Water Monitoring Report

Pacific Highway Upgrade: Woolgoolga to Ballina

Section 2 – July 2016 to June 2017

NSW GOVERNMENT

Annual Water Monitoring Report

Pacific Highway Upgrade: Woolgoolga to Ballina Section 2 – July 2016 to June 2017



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Executive Summary

This is the second annual water monitoring report for the construction phase of the Halfway Creek to Glenugie project, which is Section 2 of the Woolgoolga to Ballina (W2B) Pacific Highway upgrade. The reporting period for this annual report is 1 July 2016 to 30 June 2017. The monitoring undertaken during the reporting period includes surface water quality, groundwater quality and groundwater levels.

The water quality monitoring program is described in the Pacific Highway Upgrade – Woolgoolga to Glenugie: Water Quality Monitoring Program (WQMP) (dated 27/3/15, GeoLINK ref: 2134-1118). The purpose of the WQMP is to monitor the construction and operation impacts of the highway upgrade on surface water bodies and groundwater resources, and provide input to the environmental management of the project.

In this report, a 'result of interest' is a result that exceeds relevant criteria and has been identified as being potentially influenced by project activities.

The WQMP proposes that water quality monitoring results be assessed by comparing sampling results to the corresponding 80th percentile (P80) figure and/or 20th percentile (P20) figure (as relevant) from the baseline data. The P80 is applicable to parameters where high values are potentially an issue (e.g. turbidity), while the P20 is applicable to parameters where low values are potentially an issue (e.g. dissolved oxygen), and both figures are relevant for parameters where either a high value or a low value are potentially an issue (e.g. pH).

For surface water monitoring, where a downstream result is greater than the P80 baseline value (or is less than the P20 baseline value, where relevant) then further comparison with the upstream result collected at the same time is undertaken to determine whether the result is of interest. During the reporting period, results of interest were identified at all sites. A review was undertaken of the environmental incidents that occurred during the reporting period and have the potential to impact water quality. None of the incidents recorded during the reporting period appeared to correlate with a surface water quality result of interest.

For groundwater quality monitoring, bores have been classified as either 'up-gradient' or 'down-gradient'. For a pair of bores, the down-gradient bore is the one that typically has the lower groundwater level, indicating that the direction of groundwater flow is from the up-gradient bore to the down-gradient bore. Where the down-gradient result is greater than the P80 value (or is less than the P20 value, where relevant), it is considered to be a result of interest. During the reporting period, results of interest were identified at the only down-gradient water quality monitoring bore.

For groundwater level monitoring, the construction phase groundwater level data has been assessed by comparing the difference in groundwater levels between a pair of bores to the P80 of the difference in groundwater levels between the same pair of bores during the pre-construction monitoring period. During the reporting period, results of interest were identified at all sites.

The project responds to the water monitoring results as follows:

1. The water monitoring data is reviewed, with particular focus on the results of interest that have been identified.
2. The results assist with setting the focus for the project's environmental management inspections.
3. During these inspections, environmental controls are checked and reviewed for adequacy and any required actions (e.g. maintenance, replacement, and upgrade) are identified.
4. The aforementioned actions are tracked and implemented.

The surface water quality results of interest have been adequately closed out as part of the regular environmental inspections and meetings that occurred during the reporting period. The results were discussed at the Environmental Review Group meetings and, if required, action items were placed in the meeting notes for subsequent follow-up and close out.

With regard to the groundwater quality results of interest, road construction activities in the vicinity of the monitoring locations have been reviewed with regard to the noted results. No construction activities were identified that have the potential to influence the results.

With regard to the groundwater level results of interest, the nature and extent of works associated with the relevant highway cuttings have been reviewed and it has been determined that it is unlikely that the cuttings have influenced the noted results.

On the basis of the above, no further action is recommended with respect to the surface water quality, groundwater quality and groundwater level monitoring results.

It is recommended that the monitoring program continue in accordance with the WQMP.

1. Introduction

1.1 Background

This is the second annual water monitoring report for the construction phase of the Halfway Creek to Glenugie project, which is Section 2 of the Woolgoolga to Ballina (W2B) Pacific Highway upgrade. The reporting period for this annual report is 1 July 2016 to 30 June 2017.

1.2 Overview of Monitoring Program

The water quality monitoring program is described in the Pacific Highway Upgrade – Woolgoolga to Glenugie: Water Quality Monitoring Program (WQMP) (dated 27/3/15, GeoLINK ref: 2134-1118).

1.2.1 Objectives

The purpose of the WQMP is to monitor and manage the construction and operation impacts of the highway upgrade on surface water bodies and groundwater resources.

The key surface water quality objective of the broader W2B project is to protect downstream environments from the potential impacts of surface runoff during the construction and operational phases of the project (RMS, Aurecon, SKM, 2012a). Similarly, the key groundwater objective of the W2B project is to protect environmental receivers of groundwater flows and groundwater users from the potential impacts on groundwater levels and quality during the construction and operational phases of the project (RMS, Aurecon, SKM, 2012b).

The outcomes of the WQMP will assist with achieving water quality and hydrology related management objectives for the W2G project including:

- Mitigating impacts to surface water quality in order to protect aquatic ecology and ecosystem characteristics in adjacent catchments.
- Mitigating impacts to groundwater hydrology in order to protect licensed bores and dams, water bodies and groundwater dependant ecosystems.

2. Monitoring Methodology

2.1 Surface Water Quality

2.1.1 Monitoring Locations

The surface water monitoring locations are described in Section 2.1 and Appendix C of the WQMP. There was no change to the monitoring locations during the reporting period.

2.1.2 Sampling Regime and Parameters

As per Section 4.2.1 of the WQMP, the required frequency of sampling and the sampling parameters are as follows:

- Two wet event sampling rounds per month with:
  - Assess Type A parameters every round (refer to **Table 2.1**).
  - Assess Type B parameters every second round (refer to **Table 2.2**).
- One dry event sampling round per month:
  - Assess Type A parameters every month.
  - Assess Type B parameters every second month.

Table 2.1 Surface Water Sampling Parameters

Parameter	*Type A Parameters*	*Type B Parameters*
pH	X	
Temperature	X	
Electrical Conductivity (EC)	X	
Dissolved Oxygen (DO)	X	
Turbidity	X	
Total Suspended Solids (TSS)	X	
Total Oils and Grease	X	
Total Phosphorous, Total Nitrogen	X	
Phosphate, Ammonia, Nitrate, Nitrite		X
Total Recoverable Hydrocarbons (TRH)	*	X

* Note: TRH is to be included as a Type A parameter is oil/grease is visible at sampling location

Wet events are defined as 10 mm or more of rain within 24 hours. Wet event sampling is to be undertaken within 24 hours of the rain event.

The monitoring undertaken during the reporting period complied with the above requirements, except for the following changes that were agreed by the Environmental Representative Group (ERG) and approved by the Environmental Representative:

- TRH was discontinued as a routine sampling parameter in April 2016. A visual check for oils/ grease was undertaken and TRH monitoring was undertaken if required.
- Analysis of nutrients was discontinued in October 2016.

2.1.3 Sample and Data Collection

The collection of in-situ water quality data and the collection of water samples for laboratory analysis were undertaken in accordance with the methodology described in Sections 5.1 and 5.2 of the WQMP.

2.2 Groundwater Quality

2.2.1 Monitoring Locations

The groundwater quality monitoring locations are described in Section 2.2 and Appendix C of the WQMP. There was no change to the monitoring locations during the reporting period.

2.2.2 Sampling Regime and Parameters

As per Section 4.3.2.1 of the WQMP, the required frequency of sampling is quarterly and the sampling parameters are as per **Table 2.2** below.

Table 2.2 Groundwater Quality Sampling Parameters

Parameter Group	*Parameter*	*Field Analysis*	*Laboratory Analysis*
Physical and Chemical Properties	pH	X	
	Temperature	X	
	Electrical Conductivity (EC)	X	
	Dissolved Oxygen (DO)	X	
	Turbidity	X	
	Total Dissolved Solids (TDS)		X
Hydrocarbons	Total Recoverable Hydrocarbons (TRH)		X
Nutrients	Total Phosphorous, Total Nitrogen		X
Major Cations	Sodium (Na+), Potassium (K+), Calcium (Ca2+), Magnesium (Mg2+)		X
Major Anions	Chloride (Cl-), Sulfate (SO42-), Bicarbonate (HCO3-)		X
Heavy Metals (Dissolved)	Aluminium, Cadmium, Copper, Lead, Zinc		X

The monitoring undertaken during the reporting period complied with the above requirements.

Groundwater quality monitoring could not be undertaken at one bore on one occasion because there was insufficient water in the bore.

2.2.3 Sample and Data Collection

The collection of in-situ water quality data and the collection of water samples for laboratory analysis were undertaken in accordance with the methodology described in Sections 5.1 and 5.3 of the WQMP. Purging of groundwater bores was undertaken prior to the collection of samples during the August and December 2016 monitoring rounds. A passive sampling approach was used to collect groundwater samples during the March and June 2017 monitoring rounds.

2.3 Groundwater Levels

2.3.1 Monitoring Locations

The groundwater level monitoring locations are described in Section 2.2 and Appendix C of the WQMP. There was no change to the monitoring locations during the reporting period.

2.3.2 Sampling Regime

As per Section 4.3.1.1 of the WQMP, the required frequency of monitoring is for the automatic water level recorders to be downloaded quarterly, with physical measurement of the depth to standing water level taken at the same time.

The monitoring undertaken during the reporting period complied with the above requirements.

2.3.3 Sample and Data Collection

The collection of groundwater level data was undertaken in accordance with the methodology described in Sections 5.1 and 5.3 of the WQMP.

3. Results

3.1 Climatic Conditions

The climatic conditions recorded at the Bureau of Meteorology (BoM) Grafton Airport weather station provide an indication of the conditions experienced at the project site during the reporting period. **Figure 3.1** presents monthly rainfall totals for the reporting period compared to long-term averages (data sourced from BoM website). Total rainfall for the reporting period was 1128 mm, which is slightly lower than the long-term average annual rainfall of 1179 mm.

During July and September 2016, rainfall was close to the long-term average monthly totals. In August 2016, March 2017 and June 2017 the rainfall totals were significantly higher than average. The particularly high total for March 2017 is a result of a large rainfall event associated with ex-tropical cyclone Debbie. In the remaining months of the reporting period (October 2016 to January 2017 and April to May 2017) monthly rainfall was below average.

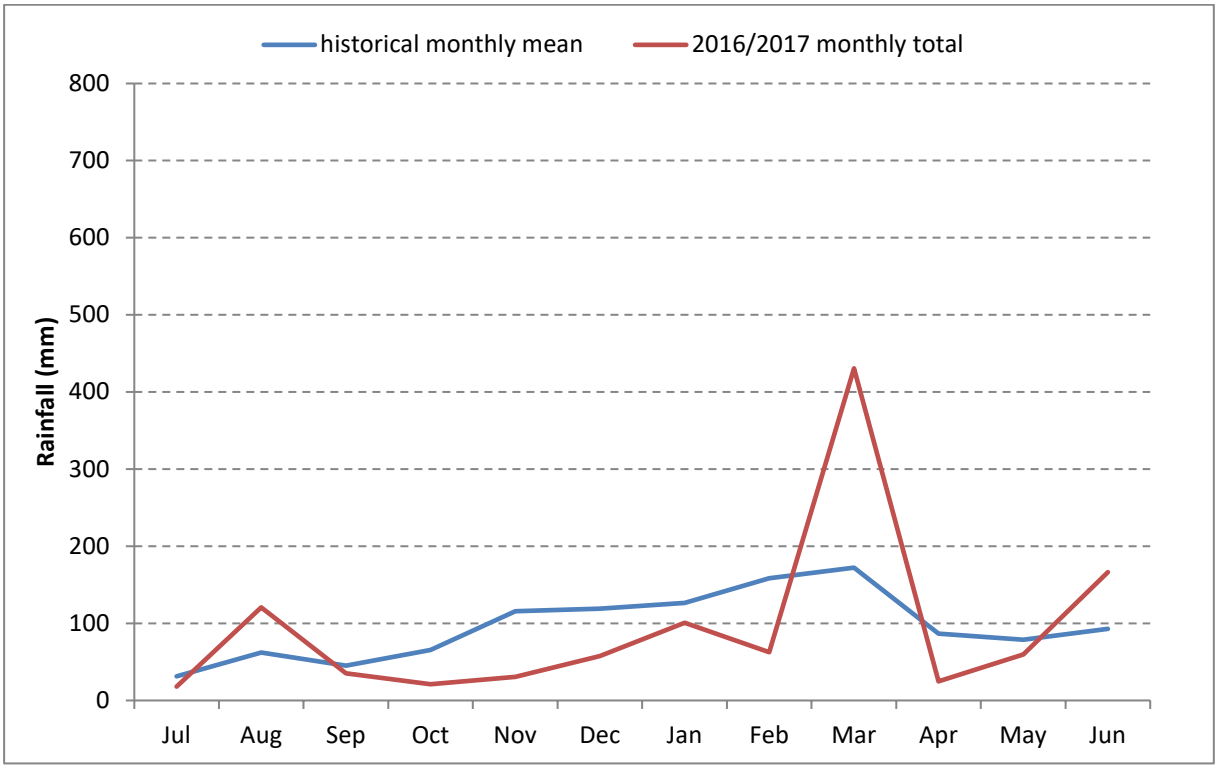

Figure 3.1 Grafton monthly rainfall over the reporting period versus long-term average

3.2 Data Analysis Approach

3.2.1 Surface Water Quality

The WQMP proposes that surface water quality monitoring results be assessed by comparing sampling results to the corresponding 80th percentile (P80) figure and/or 20th percentile (P20) figure (as relevant) from the baseline data.

The P80 is applicable to parameters where high values are potentially an issue (e.g. turbidity), while the P20 is applicable to parameters where low values are potentially an issue (e.g. dissolved oxygen), and both figures are relevant for parameters where either a high value or a low value are potentially an issue (e.g. pH).

Where a downstream result is greater than the P80 value (or is less than the P20 value, where relevant) then further comparison with the upstream result collected at the same time is undertaken. Where the downstream result is also greater than (or less than, where relevant) the corresponding upstream result, it is considered to be a result of interest. That is, the result has potentially been influenced by project activities and further investigation is undertaken.

The original baseline data set is the pre-construction data collected between May 2013 and April 2014. As per Section 7.1.2 of the WQMP, the baseline data is supplemented with the data collected from upstream monitoring sites during the construction and operational phases of the project. The upstream monitoring sites represent sites not impacted by the highway upgrade and therefore reflect 'baseline' data. This process provides a more robust set of baseline data over the course of the project.

3.2.2 Groundwater Quality

The WQMP proposes that groundwater quality monitoring results be assessed using comparisons to the P80 and P20 values from the baseline data, similar to the surface water quality approach described above.

The baseline data set is the pre-construction data collected between November 2013 and April 2014. For one site, three rounds of pre-construction data were collected during this six-month period. At the remaining site, only one round of data was collected. This was due to insufficient water in the piezometer at the time of sampling.

Three sets of data (or less) collected over a six-month period are unlikely to capture the full range of natural variability of each parameter at each site. Therefore, an alternative approach has been adopted. Each bore has been classified as either 'up-gradient' or 'down-gradient'. For a pair of bores, the down-gradient bore is the one that typically has the lower groundwater level, indicating that the direction of groundwater flow is from the up-gradient bore to the down-gradient bore. P80 values (and P20 values, where relevant) have been calculated using any available pre-construction data, as well as the construction phase data for the up-gradient bore. These P80 and P20 values are then used to assess the groundwater quality results for the corresponding down-gradient bore.

Where the down-gradient result is greater than the P80 value (or is less than the P20 value, where relevant), it is considered to be a result of interest. That is, the result has potentially been influenced by project activities and further investigation is undertaken.

3.2.3 Groundwater Levels

The WQMP proposes that the construction phase groundwater level data be assessed by comparing the difference in groundwater levels between a pair of bores to the P80 of the difference in groundwater levels between the same pair of bores during the pre-construction monitoring period. This has been implemented in the following manner:

- The difference in the groundwater levels between a pair of bores is calculated at each time interval for the pre-construction monitoring period.
- The 80th percentile (P80) of these groundwater level differences is calculated to determine the baseline P80.
- During the construction phase, the difference in the groundwater levels between a pair of bores is calculated at each time interval.
- If the difference in the groundwater levels exceeds the baseline P80, it is considered to be a result of interest. That is, the result has potentially been influenced by project activities and further investigation is undertaken.

It is noted that the groundwater levels could be impacted by other 'natural' factors, such as climatic conditions that are different to those experienced during the baseline period.

3.3 Surface Water Quality

A compilation of the results of interest for the reporting period is provided in **Appendix A** and the surface water quality monitoring results spreadsheet is provided in **Appendix B**. Results of interest are highlighted in bold red font in the spreadsheet.

As discussed in **Section 3.2.1**, the P20 and P80 values are updated as additional upstream data is collected and added to the baseline data set. The construction contractor was provided with updated P20 and P80 values at the end of the first reporting period. In **Appendix B**, there are comments in the field notes column about how the results compare to the P20 and P80 values. These comments were entered by the construction contractor on the basis of the P20 and P80 values that were available at the time the comments were entered. For example, the comments entered in early 2017 would have been based on the P20 and P80 values calculated at the end of the 2015-16 reporting period. In contrast, the results that are highlighted in bold red font in **Appendix B** are based on the P20 and P80 values as at 30 June 2017. Therefore, the comments in the field notes column will not necessarily match the results that are highlighted in bold red font.

Appendix G presents a table of environmental incidents that occurred during the reporting period and have the potential to impact water quality. The last five columns of the table assess potential correlation between incidents and surface water quality results of interest. It is considered that there is a potential correlation between an incident and a surface water quality result if the incident occurred within 50 m of a waterway or drain (or more than 50 m if the incident involved a spill greater than five litres) and a result of interest for a relevant parameter was recorded within a month following the incident.

Based on the information presented in **Appendix G**, none of the incidents recorded during the reporting period appeared to correlate with a result of interest.

3.3.1 Discussion

All sites had results of interest for at least one parameter during one or more monitoring rounds. All sites were in close proximity to construction works for at least some of the monitoring events during the reporting period. Monitoring results and the proximity and nature of construction works at some sites suggest that some results of interest were attributable to construction activities. The following observations can be made:

- **Electrical Conductivity (EC):** Aside from the influence of tidal water, EC in a waterway may be influenced by inputs such as fertiliser (i.e. Total Phosphorous (TP) and Total Nitrogen (TN) concentrations) and soils with high salt content. Fertiliser runoff and erosion associated with the project may cause increases in EC levels at monitoring sites.

  Results of interest for EC levels were recorded at all sites on eight or more occasions, including during both wet and dry sampling events (refer to **Appendix A**). While the impacts from the recorded EC levels are considered likely to be negligible, management responses can include a review of the existing measures that relate to the management of erosion and sediment control and the use of fertilisers.

- **Dissolved Oxygen (DO):** Low DO concentrations in a waterway may be a result of:

  - inputs of tannin leachates (which increases biological oxygen demand);
  - inputs of nutrients (which cause elevated algal growth that in turn depletes DO); or
  - a change in flow regime which can lead to stagnation and in turn depleted DO concentrations.

  Another potential cause of low DO concentrations, which is unrelated to construction activities, is long periods of floodplain inundation due to flood events.

  Results of interest for DO concentrations were recorded at SW11 on three occasions (1/11/16, 19/12/16 and 3/1/17), including both wet and dry sampling events. Low DO concentrations, especially over a long-term, can stress aquatic fauna. Management responses to results of interest for DO concentrations can include a review of:

  - management of cleared vegetation and mulch stockpiles (with respect to tannin leachates); and
  - maintaining the flow regime of waterways during construction works.

- **Turbidity and Total Suspended Solids:** Elevated turbidity and/or suspended solids can result from the direct disturbance and subsequent mobilisation of sediments within waterways as well as inputs of sediment laden run-off during rain. Construction activities including clearing, grubbing and earthworks typically increase the area of exposed soil and without appropriate management this can lead to erosion and transport of fine material into waterways. Direct disturbance of river and creek beds during activities such as temporary rock platform construction, creek crossings and piling associated with bridge works can also mobilise sediments and lead to increased turbidity/ suspended soils.

  Results of interest for turbidity levels and suspended solids concentrations were recorded at all sites on five or more occasions, including during both wet and dry sampling events (refer to **Appendix A**). Elevated turbidity can attenuate light and subsequently stress photosynthetic aquatic flora. Suspended solids can stress fish via interfering with the function of fish gills and when suspended solids fall out of suspension they can smother sessile aquatic biota.

Potential management responses to address significant turbidity/ suspended solid concentrations can include:

- review of existing erosion and sediment controls at relevant sites to ensure they are appropriate and functioning well, particularly during rainfall; and
- measuring turbidity levels downstream of activities that disturb or have the potential to disturb sediments in a waterway to confirm that existing controls (e.g. silt curtains) are working effectively.

- **Hydrocarbons (including Oil and Grease):** Hydrocarbons are widely used in construction plant and equipment in the form of fuels and oils. Spills and leaks from plant, equipment and storage vessels and during transport and refuelling can lead to contamination of waterways. Run-off from contaminated soil and asphalt works is also a potential pathway for hydrocarbons to enter aquatic systems.

  Oil and grease was not visible at any sites during the reporting period.

- **Nutrients:** Nutrients can enter waterways via:

  - soil erosion and off-site movement of eroded soils, particularly soils that have had fertiliser added;
  - changes to flow regimes, which can change the volumes and flow rates of water, leading to stagnation and subsequent increases in nutrients; or
  - incomplete detonation or spillage of ammonium nitrate fuel oil during blasting, leading to the leaching of nitrates into soil and subsequently into waterways.

  Elevated nutrient concentrations can result in algal blooms that in turn stress the aquatic system via light attenuation and depressed DO concentrations.

  Results of interest for nutrient concentrations were recorded at all sites on one or more occasions (SW09: 1/8/16, 4/8/16. SW10: 4/8/16. SW11: 4/7/16, 1/8/16, 4/8/16, 14/9/16). Where results of interest for nutrient concentrations are reported, potential management responses can include:

  - investigating the potential sources of nutrients (e.g. fertiliser);
  - review of existing erosion and sediment controls; and
  - confirming that the flow regime of the relevant waterway is being maintained appropriately.

- **pH:** The pH of a waterway can be affected by acidification due to exposure of acid sulfate soils, the leaching of tannins and from spills/ run-off during concreting and lime stabilisation works.

  Results of interest for pH levels (both high and low) were recorded at all sites on four or more occasions including during both wet and dry sampling events (refer to **Appendix A**). Aquatic biota can become stressed when pH levels fall outside optimal ranges. Where results of interest for pH levels are reported, potential management responses can include:

  - for low pH levels, review acid sulfate soil management and cleared vegetation/ mulch stockpile management (with respect to tannin leachates); and
  - for high pH levels, review management of spills/ leaching/ runoff associated with concreting and/or lime stabilisation.

3.4 Groundwater Quality

A compilation of the results of interest for the reporting period is provided in **Appendix C** and the groundwater quality monitoring results spreadsheet is provided in **Appendix D**. Results of interest are highlighted in bold red font in the spreadsheet.

3.4.1 Discussion

The discussion provided in **Section 3.2.1** regarding potential impacts of construction activities on specific surface water quality parameters and potential management responses to significant results is also applicable to groundwater quality.

During the reporting period, results of interest were identified at GWB31; the only down-gradient water quality monitoring bore. The results of interest were identified during three of the four monitoring rounds. On the second monitoring round (December 2016), there was insufficient water at GWB31 to collect a sample.

Results of interest for pH values were recorded during two monitoring rounds. It is noted that the baseline pH range for GWB31 is quite narrow; with a P20 of 7.09 and a P80 of 7.90. The pH results of interest were 6.84 on the 29/3/17 and 7.02 on the 23/6/17. As these pH levels are only slightly outside a relatively narrow range, they are not considered to be of concern.

A result of interest for turbidity was recorded on one occasion at GWB31. It is considered unlikely that turbidity levels in the groundwater would be influenced by road construction activities, unless there is a relatively direct hydraulic pathway between surface sources of turbid water and the groundwater.

Results of interest for salts, metals and hydrocarbon values were recorded on one or more occasions. Given the relatively small amount of data on which the P80 values have been calculated, it is possible that these results are within the range of natural variability at the site.

3.5 Groundwater Levels

A compilation of the results of interest for the reporting period is provided in **Appendix E** and charts of the groundwater levels are presented in **Appendix F**.

3.5.1 Discussion

Results of interest were recorded at all sites. Further investigation to determine the likelihood of project activities being a contributing factor to these results included:

- The timing of the cutting and/or excavation works at the specific site.
- Site observations that indicate interception of groundwater levels.

Potential management responses to the results of interest can include measures to collect and transfer groundwater seepage from the up-gradient side of the cut to the down-gradient side of the cut.

4. Project Response to Results

4.1 General

The project responds to the water monitoring results as follows:

1. The water monitoring data is reviewed, with particular focus on the results of interest that have been identified.
2. The results assist with setting the focus for the project's environmental management inspections.
3. During these inspections, environmental controls are checked and reviewed for adequacy and any required actions (e.g. maintenance, replacement or upgrade) are identified.
4. The aforementioned actions are tracked and implemented.

The project's environmental management inspections include the following:

- Daily pre-work inspection by the contractor's staff, including a check of relevant environmental controls and resources required to ensure effective operation and maintenance.
- Weekly and post rainfall inspections of the work sites by RMS and contractor environmental personnel to evaluate the effectiveness of environmental controls.
- Weekly or fortnightly joint inspections by the Environmental Representative and RMS environmental personnel.
- Regular inspections by the Soil Conservationist focusing on erosion and sediment controls.
- Regular inspections (typically monthly, tending bimonthly towards the end of construction) of the work sites by the Environmental Representative, RMS personnel and members of the Environmental Review Group (ERG).

When reviewing a result of interest, the first step is to determine whether construction activities with the potential to influence the result were underway at the time of (or prior to) the monitoring event. For example, if the result of interest is an elevated turbidity value, it should be determined whether construction activities with the potential to mobilise sediment were occurring at the time of (or prior to) the monitoring event.

Where construction activities are considered a potential source of the result of interest, existing management measures are reviewed and, where appropriate, additional management measures are considered. If it is determined that additional management measures are warranted, they are implemented and monitored for efficacy.

With regard to surface water monitoring, sometimes the downstream monitoring site is not connected by continuous water to the upstream monitoring site. In such instances, the waterway may be a series of isolated pools. The review of the result of interest and consideration of the adequacy of the management measures takes into account the lack of connectivity at the time of the monitoring event.

4.2 Surface Water Quality

The results of interest have been adequately closed out as part of the regular environmental inspections and meetings that occurred during the reporting period. The monthly water quality results were provided to the Environmental Review Group (ERG) prior to each meeting to allow members the opportunity to review results, identify issues of concern and recommend locations for the ERG inspection of site activities. The results were discussed at the ERG meeting and, if required, an action item was placed in the meeting notes for subsequent follow-up and close out. No further action is recommended.

4.3 Groundwater Quality

During the reporting period, results of interest were identified at the only down-gradient water quality monitoring bore. Road construction activities in the vicinity of the monitoring locations have been reviewed with regard to the noted results. No construction activities were identified that have the potential to influence the results. No further action is recommended.

4.4 Groundwater Levels

The results of interest indicate a possibility of highway cuttings impacting on groundwater flows.

The nature and extent of works associated with these highway cuttings have been reviewed. Visual inspections of cuttings by Surveillance Officers and Environmental Officers have not identified interception of groundwater. In addition, no engineering solutions have been required to manage any groundwater inflows. Finally, the project is aligned on the catchment divide, which further reduces the potential for interception of directional groundwater flows.

On the basis of the above, it has been determined that it is unlikely that the cuttings have influenced the noted results. No further action is recommended.

5. Recommendations

5.1 Monitoring Program

It is recommended that the monitoring program continue in accordance with the WQMP.

References

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Appendix A

Surface Water Quality: Results of Interest

Section 2 Surface Water Quality Table of Results of In

Site	Date	Wet or Dry	Results of Interest
SW09	5/07/2016	Wet	EC = 0.1 mS/cm
SW09	1/08/2016	Dry	TN = 0.51 mg/L
SW09	3/08/2016	Wet	EC = 0.11 mS/cm
SW09	4/08/2016	Wet	Turbidity = 294 NTU SS = 71 mg/L TN = 0.81 mg/L
SW09	14/09/2016	Dry	pH = 7.32 EC = 0.1 mS/cm
SW09	3/12/2016	Wet	EC = 0.24 mS/cm
SW09	19/12/2016	Dry	Turbidity = 28 NTU SS = 12 mg/L
SW09	3/01/2017	Wet	EC = 0.38 mS/cm
SW09	6/01/2017	Wet	pH = 7.7 EC = 0.37 mS/cm
SW09	24/01/2017	Dry	EC = 0.37 mS/cm
SW09	1/03/2017	Wet	EC = 0.30 mS/cm
SW09	13/03/2017	Wet	pH = 6.46 EC = 0.37 mS/cm
SW09	28/03/2017	Dry	EC = 0.13 mS/cm
SW09	10/04/2017	Dry	Turbidity = 19 NTU
SW09	27/04/2017	Wet	SS = 24 mg/L
SW09	14/05/2017	Wet	pH = 6.47
SW09	1/06/2017	Dry	EC = 0.10 mS/cm
SW09	12/06/2017	Wet	EC = 0.05 mS/cm Turbidity = 84 NTU
SW09	17/06/2017	Wet	EC = 0.06 mS/cm
SW10	4/07/2016	Dry	Turbidity = 30 NTU
SW10	5/07/2016	Wet	EC = 0.13 mS/cm
SW10	3/08/2016	Wet	EC = 0.02 mS/cm
SW10	4/08/2016	Wet	EC = 0.06 mS/cm TN = 0.96 mg/L
SW10	14/09/2016	Dry	Turbidity = 16 NTU
SW10	22/11/2016	Dry	pH = 7.04 Turbidity = 24 NTU
SW10	3/12/2016	Wet	pH = 7.14
SW10	19/12/2016	Dry	pH = 7.21 EC = 0.51 mS/cm
SW10	6/01/2017	Wet	pH = 7.45
SW10	24/01/2017	Dry	pH = 6.89
SW10	6/02/2017	Dry	pH = 7.25 EC = 0.61 mS/cm
SW10	1/03/2017	Wet	Turbidity = 65 NTU SS = 27 mg/L
SW10	13/03/2017	Wet	EC = 0.61 mS/cm
SW10	28/03/2017	Dry	EC = 0.06 mS/cm Turbidity = 15 NTU
SW10	10/04/2017	Dry	EC = 0.06 mS/cm Turbidity = 17 NTU
SW10	19/05/2017	Wet	EC = 0.09 mS/cm
SW10	1/06/2017	Dry	EC = 0.05 mS/cm Turbidity = 24 NTU

Site	Date	Wet or Dry	Results of Interest
SW10	12/06/2017	Wet	pH = 5.90 Turbidity = 32 NTU SS = 23 mg/L
SW10	20/06/2017	Wet	EC = 0.07 mS/cm
SW11	4/07/2016	Dry	Turbidity = 59 NTU TP = 0.03 mg/L TN = 1.25 mg/L
SW11	1/08/2016	Dry	EC = 0.01 mS/cm TN = 3.34 mg/L Ammonia = 1.57 mg/L Nitrate 0.24 mg/L
SW11	3/08/2016	Wet	pH = 7.62
SW11	4/08/2016	Wet	Turbidity = 207 NTU TN = 1.28 mg/L
SW11	14/09/2016	Dry	TP = 0.1 mg/L TN = 1.65 mg/L
SW11	1/11/2016	Wet	pH = 7.33 DO = 3.00 mg/L
SW11	9/11/2016	Wet	pH = 7.36
SW11	22/11/2016	Dry	pH = 7.22 EC = 0.19 mS/cm
SW11	3/12/2016	Wet	pH = 7.27
SW11	19/12/2016	Dry	pH = 7.41 EC = 0.19 mS/cm DO = 2.30 mg/L
SW11	3/01/2017	Wet	pH = 7.44 DO = 2.80 mg/L
SW11	24/01/2017	Dry	pH = 7.22
SW11	6/02/2017	Dry	pH = 7.42 EC = 0.17 mS/cm
SW11	15/02/2017	Wet	pH = 7.41
SW11	1/03/2017	Wet	pH = 7.17 EC = 0.09 mS/cm
SW11	28/03/2017	Dry	Turbidity = 119 NTU SS = 18 mg/L
SW11	27/04/2017	Wet	EC = 0.38 mS/cm
SW11	14/05/2017	Wet	EC = 0.40 mS/cm
SW11	1/06/2017	Dry	Turbidity = 55 NTU
SW11	12/06/2017	Wet	EC = 0.06 mS/cm

Appendix B

Surface Water Quality: Data

SW09 (Dry) - Halfway Creek

Dry Event Monitoring

Monitoring Location	Field Notes	Date	pH (field)	Temperature (field)	Electrical Conductivity (field)	Dissolved Oxygen (field)	Turbidity (field)	Suspended Solids	Total Phosphorus	Total Nitrogen	Phosphate	Ammonia	Nitrate	Nitrite
			pH unit	ºC	mS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Downstream Monitoring														
SW09-Halfway Ck D/S		7/07/15	**7.73**	11.5	0.15	6.04	11	*1*	0.03	0.18	0.030	0.05	0.05	0.050
SW09-Halfway Ck D/S	Dry event piling pad under construction	19/08/15	6.60	13.7	0.16	9.00	8	3	*0.02*	0.23	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ck D/S	Dry stagnant looking	14/09/15	7.01	14.0	0.16	4.10	9	6	0.01	0.30	*0.005*	*0.01*	0.06	*0.005*
SW09-Halfway Ck D/S	Dry-Type B	6/10/15	7.64	15.9	0.17	**2.00**	9	N/A	N/A	N/A	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ck D/S	pH and DO marginally below P80 results. TSS, NTU and nitrogen nutrients above background but reflective of upstream values All other parameters within P80 guidelines	26/11/15	6.57	27.6	0.13	2.70	22	**21**	0.03	**0.58**	*0.015*	*0.03*	**0.06**	*0.025*
SW09-Halfway Ck D/S	All parameters within p80 guidelines	9/12/15	6.45	25.4	0.17	2.70	18	11	0.04	**0.54**	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ck D/S	All results within p80 guidelines	11/01/16	6.10	24.8	0.20	2.10	11	7	*0.02*	0.39	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ck D/S	Results within P80 guidelines with the exception of TSS and NTU which recorded marginally above upstream and P80 but well within the maximum result recorded.	2/02/16	6.77	25.0	0.23	1.90	**32**	**15**	*0.02*	0.40	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ck D/S	All results compliant with P80 guidelines	23/03/16	6.62	24.4	**0.25**	**2.20**	30	13	*0.02*	0.35	N/A	N/A	N/A	N/A
SW09-Halfway Ck D/S	All results compliant with P80 guidelines	7/04/16	6.49	25.2	0.29	**2.10**	16	7	*0.02*	0.34	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ck D/S	All results compliant with the exception of EC (0.015) marginally above background P80	6/05/16	6.63	23.0	**0.30**	2.60	11	6	*0.02*	0.35	N/A	N/A	N/A	N/A
Halfway Ck D/S	All results compliant with P80 guidelines	1/06/16	6.44	20.5	**0.29**	**1.70**	9	8	*0.02*	**0.48**	*0.015*	*0.03*	*0.03*	*0.025*
Halfway Ck D/S	Results within p80 guidelines with the exception of NTU (4.26) above background but better than upstream result	4/07/16	6.16	20.2	0.16	5.00	17	*1*	*0.02*	0.36	N/A	N/A	N/A	N/A
Halfway Ck D/S	All results compliant	1/08/16	6.38	19.2	0.14	5.20	13	4	*0.02*	**0.51**	*0.015*	*0.03*	*0.03*	*0.025*
Halfway Ck D/S	pH (0.42) and NTU (2.8) above p80 but similar to US reading. All other results within guidelines	14/09/16	**7.32**	22.1	**0.10**	4.50	15	8	*0.02*	0.36	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH (0.03) above p80 all other results compliant	10/10/16	6.93	24.1	0.19	3.10	11	7	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH (0.1) marginally above background but similar to upstream. All other results compliant	22/11/16	7.29	25.2	0.17	3.50	9	14	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH marginally (0.45) above background. NTU (15.2) above P80. All other results compliant. Overall D/S results similar to U/S	19/12/16	7.35	23.3	0.14	3.30	**28**	**12**	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH (0.22) and EC (0.091) marginally above p80 all other results compliant	24/01/17	7.12	25.8	**0.37**	3.10	10	9	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH (0.44) and NTU (0.8) marginally above P80 SD but lower than U/S results all other results compliant	6/02/17	7.33	23.6	0.21	3.60	13	10	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	All results compliant	28/03/17	6.55	21.2	**0.13**	3.90	13	7	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH (0.08) below and NTU (6.31) above P80 SD. U/S and D/S results similar	10/04/17	6.22	22.8	0.13	4.10	**19**	8	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	Al results compliant	2/05/17	6.70	22.0	0.09	4.10	11	7	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	All results compliant	1/06/17	6.56	19.8	**0.10**	4.50	19	7	N/A	N/A	N/A	N/A	N/A	N/A
P80 & P20 Values (calculated from baseline and upstream data below)														
P80 (80th Percentile)			7.13		0.23		18	11	0.04	0.45	0.015	0.05	0.03	0.025
P20 (20th Percentile)			6.26		0.13	2.34								
Baseline (pre-construction) Monitoring														
SW09-Halfway Creek		15/05/2013	6.41	16.8	0.13	5.36	11	5	0.01	0.17				

SW09 (Dry) - Halfway Creek

Dry Event Monitoring

Monitoring Location	Field Notes	Date	pH (field)	Temperature (field)	Electrical Conductivity (field)	Dissolved Oxygen (field)	Turbidity (field)	Suspended Solids	Total Phosphorus	Total Nitrogen	Phosphate	Ammonia	Nitrate	Nitrite
			pH unit	ºC	mS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
SW09-Halfway Creek		13/06/2013												
SW09-Halfway Creek		18/07/2013	6.54	14.5	0.15	10.60	11	4	0.01	0.09		0.05	0.03	
SW09-Halfway Creek		21/08/2013	6.60	11.6	0.16	11.25	10	1	0.02	0.13				
SW09-Halfway Creek		17/09/2013												
SW09-Halfway Creek		25/10/2013	6.55	19.6	0.19	2.71	8	9	0.03	0.42				
SW09-Halfway Creek		26/11/2013	6.29	21.4	0.18	5.86	6	4	0.02	0.24				
SW09-Halfway Creek		20/12/2013	6.00	19.8	0.21	1.37	9	2	0.02	0.17				
SW09-Halfway Creek		9/01/2014	6.36	20.4	0.24	0.63	9	11	0.03	0.21				
SW09-Halfway Creek		26/02/2014	6.90	20.5	0.30	1.15	7	11	0.04	0.72				
SW09-Halfway Creek		21/03/2014												
SW09-Halfway Creek		7/04/2014	6.24	21.0	0.23	4.52	4	3	0.01	0.34				
Upstream Monitoring														
SW09-Halfway Ch. U/S		7/07/2015	7.42	11.4	0.16	5.29	11	3	0.03	0.17	0.030	0.05	0.05	0.050
SW09-Halfway Ch. U/S	Dry event piling pad under construction	19/08/2015	6.60	13.4	0.15	9.20	7	2	*0.02*	0.24	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Dry level dropped significantly	14/09/2015	7.11	13.6	0.14	3.90	8	*3*	*0.01*	0.30	*0.005*	*0.01*	0.06	*0.005*
SW09-Halfway Ch. U/S	Dry-Type B	6/10/2015	7.92	15.6	0.18	2.60	8	N/A	N/A	N/A	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Dry type A	26/11/2015	6.52	25.6	0.20	2.40	27	13	0.14	0.44	0.090	*0.03*	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Dry type A	9/12/2015	6.87	25.3	0.12	2.80	18	10	0.07	0.50	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Dry Type B	11/01/2016	6.03	24.7	0.19	2.00	0	10	*0.02*	0.39	*0.015*	0.05	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Dry type A and B	2/02/2016	6.60	24.7	0.26	1.90	19	13	0.03	0.56	*0.015*	0.05	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Dry type A	23/03/2016	6.65	23.4	0.17	2.30	37	22	0.15	0.42	N/A	N/A	N/A	N/A
SW09-Halfway Ch. U/S	Dry type A and B	7/04/2016	6.23	23.7	0.37	3.20	19	8	0.08	0.62	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Dry type A	6/05/2016	6.61	20.8	0.23	2.50	34	9	*0.02*	0.39	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Dry type A and B	1/06/2016	6.42	20.3	0.25	2.30	9	4	0.03	0.40	*0.015*	0.05	*0.03*	*0.025*
Halfway Ck. U/S	Dry Type A	4/07/2016	6.06	19.9	0.16	5.10	19	2	*0.02*	0.34	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Dry type A and B	1/08/2016	6.21	18.6	0.19	5.80	11	3	*0.02*	0.40	*0.015*	*0.03*	*0.03*	*0.025*
Halfway Ck. U/S	Dry type A	14/09/2016	7.29	19.9	0.10	4.60	18	7	0.03	0.45	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Dry type A ands B	10/10/2016	7.07	23.0	0.12	3.70	12	6	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Dry	22/11/2016	7.43	25.2	0.17	3.80	7	17	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Dry event	19/12/2016	7.85	23.0	0.38	3.30	16	10	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Dry event	24/01/2017	7.14	25.3	0.22	3.80	9	11	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Dry event	6/02/2017	7.52	23.1	0.22	3.80	14	13	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Dry event	28/03/2017	6.67	21.3	0.13	4.10	12	7	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Dry event	10/04/2017	6.18	22.6	0.12	4.80	17	3	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Dry event	2/05/2017	6.60	21.8	0.08	3.90	10	4	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Dry event	1/06/2017	6.41	17.8	0.12	5.30	19	4	N/A	N/A	N/A	N/A	N/A	N/A

SW09 (Wet) - Halfway Creek

Wet Event Monitoring

Monitoring Location	Field Notes	Date	pH (field)	Temperature (field)	Electrical Conductivity (field)	Dissolved Oxygen (field)	Turbidity (field)	Suspended Solids	Total Phosphorus	Total Nitrogen	Phosphate	Ammonia	Nitrate	Nitrite
			pH unit	ºC	mS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Downstream Monitoring														
SW09-Halfway Ck D/S	Wet	22/07/2015	**5.97**	13.1	0.14	6.41	11	3	*0.02*	0.16	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ck D/S	Wet event piling pad under construction	25/08/2015	6.40	12.2	0.21	8.10	17	14	*0.02*	0.38	*0.015*	*0.03*	**0.06**	*0.025*
SW09-Halfway Ck D/S	Wet	18/09/2015	6.89	20.8	0.13	3.60	12	7	*0.02*	0.26	N/A	N/A	N/A	N/A
SW09-Halfway Ck D/S	Wet Type A all parameters within pre construction guidelines	13/10/2015	6.79	24.7	0.19	**2.40**	11	11	*0.02*	0.33	N/A	N/A	N/A	N/A
SW09-Halfway Ck D/S	Wet type A and B 12mm all results within P80 guidelines with the exception of DO which is still within the minimum pre-construction range recorded	23/10/2015	6.60	23.1	0.22	2.10	12	9	*0.02*	0.41	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ck D/S	All parameters within P80 guidelines. DO result is low but within recorded minimum wet event for this parameter	4/11/2015	6.60	24.7	**0.32**	2.50	12	10	**0.39**	0.40	**0.310**	*0.03*	*0.03*	*0.025*
SW09-Halfway Ck D/S	NTU and DO marginally above background. All other parameters within P80 guidelines.	17/11/2015	6.92	23.8	0.12	3.50	**50**	**21**	*0.02*	0.38	N/A	N/A	N/A	N/A
SW09-Halfway Ck D/S	All results within p80 guidelines with the exception of DO and pH marginally (0.3) above p80 guidelines	3/12/2015	7.02	22.7	0.14	3.40	15	10	**0.07**	0.48	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ck D/S	All parameters within p80 guidelines	10/12/2015	6.50	25.3	0.16	3.10	29	11	0.03	0.53	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ck D/S	Results within p80 levels	6/01/2016	6.34	25.2	0.19	**2.00**	15	13	*0.02*	0.55	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ck D/S	Results within p80 guidelines	27/01/2016	6.75	24.9	**0.23**	3.10	24	16	N/A	N/A	*0.015*	0.05	*0.03*	*0.025*
SW09-Halfway Ck D/S	Natural leachate visible on surface. All parameters within P80 guidelines with the exception of pH (0.2) above background.	19/02/2016	6.80	26.3	0.25	2.60	21	5	*0.02*	0.30	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ck D/S	pH, and EC marginally above P80 but consistent with upstream result. TSS above p80 but less than US result. All other results compliant.	3/03/2016	**7.30**	25.7	**0.30**	3.90	23	29	0.03	0.46	*0.015*	**0.09**	*0.03*	*0.025*
SW09-Halfway Ck D/S	All results compliant with P80 guidelines	9/03/2016	6.95	25.2	**0.29**	3.10	15	10	*0.02*	0.40	N/A	N/A	N/A	N/A
SW09-Halfway Ck D/S	pH (0.21) and EC (0.5) marginally above p80 but similar to upstream readings. All other results compliant.	9/04/2016	6.81	24.1	**0.31**	3.70	9	7	*0.02*	0.33	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ck D/S	pH (0.27) and EC (0.045) marginally higher than P80 but similar to upstream reading. All other results compliant	25/04/2016	6.87	19.5	**0.30**	2.70	7	6	*0.02*	0.30	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH (0.37) and TN (0.05) marginally above P80. TSS (14.1) and NTU (106.5) above P80 influenced by 200mm of rain and additional upstream off site loading	6/06/2016	6.97	16.6	**0.09**	4.40	**171**	38	*0.02*	**0.97**	*0.015*	*0.03*	**0.11**	*0.025*
Halfway Ck D/S	TSS (35.1) and NTU (80.6)above P80 levels but similar to upstream result. All other results within P80 guidelines	20/06/2016	**6.41**	21.9	0.16	3.40	**121**	50	0.04	0.65	*0.015*	*0.03*	*0.03*	*0.025*
Halfway Ck D/S	pH (0.14) marginally above p80 all other results compliant	5/07/2016	6.74	12.3	**0.10**	5.90	17	7	*0.02*	0.41	*0.015*	*0.03*	*0.03*	*0.025*
Halfway Ck D/S	pH (0.43) above p80. All other results compliant	3/08/2016	7.03	21.7	**0.11**	4.40	11	3	*0.02*	0.19	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH (0.78) and Nitrate (0.365) above P8o. All other results compliant	4/08/2016	7.38	15.1	0.13	5.30	**294**	**71**	0.05	**0.81**	*0.015*	*0.03*	0.06	*0.025*
Halfway Ck D/S	pH (0.46) slightly above background but similar to upstream. All other results compliant	1/11/2016	7.06	24.0	0.19	3.80	13	10	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH (0.49) slightly above background but similar to upstream. All other results compliant	9/11/2016	7.09	24.4	0.20	3.20	11	9	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH marginally (0.69) above p80 all other results compliant	3/12/2016	7.29	23.3	**0.24**	4.30	14	13	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH (1.04) and EC (0.136) above P80 with SD but similar to U/S results. All other results compliant.	3/01/2017	7.64	24.5	**0.38**	3.30	19	8	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH (1.1) above P80 SD but similar to U/S reading. All other results compliant	6/01/2017	**7.70**	22.4	**0.37**	4.00	17	11	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH (0.39) and EC (0.055) marinally above P80 SD U/S similar to D/S result all other results compliant	9/02/17	7.29	24.2	0.34	3.60	9	7	N/A	N/A	N/A	N/A	N/A	N/A

SW09 (Wet) - Halfway Creek

Wet Event Monitoring

Monitoring Location	Field Notes	Date	pH (field)	Temperature (field)	Electrical Conductivity (field)	Dissolved Oxygen (field)	Turbidity (field)	Suspended Solids	Total Phosphorus	Total Nitrogen	Phosphate	Ammonia	Nitrate	Nitrite
			pH unit	ºC	mS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Halfway Ck D/S	pH (0.65) above background but similar to up stream result. All other results compliant	15/02/2017	7.25	23.5	0.22	3.80	18	7	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH (0.6) and EC (0.053) above P80 SD all other results compliant	1/03/2017	7.01	24.7	**0.30**	4.30	16	7	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH (0.03) and EC (0.124) above P80 SD. All other results compliant	13/03/2017	**6.46**	23.4	**0.37**	3.30	10	5	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	pH (0.12) and EC (0.1214) marginally belowow P80 SD. all other results compliant	27/04/2017	6.28	20.2	0.13	4.50	28	**24**	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	All results compiant	14/05/2017	**6.47**	14.5	0.08	5.10	16	4	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	NTU 4.5 above P80 SD but less than upstream result. All other results compliant	19/05/2017	6.60	19.7	0.11	4.70	45	3	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	TSS 7.1mg/L above P80 SD but less than upstream result, NTU 43.9 above P80 SD	12/06/2017	6.53	20.4	**0.05**	4.30	**84**	32	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck D/S	NTU 4.5 above P80 SD but less than upstream result. All other results compliant	17/06/2017	6.89	20.6	**0.06**	4.70	27	9	N/A	N/A	N/A	N/A	N/A	N/A
P80 & P20 Values (calculated from baseline and upstream data below)														
P80 (80th Percentile)			7.25		0.22		33	18	0.05	0.71	0.015	0.06	0.03	0.025
P20 (20th Percentile)			6.50		0.12	2.54								
Baseline (pre-construction) Monitoring														
SW09-Halfway Creek		15/05/2013												
SW09-Halfway Creek		13/06/2013	6.27	16.8	0.14	9.63	38	21	0.02	0.21				
SW09-Halfway Creek		18/07/2013												
SW09-Halfway Creek		21/08/2013												
SW09-Halfway Creek		17/09/2013	6.53	17.7	0.19	6.60	27	18	0.04	0.55				
SW09-Halfway Creek		25/10/2013												
SW09-Halfway Creek		26/11/2013												
SW09-Halfway Creek		20/12/2013												
SW09-Halfway Creek		9/01/2014												
SW09-Halfway Creek		26/02/2014												
SW09-Halfway Creek		21/03/2014	6.52	20.5	0.22	1.90	25	11	0.03	0.71		0.52	0.02	0.007
SW09-Halfway Creek		7/04/2014												
Upstream Monitoring														
SW09-Halfway Ch. U/S	Wet	22/07/2015	6.07	13.0	0.13	7.12	16	3	*0.02*	0.14	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Wet event piling pad under construction	25/08/2015	6.40	12.3	0.20	8.00	13	11	*0.02*	0.35	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Wet	18/09/2015	6.90	20.1	0.12	4.30	11	3	*0.02*	0.25	N/A	N/A	N/A	N/A
SW09-Halfway Ch. U/S	Wet Type A all parameters within pre construction guidelines	13/10/2015	6.91	23.9	0.15	3.80	11	9	0.03	0.35	N/A	N/A	N/A	N/A
SW09-Halfway Ch. U/S	Wet type A and B 12mm	23/10/2015	6.67	22.3	0.20	2.10	14	10	*0.02*	0.43	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Wet type A and B	4/11/2015	6.80	24.2	0.28	2.00	19	9	*0.02*	0.40	*0.015*	*0.03*	0.01	*0.025*
SW09-Halfway Ch. U/S	Wet type A	17/11/2015	7.05	23.6	0.12	3.90	43	11	1.01	0.39	N/A	N/A	N/A	N/A
SW09-Halfway Ch. U/S	Wet Type A and B	3/12/2015	6.76	22.7	0.13	2.90	15	5	*0.02*	0.34	*0.015*	*0.03*	*0.03*	*0.025*

SW09 (Wet) - Halfway Creek

Wet Event Monitoring

Monitoring Location	Field Notes	Date	pH (field)	Temperature (field)	Electrical Conductivity (field)	Dissolved Oxygen (field)	Turbidity (field)	Suspended Solids	Total Phosphorus	Total Nitrogen	Phosphate	Ammonia	Nitrate	Nitrite
			pH unit	ºC	mS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
SW09-Halfway Ch. U/S	Wet type A	10/12/2015	6.70	24.0	0.19	2.50	18	9	0.05	0.59	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Wet type A and B: water level low	6/01/2016	6.05	25.0	0.19	2.30	11	12	0.05	0.87	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Wet type B	27/01/2016	7.09	23.8	0.22	2.50	19	9	Type B	Type B	1.680	0.06	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Wet A and B	19/02/2016	6.06	26.3	0.28	2.40	29	5	0.60	0.83	*0.015*	*0.03*	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Wet A and B	3/03/2016	7.10	24.7	0.25	2.60	35	37	0.23	0.42	0.190	0.05	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Wet A	9/03/2016	6.57	24.8	0.22	2.30	15	15	0.28	0.56	N/A	N/A	N/A	N/A
SW09-Halfway Ch. U/S	Wet A and B	9/04/2016	6.67	23.9	0.22	3.10	25	18	0.05	0.48	*0.015*	0.08	*0.03*	*0.025*
SW09-Halfway Ch. U/S	Wet type A	25/04/2016	6.78	19.1	0.23	3.30	14	7	0.05	0.37	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Wet Type A and B	6/06/2016	7.15	15.7	0.10	5.10	147	39	*0.02*	0.95	*0.015*	*0.03*	0.10	*0.025*
Halfway Ck. U/S	Wet Type A	20/06/2016	6.43	21.6	0.16	4.00	102	51	0.04	0.71	*0.015*	*0.03*	*0.03*	*0.025*
Halfway Ck. U/S	Wet Type A and B	5/07/2016	6.77	12.3	0.11	5.90	18	5	*0.02*	0.38	*0.015*	*0.03*	*0.03*	*0.025*
Halfway Ck. U/S	Wet type A	3/08/2016	7.03	21.6	0.16	5.50	11	6	*0.02*	0.17	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Wet type A ands B	4/08/2016	7.40	15.8	0.12	5.40	199	60	0.03	0.79	*0.015*	0.08	0.07	*0.025*
Halfway Ck. U/S	Wet	1/11/2016	7.38	23.4	0.19	3.80	12	7	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Wet	9/11/2016	7.36	24.4	0.13	3.80	19	6	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Wet	3/12/2016	7.55	23.3	0.18	3.70	12	14	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Wet event	3/01/2017	7.67	23.5	0.37	3.60	20	15	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Wet event	6/01/2017	7.60	22.9	0.33	3.10	12	15	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Wet event	9/02/2017	7.32	24.0	0.22	3.60	7	4	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Wet event	15/02/2017	7.38	23.6	0.22	3.50	19	12	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Wet event	1/03/2017	7.10	24.5	0.28	4.50	12	7	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Wet event	13/03/2017	6.59	23.7	0.33	3.40	10	3	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Wet event	27/04/2017	6.17	20.0	0.08	4.60	12	*1*	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Wet event	14/05/2017	6.48	14.2	0.08	5.10	15	5	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Wet event	19/05/2017	6.56	18.9	0.11	4.50	53	17	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Wet event	12/06/2017	6.58	20.2	0.06	4.40	79	37	N/A	N/A	N/A	N/A	N/A	N/A
Halfway Ck. U/S	Wet event	17/06/2017	7.00	20.8	0.07	4.80	30	8	N/A	N/A	N/A	N/A	N/A	N/A

SW10 (Dry) - Wells Crossing

Dry Event Monitoring

Monitoring Location	Field Notes	Date	pH (field)	Temperature (field)	Electrical Conductivity (field)	Dissolved Oxygen (field)	Turbidity (field)	Suspended Solids	Total Phosphorus	Total Nitrogen	Phosphate	Ammonia	Nitrate	Nitrite
			pH unit	ºC	mS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
SW10-Wells Crossing		21/08/2013	5.73	13.1	0.19	5.30	10	12	0.02	0.37				
SW10-Wells Crossing		17/09/2013												
SW10-Wells Crossing		25/10/2013	5.75	22.5	0.22	4.54	7	21	0.05	0.84				
SW10-Wells Crossing		26/11/2013	4.65	25.0	0.36	2.42	2	2	0.02	0.49				
SW10-Wells Crossing		20/12/2013	5.49	27.1	0.39	3.80	8	7	0.02	0.33				
SW10-Wells Crossing		9/01/2014	5.58	23.7	0.37	3.34	32	76	0.06	0.60				
SW10-Wells Crossing		26/02/2014	6.09	26.3	0.40	3.98	3	8	0.02	0.37				
SW10-Wells Crossing		21/03/2014												
SW10-Wells Crossing		7/04/2014	5.67	22.8	0.18	1.52	3	11	0.04	1.26				
Upstream Monitoring														
SW10-Wells Crossing U/S	Particulate matter present slight tannin colour evident	7/07/2015	4.36	11.2	0.19	5.94	5	2	0.03	0.41	0.030	0.05	0.05	0.050
SW10-Wells Crossing U/S	Dry event basin construction abut B	19/08/2015	5.90	13.5	0.22	8.00	2	4	*0.02*	0.38	*0.015*	*0.03*	*0.03*	*0.025*
SW10-Wells Crossing U/S	Dry event	14/09/2015	6.60	16.0	0.27	3.30	1	*3*	0.02	0.30	*0.005*	0.14	0.02	*0.005*
SW10-Wells Crossing U/S	Dry-Type B: Shallow water level large amount of macrophytes present	6/10/2015	7.38	16.8	0.36	2.50	1	N/A	N/A	N/A	*0.015*	*0.03*	*0.03*	*0.025*
SW10-Wells Crossing U/S	Dry type A	26/11/2015	6.46	27.0	0.45	2.30	12	11	*0.02*	0.36	*0.015*	*0.03*	*0.03*	*0.025*
SW10-Wells Crossing U/S	Dry type A	9/12/2015	3.10	25.0	0.83	2.50	7	7	0.10	0.54	0.090	*0.03*	*0.03*	*0.025*
SW10-Wells Crossing U/S	Dry Type B	11/01/2016	6.21	25.4	0.40	3.10	5	21	*0.02*	0.40	*0.015*	*0.03*	*0.03*	*0.025*
SW10-Wells Crossing U/S	Dry type A and B	2/02/2016	6.61	25.6	0.39	2.90	11	8	0.36	0.28	0.360	*0.03*	*0.03*	0.050
SW10-Wells Crossing U/S	Dry type A	23/03/2016	6.58	24.3	0.46	2.20	18	12	*0.02*	0.29	N/A	N/A	N/A	N/A
SW10-Wells Crossing U/S	Dry type A and B	7/04/2016	6.49	25.6	0.50	3.80	14	31	*0.02*	0.29	*0.015*	*0.03*	*0.03*	*0.025*
SW10-Wells Crossing U/S	Dry type A	6/05/2016	6.62	22.7	0.37	3.70	30	33	*0.02*	0.40	N/A	N/A	N/A	N/A
Wells Crossing U/S	Dry type A and B	1/06/2016	6.40	20.9	0.42	2.90	6	5	*0.02*	0.33	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing U/S	Dry Type A	4/07/2016	6.08	20.1	0.15	3.40	13	5	*0.02*	0.96	N/A	N/A	N/A	N/A
Wells Crossing U/S	Dry type A and B	1/08/2016	6.28	19.2	0.13	5.00	49	30	*0.02*	0.90	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing U/S	Dry type A	14/09/2016	6.53	22.1	0.17	5.20	8	6	*0.02*	0.75	N/A	N/A	N/A	N/A
Wells Crossing U/S	Dry type A ands B	10/10/2016	6.55	23.5	0.22	2.30	7	6	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Dry	22/11/2016	7.00	25.1	0.27	3.60	3	5	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Dry event (macrophyte particles in sample)	19/12/2016	7.13	23.3	0.50	3.80	14	43	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Dry event	24/01/2017	6.86	26.0	0.54	3.50	2	7	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Dry event	6/02/2017	7.09	23.5	0.43	4.10	3	6	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Dry event	28/03/2017	6.29	21.4	0.09	2.80	12	3	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Dry event	10/04/2017	6.05	22.7	0.08	3.10	10	4	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Dry event	2/05/2017	6.30	21.8	0.50	4.00	9	7	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Dry event	1/06/2017	6.16	18.6	0.14	3.40	14	9	N/A	N/A	N/A	N/A	N/A	N/A

SW10 (Wet) - Wells Crossing

Wet Event Monitoring

Monitoring Location	Field Notes	Date	pH (field)	Temperature (field)	Electrical Conductivity (field)	Dissolved Oxygen (field)	Turbidity (field)	Suspended Solids	Total Phosphorus	Total Nitrogen	Phosphate	Ammonia	Nitrate	Nitrite
			pH unit	ºC	mS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Downstream Monitoring														
SW10-Wells Crossing D/S	Wet	22/07/2015	6.27	12.1	0.20	5.04	7	3	*0.02*	0.31	*0.015*	*0.03*	*0.03*	*0.025*
SW10-Wells Crossing D/S	Wet event basin construction abut A and B	25/08/2015	6.00	12.6	0.22	7.40	13	5	*0.02*	0.28	*0.015*	*0.03*	*0.03*	*0.025*
SW10-Wells Crossing D/S	Wet	18/09/2015	6.52	20.5	0.22	3.70	10	8	*0.02*	0.28	N/A	N/A	N/A	N/A
SW10-Wells Crossing D/S	Wet Type A all parameters within pre construction guidelines	13/10/2015	6.42	24.4	0.30	**2.90**	11	5	*0.02*	0.32	N/A	N/A	N/A	N/A
SW10-Wells Crossing D/S	Wet type A and B 12mm pH, EC, DO marginally outside of P80 guidelines All other results compliant	23/10/2015	6.31	23.7	0.32	2.60	7	5	*0.02*	0.33	*0.015*	*0.03*	*0.03*	*0.025*
SW10-Wells Crossing D/S	All parameters within P80 guidelines	4/11/2015	6.76	24.3	0.24	3.10	23	17	*0.02*	0.40	*0.015*	*0.03*	*0.03*	*0.025*
SW10-Wells Crossing D/S	All parameters within P80 guidelines with the exception of TSS and NTU. DO below P80 but above minimum record for site	17/11/2015	**5.99**	24.4	0.22	3.10	**-**	**334**	0.03	**0.88**	N/A	N/A	N/A	N/A
SW10-Wells Crossing D/S	NTU exceeds P80 . TSS still within maximum record all other results with the exception of DO within pre-construction	3/12/2015	6.50	22.9	0.27	3.20	**200**	**48**	0.03	0.42	*0.015*	*0.03*	*0.03*	*0.025*
SW10-Wells Crossing D/S	Wet type A: B15 natural discharge (75mm recorded at franklins rd.) EC TSS and NTU above P80 all other results within guidelines	10/12/2015	6.20	23.8	0.22	3.30	**642**	**452**	0.04	0.71	*0.015*	*0.03*	**0.06**	*0.025*
SW10-Wells Crossing D/S	pH, Tss and Ntu marginally higher than P80 guidelines. TPH higher than upstream record may be a rusult from highway runoff. No oil or grease visble.	6/01/2016	6.48	25.9	0.28	3.30	**56**	**27**	*0.02*	0.31	*0.015*	*0.03*	*0.03*	*0.025*
SW10-Wells Crossing D/S	NTU and TSS above p80. Note: both results improve rapidly directly downstream. All other results compliant with p80	27/01/2016	6.46	26.7	0.32	3.10	**180**	**56**	N/A	N/A	*0.015*	*0.03*	**0.22**	*0.025*
SW10-Wells Crossing D/S	pH (0.39) and EC (0.214) above P80. all other parameters P80 compliant	19/02/2016	6.69	26.9	**0.61**	3.70	22	6	*0.02*	0.24	*0.015*	*0.03*	*0.03*	*0.025*
SW10-Wells Crossing D/S	pH (0.5) and EC (0.264) above p80. Nitrate, Nitrite and Ammonia all above P80 which may be attributed to natural fluctuation due to extended dry period. All other parameter within P80 guidelines	3/03/2016	6.80	25.2	**0.66**	4.10	11	19	*0.02*	0.77	*0.015*	**0.13**	**0.09**	**0.050**
SW10-Wells Crossing D/S	pH (0.3) and TSS (0.185) above p80 all other results compliant	9/03/2016	6.88	25.1	**0.66**	3.60	11	7	*0.02*	0.19	N/A	N/A	N/A	N/A
SW10-Wells Crossing D/S	pH (0.48) and EC (0.32) marginally above P80. TSS 53.7 above wet event P80 but within the 133 maximum P80 recorded for all events. NTU 73.1 above wet event P80; this result however, reduces significantly immediately downstream.	9/04/2016	6.72	24.0	0.43	**3.00**	**121**	**74**	*0.02*	0.33	*0.015*	*0.03*	*0.03*	*0.025*
SW10-Wells Crossing D/S	pH (0.44) and EC (0.049) marginally higher than P80 but similar to upstream reading. All other results compliant	25/04/2016	6.74	19.4	**0.45**	4.10	17	17	*0.02*	0.21	N/A	N/A	N/A	N/A
Wells Crossing D/S	All results compliant with the exception of pH (0.44) and TN (0.29) marginally above background	6/06/2016	6.74	16.4	0.07	4.60	**33**	9	*0.02*	1.13	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing D/S	All results compliant. TN (0.02) marginally above P80 results	20/06/2016	6.28	21.9	**0.07**	4.60	20	7	*0.02*	0.96	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing D/S	pH (0.22) marginally above p80 all other results compliant with guidelines	5/07/2016	6.52	12.4	**0.13**	5.30	31	10	*0.02*	0.73	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing D/S	pH (0.57) above P80. All other results compliant	3/08/2016	6.87	21.3	**0.02**	5.20	22	8	*0.02*	0.47	N/A	N/A	N/A	N/A
Wells Crossing D/S	pH (1.03) and TN (0.02) above background. NTU and TSS above P80, results however, have been affected by upstream influences outside of the project. All other results compliant	4/08/2016	7.33	16.0	**0.06**	5.10	27	8	*0.02*	**0.96**	*0.015*	0.05	*0.03*	*0.025*
Wells Crossing D/S	pH (0.45) slightly above background but similar to upstream. All other results compliant	1/11/2016	6.85	24.1	0.19	4.00	8	5	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Wells Crossing D/S	pH (0.51) slightly above background but similar to upstream. All other results compliant	9/11/2016	6.81	24.3	0.20	3.10	23	8	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing D/S	All results compliant	3/12/2016	**7.14**	23.2	0.23	3.90	7	3	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing D/S	pH (0.99) above P80 with SD but similar to U/S results. All other results compliant.	3/01/2017	7.29	24.8	0.32	3.10	8	5	N/A	N/A	N/A	N/A	N/A	N/A

SW10 (Wet) - Wells Crossing

Wet Event Monitoring

Monitoring Location	Field Notes	Date	pH (field)	Temperature (field)	Electrical Conductivity (field)	Dissolved Oxygen (field)	Turbidity (field)	Suspended Solids	Total Phosphorus	Total Nitrogen	Phosphate	Ammonia	Nitrate	Nitrite
			pH unit	ºC	mS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Wells Crossing D/S	pH (1.15) above P80 SD but similar to U/S reading. All other results compliant	6/01/2017	**7.45**	22.5	0.41	4.10	8	5	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing D/S	pH (0.76) above P80 SD but similar to U/S all other results compliant	9/02/17	7.33	24.4	0.38	3.60	6	5	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing D/S	pH (0.97) above background but similar to up stream result. All other results compliant	15/02/2017	7.27	23.5	0.38	4.00	4	4	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing D/S	pH (0.56) TSS (6.4) and NTU (16.9) above P80 SD but within EPL guidelines. All other results compliant	1/03/2017	6.86	24.5	0.38	3.60	**65**	**27**	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing D/S	pH (0.09) and EC (0.214) above P80. All other results compliant	13/03/2017	6.39	23.4	**0.61**	3.20	12	6	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing D/S	pH (0.29) marginally above P80 SD. All other results compliant	27/04/2017	6.59	20.6	0.19	3.80	17	20	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing D/S	pH 0.53 abve P80 all other results compliant	14/05/2017	6.63	14.4	0.39	4.80	19	5	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing D/S	All results compliant	19/05/2017	6.49	19.3	**0.09**	3.80	9	*1*	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing D/S	TSS 2.7mg/L abve P80 SD all other results compliant	12/06/2017	**5.90**	21.7	0.04	4.30	**32**	**23**	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing D/S	All results compliant	17/06/2017	6.62	21.0	0.04	3.90	31	6	N/A	N/A	N/A	N/A	N/A	N/A
P80 & P20 Values (calculated from baseline and upstream data below)														
P80 (80th Percentile)			6.89		0.44		31	20	0.04	0.87	0.015	0.03	0.03	0.025
P20 (20th Percentile)			6.24		0.15	3.02								
Baseline (pre-construction) Monitoring														
SW10-Wells Crossing		15/05/2013												
SW10-Wells Crossing		13/06/2013	5.60	17.2	0.09	5.92	25	12	0.02	0.50				
SW10-Wells Crossing		18/07/2013												
SW10-Wells Crossing		21/08/2013												
SW10-Wells Crossing		17/09/2013	5.50	19.4	0.16	3.48	37	16	0.04	0.61				
SW10-Wells Crossing		25/10/2013												
SW10-Wells Crossing		26/11/2013												
SW10-Wells Crossing		20/12/2013												
SW10-Wells Crossing		9/01/2014												
SW10-Wells Crossing		26/02/2014												
SW10-Wells Crossing		21/03/2014	6.15	24.1	0.34	3.40	6	18	0.05	0.86		0.11	0.01	
SW10-Wells Crossing		7/04/2014												
Upstream Monitoring														
Wells Crossing U/S	Wet	22/07/2015	6.28	13.0	0.18	6.17	6	19	*0.02*	0.53	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing U/S	Wet event basin construction abut A and B	25/08/2015	5.70	12.9	0.23	7.10	4	7	*0.02*	0.32	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing U/S	Wet	18/09/2015	6.57	19.5	0.25	3.60	3	*1*	*0.02*	0.30	N/A	N/A	N/A	N/A
Wells Crossing U/S	construction guidelines Rock platform crossing under construction	13/10/2015	6.49	23.4	0.33	3.30	5	20	*0.02*	0.40	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet type A and B 12mm	23/10/2015	6.37	23.2	0.36	1.90	8	20	0.03	0.58	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing U/S	Wet type A and B	4/11/2015	6.83	23.8	0.33	1.80	12	27	0.03	0.70	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing U/S	Wet type A	17/11/2015	6.24	23.6	0.17	2.40	20	10	*0.02*	0.54	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet Type A and B	3/12/2015	6.42	22.9	0.45	2.70	8	18	0.04	0.51	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing U/S	Wet type A	10/12/2015	6.10	25.6	0.30	2.60	78	49	0.04	0.64	*0.015*	*0.03*	*0.03*	*0.025*

SW10 (Wet) - Wells Crossing

Wet Event Monitoring

Monitoring Location	Field Notes	Date	pH (field)	Temperature (field)	Electrical Conductivity (field)	Dissolved Oxygen (field)	Turbidity (field)	Suspended Solids	Total Phosphorus	Total Nitrogen	Phosphate	Ammonia	Nitrate	Nitrite
			pH unit	ºC	mS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Wells Crossing U/S	particulate matter from macrophytes in sample	6/01/2016	6.31	25.1	0.38	1.80	13	11	*0.02*	0.58	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing U/S	Wet type B	27/01/2016	6.33	26.8	0.43	3.30	8	4	N/A	N/A	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing U/S	Wet A and B	19/02/2016	6.71	26.9	0.48	2.90	22	21	*0.02*	0.47	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing U/S	Wet A and B: particulate matter from macrophytes in upstream sample	3/03/2016	6.90	25.1	0.29	3.80	10	129	0.04	0.97	*0.015*	0.10	*0.03*	*0.025*
Wells Crossing U/S	Wet A	9/03/2016	6.90	25.6	0.35	4.80	14	20	0.03	0.88	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet A and B	9/04/2016	6.78	24.0	0.38	4.30	43	29	*0.02*	0.44	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing U/S	from difficulty in obtaining sample without macrophyte debris. NTU	25/04/2016	6.77	19.3	0.35	3.90	10	209	0.05	0.85	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet Type A and B	6/06/2016	6.87	16.1	0.05	4.40	32	8	*0.02*	1.16	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing U/S	Wet Type A	20/06/2016	6.35	22.0	0.12	3.80	21	7	0.03	1.10	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing U/S	Wet Type A and B	5/07/2016	6.69	11.9	0.15	5.20	12	5	*0.02*	0.84	*0.015*	*0.03*	*0.03*	*0.025*
Wells Crossing U/S	Wet type A	3/08/2016	6.84	21.9	0.02	3.60	21	10	*0.02*	0.29	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet type A ands B	4/08/2016	7.33	16.0	0.09	4.40	36	10	*0.02*	0.94	*0.015*	0.06	*0.03*	*0.025*
Wells Crossing U/S	Wet	9/11/2016	6.68	24.3	0.20	3.90	15	7	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet	3/12/2016	7.03	23.2	0.29	3.80	13	10	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet event (macrophyte particles in sample)	3/01/2017	7.42	24.3	0.55	3.00	29	16	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet event	6/01/2017	7.42	23.1	0.40	4.20	15	18	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet event	9/02/2017	7.16	24.3	0.49	3.10	7	4	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet event	15/02/2017	7.29	23.9	0.68	7.80	4	3	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet event	1/03/2017	6.82	24.6	0.57	3.60	4	3	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet event	13/03/2017	6.39	23.4	0.44	3.20	5	7	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet event: macrophyte particles in sample	27/04/2017	6.24	20.4	0.34	3.70	39	16	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet event Macrophyte particles in sample	14/05/2017	6.24	14.2	0.60	5.10	54	11	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet event	19/05/2017	6.27	20.1	0.27	4.10	102	130	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet event Macrophyte particles in sample	12/06/2017	6.03	21.4	0.03	4.10	27	5	N/A	N/A	N/A	N/A	N/A	N/A
Wells Crossing U/S	Wet event	17/06/2017	6.87	20.9	0.04	3.70	25	7	N/A	N/A	N/A	N/A	N/A	N/A

SW11 (Dry) - Glenugie Creek

Dry Event Monitoring

Monitoring Location	Field Notes	Date	pH (field)	Temperature (field)	Electrical Conductivity (field)	Dissolved Oxygen (field)	Turbidity (field)	Suspended Solids	Total Phosphorus	Total Nitrogen	Phosphate	Ammonia	Nitrate	Nitrite
			pH unit	ºC	mS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Downstream Monitoring														
SW11-Glenugie Ck D/S	Pooled water no flow algae on surface	7/07/15	**3.70**	5.6	0.38	3.70	45	3	**0.05**	**1.71**	0.030	**0.57**	**0.52**	0.050
SW11-Glenugie Ck D/S	Pooled water no flow algae on surface	19/08/15	7.60	10.5	0.43	5.30	9	4	**0.03**	**1.26**	*0.015*	**0.06**	**0.49**	*0.025*
SW11-Glenugie Ck D/S	dry event high amounts of debris on surface	14/09/15	**6.34**	14.9	**0.19**	3.90	41	8	**0.03**	**1.00**	*0.005*	**0.04**	**0.39**	0.020
SW11-Glenugie Ck D/S	Dry-Type B no flow algae and natural leachate on surface	6/10/15	7.15	16.0	0.32	**1.70**	9	N/A	N/A	N/A	*0.015*	**0.42**	**0.32**	*0.025*
SW11-Glenugie Ck D/S	All parameters within P80 guidelines. All nutrients above pre-construction values	26/11/15	6.75	27.6	**0.17**	2.60	21	14	**0.05**	**1.54**	*0.015*	**0.40**	**0.21**	*0.025*
SW11-Glenugie Ck D/S	EC, Nitrate, total Phosphorous and Nitrogen all above P80 which may be due to natural fluctuations within the system	9/12/15	**7.20**	25.1	**0.10**	2.80	29	8	**0.06**	**1.02**	*0.015*	**0.28**	**0.15**	*0.025*
SW11-Glenugie Ck D/S	Results within P80 Guidelines with the exception of Nitrate, Nitrrite and Total Nitrogen. Increased nutrient levels possibly due to large microbat colony	11/01/16	6.55	25.0	0.20	**1.90**	49	**23**	*0.02*	**0.91**	*0.015*	**0.30**	**0.07**	*0.025*
SW11-Glenugie Ck D/S	pH marginally below P80. TSS above p80 and marginally (5) above maximum dry record. NTU Above p80 but within maximum record. Ammonia above p80 possibly due to natural fluctuations.	2/02/16	6.90	25.2	**0.22**	**1.70**	**80**	**33**	**0.03**	**0.80**	*0.015*	**0.12**	*0.03*	*0.025*
SW11-Glenugie Ck D/S	Total Nitrogen (0.69) and Total Phosphorus (0.022) above P80 all other results compliant	23/03/16	**7.07**	25.1	0.19	**1.90**	21	11	**0.05**	**1.41**	N/A	N/A	N/A	N/A
SW11-Glenugie Ck D/S	All results compliant with P80 with the exception of total nitrogen 0.43 above background. This result may be attributed to the bebo arch microbat colony.	7/04/16	6.87	24.5	**0.17**	**1.60**	15	7	**0.04**	**1.25**	*0.015*	**0.64**	**0.07**	*0.025*
SW11-Glenugie Ck D/S	pH (0.02) below P80 Total Nitrogen (0.37) and Total Phosphorous (0.220) above P80 possibly a result of the large Microbat colony residing in adjacent Bebo arch all other parameters compliant	6/05/16	6.98	23.0	**0.17**	**2.20**	23	11	**0.05**	**1.09**	N/A	N/A	N/A	N/A
Glenugie Ck D/S	pH marginally (0.35) below background. All other parameters compliant. Nutrients (with the exceptionof Phosphate) above P80 possibly a result of the large Microbat colony residing in adjacent Bebo arch	1/06/16	6.65	21.1	**0.19**	**2.40**	9	6	**0.04**	**1.65**	*0.015*	**0.77**	**0.23**	*0.025*
Glenugie Ck D/S	pH (0.58) and TN (0.89) above p80 all other results within guidelines	4/07/16	6.42	20.1	0.31	3.90	**59**	7	**0.03**	**1.25**	N/A	N/A	N/A	N/A
Glenugie Ck D/S	results compliant with the exception with nutrient levels which may be result from the microbat overwintering period	1/08/16	6.51	19.2	**0.01**	3.10	9	5	*0.02*	**3.34**	*0.015*	**1.57**	**0.24**	*0.025*
Glenugie Ck D/S	TN (0.93) above background all other results compliant	14/09/16	6.92	22.4	0.25	3.30	36	13	**0.10**	**1.65**	N/A	N/A	N/A	N/A
Glenugie Ck D/S	pH (0.18) below p80. all other results compliant	10/10/16	6.82	23.5	0.29	3.00	12	7	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	EC (0..208) below background but similar to upstream. All other results compliant	22/11/16	**7.22**	25.0	**0.19**	3.40	7	3	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Glenugie Ck D/S	All results compliant	19/12/16	**7.41**	22.9	**0.19**	**2.30**	16	9	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Glenugie Ck D/S	All results compliant	24/01/17	**7.22**	26.0	0.28	2.90	12	9	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	All results compliant	6/02/17	**7.42**	23.4	**0.17**	2.80	5	7	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	pH (0.37) TSS (14.1) and NTU (49.1) above P80 SD	28/03/17	6.83	21.4	0.30	3.80	**119**	**18**	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	All results within P80 guidelines	10/04/17	6.36	22.7	0.28	4.30	41	10	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	pH .06 below P80 SD all other results compliant	2/05/17	6.94	22.6	0.29	3.80	16	6	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	pH .09 below P80 SD all other results compliant	1/06/17	6.91	19.7	0.44	3.50	**55**	6	N/A	N/A	N/A	N/A	N/A	N/A
P80 & P20 Values (calculated from baseline and upstream data below)														
P80 (80th Percentile)			7.04		0.42		50	18	0.03	0.63	0.015	0.03	0.03	0.025
P20 (20th Percentile)			6.55		0.26	2.60								

SW11 (Dry) - Glenugie Creek

Dry Event Monitoring

Monitoring Location	Field Notes	Date	pH (field)	Temperature (field)	Electrical Conductivity (field)	Dissolved Oxygen (field)	Turbidity (field)	Suspended Solids	Total Phosphorus	Total Nitrogen	Phosphate	Ammonia	Nitrate	Nitrite
			pH unit	ºC	mS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Baseline (pre-construction) Monitoring														
SW11-Glenugie Creek		15/05/2013	7.00	17.4	0.49	2.70	19	11	0.02	0.27				
SW11-Glenugie Creek		13/06/2013												
SW11-Glenugie Creek		18/07/2013	6.87	14.7	0.35	10.33	20	5	0.02	0.33	0.006	0.03	0.01	
SW11-Glenugie Creek		21/08/2013	7.02	12.4	0.49	3.30	16	3	0.02	0.28				
SW11-Glenugie Creek		17/09/2013												
SW11-Glenugie Creek		25/10/2013	7.33	20.7	0.39	2.43	10	7	0.02	0.49				
SW11-Glenugie Creek		26/11/2013	6.81	22.1	0.25	3.45	104	28	0.03	0.82				
SW11-Glenugie Creek		20/12/2013	6.91	22.0	0.40	2.10	10	4	0.02	0.38				
SW11-Glenugie Creek		9/01/2014	7.23	21.7	0.31	0.71	16	10	0.03	0.37				
SW11-Glenugie Creek		26/02/2014	7.22	23.1	0.39	1.83	4	3	0.02	0.58				
SW11-Glenugie Creek		21/03/2014												
SW11-Glenugie Creek		7/04/2014	6.91	22.3	0.29	3.24	63	18	0.02	0.52				
Upstream Monitoring														
SW11-Glenugie Ck U/S	Pooled water no flow	7/07/2015	5.87	11.6	0.40	7.75	44	9	0.03	0.55	0.030	0.39	0.05	0.050
SW11-Glenugie Ck U/S	Pooled water no flow	19/08/2015	7.90	11.2	0.51	8.20	19	9	*0.02*	0.53	*0.015*	*0.03*	*0.03*	*0.025*
SW11-Glenugie Ck U/S	dry event no flow	14/09/2015	6.64	14.1	0.30	2.60	8	14	0.02	0.40	*0.005*	*0.01*	0.04	*0.005*
SW11-Glenugie Ck U/S	Dry-Type B: stagnant	6/10/2015	7.31	16.1	0.27	3.00	47	N/A	N/A	N/A	*0.015*	*0.03*	*0.03*	*0.025*
SW11-Glenugie Ck U/S	Dry type A	26/11/2015	6.45	28.5	0.30	3.10	22	36	*0.02*	0.58	*0.015*	*0.03*	*0.03*	*0.025*
SW11-Glenugie Ck U/S	Dry type A	9/12/2015	6.90	25.0	0.18	2.20	8	13	0.05	0.64	*0.015*	*0.03*	*0.03*	*0.025*
SW11-Glenugie Ck U/S	Dry Type B	11/01/2016	6.45	25.0	0.15	2.60	92	21	*0.02*	0.52	*0.015*	*0.03*	*0.03*	*0.025*
SW11-Glenugie Ck U/S	Dry type A and B	2/02/2016	6.80	25.1	0.28	3.00	47	17	*0.02*	0.53	*0.015*	*0.03*	*0.03*	*0.025*
SW11-Glenugie Ck U/S	Dry type A	23/03/2016	6.98	24.2	0.15	3.40	15	12	*0.02*	0.38	N/A	N/A	N/A	N/A
SW11-Glenugie Ck U/S	Dry type A and B	7/04/2016	6.76	24.9	0.18	3.10	31	8	*0.02*	0.38	*0.015*	*0.03*	*0.03*	*0.025*
SW11-Glenugie Ck U/S	Dry type A	6/05/2016	6.69	22.8	0.28	3.80	45	23	0.03	0.69	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Dry type A and B	1/06/2016												
Glenugie Ck U/S	Dry Type A	4/07/2016	6.08	20.1	0.40	4.50	40	3	*0.02*	1.19	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Dry type A and B	1/08/2016	6.45	18.7	0.31	5.80	13	6	*0.02*	0.52	*0.015*	*0.03*	*0.03*	*0.025*
Glenugie Ck U/S	Dry type A	14/09/2016	6.67	22.5	0.20	4.00	42	14	*0.02*	0.79	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Dry type A ands B	10/10/2016	6.73	23.0	0.43	3.80	40	23	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Waterway dry	22/11/2016												
Glenugie Ck U/S	System dry	19/12/2016	System Dry											
Glenugie Ck U/S	Dry event	24/01/2017	7.06	26.4	0.52	3.70	8	8	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Dry event	6/02/2017			Dry				N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Dry event	28/03/2017	6.67	21.4	0.37	4.20	70	14	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Dry event	10/04/2017	6.11	23.1	0.41	4.40	70	12	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Dry event	2/05/2017	6.71	21.8	0.41	3.90	53	6	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Dry event	1/06/2017	6.61	19.7	0.57	5.10	26	5	N/A	N/A	N/A	N/A	N/A	N/A

SW11 (Wet) - Glenugie Creek

Wet Event Monitoring

Monitoring Location	Field Notes	Date	pH (field)	Temperature (field)	Electrical Conductivity (field)	Dissolved Oxygen (field)	Turbidity (field)	Suspended Solids	Total Phosphorus	Total Nitrogen	Phosphate	Ammonia	Nitrate	Nitrite
			pH unit	ºC	mS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Downstream Monitoring														
SW11-Glenugie Ck D/S	Wet-No Flow	22/07/2015	**5.90**	10.9	0.39	3.70	32	8	**0.04**	**1.70**	*0.015*	**0.05**	**0.83**	*0.025*
SW11-Glenugie Ck D/S	Dry Pooled water no flow algae on surface	25/08/2015	**7.50**	12.8	0.21	7.50	50	22	*0.02*	0.53	*0.015*	**0.05**	**0.12**	*0.025*
SW11-Glenugie Ck D/S	Rising water very milky in appearance	18/09/2015	6.65	19.8	0.16	3.70	45	27	*0.02*	0.48	N/A	N/A	N/A	N/A
SW11-Glenugie Ck D/S	Wet Type A no flow. water quality better than upstream readings	13/10/2015	**7.15**	22.9	0.29	**2.30**	5	3	**0.06**	**1.88**	N/A	N/A	N/A	N/A
SW11-Glenugie Ck D/S	Wet type A and B 12mm all parameters within P80 guidelines with the exception of DO total Phosphorous and total Nitrogen which may be due to seasonal fluctuations	23/10/2015	6.72	23.3	0.34	1.90	4	5	**0.07**	**1.72**	**0.030**	**0.28**	**0.43**	*0.025*
SW11-Glenugie Ck D/S	Nutrients higher than P80 and upstream results which may be due to increased micro-bat activity. All other parameters within or better than P80 guidelines with the exception of DO	4/11/2015	6.78	23.3	0.31	**1.70**	3	3	**0.06**	**1.90**	**0.040**	**0.62**	**0.42**	**0.140**
SW11-Glenugie Ck D/S	pH and DO marginally below P80 results. All other parameters within P80 guidelines	17/11/2015	6.21	23.4	0.12	3.10	45	16	**0.04**	0.72	N/A	N/A	N/A	N/A
SW11-Glenugie Ck D/S	All parameters within p80 guidelines. Nitrate, Ammonia and total Nitrogen above p80 may be due to natural fluctuations within the system	3/12/2015	6.70	22.6	0.16	**2.40**	22	17	**0.04**	0.81	*0.015*	**0.17**	**0.12**	*0.025*
SW11-Glenugie Ck D/S	B26 and operational basin natural discharge. TSS, NTU, Nitrate, total Nitrogen and Phosphate above p80 but similar to upstream results. Increased turbidity and TSS likely to be due from surrounding area.	10/12/2015	**6.40**	25.2	0.14	3.80	550	**1482**	**0.09**	**1.71**	*0.015*	*0.03*	**0.13**	*0.025*
SW11-Glenugie Ck D/S	All results within P80 guidelines. TPH lower than upstream result	6/01/2016	6.71	25.3	0.18	**2.30**	82	29	*0.02*	0.73	*0.015*	**0.16**	*0.03*	*0.025*
SW11-Glenugie Ck D/S	All results within p80 guidelines	27/01/2016	6.67	26.1	0.10	**2.40**	**133**	35	N/A	N/A	*0.015*	**0.08**	0.06	*0.025*
SW11-Glenugie Ck D/S	Natural leachate visible on surface. EC slightly higher (0.106) than P80 but consistent with U/S result. All other parameters P80 compliant	19/02/2016	7.01	26.3	0.35	**2.40**	10	6	**0.04**	0.10	*0.015*	**0.10**	0.08	*0.025*
SW11-Glenugie Ck D/S	EC marginally above P80 (0.074) all other results compliant	3/03/2016	7.10	24.7	0.31	**2.90**	22	10	*0.02*	0.18	*0.015*	*0.03*	*0.03*	*0.025*
SW11-Glenugie Ck D/S	All results compliant with P80 guidelines	9/03/2016	7.16	25.1	0.18	3.50	47	21	*0.02*	0.56	N/A	N/A	N/A	N/A
SW11-Glenugie Ck D/S	Nitrate, Ammonia and Total Nitrogen all above P80 possibly a result of the large Microbat colony residing in adjacent Bebo arch. All other results compliant.	9/04/2016	**7.12**	24.0	0.12	**2.70**	43	17	**0.04**	0.97	*0.015*	**0.20**	**0.11**	*0.025*
SW11-Glenugie Ck D/S	Total Nitrogen (0.22) above P80 all other results compliant	25/04/2016	**7.30**	19.3	0.16	3.60	39	21	**0.05**	**1.15**	N/A	N/A	N/A	N/A
Glenugie Ck D/S	All results compliant with the exception of TN (0.4) above background	6/06/2016	6.65	16.4	0.19	4.80	**234**	38	*0.02*	1.33	*0.015*	*0.03*	0.09	*0.025*
Glenugie Ck D/S	pH (0.34) and TN (0.47) marginally above P80 guidelines all other parameters compliant	20/06/2016	6.26	21.9	0.15	4.50	**282**	40	0.03	**1.40**	**N/A**	*0.03*	0.08	**N/A**
Glenugie Ck D/S	All results within p80 guidelines with the exception of nitrate(.0593 above background which may be attributed to Microbat overwintering in adjacent bebo arch	5/07/2016	6.72	12.5	0.13	6.00	66	11	*0.02*	0.79	*0.015*	*0.03*	0.15	*0.025*
Glenugie Ck D/S	All results compliant	3/08/2016	**7.62**	21.0	0.12	4.90	61	17	*0.02*	0.82	N/A	N/A	N/A	N/A
Glenugie Ck D/S	NTU (2) and TN (0.35) above P80. All other results compliant	4/08/2016	6.98	20.4	0.11	5.70	**207**	76	0.04	**1.28**	*0.015*	*0.03*	0.07	*0.025*
Glenugie Ck D/S	All results compliant	1/11/2016	**7.33**	23.7	0.32	**3.00**	4	3	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	Standing water no flow	9/11/2016	**7.36**	24.2	0.20	3.30	4	2	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	EC marginally above P80 (0.071) all other results compliant	3/12/2016	**7.27**	23.2	0.31	3.50	5	5	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Glenugie Ck D/S	All results compliant	3/01/2017	**7.44**	23.9	0.21	**2.80**	10	5	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Glenugie Ck D/S	pH marginally (0.19) above P80 SD but similar to U/S reading. All other results compliant	6/01/2017	7.59	22.9	0.13	3.40	34	27	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	All results compliant	9/02/17	7.41	24.6	0.17	3.10	4	5	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	All results compliant	15/02/2017	**7.41**	23.5	0.27	3.50	4	4	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

SW11 (Wet) - Glenugie Creek

Wet Event Monitoring

Monitoring Location	Field Notes	Date	pH (field)	Temperature (field)	Electrical Conductivity (field)	Dissolved Oxygen (field)	Turbidity (field)	Suspended Solids	Total Phosphorus	Total Nitrogen	Phosphate	Ammonia	Nitrate	Nitrite
			pH unit	ºC	mS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Glenugie Ck D/S	All results compliant	1/03/2017	**7.17**	24.6	**0.09**	3.20	41	18	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	pH (0.25) and EC (0.022) below P80. All other results compliant)	13/03/2017	6.75	23.4	0.26	4.40	42	15	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	EC (0.143 above background. All other results compliant.	27/04/2017	6.87	21.1	**0.38**	3.80	25	8	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	EC (0.163) and DO (0.9) marginally above P80. All other results compliant	14/05/2017	6.97	14.4	**0.40**	4.20	14	5	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	All results compliant	19/05/2017	6.95	20.1	0.10	5.40	76	20	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	pH (0.5) below P80 SD. All other results compliant	12/06/2017	6.10	20.5	**0.06**	4.50	129	84	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck D/S	NTU (541.6) above P80 SD but less than upstream result. All results compliant. High TSS and turbidity results not associated with HC2G construction activities. Only area of construction within Glenugie Creek catchment is small area north of Franklins Road, which has completed concrete pavement and topsoiling/revegetation of batters. Result associated with State Forest area outside construction footprint. EPA Forestry section is investigating further following discussion at June 2017 ERG meeting.	17/06/2017	6.69	21.4	0.15	4.40	685	396	N/A	N/A	N/A	N/A	N/A	N/A
P80 & P20 Values (calculated from baseline and upstream data below)														
P80 (80th Percentile)			7.08		0.35		123	60	0.03	1.10	0.015	0.03	0.09	0.025
P20 (20th Percentile)			6.50		0.09	3.10								
Baseline (pre-construction) Monitoring														
SW11-Glenugie Creek		15/05/2013												
SW11-Glenugie Creek		13/06/2013	6.89	17.7	0.13	5.35	269	125	0.05	0.81				
SW11-Glenugie Creek		18/07/2013												
SW11-Glenugie Creek		21/08/2013												
SW11-Glenugie Creek		17/09/2013	6.42	21.3	0.20	5.30	51	28	0.03	0.65				
SW11-Glenugie Creek		25/10/2013												
SW11-Glenugie Creek		26/11/2013												
SW11-Glenugie Creek		20/12/2013												
SW11-Glenugie Creek		9/01/2014												
SW11-Glenugie Creek		26/02/2014												
SW11-Glenugie Creek		21/03/2014	7.11	23.2	0.19	4.97	109	37	0.02	0.46	0.005	0.11	0.08	0.004
SW11-Glenugie Creek		7/04/2014												
Upstream Monitoring														
SW11-Glenugie Ck U/S	Wet-No Flow	22/07/2015	6.20	13.2	0.44	5.47	26	12	*0.02*	0.55	*0.015*	*0.03*	*0.03*	*0.025*
SW11-Glenugie Ck U/S	Pooled water no flow	25/08/2015	7.40	13.2	0.12	8.20	50	28	*0.02*	0.45	*0.015*	*0.03*	0.05	*0.025*
SW11-Glenugie Ck U/S	Noticeable flow	18/09/2015	6.71	19.6	0.11	3.90	59	20	*0.02*	0.55	N/A	N/A	N/A	N/A
SW11-Glenugie Ck U/S	Wet Type A. No flow sediment evident in water	13/10/2015	6.70	23.7	0.32	2.60	60	38	0.03	0.69	N/A	N/A	N/A	N/A
SW11-Glenugie Ck U/S	Wet type A and B 12mm	23/10/2015	6.36	23.4	0.46	1.80	63	62	0.05	0.88	*0.015*	*0.03*	0.06	*0.025*
SW11-Glenugie Ck U/S		4/11/2015	Sampling point dry											
SW11-Glenugie Ck U/S	Wet type A	17/11/2015	6.20	23.4	0.05	3.40	75	19	0.03	0.49	N/A	N/A	N/A	N/A
SW11-Glenugie Ck U/S	Wet Type A and B	3/12/2015	6.73	22.6	0.08	3.30	53	22	0.03	0.56	*0.015*	*0.03*	*0.03*	*0.025*

SW11 (Wet) - Glenugie Creek

Wet Event Monitoring

Monitoring Location	Field Notes	Date	pH (field)	Temperature (field)	Electrical Conductivity (field)	Dissolved Oxygen (field)	Turbidity (field)	Suspended Solids	Total Phosphorus	Total Nitrogen	Phosphate	Ammonia	Nitrate	Nitrite
			pH unit	ºC	mS/cm	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
SW11-Glenugie Ck U/S	Wet type A	10/12/2015	6.80	25.6	0.12	3.20	550	1132	0.08	1.66	*0.015*	*0.03*	0.12	*0.025*
SW11-Glenugie Ck U/S	Wet type A and B	6/01/2016	6.68	25.3	0.09	3.10	108	50	0.03	0.64	*0.015*	*0.03*	*0.03*	*0.025*
SW11-Glenugie Ck U/S	Wet type B	27/01/2016	6.72	26.4	0.09	3.10	114	27	N/A	N/A	*0.015*	0.06	*0.03*	*0.025*
SW11-Glenugie Ck U/S	Wet A and B	19/02/2016	6.78	26.8	0.47	2.90	26	9	*0.02*	*0.03*	*0.015*	*0.03*	*0.03*	*0.025*
SW11-Glenugie Ck U/S	Wet A and B	3/03/2016	7.13	25.6	0.13	3.50	32	21	*0.02*	0.40	*0.015*	*0.03*	0.09	*0.025*
SW11-Glenugie Ck U/S	Wet A	9/03/2016	7.23	25.1	0.15	3.00	75	25	*0.02*	0.61	N/A	N/A	N/A	N/A
SW11-Glenugie Ck U/S	Wet A and B	9/04/2016	6.84	24.0	0.21	3.10	29	12	*0.02*	0.45	*0.015*	*0.03*	*0.03*	*0.025*
SW11-Glenugie Ck U/S	Wet type A	25/04/2016	6.87	19.2	0.26	3.80	37	18	*0.02*	0.44	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Wet Type A and B	6/06/2016	6.54	16.3	0.18	5.10	158	47	*0.02*	1.63	*0.015*	*0.03*	0.09	*0.025*
Glenugie Ck U/S	Wet Type A	20/06/2016	6.15	21.8	0.16	5.20	251	94	0.03	1.36	*0.015*	*0.03*	0.07	*0.025*
Glenugie Ck U/S	Wet Type A and B	5/07/2016	6.49	12.4	0.35	5.70	45	9	*0.02*	1.16	*0.015*	*0.03*	0.53	*0.025*
Glenugie Ck U/S	Wet type A	3/08/2016	7.15	20.9	0.44	5.30	23	14	*0.02*	0.64	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Wet type A ands B	4/08/2016	7.39	20.4	0.10	5.60	125	167	0.04	1.27	*0.015*	*0.03*	0.07	*0.025*
Glenugie Ck U/S	Wet	1/11/2016	6.97	24.0	0.53	3.20	38	21	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Standing water no flow	9/11/2016	6.86	24.3	0.51	2.90	78	25	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Wet	3/12/2016	System dry											
Glenugie Ck U/S	System dry	3/01/2017		System dry										
Glenugie Ck U/S	Wet event	6/01/2017	7.85	23.1	0.08	5.10	24	11	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Wet event	9/02/2017			Dry				N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Wet event	15/02/2017			Dry									
Glenugie Ck U/S	Wet event	1/03/2017						Dry	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Wet event	13/03/2017	6.54	23.4	0.34	3.30	30	4	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Wet event	27/04/2017	6.67	20.9	0.27	4.50	58	10	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Wet event	14/05/2017	6.77	14.2	0.29	4.80	46	9	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Wet event	19/05/2017	6.97	19.9	0.08	5.10	36	14	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Wet event	12/06/2017	6.07	20.7	0.06	4.40	158	97	N/A	N/A	N/A	N/A	N/A	N/A
Glenugie Ck U/S	Wet event	17/06/2017	6.54	21.5	0.09	4.40	850	572	N/A	N/A	N/A	N/A	N/A	N/A

Appendix C

Groundwater Quality: Results of Interest

Section 2 Groundwater Quality Table of Results of Inte

Bore	Date	Results of Interest
GWB31	18/08/2016	TDS = 1600 mg/L TP = 0.93 mg/L Calcium 165 mg/L Magnesium = 59 mg/L Sulfate = 115 mg/L Bicarbonate = 785 mg/L Zinc = 0.041 mg/L
GWB31	29/03/2017	pH = 6.84 DO = 1.6 mg/L TDS = 1540 mg/L TRH C16-C34 Fraction = 120 µg/L Potassium = 3.1 mg/L Calcium = 121 mg/L Magnesium = 55.5 mg/L Sulfate = 258 mg/L Bicarbonate = 846 mg/L Copper = 0.033 mg/L Lead 0.005 mg/L Zinc = 0.018 mg/L
GWB31	23/06/2017	pH = 7.02 DO 0.14 mg/L Turbidity = 731 NTU TDS = 1240 Potassium = 2.8 mg/L Calcium = 101 mg/L Magnesium = 45.1 mg/L Sulfate = 181 mg/L Bicarbonate = 865 mg/L Lead = 0.005 mg/L

Appendix D

Groundwater Quality: Data

GWB31

			Physical and chemical properties						Hydrocarbons			Nutrients		Major Cations				Major Anions			Heavy Metals (Dissolved)				
Monitoring Location	Field Notes	Date	pH	Temperature	EC	DO	Turbidity	TDS	TRH C10-C16 Fraction	TRH C16-C34 Fraction	TRH C34-C40 Fraction	Total Nitrogen	Total Phosphorus	Sodium	Potassium	Calcium	Magnesium	Chloride	Sulfate	Bicarbonate (Alkalinity)	Aluminium	Cadmium	Copper	Lead	Zinc
			pH unit	°C	mS/cm	mg/L	NTU	mg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Downgradient (construction) Monitoring																									
GWB31		11/09/2015	7.10	21.10	2.55	2.12	0	**1660**				1.01	**0.45**	414	**2.6**	**176.0**	**57.8**	169	**132**	**710**	0.013	*0.001*	0.001	*0.001*	**0.009**
GWB31		16/12/2015	**8.30**	23.30	2.12	2.59	**800**	**1334**				**2.41**	0.07	345	**3.0**	**126.0**	**50.0**	156	**101**	**660**	0.010	*0.001*	**0.023**	*0.001*	**0.019**
GWB31		20/05/2016	**6.67**	24.04	2.43	8.89	**771**	**1743**				0.61	0.25	394	**3.0**	**171.0**	**62.0**	177	**125**	**830**	0.005	*0.001*	**0.013**	*0.001*	**0.027**
GWB31		18/08/2016	7.30	21.40	2.42	9.67	0	**1600**				1.26	**0.93**	366	2.0	**165.0**	**59.0**	194	**115**	**785**	0.006	*0.001*	*0.005*	*0.001*	**0.041**
GWB31	Not enough to sample - no recharge 24hrs after purge.	13/12/2016						---				---	---	---	---	---	---	---	---	---	---	---	---	---	---
GWB31		29/03/2017	**6.84**	23.21	2.41	**1.60**	132	**1540**	*50*	**120**	*50*	1.34	0.15	326	**3.1**	**121.0**	**55.5**	167	**258**	**846**	*0.005*	**0.001**	**0.033**	**0.005**	**0.018**
GWB31		23/06/2017	**7.02**	20.05	2.03	**0.14**	**731**	**1240**	*13*	*50*	*50*	0.95	0.20	296	**2.8**	**101.0**	**45.1**	119	**181**	**865**	0.010	**0.001**	*0.002*	**0.005**	*0.002*
P80 & P20 Values (calculated from baseline data)																									
P80			7.90		3.02		353	1192	2100	50	50	1.49	0.35	432	2.3	42.7	8.6	392	17	422	0.351	0.001	0.012	0.003	0.009
P20			7.09		0.64	1.69		429																	
Downgradient Baseline (pre-construction) Monitoring (identifier from pre-construction)																									
GW31		9/04/2014	6.96	21.51	1.48	3.40	131		*25*	*50*	*50*														
Upgradient (construction) Monitoring																									
[redacted]																									
Upgradient Baseline (pre-construction) Monitoring (identifier from pre-construction)																									
GW30		14/11/2013	7.33	26.54	3.02	1.69	6	1930	4100	240	*50*	5.57	0.13	661	2.2	85.6	15.6	466	433	630	0.007	*0.001*	0.000	*0.001*	0.004
GW30		10/02/2014	7.29	26.57	3.34	1.37	12		2100	*50*	*50*														
GW30		9/04/2014	7.41	22.46	3.51	2.02	5		440	*50*	*50*														

Appendix E

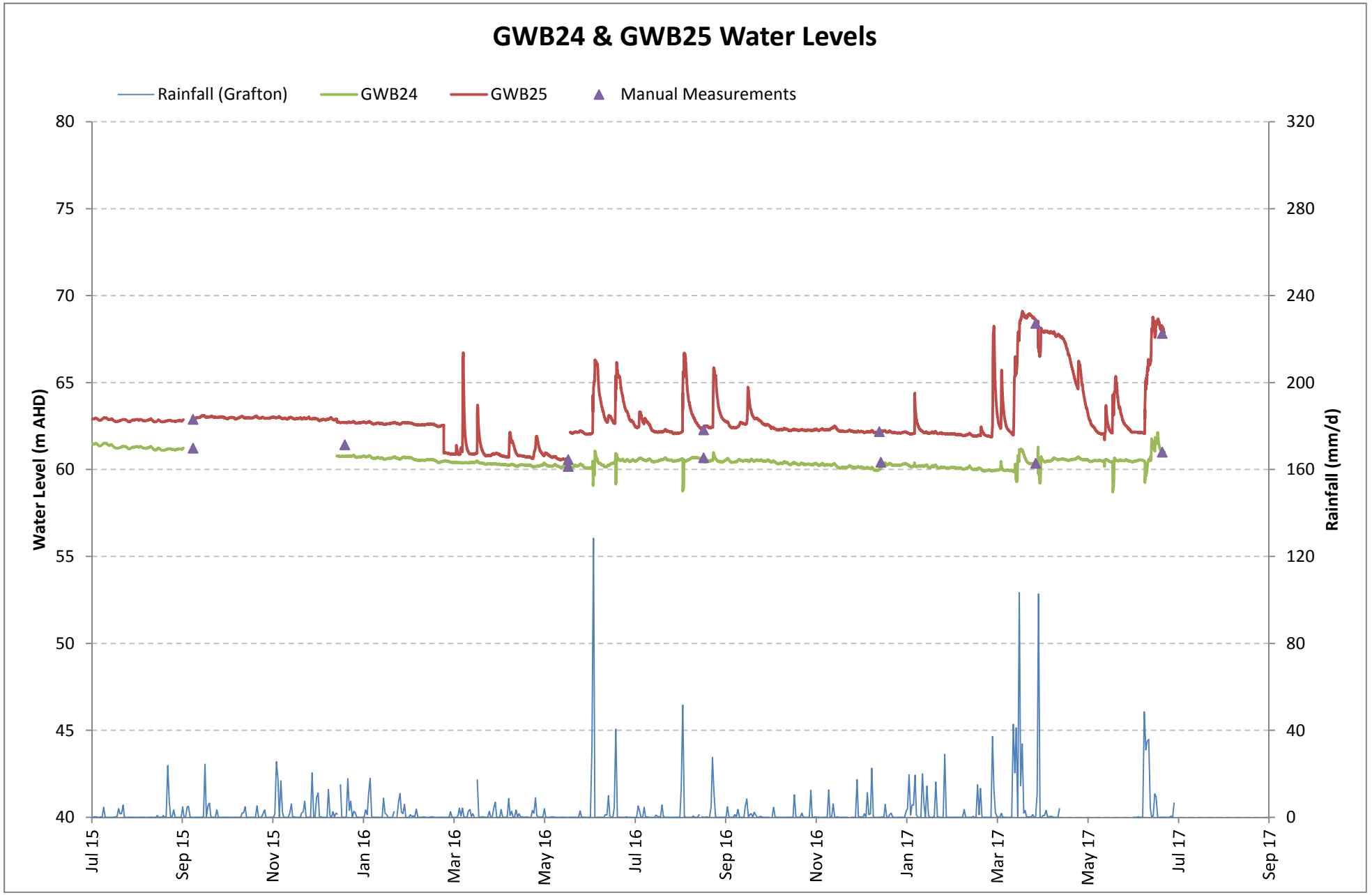
Groundwater Levels: Results of Interest

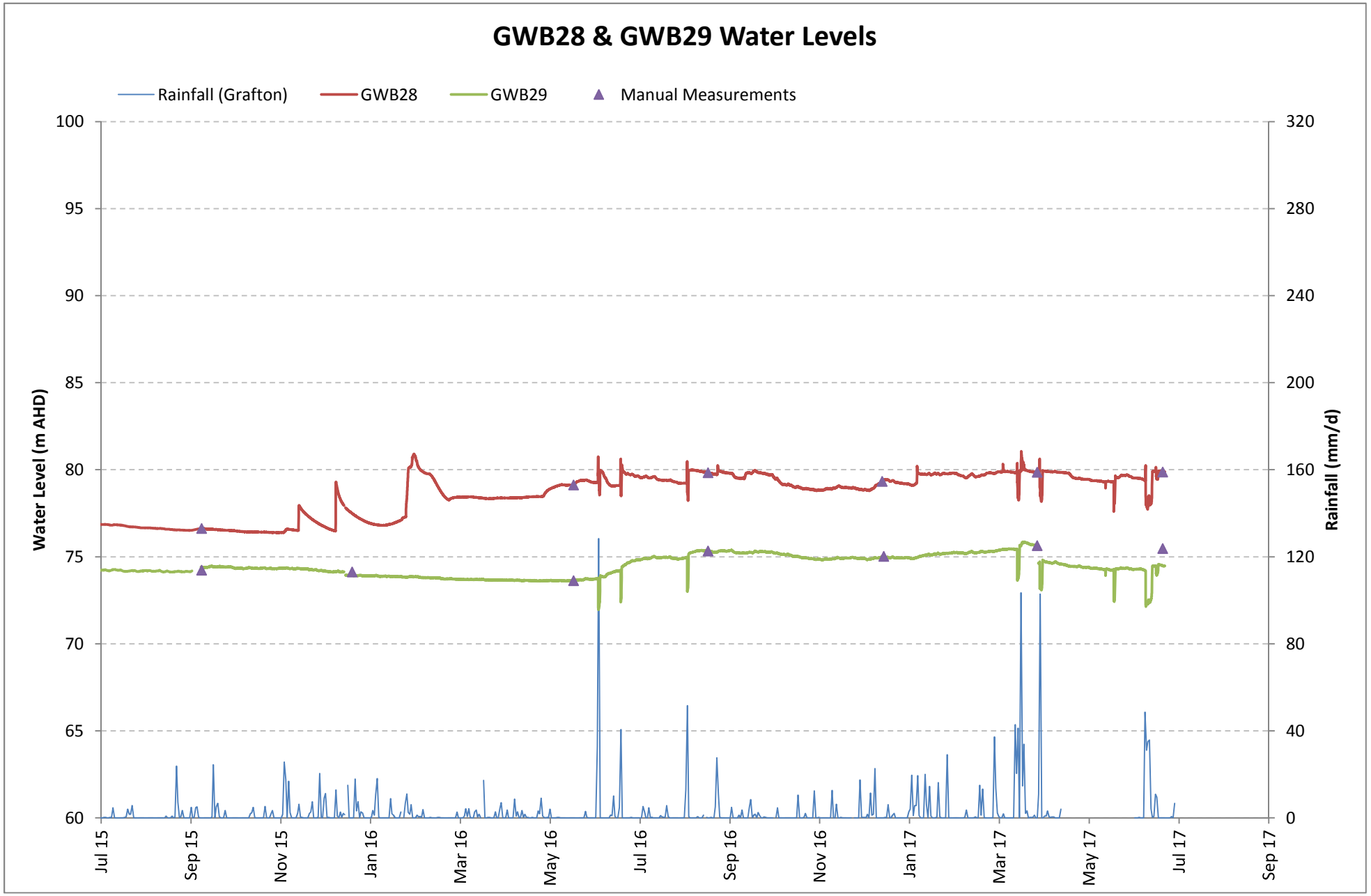
Section 2 Groundwater Levels Table of Results of Interest

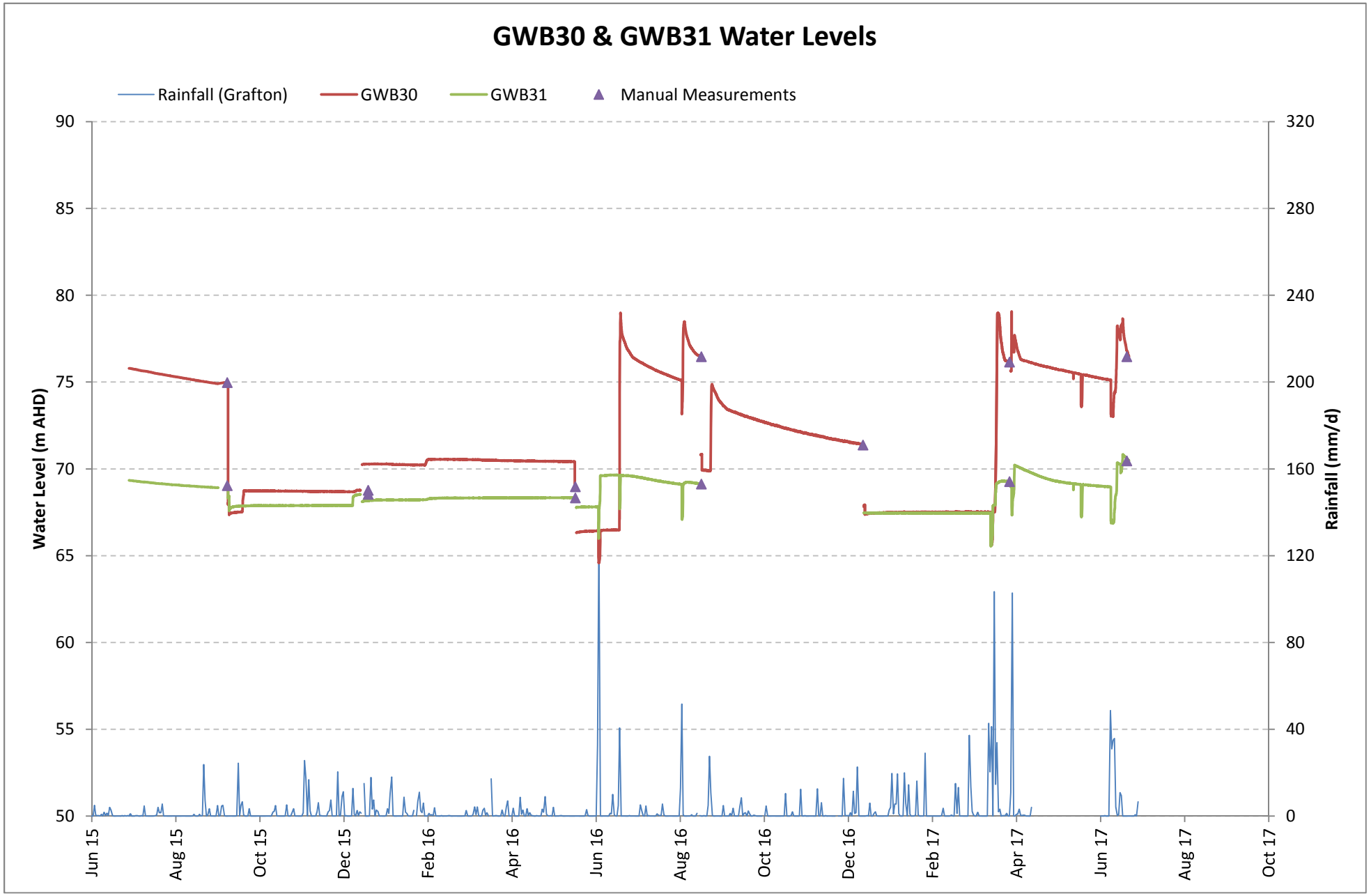
Bore	***P80 Level Difference***	***Results of Interest***
GWB24	1.94 m	5/07/16 - 12/07/16 (approx. 1 week) (max. level difference approx. 2.7 m) 3/08/16 - 13/08/16 (approx. 1.5 weeks) (max. level difference approx. 6.6 m) 24/08/16 - 9/09/16 (approx. 2 weeks) (max. level difference approx. 4.9 m) 10/09/16 - 2/10/16 (approx. 3 weeks) (max. level difference approx. 4.2 m) 23/10/16 - 15/12/16 (approx. 1.5 months) (max. level difference approx. 2.2 m) 27/02/17 - 6/05/17 (approx. 2.25 months) (max. level difference approx. 8.6 m) 19/05/17 - 29/05/17 (approx. 1.5 weeks) (max. level difference approx. 4.8 m) 10/06/17 - 23/06/17 (approx. 2 weeks) (max. level difference approx. 7.4 m)
GWB29	3.35 m	1/07/16 - 23/06/17 (approx. 1 year) (max. level difference approx. 6.3 m)
GWB31	2.63 m	1/07/16 - 17/08/16 (approx. 1.5 months) (max. level difference approx. 9.3 m) 19/03/17 - 23/06/17 (approx. 3 months) (max. level difference approx. 10.1 m)

Appendix F

Groundwater Levels: Charts


GWB24 & GWB25 Water Levels
Rainfall (Grafton)
GWB24
GWB25
Manual Measurements
Water Level (m AHD)
Rainfall (mm/d)
80
75
70
65
60
55
50
45
40
320
280
240
200
160
120
80
40
0
Jul 15
Sep 15
Nov 15
Jan 16
Mar 16
May 16
Jul 16
Sep 16
Nov 16
Jan 17
Mar 17
May 17
Jul 17
Sep 17


GWB28 & GWB29 Water Levels
Rainfall (Grafton)
GWB28
GWB29
Manual Measurements
Water Level (m AHD)
Rainfall (mm/d)
100
95
90
85
80
75
70
65
60
320
280
240
200
160
120
80
40
0
Jul 15
Sep 15
Nov 15
Jan 16
Mar 16
May 16
Jul 16
Sep 16
Nov 16
Jan 17
Mar 17
May 17
Jul 17
Sep 17


GWB30 & GWB31 Water Levels
Rainfall (Grafton)
GWB30
GWB31
Manual Measurements
Water Level (m AHD)
Rainfall (mm/d)
90
85
80
75
70
65
60
55
50
320
280
240
200
160
120
80
40
0
Jun 15
Aug 15
Oct 15
Dec 15
Feb 16
Apr 16
Jun 16
Aug 16
Oct 16
Dec 16
Feb 17
Apr 17
Jun 17
Aug 17
Oct 17

Appendix G

Incidents with Potential Water Impacts

Incident Summary (Provided by RMS)			*Assessment For Correlation with Water Quality Results*				
Date of event	***Summary of event details***	***Location***	***Incident located < 50 m to nearest waterway/ drain***	***If incident involved hydrocarbon (or liquid waste) spill more than 50 m from a waterway/drain, was the spill greater than 5 L?***	***Closest surface water monitoring site (and approx. distance and bearing from event)***	***WQMP Results of Interest (for relevant parameter) within 1 month following the incident?***	***Potential correlation between incident and WQMP results of Interest?***
17 October 2016	A short duration (15min) intense rainfall event of 6mm between 5:15pm & 5:30pm resulted in lifting of sub-base curing compound from southbound carriageway north of Wells Crossing and 100% capture in Basin 15. Note water captured remained 500mm below sediment storage zone, with over 1,000m3 of redundant storage available. The paving run was for southbound carriageway (CH 22452 - CH 22919). Approximately 20m3 of runoff containing wax emulsion (Evencure W30 Wax emulsion) was captured in Basin 15, with nil off-site discharge. Basin 15 was completely discharged prior to commencement of the paving run. Catchment assessment was completed by the Environmental Team in liaison with paving superintendent prior to paving. The paving area was confirmed to be completely contained within Basin 15 catchment.	CH 22452 - CH 22919	Yes	NA	SW10 (approx. 50 m S)	No	NA
23 May 2017	Two public vehicles were involved in a collision on the southbound carriageway of the Pacific Highway (approximate chainage 16600). They were a Hilux ute	Approx. CH 16600	Yes	NA	SW09 (approx. 4.1 km NW)	No	NA

Incident Summary (Provided by RMS)			Assessment For Correlation with Water Quality Results				
Date of event	***Summary of event details***	***Location***	***Incident located < 50 m to nearest waterway/ drain***	***If incident involved hydrocarbon (or liquid waste) spill more than 50 m from a waterway/drain, was the spill greater than 5 L?***	***Closest surface water monitoring site (and approx. distance and bearing from event)***	***WQMP Results of Interest (for relevant parameter) within 1 month following the incident?***	***Potential correlation between incident and WQMP results of Interest?***
	and a loaded truck and dog (T&D) (not related to HC2G). The Hilux contacted the T&D on the left hand side fuel tank, causing a rupture. This rupture resulted in subsequent spillage of approximately 600 litres of diesel fuel. It appears that Hilux ute was attempting illegal U-turn at the end of the Shell acceleration lane, and in the process turned directly into the side of the loaded truck and dog which was travelling at 80km/hr southbound on the Pacific Highway. There were no serious injuries. All diesel was contained within road reserve, with nil discharge into or past the operational spill basin at CH16175. Summary of containment and clean up actions: 1. All diesel contained on site via earth bunds, sand bags, absorbent pads and floor sweep absorbent material; 2. HAZMAT attended site 1 hour after collision and retrieved all free diesel product; 3. 550L of retrieved free diesel product provided to Halfway Creek Fire & Rescue for re-use in training and back burn activities; EPA were immediately notified and advised						

Incident Summary (Provided by RMS)			*Assessment For Correlation with Water Quality Results*				
Date of event	***Summary of event details***	***Location***	***Incident located < 50 m to nearest waterway/ drain***	***If incident involved hydrocarbon (or liquid waste) spill more than 50 m from a waterway/drain, was the spill greater than 5 L?***	***Closest surface water monitoring site (and approx. distance and bearing from event)***	***WQMP Results of Interest (for relevant parameter) within 1 month following the incident?***	***Potential correlation between incident and WQMP results of Interest?***
	satisfaction with reporting and actions, confirming matter considered closed.						