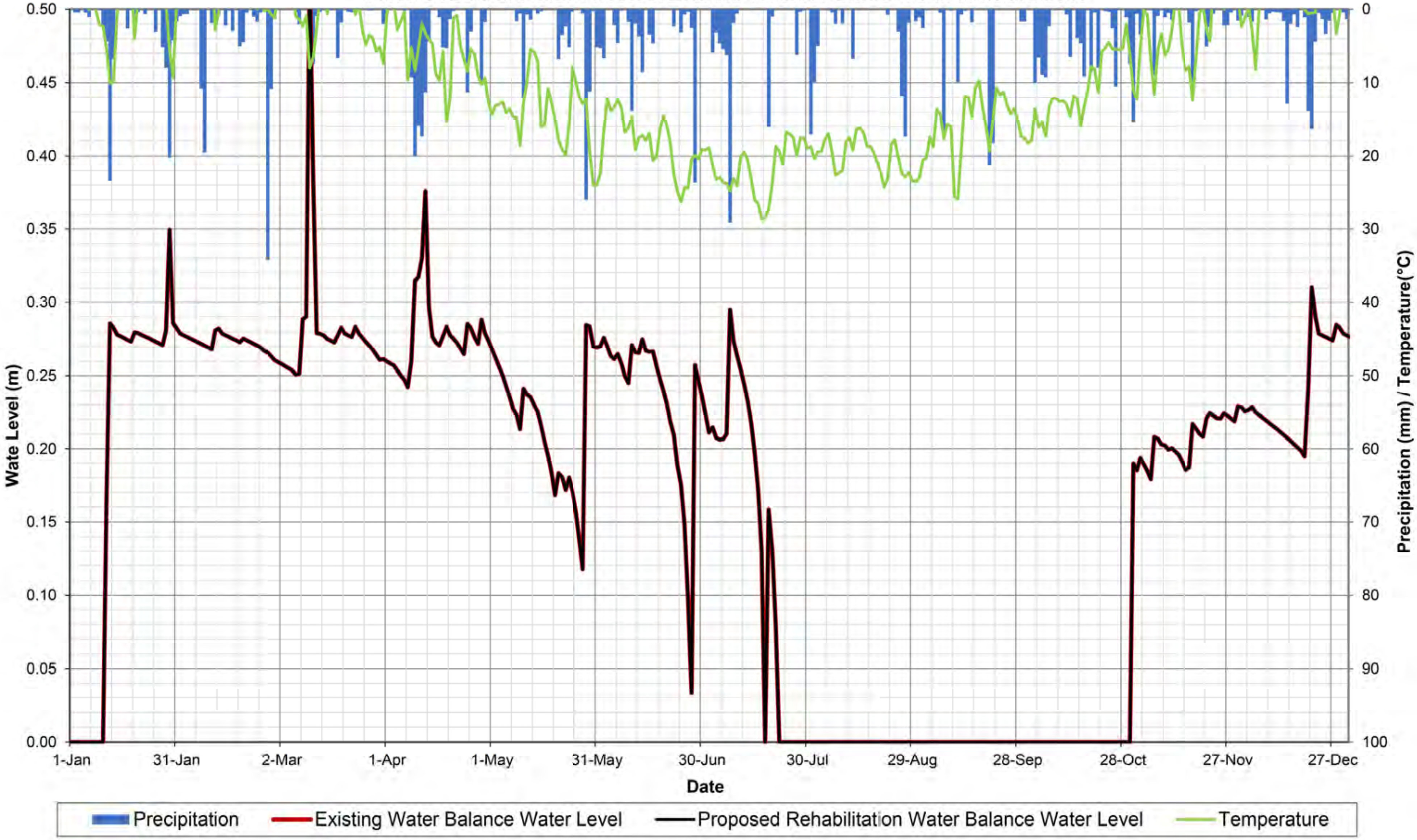

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2009
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

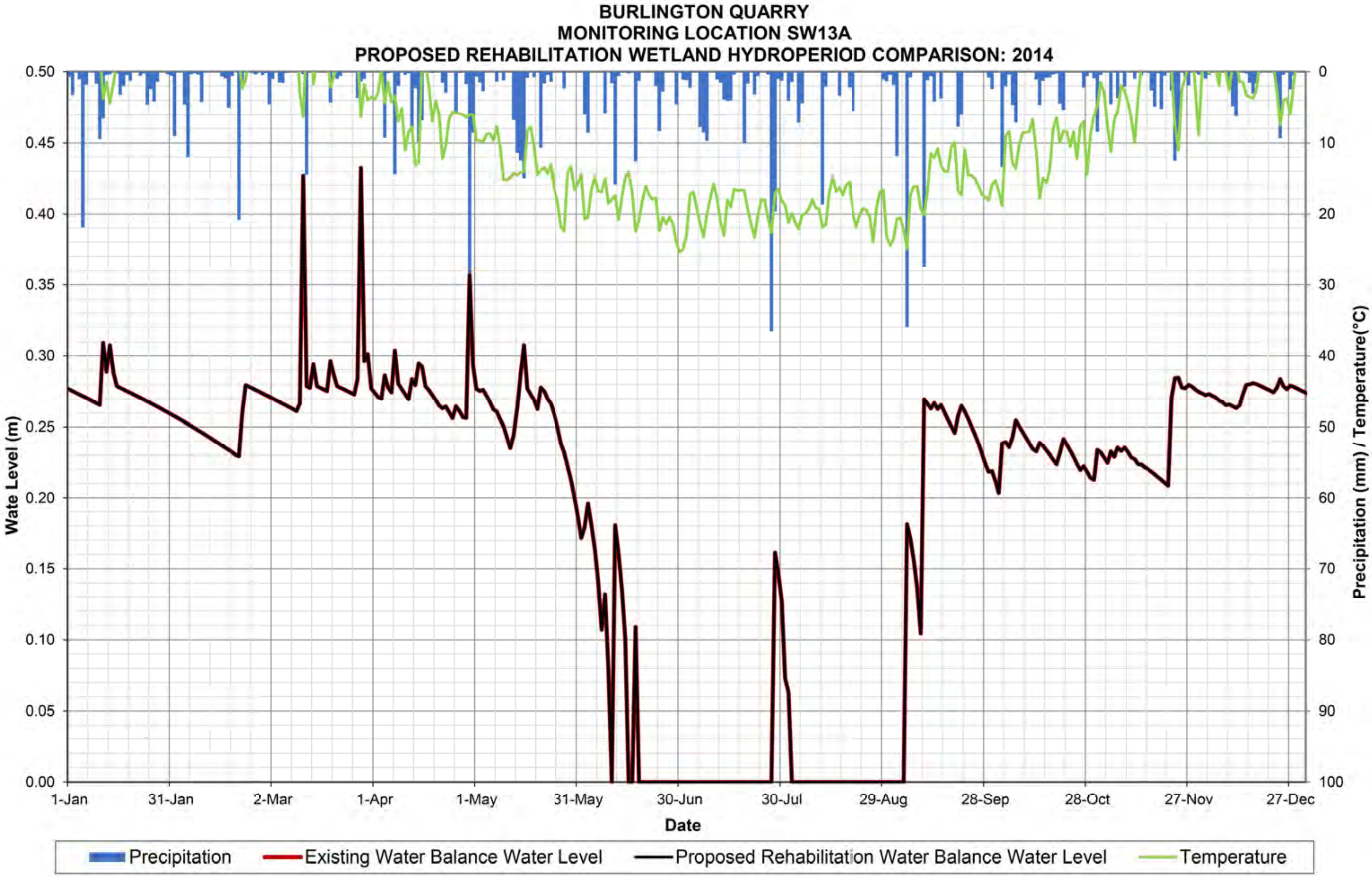

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2010
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2011

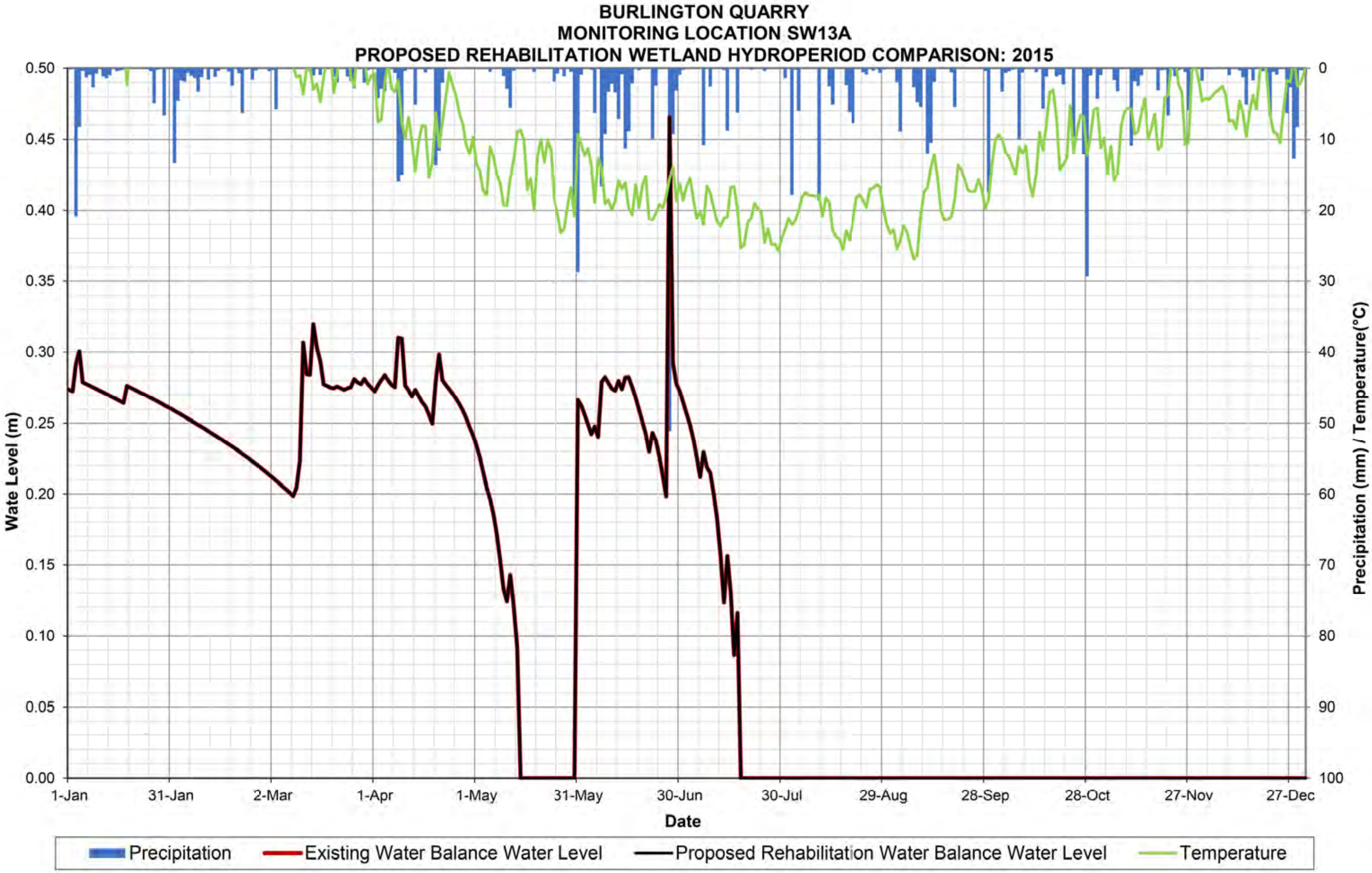

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2012
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

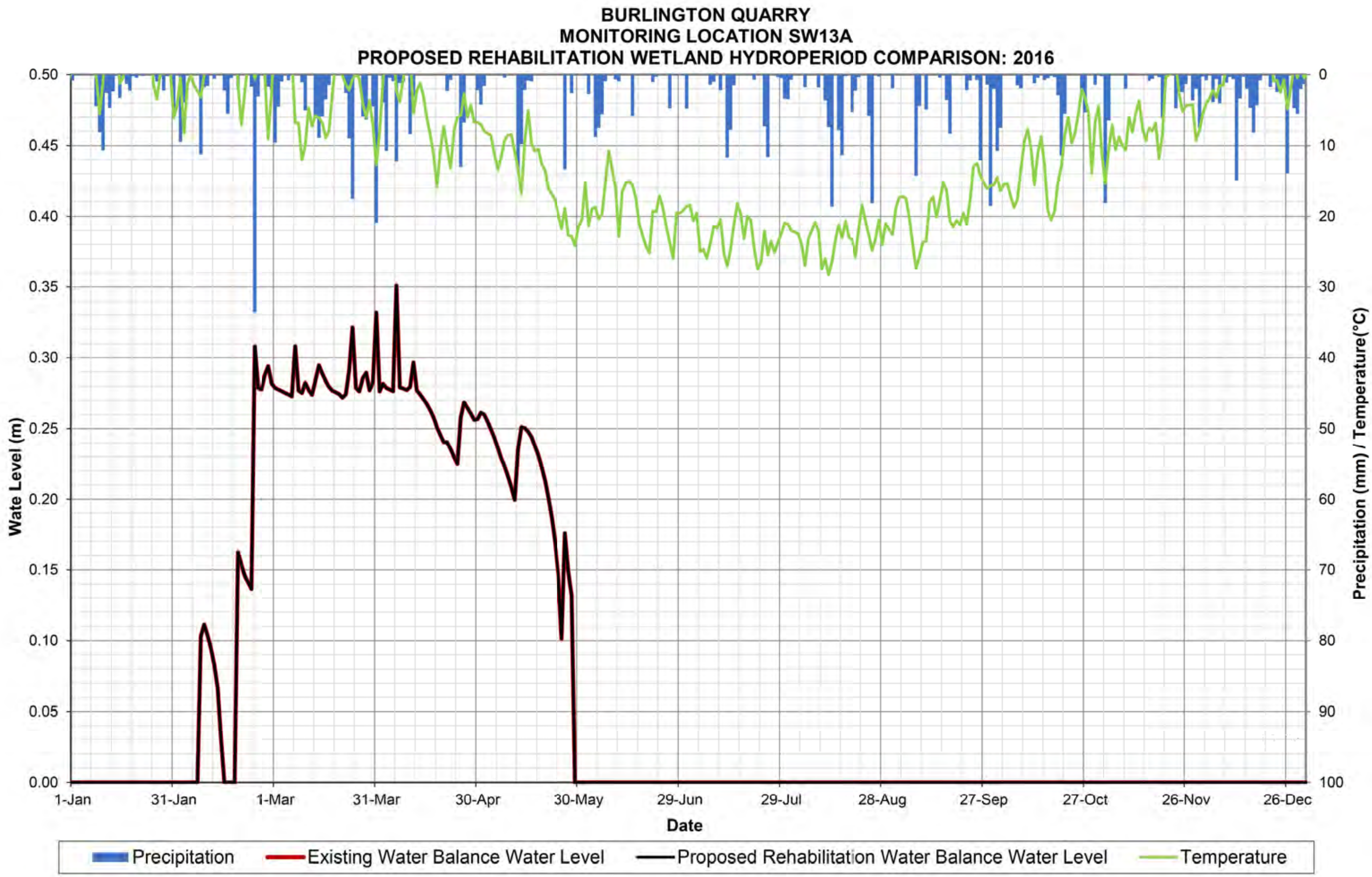
BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2013





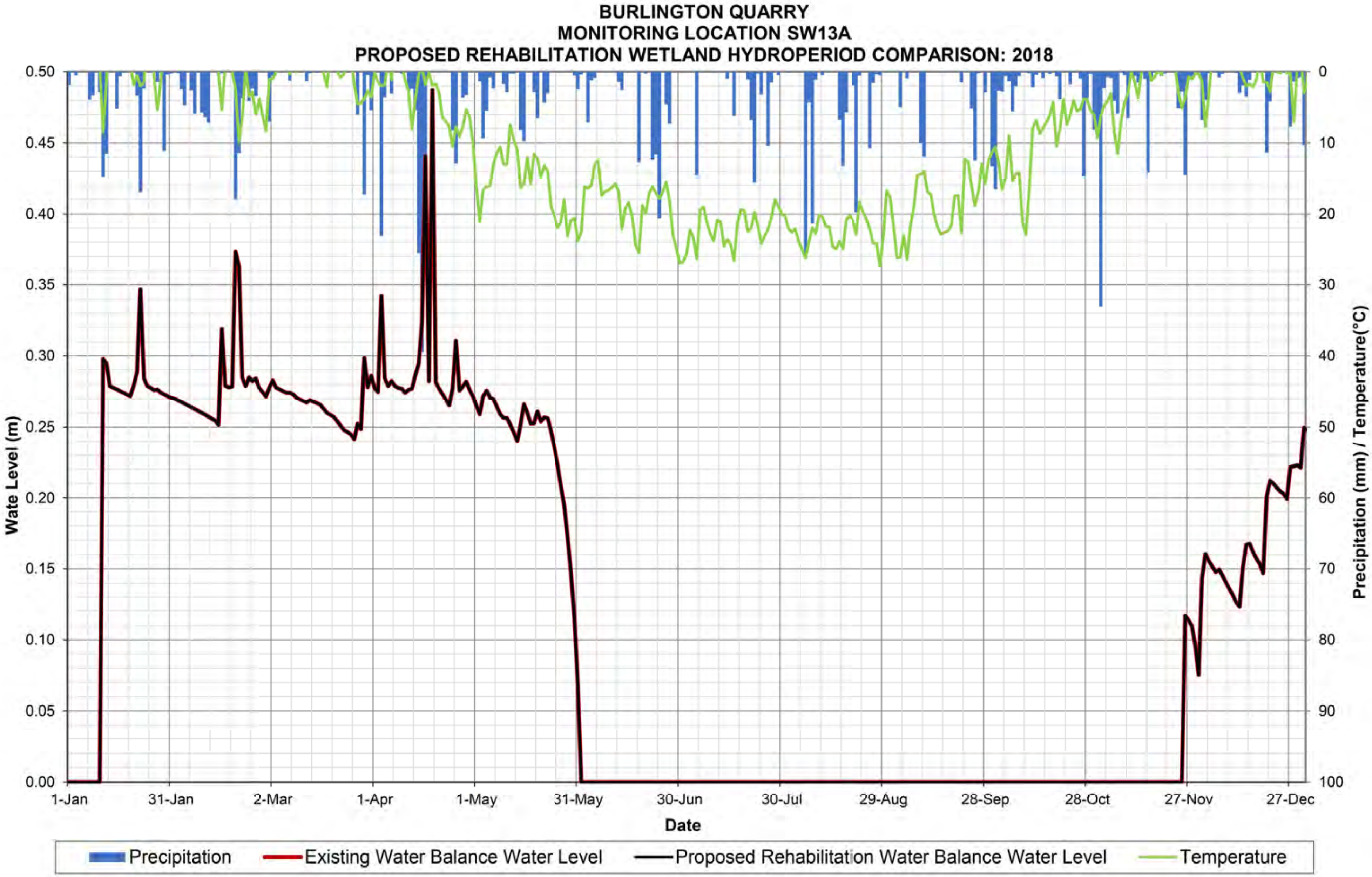
BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2014
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2015
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

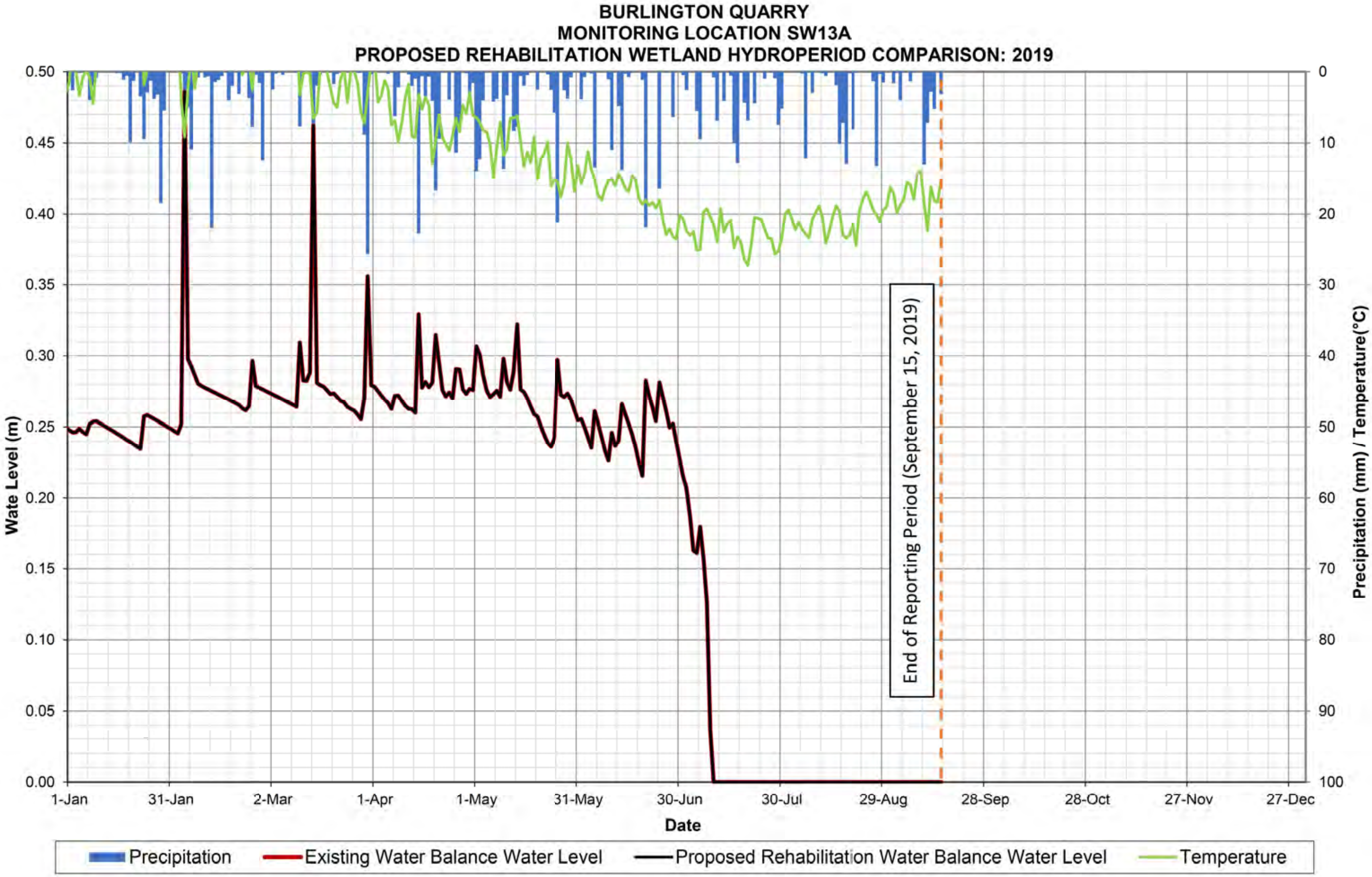


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2016
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

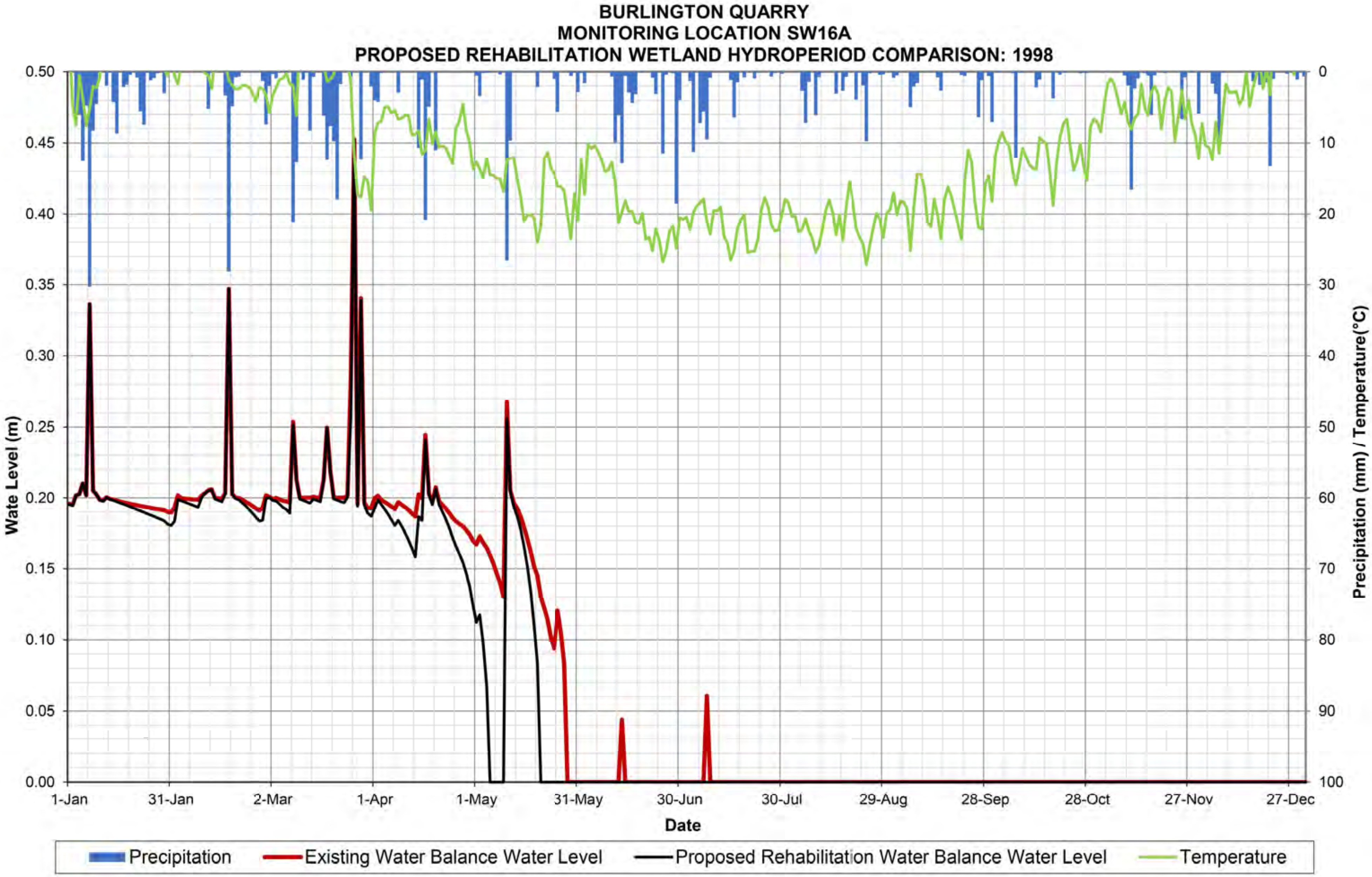

BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2017
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

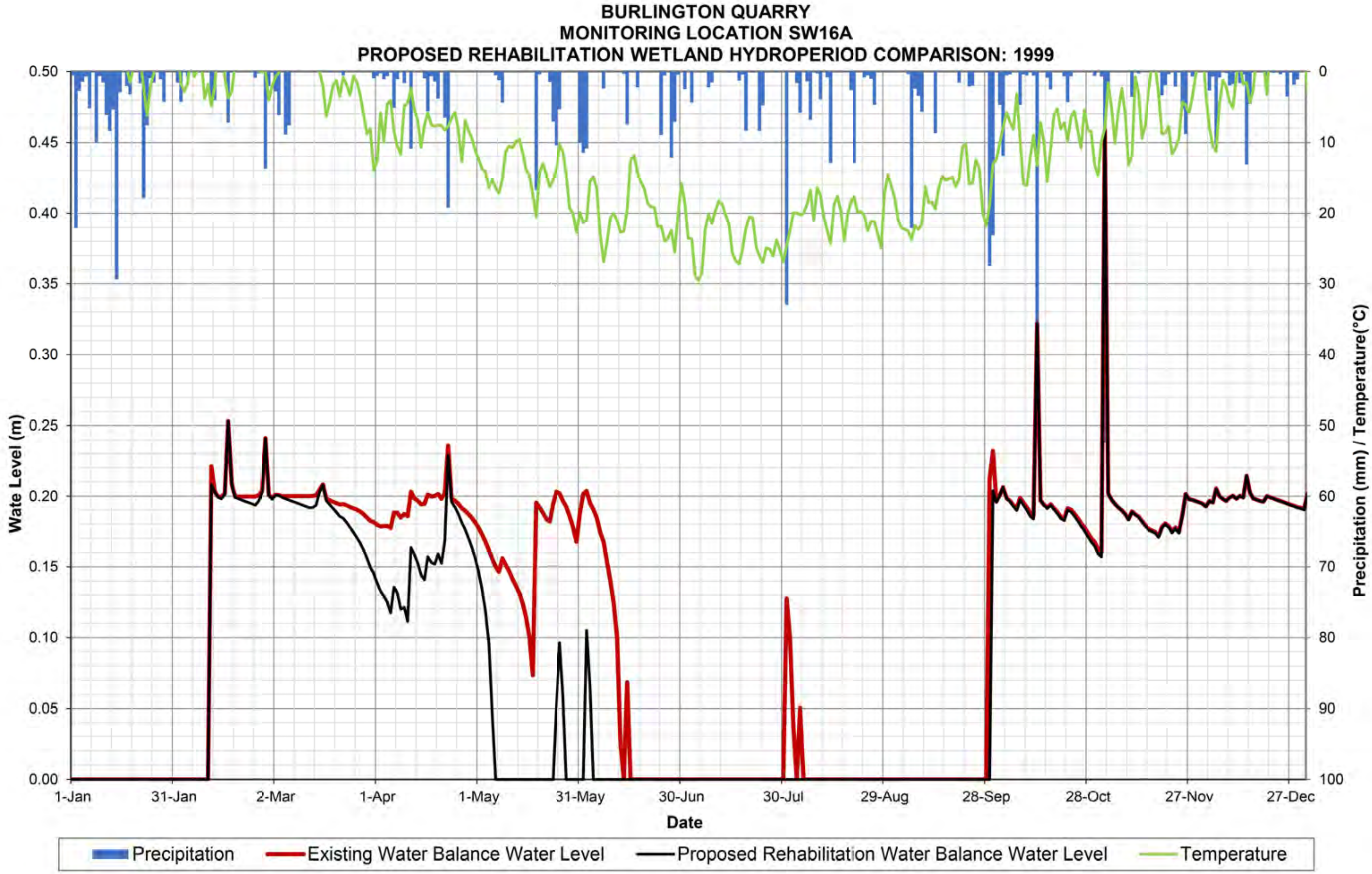


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2018
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

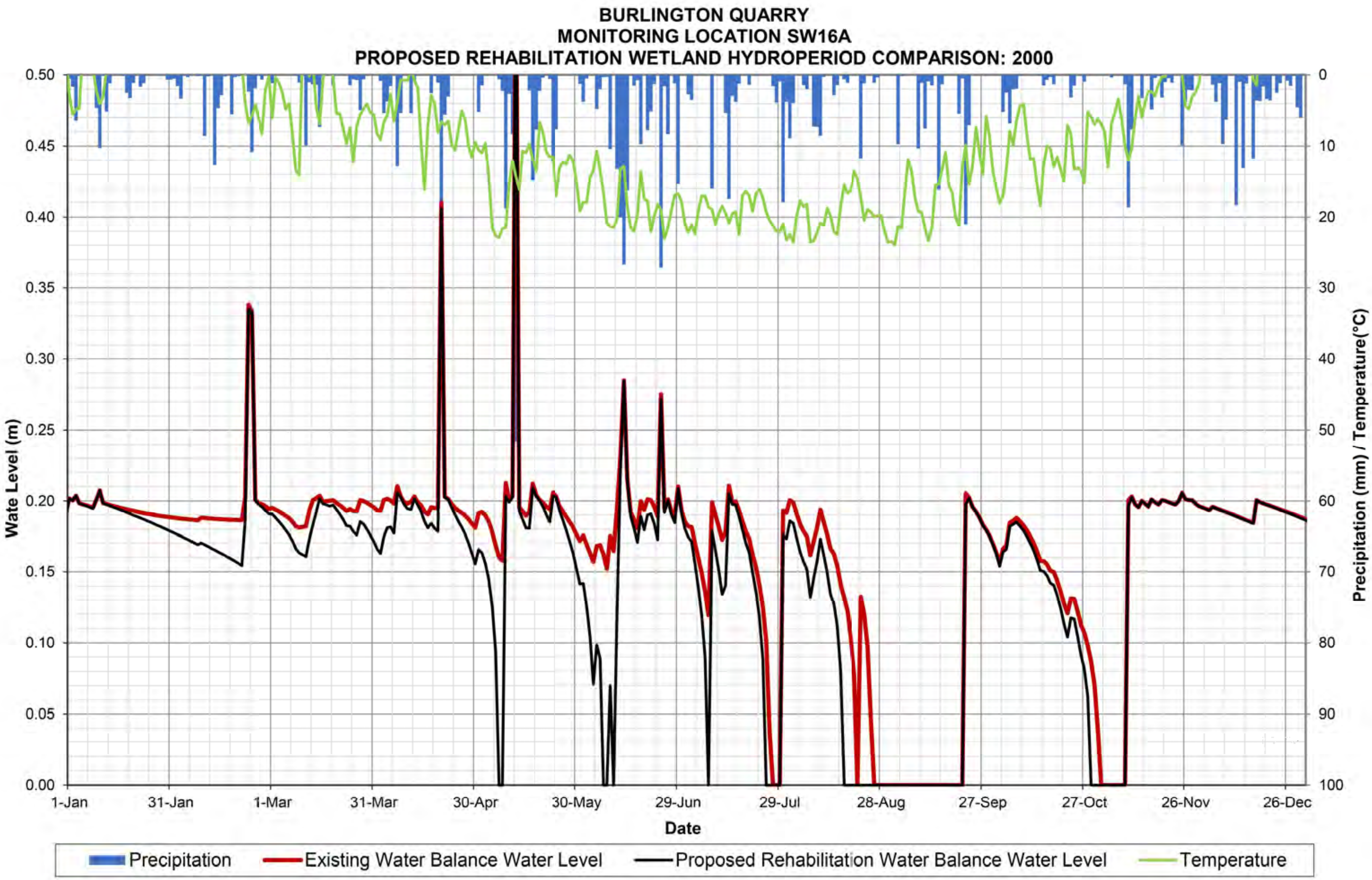


BURLINGTON QUARRY
MONITORING LOCATION SW13A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2019
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
End of Reporting Period (September 15, 2019)
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 1998
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

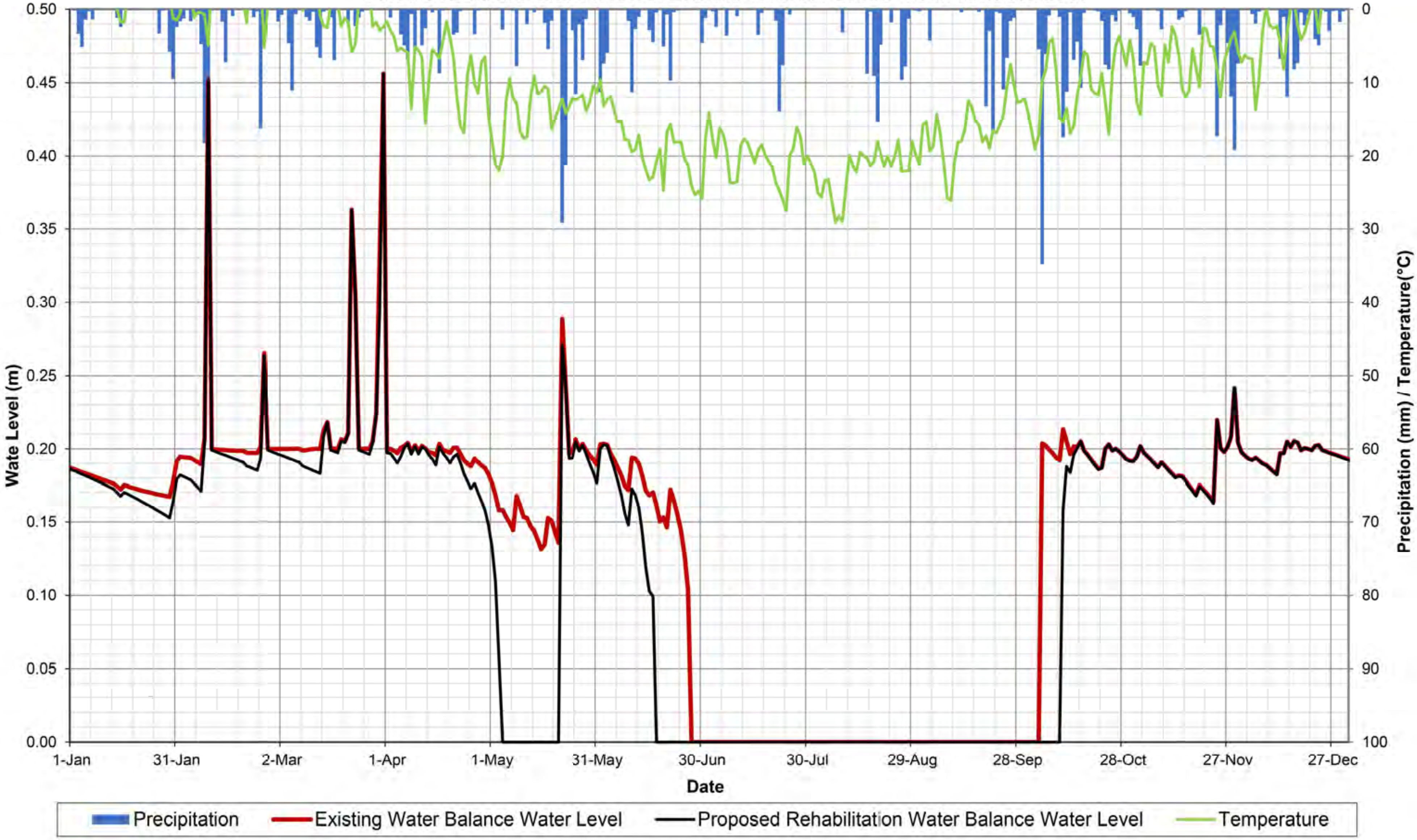


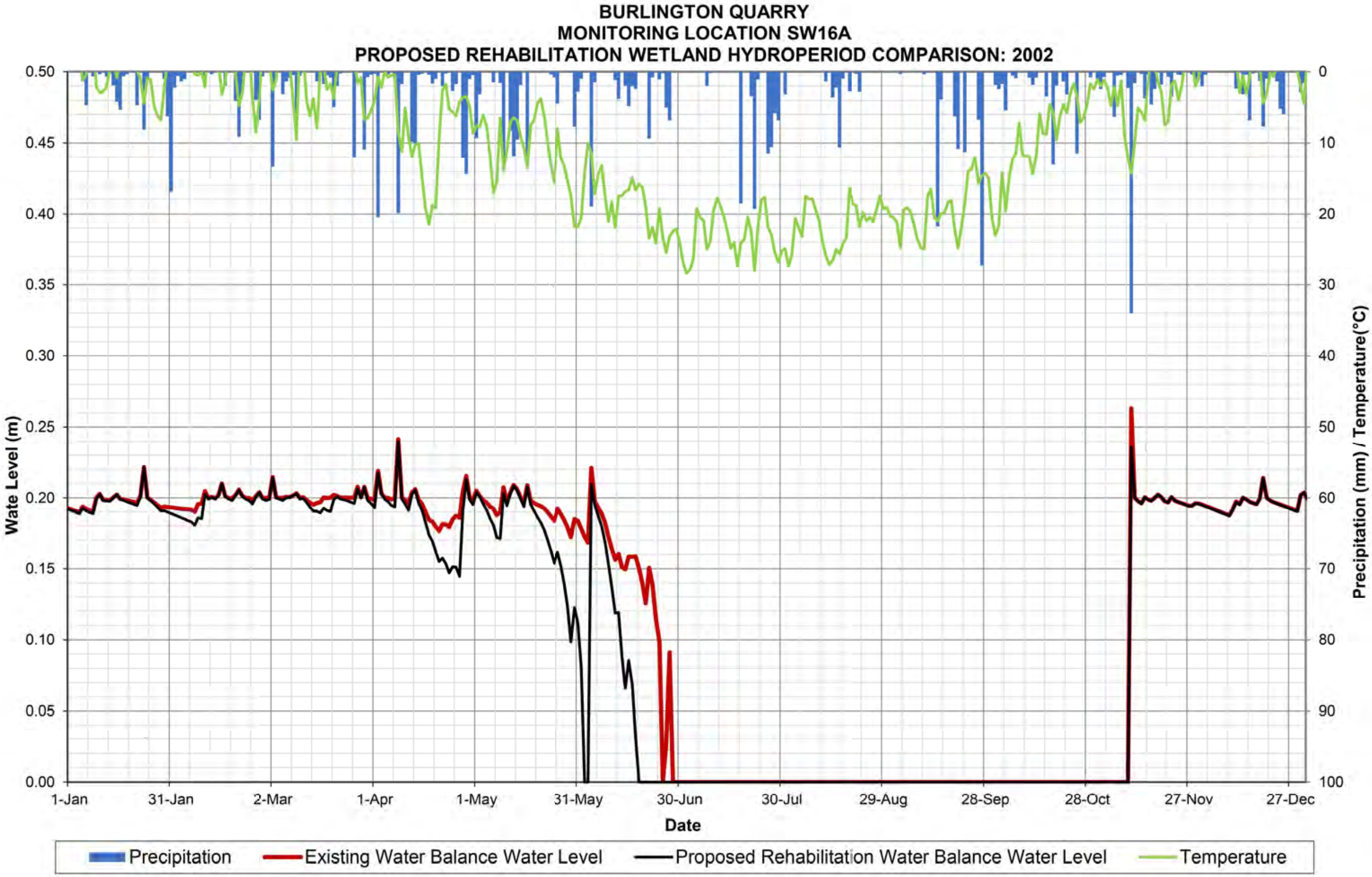
BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 1999
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



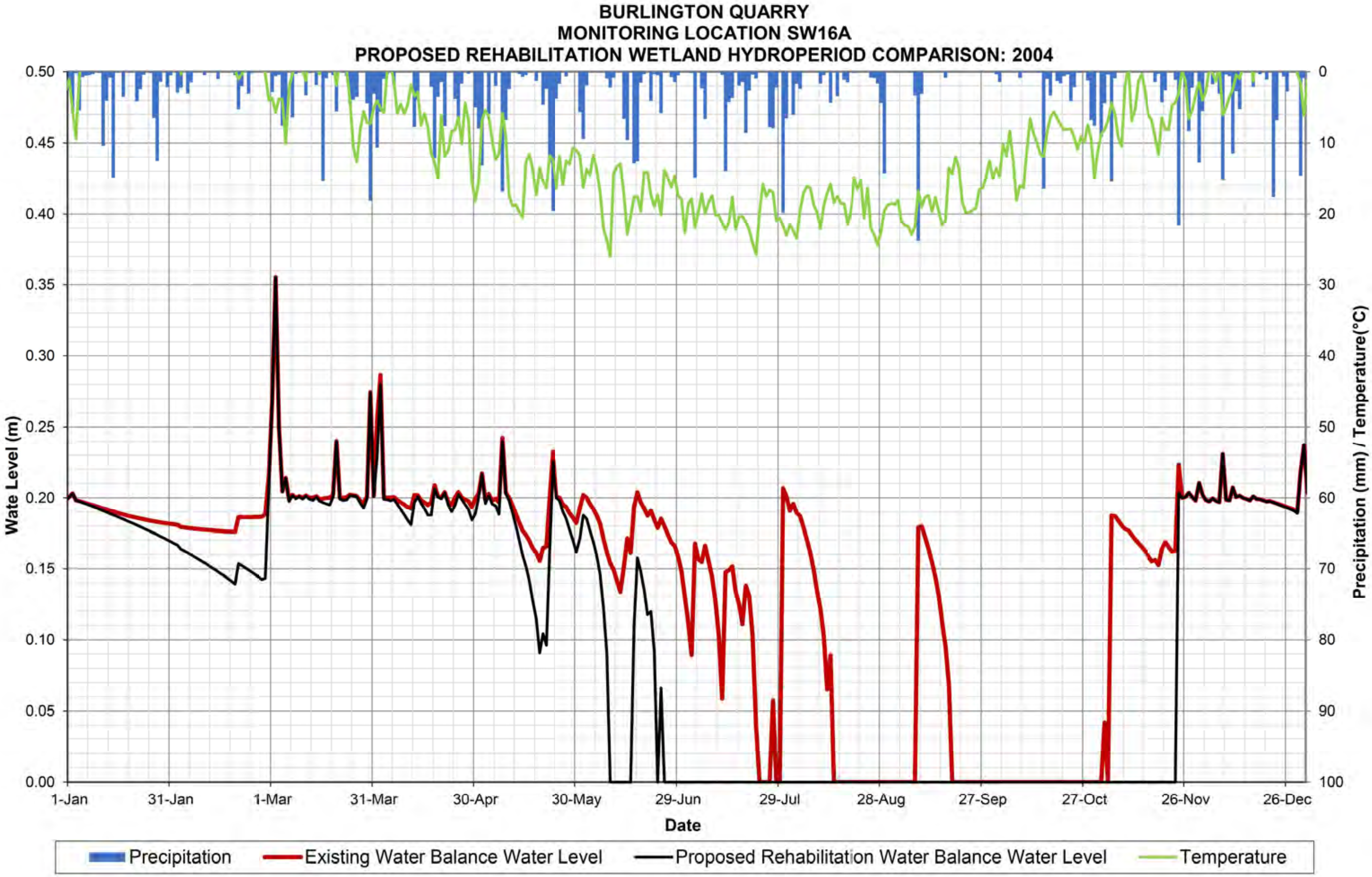
BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2000
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2001




BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2002
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2003


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2004
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
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28-Aug
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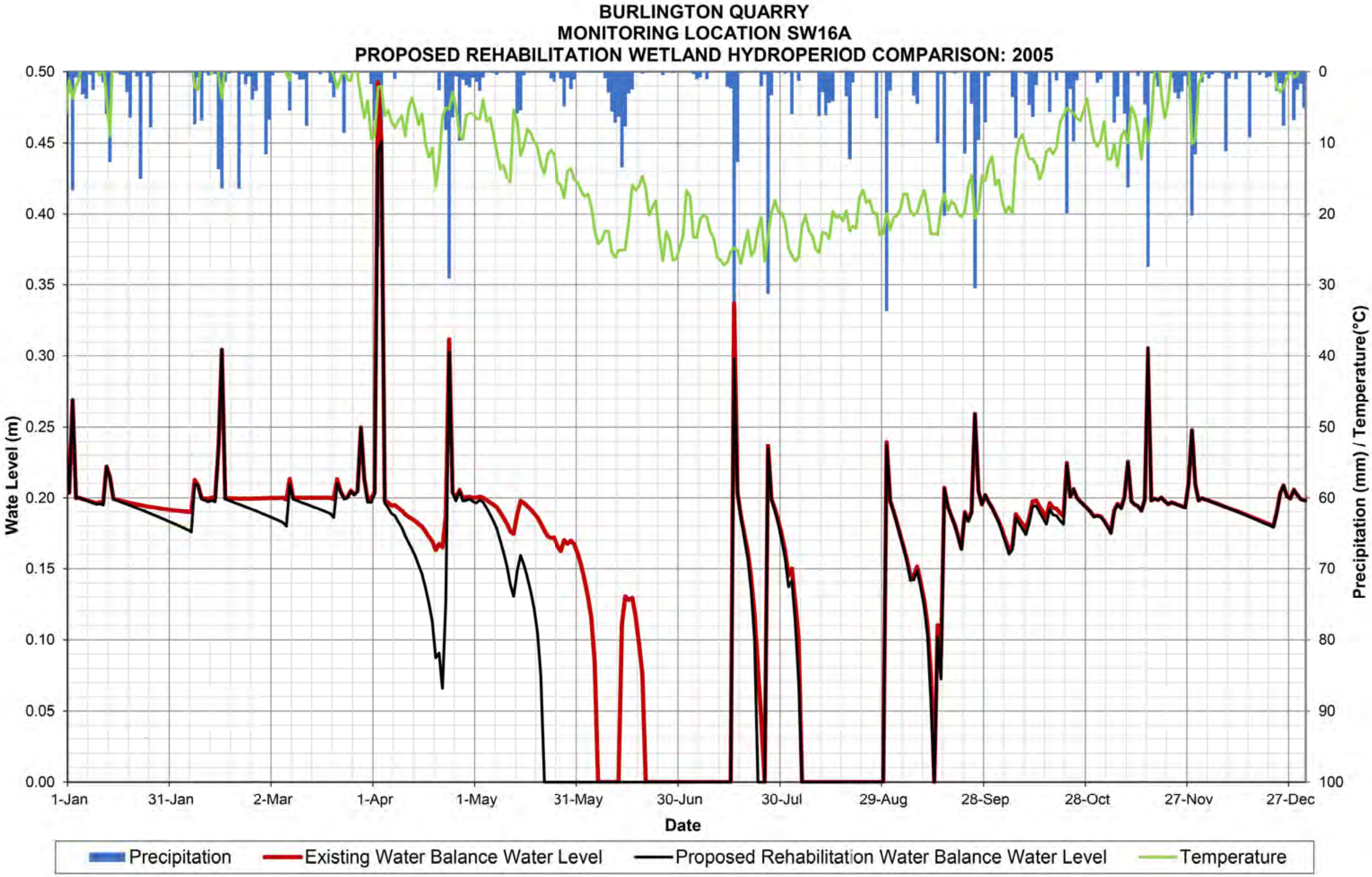
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2005
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
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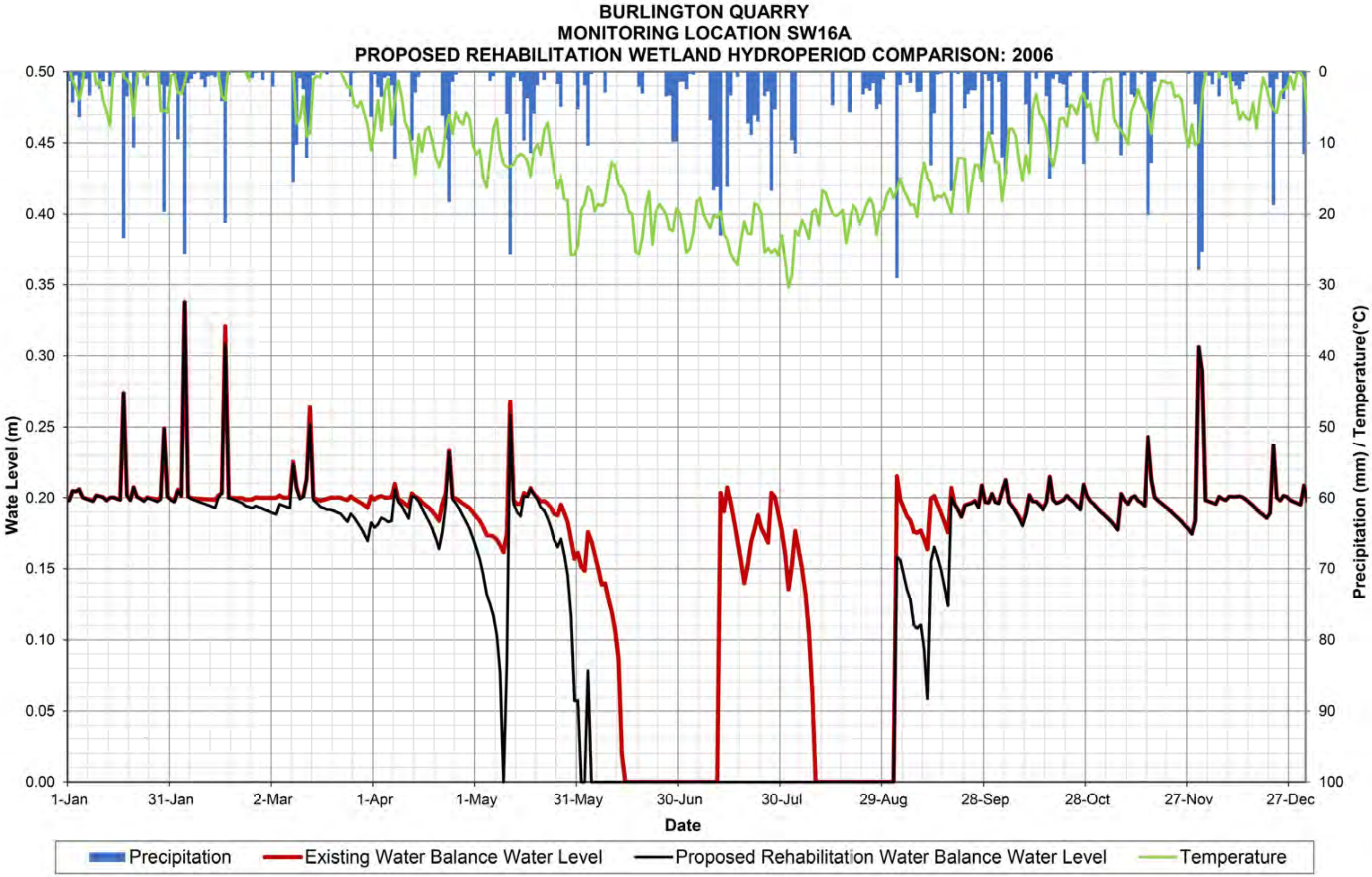
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2006
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
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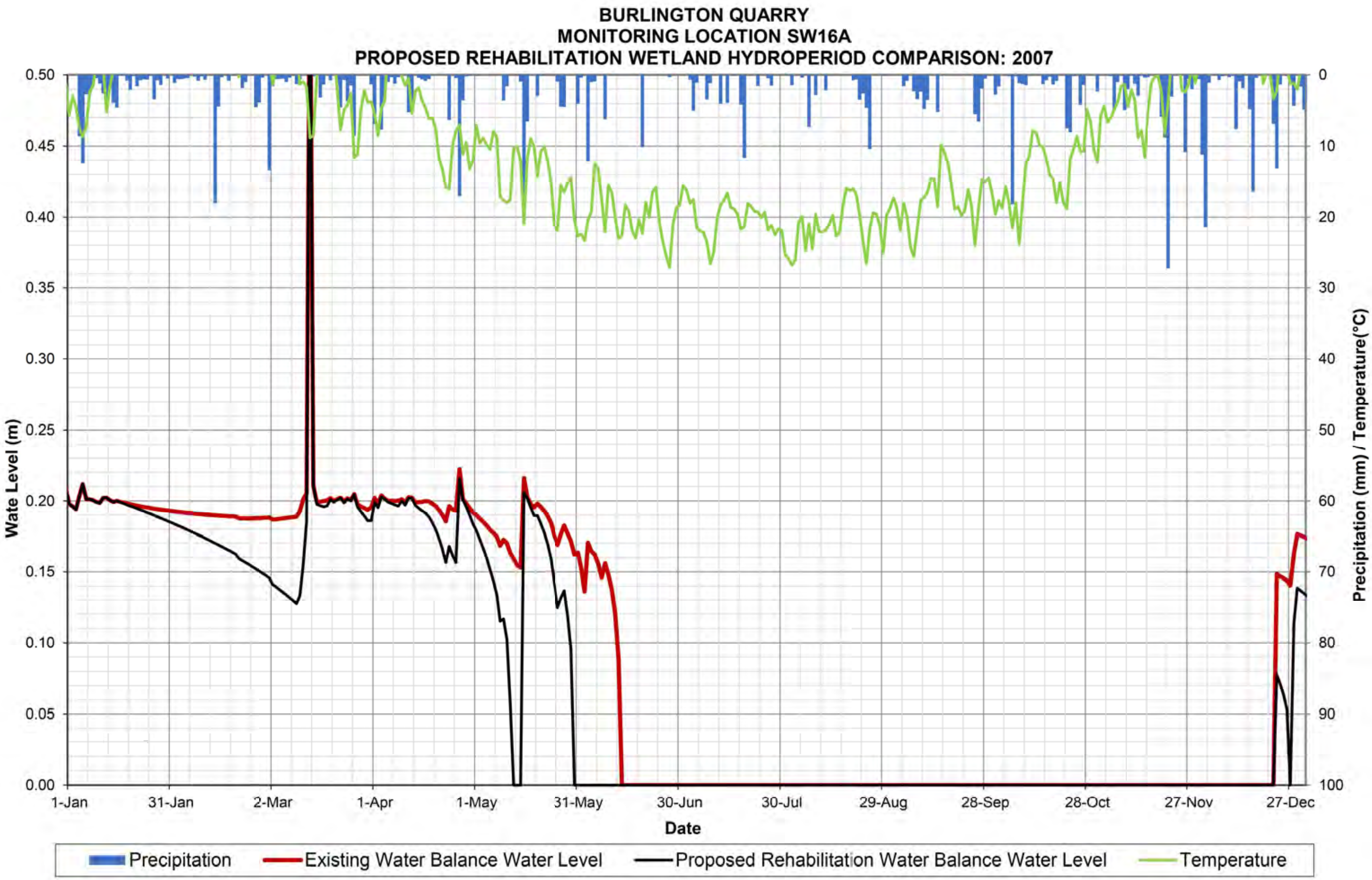
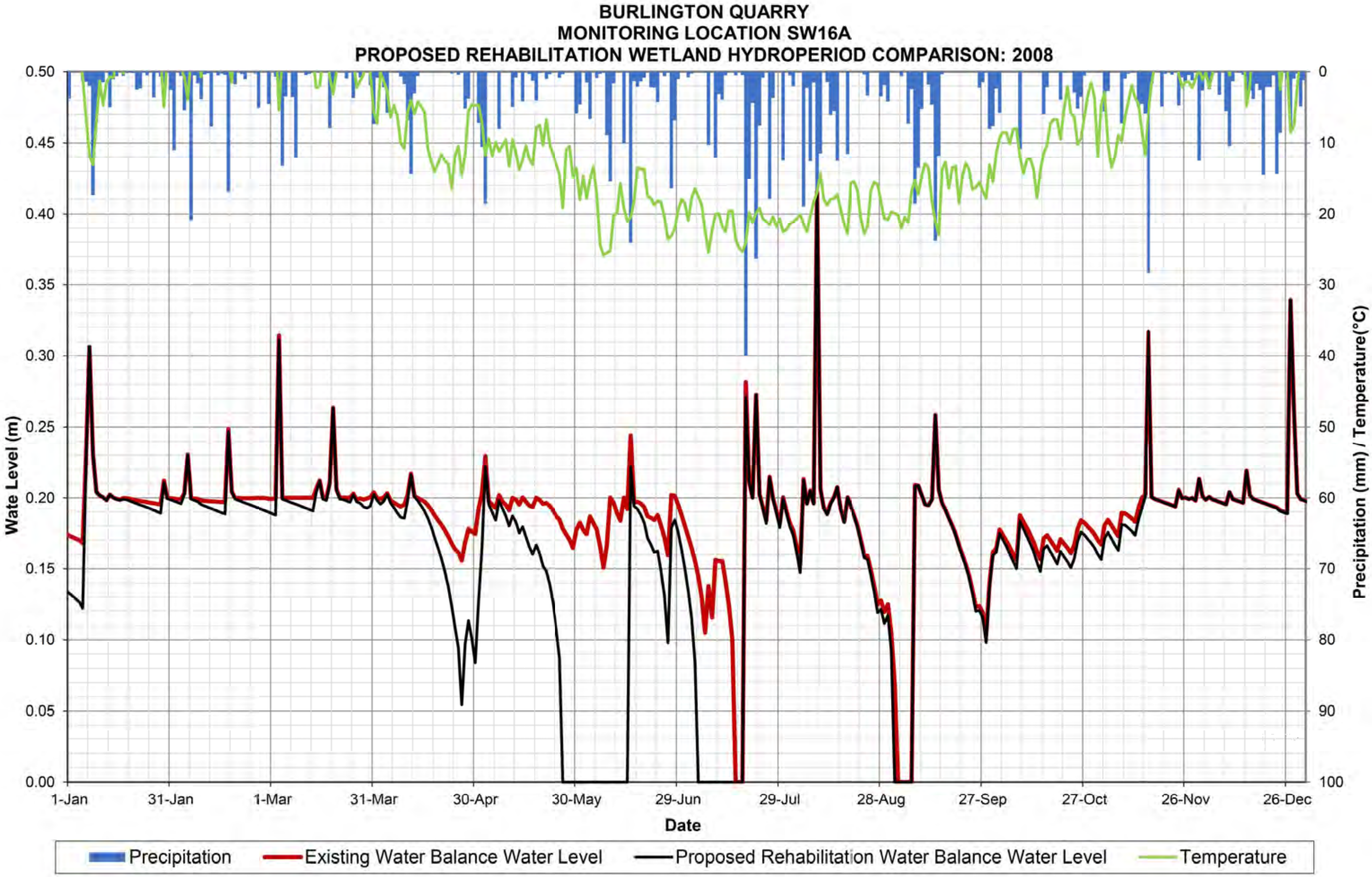
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2007
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2008
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
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10
20
30
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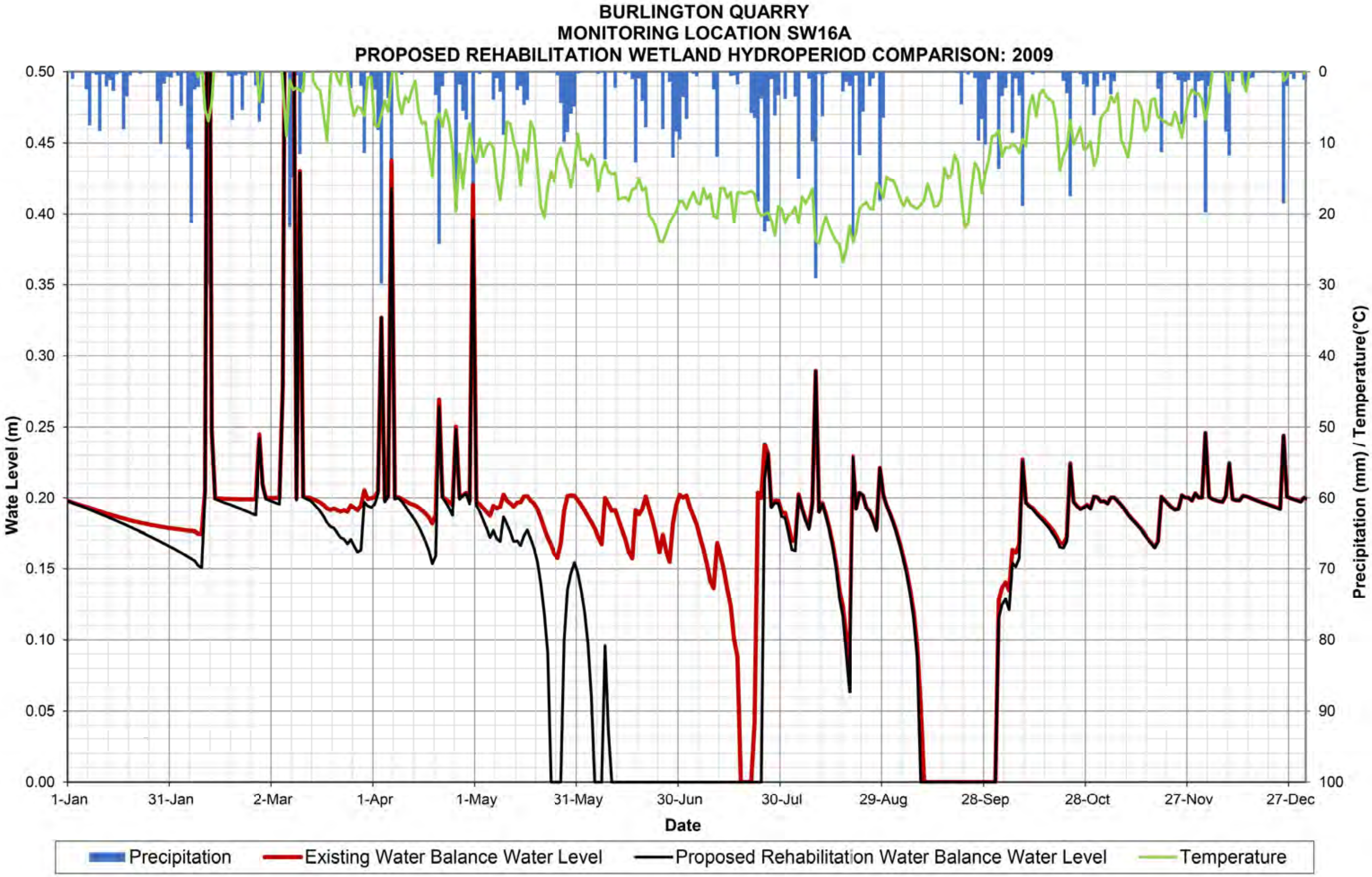
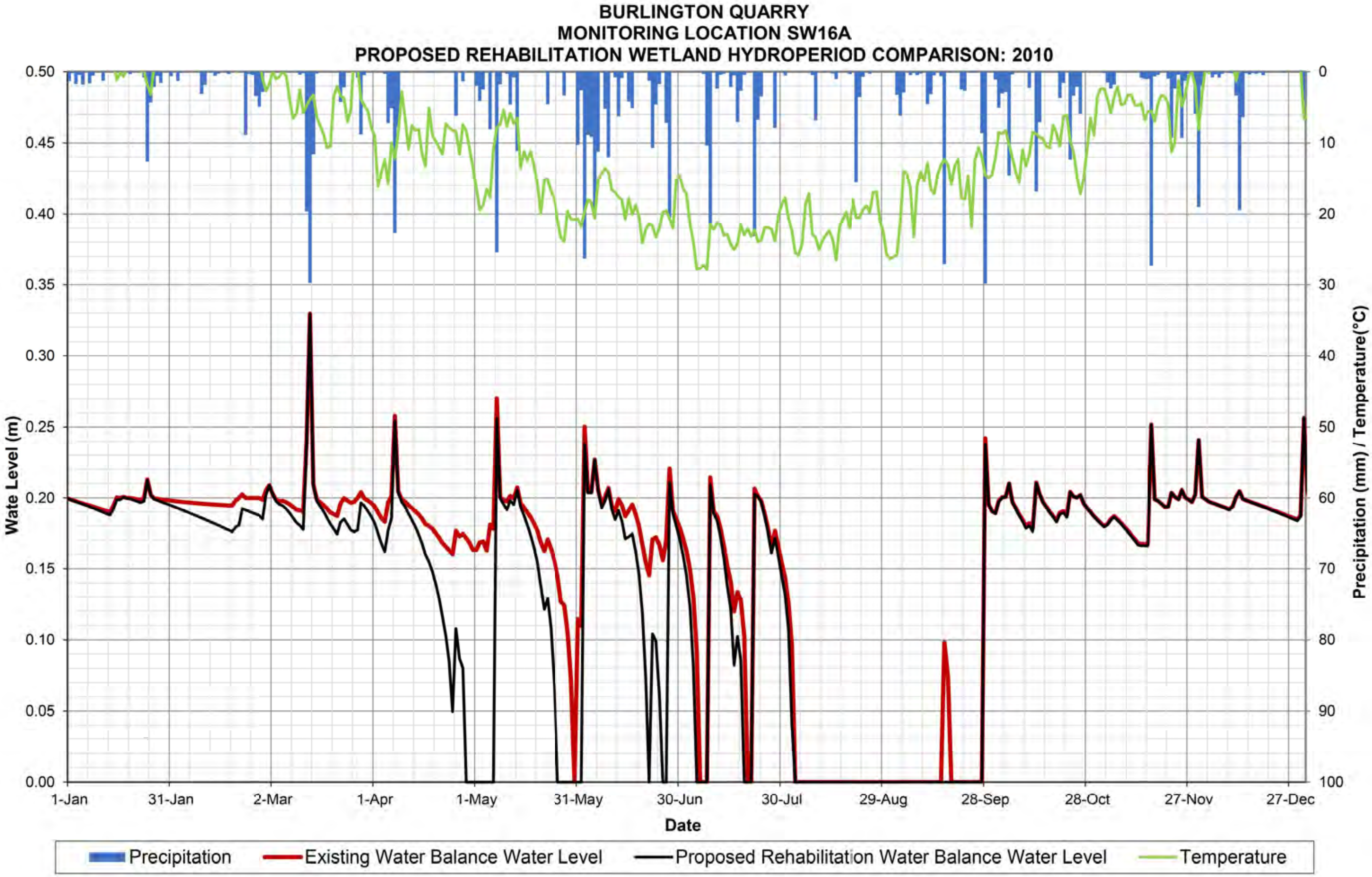
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2009
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2010
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
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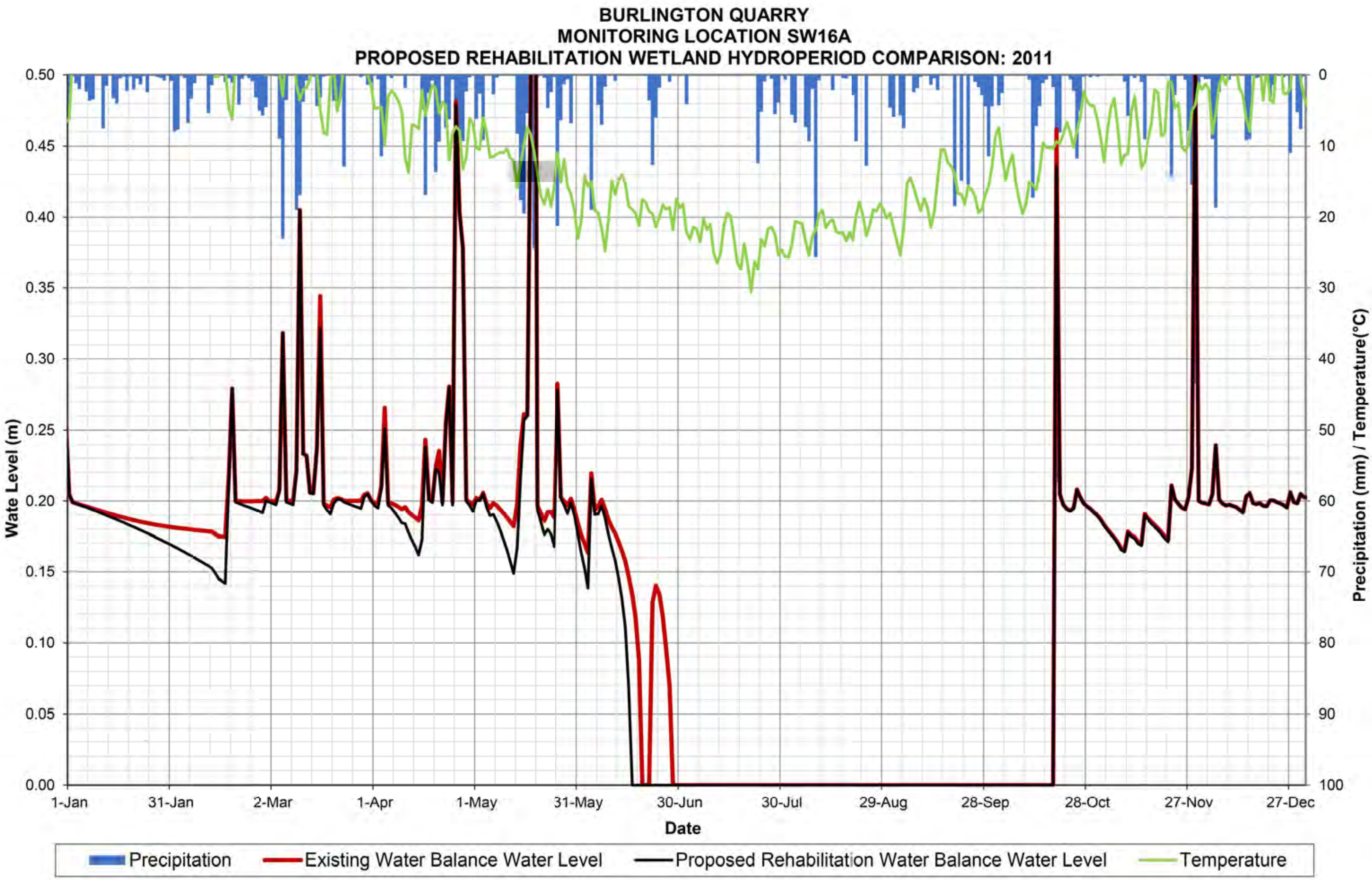
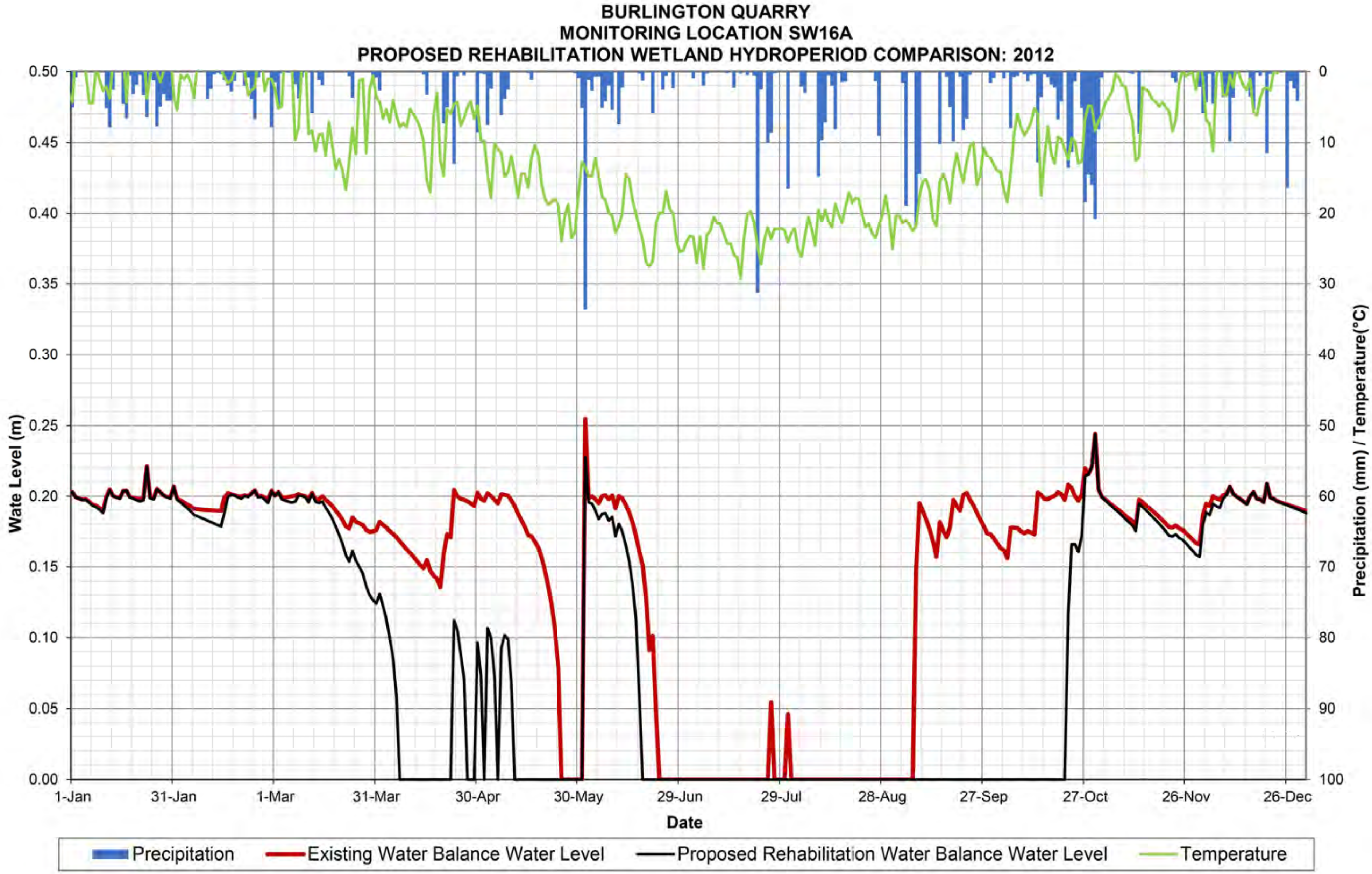
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2011
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2012
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
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70
80
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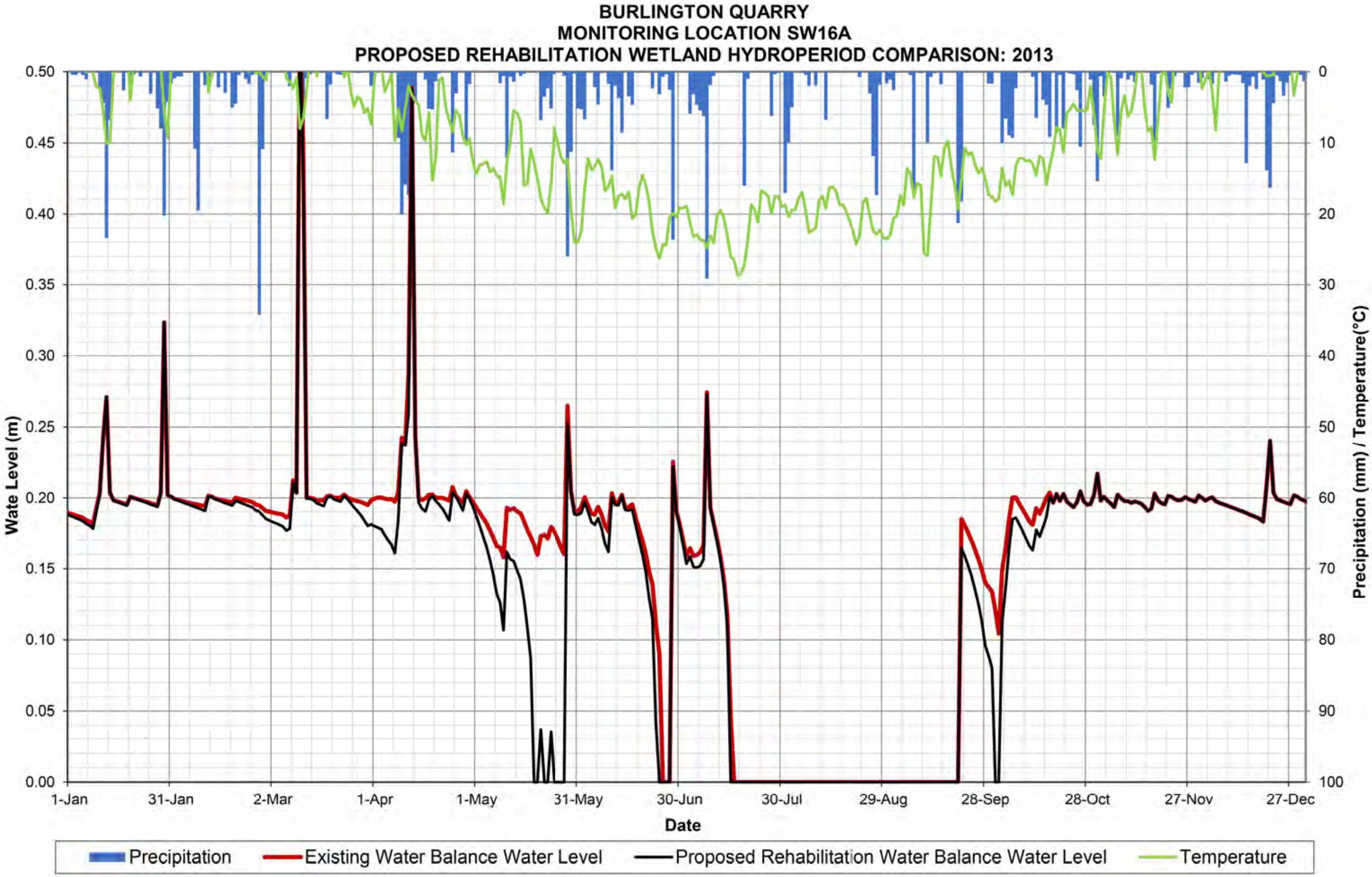
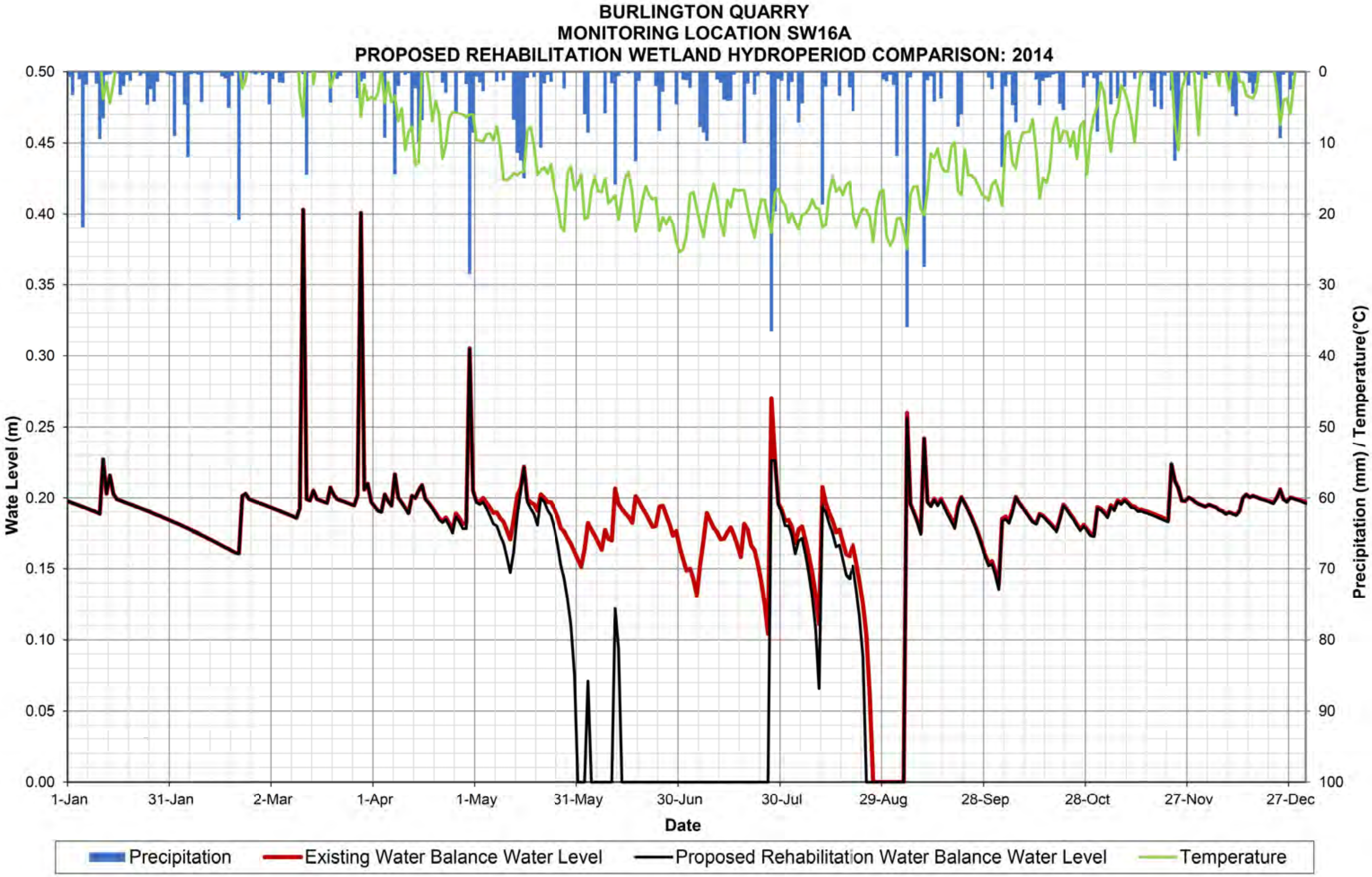
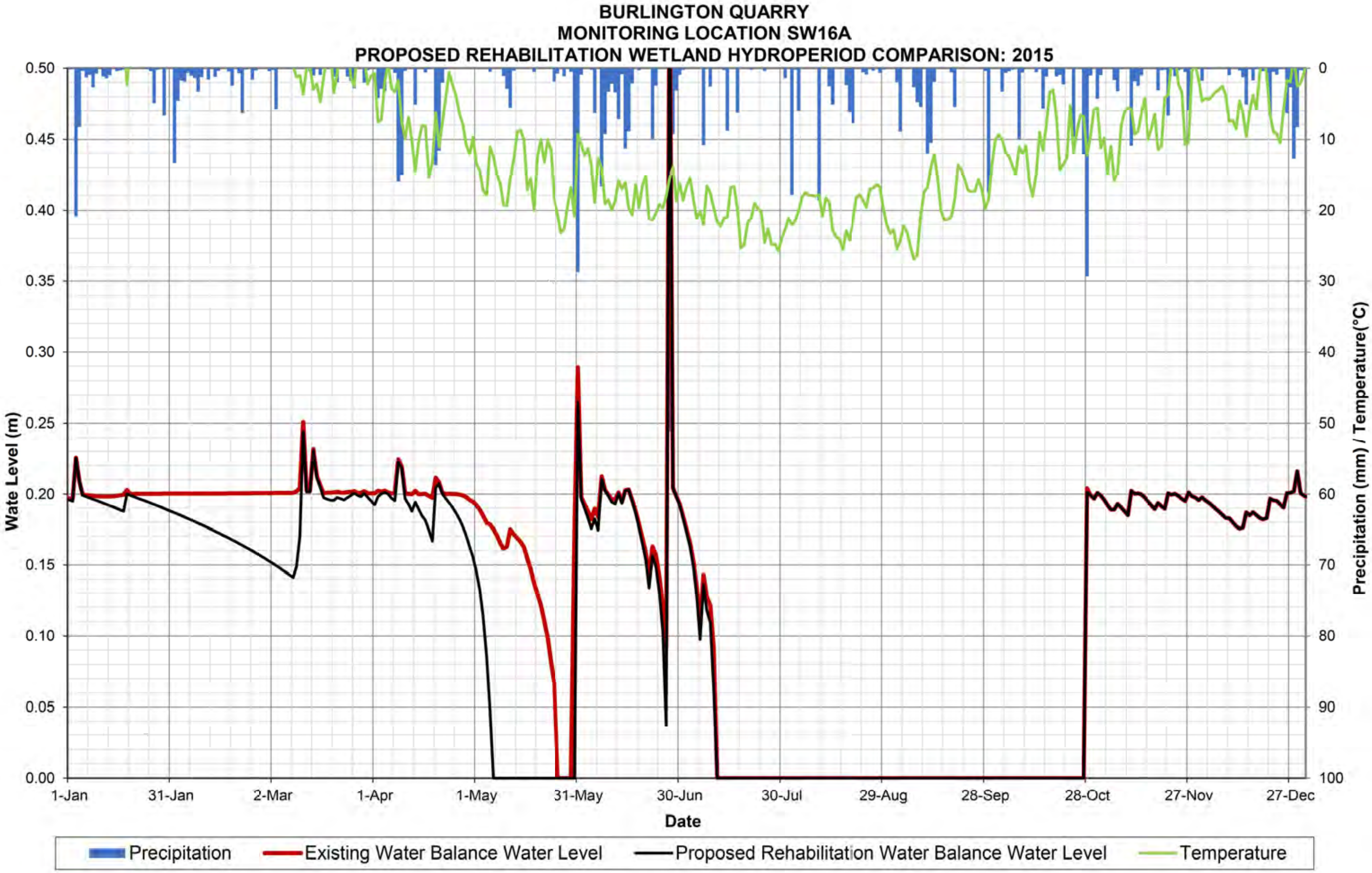
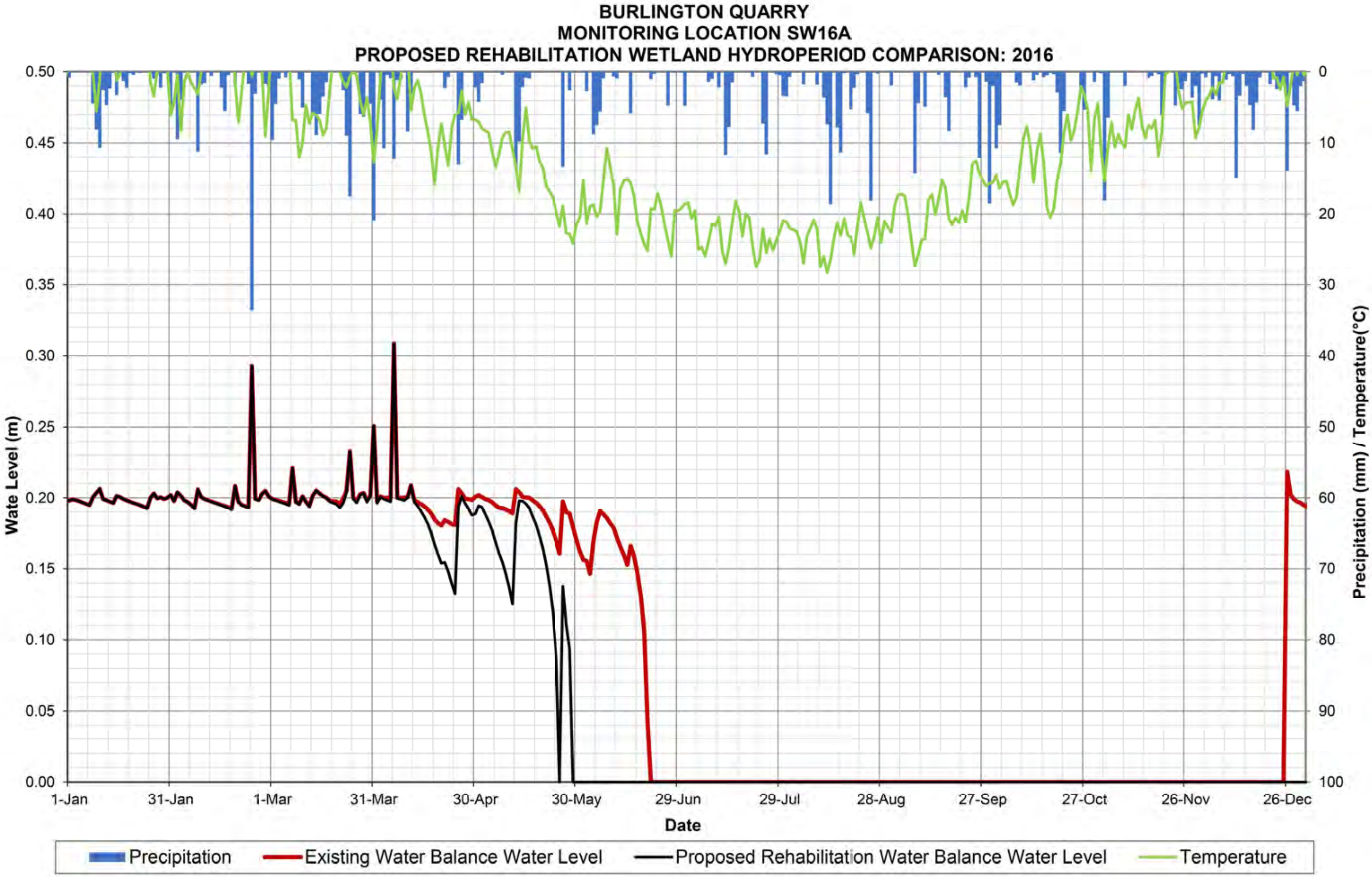
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

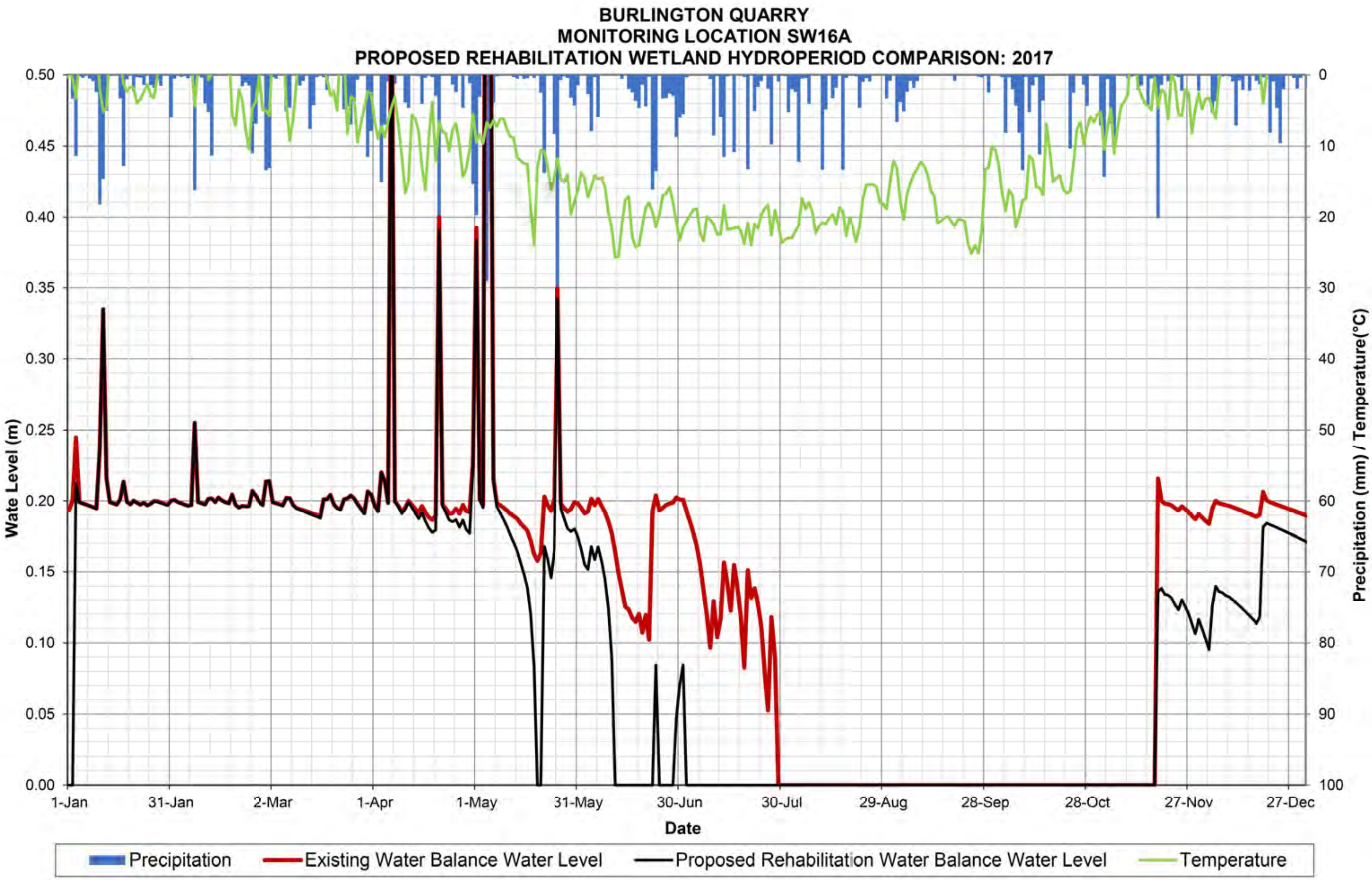


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2013
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

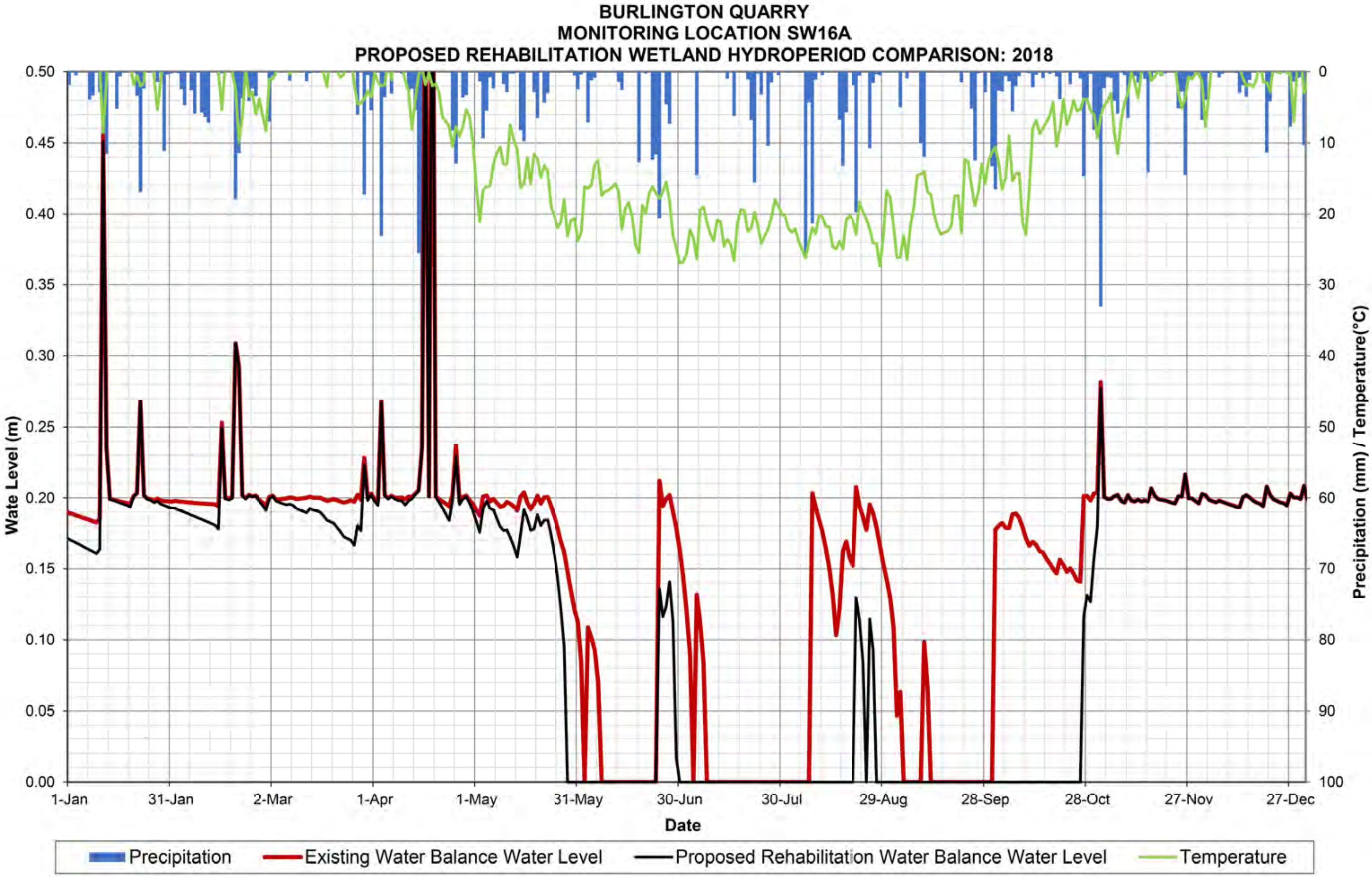

BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2014
Wate Level (m)
Precipitation (mm) / Temperature(°C)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

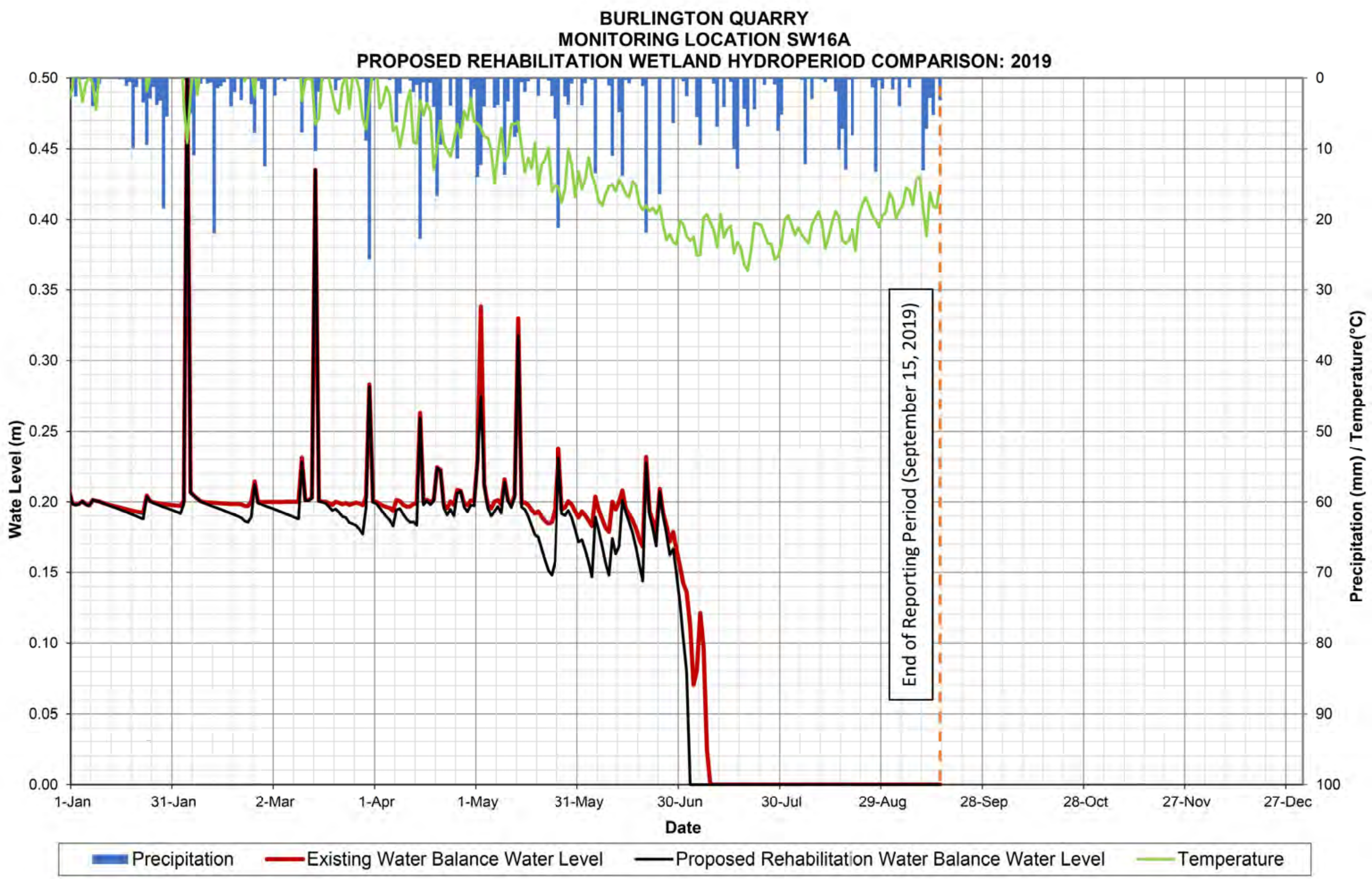

BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2015
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2016
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
1-Mar
31-Mar
30-Apr
30-May
29-Jun
29-Jul
28-Aug
27-Sep
27-Oct
26-Nov
26-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2017
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature


BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2018
Wate Level (m)
Precipitation (mm) / Temperature(°C)
Date
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature



BURLINGTON QUARRY
MONITORING LOCATION SW16A
PROPOSED REHABILITATION WETLAND HYDROPERIOD COMPARISON: 2019
Wate Level (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Precipitation (mm) / Temperature(°C)
0
10
20
30
40
50
60
70
80
90
100
1-Jan
31-Jan
2-Mar
1-Apr
1-May
31-May
30-Jun
30-Jul
29-Aug
28-Sep
28-Oct
27-Nov
27-Dec
Date
End of Reporting Period (September 15, 2019)
Precipitation
Existing Water Balance Water Level
Proposed Rehabilitation Water Balance Water Level
Temperature

Appendix S:
Proposed Conditions (Rehabilitation) Outlet Water Balance Results

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	June 23, 2023
SUBJECT	Proposed (Rehabilitation) Daily Water Balance Outlet Volumes	NAME	John Gore
		PAGE	1 OF 5

WEST ARM OF THE WEST BRANCH OF THE MOUNT NEMO TRIBUTARY OF GRINDSTONE CREEK																						
Month	**Year**																					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	1.5	0.0	1.4	0.0	1.9	0.0	0.8	4.3	8.6	2.5	3.2	1.3	1.3	1.7	5.9	8.5	3.0	2.1	0.0	4.2	5.4	0.6
February	7.9	0.7	7.4	4.9	2.5	0.0	0.0	7.6	23.0	0.0	4.3	19.7	0.1	2.9	3.0	1.4	0.2	0.0	2.5	4.4	8.7	9.8
March	25.3	2.2	0.7	25.4	2.7	12.8	24.3	9.8	6.5	11.0	15.6	40.4	7.3	32.8	0.8	28.1	13.9	4.7	9.5	8.5	1.0	11.8
April	3.1	0.8	6.2	9.3	4.6	2.5	9.2	20.6	2.0	1.2	1.8	15.9	2.3	21.5	0.0	14.2	11.9	3.3	13.7	26.5	33.7	12.3
May	0.3	0.0	10.5	2.0	3.6	6.2	3.6	0.2	1.9	0.1	0.6	4.6	0.8	25.0	0.0	0.4	4.0	0.0	0.0	27.9	0.5	13.6
June	0.0	0.0	6.1	0.6	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.3	0.0	0.2	0.0	6.0	0.0	0.2	0.0	0.5
July	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.8	0.0	1.5	0.0	0.0	0.0	0.0
August	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
September	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
October	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
November	0.0	4.9	0.0	0.0	0.0	3.7	0.0	2.6	0.7	0.0	4.7	0.4	0.1	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
December	0.0	1.8	0.0	1.6	0.0	4.5	0.0	2.9	7.7	0.0	9.2	5.8	1.9	7.9	0.4	2.9	0.8	0.0	0.0	0.0	0.0	
Total	**38.1**	**10.4**	**32.7**	**44.0**	**15.3**	**31.7**	**38.0**	**48.0**	**50.5**	**14.8**	**52.6**	**92.0**	**16.3**	**98.0**	**10.1**	**56.6**	**33.8**	**17.6**	**25.6**	**71.7**	**49.3**	**48.7**

* All volumes are in mm of runoff over drainage area

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	June 23, 2023
SUBJECT	Proposed (Rehabilitation) Daily Water Balance Outlet Volumes	NAME	John Gore
		PAGE	2 OF 5

EAST ARM OF THE WEST BRANCH OF THE MOUNT NEMO TRIBUTARY OF GRINDSTONE CREEK

Month	Year																					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	4.0	0.0	0.9	0.0	1.3	0.2	0.3	4.8	7.0	1.5	4.7	0.2	0.9	0.6	3.0	8.9	2.4	1.7	1.2	6.5	10.7	0.5
February	5.8	2.7	8.6	10.0	1.8	1.4	0.3	5.4	18.3	0.0	3.2	21.4	0.3	3.5	0.9	0.5	0.3	0.0	4.7	4.0	9.3	11.2
March	22.2	0.8	0.4	27.6	2.1	16.0	17.7	5.6	3.8	13.6	9.9	52.7	7.1	30.5	0.4	26.0	15.0	4.3	5.9	3.2	1.3	10.3
April	2.4	0.9	6.8	4.8	3.8	2.3	8.4	23.4	1.9	1.1	1.0	18.7	2.2	24.3	0.0	14.0	6.5	2.7	9.3	25.4	33.1	6.6
May	1.4	0.0	13.5	3.6	2.0	7.1	3.0	0.0	2.4	0.1	0.9	1.0	1.9	32.0	0.0	1.3	1.8	0.2	0.0	39.0	0.1	12.2
June	0.0	0.0	7.2	0.4	0.1	1.9	0.0	0.0	0.0	0.0	0.2	0.0	3.1	0.4	0.0	0.4	0.0	11.4	0.0	0.0	0.0	1.2
July	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	5.4	1.0	0.0	0.0	0.0	2.0	0.1	0.2	0.0	0.0	0.0	0.0
August	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	8.6	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
September	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	3.1	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0
October	0.0	1.2	0.0	0.0	0.0	1.0	0.0	1.2	1.0	0.0	0.0	1.8	1.2	5.3	2.2	1.1	0.0	0.0	0.0	0.0	0.0	
November	0.0	9.2	0.2	1.0	0.0	5.5	0.0	7.2	5.1	0.0	5.5	0.5	4.0	10.3	0.3	0.8	1.8	0.0	0.0	0.0	2.4	
December	0.0	1.3	0.1	1.4	1.0	3.3	2.9	1.6	6.4	0.0	8.6	5.2	2.3	4.6	1.1	2.6	0.8	0.5	0.0	0.0	1.5	
Total	**35.7**	**16.0**	**37.7**	**48.8**	**12.0**	**38.7**	**32.6**	**53.2**	**45.9**	**16.2**	**51.1**	**107.5**	**23.0**	**111.6**	**7.9**	**57.6**	**31.6**	**21.0**	**21.2**	**78.2**	**58.4**	**42.0**

* All volumes are in mm of runoff over drainage area

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	June 23, 2023
SUBJECT	Proposed (Rehabilitation) Daily Water Balance Outlet Volumes	NAME	John Gore
		PAGE	3 OF 5

WEIR POND (WETLAND 13202)

Month	Year																					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	3.6	2.4	1.2	0.3	4.4	0.3	1.6	15.9	24.6	8.5	4.8	0.0	5.7	1.8	17.7	22.0	10.4	8.5	3.4	5.6	19.2	4.2
February	12.0	6.4	16.7	19.3	12.4	1.5	4.1	18.9	19.0	0.0	7.4	34.7	3.6	10.4	7.2	2.1	3.8	0.0	19.4	15.2	23.4	23.1
March	29.1	0.9	2.8	43.1	12.8	18.3	41.2	21.0	12.9	26.5	25.9	32.8	20.6	43.6	3.3	30.4	34.5	19.7	25.0	16.9	6.7	27.0
April	9.1	3.8	16.4	5.2	17.2	8.5	10.5	20.5	10.6	7.4	5.9	31.9	7.9	26.6	1.2	24.1	19.5	13.3	11.2	25.9	37.1	17.0
May	1.7	1.3	22.1	7.8	12.3	19.9	12.9	0.4	7.0	1.0	4.7	1.0	4.1	29.4	0.3	3.5	7.6	2.3	1.7	30.0	1.7	16.4
June	0.8	0.7	20.4	3.4	0.9	6.6	1.4	0.3	0.3	0.3	2.3	1.7	10.3	1.2	0.4	2.6	1.0	12.0	0.3	1.4	1.5	4.7
July	0.2	0.0	0.6	0.0	0.0	0.0	0.9	0.8	3.0	0.0	8.7	2.8	0.1	0.0	0.0	1.4	2.7	0.0	0.0	0.1	0.0	0.1
August	0.0	0.0	0.5	0.0	0.0	0.1	0.0	1.2	0.0	0.0	19.1	12.5	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.7	1.6	0.3
September	0.0	2.6	2.2	0.6	1.5	4.0	0.6	3.6	3.1	0.0	10.7	0.8	0.8	3.0	0.4	2.4	3.1	1.0	1.2	0.0	1.2	0.6
October	0.0	3.2	0.3	5.1	1.3	2.7	1.3	2.3	3.4	1.0	1.0	7.2	2.8	5.7	6.6	4.1	1.5	3.4	1.5	1.9	2.6	
November	1.0	3.9	2.1	3.4	2.6	12.7	3.7	5.5	13.9	3.0	18.5	4.6	3.7	12.8	0.4	6.7	2.9	1.0	1.9	2.9	4.1	
December	1.2	1.3	0.4	1.8	1.6	15.8	8.0	9.6	18.0	3.0	23.7	18.3	6.8	18.7	2.1	11.4	6.0	1.6	2.4	0.8	9.3	
Total	**58.7**	**26.4**	**85.6**	**89.9**	**67.1**	**90.4**	**86.2**	**99.8**	**115.6**	**50.6**	**132.7**	**148.1**	**66.5**	**153.3**	**39.4**	**110.6**	**93.2**	**62.7**	**68.1**	**101.5**	**108.4**	**93.4**

* All volumes are in mm of runoff over drainage area

TATHAM ENGINEERING

PROJECT	Burlington Quarry	FILE	113187
		DATE	June 23, 2023
SUBJECT	Proposed (Rehabilitation) Daily Water Balance Outlet Volumes	NAME	John Gore
		PAGE	4 OF 5

BURLINGTON QUARRY																						
Month	**Year**																					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	72.8	46.1	34.5	21.8	38.6	21.6	23.0	64.9	87.6	42.2	85.3	21.3	30.3	20.2	69.8	98.4	44.5	39.2	44.3	98.0	87.1	26.9
February	75.1	103.0	68.8	71.2	48.2	35.6	27.3	70.6	76.6	14.6	54.7	114.8	23.0	43.4	36.9	24.5	24.6	14.6	66.1	65.9	81.9	81.1
March	102.3	31.3	27.2	142.5	51.1	100.7	135.0	74.7	55.3	88.8	93.1	116.3	76.5	151.7	21.4	111.8	110.6	67.2	89.5	66.8	38.1	94.9
April	42.6	36.8	60.6	35.9	71.9	44.6	49.9	85.6	43.9	38.1	30.1	108.2	31.3	94.7	20.1	90.3	80.7	51.4	57.2	100.3	126.0	69.2
May	18.3	14.5	79.8	43.4	47.2	70.5	54.0	8.9	35.1	13.4	30.9	22.7	28.5	106.3	7.3	29.6	38.3	18.2	16.7	100.0	19.4	66.2
June	13.8	13.1	76.1	15.7	10.5	23.1	15.2	6.2	6.6	5.3	25.7	15.3	50.2	12.7	18.8	23.1	12.7	61.0	5.6	15.1	17.7	27.7
July	6.7	13.3	16.1	4.3	13.7	10.9	19.5	32.4	28.8	4.6	52.7	35.1	18.3	4.1	15.7	21.9	27.9	5.0	7.1	12.4	9.6	9.9
August	4.3	9.2	8.8	10.9	2.6	7.7	6.5	19.1	7.8	4.7	60.6	46.8	5.1	17.9	10.0	11.7	9.7	13.1	15.0	12.5	26.1	13.3
September	4.7	28.2	21.9	15.0	25.0	39.8	9.5	35.7	38.8	6.7	43.5	8.1	27.6	30.4	27.8	21.2	32.7	15.5	17.2	4.9	15.0	7.9
October	9.7	46.5	11.2	66.5	23.8	40.2	18.0	35.1	52.9	16.4	20.2	49.0	39.5	81.6	89.7	60.0	25.1	42.8	21.1	23.2	37.0	
November	22.7	62.5	37.6	55.2	48.3	87.1	58.9	81.7	62.6	50.2	63.5	26.7	58.2	77.1	16.5	31.4	41.5	25.5	37.2	50.8	69.3	
December	31.6	36.0	21.0	43.9	39.6	64.0	67.3	42.5	66.5	55.4	84.4	63.5	39.4	76.2	45.0	44.7	30.6	38.2	47.2	27.5	47.9	
Total	**404.6**	**440.6**	**463.6**	**526.2**	**420.5**	**545.7**	**484.2**	**557.6**	**562.3**	**340.3**	**644.6**	**627.9**	**428.0**	**716.3**	**378.9**	**568.6**	**478.9**	**391.7**	**424.3**	**577.3**	**575.2**	**397.1**

* All volumes are in mm of runoff over drainage area

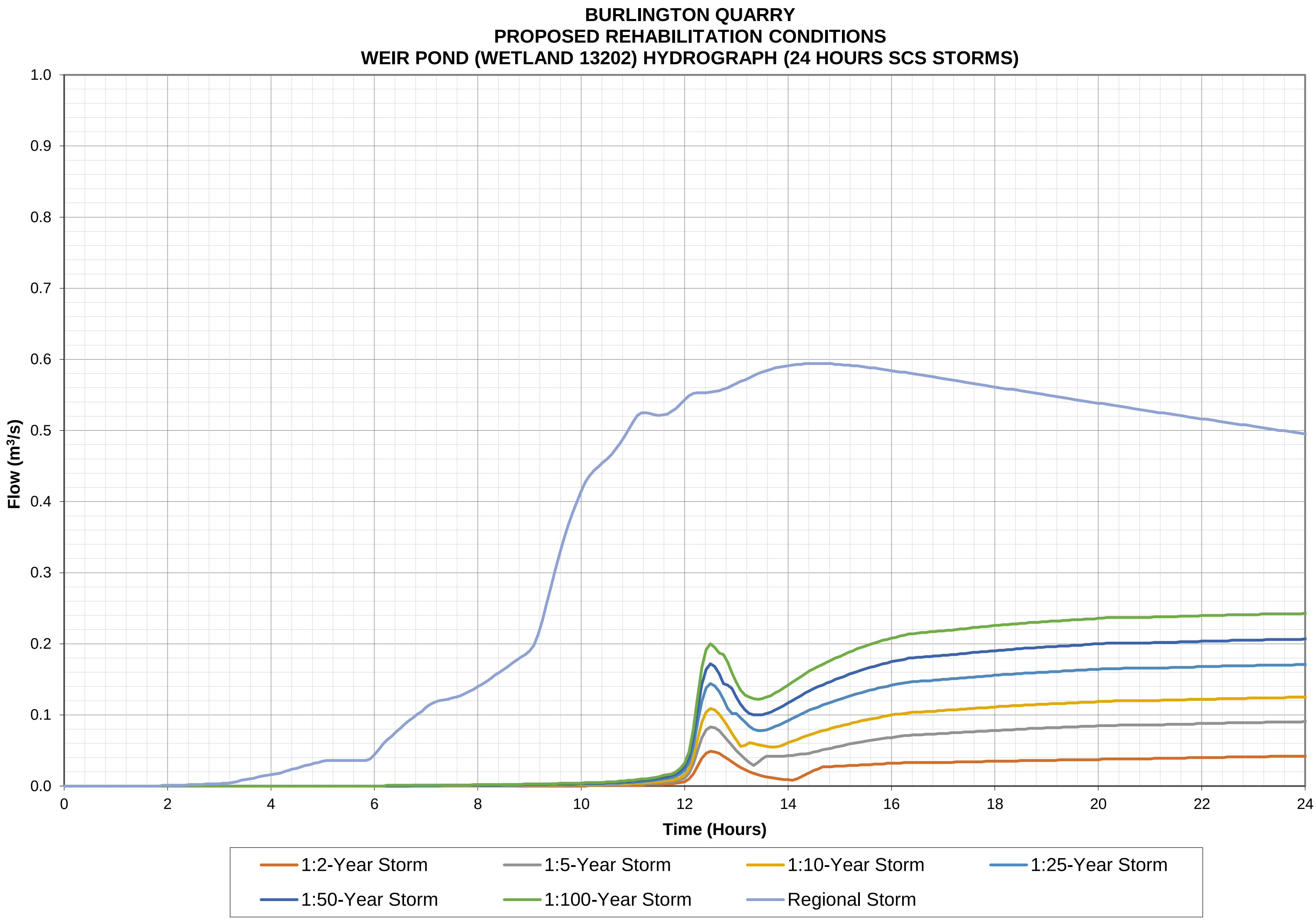
TATHAM ENGINEERING

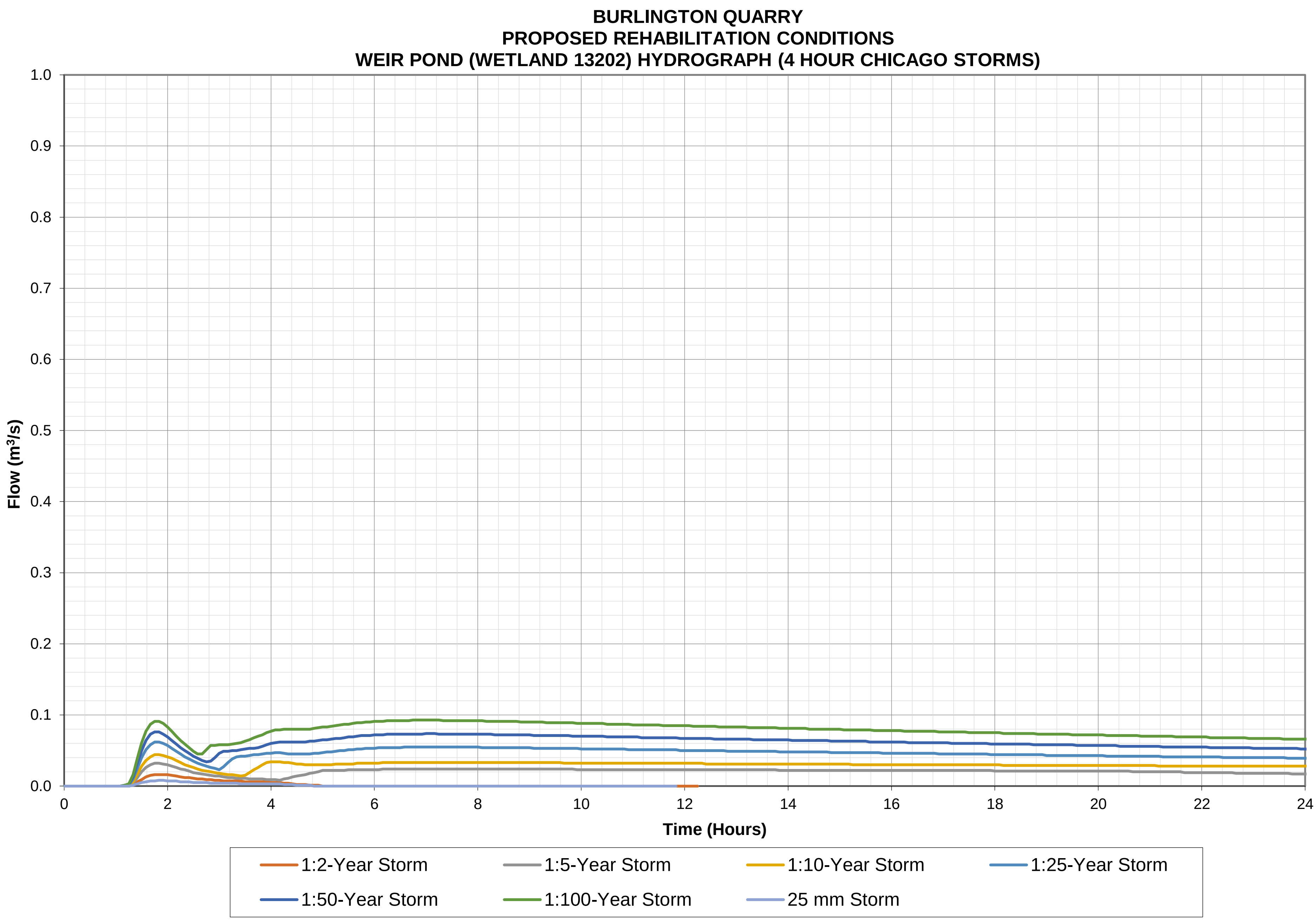
PROJECT	Burlington Quarry	FILE	113187
		DATE	June 23, 2023
SUBJECT	Proposed (Rehabilitation) Daily Water Balance Outlet Volumes	NAME	John Gore
		PAGE	5 OF 5

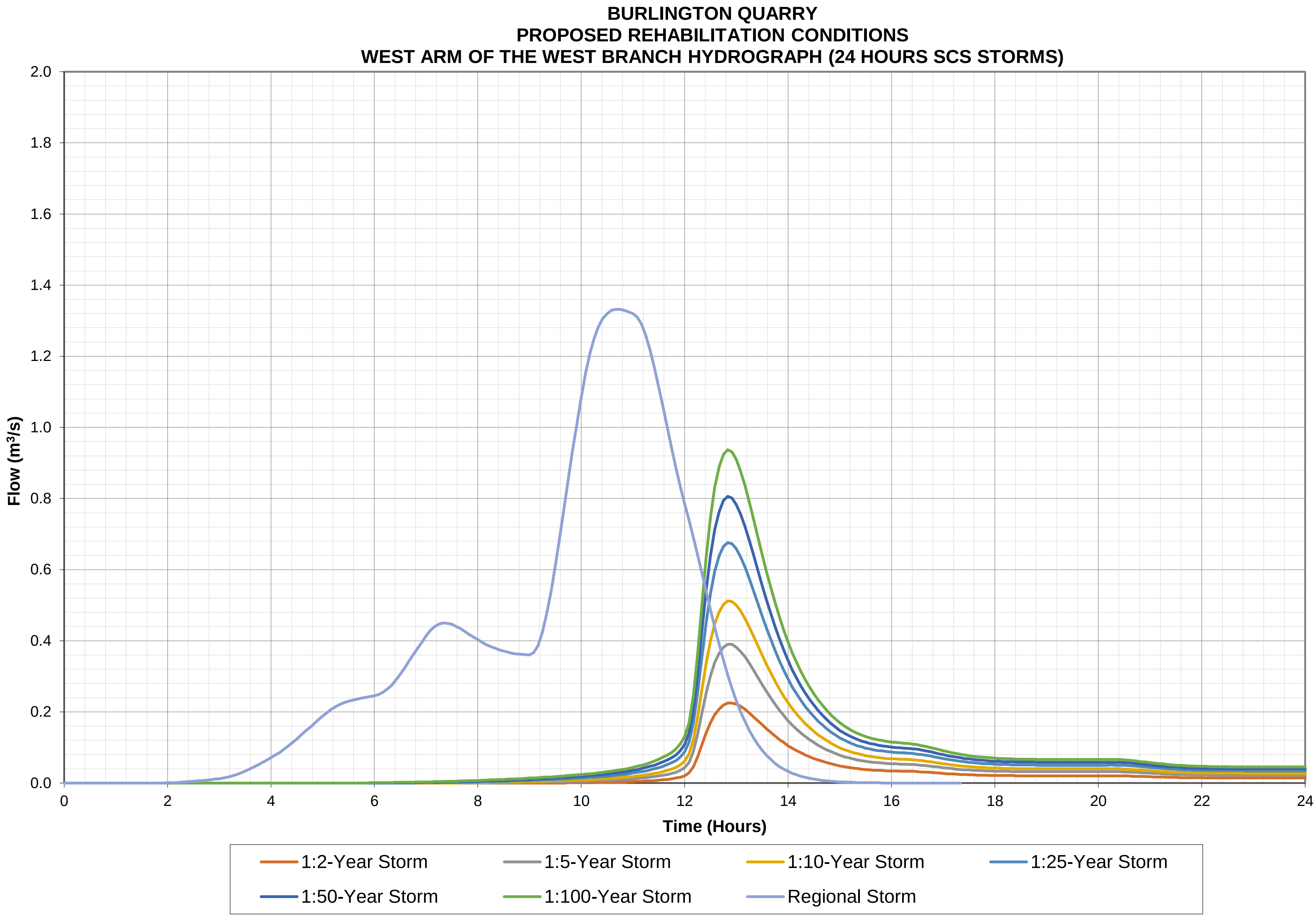
WETLAND 13021																						
Month	**Year**																					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
January	9.3	0.0	3.1	0.0	3.8	0.0	1.4	4.2	20.3	4.7	1.8	0.0	2.4	0.5	16.5	18.0	5.6	0.3	0.0	2.2	2.6	0.0
February	16.8	0.0	11.5	3.6	5.9	0.0	0.0	15.4	24.3	0.0	7.3	30.0	0.5	4.3	2.5	0.4	0.3	0.0	3.1	13.8	16.6	12.3
March	32.1	2.1	0.4	44.3	6.4	14.6	40.7	17.9	10.9	15.5	25.1	38.7	12.1	44.9	1.2	33.9	29.2	8.7	22.4	15.5	2.2	25.0
April	4.1	1.0	9.0	2.0	14.6	4.7	8.4	20.4	3.7	2.3	2.8	28.6	3.9	27.8	0.0	20.1	17.1	6.5	11.8	28.5	42.1	15.4
May	0.0	0.0	13.6	1.9	8.6	9.7	7.8	0.0	2.5	0.0	0.8	0.0	0.1	27.5	0.0	0.0	3.3	0.0	0.0	29.3	0.0	16.2
June	0.0	0.0	10.3	1.2	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0
July	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
August	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.8	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
September	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
October	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
November	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.5	0.0	8.9	1.3	0.0	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
December	0.0	0.8	0.0	0.1	0.0	9.4	0.0	1.8	10.4	0.0	21.1	10.5	0.0	10.7	0.0	2.8	0.0	0.0	0.0	0.0	0.0	
Total	**62.3**	**3.9**	**48.0**	**53.2**	**39.3**	**45.6**	**58.3**	**59.7**	**72.7**	**22.5**	**85.0**	**111.4**	**22.7**	**123.0**	**20.2**	**75.1**	**55.6**	**21.2**	**37.3**	**89.3**	**63.4**	**68.9**

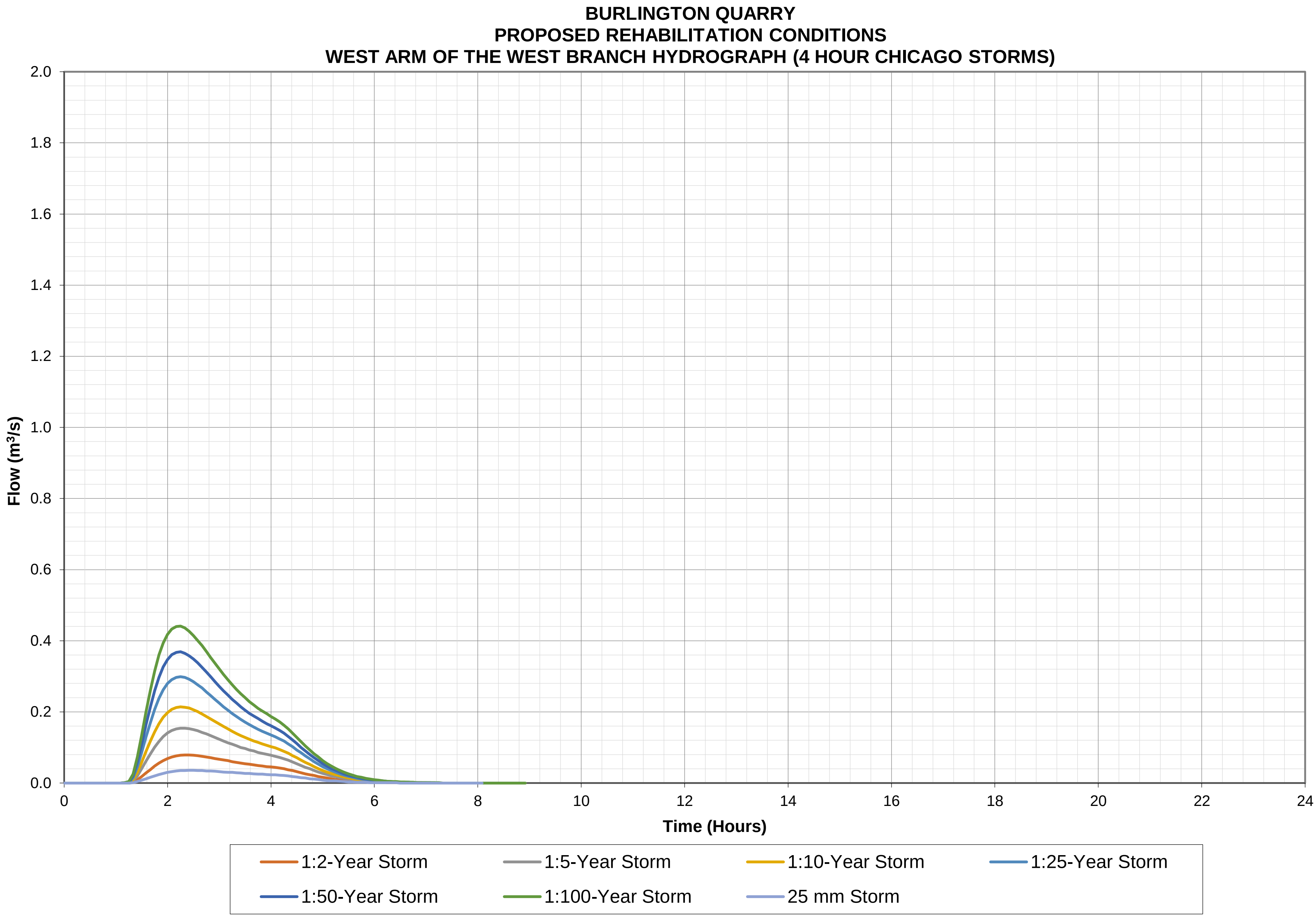
* All volumes are in mm of runoff over drainage area

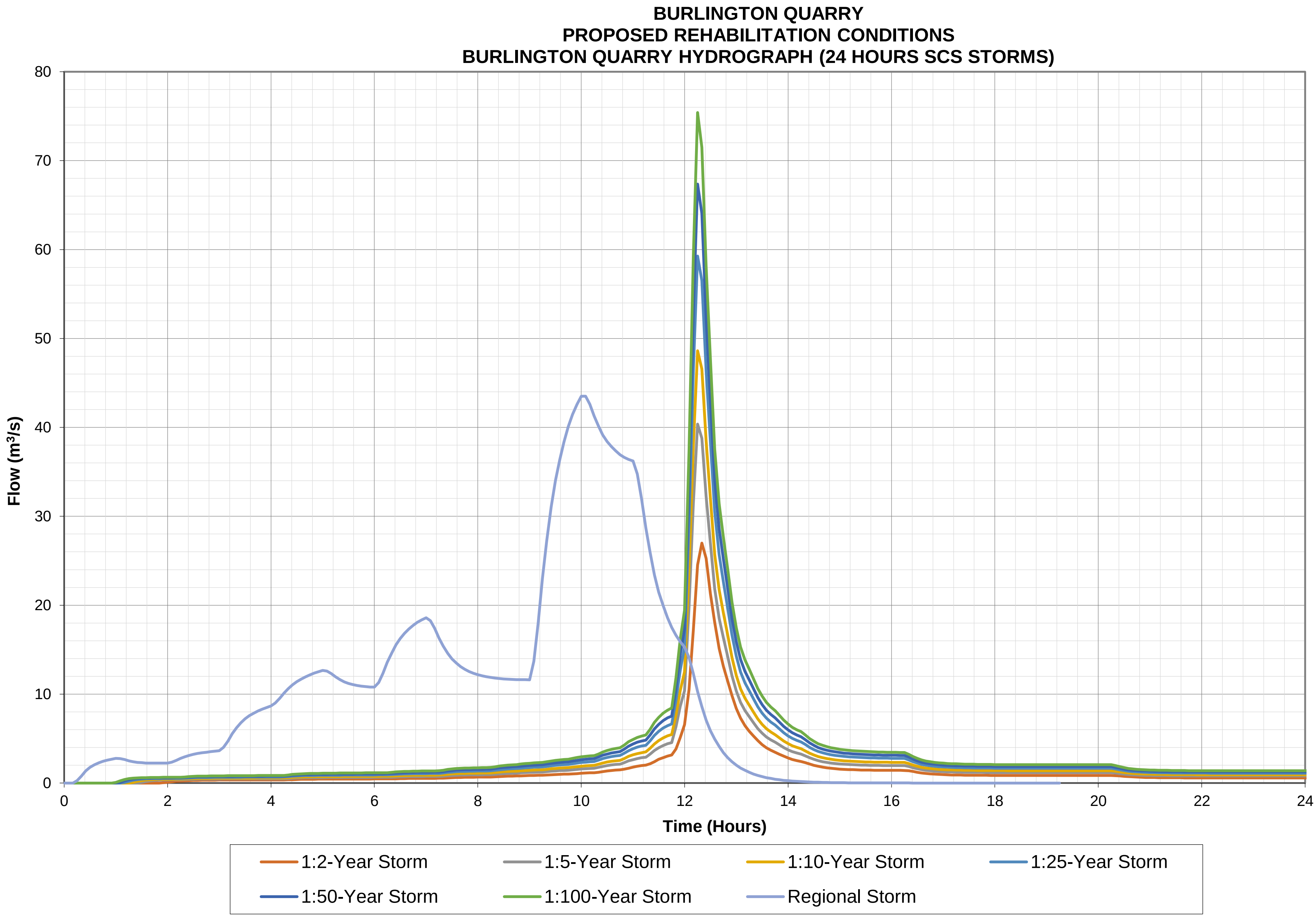
Appendix T:
Proposed Conditions (Rehabilitation) Event Based Hydrologic Model Results

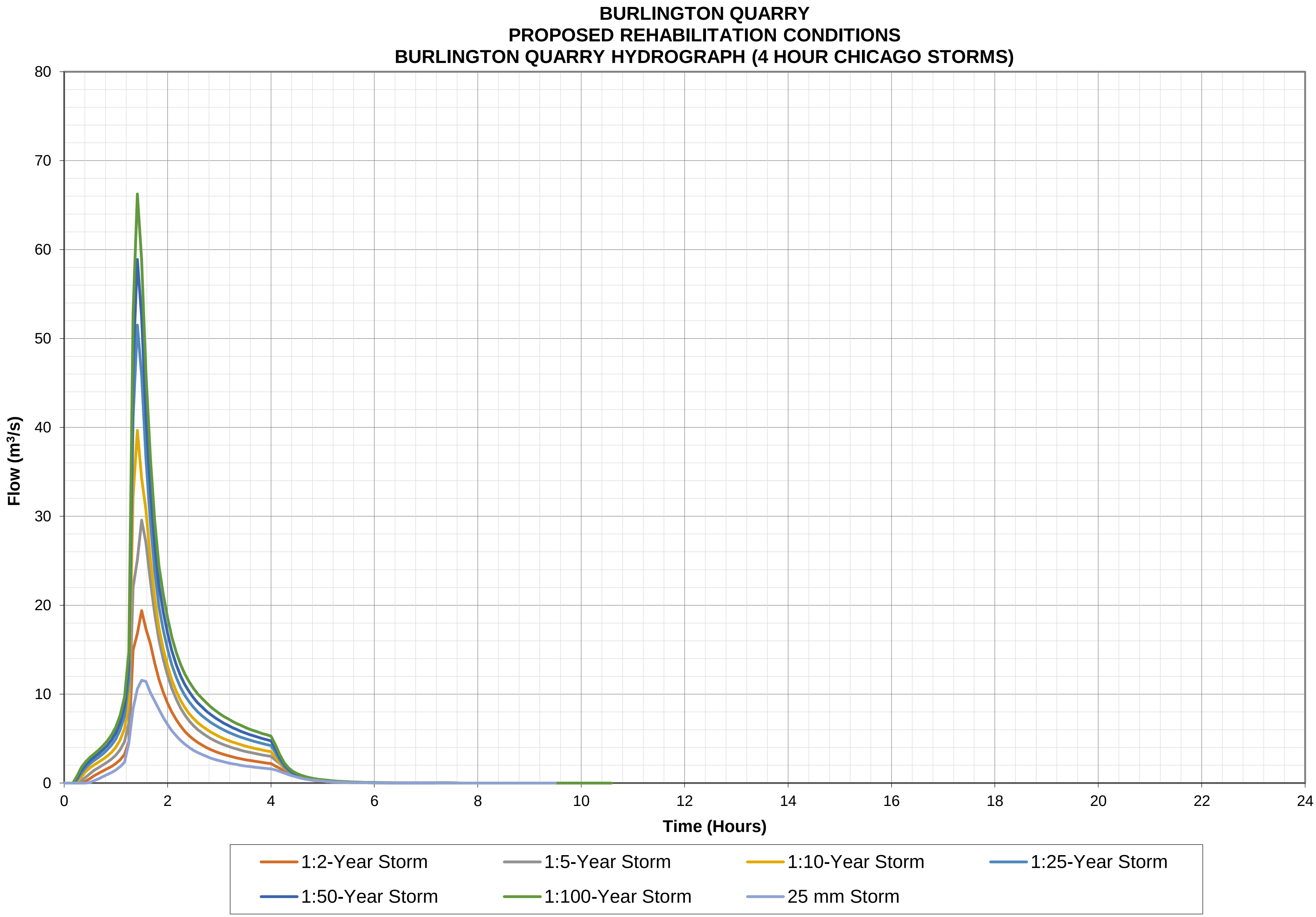

BURLINGTON QUARRY
PROPOSED REHABILITATION CONDITIONS
WEIR POND (WETLAND 13202) HYDROGRAPH (24 HOURS SCS STORMS)
Flow (m³/s)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
Regional Storm

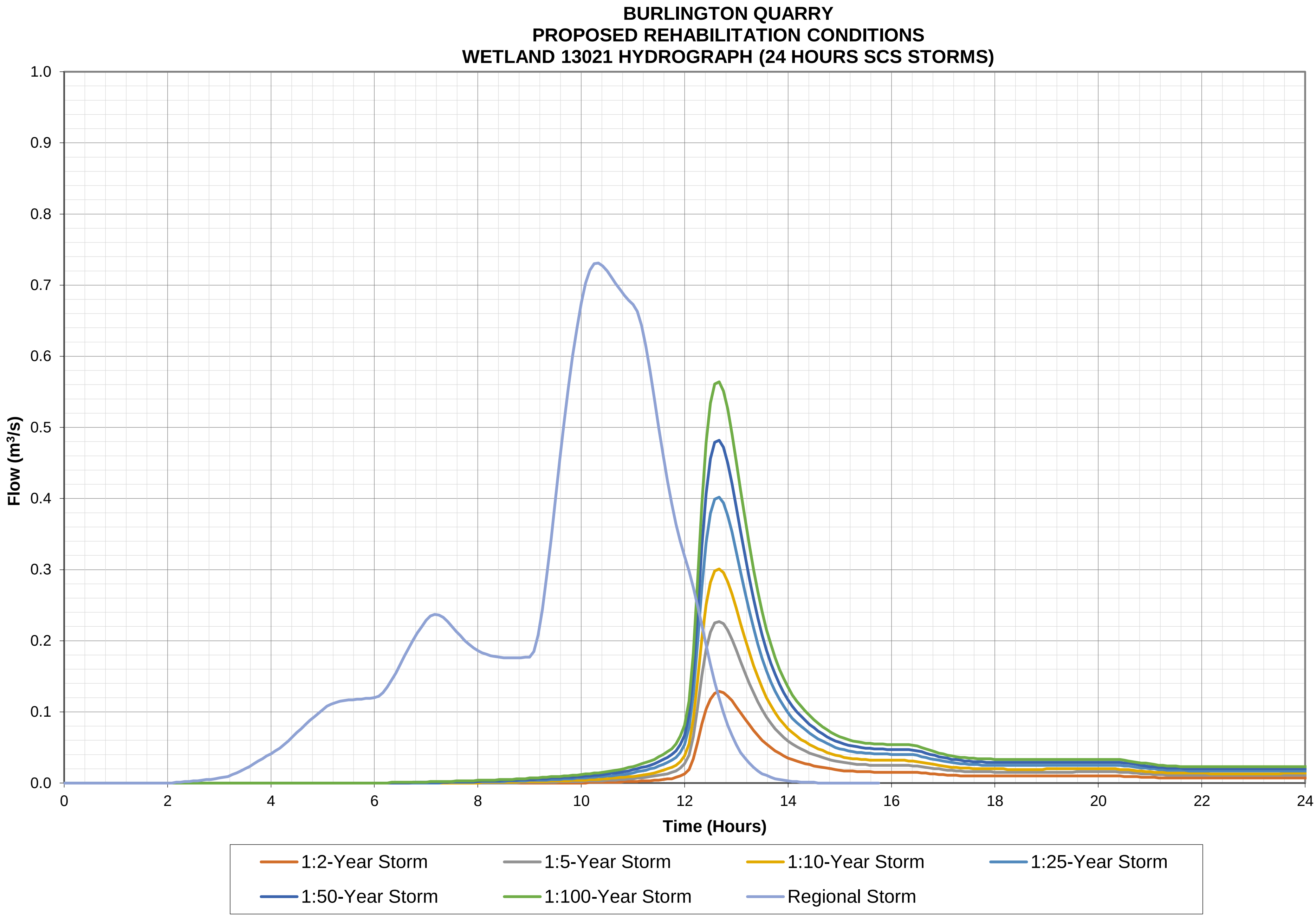

BURLINGTON QUARRY
PROPOSED REHABILITATION CONDITIONS
WEIR POND (WETLAND 13202) HYDROGRAPH (4 HOUR CHICAGO STORMS)
Flow (m³/s)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
25 mm Storm


BURLINGTON QUARRY
PROPOSED REHABILITATION CONDITIONS
WEST ARM OF THE WEST BRANCH HYDROGRAPH (24 HOURS SCS STORMS)
Flow (m³/s)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
Regional Storm

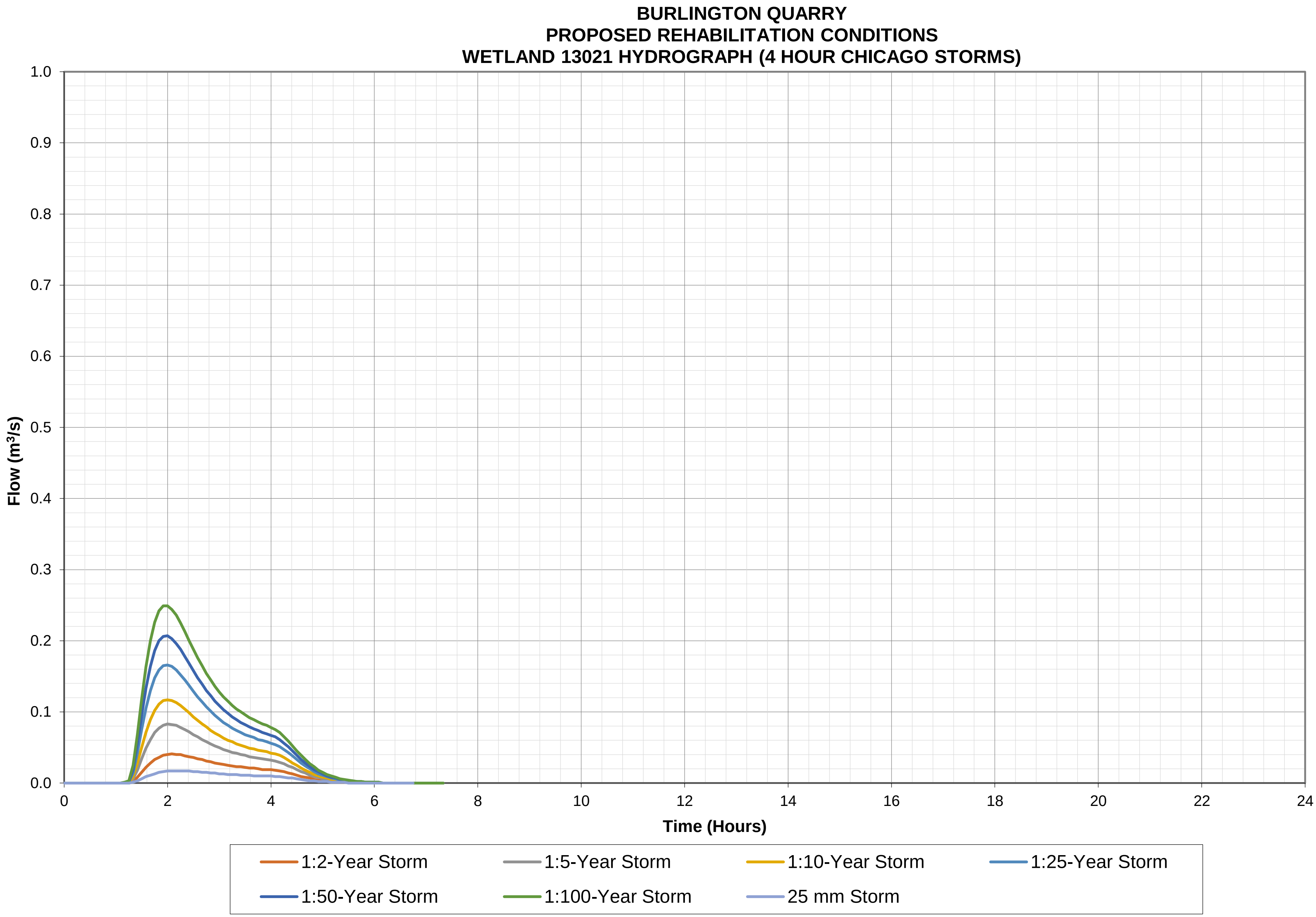

BURLINGTON QUARRY
PROPOSED REHABILITATION CONDITIONS
WEST ARM OF THE WEST BRANCH HYDROGRAPH (4 HOUR CHICAGO STORMS)
Flow (m³/s)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
25 mm Storm


BURLINGTON QUARRY
PROPOSED REHABILITATION CONDITIONS
BURLINGTON QUARRY HYDROGRAPH (24 HOURS SCS STORMS)
Flow (m³/s)
0
10
20
30
40
50
60
70
80
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
Regional Storm


BURLINGTON QUARRY
PROPOSED REHABILITATION CONDITIONS
BURLINGTON QUARRY HYDROGRAPH (4 HOUR CHICAGO STORMS)
Flow (m³/s)
0
10
20
30
40
50
60
70
80
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
25 mm Storm



BURLINGTON QUARRY
PROPOSED REHABILITATION CONDITIONS
WETLAND 13021 HYDROGRAPH (24 HOURS SCS STORMS)
Flow (m³/s)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
Regional Storm


BURLINGTON QUARRY
PROPOSED REHABILITATION CONDITIONS
WETLAND 13021 HYDROGRAPH (4 HOUR CHICAGO STORMS)
Flow (m³/s)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hours)
1:2-Year Storm
1:5-Year Storm
1:10-Year Storm
1:25-Year Storm
1:50-Year Storm
1:100-Year Storm
25 mm Storm

Appendix U:
Curriculum Vitae

TATHAM ENGINEERING

Daniel Twigger, P.Eng.
Senior Engineer, Group Leader

Career Highlights

Daniel specializes in the field of water resources engineering. He has completed many studies related to stormwater management and is skilled in stormwater management design, bridge and culvert replacements, natural hazard (flood and erosion) assessments, hydrologic and hydraulic analysis, surface water monitoring and water balance calculations. Daniel has been involved in the preparation of Master Drainage Plans, Environmental Assessments, and Comprehensive Stormwater Management Master Plans and is highly knowledgeable about water resources regulatory requirements.

Daniel has completed natural channel designs, site plans in support of Aggregate Resource Act licence applications, and stormwater retrofit designs. Daniel has advanced projects from inception to completion, participating in preliminary designs, securing approvals, preparing final designs, conducting construction inspection and contract administration.

Detailed Experience

Modelling Capabilities

Daniel is proficient with a number of hydrologic and hydraulic computational models including VISUAL OTTHYMO, SWMHYMO, PCSWMM, PCSWMM.NET, GAWSER and HEC-RAS. He has completed advanced hydraulic and hydrologic modeling courses in HEC-RAS, GAWSER and PCSWMM.

Hydrologic & Hydraulic Studies

Involved in hydrologic and hydraulic investigations undertaken in conjunction with planning and proposed development activity. These studies have evaluated existing sewer capacities, hydraulics, replacement requirements and priority, determined floodplain or fill limits, culvert and bridge sizing, preliminary stormwater management constraints and assessed pond and dam works.

Daniel has participated in such studies for:

- The Blue Mountains TRIP SWM Need Study
- Barrie City Wide Minor/Major SWM Model Development Project
- 27th/28th Sideroad Road Improvements Project
- Poplar Sideroad Road Improvements Project
- Tenth Line Road Improvements Project
- Lackies Bush Pond Hydraulic Analysis
- Kidd's Creek Hydraulic Analysis
- Little Lake Sub-Watershed Drainage System Analysis
- Hewitt's Creek Hydraulic Analysis
- Simcoe County North River Bridge Hydraulic Analysis
- Ramara Township Concession Road 1 Bridge Hydraulic Analysis
- Municipality of Arran Christie Bridge Replacement
- Municipality of Arran Proud Bridge Replacement
- Summerhaven Windfarm Hydrologic/Hydraulic Analysis
- Town of Bracebridge McCutcheon Bridge Hydraulic Analysis
- North Bay Lakeshore Drive Bridge Replacement
- Huron Haven Village Storm Outfall Hydraulic Analysis

Qualifications

2005	Bachelor of Science in Engineering (Water Resources) University of Guelph Guelph, ON

Professional Designations, Licences, Registrations

- Professional Engineers Ontario

Professional Experience

2005 to Present	Tatham Engineering Limited /C.C. Tatham & Associates Ltd. Collingwood, ON

Stormwater Management Plans

Involved in the design of preliminary and detailed stormwater management plans for a variety of development scenarios including residential subdivisions, industrial and commercial sites and highway development. Specific duties have included the development of hydrologic models, water balance calculations, hydraulic grade line analysis, design of stormwater management facilities and report preparation.

Projects Daniel has participated in extensively include:

- Plateau East, The Blue Mountains
- Second Nature, The Blue Mountains
- Windfall Development, The Blue Mountains
- Founder's Village Subdivision, Wasaga Beach
- Osprey Quarry, Grey Highlands
- Mair Mills Village Subdivision, Collingwood
- New England Village Development, Wasaga Beach
- Springwater Meadows Subdivision, Springwater Township
- Richvale Athletic Field, Richmond Hill
- Stonebridge on the Bay Development, Wasaga Beach
- Windrose Valley Estates Subdivision, Clearview Township
- 11 Bay Street Condominium Development, The Blue Mountains
- MacDonald Street Self Storage Development, Collingwood
- Trillium Forest North Development, Wasaga Beach
- Barrie BMW/Mini Dealership, Barrie
- River's Edge Subdivision, Wasaga Beach
- Wolf Steel Warehouse Facility, Oro-Medonte
- Zenetec Collision Centre, Collingwood
- Welland Retirement Centre, Welland
- Wyldewood Trailside Condos, Collingwood
- Wyldewood Cove, Collingwood
- Huron Have Village, Goderich

Master Drainage Plans, Environmental Assessments and Comprehensive Master Plans

The technical Guidance Documents provide municipalities an opportunity to establish short and long term strategies for effective stormwater management within existing and expanding settlement areas. The documents provide an opportunity to identify, prioritize and implement SWM improvements within existing settlement areas and SWM requirements for planned developments.

Projects Daniel has participated in extensively include:

- Drainage Master Plan, Barrie
- Sophia Creek Watershed and Mulcaster Drainage Area EA Update, Barrie
- Thornbury West Drainage Master Plan, The Blue Mountains
- Osler Bluff Secondary Plan, The Blue Mountains
- Airport Heights SWM Pond Class EA, North Bay
- Sophia Creek West Branch Drainage and Infrastructure Improvements Class EA, Barrie
- Sophia Creek Master Drainage Plan Class EA Update, Barrie
- Leslie Street Extension Environmental Assessment, Innisfil
- Lovers Creek, Hewitts Creek and Annexation Lands Study Area CSWM Master Plan, Barrie
- Barrie Creeks Study Area CSWM Master Plan, Barrie

Water Quality/Quantity Monitoring

Involved in water quality/quantity monitoring for the purpose of Permit to Take Water, Certificate of Approval compliance, I/I studies and hydrologic/hydraulic model calibration. Daniel has undertaken the specific responsibilities of field investigations and sample collection, stream gauging, data logger installation/maintenance, water quality data collection, statistical analysis and interpretation of results, technical support and reporting.

Projects Daniel has participated in extensively include:

- Collingwood Sanitary Sewer Renewal Program
- Devil's Glen PTTW Compliance Monitoring
- Osler Bluff Ski Club PTTW Compliance Monitoring
- OslerBrook Golf and Country Club PTTW Compliance Monitoring
- Castle Glen Development Area
- Blue Mountain Resorts PTTW/ECA Compliance Monitoring
- Osprey Quarry ECA Compliance Monitoring
- Reeb Quarry ECA Compliance Monitoring
- Hewitt Quarry ECA Compliance Monitoring
- Barrie Creek Flow Monitoring
- Alliston Aggregates Sand and Gravel Pit, Surface Water Monitoring
- Beaver Valley Ski Club, Surface Water Monitoring
- Hockley Valley Ski Club, PTTW
- Nelson Aggregates, Burlington Quarry, PTTW Compliance Monitoring

PTTW, ECA and ARA License Applications

Daniel has completed the following Permit to Take Water (PTTW), Environmental Compliance Approval (ECA), and Aggregate Resources Act (ARA) applications in support of agricultural, commercial and industrial developments:

- Botden Orchard PTTW
- Devil's Glen Ski Club PTTW
- Osler Bluff Ski Club PTTW
- Quality Sod Farm PTTW
- Thornbury Horse Park PTTW
- Sutherland Quarry Expansion ECA
- Blue Mountain Resorts ECA
- Nelson Waynco Wash Pond ECA
- Hamilton Brothers Works Yard ECA
- Georgian Triangle Anglers Association PTTW
- Alliston Aggregates Sand and Gravel Pit ARA License
- Osprey Quarry ECA/PTTW and ARA License
- Nelson Aggregates Burlington Quarry PTTW
- Beaver Valley Ski Club PTTW

Natural Hazard Assessments

Natural hazard assessments undertaken in conjunction with planning and proposed development activity generally establish the flood hazard, meander belt width, and/or erosion hazards and consequently the allowable development limits on a property.

Projects Daniel has participated in extensively include:

- Huron Haven Village Gully Erosion Hazard Assessment
- Huron Park Flood and Erosion Hazard Assessment
- Violet Hill Pit Erosion Hazard Assessment
- Devil's Glen Escarpment Brow Delineation
- Windfall Flood and Erosion Hazard Assessment
- Alliston Aggregates Flood and Erosion Assessment
- Sunnidale Trails Flood and Erosion Hazard Assessment
- Monterra Phase 2 Natural Hazard Assessment

Dan Hurley, P.Eng.
President

Career Highlights

Dan specializes in the field of water resources, land development and environmental engineering and has technical and project management experience in many water resources and environmental projects. He has completed many studies relating to water resources including: Master Drainage Plans, Floodplain Studies and Creek/Pond Rehabilitation Studies. He is an expert in stormwater management and the proper environmental implementation of many land development and aggregate resource development projects including securing approvals and preparing final designs. These works include hydrologic modeling, detailed water balance calculations, and report writing. He has completed many hydraulic studies defining flood lines and solving many complex flood plain and bridge hydraulic issues.

Dan has completed several creek and shoreline rehabilitation projects including bioengineering, rip-rap and armour stone protection. He has appeared as an expert witness in the fields of water resources and land/aggregate development servicing in front of the OMB on several occasions.

Modelling Capabilities

Dan is proficient with a number of water resources simulation packages such as VISUAL OTTHYMO, SWMHYMO, MIDUSS, GAWSER, XP-SWMM, BOSS-SMS, QUAL-HYMO, HEC-RAS and HEC2. He is also knowledgeable of ARC-GIS, AutoCAD, WordPerfect, Word and Excel. Dan has completed advanced hydraulic and hydrologic modeling courses in HEC-RAS and XP-SWMM.

Detailed Experience

Environmental Assessments, Master Drainage and Secondary Plans

Environmental Assessments, Master Drainage or Secondary Plans are interdisciplinary studies carried out on planning areas or development properties. Typically these studies establish: 1) the natural environmental features and areas to be retained/protected as development proceeds; 2) the natural environment features to be retained where technically feasible; 3) a preferred drainage scheme and management measures that when implemented will maintain and enhance the condition of the receiving waters; and 4) opportunities for enhancing the current environmental condition of the development area. Typical studies include Environmental Implementation Reports (EIR), Environmental Assessments (EA), Secondary Plans and Watershed Studies.

Dan's specific duties have included co-authoring of the reports and the preparation of hydrologic and hydraulic modeling along with storm water management basin sizing for:

- Town of Innisfil, Comprehensive Stormwater Management Master Plan
- City of Barrie, City Wide Master Drainage Plan
- Township of Oro-Medonte, Comprehensive Stormwater Management Master Plan
- City Wide Hydraulic and Hydrologic Model Update, City of Barrie
- Osler Bluff Secondary Plan – Master Drainage Plan, Blue Mountains
- Sophia Creek Master Drainage Plan Class EA Update
- Lefroy – Belle Ewart Master Drainage Plan

Qualifications

1995 — Bachelor of Applied Science (Honors Civil)
University of Waterloo
Waterloo, ON

Professional Designations, Licences, Registrations

- Professional Engineers Ontario

Professional Experience

1999 to present — Tatham Engineering Limited/C.C. Tatham & Associates Ltd.
Collingwood, ON

1996 to 1999 — Stantec Consulting
Kitchener, ON
Project Engineer/Manager

1995 to 1996 — Essex Region Conservation Authority
Essex, ON
Water Resources Engineer

- Intrawest Village Core Master Drainage Plan, The Blue Mountains
- Castle Glen Development Area Secondary Plan, The Blue Mountains
- Little Creek Drainage Area System Analysis, Barrie
- Hyde Park Community Planning Study, London
- Southeast Galt Environmental Assessment, Cambridge
- Oliphant Water Management and Land Use Study, Oliphant
- Huron Road Development EIR, Kitchener
- Sunningdale Community Planning Study, London

Stormwater Management & Water Resources Rehabilitation Projects

These projects consist of combining the efforts of a multi-disciplinary team to successfully complete projects that involve constructing or rehabilitating existing water resources facilities such as storm sewers**,** rivers, streams and stormwater management ponds. They involve taking a project through the preliminary design and approval stage and often involving proceedings through the Municipal Class Environmental Assessment Process. Projects include channel rehabilitation and realignments, culvert and storm sewer replacements and stormwater management pond retrofits.

Projects Dan has managed in this field of work include:

- Taylor's Creek Design and Rehabilitation, Collingwood
- Collingwood Industrial Park SWM Retrofit, Collingwood
- Royal Alcona Stormwater Management Pond Class EA and Retrofit, Innisfil
- St. Johns Sideroad Stormwater Management Pond Class EA and Retrofit, Aurora
- Park Stormwater Management Pond Retrofit, Aurora
- Intrawest at Blue Mountain Mills Pond Rehabilitation and Retrofit, The Blue Mountains
- Lakefield Watercourse Realignment Project and Culvert Replacement, Lakefield
- Sophia Creek West Branch Realignment Class EA, Barrie
- Hotchkiss Creek Master Drainage Plan EA, Barrie
- Dyments Creek Re-alignment Hydraulic Design

Land Development & Project Management

Land development projects can entail a broad range of engineering applications including developing concepts and securing approvals in the planning stage, completing the engineering design and construction management of the project through completion. Land development projects can vary from subdivisions and site plans to golf course development. Projects Dan has managed and/or participated extensively in include:

- Windfall Development, The Blue Mountains
- Second Nature Subdivision, The Blue Mountains
- Georgian Downs Raceway and Gaming Centre, Innisfil
- Intrawest – Village at Blue Mountain, The Blue Mountains
- Historic Snowbridge, The Blue Mountains
- River Run Phase 2 Subdivision, Collingwood
- Bay St. Development, Thornbury
- Mair Mills Estates Subdivision, Collingwood
- OslerBrook Golf and Country Club, Clearview Township
- Batteaux Creek Golf Club, Clearview Township
- Horseshow Expansion, Collingwood
- Windrose Valley Estates, Clearview Township

Hydrologic & Hydraulic Investigations

Hydrologic and hydraulic investigations are usually driven by land development activity or by region-wide flood control requirements. Such investigations are undertaken to determine floodplain or fill limits, watercourse erosion potential, culvert and bridge opening sizes, or preliminary/conceptual storm water management design constraints.

Dan has participated in such investigations for:

- Barrie Creeks Floodplain Mapping Study, Barrie
- Kidd's Creek Floodline Analysis, Barrie
- Whiskey Creek Flood Control Structure, Barrie
- Tottenham Dam Spillway Analysis and Redesign, Tottenham
- Bay Street Development Setback Assessment, Thornbury
-
- Pretty River Floodplain Management Study, Collingwood
- Museum Hydraulic Analysis, Collingwood
- Town Creek Culvert – Timmins, Hydraulic Study

- Bender Bridge Replacement, Hydraulic Analysis
- Thamesford Cold Springs Farm, Floodplain Analysis
- Pioneer Tower Golf Course Hydraulic Study
- Bridgeport North-Grand River Hydraulic Modelling Update
- Clair Creek Hydraulic Model Update

Water Quality/Quantity Monitoring

Water quality/quantity monitoring is undertaken for the purpose of compliance monitoring, watercourse assimilation studies, non-point source studies, etc. Specific responsibilities have included development of monitoring programs (both discrete and continuous), field investigations and sample collection, stream gauging, data logger installation/maintenance, water quality data collection (DO, pH, temperature, TSS, etc.), statistical analysis and interpretation of results, technical support, agency liaison and reporting:

- Osprey Quarry, Grey Highlands
- Hewitt Quarry, Severn
- Burlington Quarry, Burlington
- Aliston Pit, Adjala-Tosorontio
- Craig Pit, Clearview
- Castle Glen Development Area
- OslerBrook Golf and Country Club Compliance Monitoring
- Devil's Glen PTTW Compliance Monitoring
- Osler Bluff Ski Club PTTW Compliance Monitoring
- Blue Mountain Resorts PTTW Compliance Monitoring
- Caledon Ski Club PTTW Compliance Monitoring
- South Clair Creek SWM Compliance Monitoring

Stormwater Management

The following list represents a sampling of storm water management projects completed to date involving the assessment of potential impacts associated with development on water quality, erosion, flood hazard, infiltration rates and/or environmental habitat. Specific duties have included co-authoring the text of the reports, hydrologic modelling (both event and continuous series based), hydraulic modelling, basin sizing/design and detailed infiltration potential calculations:

- Mountaincroft Subdivision, Collingwood
- Mair Mills Estates Subdivision, Collingwood
- Mair Mills Village Subdivision, Collingwood
- Georgian Gate Subdivision, Collingwood
- Highland Quarry, Grey-Highlands
- Reeb Quarry, Port Colborne
- Hewitt Quarry, Severn Township
- Windrose Valley Estates Subdivision, Clearview Township
- Western Commercial Node Area, Collingwood
- Alpine Flatlands Subdivision, Blue Mountains
- Craigleith Meadows Subdivision, Blue Mountains
- Ravenshoe Development, East Gwillimbury
- Wellington Glen Subdivision, Collingwood
- Intrawest Village Core Drainage Plan, Blue Mountains
- Alpine Ski Hill Expansion Drainage Plan, Blue Mountains
- Centre St. Development, Stayner
- Northwest Crossings Development, London
- Lambeth Meadows Subdivision, London
- CP Britt Railyard Storm Drainage Study
- CP Windsor Railyard Storm Drainage Study
- Grangehill Townhouses, Guelph
- Laurelwood Commercial Site, Waterloo
- Laurelwood Area IV-B, Waterloo
- Langs Cold Storage Expansion, London
- Maple Ridge Meadows, Ingersoll
- Sunningdale Area - Phase 1, London

Shoreline/Infrastructure Rehabilitation & Remediation

Shoreline/Infrastructure Rehabilitation and Remediation project experience includes the design, tendering, contract administration and field inspection:

- Litchen Shoreline Protection, Thornbury
- Pulver Shoreline Protection, Thornbury
- CP Windsor Railyard – OWS/Infrastructure Upgrades
- CP North Bay Railyard – OWS and Storm Drainage Upgrades
- CP Chapleau Railyard – OWS/Infrastructure Upgrades
- Holiday Beach Wetland/Habitat Creation Project, Amherstburg
- Mersea Beach Shoreline Rehabilitation Project, Leamington
- Cedar Creek Wetland/Habitat Creation Project, Kingsville
- Hillman Marsh Shoreline Rehabilitation Project, Leamington
- Keele Valley Landfill Site, Landfill Gas Monitoring, Toronto
- Morningside Landfill Site, Landfill gas Monitoring, TorontoPetroleum contaminated site clean-up and decommissioning, Toronto