BARCALDINE REGIONAL COUNCIL
71 Ash Street (PO BOX 191)
Barcaldine QLD 4725

Service Provider ID 473

DRINKING WATER QUALITY MANAGEMENT PLAN

May 2018

GBA CONSULTING ENGINEERS

Document Control

	Prepared by:			Approved by:	
Rev	**Name**	**Review / Release**	**Comment**	**Signature/Name**	**Date**
1	P.J. Cullivan	Review	Issued to Council for Council Approval		20/03/2012
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6	William Green	Review	Amendment of document. Report released to Council followed by Regulator for comment.		24/05/2018

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Contact for enquiries and proposed changes

If you have any questions regarding this document or if you have a suggestion for improvements, please contact:

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1 Registered Service Details

Barcaldine Regional Council (BRC) is located in the Central West of Queensland and comprises the now amalgamated Shires of Aramac, Barcaldine and Jericho covering an area of 53,677 km^2. To illustrate the vastness of the area served the community furthest West (Muttaburra) is approximately 293km by road west of the community furthest East (Alpha). Figure 1.1 shows the location of the town of Barcaldine relative to Mt. Isa, Townsville, Rockhampton and Brisbane.

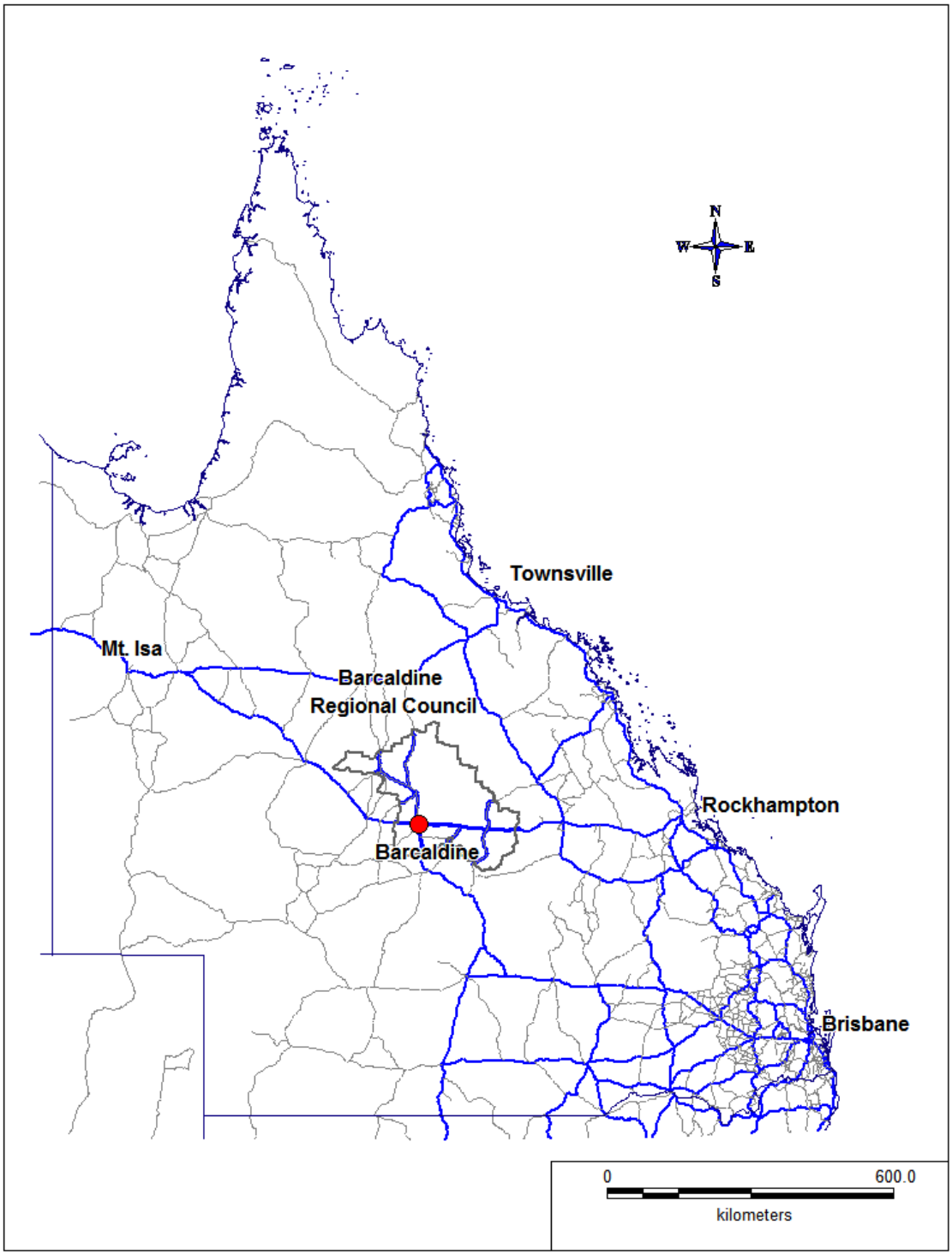


Figure 1.1 Barcaldine Location Map

BRC is the drinking water service provider (SPID 473) for the following five drinking water supply schemes in the region (refer to Figure 1.2):

- **Alpha Water Supply Scheme**

  Alpha is located approximately 460km west of Rockhampton on the Capricorn Highway on the eastern side of the Great Dividing Range on the flood plain of Alpha Creek.

- **Aramac Water Supply Scheme**

  Aramac is located 67km north of Barcaldine. Aramac is located on the northern side of Aramac Creek which runs into the Thompson River midway between Longreach and Muttaburra.

- **Barcaldine Water Supply Scheme**

  Barcaldine is located at the intersection of the Landsborough and Capricorn Highways, 600km due west of Rockhampton.

- **Jericho Water Supply Scheme**

  Jericho is located approximately 520km west of Rockhampton on the Capricorn Highway, on the western side of the Great Dividing Range.

- **Muttaburra Water Supply Scheme**

  Muttaburra is located 119km north of Longreach and 85km north-west of Aramac.

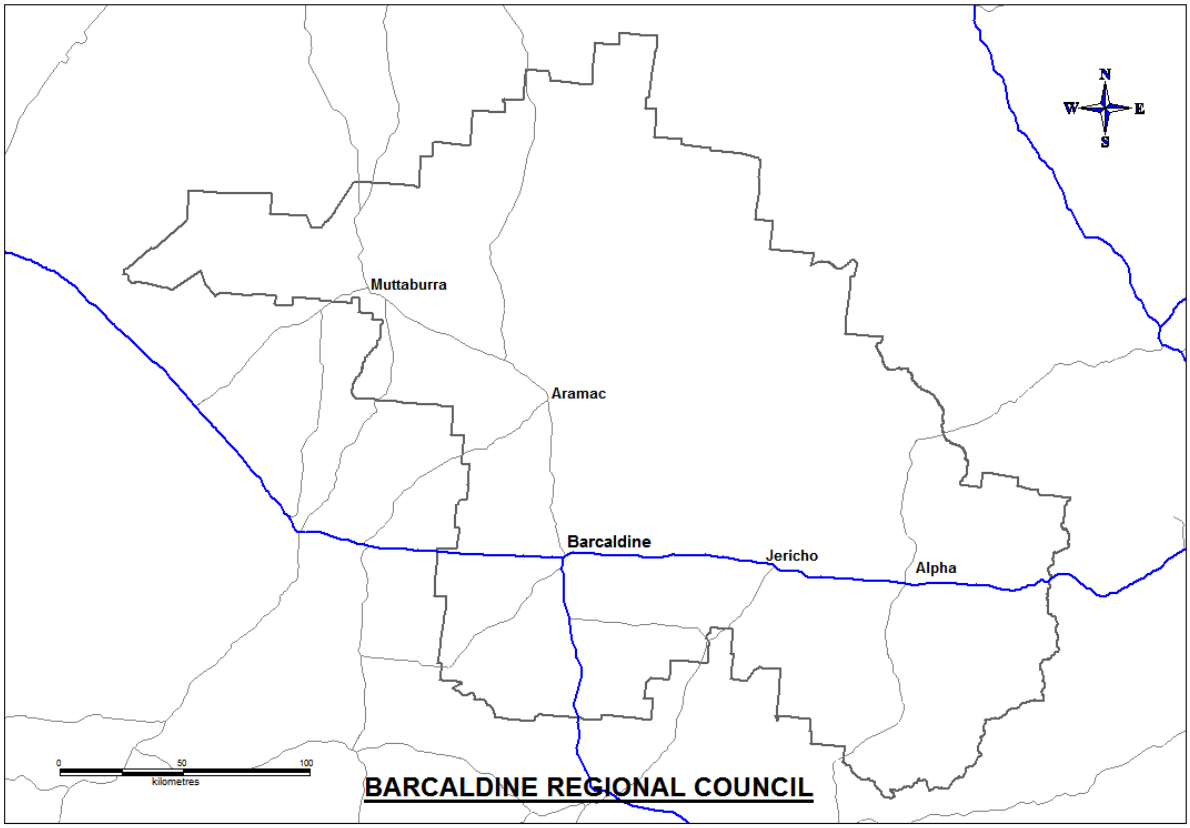


Figure 1.2 Barcaldine Regional Council

BRC is a medium Drinking Water Service Provider (DWSP) as defined in the Water Supply (Safety and Reliability) Act 2008 and provides drinking water for an approximate population of 2,259 with a total demand of approximately 6.725 ML/d. BRC may be referred to as the DWSP throughout this document.

1.1 Approval Application Form

Refer to Appendix A Drinking Water Quality Management Plan Approval Application.

1.2 Further Information Required

Table 1.1 below lists the drinking water schemes, identifies the operational responsibilities for each scheme and details the current and future population and demand for each scheme.

Table 1.1 Listing of Drinking Water Schemes

Scheme Name	Operator (organisation)	Communities Served	2016			Future (2026)[1]		
			Population Served	Connections	Demand ML/d	Population Served	Connections	Demand ML/d
Alpha	Barcaldine Regional Council	Alpha	335	304	0.841	361	316	0.908
Aramac		Aramac	299	233	0.73	323	252	0.788
Barcaldine		Barcaldine	1422	845	4.398	1536	912	4.750
Jericho		Jericho	115	139	0.132	124	150	0.143
Muttaburra		Muttaburra	88	104	0.624	95	112	0.674
Total			2259	1625	6.725	2439	1742	7.263

[1] A population growth of .08% per annum has been applied in accordance with QLD gov statistics office regional projections. BRC will monitor population changes and undertake a network analysis of the affected schemes. Should significant growth be observed. BRC will incorporate any new information into the DWQMP during future reviews.

2 Details of Infrastructure for Providing the Service

BRC is the DWSP for five water supply schemes. The infrastructure for providing the service is detailed in the sections outlined below:

- 2.1 Alpha Water Supply Scheme
- 2.2 Aramac Water Supply Scheme
- 2.3 Barcaldine Water Supply Scheme
- 2.4 Jericho Water Supply Scheme
- 2.5 Muttaburra Water Supply Scheme

For Alpha and Jericho water supply schemes, sub artesian bore water is pumped to a water treatment plant where the water undergoes the following water treatment processes:

- aeration,
- flocculation,
- clarification,
- filtration,
- chlorination,
- pH adjustment.

After treatment water is stored in a ground level reservoir and elevated reservoir prior to being reticulated to the communities.

For Aramac, Barcaldine and Muttaburra water supply schemes, water is untreated and artesian bore water is reticulated to the communities. For Aramac and Muttaburra bore water is supplied directly into reticulation. Barcaldine bore water is pumped into ground level reservoirs before being pumped into reticulation.

2.1 Alpha Water Supply Scheme

Alpha water supply scheme is comprised of five pumped sub-artesian bores delivering water to a water treatment plant. The bore water requires treatment prior to delivery into the water reticulation system.

The treatment process includes aeration, flocculation, clarification, filtration, chlorination and pH adjustment. Prior to flocculation water is dosed with alum. Water is mixed in a flocculation tank and then passed through an inclined plate clarifier prior to rapid gravity sand filtration. The treated water is dosed with Chlorine and the pH is adjusted prior to delivery to the ground level and elevated reservoirs. The rapid gravity sand filters are back washed using water from the ground level reservoir; the backwash is stored in the recycled water tank. Liquid alum sludge can also be drawn off the flocculation tank and clarifier and this is stored in the recycled water tanks. Water stored in the recycled water tanks can be used for irrigation purposes on the green surrounding the water treatment plant. Treated water is then pumped into a 1,071kL ground level reservoir and then into a 329kL elevated reservoir and reticulation.

The treatment plant may be bypassed during maintenance / breakdown however considering the storage capacity on site the treatment plant may only be bypassed in exceptional circumstances. During the unlikely event of water shortages water can be carted from artesian sources.

During power outages a limited supply of treated water can be supplied to the town via the elevated reservoir. This gives sufficient time for the town back-up generators to come online. The town back-up generators are maintained by Ergon.

2.1.1 Schematic

Figure 2.1 shows a schematic of the Alpha water supply scheme. Figure 2.2 below shows a schematic of the Alpha Water Treatment Plant. Refer to Appendix B for water supply layouts superimposed on aerial photos.

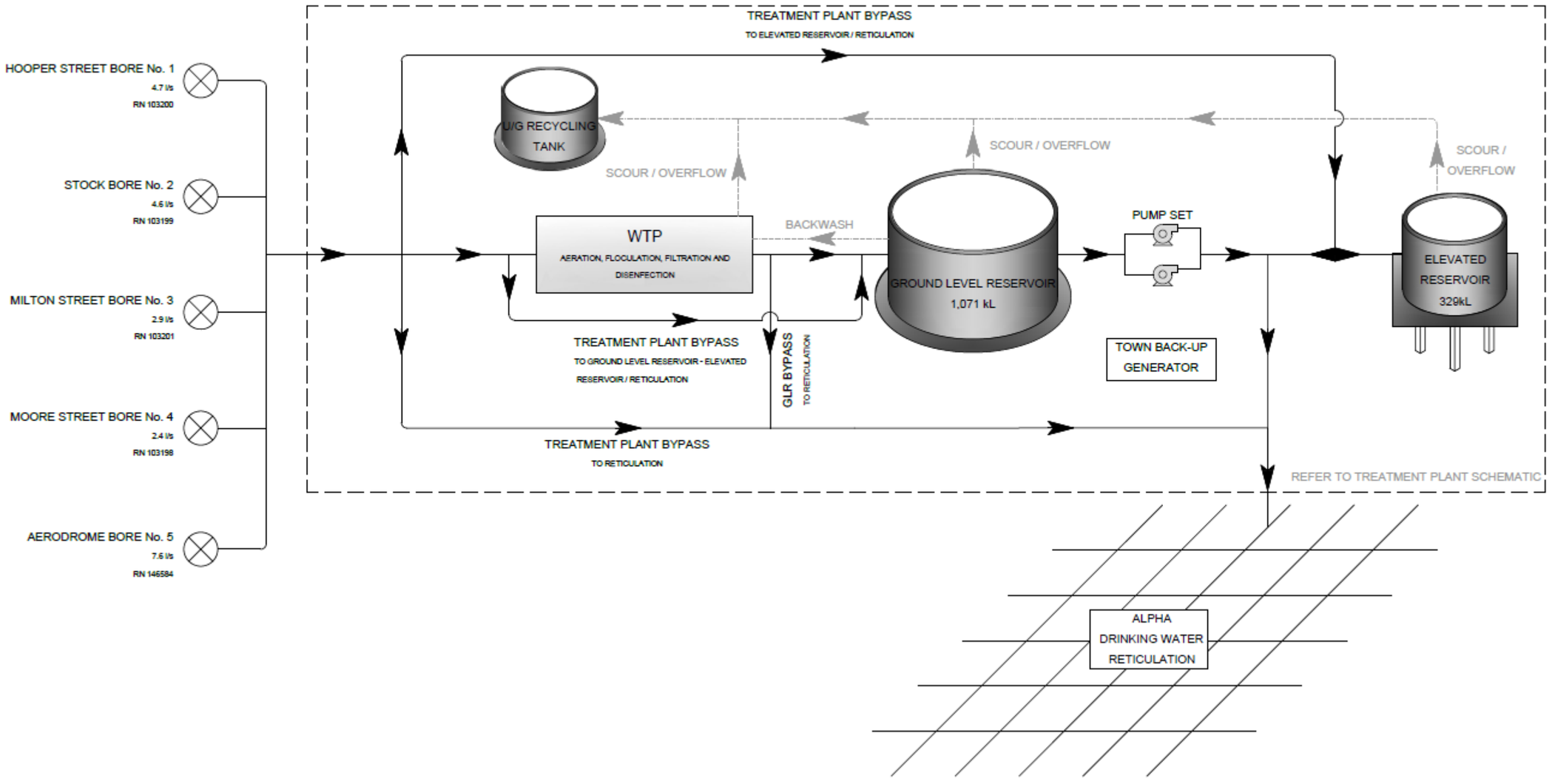


Figure 2.1 Alpha Service Schematic Layout

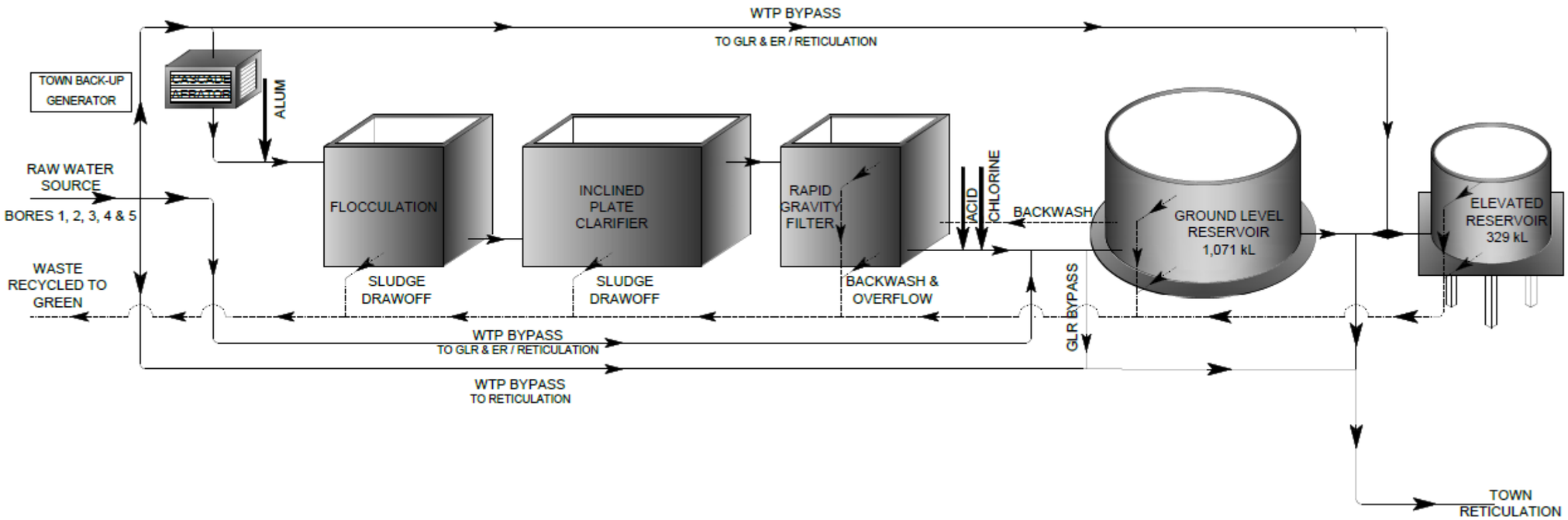


Figure 2.2 Alpha Treatment Plant Schematic

2.1.2 Source, Treatment and Distribution Details

Table 2.1 provides the following information for Alpha's infrastructure:

- Source details;
- Treatment processes;
- Disinfection processes; and
- Distribution and reticulation.

Table 2.1 Alpha Infrastructure Details

Component		Alpha Water Supply Scheme
Sources	Name	Hooper Street Bore (No. 1)
	Type	*Shallow Bore (RN 100673)*
	% of supply	*21*
	Reliability	*Does not run dry*
	Water quality issues	*Raw water does not comply with the Australian Drinking Water Guidelines.*
	Name	Stock Bore (No. 2)
	Type	Shallow Bore (RN 100674)
	% of supply	21
	Reliability	*Does not run dry*
	Water quality issues	*Raw water does not comply with the Australian Drinking Water Guidelines*
	Name	Milton Street Bore (No. 3)
	Type	Shallow Sub Artesian Bore (RN 100676)
	% of supply	13
	Reliability	*Reliable*
	Water quality issues	*Raw water does not comply with the Australian Drinking Water Guidelines.*
	Name	Moore Street Bore (No. 4)
	Type	Shallow Bore (RN 100675)
	% of supply	11
	Reliability	*Reliable*
	Water quality issues	*Raw water does not comply with the Australian Drinking Water Guidelines.*
	Name	Aerodrome Bore (No. 5)
	Type	Shallow Bore (RN 146584)
	% of supply	34
	Reliability	*Reliable*
	Water quality issues	*Raw water does not comply with the Australian Drinking Water Guidelines.*
Sourcing Infrastructure	Type	Shallow Sub Artesian Bore
	Description	*The 5 bores are located in Alpha on Hopper, Milton and Moore Streets, adjacent to the Stock Yard and at the Alpha Aerodrome. The bores are approximately 70 m deep and yield 4.7, 4.6, 2.9, 2.4 and 7.6 l/s respectively for Bores 1, 2, 3, 4 and 5. Bore use is rotated therefore changes to yield are unnoticeable.*

Component		Alpha Water Supply Scheme
Are there any sources that **do not** undergo treatment prior to supply?	No	
Water Treatment Plant	Name	Alpha Water Treatment Plant
	Process	*Process comprises cascade aeration, flocculation, inclined plate clarification, rapid gravity sand filtration and pH adjustment*
	Design Capacity (20 hr. operation)	720 kL
	Daily flow range	10 l/s (capacity)
	Chemicals added	Calcium hypochlorite, alum and acid
	Standby chemical dosing facilities (Y/N)	No
	Water sourced from and %	Hooper Street Bore (No. 1) 21% Stock Bore (No. 2) 21% Milton Street Bore (No. 3) 13% Moore Street Bore (No. 4) 11% Aerodrome Bore (No. 5) 34%
	% of average day demand provided	100
	% of scheme supply	100
	Distribution area supplied	
	Bypasses / Variations	Treatment plant can be bypassed in the event of a breakdown for short periods. Reservoirs can also be bypassed (either before or after treatment plant bypass).
Are there any sources that **do not** undergo disinfection prior to supply?	No	
Disinfection	Location	After flocculation and filtration.
	Type	Chlorination
	Dose rate	56l/day (average) (solution in water 1.5% available chlorine)
	Target residual levels	0.5mg/l
	Duty/standby	Duty (and spares)
	Dosing arrangements	*fixed*
	Alarms	*Yes*
	Auto shut-off arrangements	Not applicable

Component		Alpha Water Supply Scheme
Distribution and Reticulation System	Pipe material Age range Approx. % of total length	uPVC 16 (2018) 80%
	Pipe material Age range Approx. % of total length	Poly 21 – 33 (2018) 20%
	Areas where potential long detention periods could be expected	None
	Areas where low water pressure (eg < 12 m) could be expected during peak or other demand periods)	The golf course and houses in that vicinity may experience brief periods of low water pressure during peak demand.
Reservoirs	**Ground Level (No)** Name Capacity (ML) Roofed Vermin-proof (Y/N) Runoff directed off roof	1 Alpha Ground Level Reservoir 1.071 Yes Yes Yes
	Elevated (No) Name Capacity (ML) Roofed Vermin-proof Runoff directed off roof	1 Alpha Elevated Reservoir 0.329 Yes Yes Yes
Water quality responsibility changes	Entire water supply scheme	Barcaldine Regional Council

2.2 Aramac Water Supply Scheme

Aramac water supply scheme is comprised of two artesian bores (one pumped) delivering water directly to reticulation. The water supplied into reticulation is artesian bore water. The bore water is of a quality that does not require treatment as raw water quality complies with the Australian Drinking Water Guidelines. Refer to Table 3.7 and Section 3.2.1 (b) for water quality data indicating why the source does not undergo treatment.

Power outages will have limited effect on the Aramac water supply scheme as currently one of the bores have natural artesian pressure and can provide sufficient water supply during power outages.

2.2.1 Schematic

Figure 2.3 shows a schematic of the Aramac's Water Supply Scheme. Refer to Appendix B for water supply layouts superimposed on aerial photos.

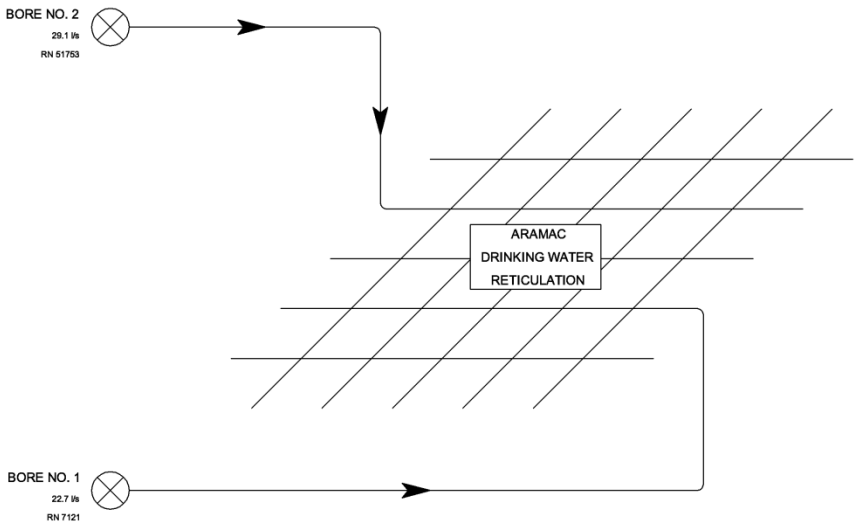


Figure 2.3 Aramac Service Schematic Layout

2.2.2 Source, Treatment and Distribution Details

Table 2.2 provides the following information for Aramac's infrastructure:

- Source details;
- Distribution and reticulation.

Table 2.2 Aramac Infrastructure Details

Component		Aramac Water Supply Scheme
Sources	Name	*Bore No. 1*
	Type	*Deep Artesian Bore (RN 7121)*
	% of supply	*53%*
	Reliability	*Does not run dry however lack of storage may present problems during fire fighting*
	Water quality issues	*Raw water complies with the Australian Drinking Water Guidelines.*
	Name	*Bore No. 2*
	Type	*Deep Artesian Bore (RN 51753)*

Component		Aramac Water Supply Scheme
	% of supply Reliability Water quality issues	*47%* *Does not run dry however lack of storage may present problems during fire fighting* *Raw water complies with the Australian Drinking Water Guidelines.*
Sourcing Infrastructure	Type Description	*Deep Artesian Bore* *The town bores 1 and 2 are located on the eastern and western ends of Kerr Street respectively. Bores 1 and 2 are 366m and 362m deep respectively. The bores currently yield 32.7 l/s and 29.1 l/s respectively. Bore No. 1 is free flowing, while Bore No. 2 is pumped. Bore use is rotated therefore changes to yield are unnoticeable.*
Are there any sources that **do not** undergo treatment prior to supply?	Yes Town Bores 1 and 2. Deep artesian bores with water of a quality that generally does not require treatment. Raw water quality generally complies with the Australian Drinking Water Guidelines	
Are there any sources that **do not** undergo disinfection prior to supply?	Yes Town Bores 1 and 2. Deep artesian bores with water of a quality that generally does not require disinfection.	
Distribution and Reticulation System	Pipe material Age range Approx. % of total length	*AC* *35 – 70 (2018)* *31.0%*
	Pipe material Age range Approx. % of total length	*GI* *70 (2018)* *4.0%*
	Pipe material Age range Approx. % of total length	*POLY* *42 (2018)* *29.0%*
	Pipe material Age range Approx. % of total length	*PVC* *12 – 35 (2018)* *3%*
	Pipe material Age range Approx. % of total length	*VI* *12 (2018)* *26%*
	Areas where potential long detention periods could be expected	*Yes, Dead ends on Boundary St and Lodge St*
	Areas where low water pressure (eg < 12 m) could be expected during peak or other demand periods)	*None*

Component		Aramac Water Supply Scheme
Water quality responsibility changes	Entire water supply scheme	*Barcaldine Regional Council*

2.3 Barcaldine Water Supply Scheme

Barcaldine water supply scheme is comprised of two pumped artesian bores. Bore water is pumped from Pomona Bore into a 1,450 kL ground level reservoir. From the reservoir water is pumped directly into reticulation. Bore water is also pumped from Acacia Street Bore into a 2,870 kL ground level reservoir. Water is then pumped into reticulation from the reservoir or may be pumped directly into reticulation from the bore should it be required. The water supplied into reticulation is untreated. Bore water is of a quality that does not require treatment as the raw water quality complies with the Australian Drinking Water Guidelines. Refer to Table 3.11 and Section 3.3.1 for water quality data indicating why the source does not undergo treatment.

During power outage the Acacia Street back-up generator can be used to power pumps to supply water to the town.

2.3.1 Schematic

Figure 2.4 shows a schematic of the Barcaldine water supply scheme. Refer to Appendix B for water supply layouts superimposed on aerial photos.

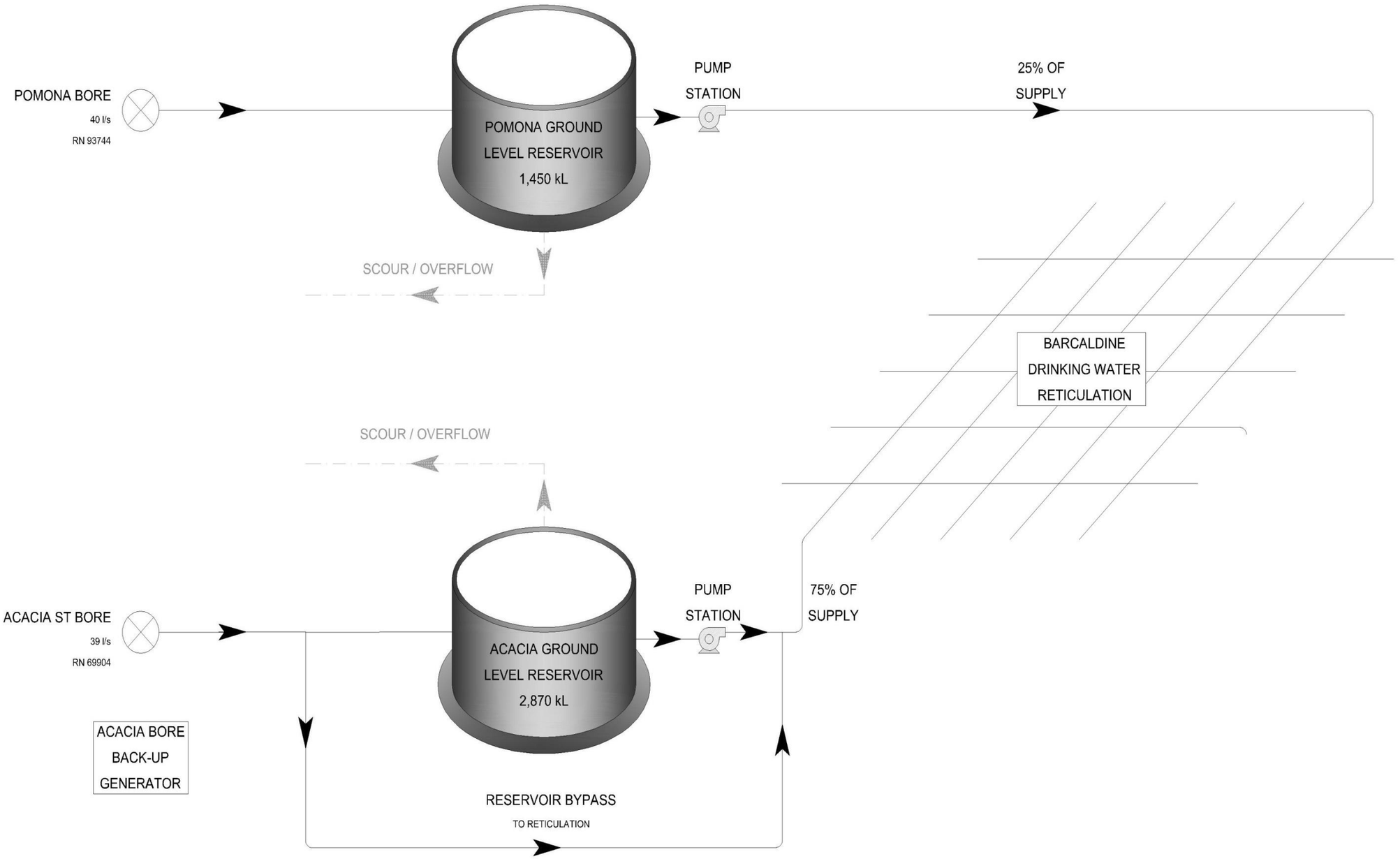


Figure 2.4 Barcaldine Service Schematic Layout

2.3.2 Source, Treatment and Distribution Details

Table 2.3 provides the following information for Barcaldine's infrastructure:

- Source details;
- Distribution and reticulation.

Table 2.3 Barcaldine Infrastructure Details

Component		**Barcaldine Water Supply Scheme**
Sources	Name	*Acacia Street Bore*
	Type	*Deep Artesian Bore (RN 69904)*
	% of supply	*75%*
	Reliability	*Does not run dry*
	Water quality issues	*Raw water generally complies with the Australian Drinking Water Guidelines*
	Name	*Pomona Bore*
	Type	*Deep Artesian Bore (RN 93744)*
	% of supply	*25%*
	Reliability	*Does not run dry*
	Water quality issues	*Raw water generally complies with the Australian Drinking Water Guidelines.*
Sourcing Infrastructure	Type	*Deep Artesian Bore*
	Description	*The Acacia Street bore is located at the Western end of Acacia. Pomona Bore is located on the Corner of Pine and Yew Street. The bores are 460m and 465m deep respectively. The bores yield is 37 l/s and 40 l/s respectively. The Acacia Street Bore has a free flowing pressure of 5m and yield of 21 l/s. Bore use is rotated therefore changes to yield are unnoticeable.*
Are there any sources that **do not** undergo treatment prior to supply?	Yes Town Bore. Deep artesian bores with water of a quality that generally does not require treatment. Raw water quality generally complies with the Australian Drinking Water Guidelines	
Are there any sources that **do not** undergo disinfection prior to supply?	Yes Acacia Street and Pomona Bores. Deep artesian bores with water of a quality that generally does not require disinfection.	
Distribution and Reticulation System	Pipe material	*AC*
	Age range	*25 – 58 (2018)*
	Approx. % of total length	*17.0%*
	Pipe material	*PVC*
	Age range	*4 - 74*
	Approx. % of total length	*37.7%*
	Pipe material	*DICL*

Component		Barcaldine Water Supply Scheme
	Age range Approx. % of total length	*15 (2018)* *0.1%*
	Pipe material Age range Approx. % of total length	*GI* *78 (2018)* *5%*
	Pipe material Age range Approx. % of total length	*POLY* *–8 – 58 (2018)* *33%*
	Pipe material Age range Approx. % of total length	*RCP* *43 – 78 (2018)* *7.7%*
	Areas where potential long detention periods could be expected	*None*
	Areas where low water pressure (eg < 12 m) could be expected during peak or other demand periods)	*None*
Reservoirs	**Ground Level (No)** Name Capacity (ML) Roofed Vermin-proof Runoff directed off roof	*1* *Pomona Bore Ground Level Reservoir* *1.45* *Yes* *Yes* *Yes*
	Ground Level (No) Name Capacity Roofed Vermin-proof	*2* *Acacia Street Bore Ground Level reservoir* *2.87* *Yes* *Yes*
	Runoff directed off roof	*Yes*
Water quality responsibility changes	Entire water supply scheme	*Barcaldine Regional Council*

2.4 Jericho Water Supply Scheme

Jericho water supply scheme is comprised of two pumped sub-artesian bores delivering water to a water treatment plant. The bore water requires treatment prior to delivery into the water reticulation system.

The treatment process includes aeration, flocculation, clarification, filtration, chlorination and pH adjustment. Prior to flocculation water is dosed with alum and pre dosed with chlorine. Water is mixed in a flocculation tank and then passed through an inclined plate clarifier prior to rapid gravity sand filtration. The treated water is dosed with Chlorine and the pH is adjusted prior to delivery to the ground level and elevated reservoirs. The rapid gravity sand filters are back washed using water from the ground level reservoir; the backwash is stored in the recycled water tank. Liquid alum sludge can also be drawn off the flocculation tank and clarifier and this is stored in the recycled water tanks. Water stored in the recycled water tanks can be used for irrigation purposes on the green surrounding the water treatment plant.

Treated water is then pumped into a 507 kL ground level reservoir and then into a 253 kL elevated reservoir and reticulation.

The treatment plant may be bypassed during maintenance / breakdown however considering the storage capacity on site the treatment plant may only bypassed in exceptional circumstances. During the unlikely event of water shortages water can be carted from artesian sources.

During power outages a limited supply of treated water can be supplied to the town via the elevated reservoir. This gives sufficient time for the mobile back-up generators to come online.

2.4.1 Schematic

Figure 2.5 shows a schematic of the Jericho water supply scheme. Figure 2.6 shows a schematic of the Jericho Water Treatment Plant. Refer to Appendix B for water supply layouts superimposed on aerial photos.

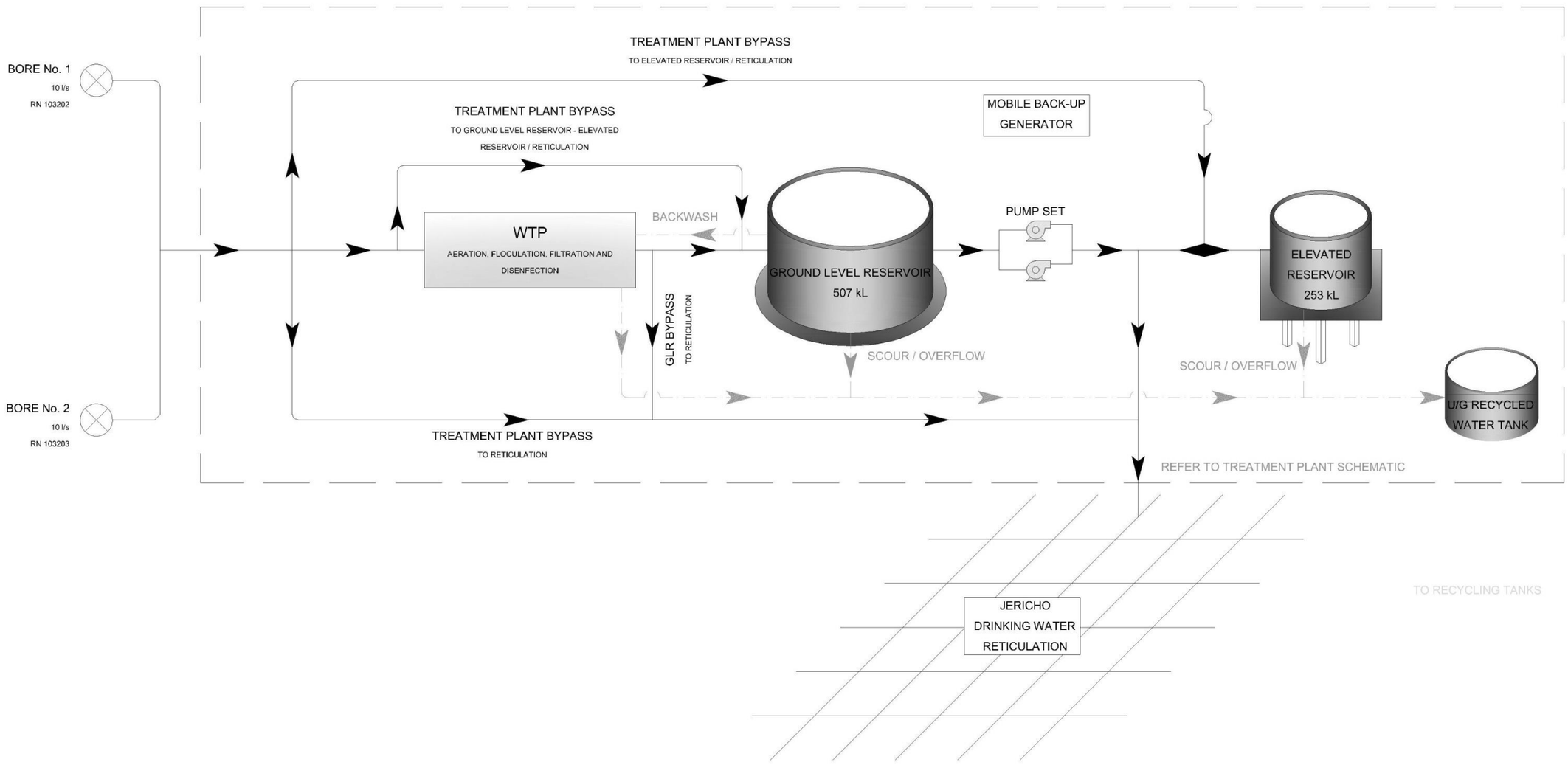


Figure 2.5 Jericho Service Schematic Layout

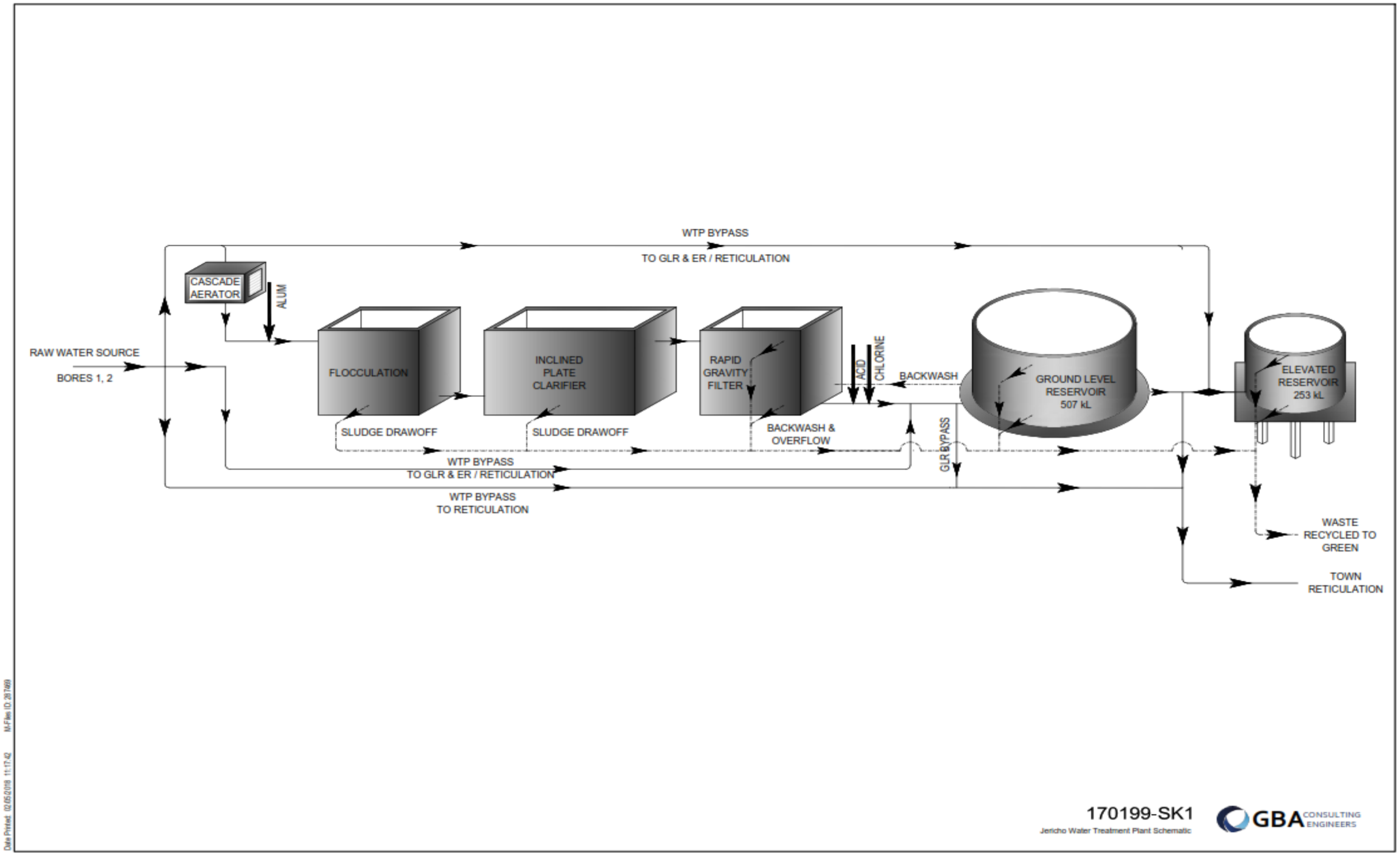


Figure 2.6 Jericho Treatment Plant Schematic

2.4.2 Source, Treatment And Distribution Details

Table 2.4 provides the following information for Jericho's infrastructure:

- Source details;
- Treatment processes;
- Disinfection processes; and
- Distribution and reticulation.

Table 2.4 Jericho Infrastructure Details

Component		**Jericho Water Supply Scheme**
Sources	Name	Darwin Street Bore No. 1
	Type	Shallow Bore (RN 103202)
	% of supply	50
	Reliability	Does not run dry
	Water quality issues	Raw water does not completely comply with the Australian Drinking Water Guidelines. Iron, high pH and TDS are generally outside aesthetic guideline values.
	Name	Darwin Street Bore No. 2
	Type	Shallow Bore (RN 103203)
	% of supply	50
	Reliability	Does not run dry
	Water quality issues	Raw water generally does not completely comply with the Australian Drinking Water Guidelines. Iron, high pH and TDS are occasionally outside aesthetic guideline values.
Sourcing Infrastructure	Type	Shallow Sub Artesian Bore
	Description	The dual bore field is located on the same site as the water treatment plant off Darwin Street. The bores are 120m and 124m deep respectively. And yield 10 l/s each. Bore use is rotated therefore changes to yield are unnoticeable. Refer to Appendix D Bore Casing and Stratification Details
Are there any sources that **do not** undergo treatment prior to supply?	No	
Water Treatment Plant	Name	Jericho Water Treatment Plant
	Process	Process comprises cascade aeration, flocculation, inclined plate clarification, rapid gravity sand filtration and pH adjustment
	Design Capacity (20 hr. operation)	1008 kL
	Daily flow range	14 l/s (capacity)

Component		Jericho Water Supply Scheme
	Chemicals added	Calcium hypochlorite (post), alum and Hydrochloric Acid.
	Standby chemical dosing facilities	Yes
	Water sourced from and %	Bore No. 1 50% Bore No. 2 50%
	% of average day demand provided	100
	% of scheme supply	100
	Distribution area supplied	
	Bypasses / Variations	Treatment plant can be bypassed in the event of a breakdown for short periods. Reservoirs can also be bypassed (either before or after treatment plant bypass).
Are there any sources that **do not** undergo disinfection prior to supply?	No	
Disinfection	Location	After cascade aeration and post flocculation and filtration.
	Type	Chlorination
	Dose rate	9l/day (average) (solution in water, 1.5% available chlorine)
	Target residual levels	0.5mg/l
	Duty/standby	Duty and standby
	Dosing arrangements	Fixed
	Alarms	Yes
	Auto shut-off arrangements	None
Distribution and Reticulation System	Pipe material	*uPVC*
	Age range	*17 (2018)*
	Approx. % of total length	*85%*
	Pipe material	*Poly*
	Age range	*17 – 35 (2018)*
	Approx. % of total length	*15%*
	Areas where potential long detention periods could be expected	None
	Areas where low water pressure (eg < 12 m) could be expected during peak or other demand periods)	None
Reservoirs	**Ground Level (No)**	1
	Name	Jericho Ground Level Reservoir (WTW)
	Capacity (ML)	0.507
	Roofed	Yes

Component		Jericho Water Supply Scheme
	Vermin-proof	Yes
	Runoff directed off roof	Yes
	Construction Materials	Steel construction with internal lining
	Elevated (No)	1
	Name	Jericho Elevated Reservoir (WTW)
	Capacity	0.253
	Roofed	Yes
	Vermin-proof	Yes
	Runoff directed off roof	Yes
Water quality responsibility changes	Entire water supply scheme	Barcaldine Regional Council

2.5 Muttaburra Water Supply Scheme

Muttaburra water supply scheme is comprised of two artesian bores delivering water directly to reticulation. Both bores are connected to the reticulation system and are supplying water throughout the distribution system. The water supplied into reticulation is untreated. The bore water is of a quality that does not require treatment as the raw water quality complies with the Australian Drinking Water Guidelines. Refer to Table 3.20 and Section 3.5.1 for water quality data indicating why the source does not undergo treatment.

Power outages will have no effect on the Muttaburra water supply scheme as the bore currently supplies water to town under natural artesian pressure.

2.5.1 Schematic

Figure 2.7 shows a schematic of the Muttaburra's Water Supply Scheme. Refer to Appendix B for water supply layouts superimposed on aerial photos.

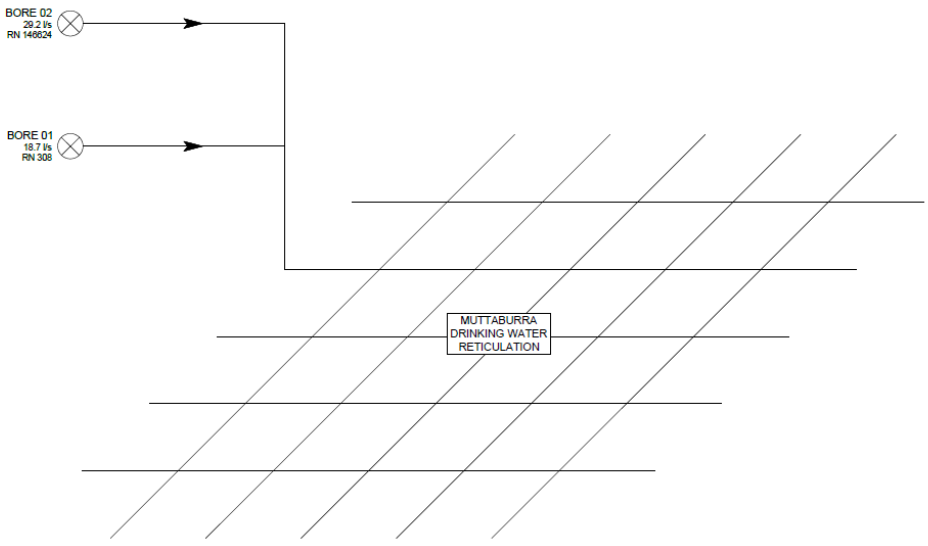


Figure 2.7 Muttaburra Service Schematic Layout

2.5.2 Source, Treatment And Distribution Details

Table 2.5 provides the following information for Muttaburra's infrastructure:

- Source details;
- Distribution and reticulation.

Table 2.5 Muttaburra Infrastructure Details

Component		**Muttaburra Water Supply Scheme**
Sources	Name	*Town Bore No.1*
	Type	*Deep Artesian Bore (RN 308)*
	% of supply	*30%*
	Reliability	*Does not run dry however lack of storage may present problems during fire fighting*
	Water quality issues	*Raw water generally complies with the Australian Drinking Water Guidelines*
	Name Type % of supply Reliability	*Town Bore No. 2* *Deep Artesian Bore (RN146624)* *70%* *Does not run dry however lack of storage may present problems during fire fighting*
	Water quality issues	*Raw water generally complies with the Australian Drinking Water Guidelines*
Sourcing Infrastructure	Type	*Deep Artesian Bore*
	Description	*The Town Bore 1 and 2 are located at the western end of Sword Street. The bores are 825m and 823m deep respectively. The bores have a free flowing yield is 18.7 l/s and 29.2l/s. The bores have a free flowing pressure of 24.5kpa and 22.9kpa. These bores deliver water directly into reticulation without pumping.*
Are there any sources that **do not** undergo treatment prior to supply?	Yes Town Bore 1 and 2. Deep artesian bores with water of a quality that generally does not require treatment. Raw water quality generally complies with the Australian Drinking Water Guidelines	
Are there any sources that **do not** undergo disinfection prior to supply?	Yes Town Bore 1 and 2. Deep artesian bore with water of a quality that generally does not require disinfection.	
Distribution and Reticulation System	Pipe material	*AC*
	Age range	*33 (2018)*
	Approx. % of total length	*63%*
	Pipe material	*PVC*
	Age range	*20 (2018)*
	Approx. % of total length	*6.0%*
	Pipe material	*POLY*

Component		Muttaburra Water Supply Scheme
	Age range	*21 – 23 (2018)*
	Approx. % of total length	*31%*
	Areas where potential long detention periods could be expected	*None*
	Areas where low water pressure (eg < 12 m) could be expected during peak or other demand periods)	*Low pressure can be expected during firefighting or during periods of sustained high demand.*
Water quality responsibility changes	Entire water supply scheme	*Barcaldine Regional Council*

2.6 Key Stakeholders

Table 2.6 below outlines the relevant stakeholders for BRC water supply schemes in Alpha, Aramac, Barcaldine, Jericho and Muttaburra.

Table 2.6 Barcaldine Regional Council Stakeholders

Organisation	Contact Name and Details	Relevance to management of drinking water quality	How the stakeholder is engaged in the DWQMP
Barcaldine Regional Council	Steven Boxall, Chief Executive Officer P (07) 4651 5625 E: ceo@barcaldinerc.qld.gov.au or Rick Rolfe, Manager of Engineering Services P (07) 4651 5625 E: rickr@barc.qld.gov.au	First Point of Contact Medium Drinking Water Service Provider	Medium Drinking Water Service Provider
George Bourne & Associates	P: (07) 4651 5177 E: admin@gbassoc.com.au	Consulting Engineers	Risk Management participant, engineering supervision
Barcaldine Hospital	Oak Street Barcaldine, QLD P: +61 7 4650 4099	Sensitive User	Sensitive User
Queensland Health Forensic & Scientific Services	P: (07) 3274 9070	Water Analysis Authority	Chemical Analysis and Reporting on Water Quality
Queensland Health Public Health Unit	82-86 Bolsover Street, Rockhampton QLD 4700 PO Box 946, Rockhampton QLD 4700 P: (07) 4920 6989	Public Health	Public Health
Aramac Health Care Centre	P: (07) 4651 3259	Sensitive User	Sensitive User
Alpha Hospital	P: +61 7 4809 700	Sensitive User	Sensitive User
Muttaburra Health Care Centre	P: +61 7 4658 7500	Sensitive User	Sensitive User
Barcaldine State School	P: (07) 4651 5333	Sensitive User	Sensitive User
St Joseph's Catholic Primary School Barcaldine	P: (07) 4651 2450	Sensitive User	Sensitive User
Aramac State School	P: (07) 4651 3177	Sensitive User	Sensitive User
Muttaburra State School	P: (07) 4658 7289	Sensitive User	Sensitive User
Jericho State School	P: (07) 4651 4162	Sensitive User	Sensitive User
Alpha State School	P: (07) 4987 0888	Sensitive User	Sensitive User

3 Identify Hazards and Hazardous Events

3.1 Alpha Water Quality and Catchment Characteristics

Alpha water supply is composed of five sub artesian bores which are treated prior to reticulation. The source water was not of a sufficient quality to reticulate directly to the town.

3.1.1 Water Quality Information

Water quality information for Alpha includes the following:

(a) Summary
(b) Interpolation

3.1.1 (a) Summary

Table 3.1 below summarises the available reticulated water quality for the Alpha water supply scheme. Table 3.3 below summarises the limited raw water quality available[2].

Figure 3.1 to Figure 3.17 below shows trends of the main characteristics contained in Table 3.1. Figure 3.19 to Figure 3.35 below shows trends of the main characteristics contained in Table 3.3.

The responsibility for obtaining the water samples rests with the DWSP and samples are collected by the Technical Officer monthly. Samples are sent to Queensland Health Scientific Services for analysis. The DWSP also samples and analyses drinking water for E. coli.

[2] DWSP generally only monitors the treated water supplied to reticulation

Table 3.1 Alpha Reticulated Water

Alpha Water Supply		Start Date	21/04/2010		End Date:	19/12/2017				
Characteristic	Units	No. of Samples	Summary of Results					Guideline Value		
			Maximum Value	Average Value	Minimum Value	Std Dev	95th Percentile	Health	Exceedances	Aesthetic	Exceedances
Conductivity	uS/cm	89	1930.000	1618.258	878.000	236.624	1836.000				0
pH		89	8.240	7.689	6.830	0.481	8.172			≥6.5 & ≤ 8.5	0
Total Hardness	mg/L as CaCO3	89	299.000	234.551	82.000	35.161	261.600			200	73
Temporary Hardness	mg/L as CaCo3	89	223.000	171.674	38.000	21.062	192.600			200	2
Alkalinity	mg/L $CaCo_3$	89	223.000	150.787	0.000	57.451	192.600				0
Residual Alkalinity	meq/L	89	191.000	20.775	0.000	58.399	184.000				0
Silica	mg/L	89	87.000	74.618	12.000	11.248	84.000			80	32
Total Dissolved Ions	mg/L	89	1150.000	953.461	469.000	143.088	1070.000				0
Total Dissolved Solids	mg/L	89	1110.000	923.056	458.000	139.727	1030.000			600	87
True Colour	Hazen	89	21.000	1.433	0.500	2.544	5.600			15	1
Turbidity	NTU	89	7.000	0.629	0.500	0.697	1.000			5	1
pH (Saturation)*		89	9.100	7.733	7.500	0.228	7.900				0
Saturation Index		89	0.600	-0.048	-2.000	0.508	0.500				0
Mole Ratio		89	4.000	3.019	2.400	0.511	3.800				0
Sodium Absorption Ratio		89	63.600	7.187	4.700	6.054	7.300				0
Figure of Merit		89	0.600	0.488	0.300	0.052	0.560				0
Sodium	mg/L	89	272.000	230.933	134.000	38.001	268.000			180	74
Potassium	mg/L	89	13.000	11.048	7.600	0.791	12.000				0
Calcium	mg/L	89	46.000	34.819	5.900	5.752	39.000				0
Magnesium	mg/L	89	45.000	35.921	16.000	5.176	40.000				0
Hydrogen	mg/L	89	0.000	0.000	0.000	0.000	0.000				0
Bicarbonate	mg/L	89	272.000	203.978	20.000	36.552	233.600				0
Carbonate	mg/L	89	2.200	0.915	0.000	0.657	1.860				0
Hydroxide	mg/L	89	0.000	0.000	0.000	0.000	0.000				0
Chloride	mg/L	89	460.000	363.258	220.000	57.482	410.000			250	80

Alpha Water Supply		Start Date	21/04/2010		End Date:	19/12/2017					
Characteristic	Units	No. of Samples	Summary of Results					Guideline Value			
			Maximum Value	Average Value	Minimum Value	Std Dev	95th Percentile	Health	Exceedances	Aesthetic	Exceedances
Fluoride	mg/L	89	0.400	0.263	0.025	0.064	0.356	1.5	0		0
Nitrate	mg/L	89	41.000	30.878	0.500	8.480	40.000	50	0		0
Sulphate	mg/L	89	48.000	39.157	19.000	7.473	46.600	500	0	250	0
Iron	mg/L	89	0.020	0.005	0.005	0.002	0.005			0.3	0
Manganese	mg/L	89	0.005	0.005	0.005	0.000	0.005	0.5	0	0.1	0
Zinc	mg/L	89	0.610	0.027	0.005	0.080	0.074			3	0
Aluminium	mg/L	88	0.180	0.035	0.025	0.027	0.080			0.2	0
Boron	mg/L	89	0.340	0.279	0.110	0.038	0.330	4	0		0
Copper	mg/L	89	0.140	0.017	0.015	0.014	0.015	2	0	1	0
Chlorate	mg/L	64	1.960	0.620	0.000	0.346	1.219				
E. coli		241	0.000	0.000	0.000	0.000	0.000	0	0		0

Aesthetic Guideline Exceedance

Health Guideline Exceedance

Table 3.2 Alpha water quality complaints

Year	No of Water Quality Complaints	Water Quality Complaints per 1000 Connections	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2018	0	0	Data not available		
2017	0	0			
2016	0	0			
2015	0	0			
2014	0	0			
2013	0	0			
2012	0	0			
2011	0	0			
2010	4	16.6			
2009	4	16.6			

Figure 3.1 Alpha Treated - pH at 23°C

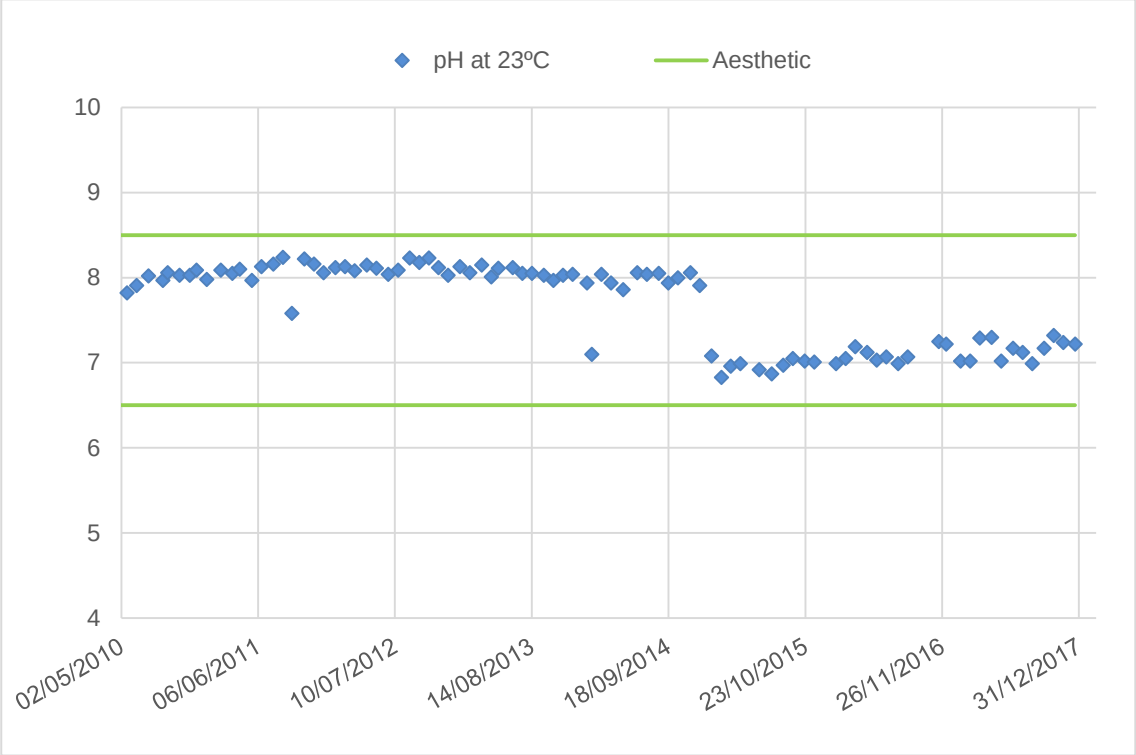


Figure 3.2 Alpha Treated - Total Hardness

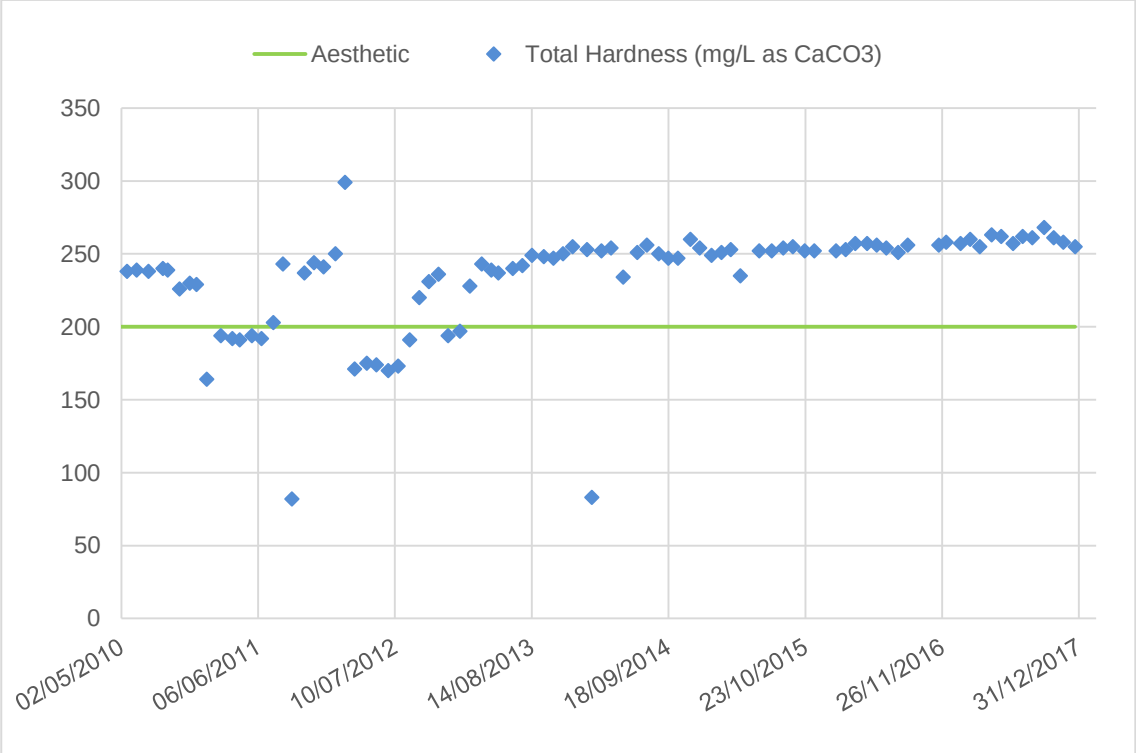


Figure 3.3 Alpha Treated – Silica

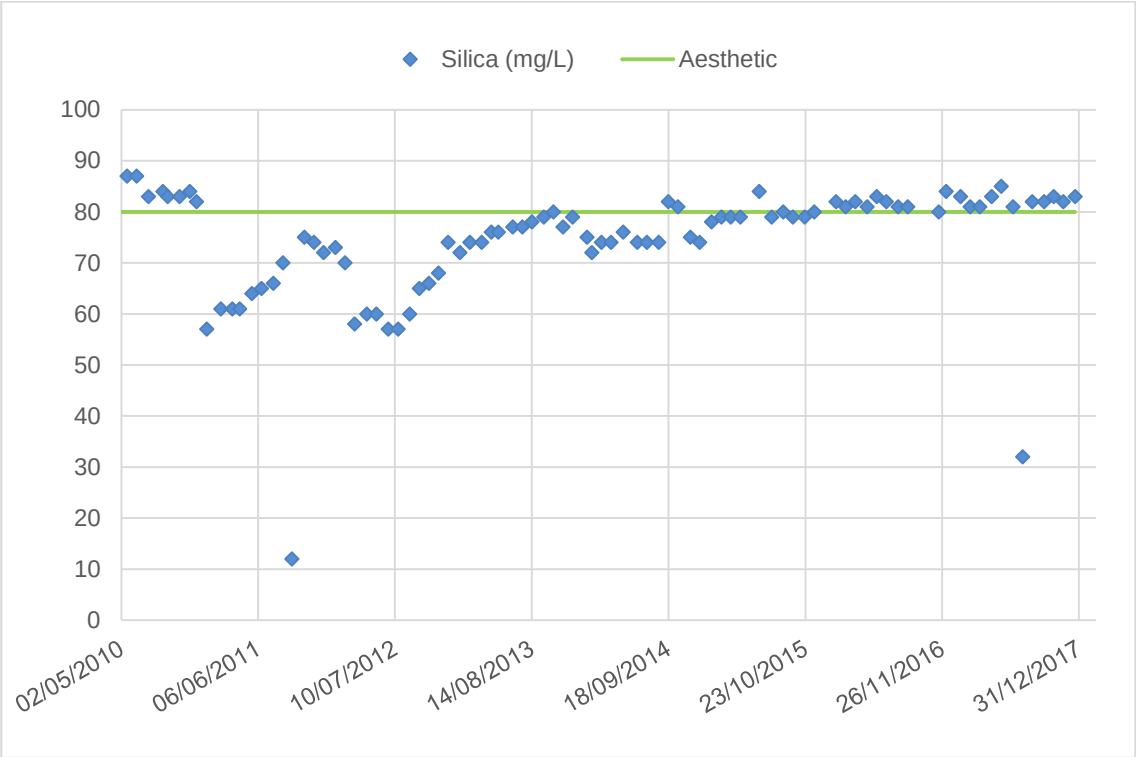


Figure 3.4 Alpha Treated - Total Dissolved Solids

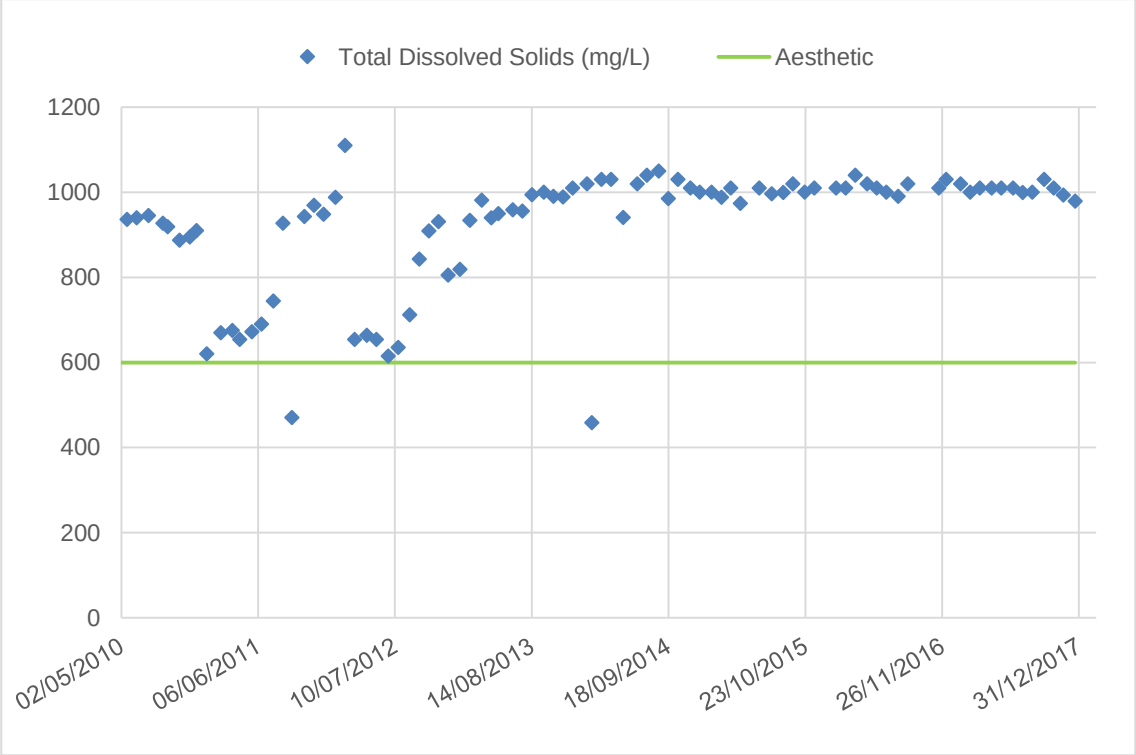


Figure 3.5 Alpha Treated - True Colour

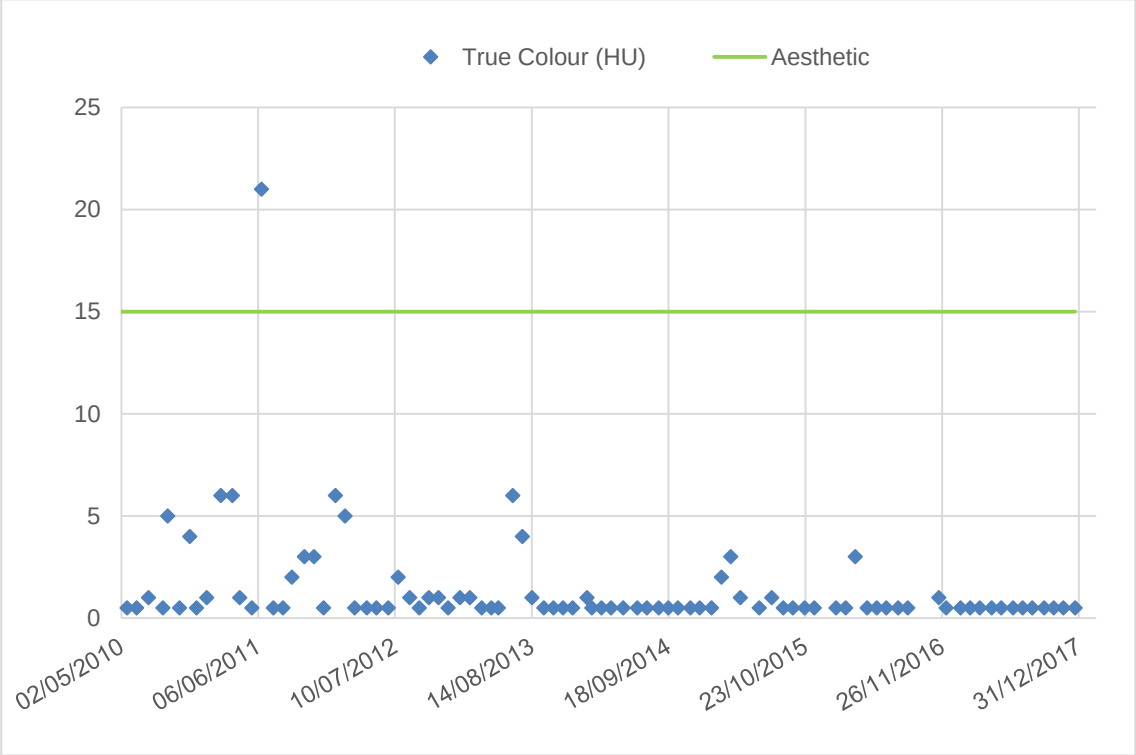


Figure 3.6 Alpha Treated – Turbidity

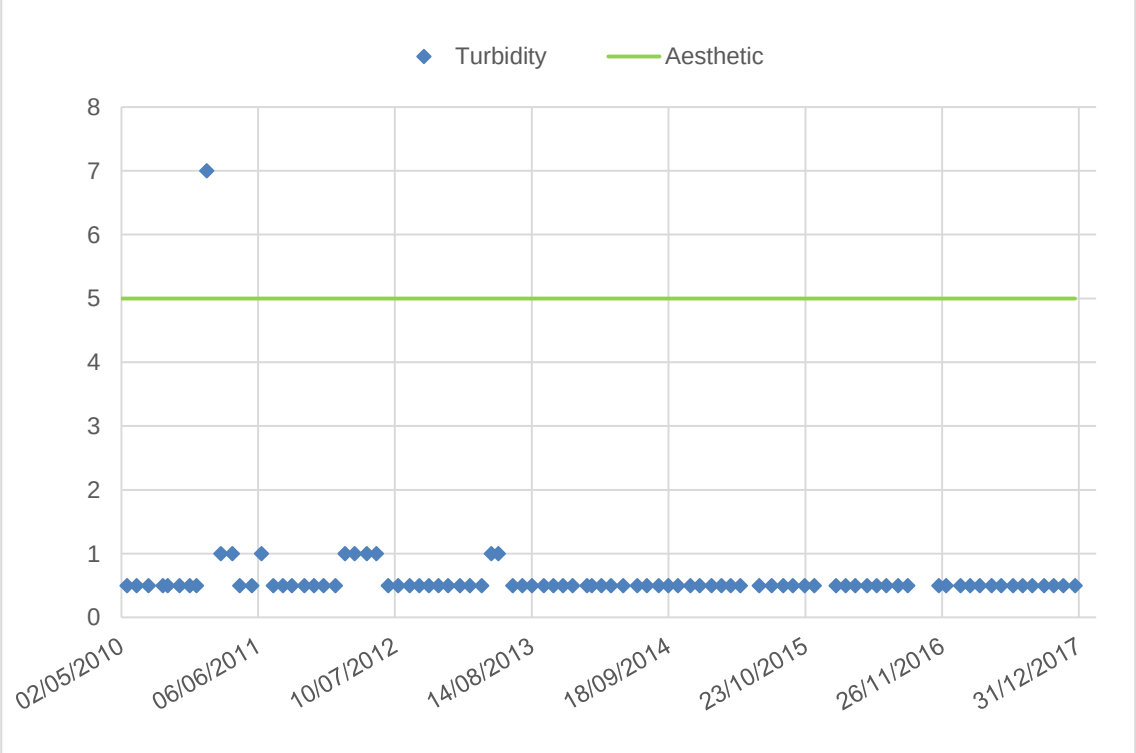


Figure 3.7 Alpha Treated - Sodium

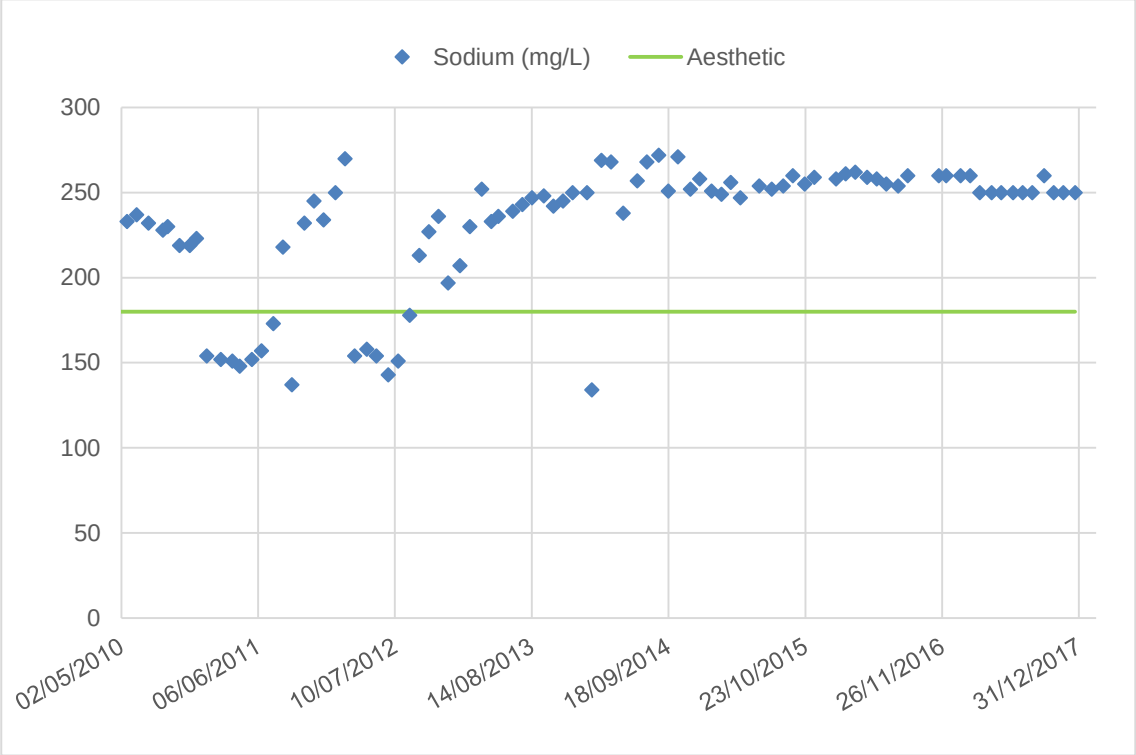


Figure 3.8 Alpha Treated – Chloride

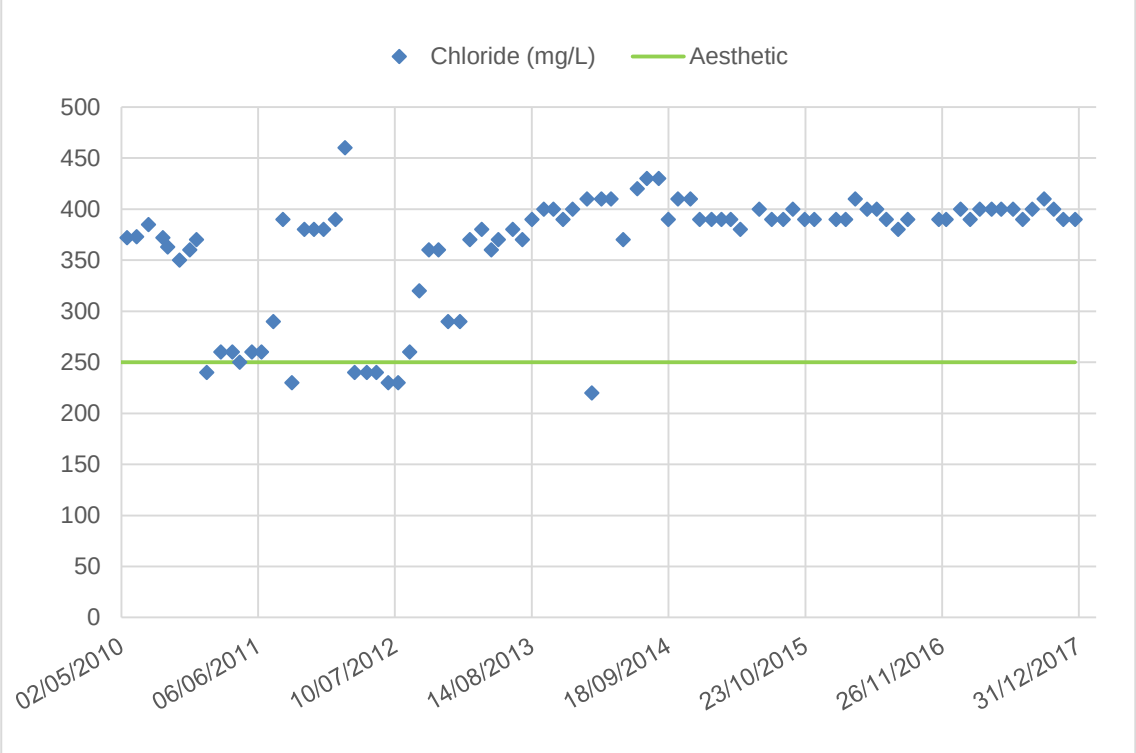


Figure 3.9 Alpha Treated – Fluoride

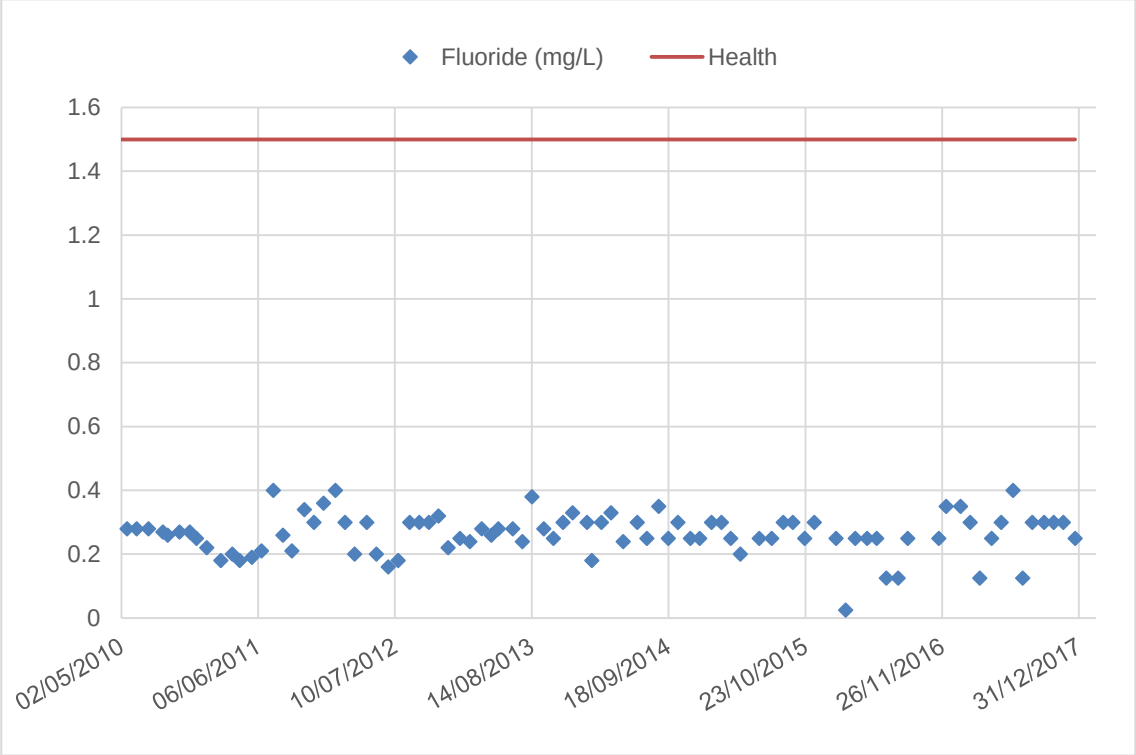


Figure 3.10 Alpha Treated – Nitrate

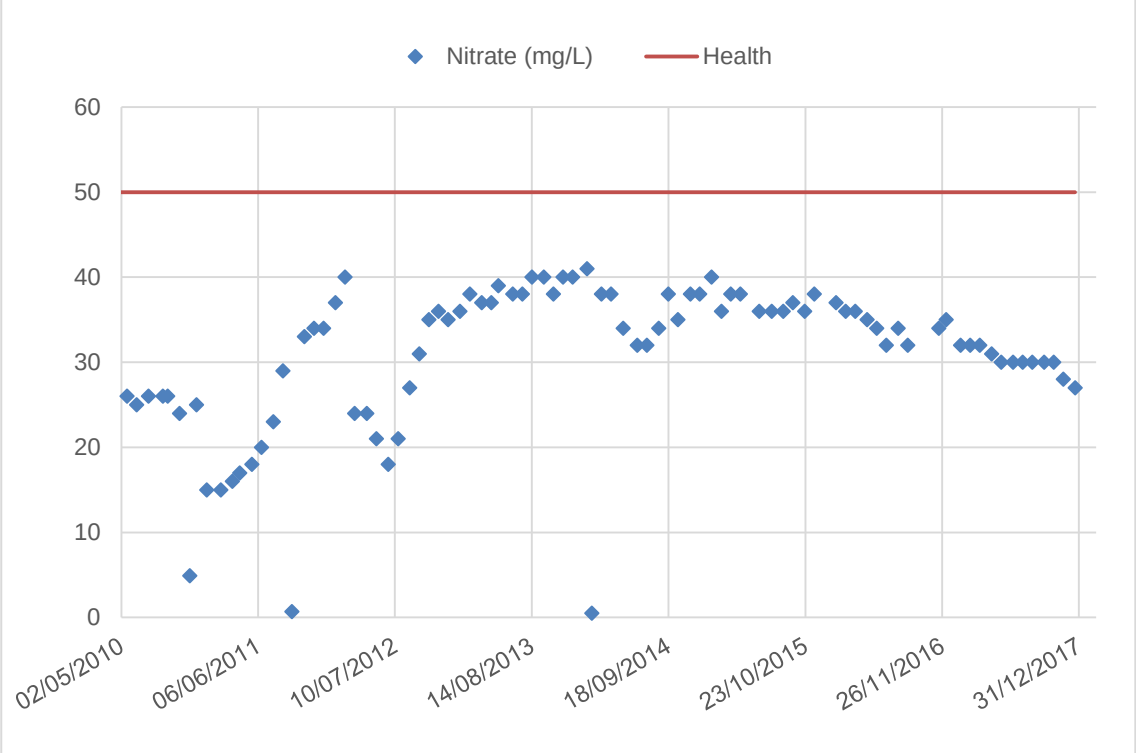


Figure 3.11 Alpha Treated - Sulphate

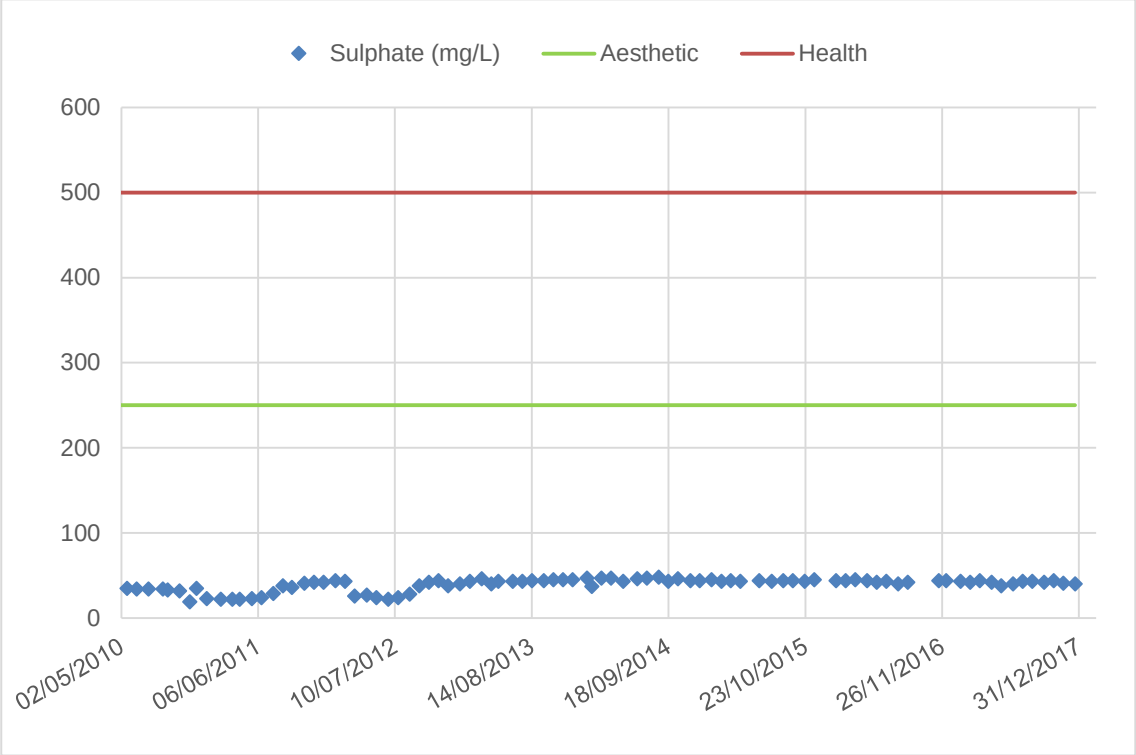


Figure 3.12 Alpha Treated – Iron

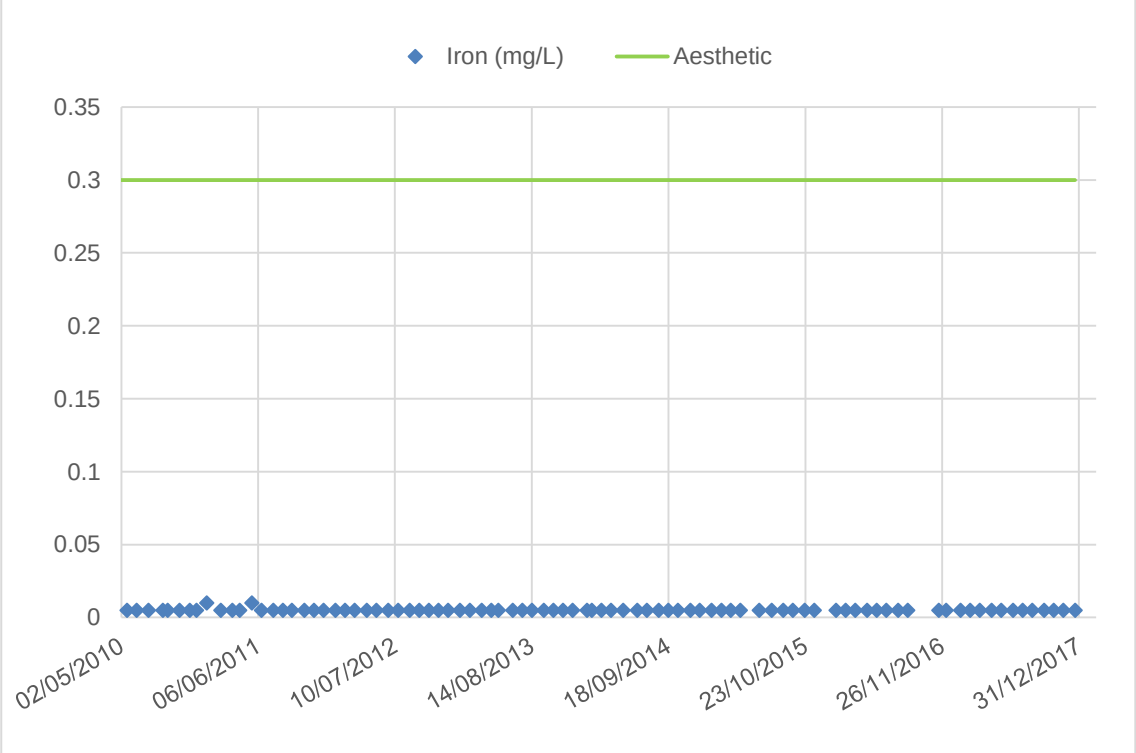


Figure 3.13 Alpha Treated - Manganese

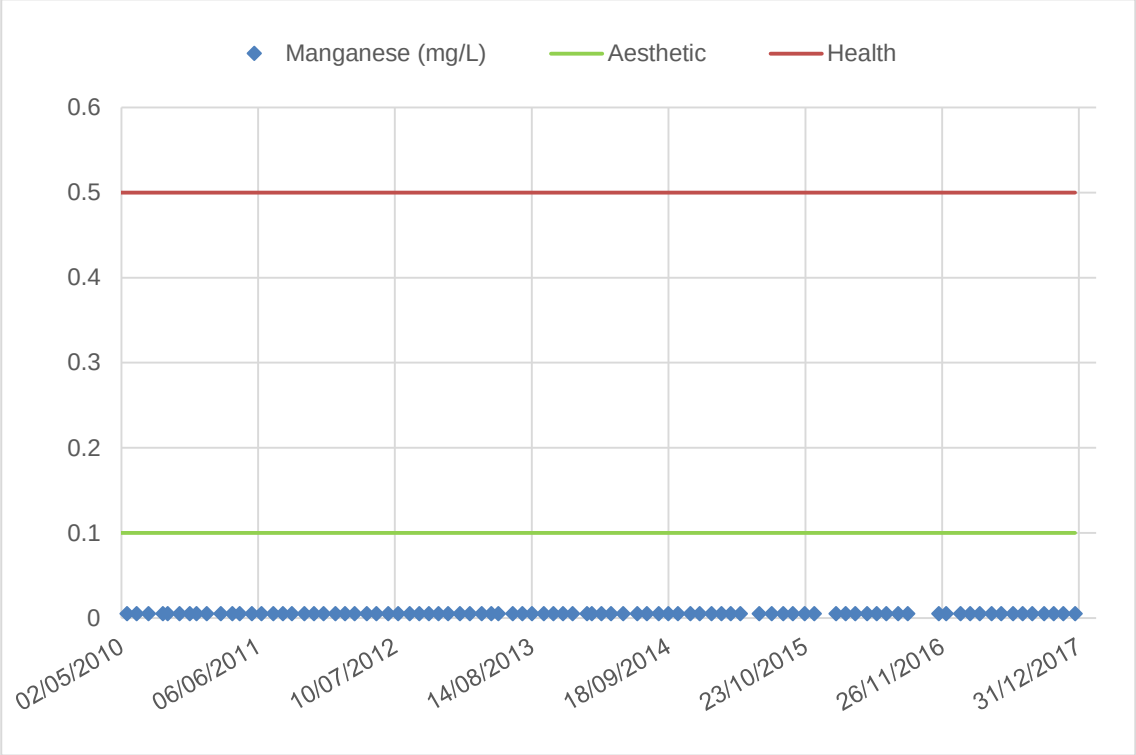


Figure 3.14 Alpha Treated – Zinc

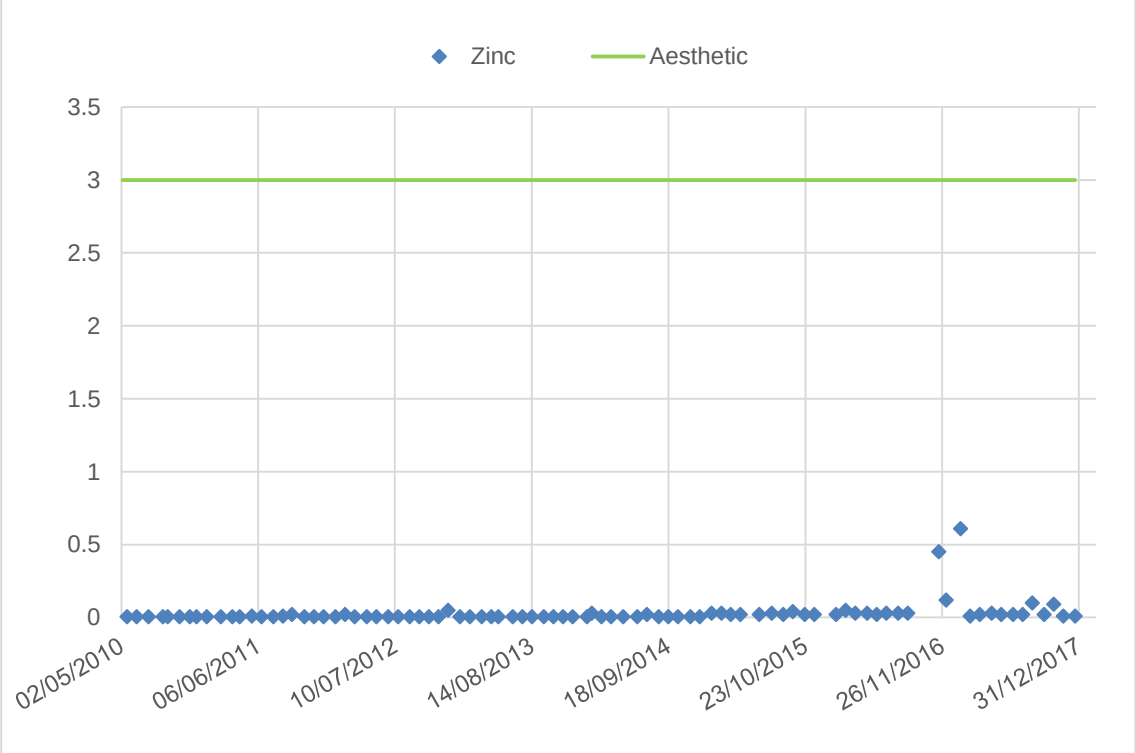


Figure 3.15 Alpha Treated – Aluminium

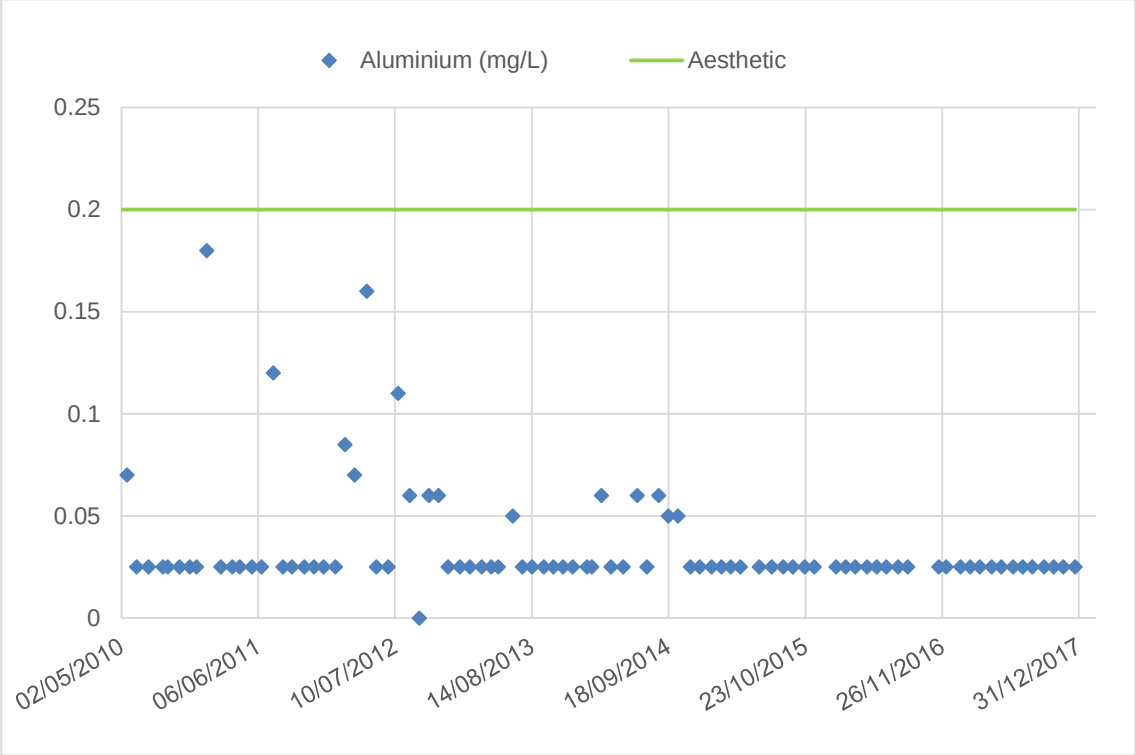


Figure 3.16 Alpha Treated – Boron

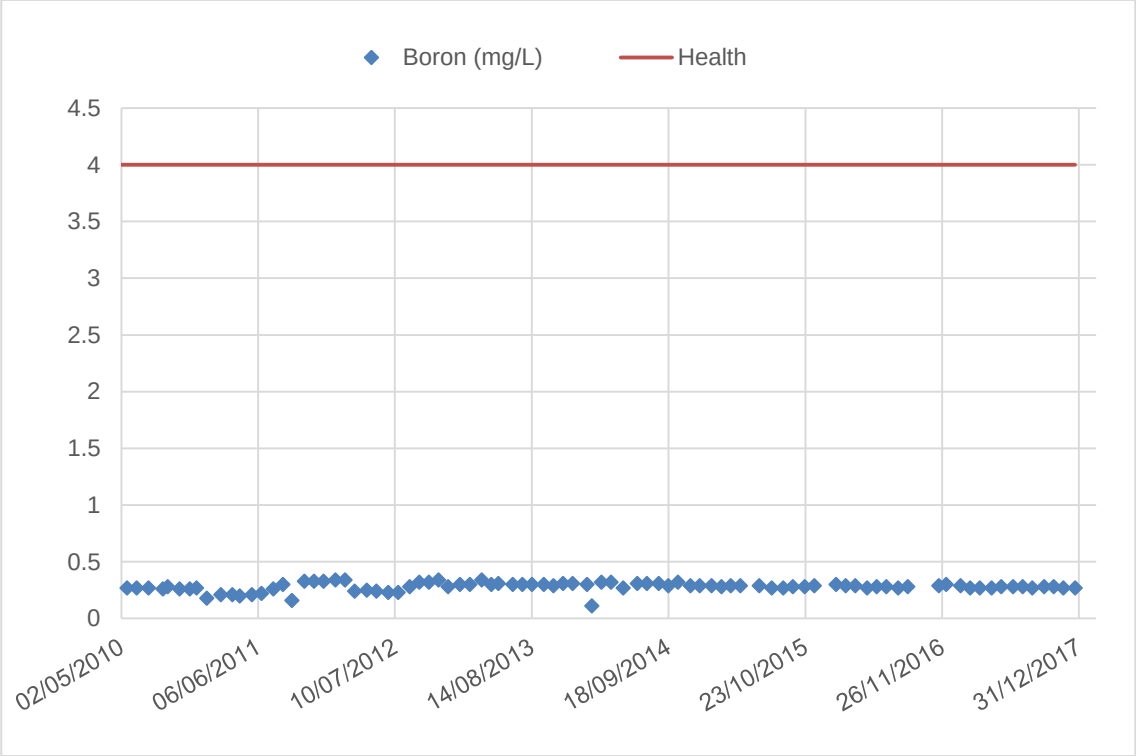


Figure 3.17 Alpha Treated – Copper

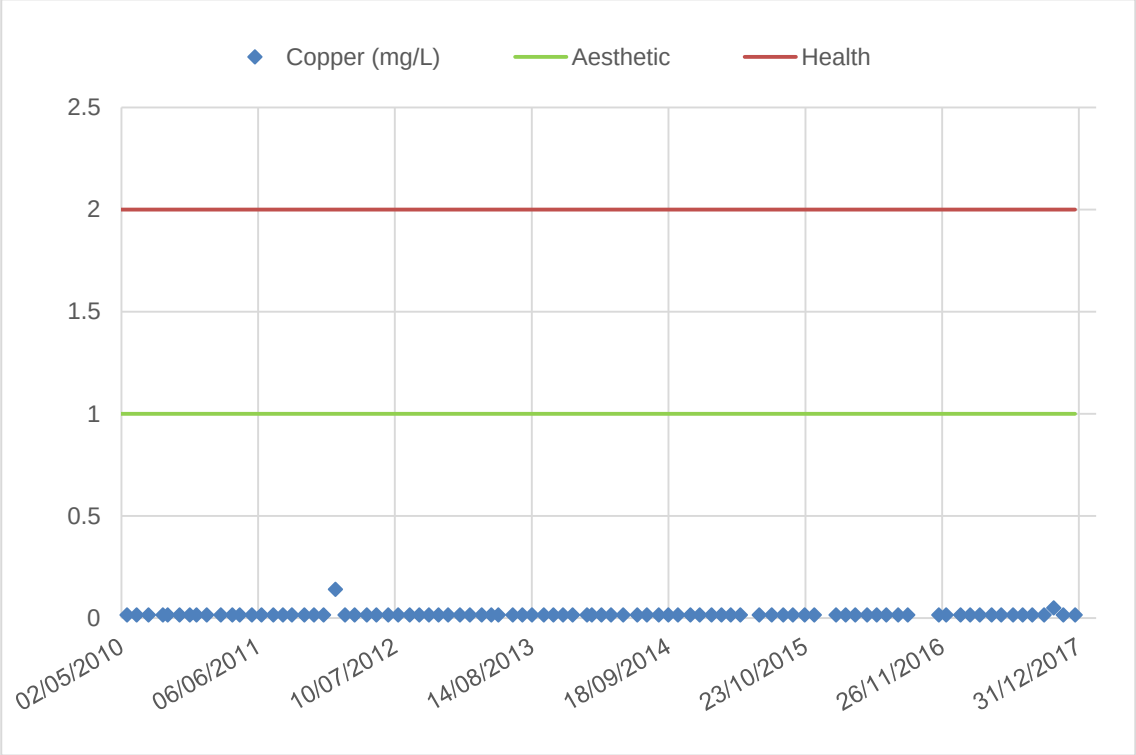


Figure 3.18 Alpha Treated – Chlorate

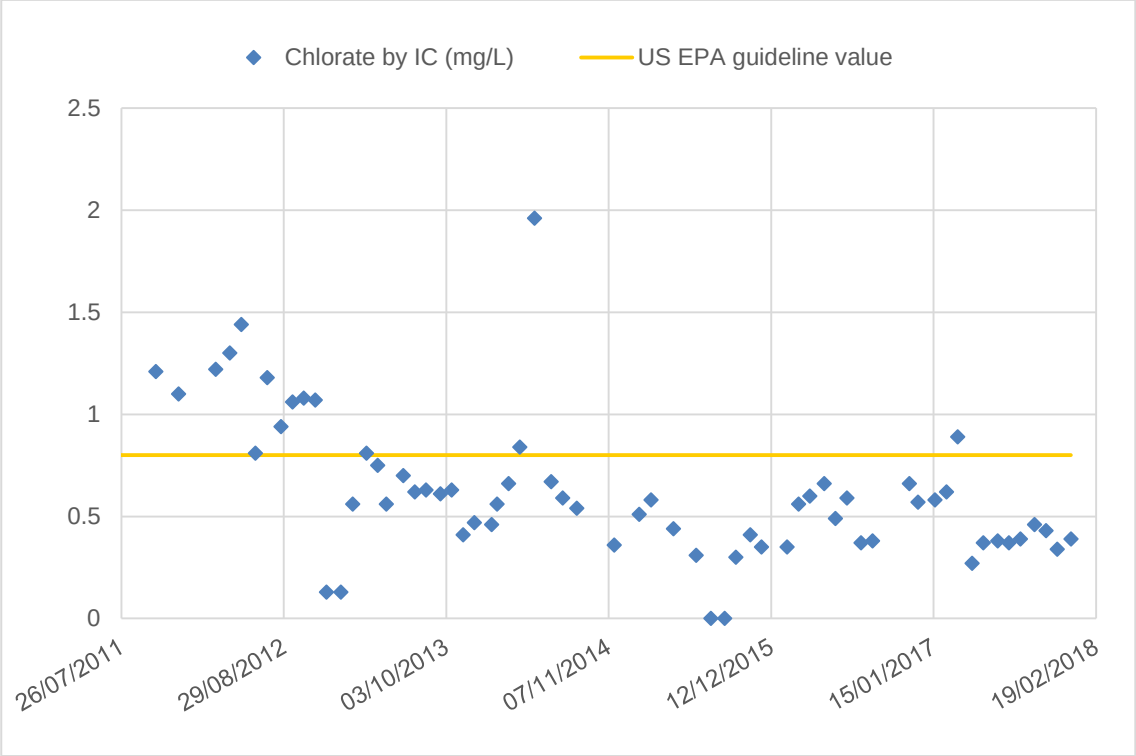


Figure 3.19 Alpha Treated – E Coli

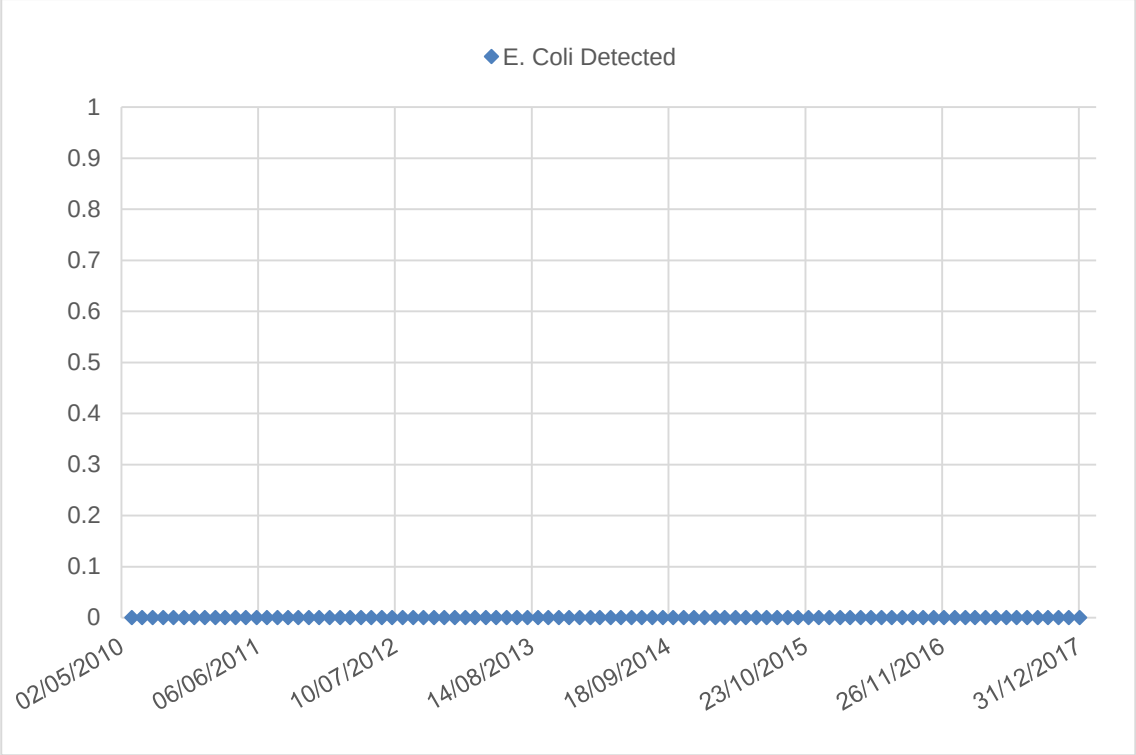


Table 3.3 Alpha Source Water

Alpha Water Supply		Start Date	29/10/1999		End Date:	11/08/2011					
Characteristic	Units	No. of Samples	Summary of Results					Guideline Value			
			Maximum Value	Average Value	Minimum Value	Std Dev	95th Percentile	Health	Exceedances	Aesthetic	Exceedances
Conductivity	uS/cm	21	2150.000	1496.667	330.000	370.795	2000.000				
pH at 23ºC		22	8.100	7.080	6.300	0.379	7.776			≥6.5 & ≤ 8.5	1
Total Hardness	mg/L as CaCO3	22	375.000	213.603	30.000	64.958	269.000			200	16
Temporary Hardness	mg/L as CaCo3	21	225.000	156.190	30.000	47.614	225.000			200	3
Alkalinity	mg/L CaCo3	22	285.000	162.636	34.000	46.459	224.250				
Residual Alkalinity	meq/L	21	1.300	0.119	0.000	0.367	1.200				
Silica	mg/L	21	100.000	74.286	13.000	18.043	100.000			80	8
Total Dissolved Ions	mg/L	21	1320.000	896.905	230.000	234.211	1290.000				
Total Dissolved Solids	mg/L	22	1240.000	872.227	220.000	212.542	1203.500			600	20
True Colour	Hazen	22	14.000	2.750	0.000	3.916	12.750			15	0
Turbidity (NTU)	NTU	22	13.000	1.523	0.000	2.769	4.950			5	1
pH Sat		21	708.000	41.181	7.500	149.106	9.200				
Saturation Index		21	0.400	-0.738	-2.800	0.600	0.000				
Mole Ratio		21	4.900	3.510	2.500	0.482	4.100				
Sodium Absorpt. Ratio		21	9.900	6.614	4.400	1.066	8.000				
Figure of Merit Ratio		21	0.600	0.448	0.300	0.079	0.500				
Sodium	mg/L	21	340.000	220.048	55.000	56.304	295.000			180	18
Potassium	mg/L	21	13.000	9.452	4.300	1.911	12.500				
Calcium	mg/L	21	56.000	32.157	4.200	10.944	41.000				
Magnesium	mg/L	21	57.000	32.276	4.800	9.633	41.000				
Hydrogen	mg/L	21	0.000	0.000	0.000	0.000	0.000				
Bicarbonate	mg/L	21	350.000	196.643	41.500	58.100	275.000				
Carbonate	mg/L	21	1.800	0.290	0.000	0.391	0.900				
Hydroxide	mg/L	21	0.000	0.000	0.000	0.000	0.000				
Chloride	mg/L	21	530.000	337.214	40.500	88.393	400.000			250	18
Fluoride	mg/L	21	0.600	0.284	0.200	0.099	0.400	1.5	0		
Nitrate	mg/L	21	80.000	34.785	1.800	18.653	70.000	50	4		
Sulphate	mg/L	21	69.000	36.490	5.800	12.070	53.000	500	0	250	0
Iron	mg/L	23	0.040	0.012	0.002	0.012	0.040			0.3	0
Manganese	mg/L	23	0.030	0.013	0.000	0.007	0.029	0.5	0	0.1	0
Zinc	mg/L	22	0.190	0.032	0.005	0.037	0.056			3	0
Aluminium	mg/L	22	0.025	0.025	0.014	0.002	0.025			0.2	0

Alpha Water Supply			Start Date 29/10/1999			End Date: 11/08/2011					
Characteristic	Units	No. of Samples	Summary of Results					Guideline Value			
			Maximum Value	Average Value	Minimum Value	Std Dev	95th Percentile	Health	Exceedances	Aesthetic	Exceedances
Boron	mg/L	22	0.700	0.289	0.140	0.118	0.439	4	0		
Copper	mg/L	22	0.025	0.019	0.002	0.006	0.025	2	0	1	0

Aesthetic Guideline Exceedance
Health Guideline Exceedance

Figure 3.19 Alpha Source - pH at 23°C

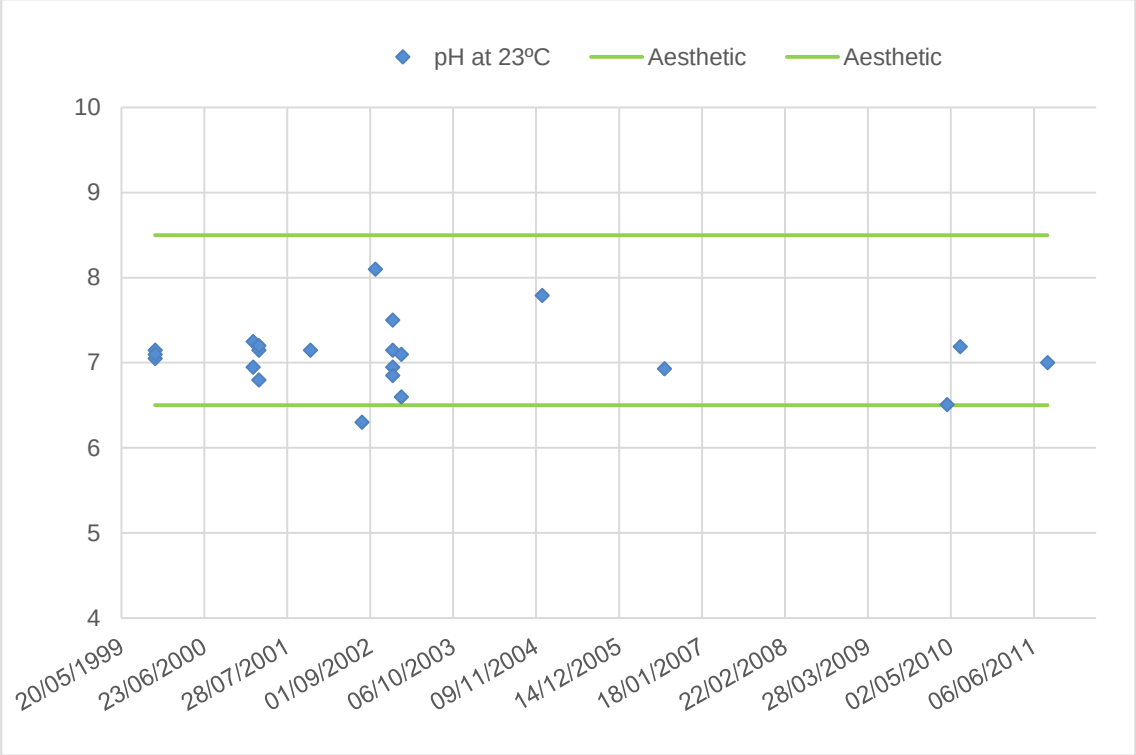


Figure 3.20 Alpha Source - Total Hardness

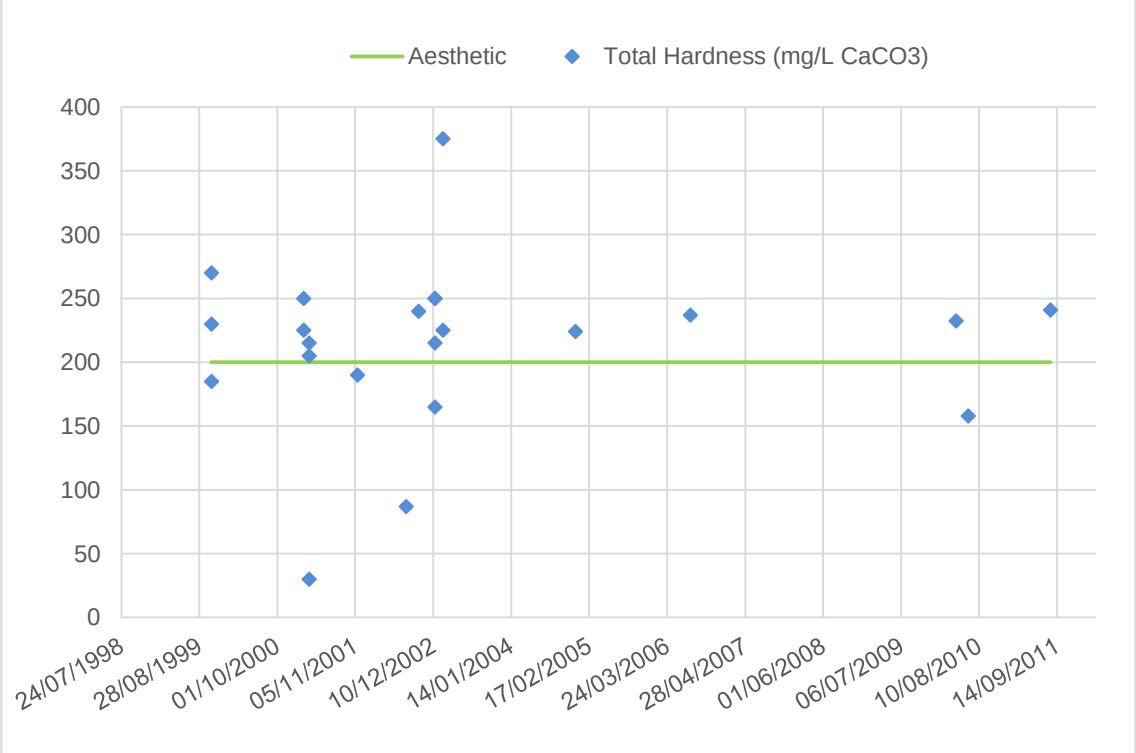


Figure 3.21 Alpha Source - Silica

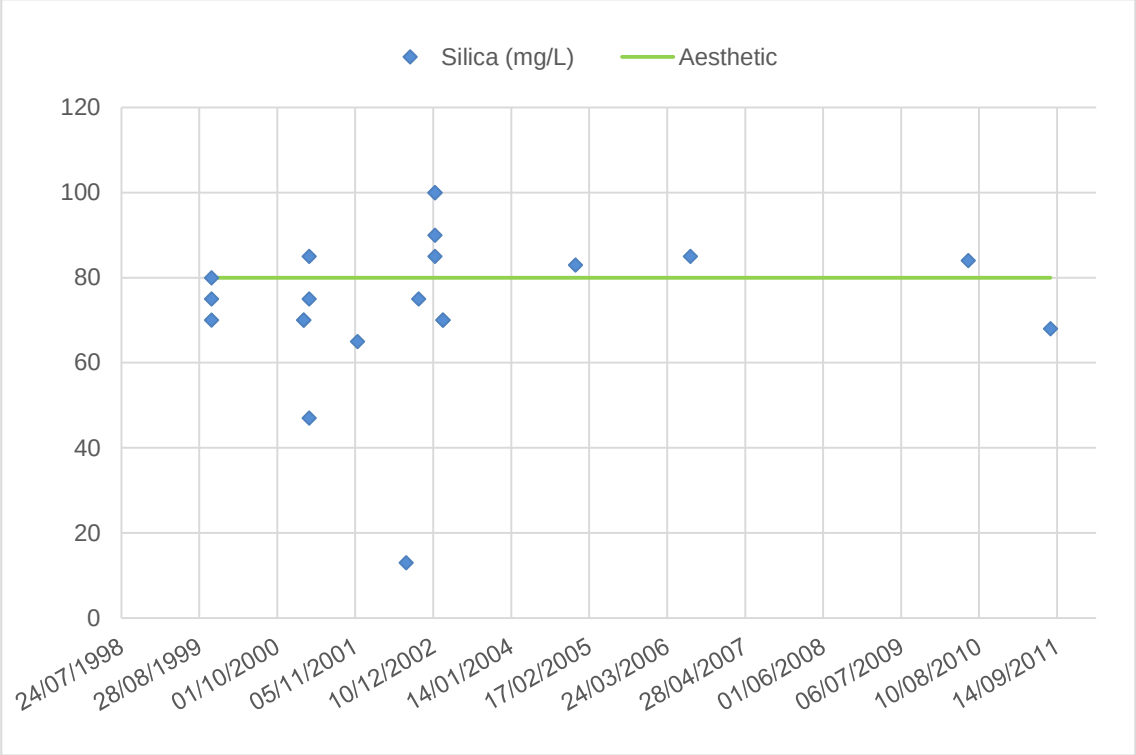


Figure 3.22 Alpha Source - Total Dissolved Solids

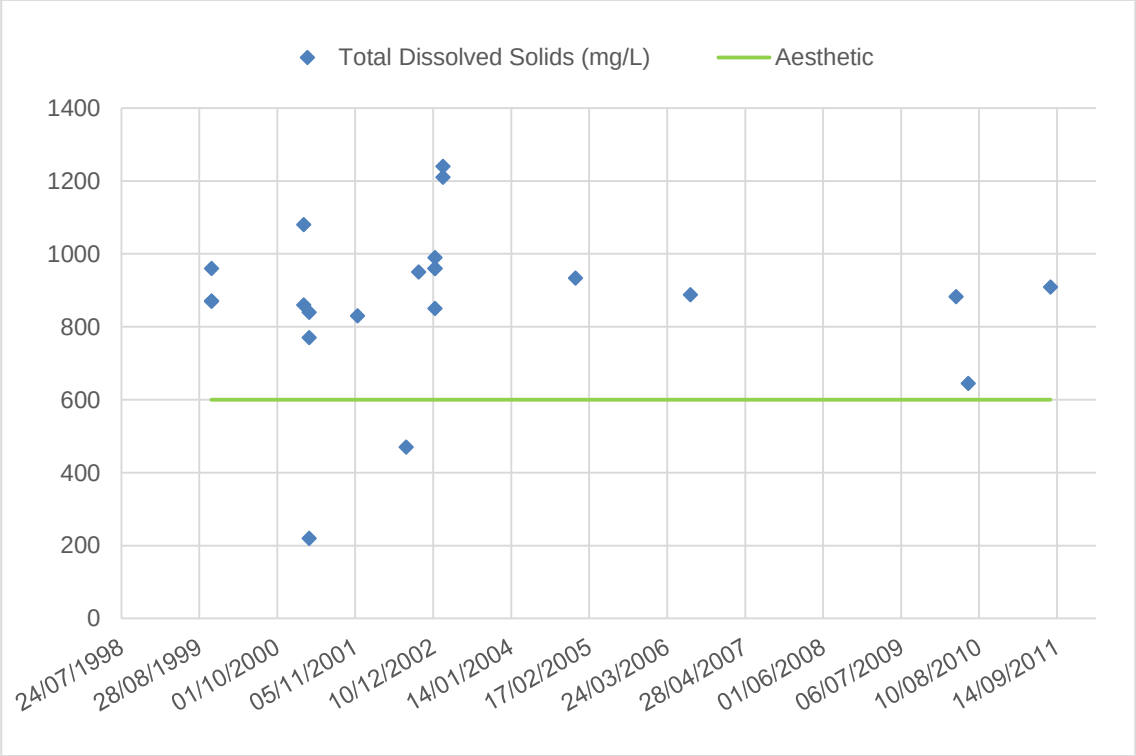


Figure 3.23 Alpha Source - True Colour

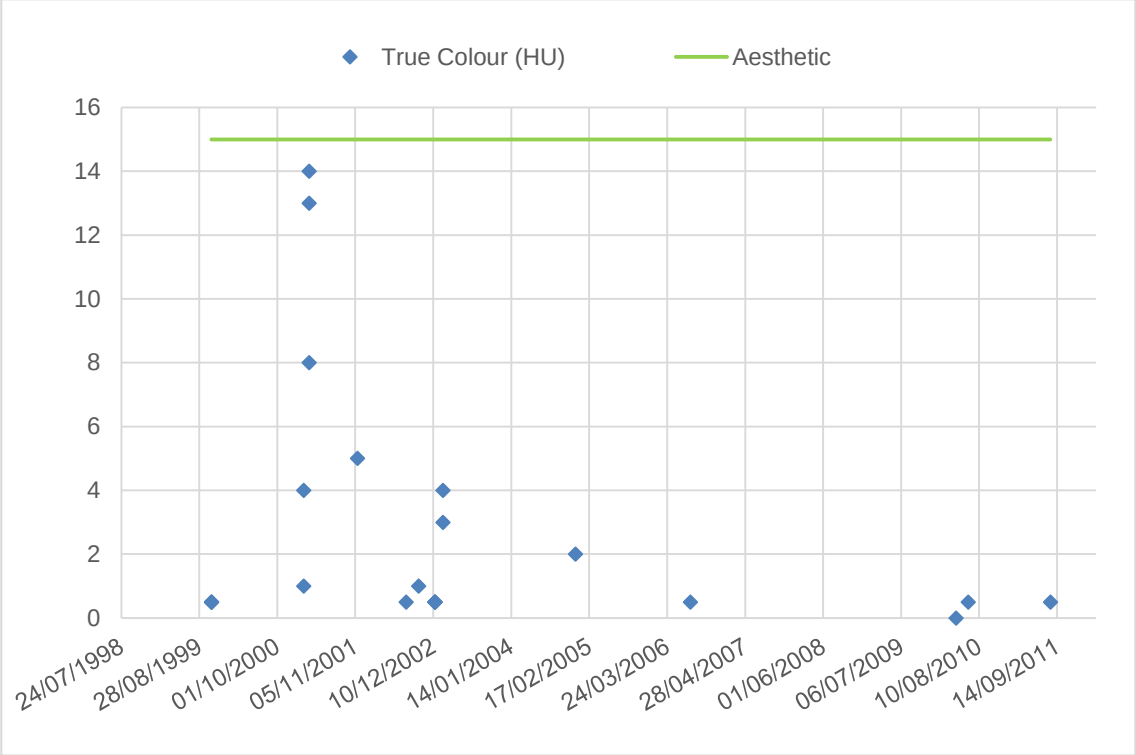


Figure 3.24 Alpha Source – Turbidity

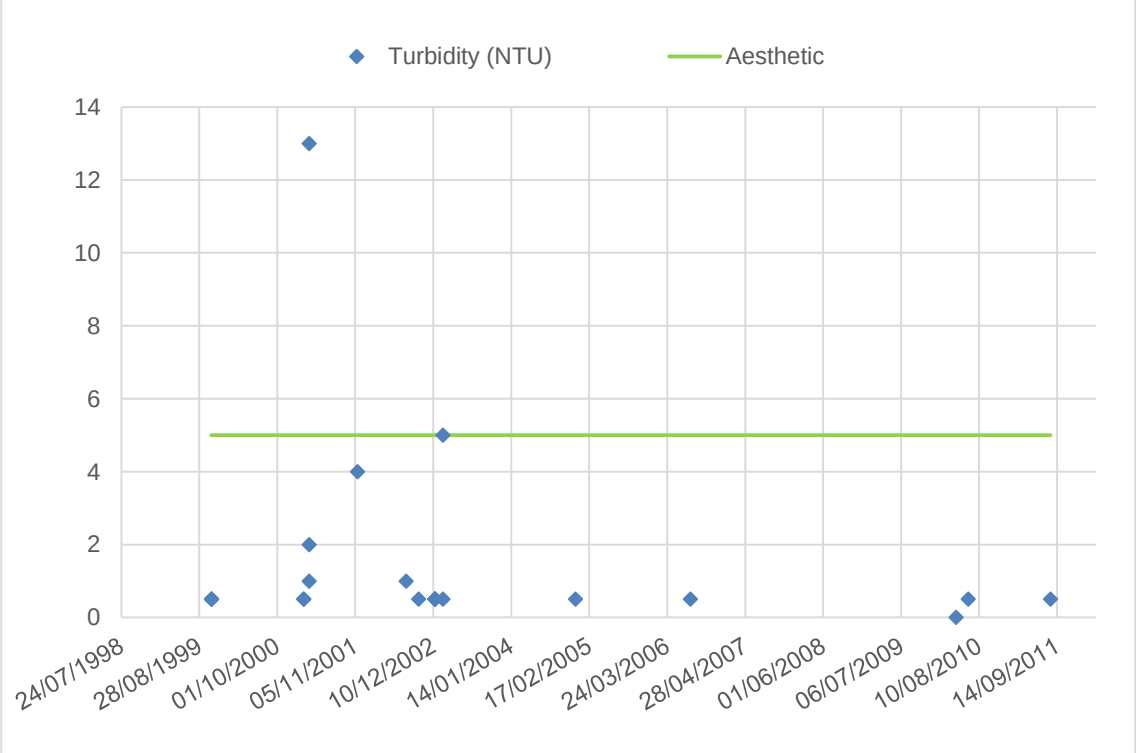


Figure 3.25 Alpha Source - Sodium

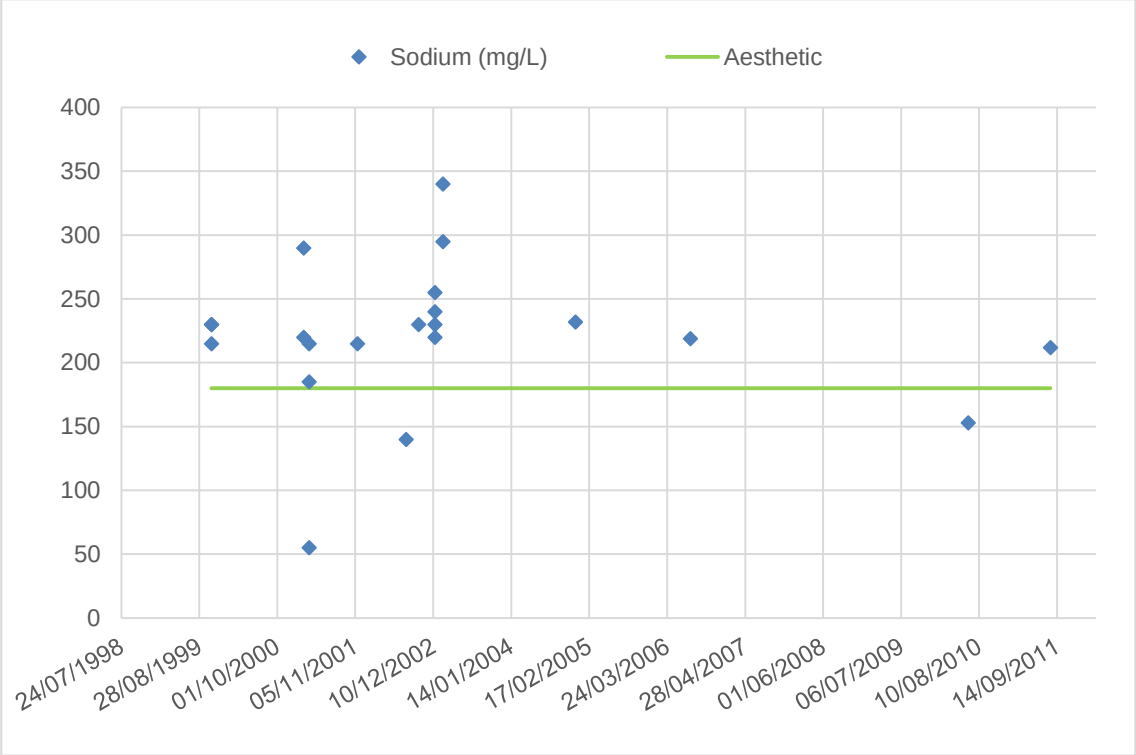


Figure 3.26 Alpha Source – Chloride

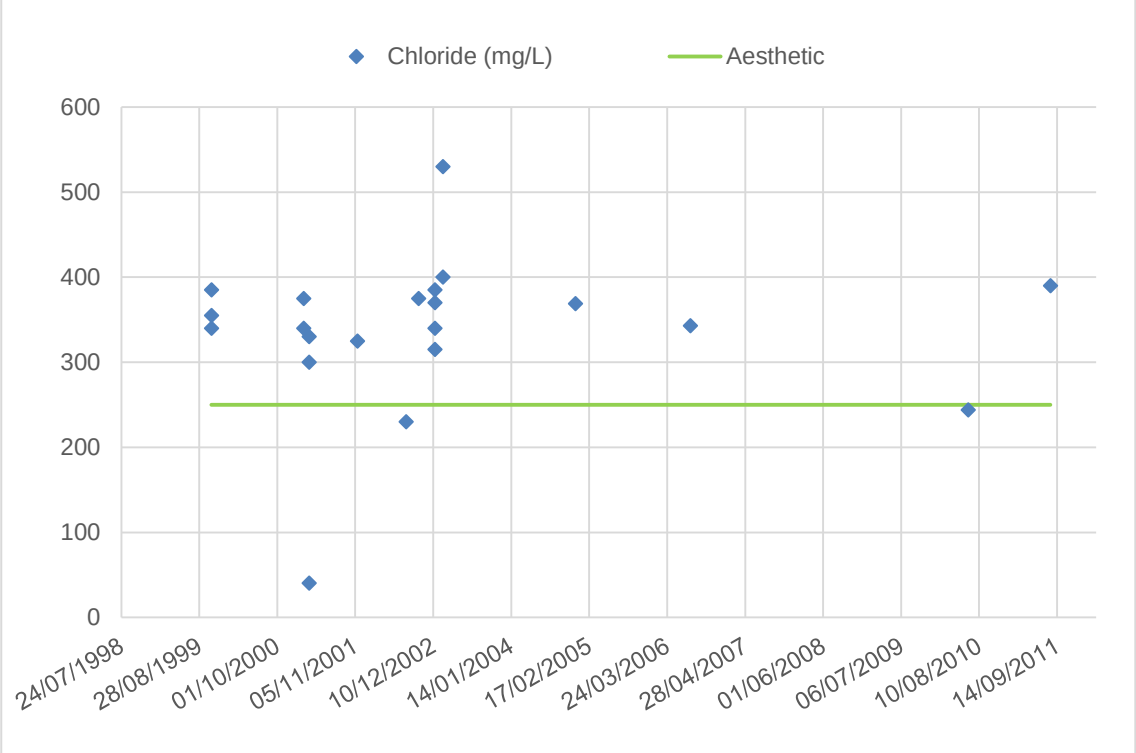


Figure 3.27 Alpha Source - Fluoride

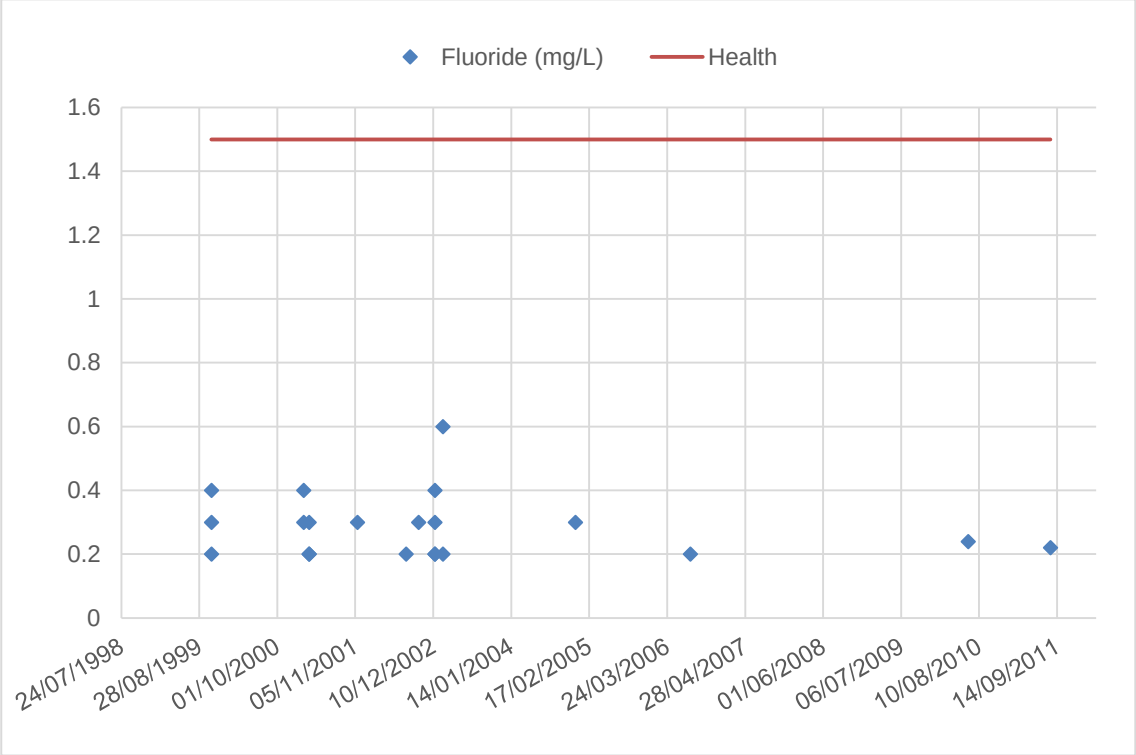


Figure 3.28 Alpha Source – Nitrate

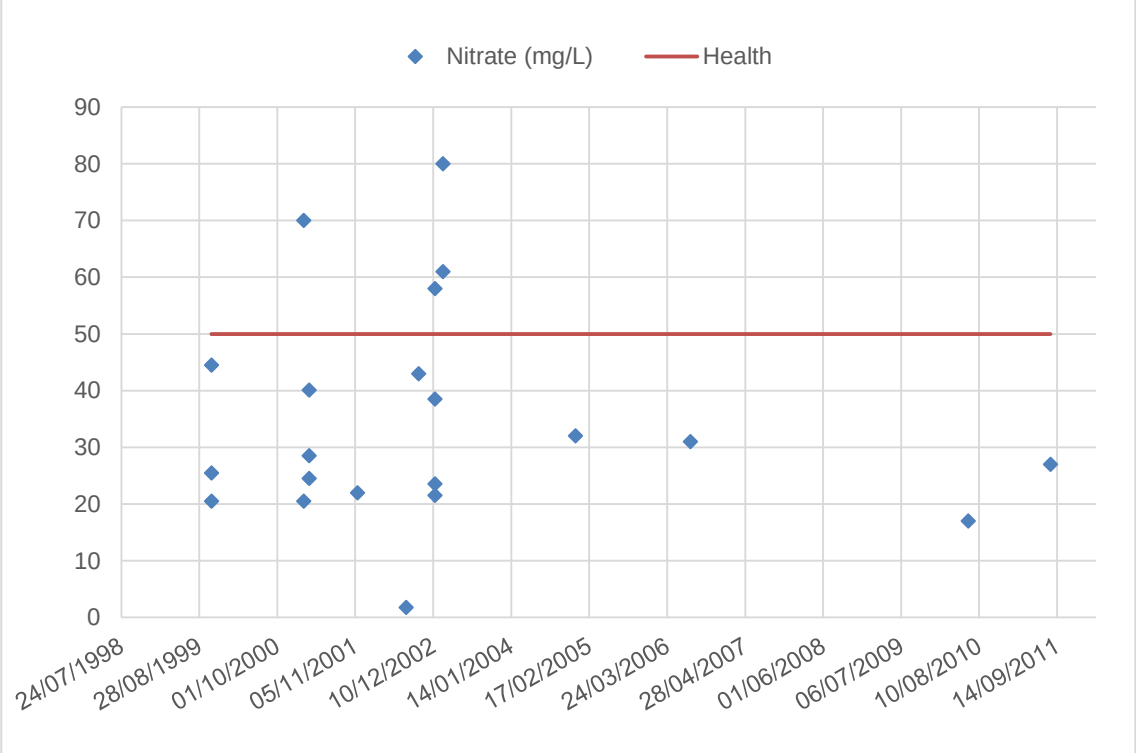


Figure 3.29 Alpha Source - Sulphate

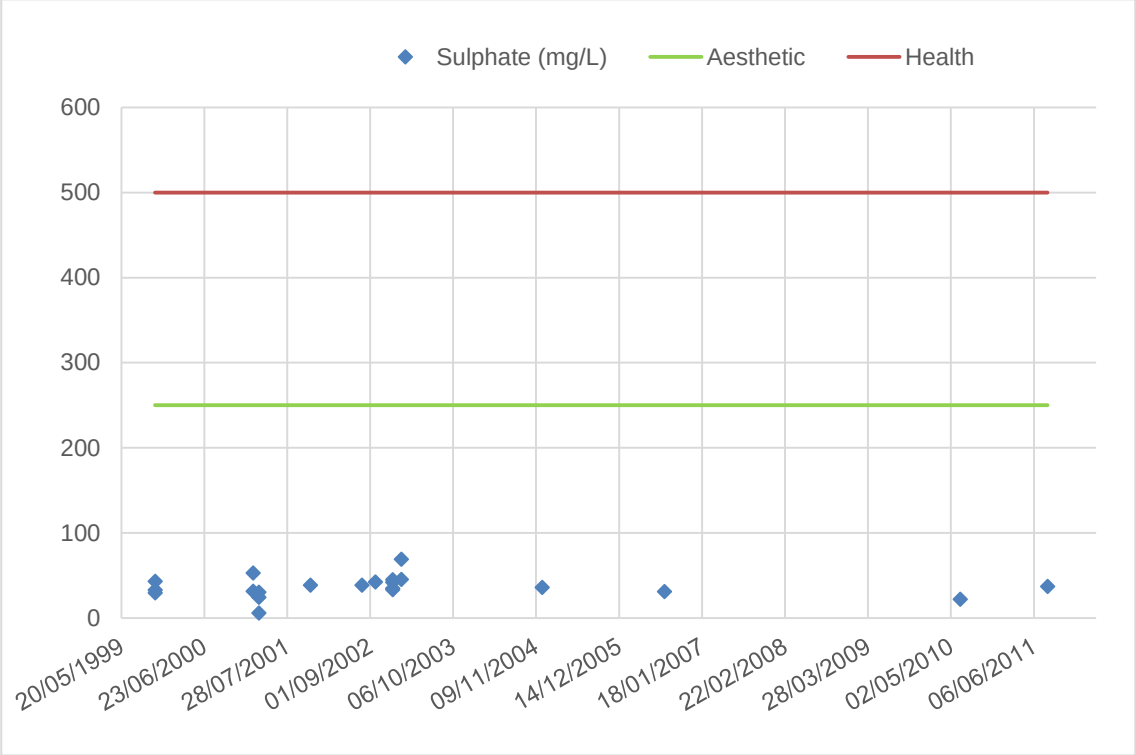


Figure 3.30 Alpha Source - Iron

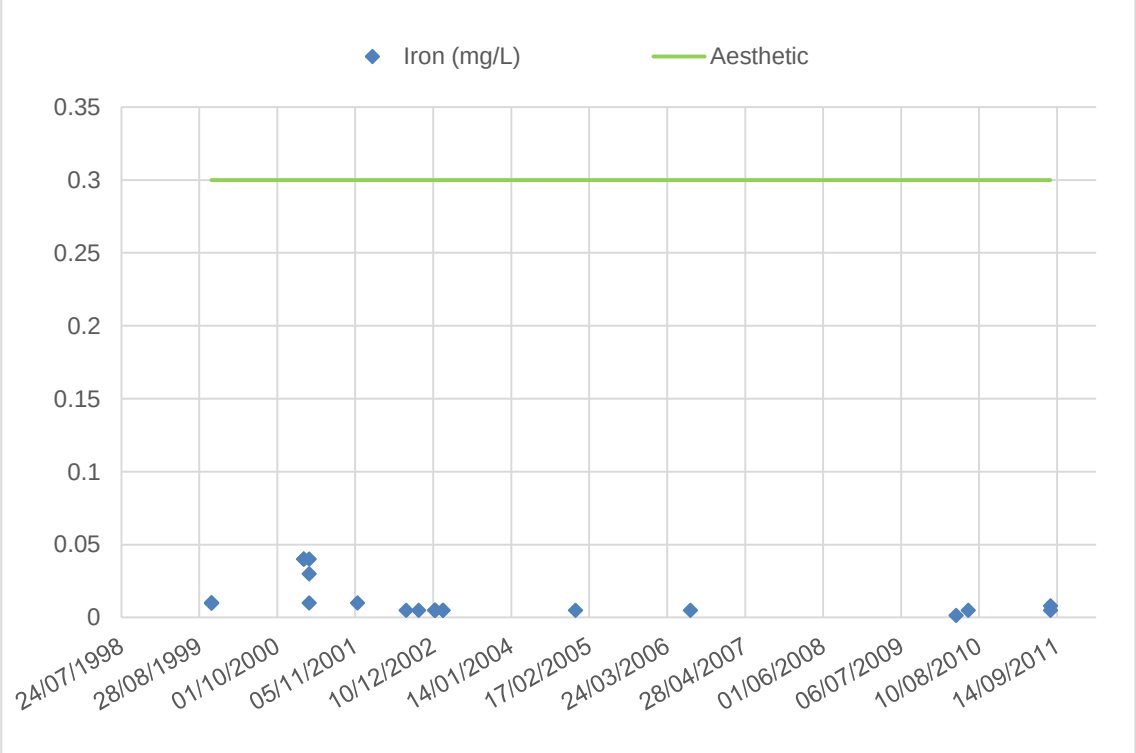


Figure 3.31 Alpha Source - Manganese

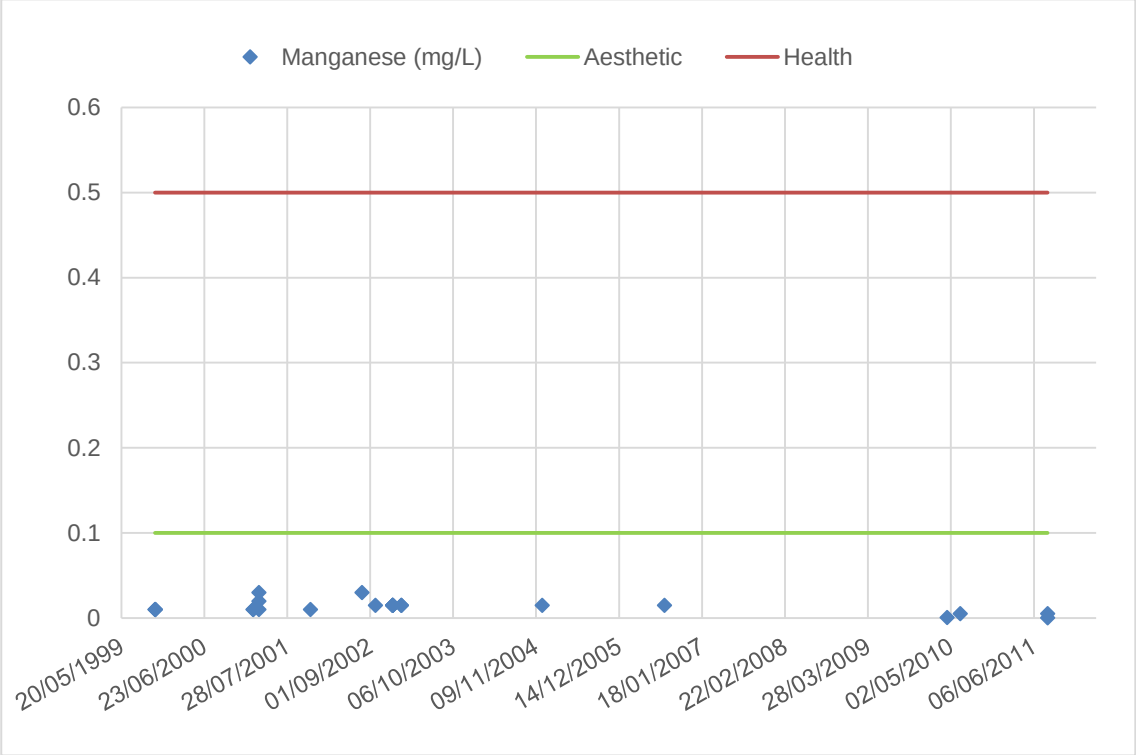


Figure 3.32 Alpha Source – Zinc

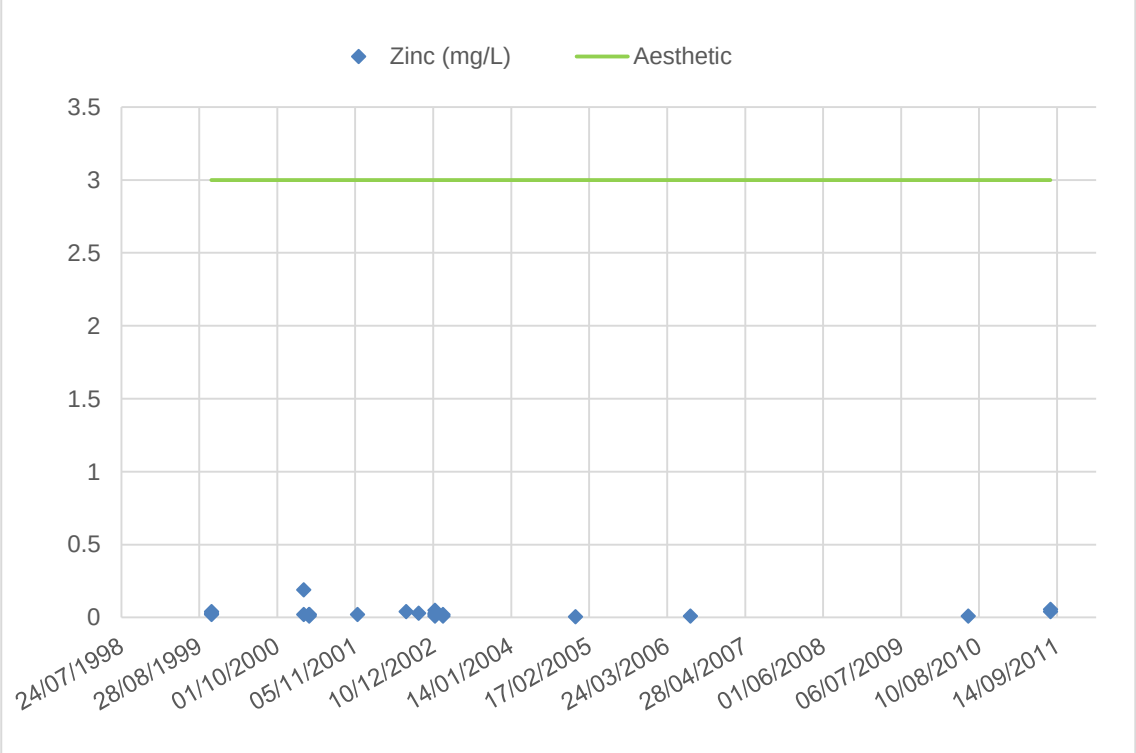


Figure 3.33 Alpha Source – Aluminium

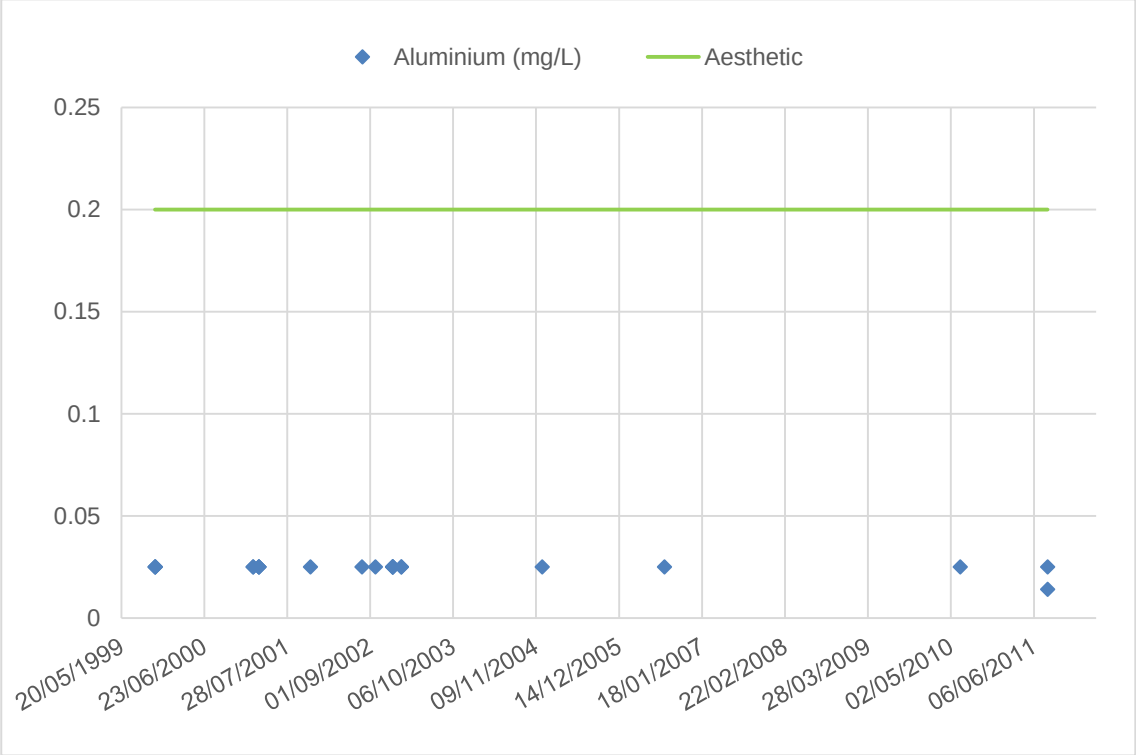


Figure 3.34 Alpha Source – Boron

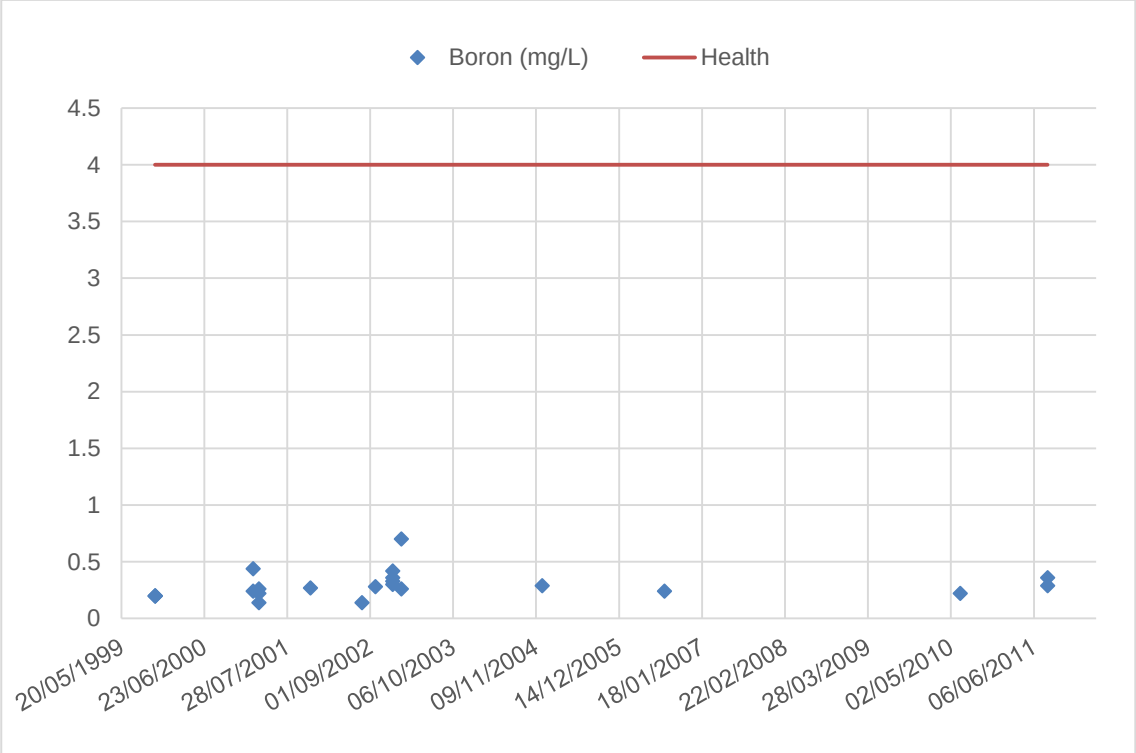
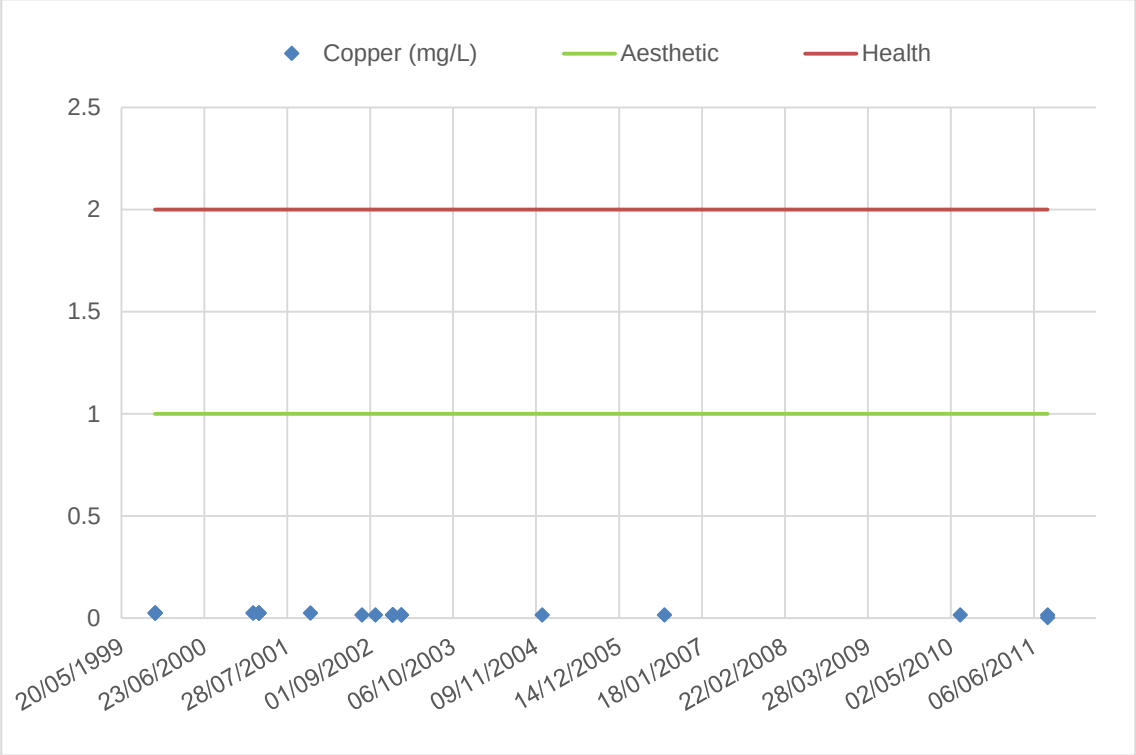


Figure 3.35 Alpha Source – Copper



3.1.1 (b) Interpretation

Table 3.1 above shows aesthetic guideline value exceedances[3] for hardness, silica, total dissolved solids, colour, turbidity, sodium and chloride in the treated water.

The following aesthetic characteristics were detected (highlighted show exceedances):

- pH
- **Hardness**
- **Silica**
- **Total Dissolved Solids**
- **Colour**
- **Turbidity**
- **Sodium**
- **Chloride**
- Sulphate
- Aluminium

The following health characteristics were detected (highlighted shows exceedances):

- Fluoride
- **Nitrate**
- Sulphate
- Boron

Figure 3.2 provides a trend for the analysis of total hardness; there are seventy-three exceedances. A maximum value of 299mg/l, average value of 234.5mg/l and a 95th percentile value of 261.6mg/l have been determined. The aesthetic guideline value is 200 mg/l (as $CaCO_3$). For hardness no health based guideline value is considered necessary. The minority of the samples have a value (60 - 200mg/l) which would be regarded as a good quality drinking water. The remainder fall into increasing scaling problems (200 – 500 mg/l).

Figure 3.3 provides a trend for the analysis of silica; there are thirty-two exceedances. The aesthetic guideline value is 80 mg/l. For silica no health based guideline is considered necessary. A maximum value of 87 mg/l, average value of 74.6 mg/l and a 95th percentile of 84mg/l have been determined. Silica is an important characteristic for both aesthetics and treatment processes.

Figure 3.4 provides a trend for the analysis of total dissolved solids; there are eighty-seven exceedances. The aesthetic guideline value is 600 mg/l. For total dissolved solids no health based guideline value is considered necessary. A maximum value of 1,110mg/l, average value of 923.1mg/l and a 95th percentile of 1030mg/l have been determined. The minimum value of 458mg/l (<500mg/l) is regarded as a good quality drinking water based on taste, however this is the only sample that meets this criteria.

Figure 3.5 provides a trend for the analysis of true colour, there was one exceedance. The aesthetic guideline value is 15 HU. For total colour no health based guideline value is considered necessary, however it should be noted that if colour is high at the time of disinfection then the water should be checked for disinfection by products such as Trihalomethane (THM) which have been associated through epidemiological studies with some adverse health effects. A maximum value of 21 HU, average value of 1.4 HU and a 95th percentile of 5.6 HU have been determined. The majority of the samples have acceptable true colour (<15 HU). Up to 25 HU is acceptable were turbidity is low, while 15 HU is just noticeable in a glass.

[3] As per the Australian Drinking Water Guidelines (2011)

Figure 3.6 provides a trend for the analysis of turbidity, there was one exceedance. The aesthetic guideline value is 5 NTU. For turbidity there is insufficient data to set a guideline value based on health considerations, however where water has a value greater than 1 NTU some microorganisms may be shielded from disinfection. A maximum value of 7 NTU, average value of 0.63 NTU and a 95th percentile of 1 NTU have been determined. The average and 95th percentile values (<5 NTU) have acceptable levels of turbidity, with seventeen samples meeting this criteria. Majority of the samples meet the lower criteria of <1 NTU allowing for effective disinfection. Only one sample exceeded the aesthetic guideline of 5 NTU with a value of 7 NTU.

Figure 3.7 provides a trend for the analysis of sodium; there are seventy-four exceedances. A maximum value of 272mg/l, average value of 231mg/l and a 95th percentile value of 268mg/l have been determined. The aesthetic guideline value is 180 mg/l. For sodium no health based guideline value is considered necessary. A minority of the samples analysed have a water quality which is acceptable based on a taste threshold (<180mg/l). The remainder are above the aesthetic guideline value.

Figure 3.8 provides a trend for the analysis of chloride for the treated water; there are eighty exceedances. A maximum value of 460mg/l, average value of 363mg/l and a 95th percentile value of 410mg/l have been determined. The aesthetic guideline value is 180mg/l. For chloride no health based guideline value is considered necessary. Minority of the samples analysed have a water quality acceptable based on a taste threshold (<250mg/l). The remainder are above the aesthetic guideline value. High concentrations of chloride are generally more common in groundwater.

There are seven aesthetic guideline value[5] exceedances, and two health guideline value[4] exceedance recorded during the period summarised in Table 3.1 for treated water.

Of the two-hundred and forty-one (241) samples analysed for E. coli there have been zero (0) E. coli colonies detected (Figure 3.18).

Table 3.3 above shows aesthetic guideline value exceedances[5] for pH, hardness, silica, total dissolved solids, turbidity, sodium and chloride and health guideline value exceedances for nitrate in the source water. The aesthetic guideline values are not discussed here.

Chlorate is a by-product of chlorination. While there is currently insufficient data to set a health-related guideline value, the USA EPA value of 0.8mg/l has been adopted to determine health risks associated with concentrations present. Chlorate has been detected above the US EPA recommended value on 15 occasions since BRC commenced a program of monitoring for Chlorates. A maximum value of 1.96mg/l, average value of .62mg/l and a 95th percentile value of 1.2mg/l were determined.

Figure 3.28 provides a trend for the analysis of nitrate for the source water; there are 4 exceedances from twenty one samples. A maximum value of 80 mg/l, average value of 34.8 mg/l, a minimum value of 1.8mg/l and a 95th percentile of 70 mg/l have been recorded. The health guideline value is 50 mg/l. Nitrate occurs naturally and is increasing in some groundwater due to intensive farming and sewage effluent. The health guideline value will protect bottle-fed infants less than three months old from methaemoglobinaemia. Adults and children can safely drink water with up to 100 mg/l nitrate. While there is health exceedances measured, these have all been recorded prior to 2004. Data after 2004 however is limited as the DWSP generally only monitored the reticulated water supply. No exceedances of nitrates have been recorded in the reticulated water.

[4] As per the USA EPA (based on Snap Shot Information Sheet)
[5] As per the Australian Drinking Water Guidelines (2011)

3.1.2 Catchment Characteristics

Alpha creek forms part of the upper catchment of the Burdekin River system. The Alpha Creek system has a catchment area of approximately 2600 km² to Alpha. Considering the high absorption value of the natural soil within the sub-catchment, Alpha Creek will only run during periods of heavy rainfall. 70% of Alpha town is located on the floodplain of the creek. The remainder of the town is located on steeper terrain rising upwards to the west from the flood plain. Alpha is located on porous sandy loam natural soil underlain by varying subsoil clay and sandy clay strata. Generally the countryside is devoid of grass due to the low rainfall and reasonably high temperatures in the region. Alpha has a current population of 402 permanent residents and has a current demand of 0.238 Ml/day.

Alpha is located in the prominent Central Western Queensland beef and wool producing area. Whilst cattle and sheep grazing are the main industries, rail transport and road infrastructure construction and maintenance also contributes significantly to provide a stable employment base for the area. There is also a future prospect of mining in the Alpha suburban area. Tourism is also a significant industry within the town.

The average annual rainfall for Alpha is 497mm[6]. With the majority of the rain falling between late December and late March with little or no rainfall during any other period. The mean maximum temperature is 30.4°C[6] although temperatures often exceed the 40°C mark during the summer months. The average annual pan evaporation for Alpha is approximately 2,800mm[7].

The town of Alpha has been affected by several significant flood events over the past sixty years. The most severe event was April 1990 with an approximate maximum flood height of 10.26m recorded at the town gauge on the upstream side of the main railway line. This event resulted in inundation of a large proportion of the town and excavation of seventy per cent of the population. Other major events include the 1950, 1997, 2003 and 2011.

Currently there are five sub artesian water supply bores in Alpha. The five bores are located on Hopper Street, near the Stock Yard, Milton Street, Moore Street and the Alpha Aerodrome. The bores are ranging from 36 to 96m deep and yield 4.7, 4.6, 2.9, 2.4 and 7.6l/s respectively. Appendix B Figure M-2012-003 shows the bores and water treatment plant locations and water reticulation layout on an aerial photo of the town.

Access to all bores is limited to authorised personnel only by way of security fencing and all bore headworks are sealed against the possibility of deliberate contamination. The bore water quality does not comply with Australian Drinking Water Quality Guidelines and therefore requires treatment.

There are three potential water bearing formations in the Alpha area, the Colinlea Sandstone, the Alpha Creek Alluvium and the Tertiary Sediments. During test drilling the Colinlea Sandstone and the Alpha Creek Alluvium formations were ruled out as potential sources due to high infrastructure costs and limited water supplies respectively.

The tertiary formation is considerably older than the recent Alpha Creek Alluvium and consists of fine sands, sandstone, siltstone, claystone, and shales. The unconsolidated sediments in this formation are also “alluvial” in nature but these sediments were deposited by much older and larger fluvial systems than the present creeks in the area. Similar Tertiary Sediments are known to cover thousands of square kilometres in Central Queensland.

Groundwater is extracted from the fine sands and weathered sandstones in this formation. The yields and quality from the Tertiary Sediments in Central Queensland are known to be extremely variable and around the Alpha area the formation runs true to form. Supplies can vary from 0.5 to 12.0 l/s

[6] 30 year mean at Barcaldine Post Office (nearest available climate statistics)
[7] DPI Water Resource’s Commission

and the quality from very good to saline. There are a number of small, possibly interconnected water beds in this formation and these may occur to depths as deep as 120m. The data indicates that these water beds occur as horizontal layers that extend both east/west and north/south of the town. The water beds are made up of very fine sands or weathered sandstone and each water bed can vary from less than 1m to 10m in thickness. In the town area there are at least three known, tertiary aquifers and it is likely that there is some interconnection between the top two. Data from bores outside town indicates that there are likely to be deeper aquifers, which contain saline water.

Alpha currently does not have a sewage collection or treatment system with sewage conveyed to individual septic tanks (with percolation). BRC are currently in the planning phase for the design of sewage collection and treatment system for the town. While the treated water supply shows no indication of contamination from the septic tanks, high concentrations of nitrates were detected in the source water before treatment of the supply commenced. It has been previously suspected that the high nitrates originated from septic systems and that they were located in the shallow Alpha creek Alluvium. (This water bed is only saturated on rare occasions so there are no nitrate analyses to support this theory.) The nitrates were thought to be migrating down the outside of the bore casing through the gravel pack material when pumping occurred. This has been used to explain the large fluctuations in nitrate levels experienced in the past. However it is thought unlikely to be caused by human or animal waste as indicator bacteria such as E-coli is not present. To this extent the cause of high nitrates in the water supply in the past is unknown. The sub artesian bores have been annuli sealed off to prevent contamination from surface water leachate. However during reasonably large flood events, contamination of the bore water with surface water may occur as flood waters may inundate private bores.

3.1.2 (a) Scale and Location of Significant Current and Proposed Major Land Uses (Mining)

At least four mines are proposed for the Barcaldine Region (Refer to Appendix F Existing Mining Leases and Exploration Areas) with three proponent EIS issued to date for above ground and underground coal mining activities. The total cumulative mining workforce including adjoining areas within the Barcaldine Regional Council jurisdiction in total predicted numbers is shown in Table 3.4 below.

Table 3.4 Cumulative Mining Workforce

Mining projects within Barcaldine Region	Predicted mining workforce
Kevin‘s Corner Coal Mine	1600
South Galilee	750
Alpha Coal	1600
Waratah Galilee Coal Mine (China First)	1500
Proposed Galilee Basin IGCC Power Station	60
Total Projected Cumulative Workforce	**5510**

This presents a total of 5510 operational personnel with a local resident population increase of 44 (Region wide) which excludes contractors, subcontractors or their families residing locally. The exact numbers of local resident workforce are subject to employee choice. There are no details on indirect partners or families to be housed locally. A workforce including a further 225 is expected during the operational phase of rail construction for Hancock Coal.

Based on information within EIS reporting from mining proponents for an operation period of 30 years (min) and average inflow/ ingress (provided this has been predicted by estimation) that between 220GL to 700GL per annum will be extracted. It has been predicted that current local water supply would be insufficient to support the mining expansion. However, it is not envisaged that Council will

supply this water from their town supplies and this would necessitate a reliance on alternative (piped) water for longer-term supply for mining proponents.

Should the mining projects within the Barcaldine Region proceed they may have the potential to significantly impact groundwater dependent systems / springs and reduce the quantity of surface water, and cause depressurisation of deeper aquifers based on EIS reporting to date. Radiating groundwater drawdowns are predicted from 10km to 30km away from mining activities however further information is required from the mining proponents on predicted impacts to the shallow aquifers in Alpha and Jericho which would include additional monitoring.

A draft figure of the existing mining leases and exploration areas are provided in Appendix F based on information as at April 2012, which provide a footprint for potential groundwater impact areas.

This plan would require amending if the planned mining projects proceed, to reflect the mining expansion for the region, when further detailed information from regulatory authorities, water providers and mining proponents becomes available.

3.1.3 Hazard Identification

The hazards and hazardous events and their sources that adversely affect water quality are documented in Table 3.5 below and include those affecting:

- Catchment
- Sourcing infrastructure
- Treatment plants (where applicable)
- Disinfection process(es) (where applicable)
- Distribution system

3.1.3 (a) Identifying and Documenting Hazards and Hazardous Events

The hazards and hazardous events were identified using data contained in the plan and following site visits and a risk assessment workshop which was conducted on 8 and 9 November 2011. A more recent risk assessment workshop was conducted in December 2017 prior to amendment of the plan;

- Section 2.1 Alpha Water Supply Scheme
- Section 3.1.1 Water Quality Information
- Section 3.1.2 Catchment Characteristics

Table 3.5 Alpha Hazard Identification, Risk Assessment and Uncertainty

Scheme Component / Sub-component	Hazardous Event	Hazard	Maximum Risk			Existing Preventive Measures / Barriers.	Residual risk			Uncertainty	Comments/ Proposed Further Risk Reduction Actions
			Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
Source	Septic system discharges	Bacteria	Catastrophic	Unlikely	High (10)	Disinfection Automated Chlorine monitoring Telemetry alarms for dosing failure	Moderate	Rare	Low (3)	Reliable	Continue to monitor for E.coli. **AL1**: Draft standard operating procedures and / or manual of operations. **AL2** Commence sampling source water in addition to treated water.
	Flood event	Biological	Catastrophic	Unlikely	Medium (6)	Disinfection/Treatment Automated, Turbidity and pH monitoring Telemetry alarms for critical level exceedance	Moderate	Rare	Low (3)	Uncertain	**AL3** Identify effect of flooding on bore water quality considering private bores which exist on the flood plain which may not be capped. **AL 4** Identify uncapped bores under councils jurisdiction and cap bores to reduce risk of pathogenic ingress. **AL1**: Draft and implement procedure flood event monitoring of source water to detect bacterial contaminants.
	Hazard that arises from the natural geological processes in the aquifer.	True Colour	Insignificant	Possible	Low (3)	flocculation, clarification and filtration	Insignificant	Rare	Low (1)	Reliable	Acceptable risk, continue to monitor for exceedances. **AL2** Commence testing source water in addition to treated water.
		Turbidity	Insignificant	Possible	Low (3)	flocculation, clarification and filtration	Insignificant	Unlikely	Low (2)	Reliable	
		Hardness	Insignificant	Possible	Low (3)	Nil	Insignificant	Possible	Low (3)	Reliable	
		TDS	Insignificant	Almost Certain	Medium (6)	Nil	Insignificant	Almost Certain	Medium (6)	Reliable	
		Sodium	Insignificant	Likely	Medium (5)	Nil	Insignificant	Likely	Medium (5)	Reliable	
		Chloride	Insignificant	Likely	Medium (5)	Nil	Insignificant	Likely	Medium (5)	Reliable	
		Nitrates	Moderate	Unlikely	Medium (6)	Nil	Moderate	Unlikely	Medium (6)	Reliable	
Sourcing Infrastructure	Power Outage	Disruption to supply	Moderate	Unlikely	Medium (6)	Elevated reservoir (limited backup) and Town Backup generator	Insignificant	Rare	Low (1)	Confident	Acceptable risk
	Flood event	Loss of infrastructure	Catastrophic	Rare	Medium (6)	Critical Infrastructure constructed above flood level	Moderate	Rare	Low (3)	Uncertain	
	Maintenance and repair of raw water main	Bacteria	Catastrophic	Unlikely	High (10)	Mains repair procedure and treatment.	Moderate	Rare	Low (3)	Reliable	**AL1** Draft procedure for reticulation repair. Current procedures are inadequate.
Treatment Plant & Reservoirs	Power Outage	Disruption to supply	Moderate	Unlikely	Medium (6)	Elevated reservoir (limited backup) and Town Backup generator	Insignificant	Rare	Low (1)	Confident	Acceptable risk

Scheme Component / Sub-component	Hazardous Event	Hazard	Maximum Risk			Existing Preventive Measures / Barriers.	Residual risk			Uncertainty	Comments/ Proposed Further Risk Reduction Actions
			Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
	Flood event	Loss of infrastructure	Catastrophic	Rare	Medium (6)	Critical Infrastructure constructed above flood level	Moderate	Rare	Low (3)	Uncertain	
	Bypass treatment plant	True Colour	Insignificant	Possible	Low (3)	On-site drawings showing valve numbering, training and valve maintenance. Procedure for plant operations, maintenance and backwash.	Insignificant	Rare	Low (1)	Reliable	**AL1**: Draft and implement standard operating procedures and / or manual of operations. Current Procedures are inadequate and do not cover specific operations. **AL5** Operator requires training and handover process to be implemented.
		Turbidity	Insignificant	Possible	Low (3)		Insignificant	Unlikely	Low (2)	Reliable	
		Bacteria	Catastrophic	Unlikely	High (10)		Moderate	Rare	Low (3)	Reliable	
	Alum under dose affecting treatment / Failure of Alum Dosing Equipment	True Colour	Insignificant	Possible	Low (3)	Operational monitoring, manual adjustment. Automated, Turbidity and pH monitoring Telemetry alarms for critical level exceedance	Insignificant	Rare	Low (1)	Reliable	**AL1** Draft standard operating procedures and / or manual of operations. Current Procedures are inadequate. **AL5** Operator requires training and handover process to be implemented.
		Turbidity	Insignificant	Possible	Low (3)		Insignificant	Unlikely	Low (2)	Reliable	
		Bacteria	Catastrophic	Unlikely	High (10)		Moderate	Rare	Low (3)	Reliable	
	Alum over dosing	Alum	Moderate	Rare	Low (3)		Moderate	Rare	Low (3)	Uncertain	
	Hydrochloric over / under dosing	Hydrochloric Acid	Minor	Rare	Low (2)	Nil	Minor	Rare	Low (2)	Reliable	
	Accidental Contamination	Substances (not identified)	Catastrophic	Rare	Medium (6)	Restricted access, operator training.	Moderate	Rare	Low (3)	Uncertain	
Disinfection Process	Over Chlorination	Chlorine	Moderate	Unlikely	Medium (6)	Automated Chlorine monitoring Telemetry alarms for dosing failure	Moderate	Rare	Low (3)	Estimate	
	Under Chlorination	Bacteria	Catastrophic	Unlikely	High (10)		Catastrophic	Rare	Medium (6)	Estimate	
	Low residual chlorine in Elevated Reservoir	Chlorine	Moderate	Unlikely	Medium (6)	Tank automatically refills at 70% full in order to turn water over	Moderate	Rare	Low (3)	Uncertain	
	Failure of Disinfectant Dosing Pumps	Bacteria	Catastrophic	Unlikely	High (10)	Automated Chlorine monitoring Telemetry alarms for dosing failure	Catastrophic	Rare	Medium (6)	Estimate	
	Power Outage	Disruption to supply	Moderate	Unlikely	Medium (6)	Elevated reservoir (limited backup) and Town Backup generator	Insignificant	Rare	Low (1)	Confident	Acceptable risk
	Disinfection by-products (Degradation of chemicals)	Chlorate	Major	Possible	High (12)	Installation of calcium hypochlorite system Verification monitoring of Chlorates Automated chlorine monitoring	Major	Unlikely	Medium (6)	Estimate	**AL1** Draft standard operating procedures and / or operations manual.
	pH >8	Chlorine	Moderate	Unlikely	Medium (6)	Automated pH, Chlorine monitoring Telemetry alarms for dosing failure	Moderate	Unlikely	Medium (6)	Estimate	**AL1** Current Procedures are inadequate. Draft standard operating procedures and / or operations manual.

Scheme Component / Sub-component	Hazardous Event	Hazard	Maximum Risk			Existing Preventive Measures / Barriers.	Residual risk			Uncertainty	Comments/ Proposed Further Risk Reduction Actions
			Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
	Insufficient contact time	Chlorine	Moderate	Unlikely	Medium (6)		Moderate	Rare	Low (3)	Estimate	Acceptable risk
Distribution System	Reticulation maintenance and repair	Bacteria	Catastrophic	Unlikely	High (10)	Mains repair procedure and Monitoring	Moderate	Rare	Low (3)	Uncertain	**AL1** Draft revised procedure for reticulation repair and monitor
Whole of system	Flights carrying samples to lab delayed/cancelled	Logistical	Insignificant	Possible	Low (3)	Nil	Insignificant	Possible	Low (3)	Confident	Acceptable risk

3.1.3 (b) Hazard Identification (And Risk Assessment) Team

The personnel responsible for the hazard identification and risk assessment process, their roles and responsibilities are detailed in the Table below.

Table 3.6 Hazard Identification and Risk Assessment Team

Typical job title for key personnel	What role did each person play on the team?	What expertise and system knowledge did the person bring?
Manager of Engineering Services	Management of DWQMP Process, Risk Assessment Procedure & Chairing Risk Assessment Workshop	High level knowledge, risk assessment and general engineering experience in the management of the systems
Engineer (Internal / External)	Author, Risk Assessment, Risk Assessment Workshop	Detailed knowledge of the system, water risk assessment
Water Engineer (Internal / External)	Risk Assessment Workshop	Detailed knowledge of drinking water quality management, outside perspective, risk assessment
Water / Technical Officers	Risk Assessment Workshop	Detailed knowledge of individual schemes, risk assessment

3.2 Aramac Water Quality and Catchment Characteristics

Aramac water supply is composed of two flowing artesian bores. The source water is not treated prior to reticulation.

3.2.1 Water Quality Information

Water quality information for Aramac includes the following:

(a) Summary
(b) Interpolation

3.2.1 (a) Summary

Table 3.7 below summarises the available reticulated water quality for the Aramac water supply scheme.

Figure 3.36 to Figure 3.53 below show trends of the main parameters contained in Table 3.7.

The responsibility for obtaining the water samples rests with the DWSP and samples are collected by the Technical Officer monthly. Samples are sent to Queensland Health Scientific Services for analysis. The DWSP also samples and analyses drinking water for E. coli.

Table 3.7 Aramac Reticulated Water

Aramac Water Supply	Start Date	09/06/2010	End Date:	03/01/2018							
Characteristic	Units	No. of Samples	Summary of Results					Guideline Value			
			Maximum Value	Average Value	Minimum Value	Std Dev	95th Percentile	Health	Exceedances	Aesthetic	Exceedances
Conductivity	uS/cm	184	488.000	461.511	443.000	9.584	478.850				
pH		184	8.340	7.942	7.630	0.100	8.090			≥6.5 & ≤ 8.5	0
Total Hardness	mg/L as $CaCO_3$	184	49.000	17.614	5.900	2.625	19.000			200	0
Temporary Hardness	mg/L as $CaCo_3$	184	21.000	17.451	5.900	1.233	19.000			200	0
Alkalinity	mg/L $CaCo_3$	184	186.000	152.082	2.900	52.174	177.000				
Residual Alkalinity	meq/L	184	183.000	21.585	2.900	53.094	173.700				
Silica	mg/L	184	29.000	19.690	18.000	0.870	20.000			80	0
Total Dissolved Ions	mg/L	184	3968.000	372.957	256.000	266.037	368.850				
Total Dissolved Solids	mg/L	184	285.000	269.446	259.000	5.038	277.850			600	0
True Colour	Hazen	170	17.000	3.559	0.500	3.062	9.550			15	2
Turbidity	NTU	112	2.000	0.571	0.500	0.210	1.000			5	0
pH (Saturation)*		184	8.900	8.402	8.300	0.047	8.400				
Saturation Index		184	-0.100	-0.463	-1.000	0.116	-0.300				
Mole Ratio		184	2.100	1.817	1.400	0.105	2.000				
Sodium Absorption Ratio		184	18.000	9.704	8.600	0.717	10.000				
Figure of Merit		176	0.100	0.099	0.000	0.008	0.100				
Sodium	mg/L	184	102.000	93.223	88.000	2.456	97.000			180	0
Potassium	mg/L	184	8.300	6.072	5.700	0.236	6.385				
Calcium	mg/L	184	7.300	6.516	2.000	0.449	7.000				
Magnesium	mg/L	184	0.700	0.312	0.200	0.061	0.400				
Hydrogen	mg/L	176	0.000	0.000	0.000	0.000	0.000				
Bicarbonate	mg/L	184	224.000	204.823	2.400	15.887	216.850				
Carbonate	mg/L	184	2.500	1.075	0.100	0.282	1.585				
Hydroxide	mg/L	184	0.000	0.000	0.000	0.000	0.000				
Chloride	mg/L	184	48.000	40.658	33.000	1.082	42.000			250	0
Fluoride	mg/L	184	0.600	0.497	0.230	0.041	0.559	1.5	0		
Nitrate	mg/L	106	0.250	0.225	0.025	0.070	0.250	50	0		

Aramac Water Supply	Start Date	09/06/2010	End Date:	03/01/2018						
Characteristic	Units	No. of Samples	Summary of Results					Guideline Value			
			Maximum Value	Average Value	Minimum Value	Std Dev	95th Percentile	Health	Exceedances	Aesthetic	Exceedances
Sulphate	mg/L	98	0.500	0.500	0.500	0.000	0.500	500	0	250	0
Iron	mg/L	184	0.360	0.118	0.005	0.066	0.239			0.3	5
Manganese	mg/L	184	0.070	0.030	0.005	0.005	0.040	0.5	0	0.1	0
Zinc	mg/L	119	0.330	0.018	0.005	0.039	0.071			3	0
Aluminium	mg/L	106	0.025	0.025	0.025	0.000	0.025			0.2	0
Boron	mg/L	184	0.090	0.060	0.050	0.006	0.070	4	0		
Copper	mg/L	99	0.080	0.016	0.015	0.008	0.016	2	0	1	0
E. coli		399	0.000	0.000	0.000	0.000	0.000	0	0		

Aesthetic Guideline Exceedance
Health Guideline Exceedance

Table 3.8 Aramac water quality complaints

Year	No of Water Quality Complaints	Water Quality Complaints per 1000 Connections	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2017	2	8.58	Smell	Pipes / reservoir contaminated	Decontaminate reticulation
2016	0	0			
2015	No Data	No Data	Data Not Available		
2014					
2013					
2012					
2011	6	25.75			
2010	6	25.87			
2009	6	25.98			

Figure 3.36 Aramac - pH at 23°C

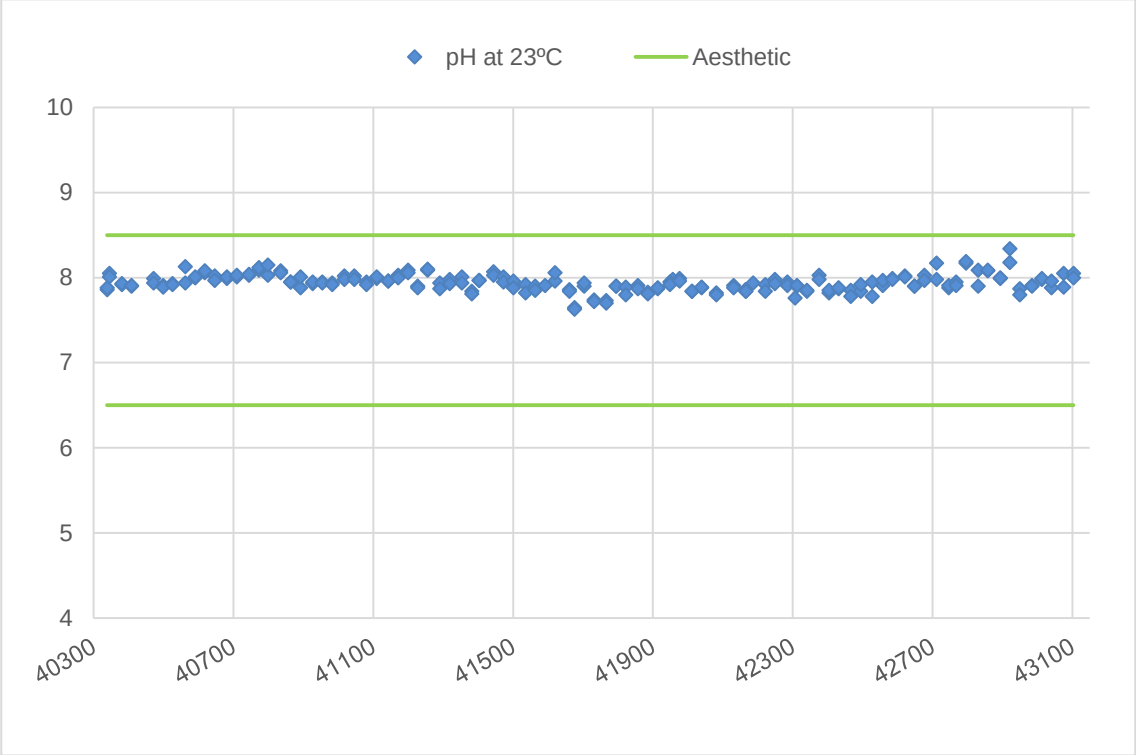


Figure 3.37 Aramac - Total Hardness

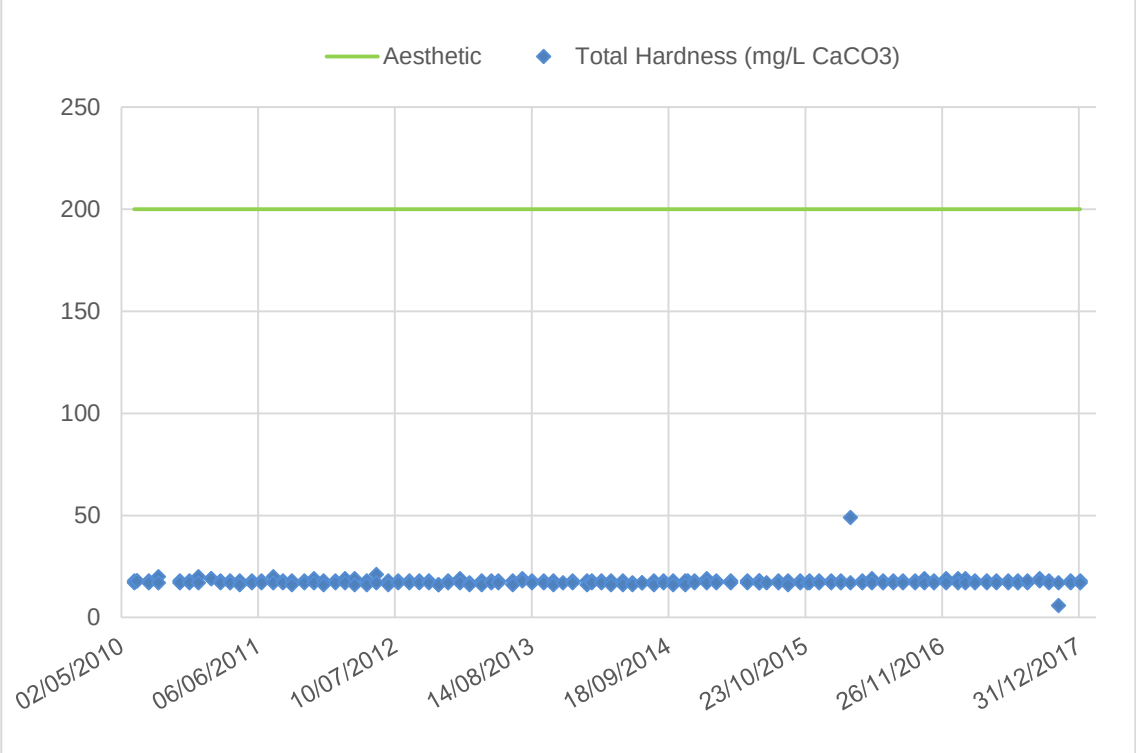


Figure 3.38 Aramac – Silica

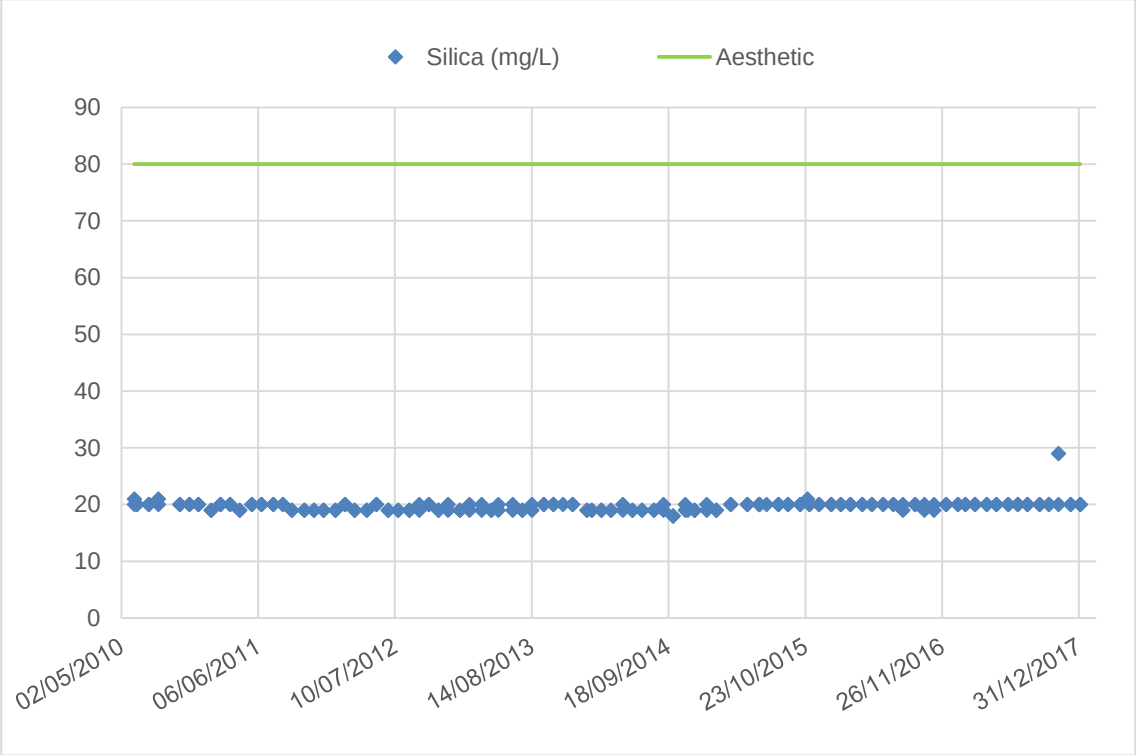


Figure 3.39 Aramac - Total Dissolved Solids

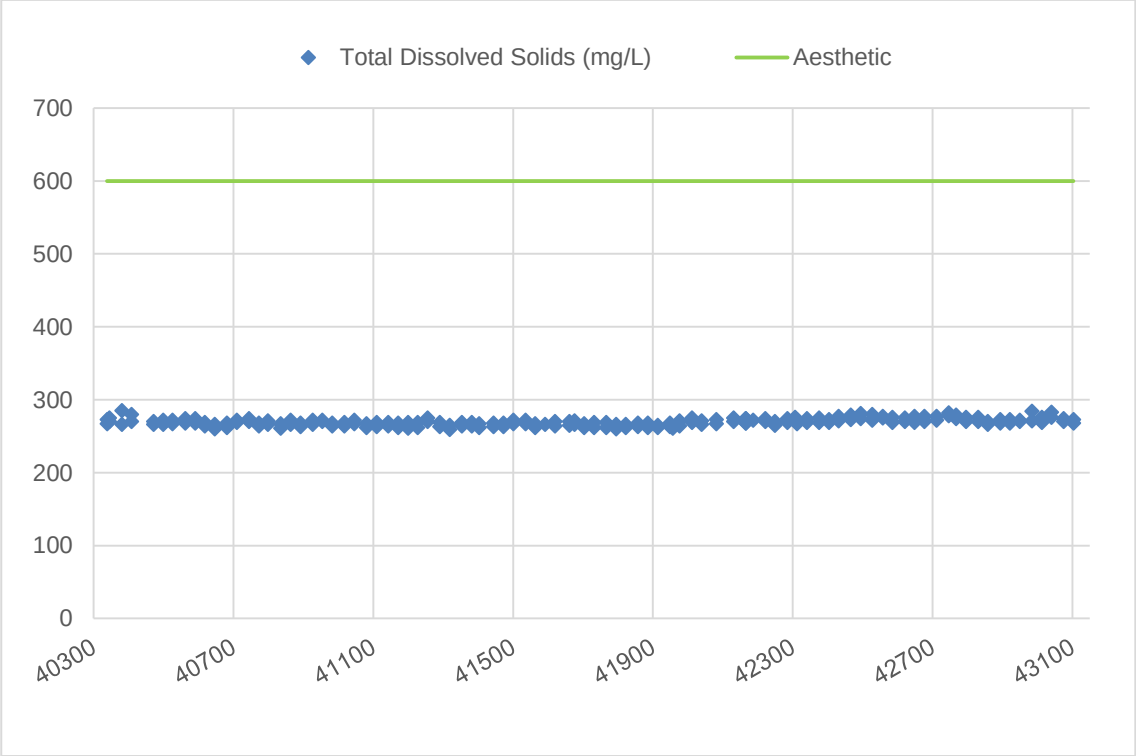


Figure 3.40 Aramac - True Colour

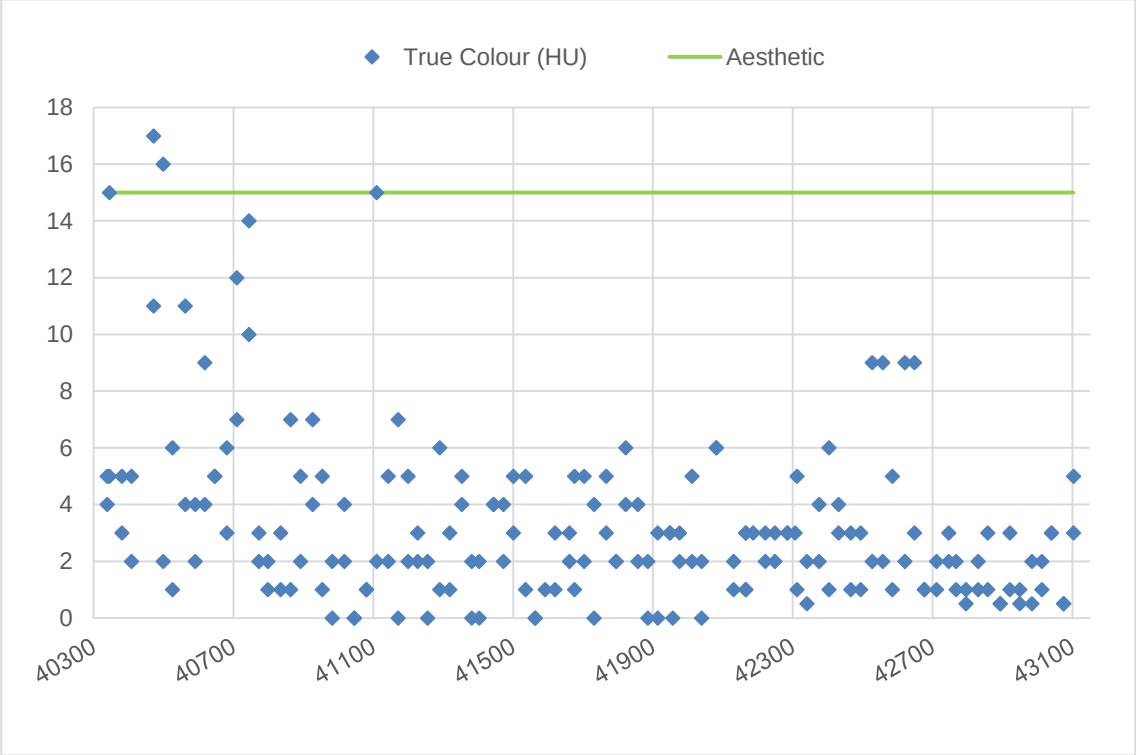


Figure 3.41 Aramac – Turbidity

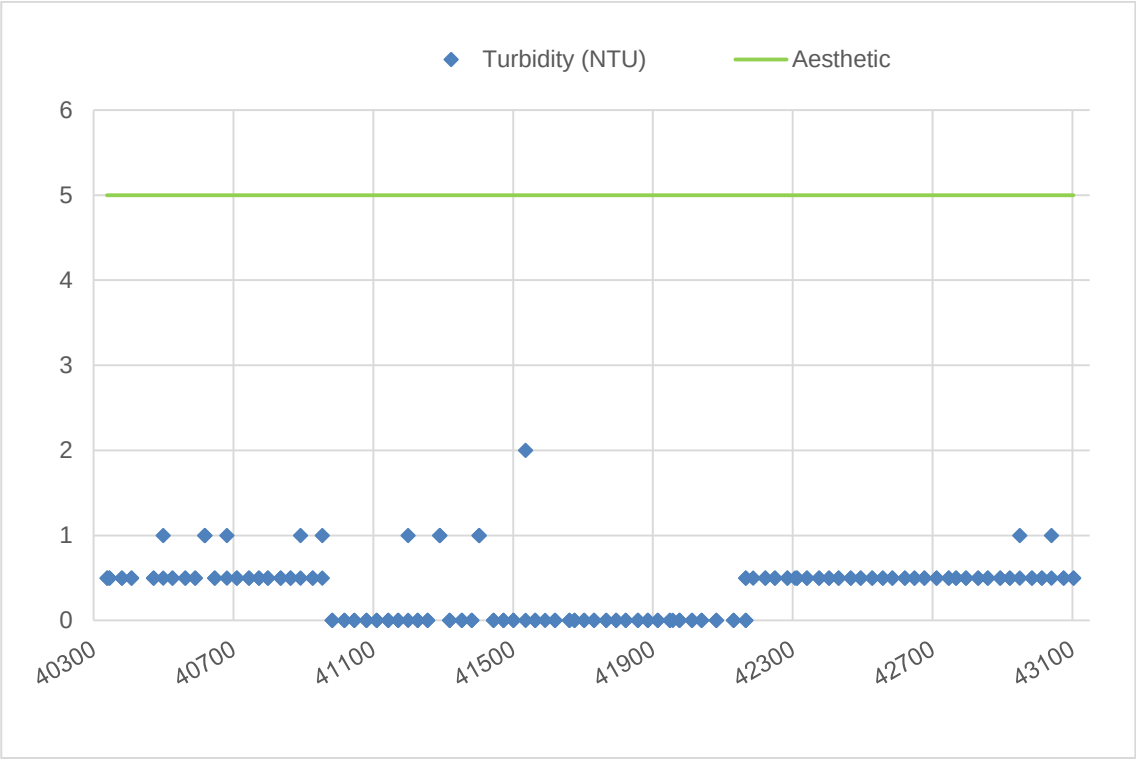


Figure 3.42 Aramac – Sodium

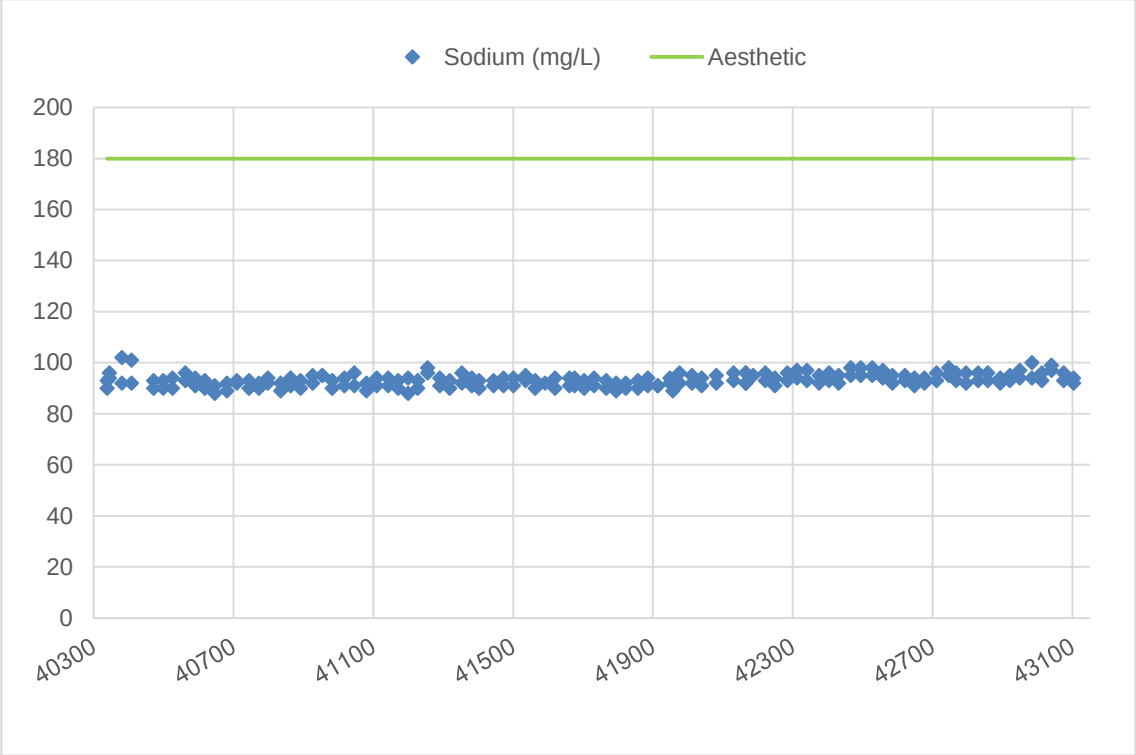


Figure 3.43 Aramac – Chloride

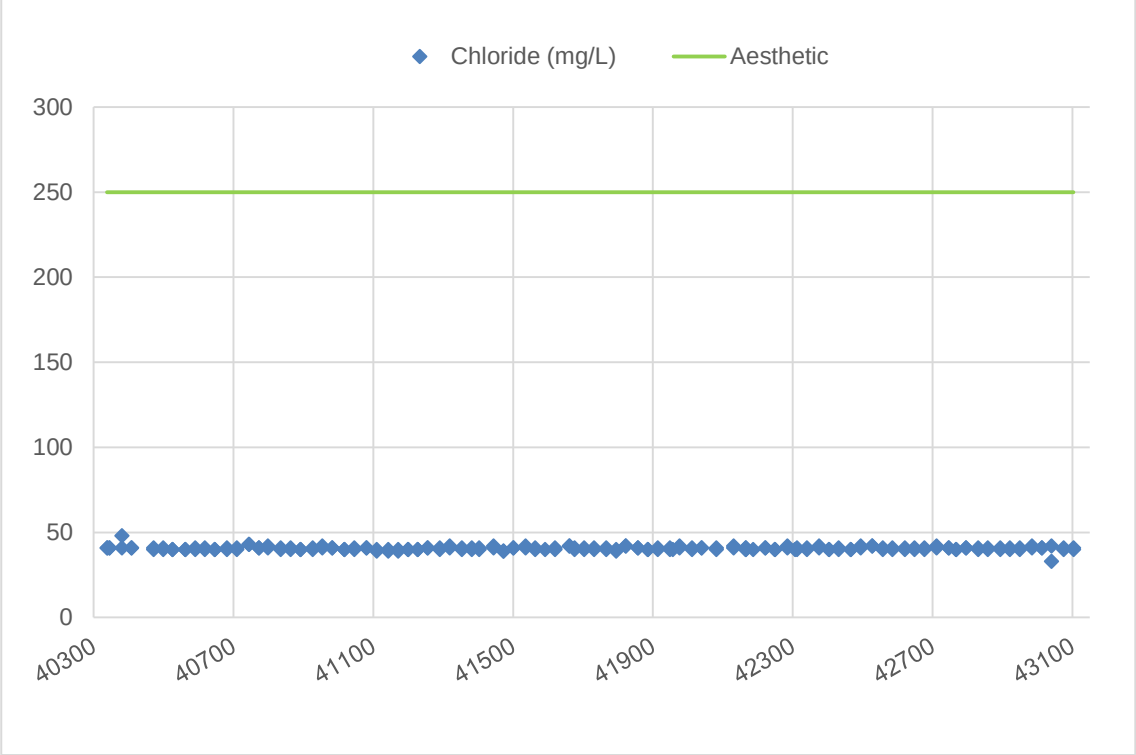


Figure 3.44 Aramac - Fluoride

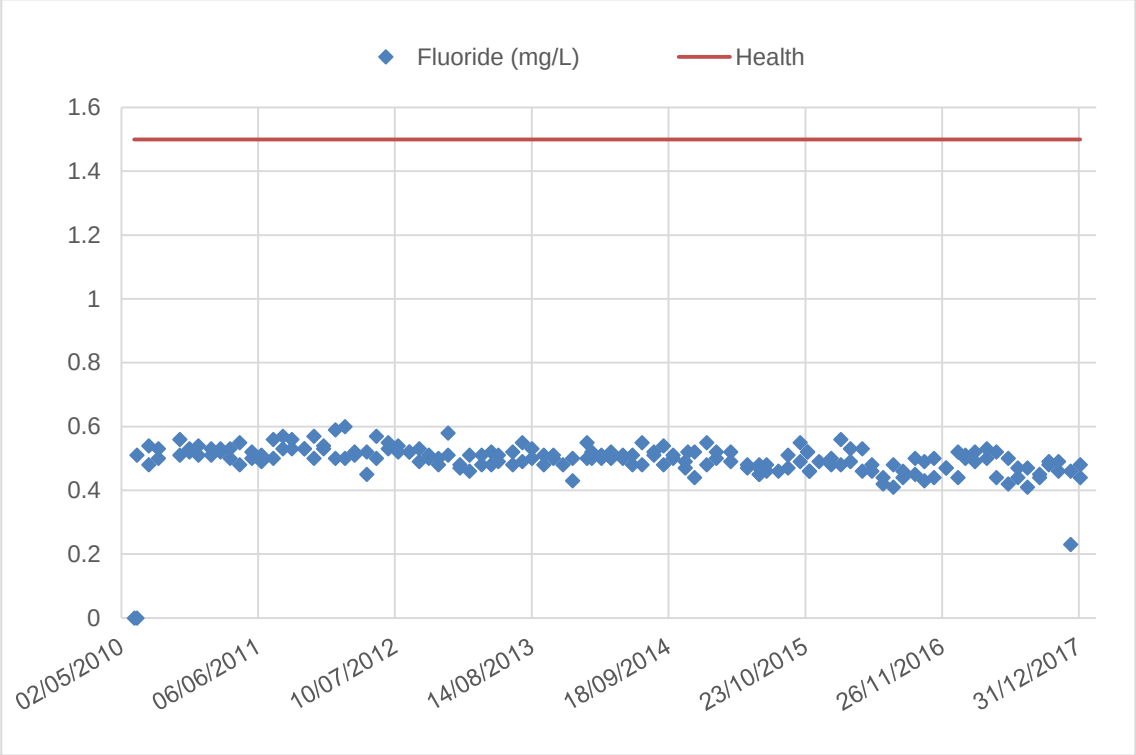


Figure 3.45 Aramac - Nitrate

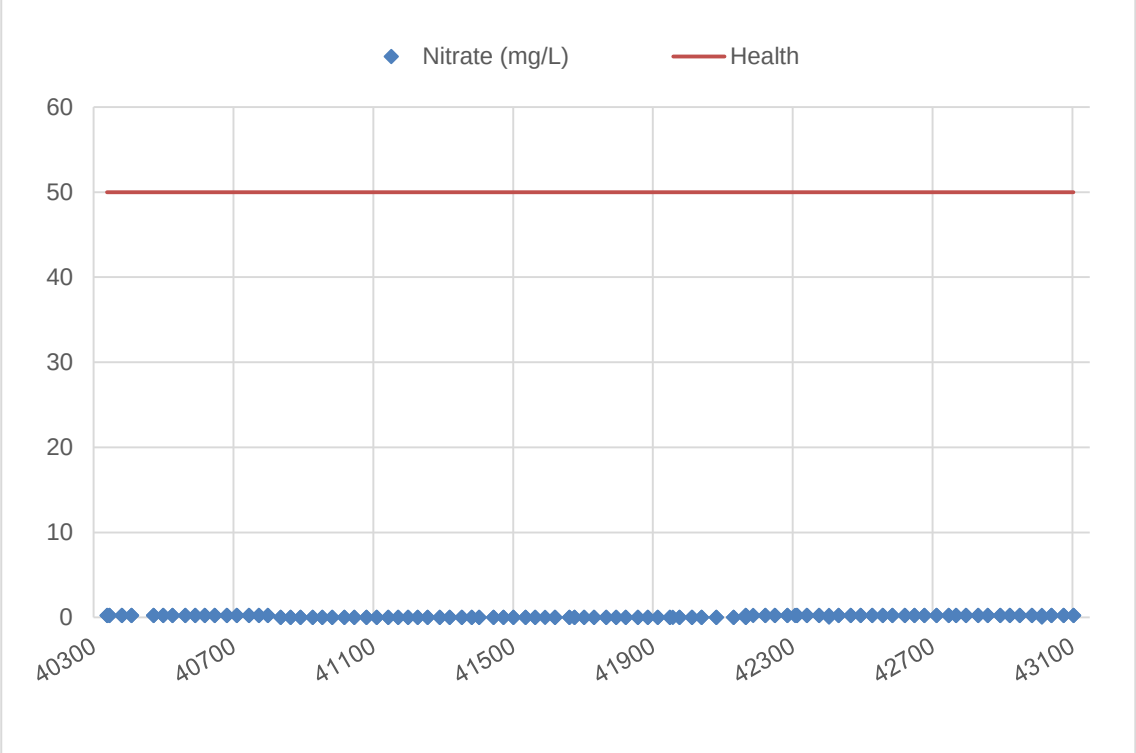


Figure 3.46 Aramac - Sulphate

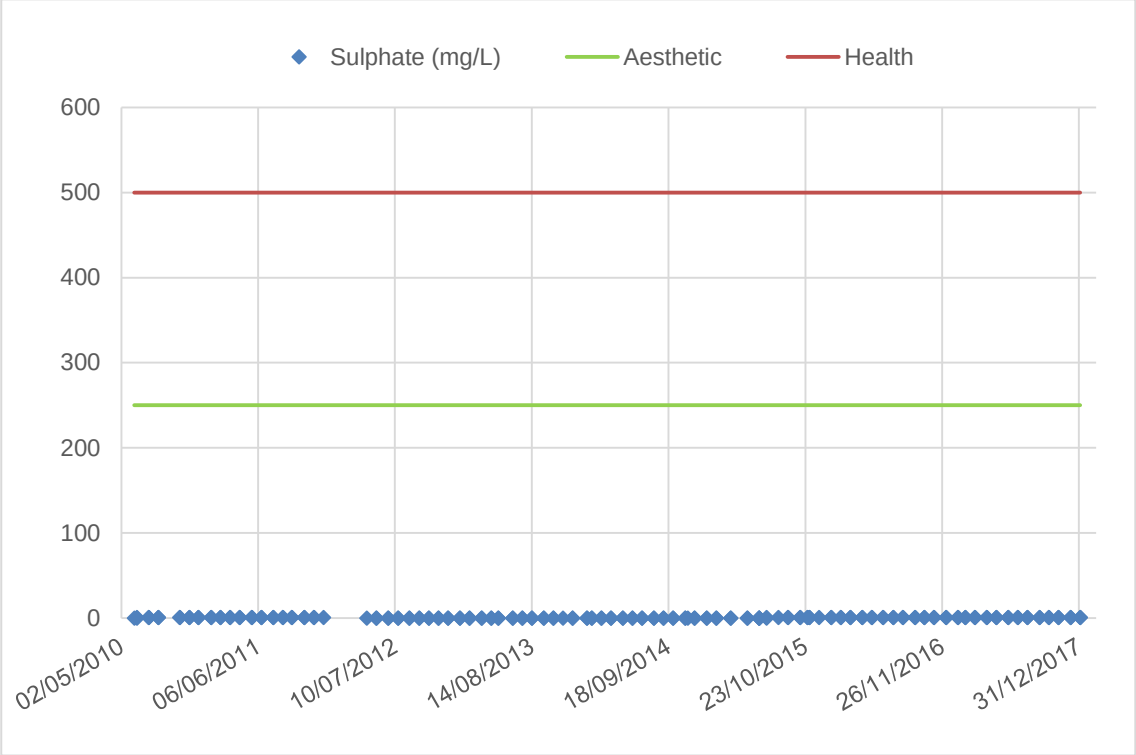


Figure 3.47 Aramac – Iron

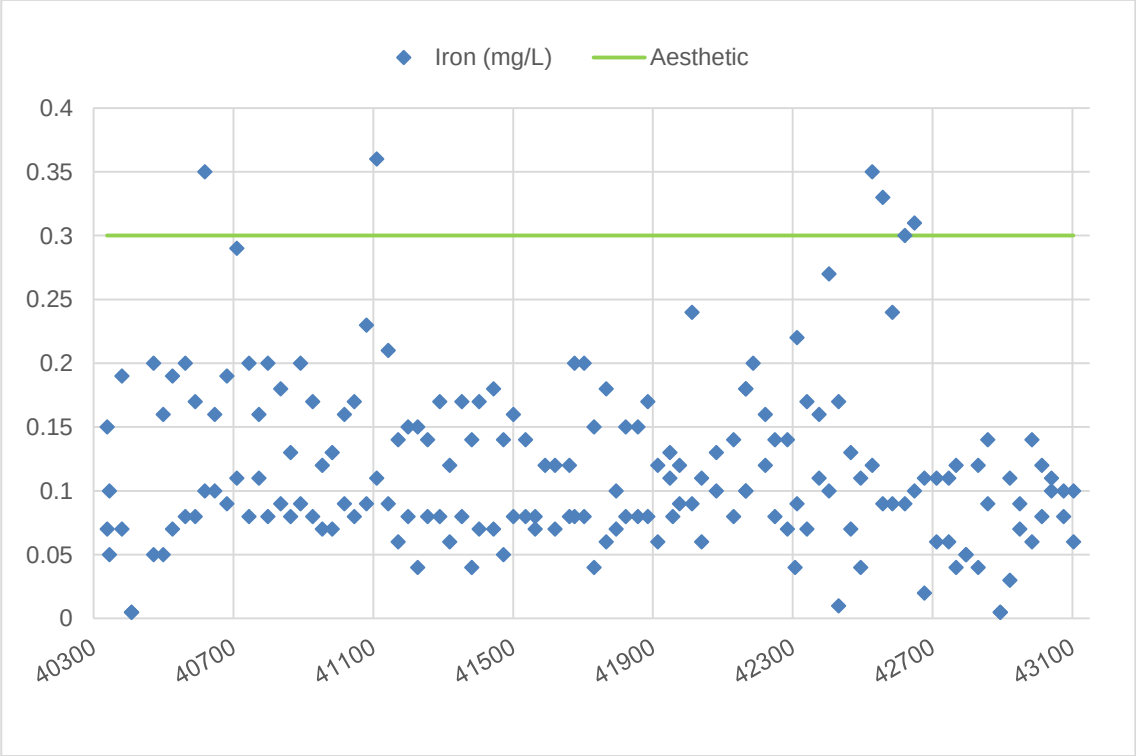


Figure 3.48 Aramac - Manganese

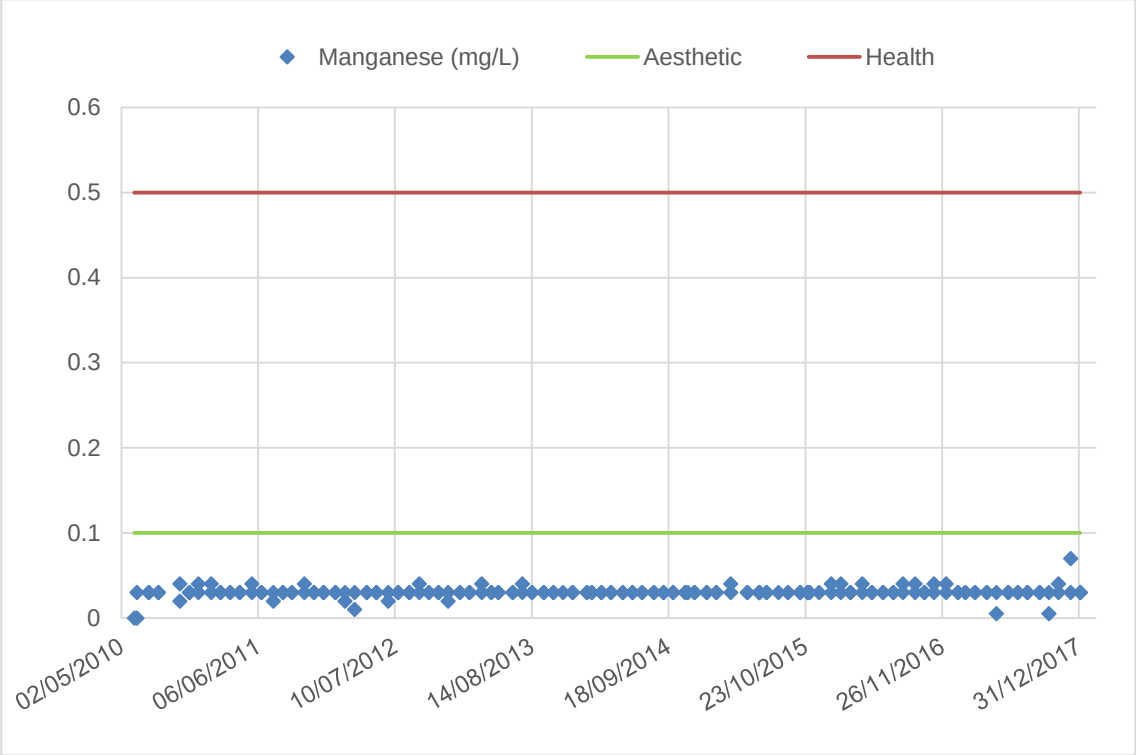


Figure 3.49 Aramac - Zinc

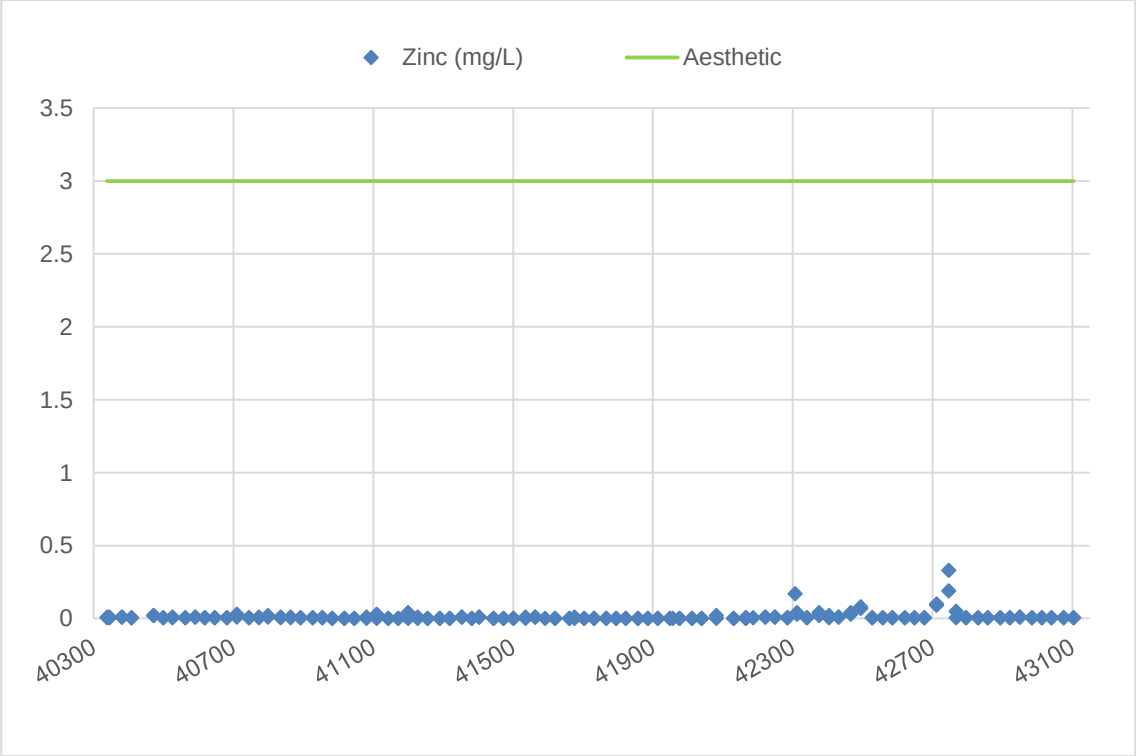


Figure 3.50 Aramac - Aluminium

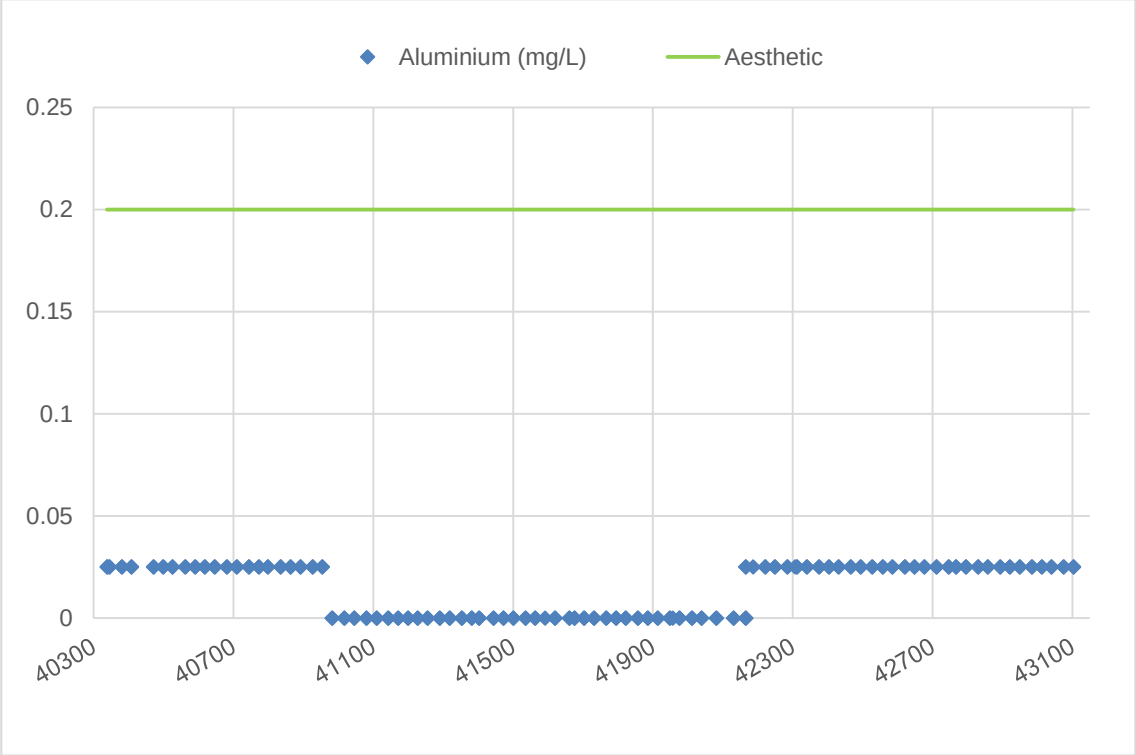


Figure 3.51 Aramac – Boron

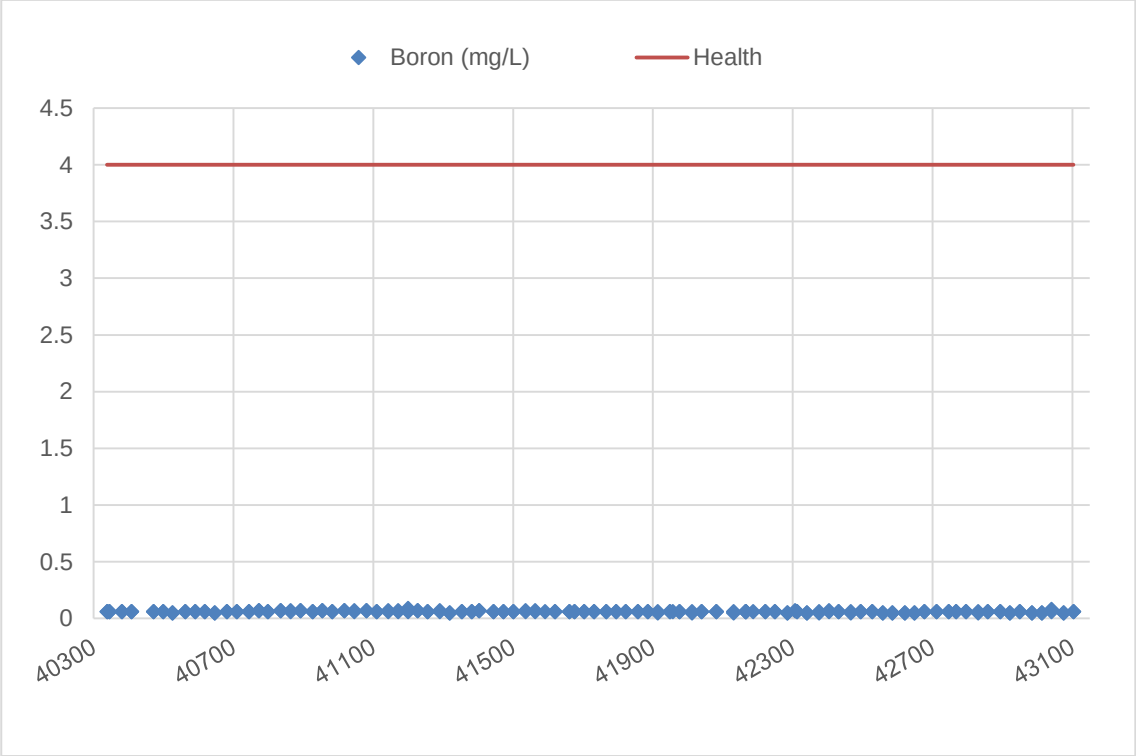


Figure 3.52 Aramac – Copper

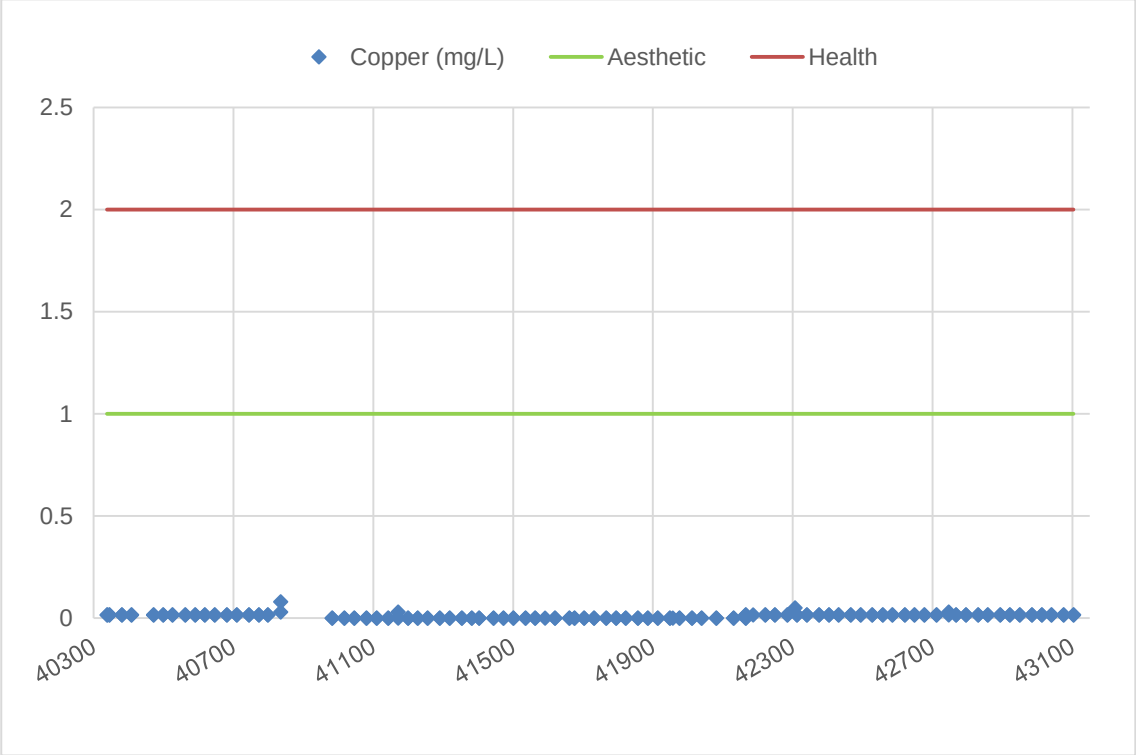
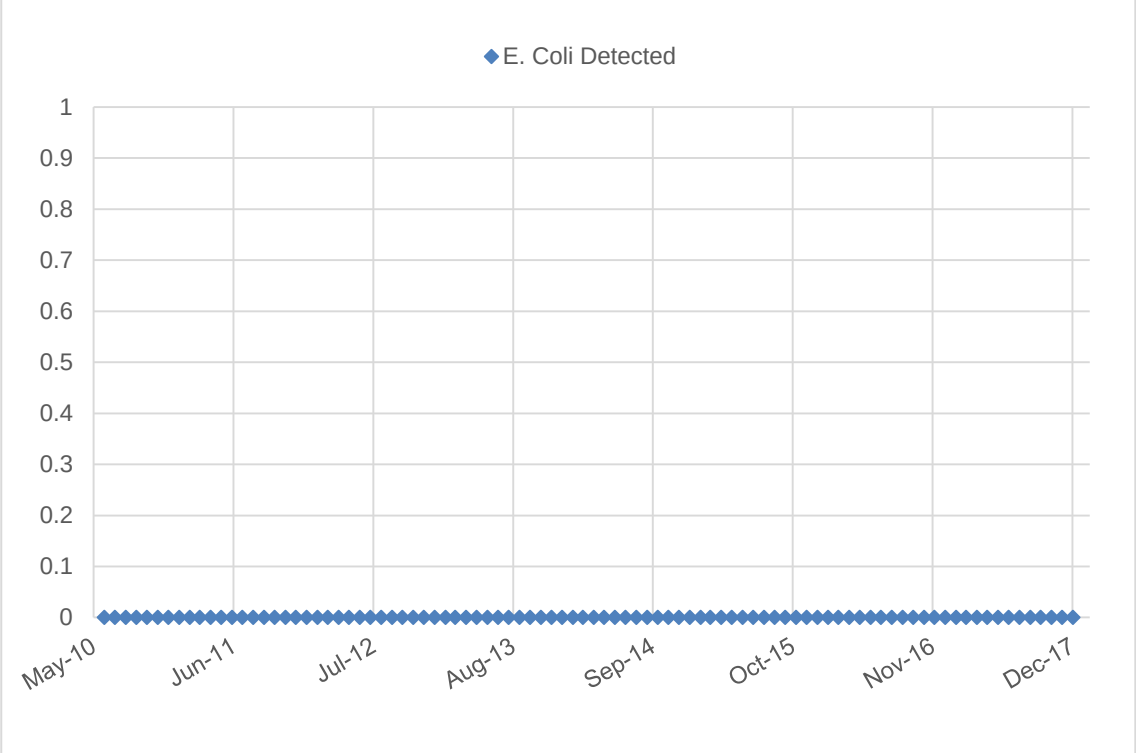


Figure 3.53 Aramac - E. Coli



3.2.1 (b) Interpretation

Table 3.7 above shows aesthetic guideline value exceedances[8] for true colour and iron.

The following aesthetic characteristics were detected (highlighted show exceedances):

- pH
- Hardness
- Silica
- Total Dissolved Solids
- **Colour**
- Turbidity
- Sodium
- Chloride
- **Iron**
- Manganese

The following health characteristics were detected (highlighted shows exceedances):

- Fluoride
- Manganese

Figure 3.40 provides a trend for the analysis of true colour, there were two exceedances. The aesthetic guideline value is 15 HU. For true colour no health based guideline value is considered necessary. A maximum value of 17 HU, average value of 3.6 HU and a 95th percentile of 9.55 HU has been determined. Up to 25 HU is acceptable were turbidity is low, while 15 HU is just noticeable in a glass.

Figure 3.47 provides a trend for the analysis of iron; there was five exceedances. A maximum value of 0.36mg/l, average value of 0.118 mg/l and a 95th percentile value of 0.239mg/l have been determined. The aesthetic guideline value is 0.3mg/l. For iron there is insufficient data to set a guideline value based on health considerations. Iron occurs naturally in water, < 1mg/l but up to 100mg/l in oxygen depleted groundwater. The taste threshold is 0.3mg/l. High concentrations of iron may stain laundry and fittings with iron bacteria causing blockages, taste / odour and corrosion. Iron bacteria, historically, has not been a problem for this water supply.

While there were aesthetic guideline value exceedances, there were no health guideline value[8] exceedances recorded during the period summarised in Table 3.7.

Of three-hundred and ninety-nine (399) samples analysed for E. coli there have been zero E. coli colonies detected (see Figure 3.53).

[8] As per the Australian Drinking Water Guidelines (2004)

3.2.2 Catchment Characteristics

Aramac is located 67 km north of Barcaldine on the northern side of the Aramac Creek in the Thompson River catchment. Aramac Creek runs into the Thompson River midway between Longreach and Muttaburra. Aramac is located on gently undulating black soil terrain.

The average annual rainfall for Aramac is 497mm[9]. With the majority of the rain falling between late December and late March with little or no rainfall during any other period. The mean maximum temperature is 30.4°C[9] although temperatures often exceed the 40°C mark during the summer months. The average annual pan evaporation for Aramac is approximately 2,800mm[10]. Aramac has a current population of 299 permanent residents and has a current demand of 0.73 Ml/day. The town and water supply infrastructure is not prone to flooding.

Aramac is located in the prominent Central Western Queensland beef and wool producing area. Whilst cattle and sheep grazing are the main industries, road infrastructure construction and maintenance also contributes significantly to provide a stable employment base for the area. Tourism is also a significant industry within the town with attractions such as the Aramac Tramway Museum, Grey Rock (Cobb & Co. staging area), Lake Dunn and Lake Galilee. Tourism numbers can sometimes place major demand on the town's reticulation system.

The Great Artesian Basin (GAB) covers approximately one-fifth of the Australian continent and contains 8.7 x 10^6 GL of groundwater in the Jurassic sandstone aquifers. It is the largest groundwater and artesian basin in the world. The basin is located under mostly arid and semi-arid landscapes to the west of the Great Dividing Range. The GAB supports a wide array of activities such as pastoral, agriculture and mining as well as the rural communities, cultural and tourism activities. In the Barcaldine area the capping of existing free flowing aquifers has improved the pressure in the main town aquifers. The GAB is recharged by rainfall and stream flow infiltrating into the exposed sandstone on the edges of the basin. One of the first drilling locations of the GAB occurred in 1887 in Barcaldine, comprising of a free flowing artesian Bore.

Currently there are two bores in Aramac. Bore No 1 (RN 7121) and Bore No 2 (RN 51753). Figure 3.54 shows the recharge, discharge and flow of the GAB and Barcaldine's relative location in relation to the GAB. The town bores 1 and 2 are located on the eastern and western ends of Kerr Street. Bores 1 and 2 are 366m and 362m deep respectively. The bores currently yield 22.7 l/s and 29.1 l/s respectively. Bore No. 1 is free flowing, while Bore No. 2 is pumped. Bore 1 was drilled in 1933 and Bore No. 2 was drilled in 1983. All bore headworks are sealed against the possibility of deliberate contamination. Appendix B Figure M-2012-004 shows the bore locations and water reticulation layout on an aerial photo of the town. Appendix C contains a copy of the bore card reports obtained from Department of Environmental & Resource Management.

Aramac sewerage collection scheme is comprised of a conventional gravity mains collection system with pumped rising main to a trickling filter treatment plant. The treatment plant is comprised of one imhoff tank, one trickling filter, four effluent holding lagoons, sludge drying beds and an evaporation pond. Effluent from the ponds is discharged to a drain at Aramac Creek where it generally evaporates before it reaches the creek. Sludge's are captured, dried and disposed of separately. The ground water sources show no indication of contamination from the sewage treatment plant. The artesian bores have been annuli sealed off to prevent contamination from surface water leachate. Currently effluent is not reused however this may be reviewed in the future.

[9] 30 year mean at Barcaldine Post Office (nearest available climate statistics)
[10] DPI Water Resource's Commission

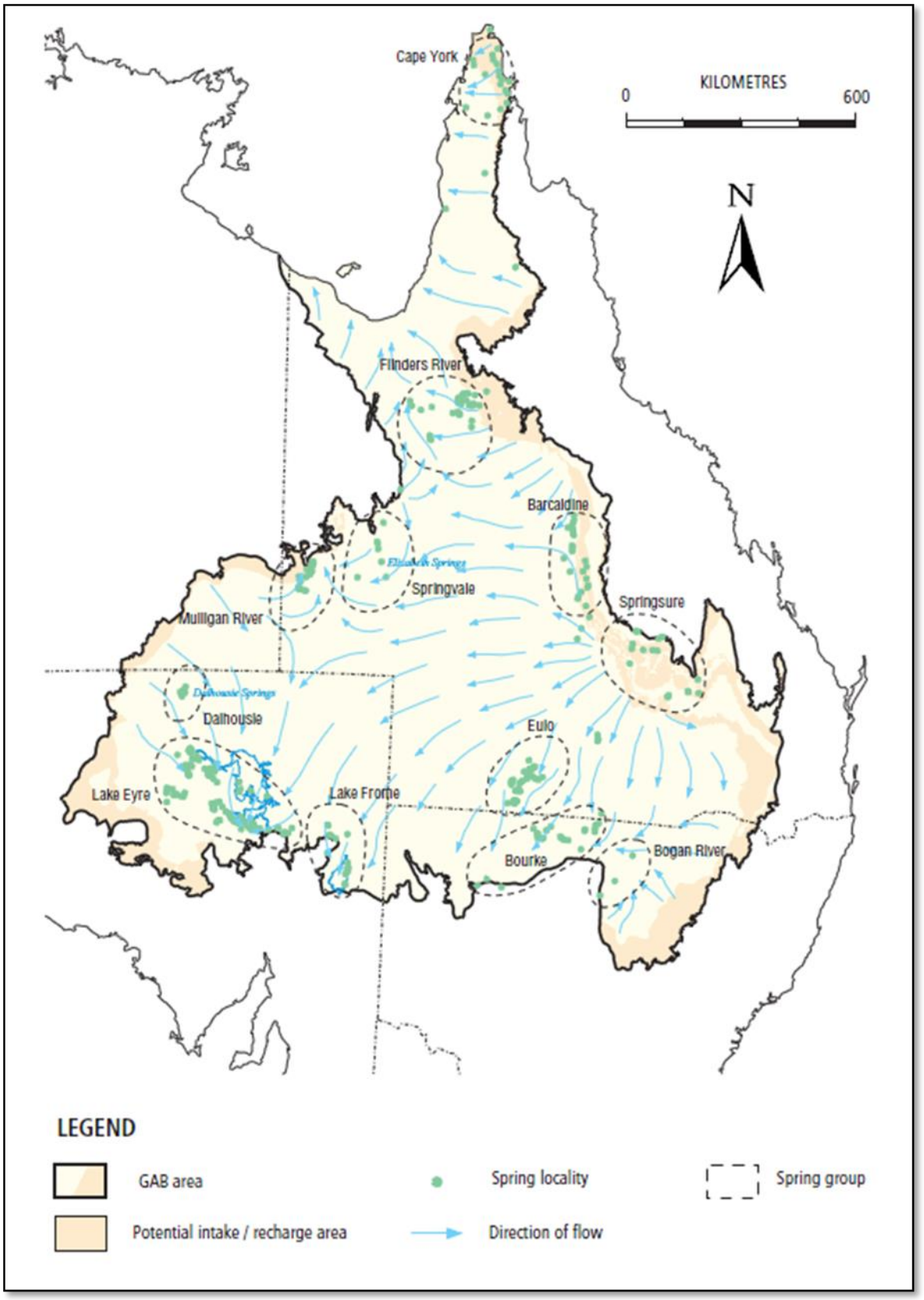


Figure 3.54 GAB Recharge, Discharge and Flow[11]

[11] Great Artesian Basin, Resource Study Summary, Great Artesian Basin Consultative Council

3.2.3 Hazard Identification

The hazards and hazardous events and their sources that adversely affect water quality are documented in Table 3.22 below and include those affecting:

- Catchment
- Sourcing infrastructure
- Treatment plants (where applicable)
- Disinfection process(es) (where applicable)
- Distribution system

3.2.3 (a) Identifying and documenting hazards and hazardous events

The hazards and hazardous events were identified using data contained in the plan and following site visits and a risk assessment workshop which was conducted on 8 and 9 November 2011. A more recent risk assessment workshop was conducted in December 2017 prior to amendment of the plan;

- Section 2.2 Aramac Water Supply Scheme
- Section 3.2.1 Water quality information
- Section 3.2.2 Catchment Characteristics

Table 3.9 Aramac Hazard Identification, Risk Assessment and Uncertainty

Scheme Component / Sub-component	Hazardous Event	Hazard	Maximum Risk			Existing Preventive Measures / Barriers.	Residual risk			Uncertainty	Comments/ Proposed Further Risk Reduction Actions
			Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
Bore	Sewage system discharges, agricultural run-off	Bacteria	Moderate	Rare	Low (3)	Nil	Moderate	Rare	Low (3)	Reliable	Acceptable risk, continue to monitor for exceedances
	Hazard that arises from the natural geological processes in the aquifer	Iron	Insignificant	Rare	Low (1)	Nil	Insignificant	Rare	Low (1)	Reliable	
		True Colour	Insignificant	Rare	Low (1)	Nil	Insignificant	Rare	Low (1)	Reliable	
Sourcing Infrastructure	High demand during peak tourism	Low pressure	Moderate	Rare	Low (3)	Nil	Moderate	Rare	Low (3)	Reliable	Acceptable risk
	Accidental or intentional contamination	Harmful substances (not identified)	Catastrophic	Unlikely	High (10)	Restricted access to bore sites	Catastrophic	Rare	Medium (6)	Uncertain	**Acceptable risk**
Treatment Plant	Reticulated Water Untreated										
Disinfection Process	Reticulated Water Not Disinfected										
Distribution System	Reticulation maintenance and repair	Bacteria	Moderate	Rare	Low (3)	Mains repair procedure and Monitoring	Moderate	Rare	Low (3)	Uncertain	**ABM1** Operational & Maintenance Procedures
	Expired Mains	Bacteria	Catastrophic	Unlikely	High (10)	Mains replacement priority layout plan to replace expired mains.	Catastrophic	Unlikely	High (10)	Uncertain	**ABM2** Replace ageing mains in accordance with asset replacement program. Continue to apply for internal & external funding.
	Dead ends	Bacteria	Catastrophic	Unlikely	High (10)	Routine flushing	Catastrophic	Rare	Medium (6)	Uncertain	**ABM3** Create flushing schematic layout to go with the SOP Air scouring every 5 years. Mains replacement including reconfiguration of layout to improve flow.
Whole of System	Flights carrying samples to lab delayed/cancelled	Logistical	Insignificant	Possible	Low (3)	Nil	Insignificant	Possible	Low (3)	Confident	Acceptable risk

3.2.3 (b) Hazard Identification (and Risk Assessment) Team

The personnel responsible for the hazard identification and risk assessment process, their roles and responsibilities are detailed in the Table below.

Table 3.10 Hazard Identification and Risk Assessment Team

Typical Job Title for Key Personnel	What Role Did Each Person Play On the Team?	What Expertise and System Knowledge Did the Person Bring?
Manager of Engineering Services	Management of DWQMP Process, Risk Assessment Procedure & Chairing Risk Assessment Workshop	High level knowledge, risk assessment and identification, general engineering experience in the management of the systems
Engineer (Internal / External)	Author, Risk Assessment, Risk Assessment Workshop	Detailed knowledge of the system, water risk assessment and identification
Water Engineer (Internal / External)	Risk Assessment Workshop	Detailed knowledge of drinking water quality management, outside perspective, risk assessment and identification
Water / Technical Officers	Risk Assessment Workshop	Detailed knowledge of individual schemes, risk identification

3.3 Barcaldine Water Quality and Catchment Characteristics

Barcaldine water supply is composed of two sub artesian bores. Pomona and Acacia Street bores are pumped into a ground level reservoir and then pumped directly into reticulation. The Acacia Street bore may bypass the ground level reservoir and pump directly into reticulation if required. The source water is not treated prior to reticulation.

3.3.1 Water quality information

Water quality information for Barcaldine includes the following:

(a) Summary
(b) Interpolation

3.3.1 (a) Summary

Table 3.11 below summarises the available reticulated water quality for the Barcaldine water supply scheme.

Figure 3.55 to Figure 3.72 below show trends of the main parameters contained in Table 3.11. The responsibility for obtaining the water samples rests with the DWSP and samples are collected by the Water Officer fortnightly. Samples are sent to Queensland Health Scientific Services for analysis. The DWSP also samples and analyses drinking water for E. coli.

Table 3.11 Barcaldine Reticulated Water

Barcaldine Water Supply		Start Date	15/06/1998		End Date:	03/01/2018				
Characteristic	**Units**	**No. of Samples**	**Summary of Results**					**Guideline Value**		
			Maximum Value	**Average Value**	**Minimum Value**	**Std Dev**	**95th Percentile**	**Health**	**Exceedances**	**Aesthetic**	**Exceedances**
Conductivity	uS/cm	420	710.000	406.393	355.000	47.858	437.000				
pH		420	8.810	8.316	7.960	0.129	8.480			≥6.5 & ≤ 8.5	15
Total Hardness	mg/L as CaCO3	420	312.000	11.237	4.800	14.952	16.000			200	1
Temporary Hardness	mg/L as $CaCo_3$	420	19.500	10.523	4.800	2.768	15.525			200	0
Alkalinity	mg/L $CaCo_3$	420	270.000	121.834	2.400	51.571	151.000				
Residual Alkalinity	meq/L	420	146.000	22.109	2.400	47.761	139.050				
Silica	mg/L	420	26.000	22.945	2.300	1.863	24.000			80	0
Total Dissolved Ions	mg/L	420	560.000	302.420	3.100	50.309	330.100				
Total Dissolved Solids	mg/L	420	430.000	242.583	32.000	31.237	263.150			600	0
True Colour	Hazen	419	33.000	2.179	<0.1	3.562	7.000			15	5
Turbidity	NTU	420	250.000	1.594	<0.1	13.819	1.000			5	6
pH (Saturation)*		420	9.300	8.728	8.200	0.133	8.900				
Saturation Index		420	0.300	-0.412	-1.100	0.158	-0.100				
Mole Ratio		420	1.900	1.505	1.000	0.143	1.700				
Sodium Absorption Ratio		420	163.000	11.992	8.600	7.580	14.000				
Figure of Merit		420	0.100	0.053	0.000	0.050	0.100				
Sodium	mg/L	420	160.000	85.386	78.000	11.550	92.000			180	0
Potassium	mg/L	420	3.800	2.706	1.600	0.749	3.600				
Calcium	mg/L	420	6.700	3.881	1.800	0.946	5.600				
Magnesium	mg/L	419	0.900	0.214	0.010	0.135	0.400				
Hydrogen	mg/L	420	6.400	0.015	0.000	0.312	0.000				
Bicarbonate	mg/L	420	320.000	167.505	153.000	22.371	181.000				
Carbonate	mg/L	420	6.200	2.146	0.900	0.721	3.205				
Hydroxide	mg/L	420	0.100	0.006	0.000	0.024	0.100				
Chloride	mg/L	420	73.000	38.535	0.600	5.365	42.050			250	0
Fluoride	mg/L	418	1.230	0.246	0.020	0.111	0.300	1.5	0		
Nitrate	mg/L	420	3.100	0.363	<0.5	0.237	0.600	50	0		
Sulphate	mg/L	420	14.500	4.519	0.500	1.170	5.700	500	0	250	0
Iron	mg/L	419	1.300	0.049	<0.01	0.085	0.100			0.3	8
Manganese	mg/L	419	0.100	0.016	<0.01	0.012	0.030	0.5	0	0.1	0
Zinc	mg/L	420	20.000	0.061	<0.01	0.975	0.030			3	1
Aluminium	mg/L	419	0.060	0.025	<0.05	0.003	0.025			0.2	0

Barcaldine Water Supply		Start Date 15/06/1998			End Date: 03/01/2018						
Characteristic	Units	No. of Samples	Summary of Results					Guideline Value			
			Maximum Value	Average Value	Minimum Value	Std Dev	95th Percentile	Health	Exceedances	Aesthetic	Exceedances
Boron	mg/L	420	0.500	0.049	<0.02	0.072	0.101	4	0		
Copper	mg/L	420	0.080	0.016	<0.03	0.007	0.025	2	0	1	0
E. coli		992	0.000	0.000	0.000	0.000	0.000	0	0		

Aesthetic Guideline Exceedance
Health Guideline Exceedance

Table 3.12 Water quality complaints

Year	No of Water Quality Complaints	Water Quality Complaints per 1000 Connections	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2018	2	2.4	Colour	Pipes / reservoir needing scouring	Scour reservoir
2017	5	5.9	Colour	Pipes / reservoir needing scouring	Scour reservoir
2016	7	8.3	Colour, Turbidity	Pipes / reservoir needing scouring	Scour reservoir
2015	No Data				
2014					
2013					
2012					
2011	6	7.1	Colour	Pipes / reservoir needing scouring	Scour reservoir
2010	9	10.7	Colour	Pipes / reservoir needing scouring	Scour reservoir
2009	16	19.0	Colour	Pipes / reservoir needing scouring	Scour reservoir

Figure 3.55 Barcaldine- pH at 23°C

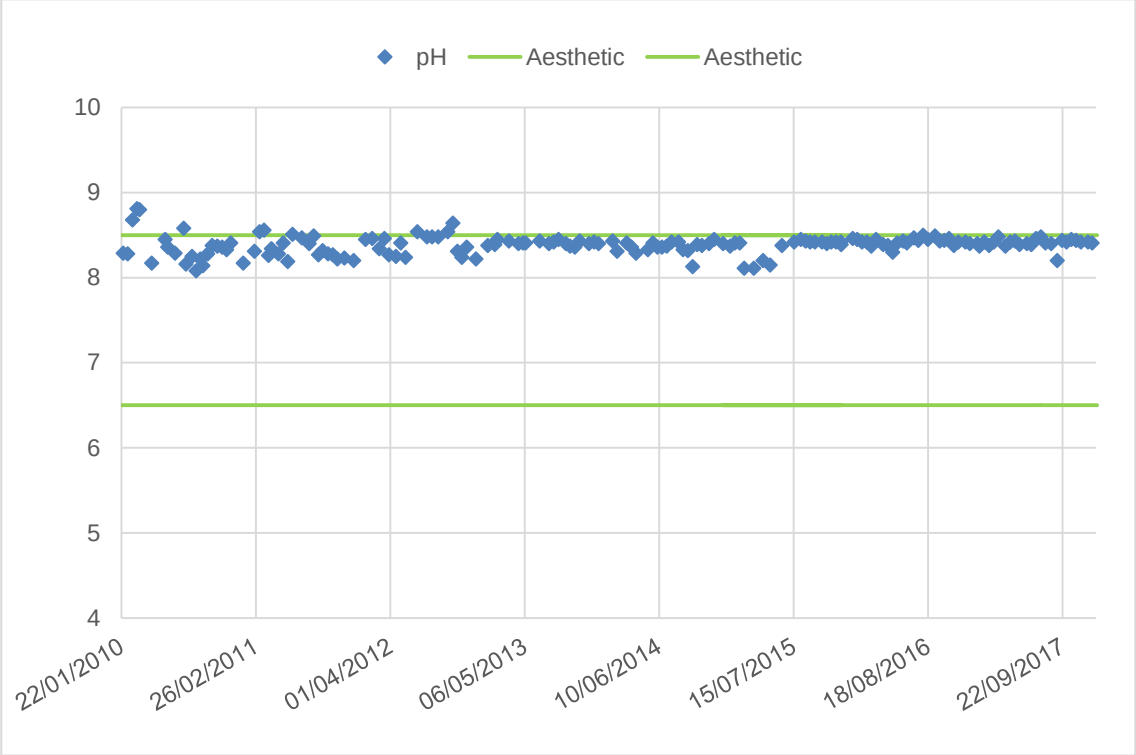


Figure 3.56 Barcaldine- Total Hardness

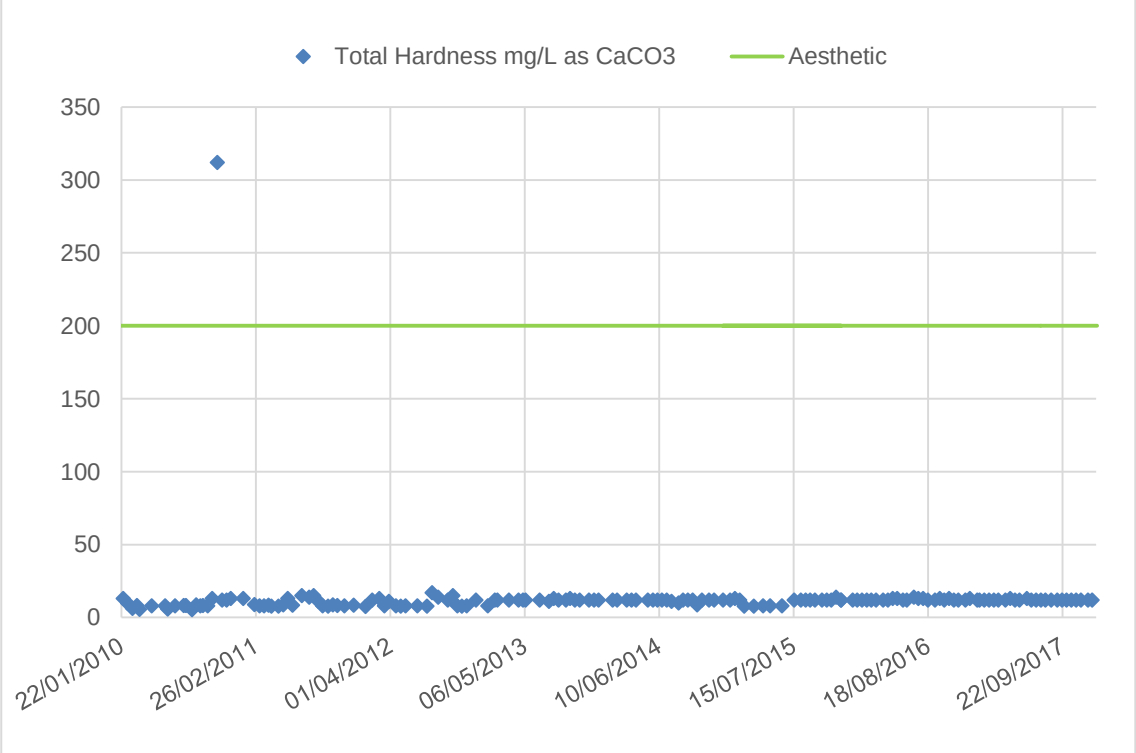


Figure 3.57 Barcaldine- Silica

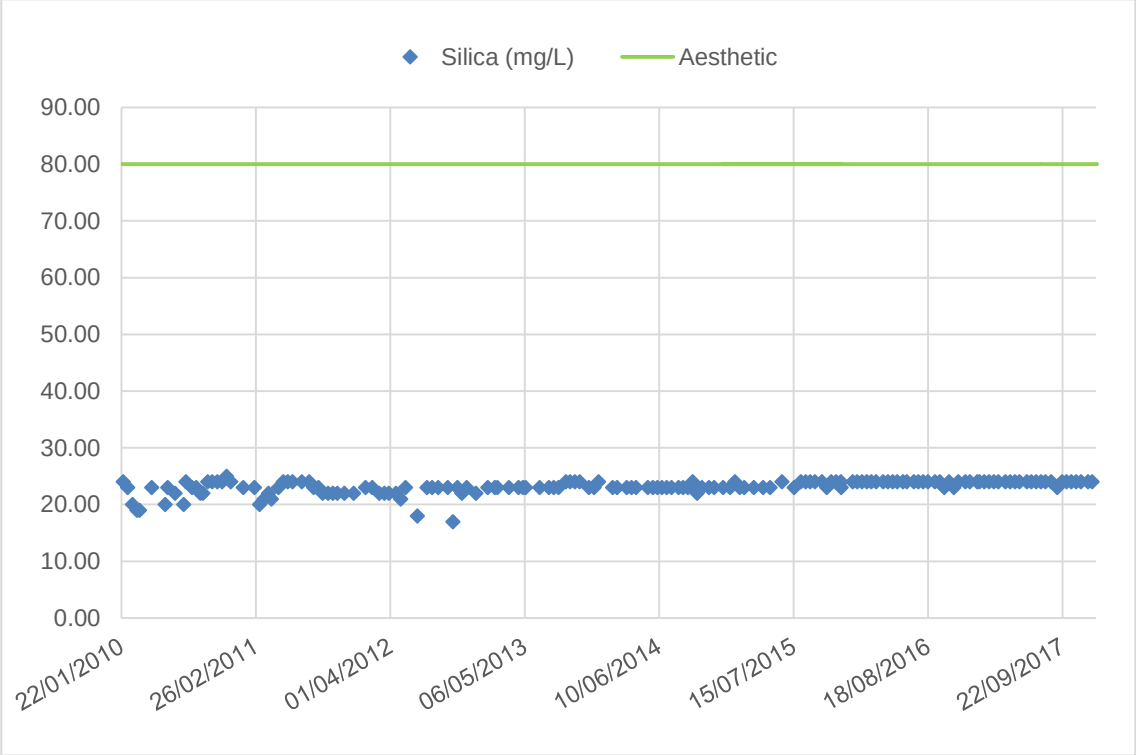


Figure 3.58 Barcaldine- Total Dissolved Solids

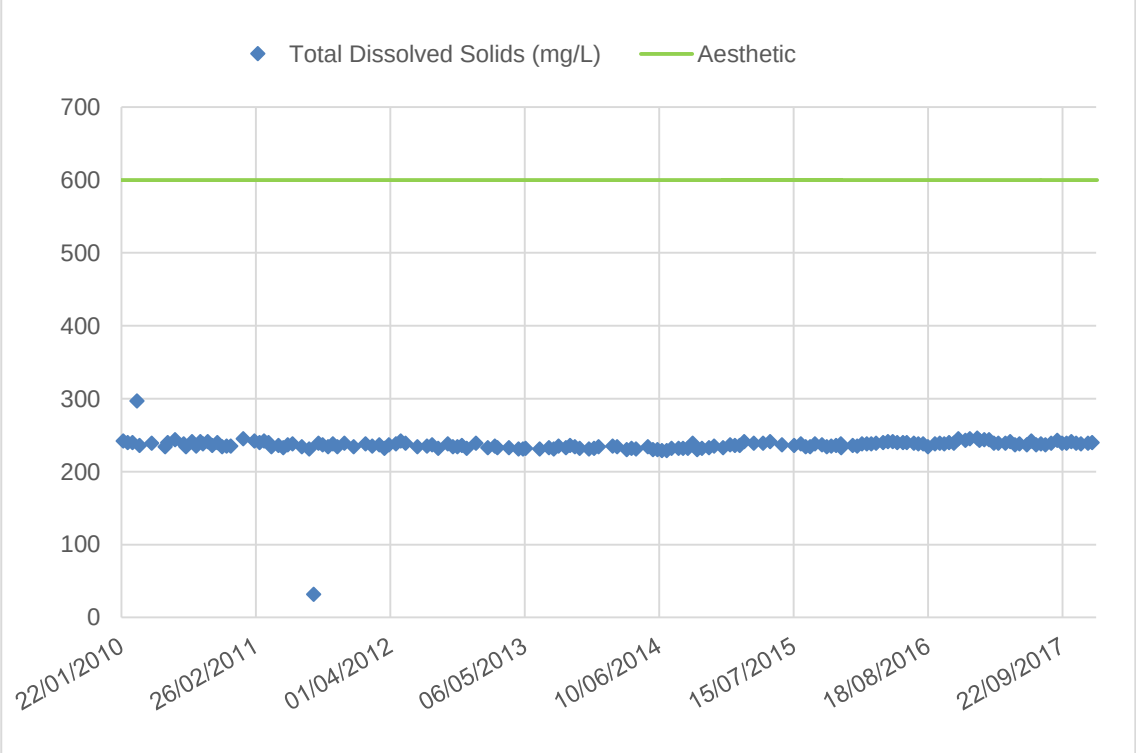


Figure 3.59 Barcaldine- True Colour

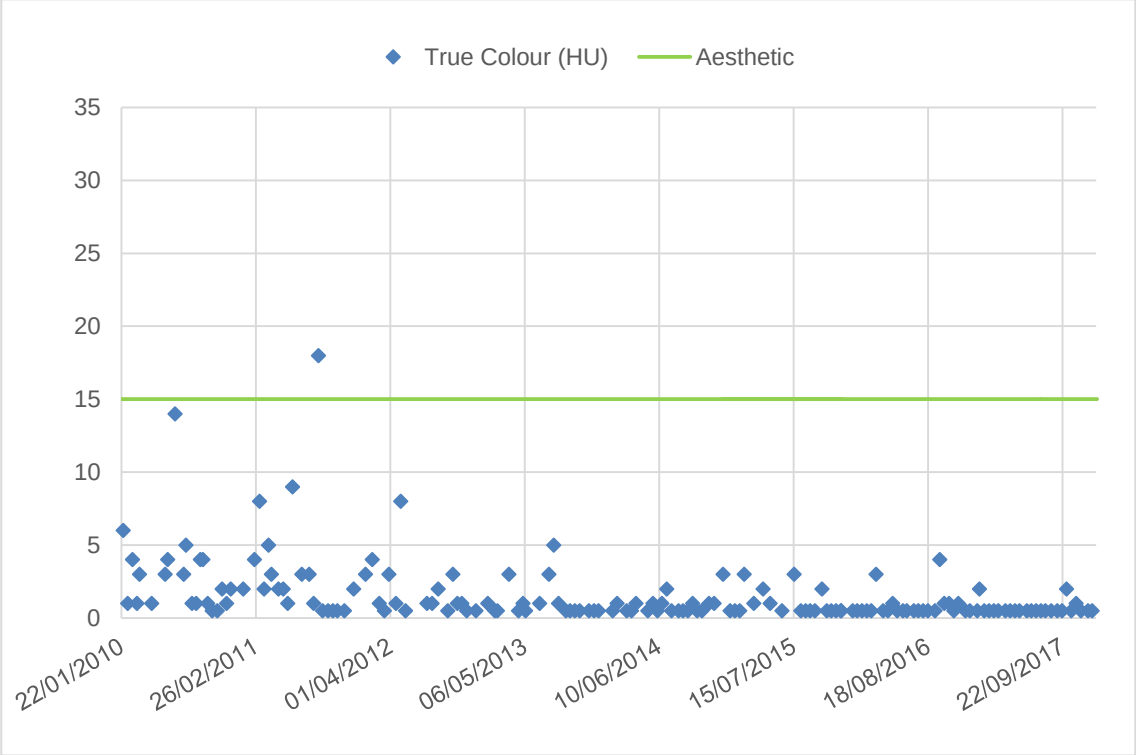


Figure 3.60 Barcaldine- Turbidity

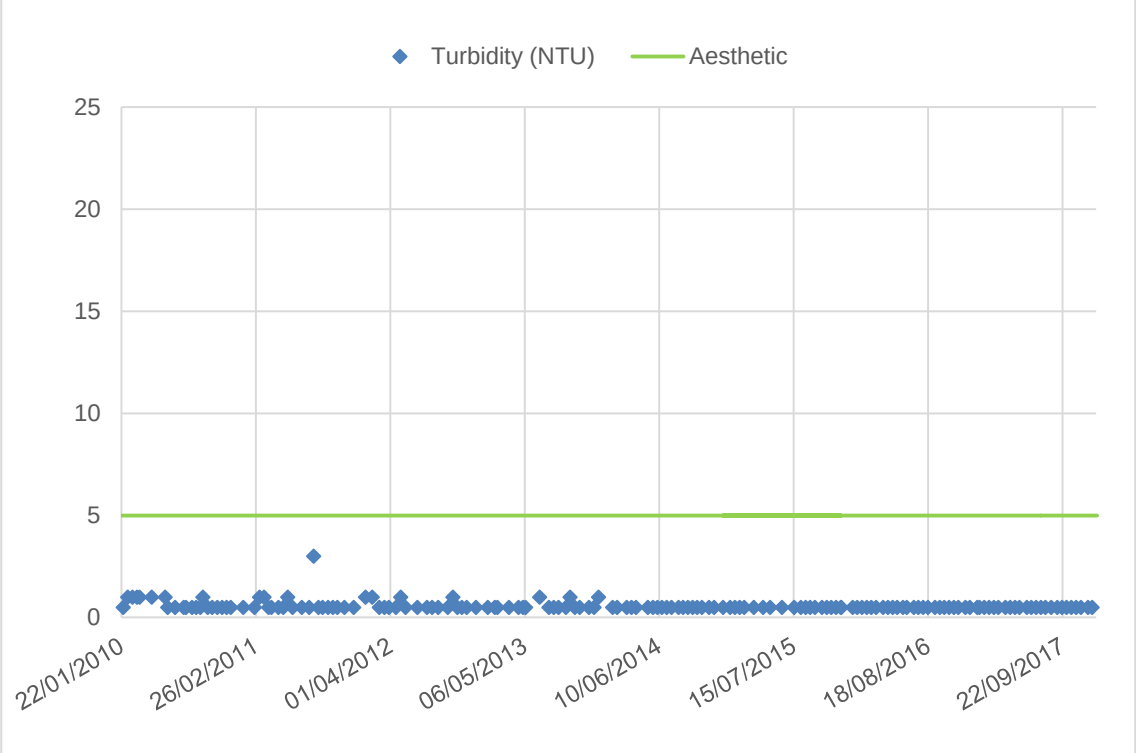


Figure 3.61 Barcaldine- Sodium

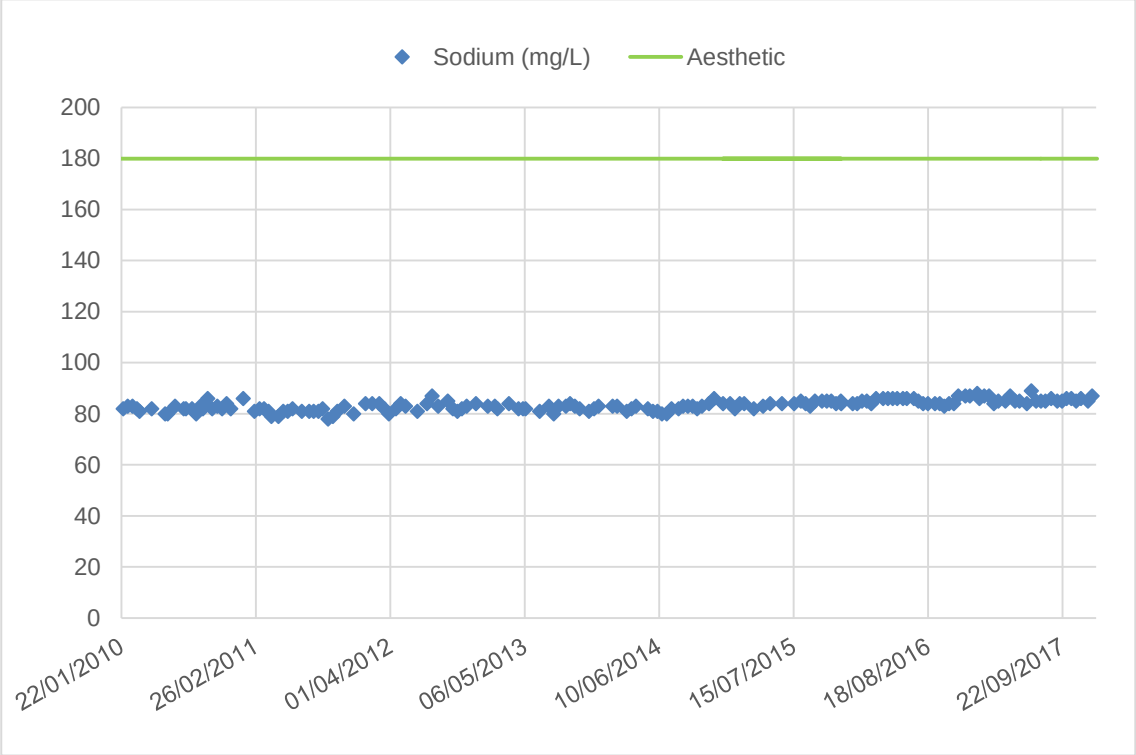


Figure 3.62 Barcaldine- Chloride

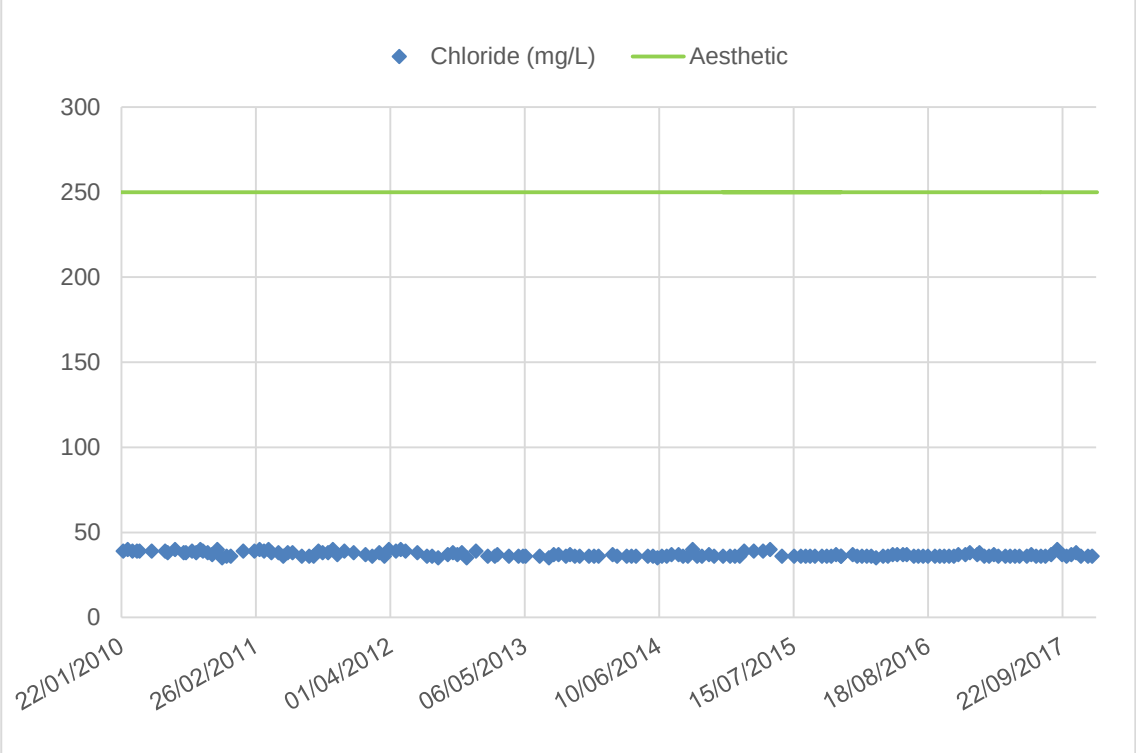


Figure 3.63 Barcaldine- Fluoride

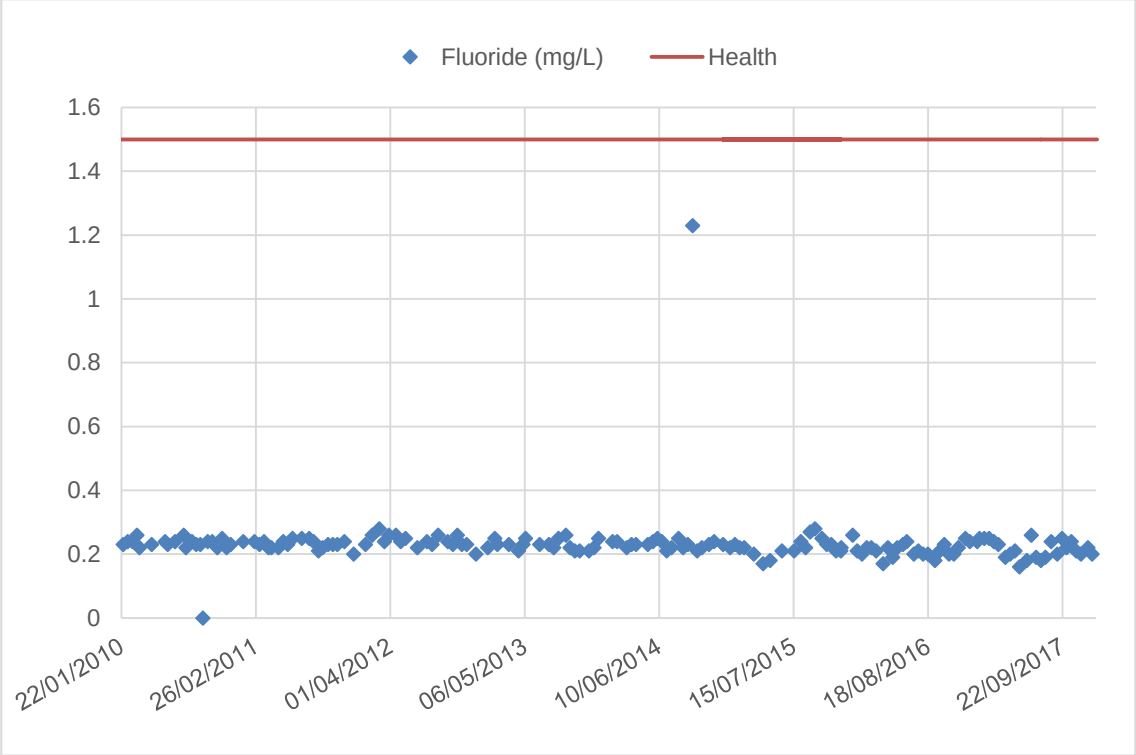


Figure 3.64 Barcaldine- Nitrate

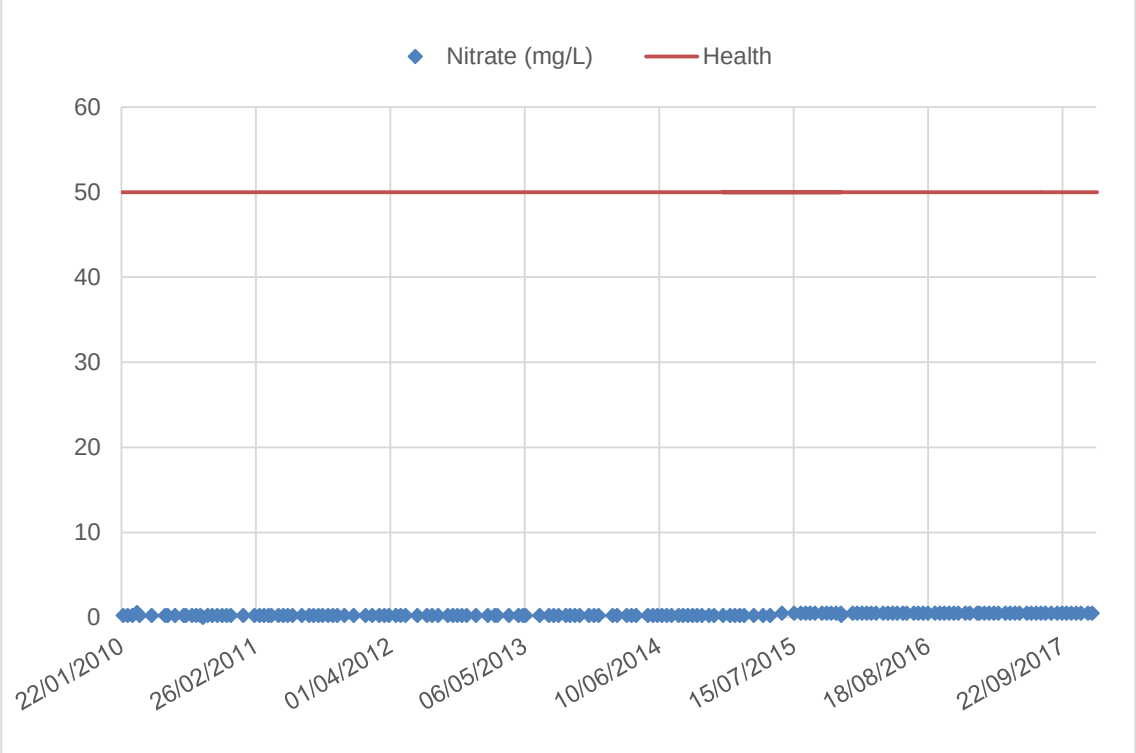


Figure 3.65 Barcaldine- Sulphate

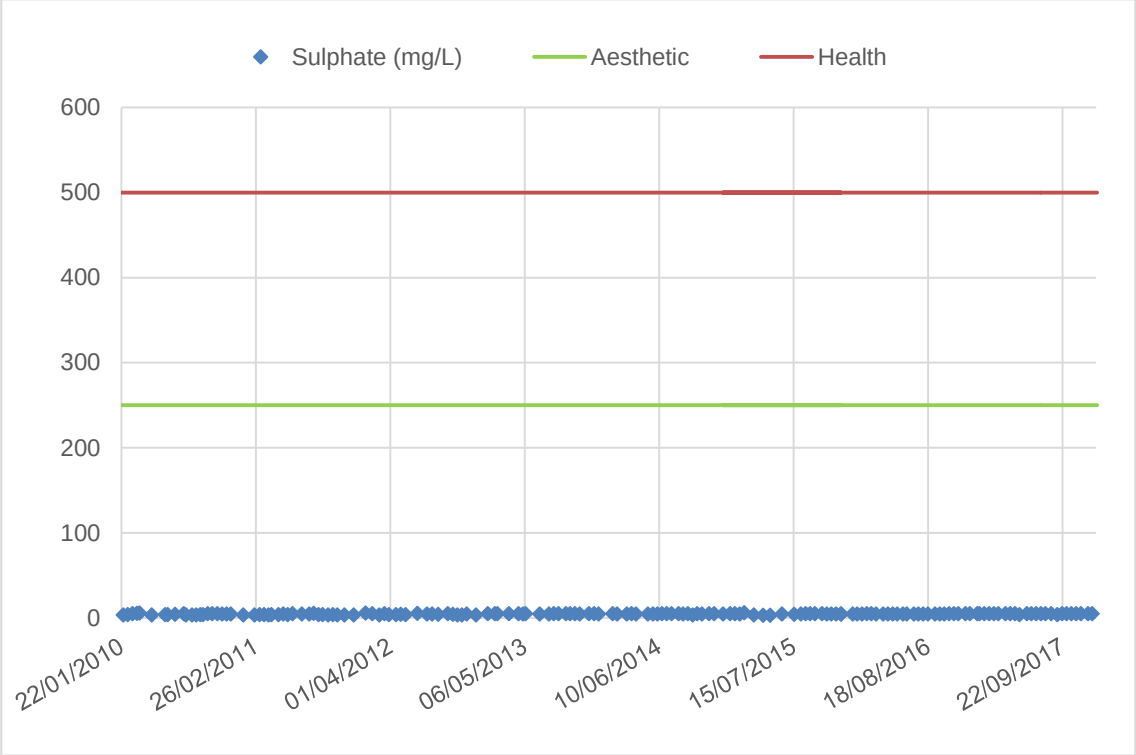


Figure 3.66 Barcaldine- Iron

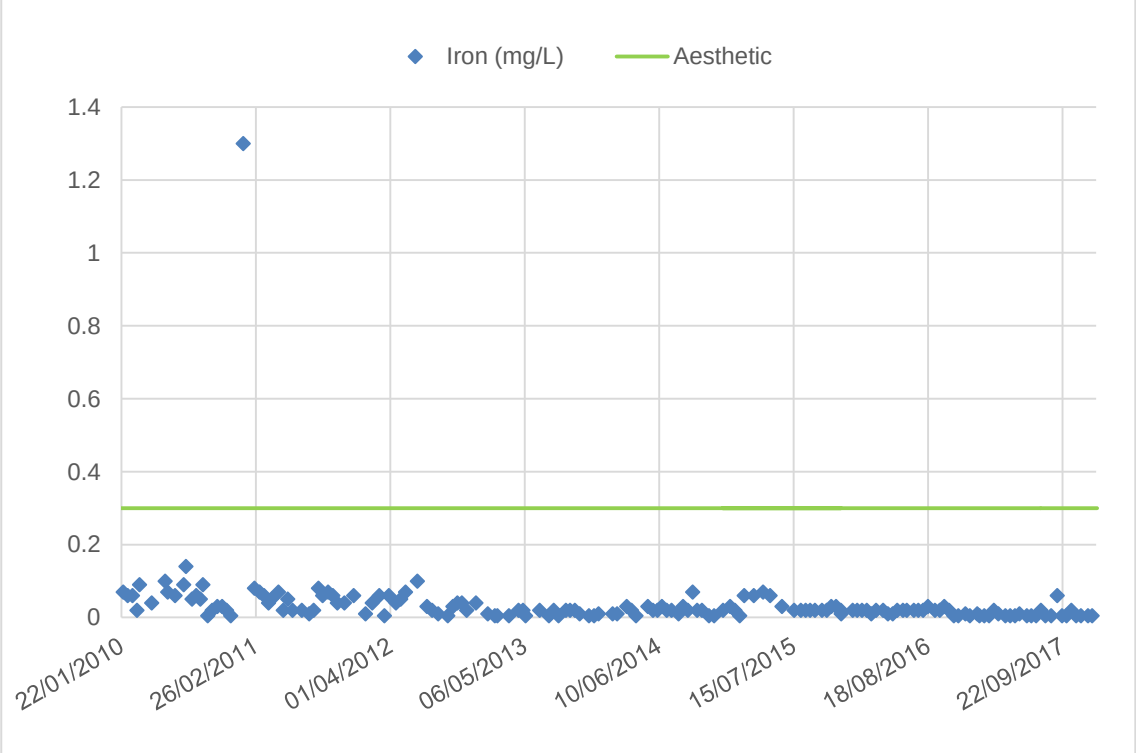


Figure 3.67 Barcaldine- Manganese

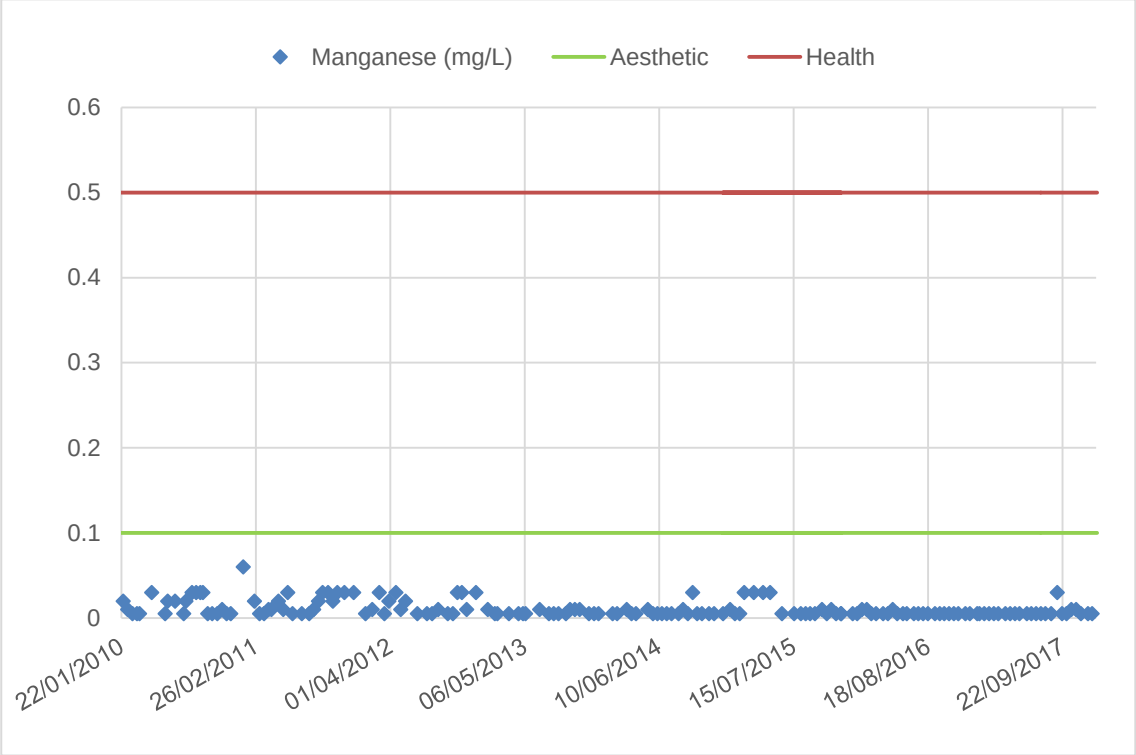


Figure 3.68 Barcaldine- Zinc

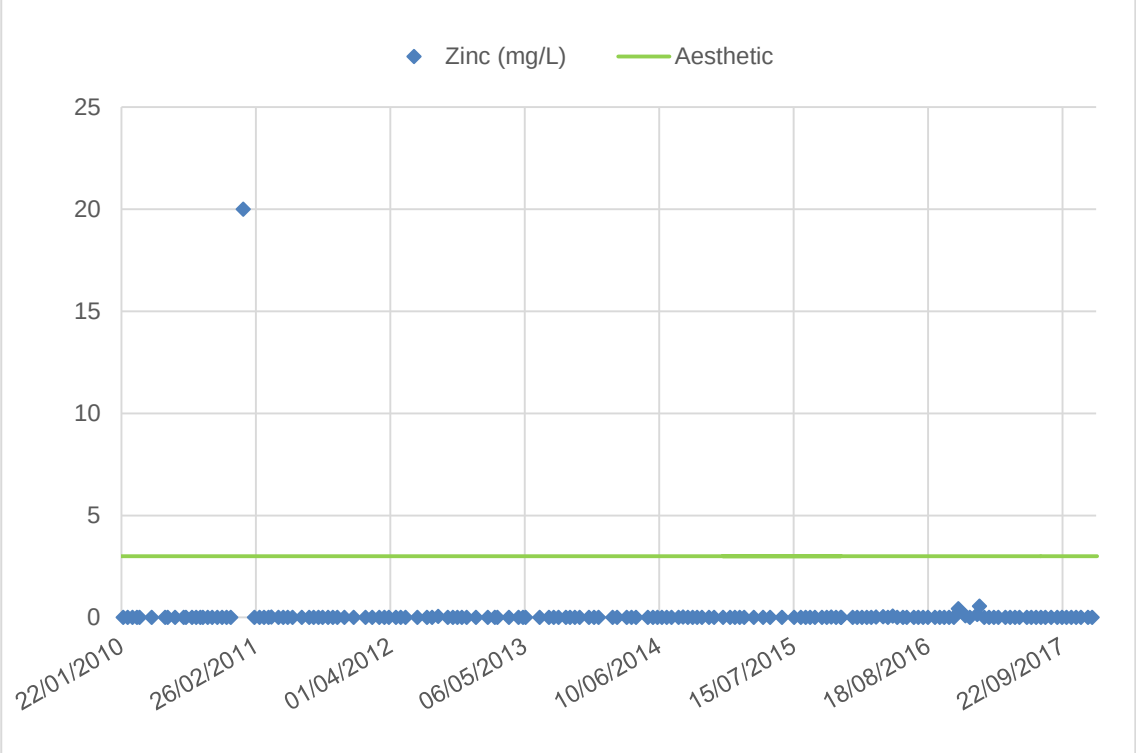


Figure 3.69 Barcaldine- Aluminium

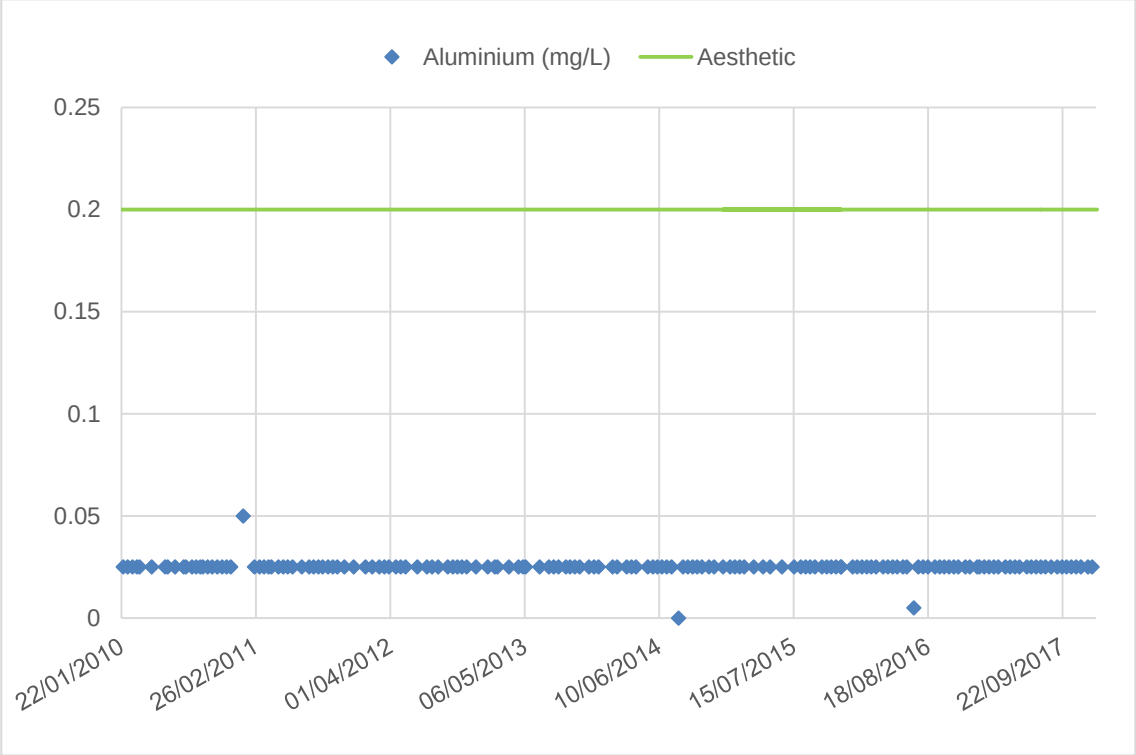


Figure 3.70 Barcaldine- Boron

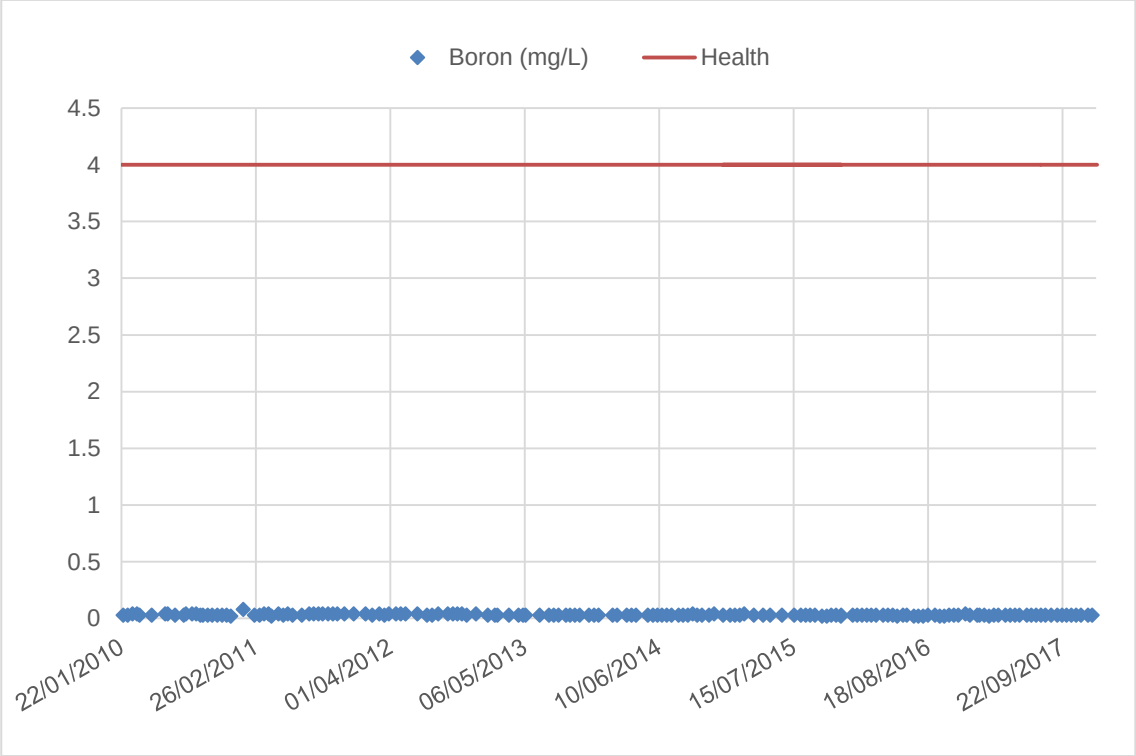


Figure 3.71 Barcaldine- Copper

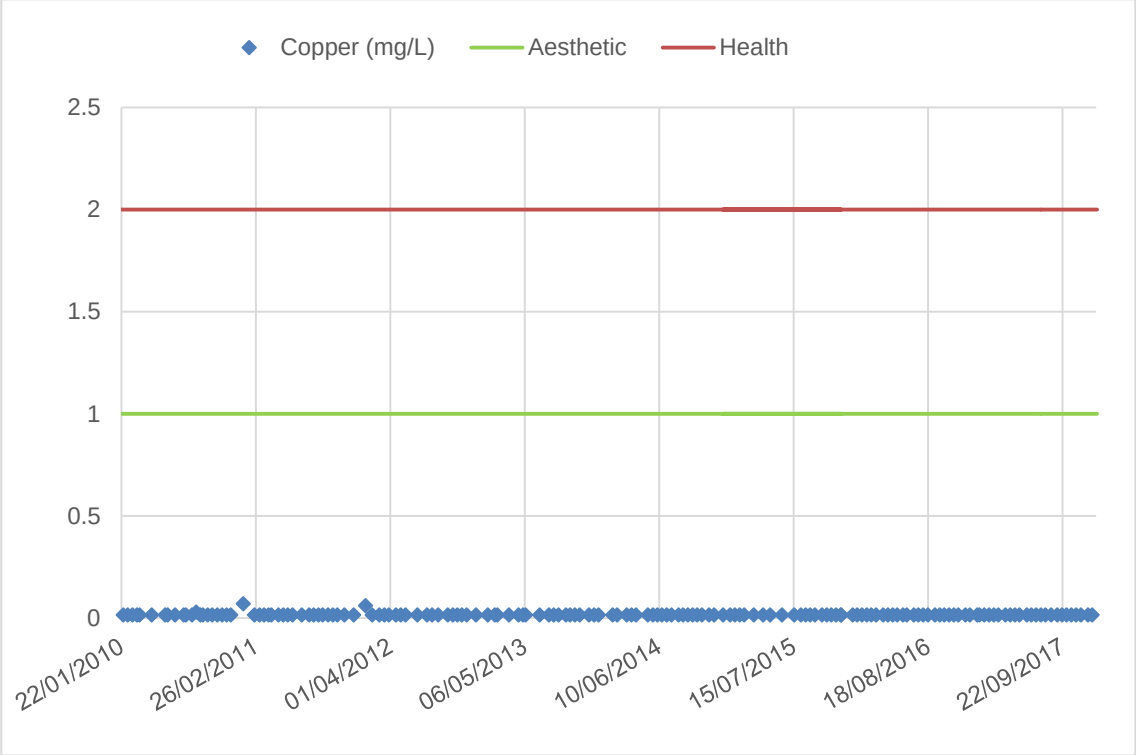
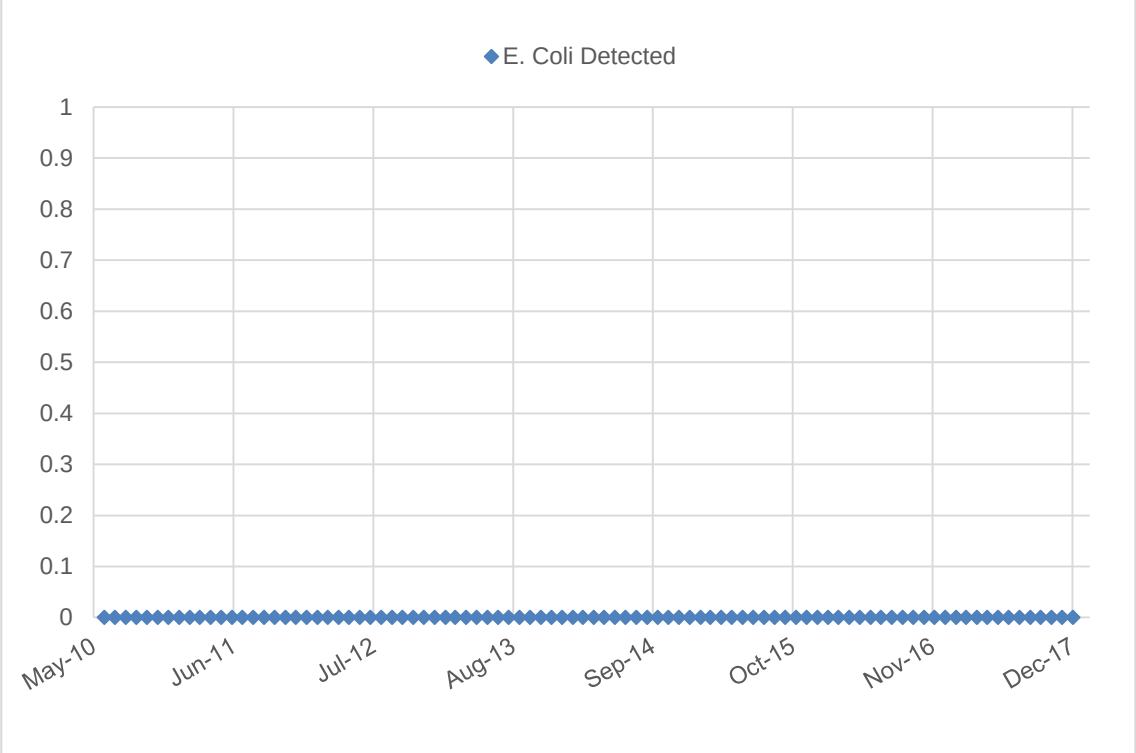


Figure 3.72 Barcaldine- E Coli



3.3.1 (b) Interpretation

Table 3.11 above shows aesthetic guideline value exceedances[12] for true colour, turbidity, iron, manganese and zinc.

The following aesthetic characteristics were detected (highlighted show exceedances):

- **pH**
- **Hardness**
- Silica
- Total Dissolved Solids
- **True Colour**
- **Turbidity**
- Sodium
- Chloride
- Sulphate
- **Iron**
- Manganese
- **Zinc**
- Aluminium
- Copper

The following health characteristics were detected (highlighted shows exceedances):

- Fluoride
- Nitrate
- Sulphate
- Manganese
- Boron
- Copper

Figure 3.55 provides a trend for the analysis of pH; there are fifteen exceedances. A maximum value of 8.81, average value of 8.316, a minimum value of 7.96 and a 95th percentile value of 8.48 have been determined. The aesthetic guideline value has a range of 6.5 – 8.5. While extreme pH values (<4 and >11) may adversely affect health, there is insufficient data to set a health guideline value. Water with a pH less than 6.5 may be corrosive. Were pH exceeds 8 the efficiency of chlorination decreases. Above 8.5 may cause scale and taste problems.

Figure 3.59 provides a trend for the analysis of true colour; there are five exceedances. The aesthetic guideline value is 15 HU. For total colour no health based guideline value is considered necessary. A maximum value of 33 HU, average value of 2.2 HU and a 95th percentile of 7 HU have been determined. Up to 25 HU is acceptable were turbidity is low, while 15 HU is just noticeable in a glass.

Figure 3.60 provides a trend for the analysis of turbidity; there are six exceedances. The aesthetic guideline value is 5 NTU. For turbidity there is insufficient data to set a guideline value based on health considerations, however where water has a value greater than 1 NTU some microorganisms may be shielded from disinfection. A maximum value of 250 NTU, average value of 1.6 NTU and a 95th percentile of 1 NTU have been determined. Six samples exceeded the aesthetic guideline of 5 NTU.

Figure 3.66 provides a trend for the analysis of iron; there are eight exceedances. A maximum value of 1.3mg/l, average value of 0.049mg/l and a 95th percentile value of 0.1mg/l have been determined. The aesthetic guideline value is 0.3mg/l. For iron there is insufficient data to set a guideline value

[12] As per the Australian Drinking Water Guidelines (2011)

based on health considerations. Iron occurs naturally in water, <1mg/l but up to 100mg/l in oxygen depleted groundwater. The taste threshold is 0.3mg/l. High concentrations of iron may stain laundry and fittings with iron bacteria causing blockages, taste / odour and corrosion. Iron bacteria, historically, has not been a problem for this water supply.

Figure 3.68 provides a trend for the analysis of Zinc; there was one exceedance. A maximum value of 20mg/l, average value of 0.061mg/l and a 95th percentile value of 0.03mg/l have been determined. The aesthetic guideline value is 3mg/l. There is insufficient data to set a guideline value based on health considerations. Four-hundred and nineteen samples analysed (<3mg/l) have acceptable levels of zinc, below taste thresholds. Natural concentrations are generally less than 0.01mg/l with most samples below this natural limit. Zinc occurs naturally in water and is typically higher in groundwater at the bottom of deep storages.

Of nine-hundred and ninety-two (992) samples analysed for E. coli there have been zero E. coli colonies detected (see Figure 3.91).

While there were aesthetic guideline value[13] exceedances, there were no health guideline value exceedances recorded during the period summarised in Table 3.11.

3.3.2 Catchment Characteristics

Barcaldine is situated at the intersection of the Landsborough (A2) and Capricorn (A3) highways approximately 600km due west of Rockhampton. Barcaldine is east of Lagoon Creek in the Barcoo River catchment. Barcaldine is located on the join between sandy loam “desert” country and blacksoil “rolling plains” country 5 km north of the Alice River. The eastern side of Barcaldine is situated on highly permeable sandy loam natural soil underlain by an uneven hard rock which forms a basin that maintains a relatively high water table in places throughout the town. The western side of Barcaldine is situated on low permeable blacksoil. Barcaldine has a current population of 1,422 permanent residents and has a current demand of 4.4 Ml/day.

The average annual rainfall for Barcaldine is 497mm[14]. With the majority of the rain falling between late December and late March with little or no rainfall during any other period. The mean maximum temperature is 30.4°C[14] although temperatures often exceed the 40°C mark during the summer months. The average annual pan evaporation for Barcaldine is approximately 3,000mm[15]. The town and the water supply infrastructure is not prone to flooding.

The Great Artesian Basin (GAB) covers approximately one-fifth of the Australian continent and contains 8.7 x 10^6 GL of groundwater in the Jurassic sandstone aquifers. It is the largest groundwater and artesian basin in the world. The basin is located under mostly arid and semi-arid landscapes to the west of the Great Dividing Range. The GAB supports a wide array of activities such as pastoral, agriculture and mining as well as the rural communities, cultural and tourism activities. In the Barcaldine area the capping of existing free flowing aquifers has improved the pressure in the main town aquifers. The GAB is recharged by rainfall and stream flow infiltrating into the exposed sandstone on the edges of the basin. One of the first drilling of the GAB occurred in 1887 in Barcaldine, comprising of a free flowing artesian Bore. .

Currently there are two bores in Barcaldine (Pomona and Acacia Street). Pomona Bore (RN 93744) has an annual allocation of 446 ML and the Acacia Street Bore (RN 69904) has an annual allocation of 904 ML. Figure 3.54 above shows the recharge, discharge and flow of the GAB and Barcaldine’s relative location in relation to the GAB.

[13] As per the Australian Drinking Water Guidelines (2011)
[14] 30 year mean at Barcaldine Post Office (nearest available climate statistics)
[15] DPI Water Resource’s Commission

The Acacia Street bore is located at the Western end of Acacia Street. Pomona Bore is located on the Corner of Pine and Yew Street. The bores are 460m and 465m deep *respectively*. The bores yields are 39 l/s and 40 l/s respectively. The Acacia Street Bore has a free flowing pressure of 5m and free flowing yield of 21 l/s. Access to all bores is limited to authorised personnel only by way of security fencing and all bore headwork's are sealed against the possibility of deliberate contamination. The Pomona Bore was drilled in 2002. Appendix B Figure M-2012-005 shows the bore and reservoir locations and water reticulation layout on an aerial photo of the town. Appendix C contains a copy of the bore card reports obtained from Department of Environmental & Resource Management.

Barcaldine sewerage collection scheme is comprised of a conventional gravity mains collection system with pumped rising main to a trickling filter treatment plant. The treatment plant is comprised of one imhoff tank, trickling filter, sludge ponds and oxidation ponds. Treated effluent from the ponds is discharged to a drain at Lagoon Creek where it is left to evaporate. Sludge's are captured, dried and disposed of separately. The ground water sources show no indication of contamination from the sewage treatment plant however the artesian bores have been annuli sealed off to prevent contamination from surface water leachate. Currently effluent is not reused however this may be reviewed in the future.

3.3.3 Hazard Identification

The hazards and hazardous events and their sources that adversely affect water quality are documented in Table 3.13 below and include those affecting:

- Catchment
- Sourcing infrastructure
- Treatment plants (where applicable)
- Disinfection process(es) (where applicable)
- Distribution system

3.3.3 (a) Identifying and Documenting Hazards And Hazardous Events

The hazards and hazardous events were identified using data contained in the plan and following site visits and a risk assessment workshop which was conducted on 8 and 9 November 2011. A recent risk assessment workshop was conducted in December 2017 prior to amendment of the plan;

- Section 2.3 Barcaldine Water Supply Scheme
- Section 3.3.1 Water quality information
- Section 3.3.2 Catchment Characteristics

Table 3.13 Barcaldine Hazard Identification, Risk Assessment and Uncertainty

Scheme Component / Sub-component	Hazardous Event	Hazard	Maximum risk			Existing Preventive Measures / Barriers.	Residual risk			Uncertainty	Comments/ Proposed Further Risk Reduction Actions
			Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
Bore	Sewage system discharges, agricultural run-off	Bacteria	Moderate	Rare	Low (3)	Nil	Moderate	Rare	Low (3)	Reliable	Acceptable risk, continue to monitor for exceedances
	Hazard that arises from the natural geological processes in the aquifer.	Hardness	Insignificant	Rare	Low (1)	Nil	Insignificant	Rare	Low (1)	Confident	
		pH	Insignificant	Unlikely	Low (2)	Nil	Insignificant	Unlikely	Low (2)	Confident	
		True Colour	Insignificant	Rare	Low (1)	Nil	Insignificant	Rare	Low (1)	Confident	
		Turbidity	Insignificant	Rare	Low (1)	Nil	Insignificant	Rare	Low (1)	Confident	
		Iron	Insignificant	Rare	Low (1)	Nil	Insignificant	Rare	Low (1)	Confident	
		Zinc	Insignificant	Rare	Low (1)	Nil	Insignificant	Unlikely	Low (2)	Confident	
Sourcing Infrastructure	Power Outage	Disruption to supply	Moderate	Unlikely	Medium (6)	Backup generator	Insignificant	Rare	Low (1)	Confident	Acceptable risk
	Vermin barrier not secured	Bacteria	Moderate	Rare	Low (3)	Vermin barrier protection Visual check	Moderate	Rare	Low (3)	Confident	**ABM1** Operational & Maintenance Procedures
	Accidental or intentional contamination	Harmful substances (not identified)	Catastrophic	Rare	Medium (6)	Chain-link fencing and locked gates. Reservoir roof lids.	Catastrophic	Rare	Medium (6)	Uncertain	
Treatment Plant	Reticulated Water Untreated										
Disinfection Process	Reticulated Water Not Disinfected										
Distribution System	Reticulation maintenance and repair	Bacteria	Moderate	Rare	Low (3)	Mains repair procedure and Monitoring	Moderate	Rare	Low (3)	Uncertain	**ABM1** Operational & Maintenance Procedures
Whole of System	Flights carrying samples to lab delayed/cancelled	Logistical	Insignificant	Possible	Low (3)	Nil	Insignificant	Possible	Low (3)	Confident	Acceptable risk

3.3.3 (b) Hazard Identification (and Risk Assessment) Team

The personnel responsible for the hazard identification and risk assessment process, their roles and responsibilities are detailed in the Table below.

Table 3.14 Hazard Identification and Risk Assessment Team

Typical Job Title for Key Personnel	What Role Did Each Person Play On the Team?	What Expertise and System Knowledge Did the Person Bring?
Manager of Engineering Services	Management of DWQMP Process, Risk Assessment Procedure & Chairing Risk Assessment Workshop	High level knowledge, risk assessment and identification, general engineering experience in the management of the systems
Engineer (Internal / External)	Author, Risk Assessment, Risk Assessment Workshop	Detailed knowledge of the system, water risk assessment and identification
Water Engineer (Internal / External)	Risk Assessment Workshop	Detailed knowledge of drinking water quality management, outside perspective, risk assessment and identification
Water / Technical Officers	Risk Assessment Workshop	Detailed knowledge of individual schemes, risk identification

3.4 Jericho Water Quality and Catchment Characteristics

Jericho water supply is composed of two sub artesian bores which are treated prior to reticulation. The source water was not of a sufficient quality to reticulate directly to the town.

3.4.1 Water Quality Information

Water quality information for Jericho includes the following:

(a) Summary
(b) Interpolation

3.4.1 (a) Summary

Table 3.15 below summarises the available reticulated water quality for the Jericho water supply scheme. Table 3.17 below summarises the limited raw water quality available[16].

Figure 3.73 to Figure 3.91 below show trends of the main characteristics contained in Table 3.15 for the treated water. Figure 3.90 to Figure 3.106 below show trends of the main characteristics contained in Table 3.17 for the raw water.

The responsibility for obtaining the water samples rests with the DWSP and samples are collected by the Technical Officer monthly. Samples are sent to Queensland Health Scientific Services for analysis. The DWSP also samples and analyses drinking water for E. coli.

[16] DWSP generally only monitors the treated water supplied to reticulation

Table 3.15 Jericho Reticulated Water

Jericho Water Supply	Start Date		23/09/2009	End Date:	19/12/2017						
Characteristic	Units	No. of Samples	Summary of Results					Guideline Value			
			Maximum Value	Average Value	Minimum Value	Std Dev	95th Percentile	Health	Exceedances	Aesthetic	Exceedances
Conductivity	uS/cm	90	1760.000	916.700	866.000	122.163	927.100				
pH		91	8.200	7.352	6.080	0.302	7.600			≥6.5 & ≤ 8.5	4
Total Hardness	mg/L as CaCO3	90	238.000	85.267	80.000	16.290	86.550			200	1
Temporary Hardness	mg/L as $CaCo_3$	90	179.000	38.344	28.000	20.776	43.000			200	0
Alkalinity	mg/L $CaCo_3$	90	179.000	38.344	28.000	20.776	43.000				
Residual Alkalinity	meq/L	90	0.000	0.000	0.000	0.000	0.000				
Silica	mg/L	90	72.000	13.178	12.000	6.258	13.000			80	0
Total Dissolved Ions	mg/L	90	1060.000	480.533	166.000	92.152	486.550				
Total Dissolved Solids	mg/L	91	1020.000	471.813	441.000	77.365	472.500			600	2
True Colour	Hazen	91	17.000	1.453	0.050	2.589	5.500			15	1
Turbidity	NTU	91	3.000	0.535	0.050	0.392	1.000			5	0
pH (Saturation)*		90	9.300	9.099	7.600	0.249	9.200				
Saturation Index		90	0.500	-1.754	-3.100	0.439	-1.500				
Mole Ratio		90	5.000	3.736	2.500	0.335	4.100				
Sodium Absorption Ratio		90	7.200	6.421	6.200	0.140	6.600				
Figure of Merit		90	0.500	0.303	0.300	0.023	0.300				
Sodium	mg/L	90	265.000	137.600	128.000	17.196	140.550			180	2
Potassium	mg/L	90	12.000	7.749	7.200	0.658	7.955				
Calcium	mg/L	90	37.000	6.729	5.000	4.499	6.855				
Magnesium	mg/L	90	39.000	17.089	16.000	3.126	17.000				
Hydrogen	mg/L	90	0.000	0.000	0.000	0.000	0.000				
Bicarbonate	mg/L	90	202.000	44.600	34.000	17.258	52.000				
Carbonate	mg/L	90	2.000	0.120	0.000	0.229	0.100				
Hydroxide	mg/L	90	0.022	0.000	0.000	0.002	0.000				
Chloride	mg/L	90	400.000	226.911	210.000	25.111	230.000			250	2
Fluoride	mg/L	89	0.330	0.195	0.140	0.026	0.240	1.5	0		
Nitrate	mg/L	90	31.000	0.825	0.025	3.207	1.110	50	0		
Sulphate	mg/L	90	46.000	36.756	34.000	1.809	39.550	500	0	250	0
Iron	mg/L	90	0.060	0.006	0.005	0.007	0.005			0.3	0
Manganese	mg/L	90	0.040	0.006	0.005	0.005	0.005	0.5	0	0.1	0
Zinc	mg/L	88	0.620	0.055	0.010	0.087	0.080			3	0
Aluminium	mg/L	90	0.100	0.026	0.020	0.008	0.025			0.2	0
Boron	mg/L	90	0.310	0.120	0.100	0.029	0.130	4	0		
Copper	mg/L	90	0.015	0.015	0.015	0.000	0.015	2	0	1	0
Chlorate	mg/L	55	0.890	0.322	0.090	0.190	0.689				
E. coli		256	0.000	0.000	0.000	0.000	0.000	0	0		

Aesthetic Guideline Exceedance
Health Guideline Exceedance

Table 3.16 Water quality complaints

Year	No of Water Quality Complaints	Water Quality Complaints per 1000 Connections	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2018	0	0	Data not available		
2017	0	0			
2016	0	0			
2015	No Data				
2014					
2013					
2012					
2011	6	43			
2010	3	23			
2009	3	23			

Figure 3.73 Jericho Treated - pH at 23°C

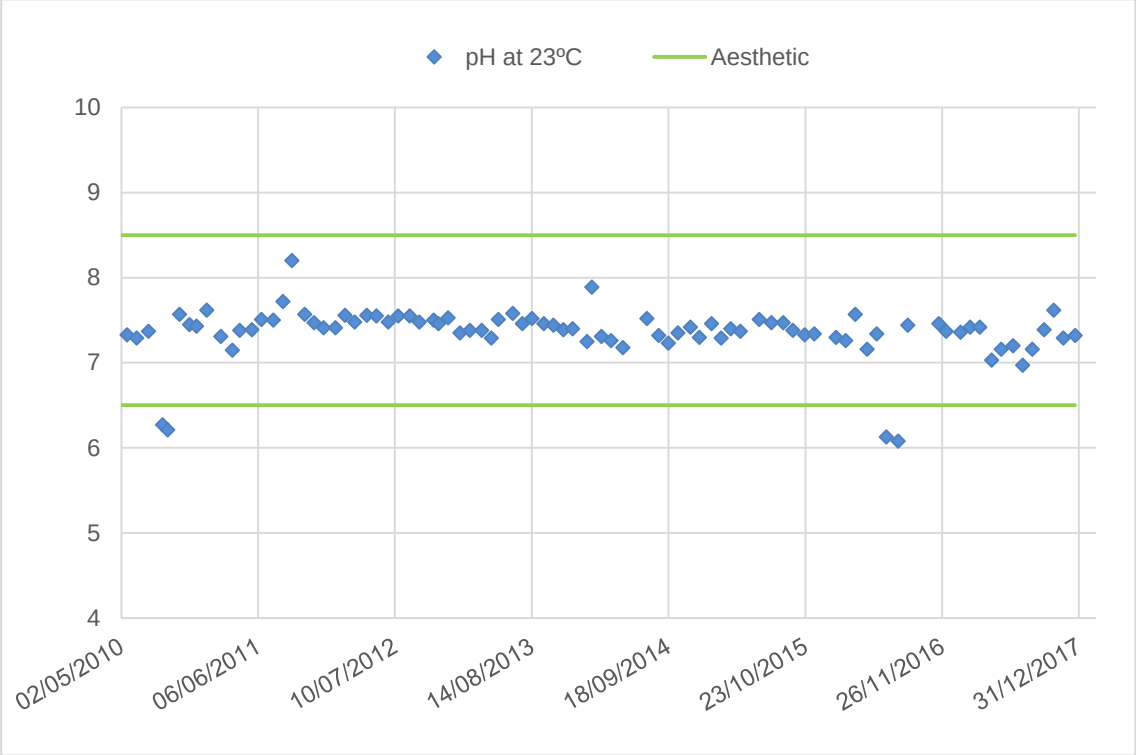


Figure 3.74 Jericho Treated - Total Hardness

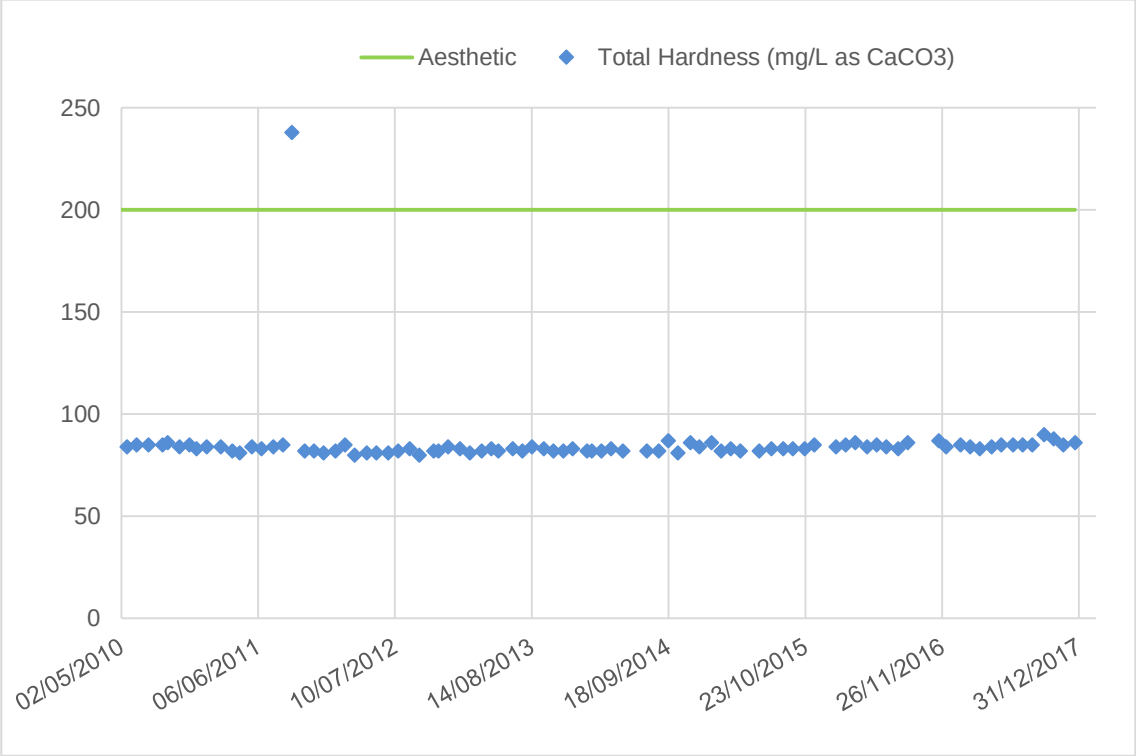


Figure 3.75 Jericho Treated – Silica

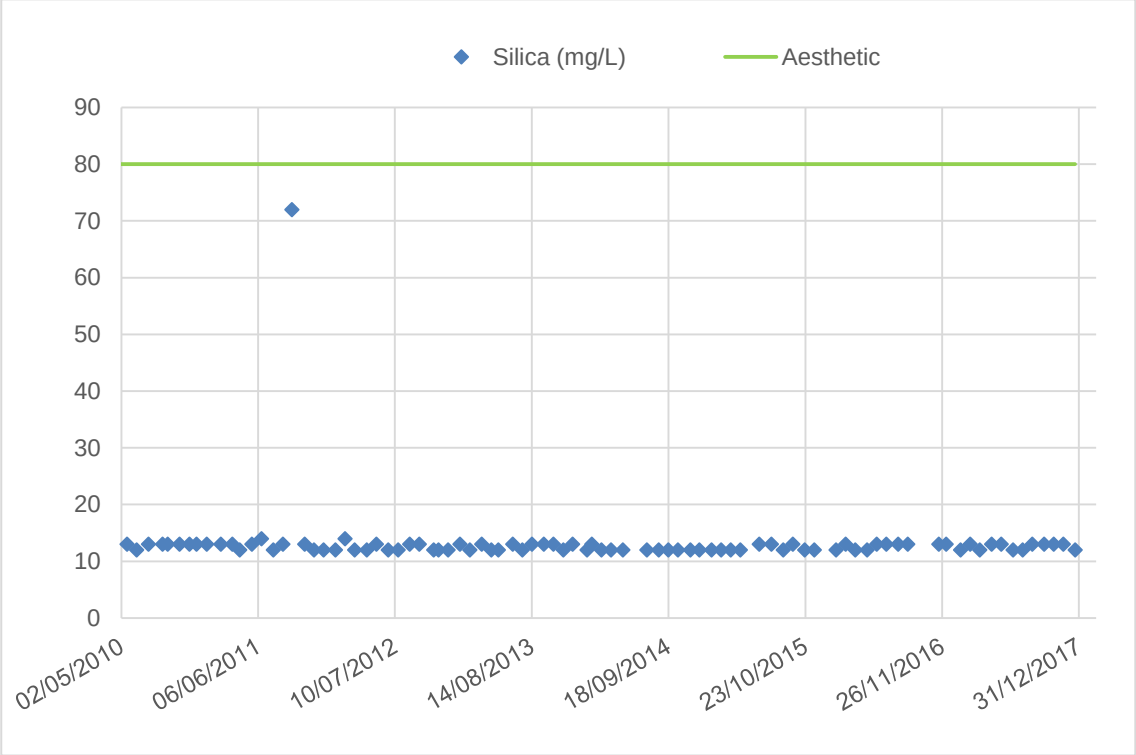


Figure 3.76 Jericho Treated - Total Dissolved Solids

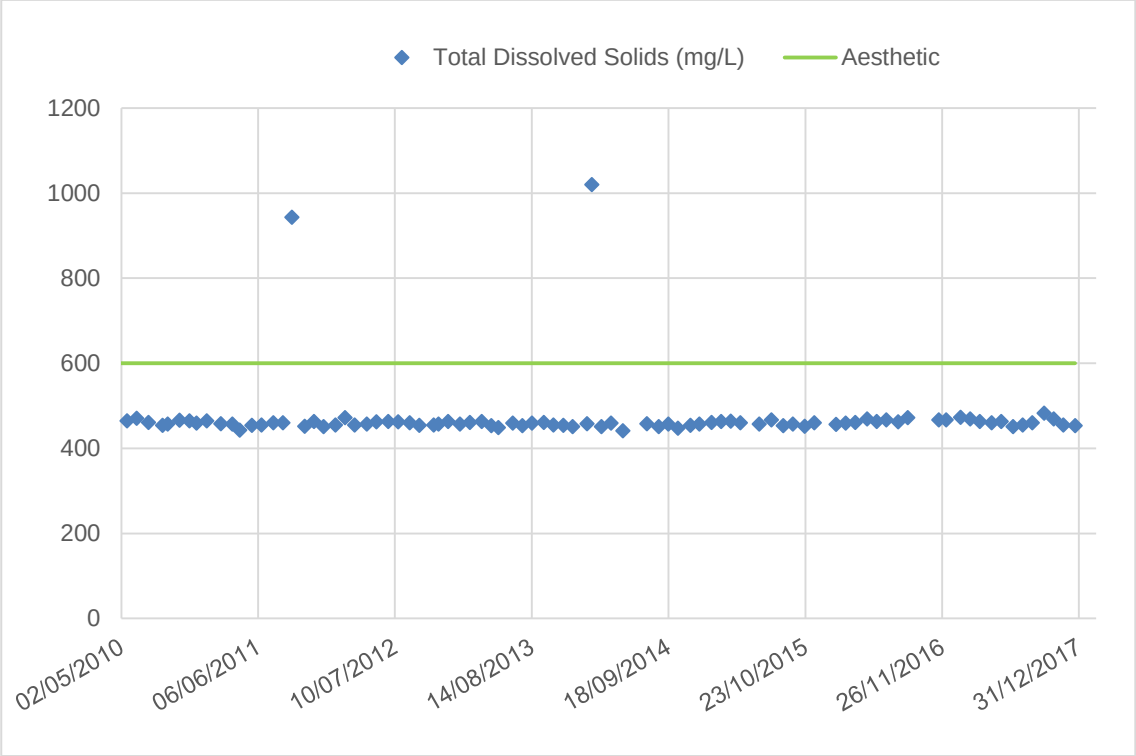


Figure 3.77 Jericho Treated - True Colour

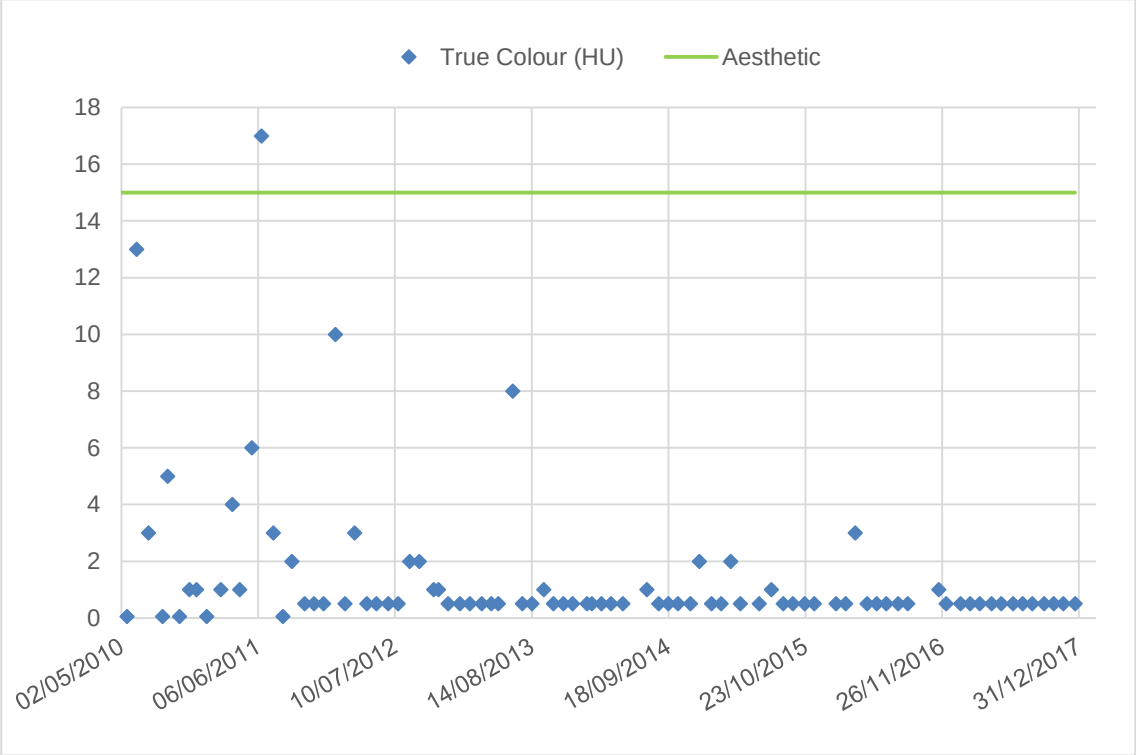


Figure 3.78 Jericho Treated – Turbidity

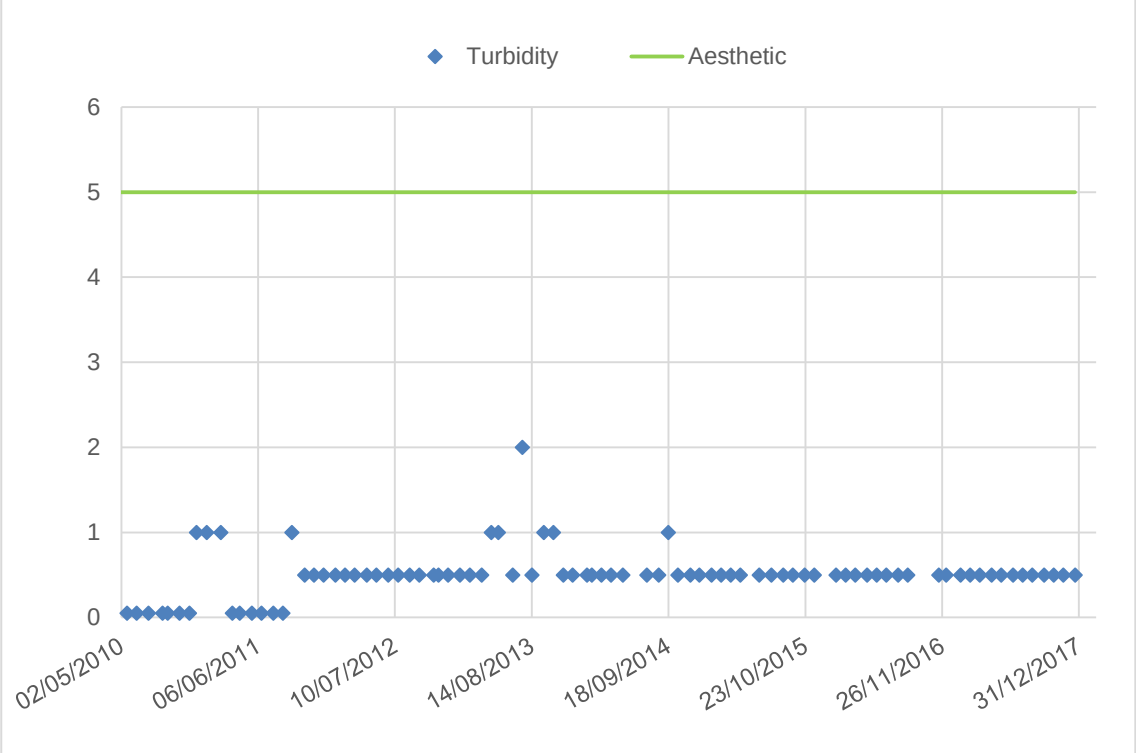


Figure 3.79 Jericho Treated - Sodium

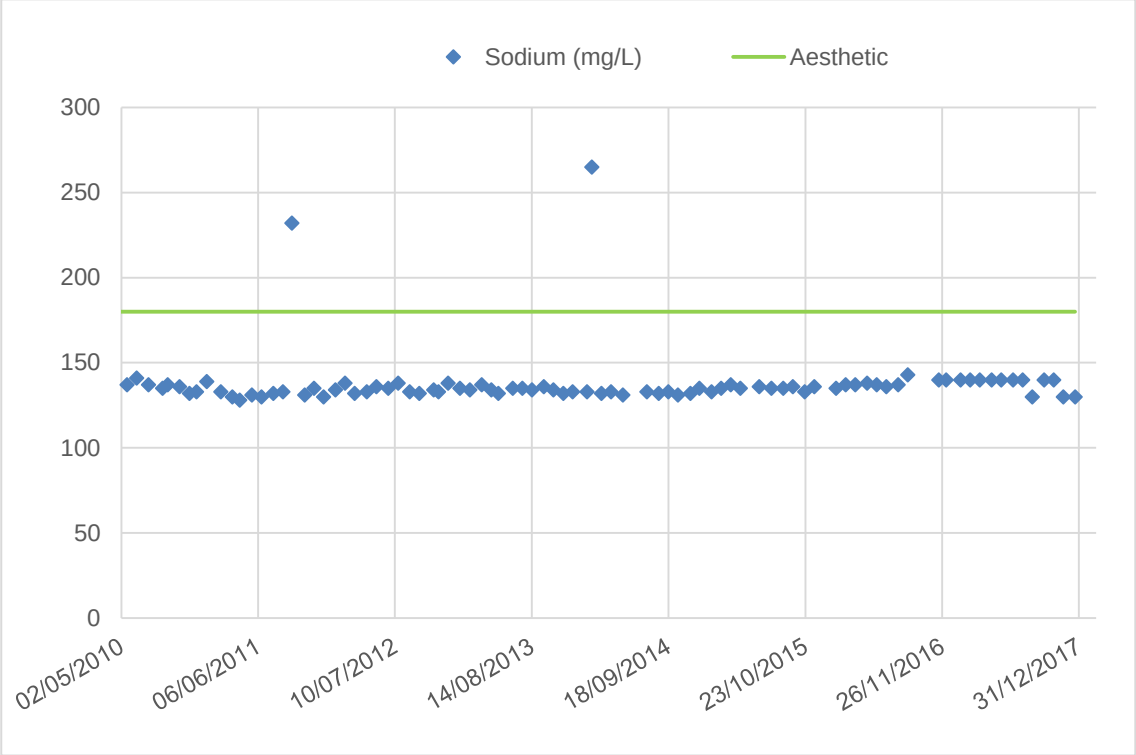


Figure 3.80 Jericho Treated – Chloride

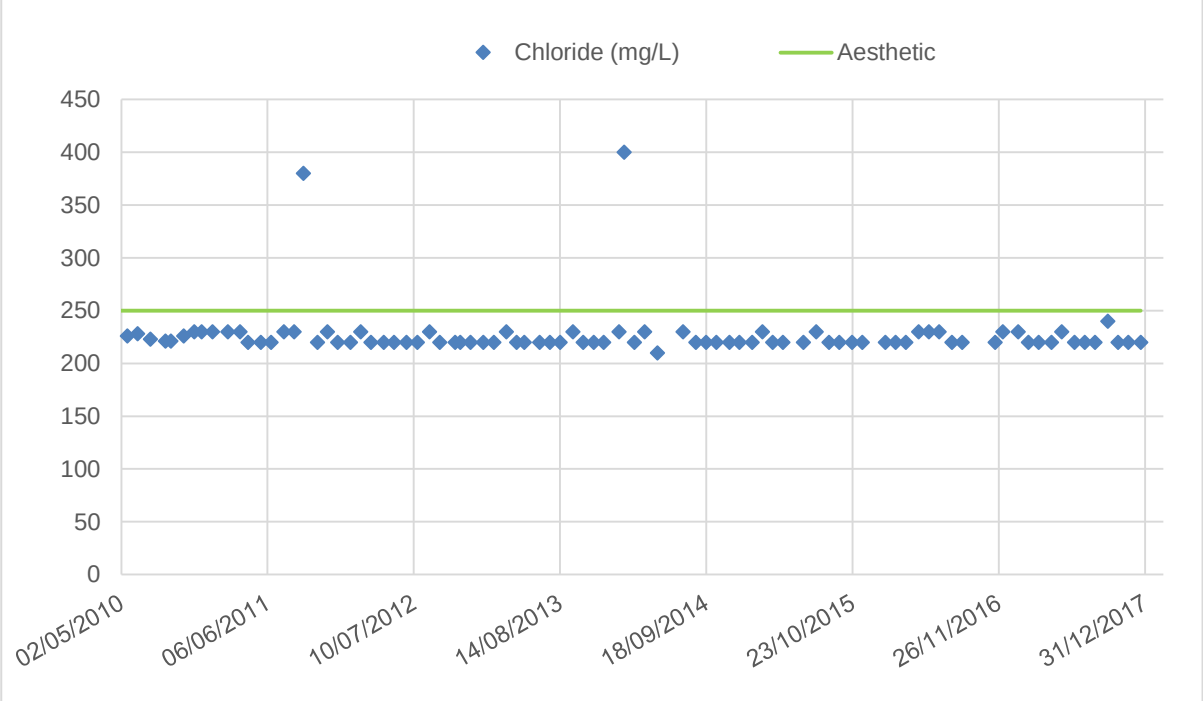


Figure 3.81 Jericho Treated – Fluoride

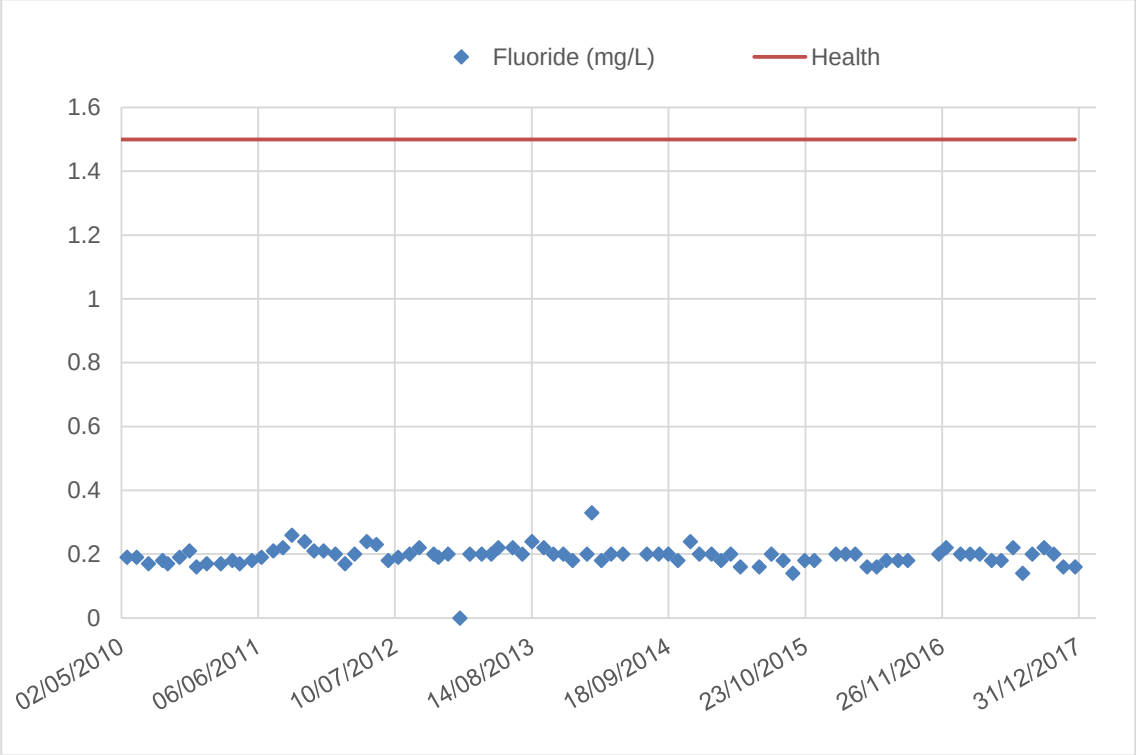


Figure 3.82 Jericho Treated - Nitrate

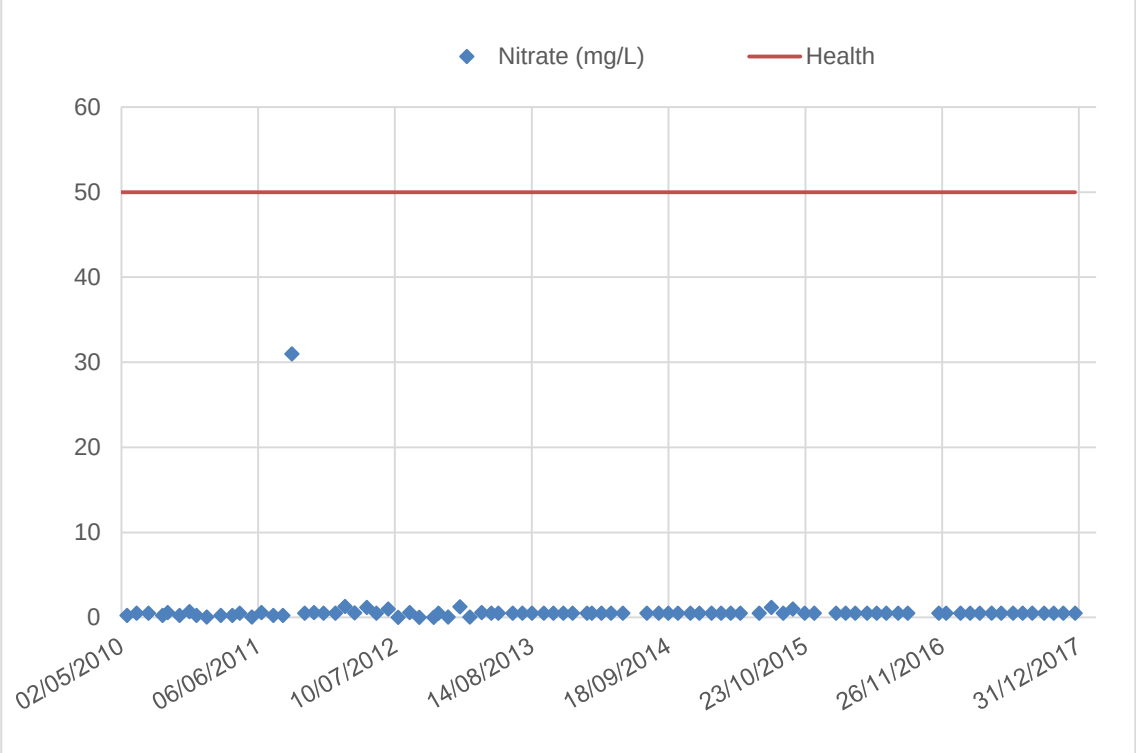


Figure 3.83 Jericho Treated - Sulphate

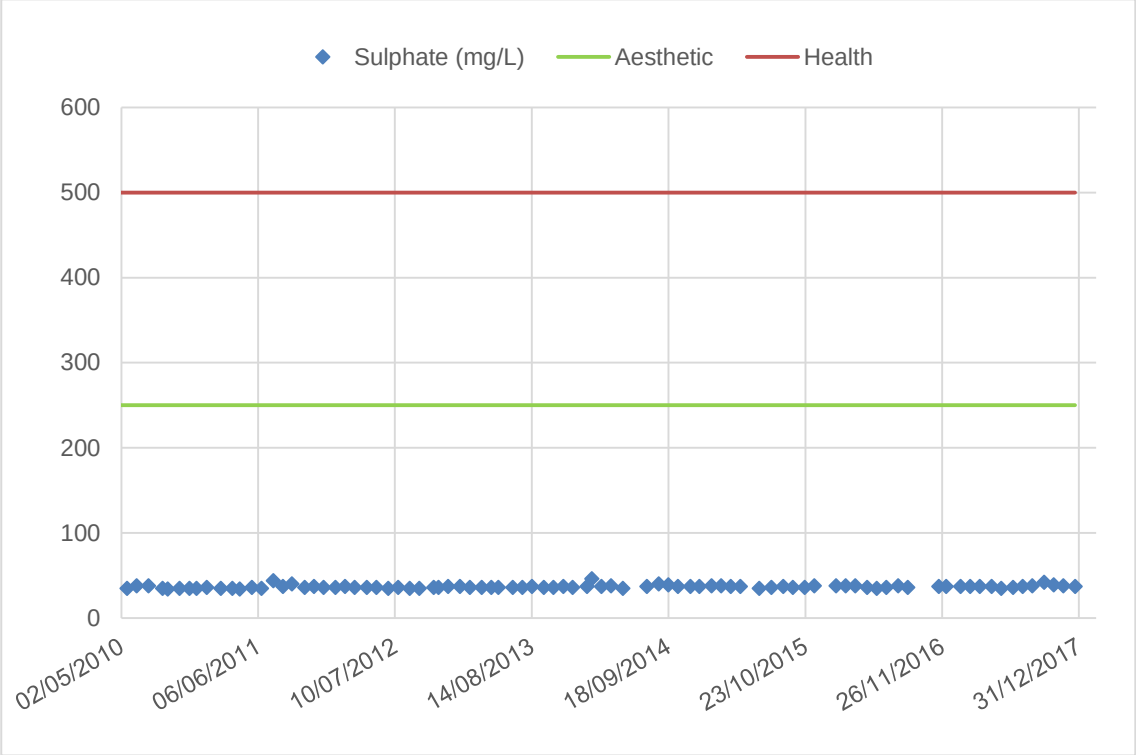


Figure 3.84 Jericho Treated – Iron

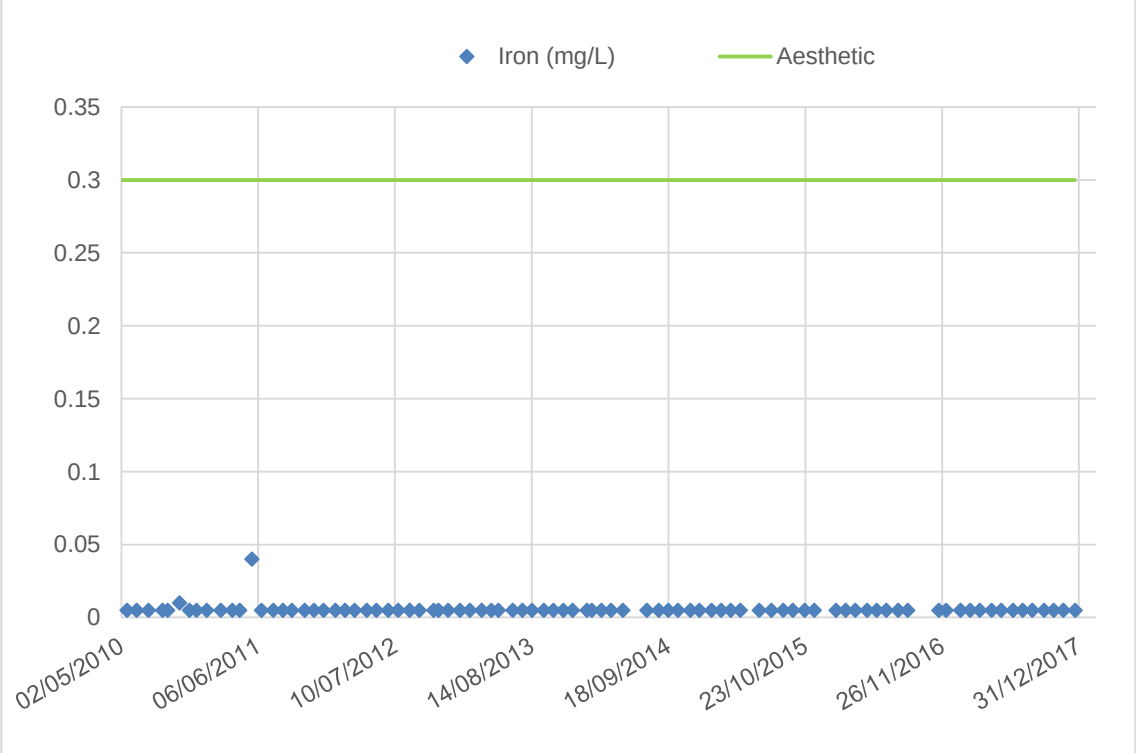


Figure 3.85 Jericho Treated – Manganese

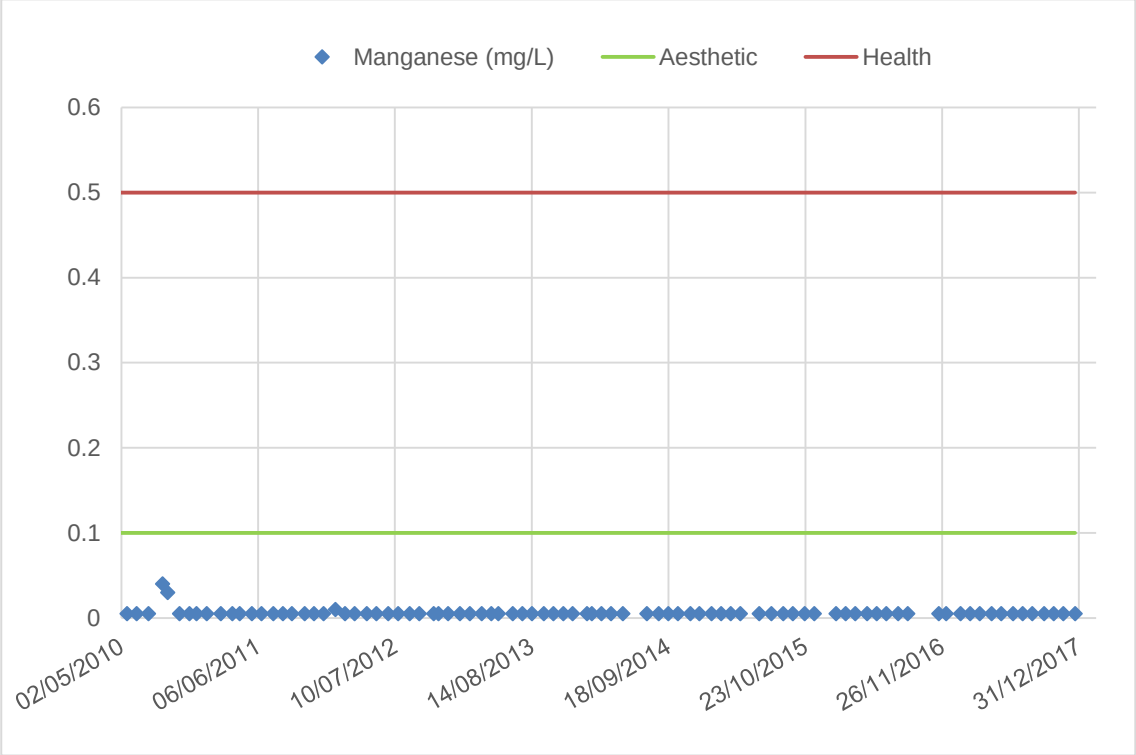


Figure 3.86 Jericho Treated – Zinc

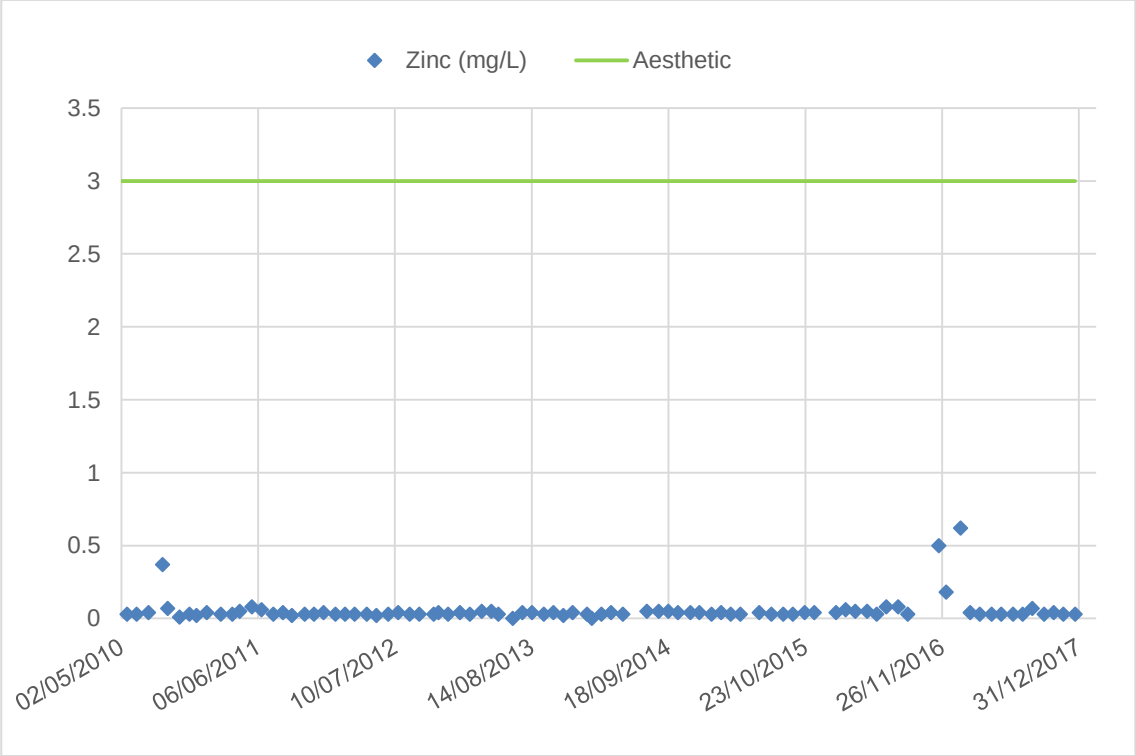


Figure 3.87 Jericho Treated - Aluminium

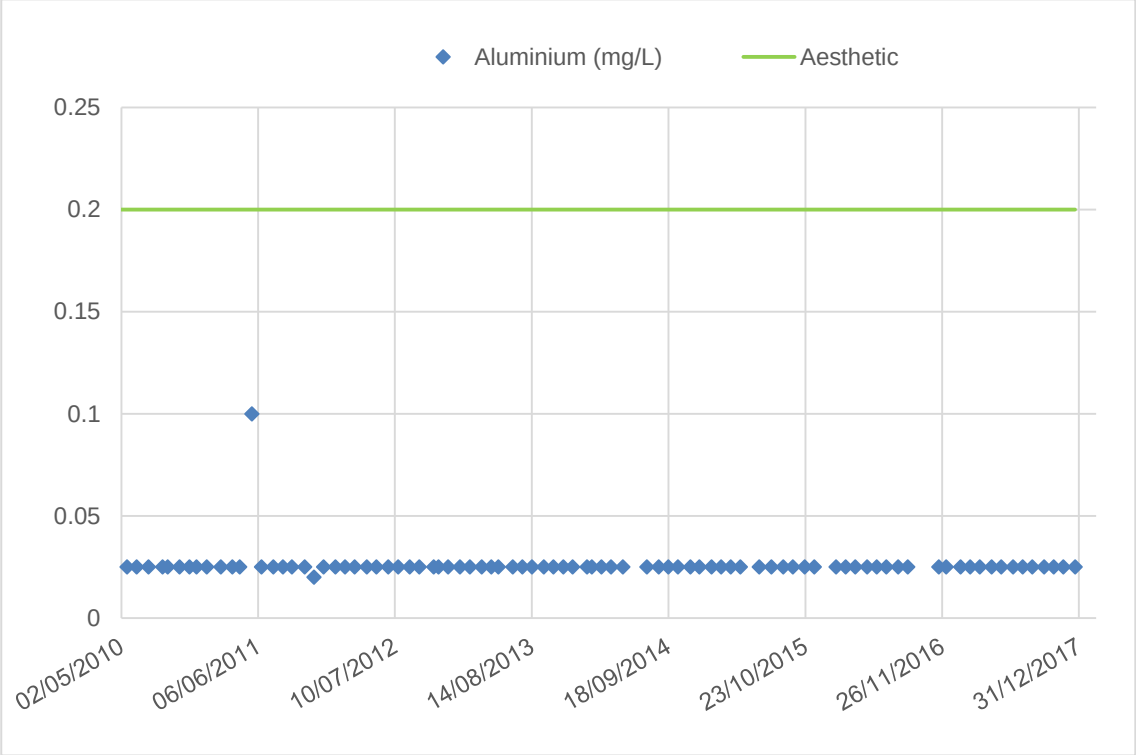


Figure 3.88 Jericho Treated – Boron

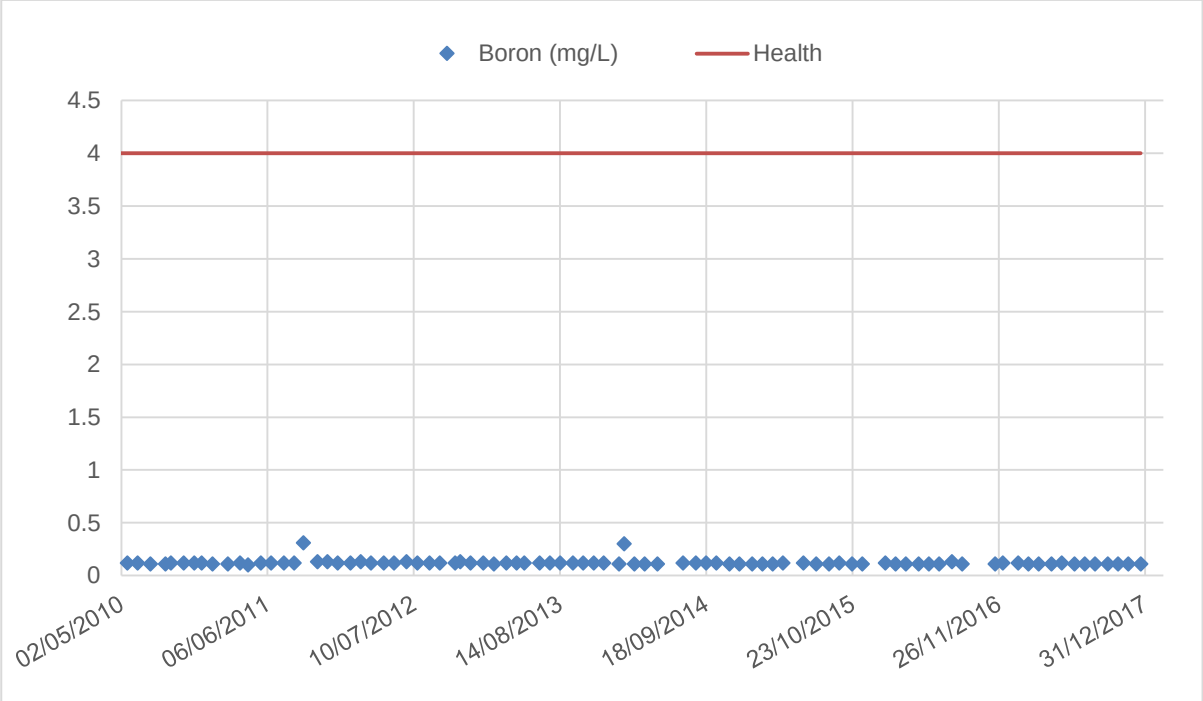


Figure 3.89 Jericho Treated - Copper

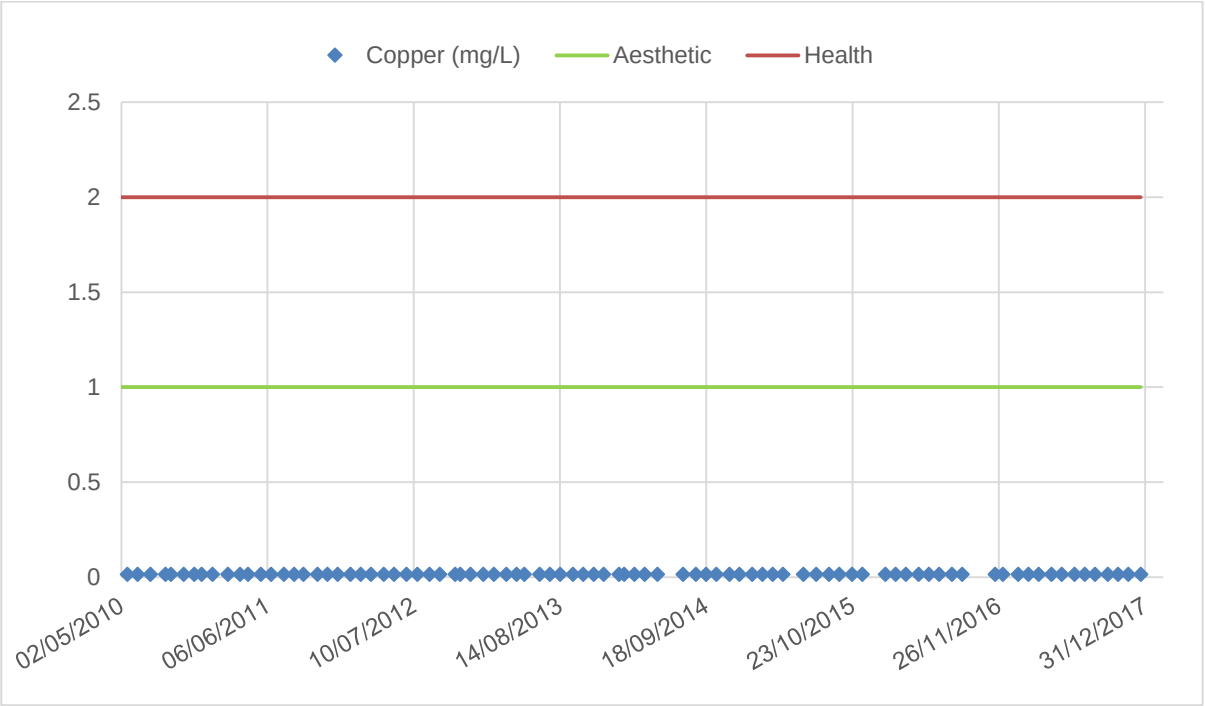


Figure 3.90 Jericho Treated - Chlorate

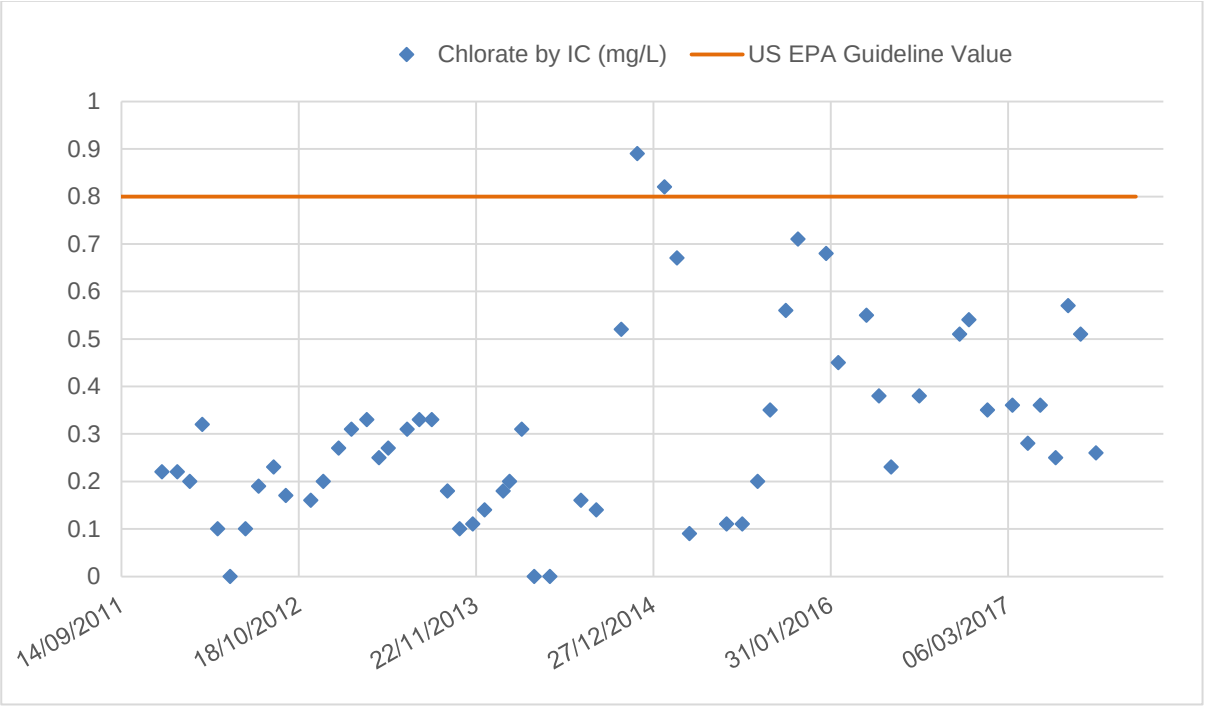


Figure 3.91 Jericho Treated – E. Coli

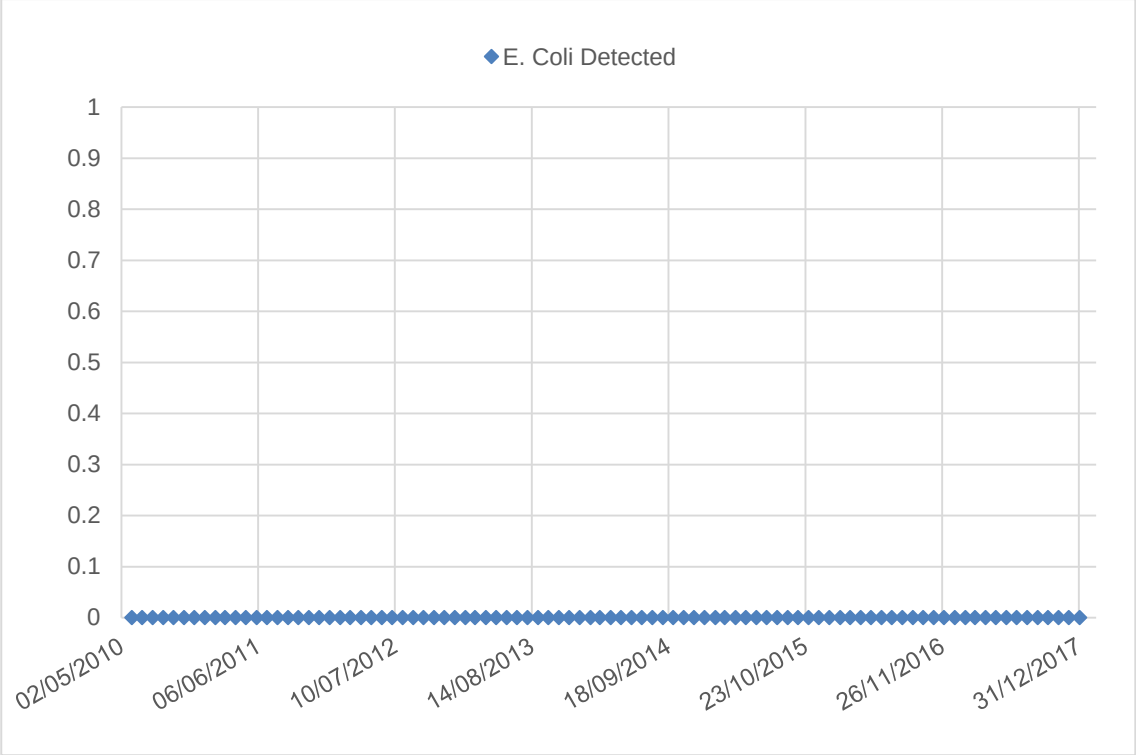


Table 3.17 Jericho Source Water

Alpha Water Supply	Start Date	16/11/2001		End Date:	11/09/2011					
Characteristic	No. of Samples	Summary of Results					Guideline Value			
		Maximum Value	Average Value	Minimum Value	Std Dev	95th Percentile	Health	Exceedances	Aesthetic	Exceedances
Conductivity (µS/cm at 25ºC)	11	1650.000	1004.818	792.000	273.268	1575.000				
pH at 23ºC	12	7.360	6.753	5.150	0.646	7.333			≥6.5 & ≤ 8.5	3
Total Hardness (as CaCO3)	12	242.000	109.341	79.000	55.702	232.650			200	2
Temporary Hardness (mg/L $CaCO_3$)	11	167.000	57.864	26.000	48.974	161.000			200	0
Alkalinity (mg/L $CaCO_3$)	12	167.000	57.042	26.000	46.968	160.400				
Residual Alkalinity (meq/L)	11	0.000	0.000	0.000	0.000	0.000				
Silica (mg/L)	11	82.000	24.364	11.000	25.578	78.500			80	1
Total Dissolved Ions (mg/L)	11	964.000	552.182	439.000	184.515	942.000				
Total Dissolved Solids (mg/L)	12	942.000	538.500	431.000	172.289	918.900			600	2
True Colour	12	6.000	1.875	0.500	1.660	4.900			15	0
Turbidity (NTU)	12	4.000	1.125	0.000	1.120	3.450			5	0
pH Sat (calc for $CaCO_3$)	11	9.300	8.900	7.700	0.548	9.250				
Saturation Index	11	-0.700	-2.000	-3.200	0.773	-0.700				
Mole Ratio	11	5.200	4.173	3.600	0.548	5.150				
Sodium Absorpt. Ratio	11	6.700	6.400	6.000	0.241	6.700				
Figure of Merit Ratio	11	0.500	0.336	0.300	0.077	0.500				
Sodium Na+	11	240.000	152.091	125.000	39.420	235.000			180	2
Potassium K^+	11	9.700	7.782	6.900	0.883	9.500				
Calcium Ca^{++}	11	36.000	11.173	5.600	11.021	34.500				
Magnesium Mg^{++}	11	37.000	20.273	16.000	7.222	35.500				
Hydrogen H^+	11	0.000	0.000	0.000	0.000	0.000				
Bicarbonate HCO_3^-	11	203.000	70.000	32.000	58.921	194.000				
Carbonate CO_3^{--}	11	0.200	0.045	0.000	0.066	0.150				
Hydroxide OH^-	11	0.000	0.000	0.000	0.000	0.000				
Chloride Cl-	11	372.000	248.182	205.000	55.897	366.000			250	2
Fluoride F^-	11	0.300	0.208	0.170	0.031	0.260	1.5	0		
Nitrate NO_3^-	11	33.500	6.009	0.250	12.158	31.750	50	0		
Sulphate SO_4^{--}	11	46.000	36.818	32.000	3.537	42.500	500	0	250	0
Iron FE	13	0.109	0.020	0.005	0.030	0.080			0.3	0

Alpha Water Supply	Start Date	16/11/2001		End Date:	11/09/2011					
Characteristic	No. of Samples	Summary of Results					Guideline Value			
		Maximum Value	Average Value	Minimum Value	Std Dev	95th Percentile	Health	Exceedances	Aesthetic	Exceedances
Manganese Mn	13	0.081	0.022	0.005	0.019	0.051	0.5	0	0.1	0
Zinc Zn	12	0.370	0.065	0.005	0.094	0.216			3	0
Aluminium Al	12	0.260	0.045	0.025	0.065	0.131			0.2	1
Boron B	12	0.270	0.133	0.000	0.070	0.270	4	0		
Copper Cu	12	0.140	0.025	0.001	0.035	0.077	2	0	1	0

Aesthetic Guideline Exceedance
Health Guideline Exceedance

Figure 3.90 Jericho Source - pH at 23°C

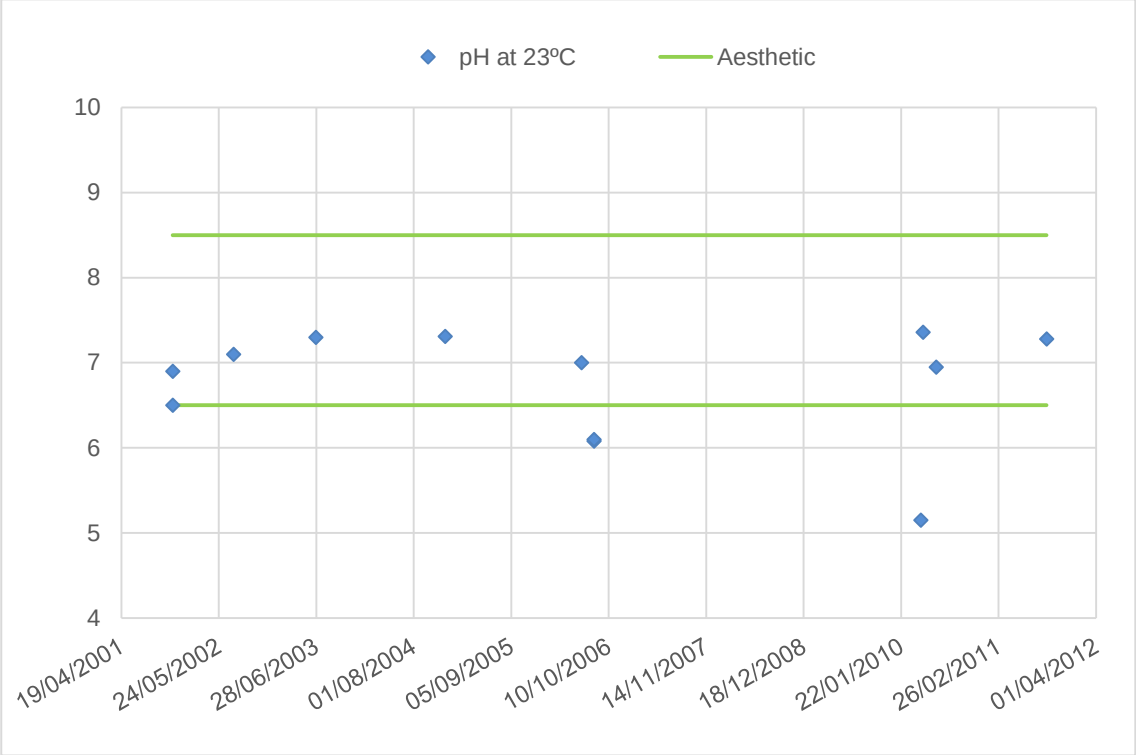


Figure 3.91 Jericho Source - Total Hardness

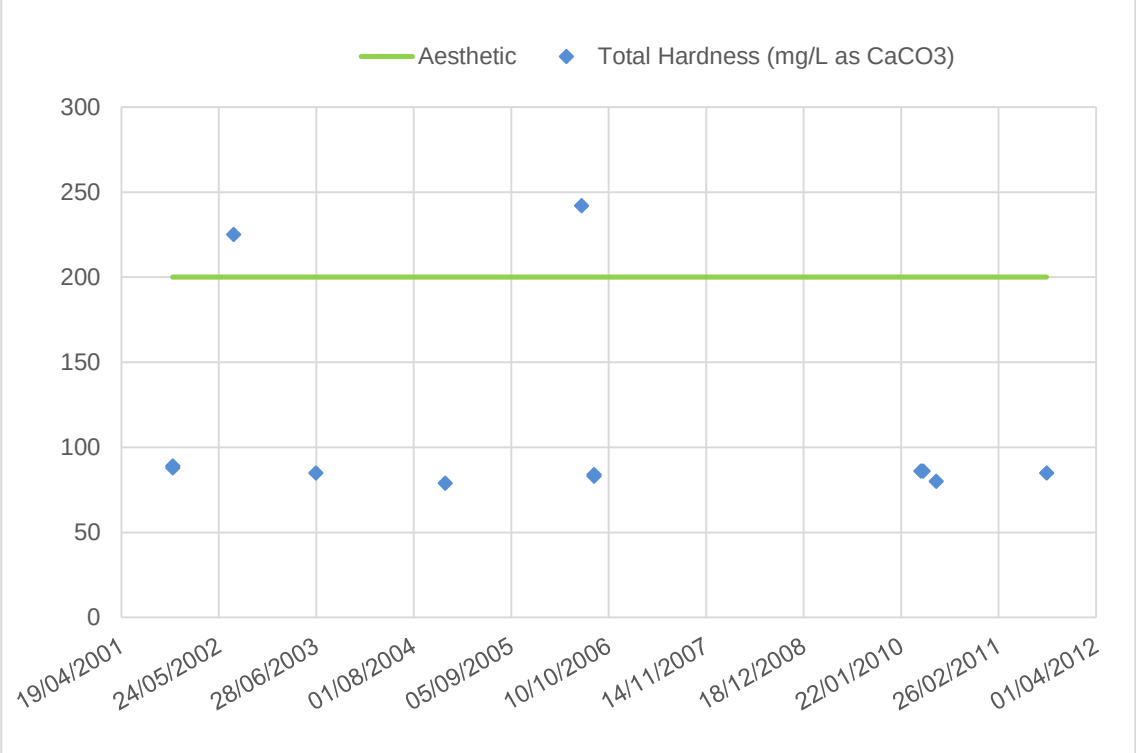


Figure 3.92 Jericho Source – Silica

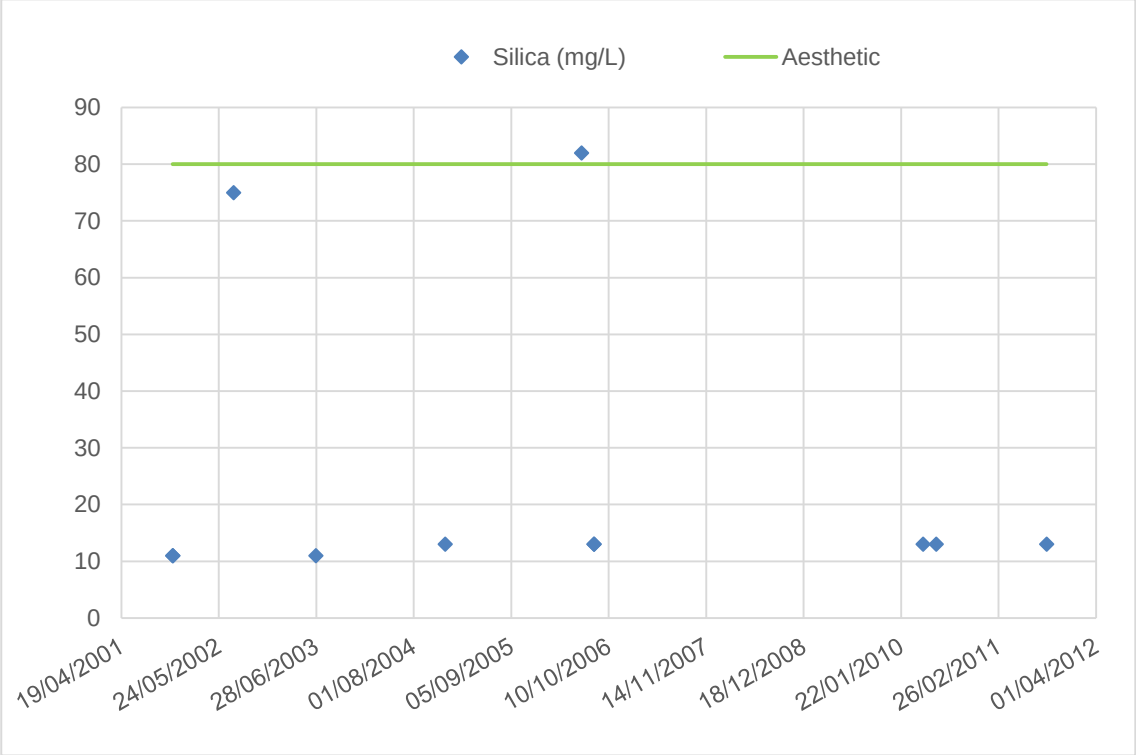


Figure 3.93 Jericho Source - Total Dissolved Solids

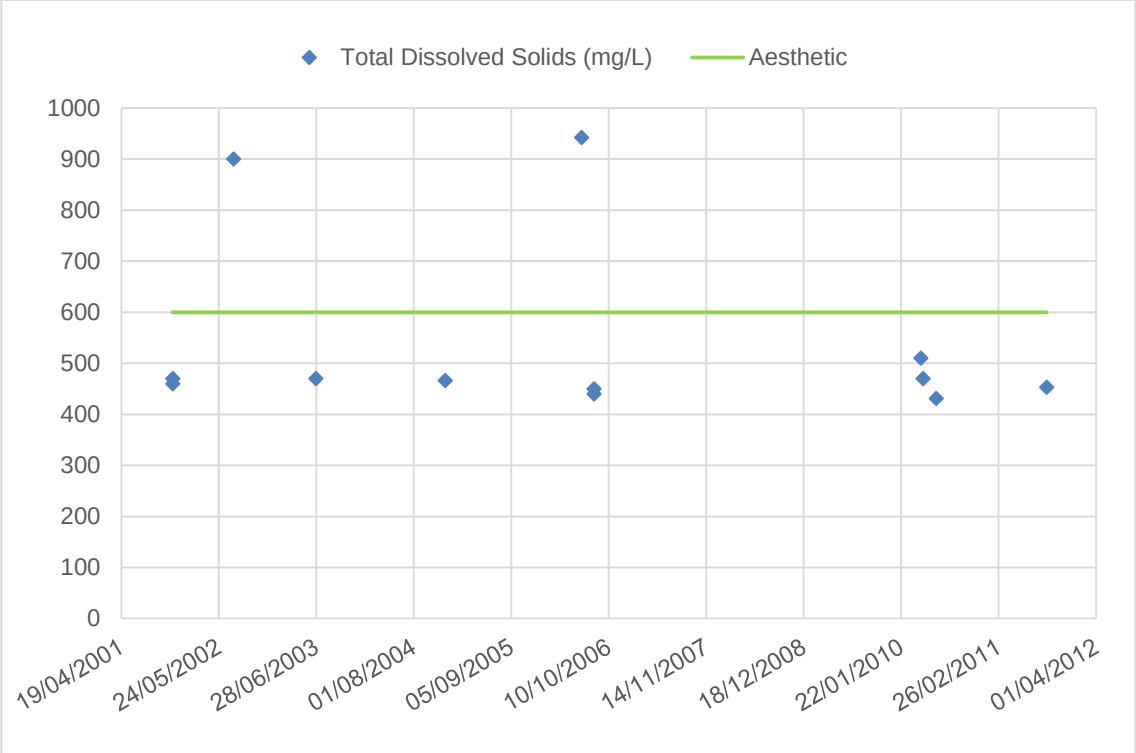


Figure 3.94 Jericho Source - True Colour

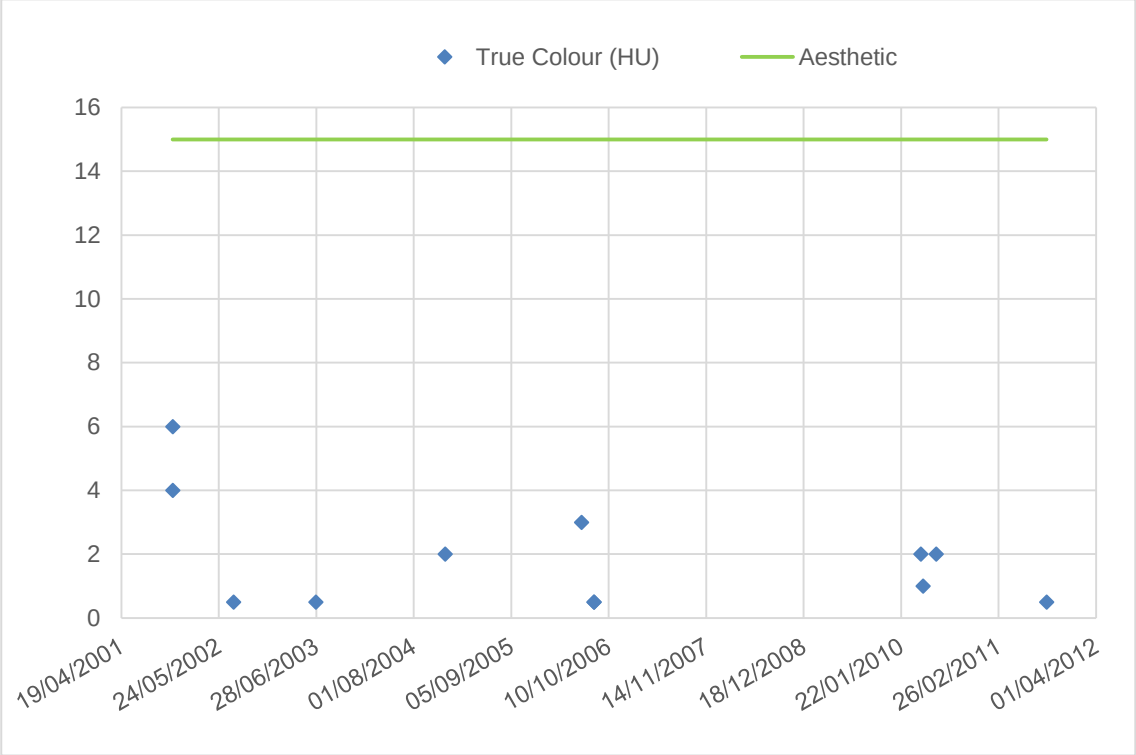


Figure 3.95 Jericho Source – Turbidity

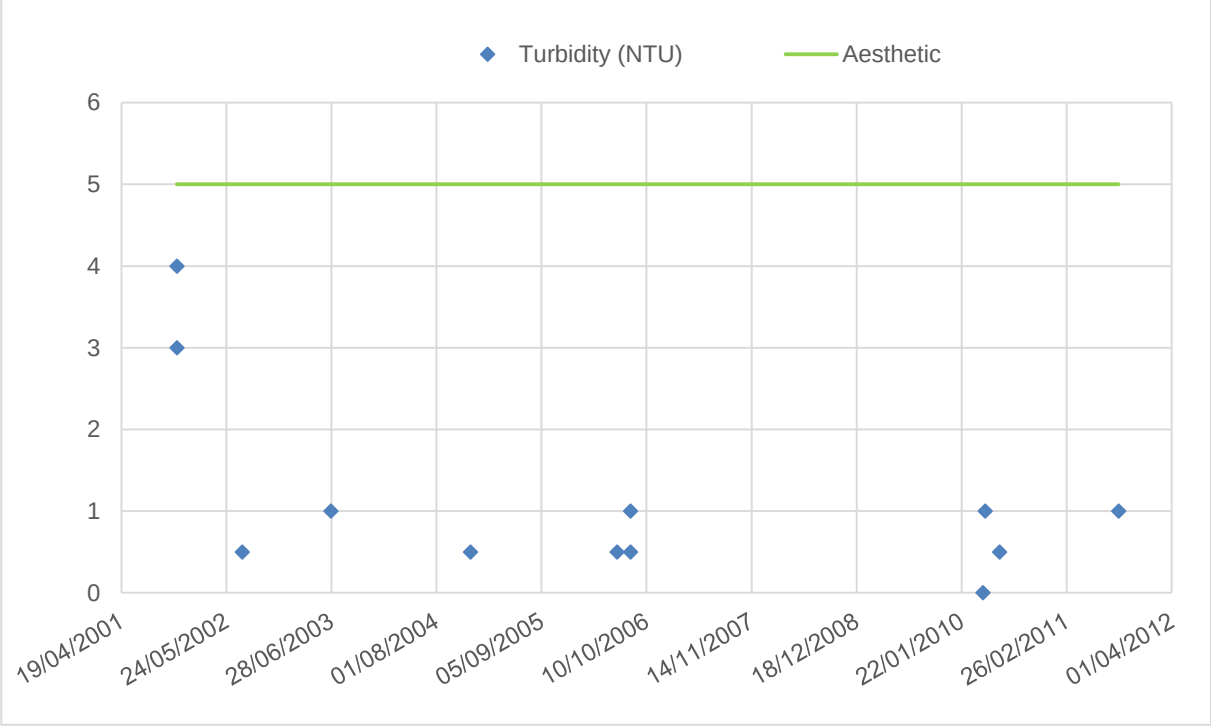


Figure 3.96 Jericho Source - Sodium

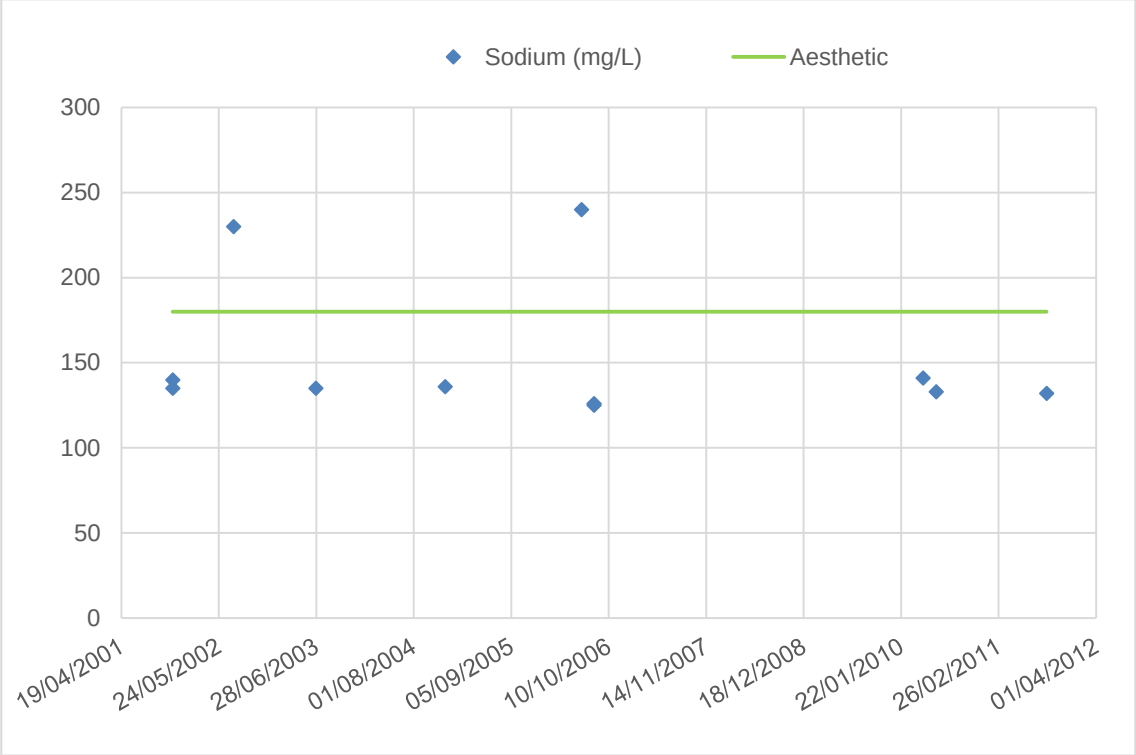


Figure 3.97 Jericho Source – Chloride

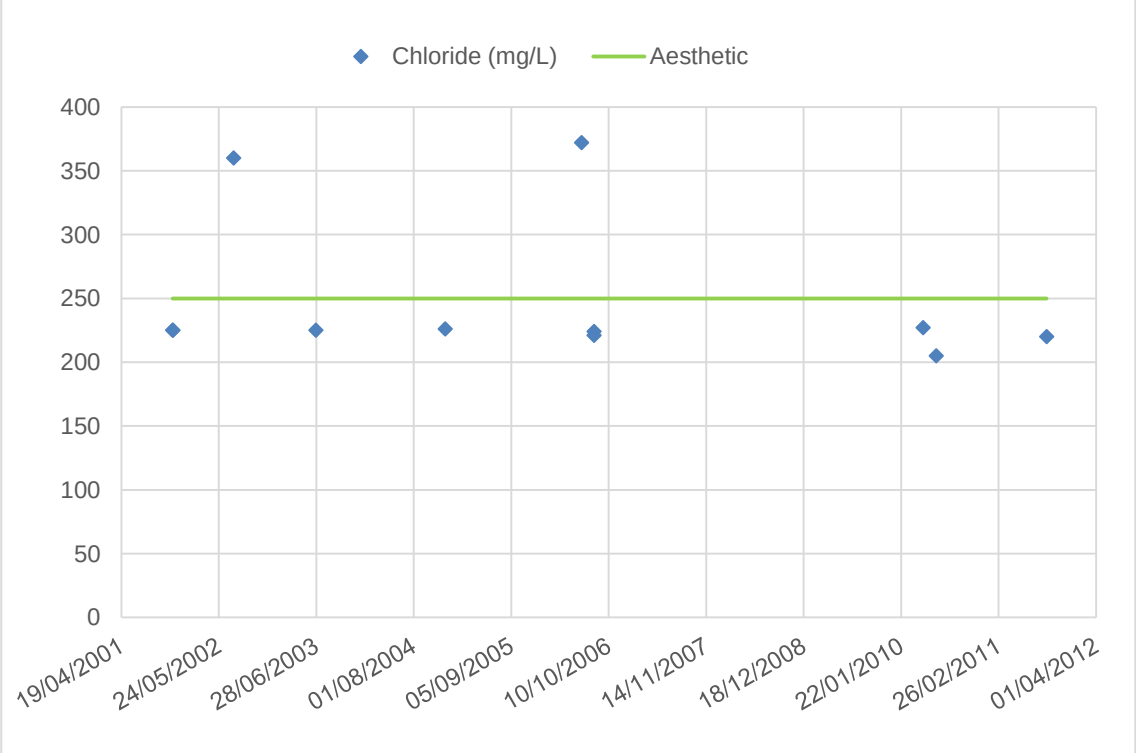


Figure 3.98 Jericho Source - Fluoride

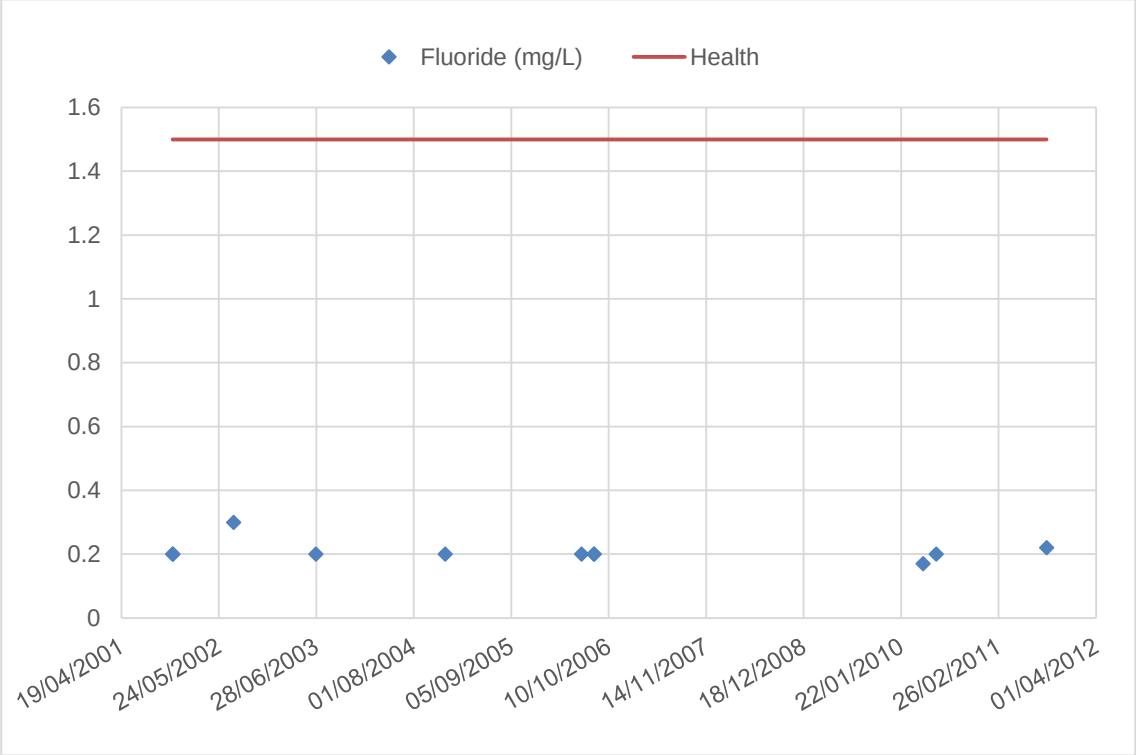


Figure 3.99 Jericho Source – Nitrate

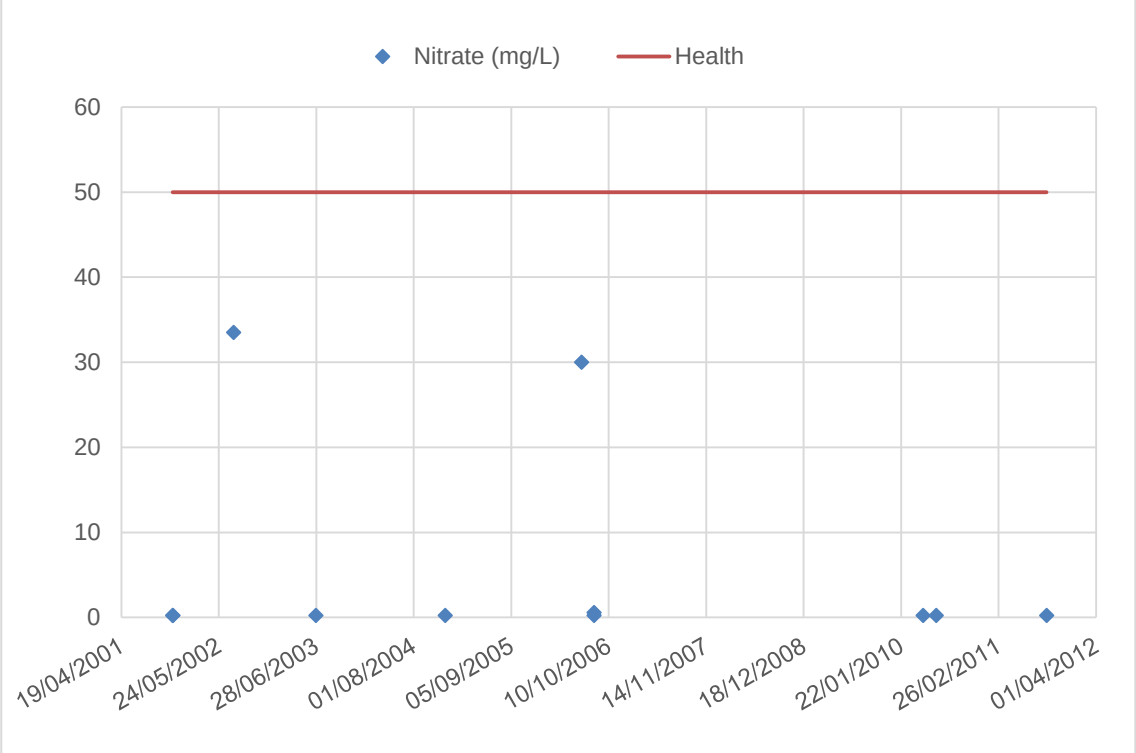


Figure 3.100 Jericho Source – Sulphate

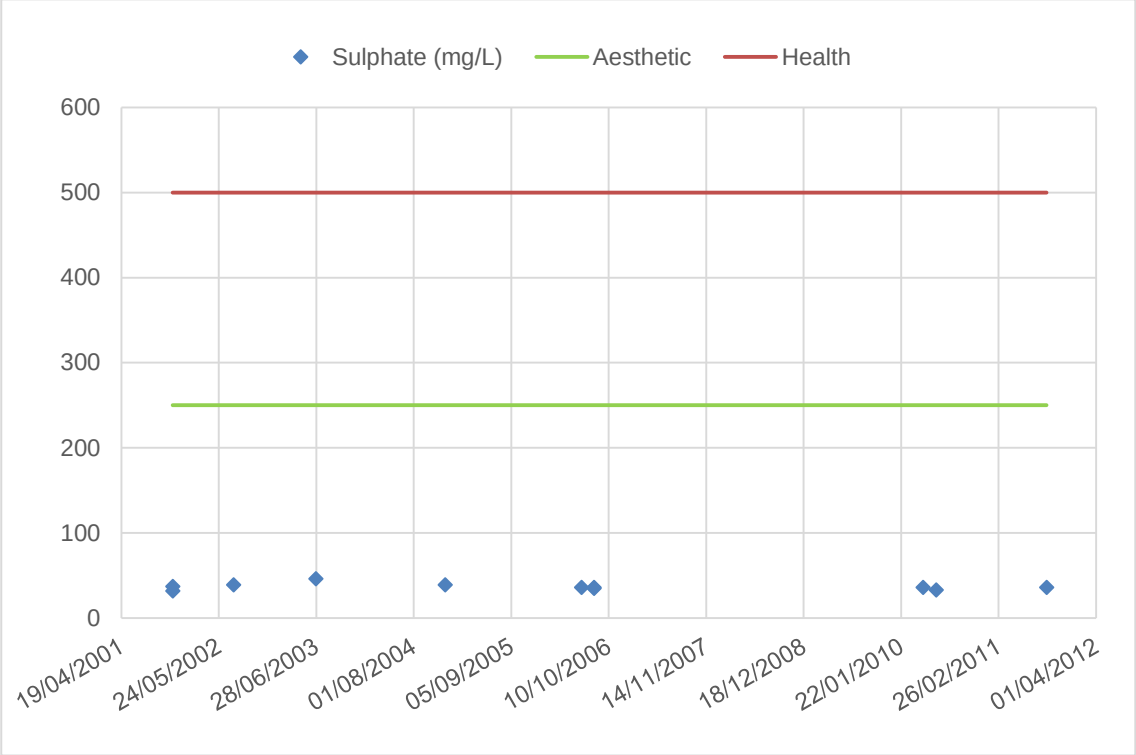


Figure 3.101 Jericho Source – Iron

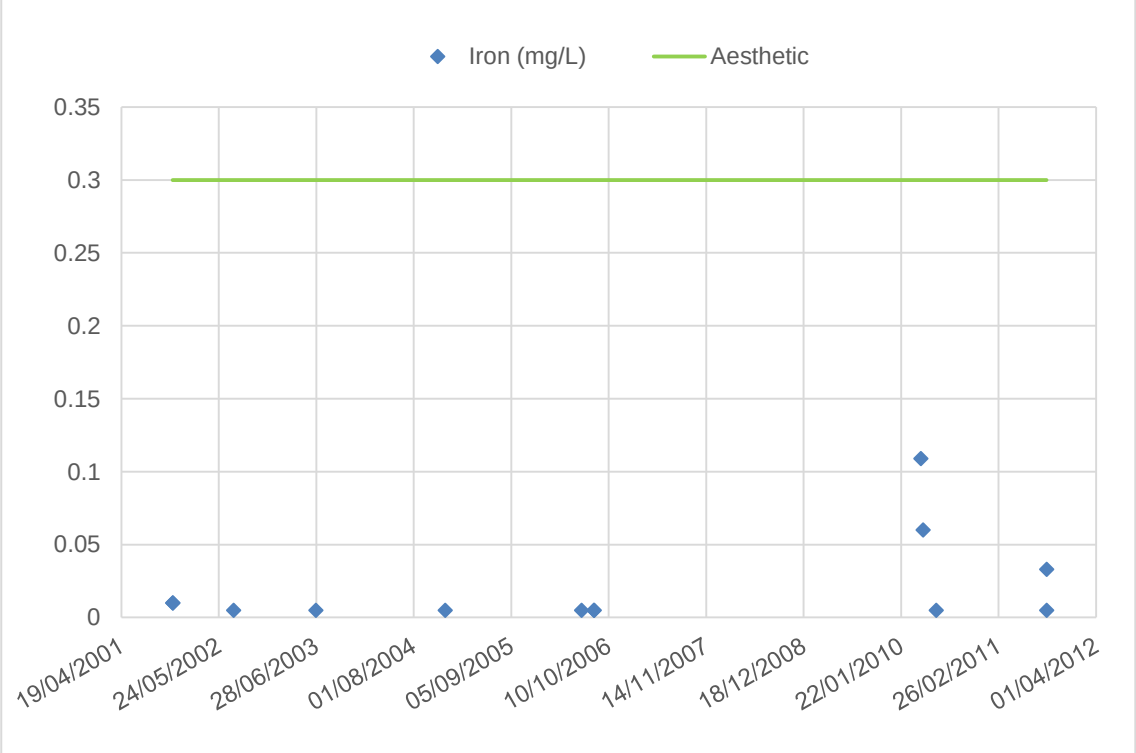


Figure 3.102 Jericho Source – Manganese

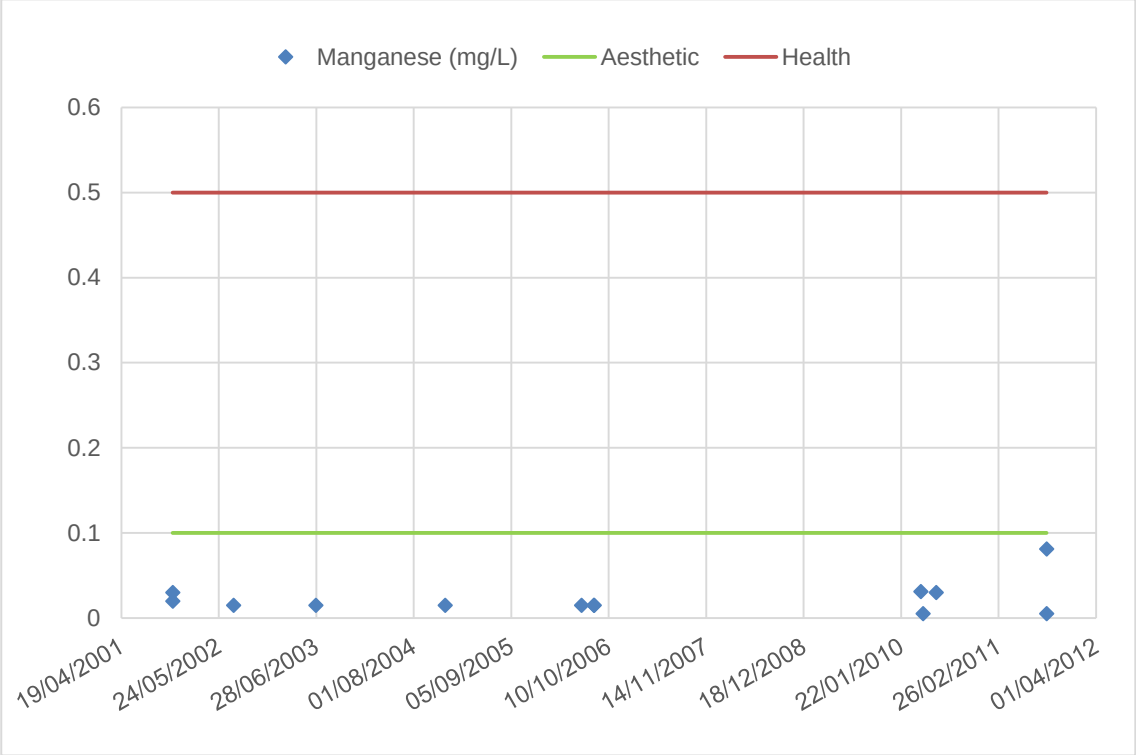


Figure 3.103 Jericho Source - Zinc

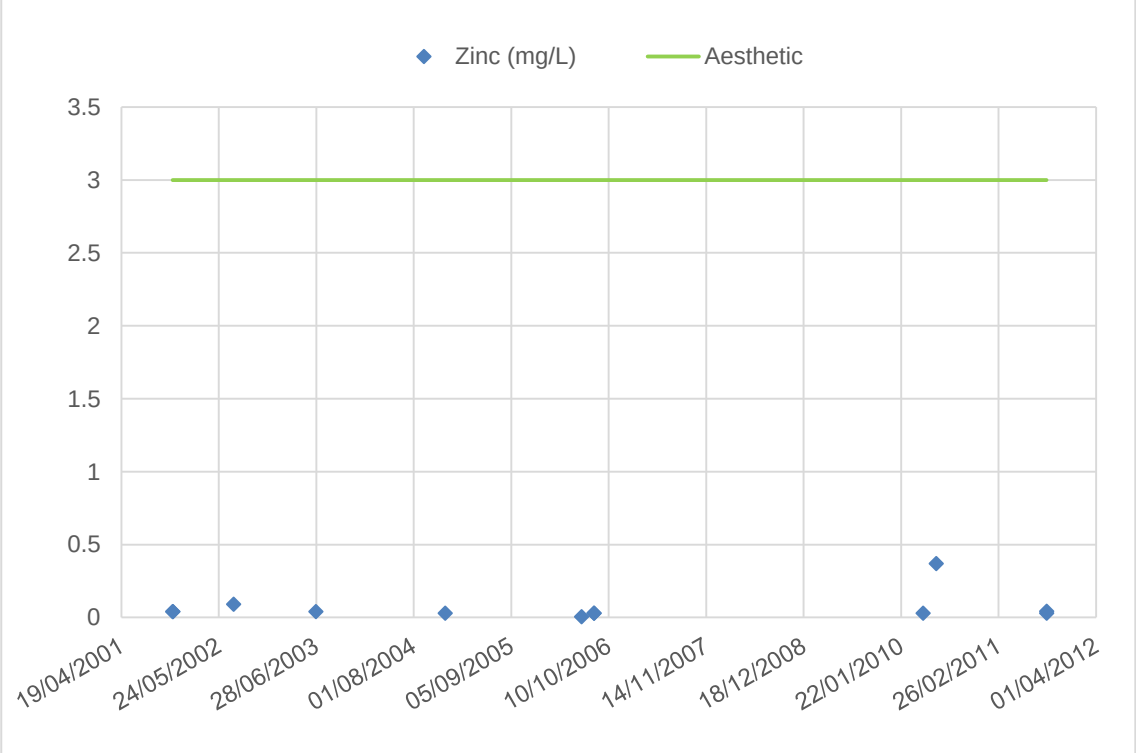


Figure 3.104 Jericho Source - Aluminium

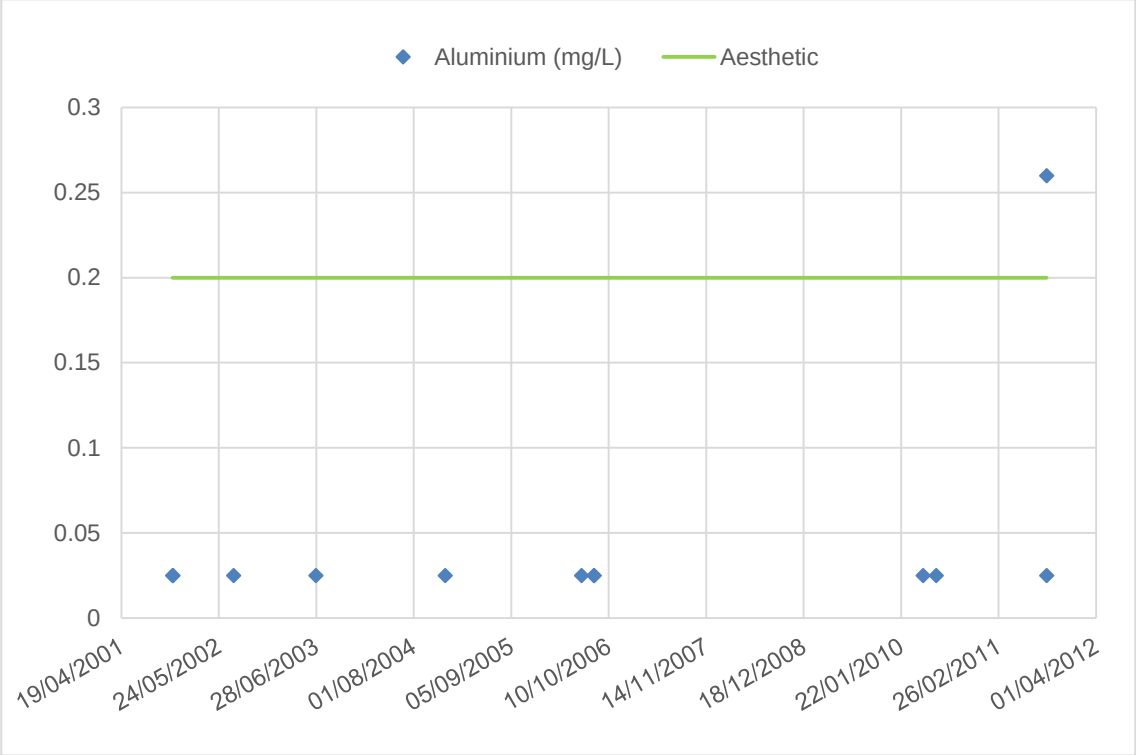


Figure 3.105 Jericho Source - Boron

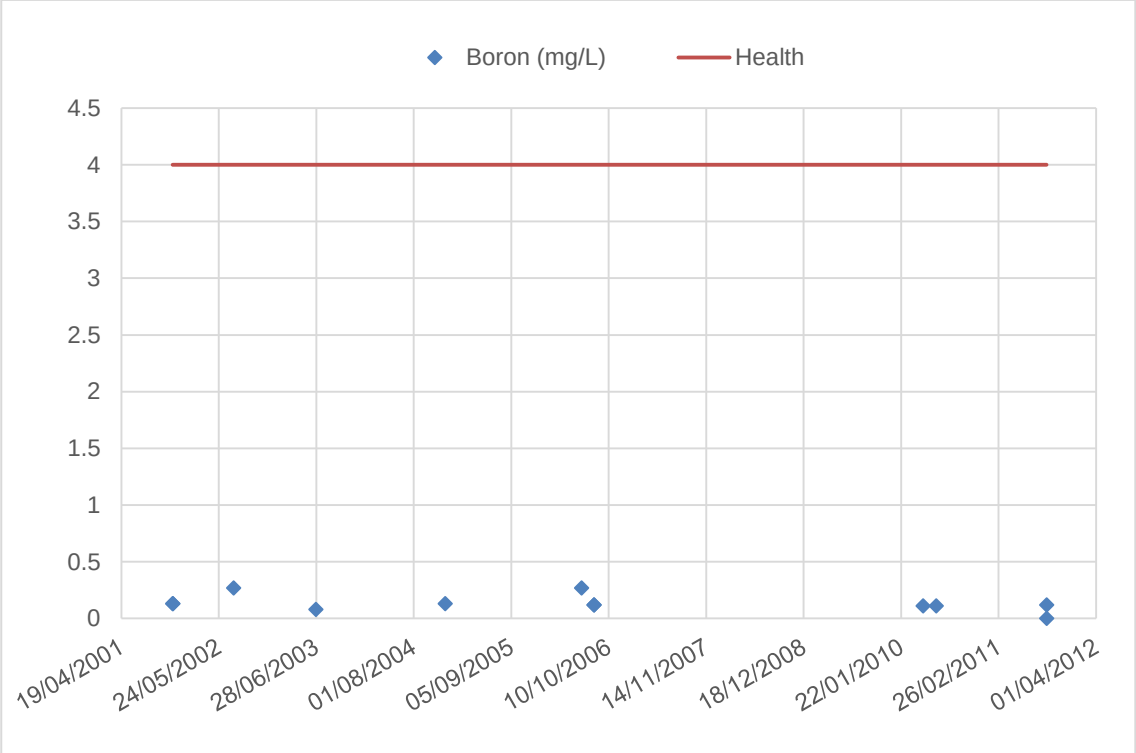
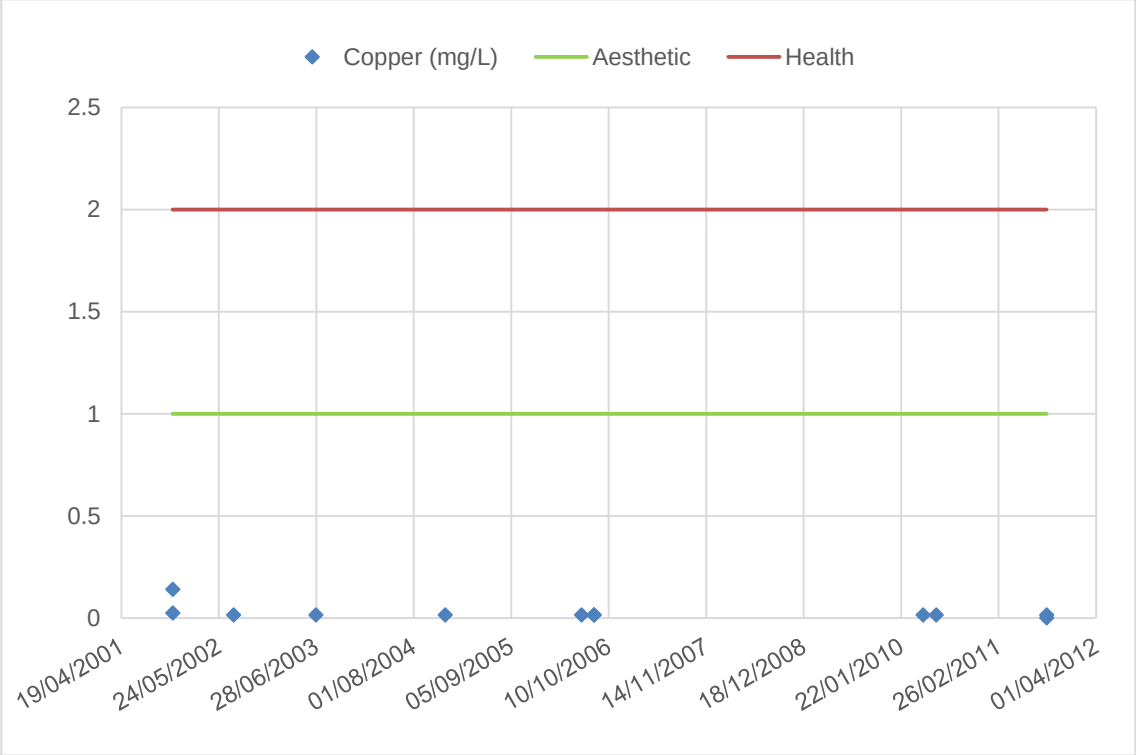


Figure 3.106 Jericho Source - Copper



3.4.1 (b) Interpretation

Table 3.15 above shows aesthetic guideline value exceedances[17] for pH, total hardness, total dissolved solids, true colour, sodium and chloride.

The following aesthetic characteristics were detected for the treated water supply (highlighted show exceedances):

- **pH**
- **Hardness**
- Silica
- **Total Dissolved Solids**
- **True colour**
- Turbidity
- **Sodium**
- **Chloride**
- Fluoride
- Iron
- Manganese
- Zinc
- Aluminium

The following health characteristics were detected (highlighted shows exceedances):

- Fluoride
- Nitrate
- Sulphate
- Boron
- **Chlorate**

Figure 3.73 provides a trend for the analysis of pH; there were four exceedances. A maximum value of 8.2, average value of 7.35, a minimum value of 6.08 and a 95th percentile value of 7.6 have been determined. The aesthetic guideline value has a range of 6.5 – 8.5. While extreme pH values (<4 and > 11) may adversely affect health, there is insufficient data to set a health guideline value. Water with a pH less than 6.5 may be corrosive. Were pH exceeds 8 the efficiency of chlorination decreases. Above 8.5 may cause scale and taste problems.

Figure 3.74 provides a trend for the analysis of total hardness; there is one exceedance. A maximum value of 238mg/l, average value of 85.3mg/l and a 95th percentile value of 86.6mg/l have been determined. The aesthetic guideline value is 200 mg/l (as $CaCO_3$). For hardness no health based guideline value is considered necessary. Water with a hardness of 60 – 200mg/l is regarded as a good quality drinking water.

Figure 3.76 provides a trend for the analysis of total dissolved solids; there was two exceedances. The aesthetic guideline value is 600 mg/l. For total dissolved solids no health based guideline value is considered necessary. A maximum value of 1020mg/l, average value of 471.8mg/l and a 95th percentile of 472.5mg/l were determined.

Figure 3.77 provides a trend for the analysis of true colour, there was one exceedance. The aesthetic guideline value is 15HU. For total colour no health based guideline value is considered necessary, however it should be noted that if colour is high at the time of disinfection then the water should be checked for disinfection by products such as Trihalomethane (THM) which have been associated through epidemiological studies with some adverse health effects. Water is disinfected before

[17] As per the Australian Drinking Water Guidelines (2011)

reticulation. A maximum value of 17HU, average value of 1.5HU and a 95th percentile of 5.5HU were determined. Up to 25 HU is acceptable were turbidity is low, while 15 HU is just noticeable in a glass.

Figure 3.79 provides a trend for the analysis of sodium; there was two exceedances. A maximum value of 265mg/l, average value of 137.6mg/l and a 95th percentile value of 140.6mg/l were determined. The aesthetic guideline value is 180 mg/l. For sodium no health based guideline value is considered necessary.

Figure 3.80 provides a trend for the analysis of chloride; there was two exceedances. A maximum value of 400mg/l, average value of 226.9mg/l and a 95th percentile value of 230mg/l were determined. The aesthetic guideline value is 180 mg/l. For chloride no health based guideline value is considered necessary. High concentrations of chloride are more common in groundwater supplies.

Chlorate is a by-product of chlorination. While there is currently insufficient data to set a health-related guideline value, the USA EPA value of 0.8mg/l has been adopted to determine health risks associated with concentrations present. Chlorate has been detected above the US EPA recommended value on two occasions since BRC commenced a program of monitoring for Chlorates. A maximum value of .89mg/l, average value of .32mg/l and a 95th percentile value of .69mg/l were determined.

There are aesthetic guideline value exceedances, and two health guideline value[18] exceedances recorded during the period summarised in Table 3.11 for treated water.

Of two-hundred and fifty-six (256) samples analysed for E. coli there have been zero E. coli colonies detected (see Figure 3.91).

Table 3.17 above shows aesthetic guideline value exceedances[19] for pH, hardness, silica, total dissolved solids, sodium, chloride and aluminium for raw water. These exceedances are not discussed here.

3.4.2 Catchment Characteristics

Jericho is located on the western side of the Great Dividing range on the flood plain of the Jordan Creek and in the Barcoo River catchment. The Jordan Creek sub-catchment extends approximately 70km to the south and includes a number of tributary catchments. Generally Jordan Creek will run annually. Jericho is located on porous sandy loam natural soil underlain by varying subsoil clay and sandy clay strata. Generally the countryside is devoid of grass due to the low rainfall and reasonably high temperatures in the region. Jericho is flat and has been prone to flooding in the past. A levee has been constructed and should provide additional protection in the event of a flooding event. Jericho has a current population of 139 permanent residents and has a current demand of 0.132 Ml/day.

Jericho is located in the prominent Central Western Queensland beef and wool producing area. Whilst cattle and sheep grazing are the main industries, rail transport and road infrastructure construction and maintenance also contributes significantly to provide a stable employment base for the area. Tourism is also a significant industry within the town.

The average annual rainfall for Jericho is 497mm[20]. With the majority of the rain falling between late December and late March with little or no rainfall during any other period. The mean maximum temperature is 30.4°C[20] although temperatures often exceed the 40°C mark during the summer months. The average annual pan evaporation for Jericho is approximately 2,800mm[21].

[18] As per the USA EPA standard
[19] As per the Australian Drinking Water Guidelines (2011)
[20] 30 year mean at Barcaldine Post Office (nearest available climate statistics)
[21] DPI Water Resource's Commission

Severe flooding of Jericho has occurred on a number of occasions. In 1990 the town was inundated except for a small section of the railway where the Capricorn Highway crosses the central railway line on the north-eastern end of town. The town has experienced six to seven major floods in the past century including the most recent event in 2010/2011. The recently completed levee bank should provide additional protection in the event of a flood.

Currently there are two sub artesian bores in Jericho. The dual bore field is located on the same site as the water treatment plant off Darwin Street. The bores are 120m and 124m deep and yield 10 l/s each. Access to all bores is limited to authorised personnel only by way of security fencing and all bore headwork's are sealed against the possibility of deliberate contamination. The bore water quality does not comply with Australian Drinking Water Quality Guidelines. Appendix B Figure M-2012-006 shows the bores and water treatment plant locations and water reticulation layout on an aerial photo of the town.

There are three potential water bearing formations in the Jericho area, the Clemantis Sandstone, the Jordan Creek Alluvium and the Tertiary Sediments. During test drilling the Clemantis Sandstone and the Jordan Creek Alluvium formations were ruled out as potential sources due to high infrastructure costs and limited water supplies respectively.

The town is located just west of the Great Dividing Range and on the edge of the Great Artesian Basin. The Clematis Sandstone is a water bearing formation and is part of the artesian basin. This formation outcrops east of Jericho and dips to the west.

It is overlain by Moolyamber Formation (a poor producer of water) and the sedimentary Jordan Creek Alluvium and Clemantis Sandstone materials at Jericho. The Clematis is not generally tapped in the western parts of the artesian basin due to its extreme depth, the shallower artesian units more commonly tapped outcrop about 30 kilometres west of Jericho and do not occur in this area.

Although the mapping in this area does not show any detail on major structures, there is a possibility that features such as faults and folds are located in the vicinity of Jericho.

The Tertiary Sediments formation is considerably older than the recent Jordan Creek Alluvium and consists of fine sands, sandstone, siltstone, claystone, and shales. The unconsolidated sediments in this formation are also "alluvial" in nature but these sediments were deposited by much older and larger fluvial systems than the present creeks in the area. Similar Tertiary Sediments are known to cover thousands of square kilometres in Central Queensland, and are also located at Alpha.

Groundwater is extracted from the fine sands and weathered sandstones in this formation. The yields and quality from the Tertiary Sediments in Central Queensland are known to be extremely variable and around the Jericho area the formation runs true to form. Supplies can vary from 0.5 to 18.0 l/s and the quality from very good to saline. There are a number of small, possibly interconnected water beds in this formation and these may occur to depths as deep as 150m at Jericho. Data indicates that these water beds occur as horizontal layers that extend for some distance. The water beds are made up of very fine sands or weathered sandstone and each water bed can vary from less than 1m to 10m in thickness.

Jericho does not have a sewage collection or treatment system with sewage conveyed to individual septic tanks (with percolation). BRC is currently considering the feasibility of constructing a sewage collection and treatment system for the town with the possibility of utilising the reclaimed water for irrigation purposes. The groundwater sources show no indication of contamination from the septic tanks. The sub artesian bores have been annuli sealed off to prevent contamination from surface water leachate.

3.4.2 (a) Proposed Mining Impact

3.1.2 (a) above refers.

3.4.3 Hazard Identification

The hazards and hazardous events and their sources that adversely affect water quality are documented in Table 3.22 below and include those affecting:

- Catchment
- Sourcing infrastructure
- Treatment plants (where applicable)
- Disinfection process(es) (where applicable)
- Distribution system

3.4.3 (a) Identifying and documenting hazards and hazardous events

The hazards and hazardous events were identified using data contained in the plan and following site visits and a risk assessment workshop which was conducted on 8 and 9 November 2011. A recent risk assessment workshop was conducted in December 2017 prior to amendment of the plan;

- Section 2.4 Jericho Water Supply Scheme
- Section 3.4.1 Water quality information
- Section 3.4.2 Catchment Characteristics

Table 3.18 Jericho Hazard Identification, Risk Assessment and Uncertainty

Scheme Component / Sub-component	Hazardous Event	Hazard	Maximum Risk			Existing Preventive Measures / Barriers.	Residual risk			Uncertainty	Comments/ Proposed Further Risk Reduction Actions
			Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
Source	Septic system discharges	Bacteria	Catastrophic	Unlikely	High (10)	Disinfection Automated Chlorine monitoring Telemetry alarms for dosing failure	Moderate	Rare	Low (3)	Reliable	Continue to monitor for E.coli. **J1**: Draft standard operating procedures and / or manual of operations. **J2** Commence sampling source water in addition to treated water. **J3** Identify effect of flooding on bore water quality considering private bores which exist on the flood plain which may not be capped.
	Flood event	Substances (not identified)	Catastrophic	Rare	Medium (6)	Treatment, Capped Bores	Moderate	Rare	Low (3)	Uncertain	
	Hazard that arises from the natural geological processes in the aquifer.	pH	Insignificant	Unlikely	Low (2)	pH Adjustment, Automated monitoring	Insignificant	Rare	Low (1)	Reliable	
		Hardness	Insignificant	Possible	Low (3)	Nil	Insignificant	Possible	Low (3)	Reliable	
		TDS	Insignificant	Almost Certain	Medium (6)	Nil	Insignificant	Almost Certain	Medium (6)	Reliable	
		True Colour	Insignificant	Rare	Low (1)	flocculation, clarification and filtration	Insignificant	Rare	Low (1)	Reliable	
		Sodium	Insignificant	Likely	Medium (5)	Nil	Insignificant	Likely	Medium (5)	Reliable	
		Chloride	Insignificant	Likely	Medium (5)	Nil	Insignificant	Likely	Medium (5)	Reliable	
Sourcing Infrastructure	Power Outage	Disruption to supply	Moderate	Unlikely	Medium (6)	Elevated reservoir (limited backup) and Mobile Backup generator	Insignificant	Rare	Low (1)	Confident	Acceptable risk
	Flood event	Loss of infrastructure	Catastrophic	Rare	Medium (6)	Flood Mitigation (levee)	Moderate	Rare	Low (3)	Uncertain	
	Maintenance and repair of raw water main	Bacteria	Catastrophic	Unlikely	High (10)	Mains repair procedure and treatment	Moderate	Rare	Low (3)	Reliable	**J1** Draft procedure for reticulation repair. Current procedures are inadequate.
Treatment Plant	Power Outage	Disruption to supply	Moderate	Unlikely	Medium (6)	Elevated reservoir (limited backup) and Mobile Backup generator	Insignificant	Rare	Low (1)	Confident	Acceptable risk
	Flood event	Loss of infrastructure	Catastrophic	Rare	Medium (6)	Flood Mitigation (levee)	Moderate	Rare	Low (3)	Uncertain	
	Bypass treatment plant	True Colour	Insignificant	Rare	Low (1)	On-site drawings showing valve numbering, training and valve maintenance. Procedure for plant operations and maintenance and backwash.	Insignificant	Rare	Low (1)	Reliable	**J1**: Draft and implement standard operating procedures and / or manual of operations. Current Procedures are inadequate and do not cover specific operations. **J4** Operator requires training and handover process to be implemented.
		Turbidity	Insignificant	Unlikely	Low (2)		Insignificant	Rare	Low (1)	Reliable	
		Bacteria	Catastrophic	Unlikely	High (10)		Moderate	Rare	Low (3)	Reliable	
	Alum under dose / Failure of Alum Dosing Equipment	True Colour	Insignificant	Rare	Low (1)	Operational monitoring, manual adjustment Automated Turbidity and pH monitoring Telemetry alarms for critical level exceedance	Insignificant	Rare	Low (1)	Reliable	**J1** Draft standard operating procedures and / or manual of operations. Current Procedures are inadequate. **J4** Operator requires training and handover process to be implemented.
		Turbidity	Insignificant	Unlikely	Low (2)		Insignificant	Unlikely	Low (2)	Reliable	
		Bacteria	Catastrophic	Unlikely	High (10)		Moderate	Rare	Low (3)	Reliable	
	Alum over dosing	Alum	Moderate	Rare	Low (3)		Moderate	Rare	Low (3)	Uncertain	

Scheme Component / Sub-component	Hazardous Event	Hazard	Maximum Risk			Existing Preventive Measures / Barriers.	Residual risk			Uncertainty	Comments/ Proposed Further Risk Reduction Actions
			Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
	Hydrochloric Acid over / under dosing	Hydrochloric Acid	Insignificant	Rare	Low (1)	Automated pH monitoring and Telemetry alarms for critical level exceedance	Insignificant	Rare	Low (1)	Confident	
	Walkway Access over filtration tank	Harmful substances (not identified)	Catastrophic	Rare	Medium (6)	Restricted access, operator training.	Moderate	Rare	Low (3)	Uncertain	
Disinfection Process	Over Chlorination	Chlorine	Moderate	Unlikely	Medium (6)	Automated Chlorine monitoring Telemetry alarms for dosing failure	Moderate	Rare	Low (3)	Estimate	
	Under Chlorination	Bacteria	Catastrophic	Unlikely	High (10)		Catastrophic	Rare	Medium (6)	Estimate	
	Low residual chlorine in Elevated Reservoir	Chlorine	Moderate	Unlikely	Medium (6)	Tank automatically refills at 70% full in order to turn water over	Moderate	Rare	Low (3)	Uncertain	
	Failure of Disinfectant Dosing Pumps	Bacteria	Catastrophic	Unlikely	High (10)	Automated Chlorine monitoring Telemetry alarms for dosing failure	Catastrophic	Rare	Medium (6)	Estimate	
	Power Outage	Disruption to supply	Moderate	Unlikely	Medium (6)	Elevated reservoir and Backup mobile generator	Insignificant	Rare	Low (1)	Confident	Acceptable risk
	Chlorination By-products	Chlorate	Major	Possible	High (12)	Installation of calcium hypochlorite system Verification monitoring of Chlorates Automated chlorine monitoring	Major	Unlikely	Medium (8)	Estimate	**J1** Draft standard operating procedures and / or operations manual.
	pH >8	Chlorine	Moderate	Unlikely	Medium (6)	pH adjustment Automated monitoring of pH Telemetry alarms for critical level exceedance	Moderate	Unlikely	Medium (6)	Estimate	**J1** Current Procedures are inadequate, Draft standard operating procedures and / or operations manual.
	Insufficient contact time	Chlorine	Moderate	Unlikely	Medium (6)	Automated Chlorine monitoring Telemetry alarms for dosing failure	Moderate	Rare	Low (3)	Estimate	**Acceptable risk**
Distribution System	Reticulation maintenance and repair	Bacteria	Catastrophic	Unlikely	High (10)	Mains repair procedure and Monitoring	Moderate	Rare	Low (3)	Uncertain	**J1** Draft revised procedure for reticulation repair and monitor
Whole of system	Flights carrying samples to lab delayed/cancelled	Logistical	Insignificant	Possible	Low (3)	Nil	Insignificant	Possible	Low (3)	Confident	Acceptable risk

3.4.3 (b) Hazard Identification (and Risk Assessment) Team

The personnel responsible for the hazard identification and risk assessment process, their roles and responsibilities are detailed in the Table below.

Table 3.19 Hazard Identification and Risk Assessment Team

Typical Job Title for Key Personnel	What Role Did Each Person Play On the Team?	What Expertise and System Knowledge Did The Person Bring?
Manager of Engineering Services	Management of DWQMP Process, Risk Assessment Procedure & Chairing Risk Assessment Workshop	High level knowledge, risk assessment and identification, general engineering experience in the management of the systems
Engineer (Internal / External)	Author, Risk Assessment, Risk Assessment Workshop	Detailed knowledge of the system, water risk assessment and identification
Water Engineer (Internal / External)	Risk Assessment Workshop	Detailed knowledge of drinking water quality management, outside perspective, risk assessment and identification
Water / Technical Officers	Risk Assessment Workshop	Detailed knowledge of individual schemes, risk identification

3.5 Muttaburra Water Quality and Catchment Characteristics

Muttaburra water supply scheme is comprised of two artesian bores delivering water directly to reticulation. The source water is not treated prior to reticulation.

3.5.1 Water Quality Information

Water quality information for Muttaburra includes the following:

(a) Summary
(b) Interpolation

3.5.1 (a) Summary

Table 3.20 below summarises the available reticulated water quality for the Muttaburra water supply scheme.

Figure 3.107 to Figure 3.124 below show trends of the main parameters contained in Table 3.20 over the time period specified.

The responsibility for obtaining the water samples rests with the DWSP and samples are collected by the Water Officer monthly. Samples are sent to Queensland Health Scientific Services for analysis. The DWSP also samples and analyses drinking water for E. coli.

Table 3.20 Muttaburra Reticulated Water

Muttaburra Water Supply		Start Date	09/06/2010		End Date:	03/01/2018					
Characteristic	Units	No. of Samples	Summary of Results					Guideline Value			
			Maximum Value	Average Value	Minimum Value	Std Dev	95th Percentile	Health	Exceedances	Aesthetic	Exceedances
Conductivity	uS/cm	150	542.000	450.340	430.000	13.538	469.100				
pH		150	8.360	7.758	7.460	0.302	8.002			≥6.5 & ≤ 8.5	0
Total Hardness	mg/L as $CaCO_3$	150	96.600	6.945	5.500	7.429	7.000				
Temporary Hardness	mg/L as $CaCo_3$	150	18.000	6.344	5.500	1.118	6.910			200	0
Alkalinity	mg/L $CaCo_3$	150	192.000	155.509	3.400	59.838	189.550				
Residual Alkalinity	meq/L	150	194.000	27.357	3.000	60.980	185.550				
Silica	mg/L	150	30.000	28.467	20.000	0.914	29.000			80	0
Total Dissolved Ions	mg/L	150	378.000	355.767	263.000	12.214	372.550				
Total Dissolved Solids	mg/L	150	600.000	276.680	247.000	27.299	285.550			600	0
True Colour	Hazen	150	68.000	10.057	0.500	10.117	26.550			15	37
Turbidity	NTU	150	13.000	0.723	0.500	1.070	1.000			5	1
pH (Saturation)*		150	8.900	8.867	7.900	0.100	8.900				
Saturation Index		150	0.500	-1.081	-1.400	0.204	-0.800				
Mole Ratio		150	8.900	1.898	1.300	0.592	2.000				
Sodium Absorption Ratio		150	18.000	16.549	-1.200	1.874	18.000				
Figure of Merit		150	2.000	0.015	0.000	0.163	0.000				
Sodium	mg/L	150	103.000	94.673	16.000	7.080	100.000			180	0
Potassium	mg/L	150	9.300	8.473	0.000	0.910	9.100				
Calcium	mg/L	149	94.000	2.772	1.900	7.512	2.360				
Magnesium	mg/L	150	8.900	0.265	0.200	0.708	0.300				
Hydrogen	mg/L	150	2.200	0.015	0.000	0.179	0.000				
Bicarbonate	mg/L	150	234.000	215.775	0.200	18.918	230.550				
Carbonate	mg/L	150	2.800	0.796	0.000	0.334	1.255				
Hydroxide	mg/L	150	212.000	1.413	0.000	17.252	0.000				
Chloride	mg/L	150	42.000	31.844	0.600	2.803	33.000			250	0
Fluoride	mg/L	149	0.525	0.239	0.000	0.046	0.280	1.5	0		

Muttaburra Water Supply		Start Date	09/06/2010		End Date:	03/01/2018				
Characteristic	Units	No. of Samples	Summary of Results					Guideline Value		
			Maximum Value	Average Value	Minimum Value	Std Dev	95th Percentile	Health	Exceedances	Aesthetic	Exceedances
Nitrate	mg/L	150	31.000	0.455	0.250	2.502	0.250	50	0		
Sulphate	mg/L	150	0.500	0.498	0.200	0.024	0.500	500	0	250	0
Iron	mg/L	151	2.300	0.352	0.005	0.337	0.880			0.3	65
Manganese	mg/L	151	0.100	0.076	0.005	0.010	0.090	0.5	0	0.1	0
Zinc	mg/L	151	0.680	0.025	0.002	0.073	0.105			3	0
Aluminium	mg/L	151	0.080	0.025	0.000	0.006	0.025			0.2	0
Boron	mg/L	151	0.100	0.078	0.015	0.008	0.090	4	0		
Copper	mg/L	150	0.150	0.017	0.001	0.012	0.015	2	0	1	0
E. coli		165	0.000	0.000	0.000	0.000	0.000	0	0		

Table 3.21 Water quality complaints

Year	No of Water Quality Complaints	Water Quality Complaints per 1000 Connections	Main Reasons for Complaints	Likely Sources / Causes of Problems	Resolution of Problem
2018	0	0	Data not available		
2017	0	0			
2016	0	0			
2015	No Data				
2014					
2013					
2012					
2011	2	19.23			
2010	2	18.35			
2009	2	18.35			

Figure 3.107 Muttaburra - pH at 23°C

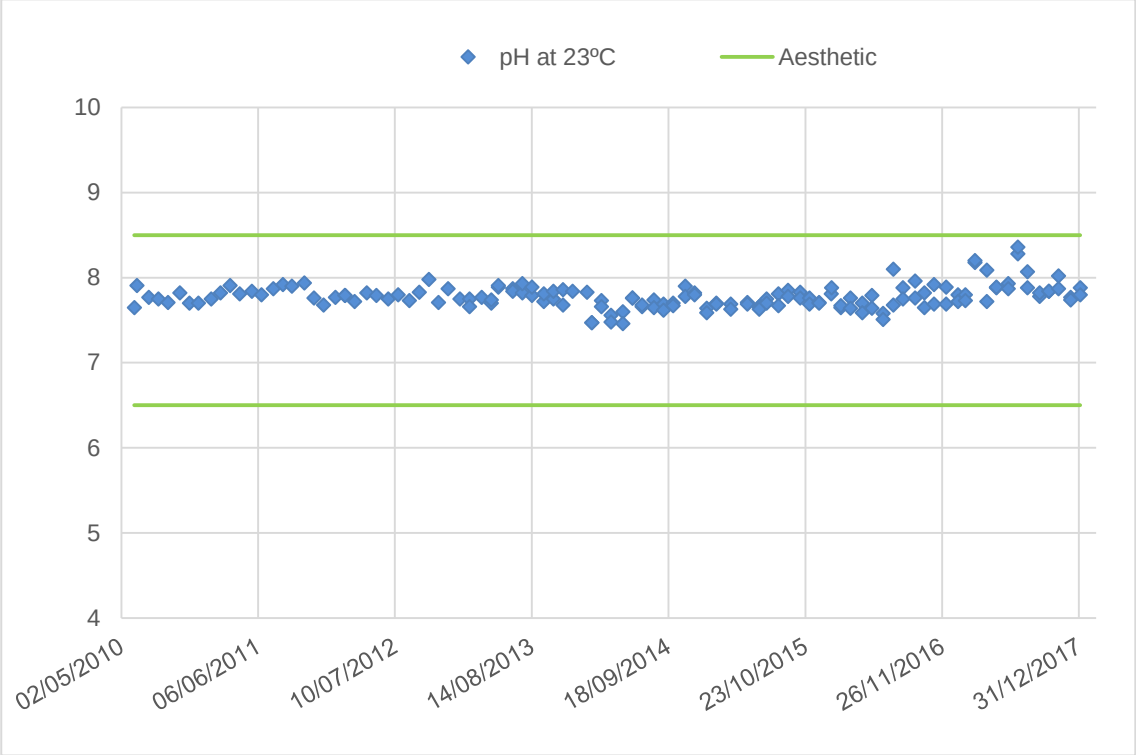


Figure 3.108 Muttaburra - Total Hardness

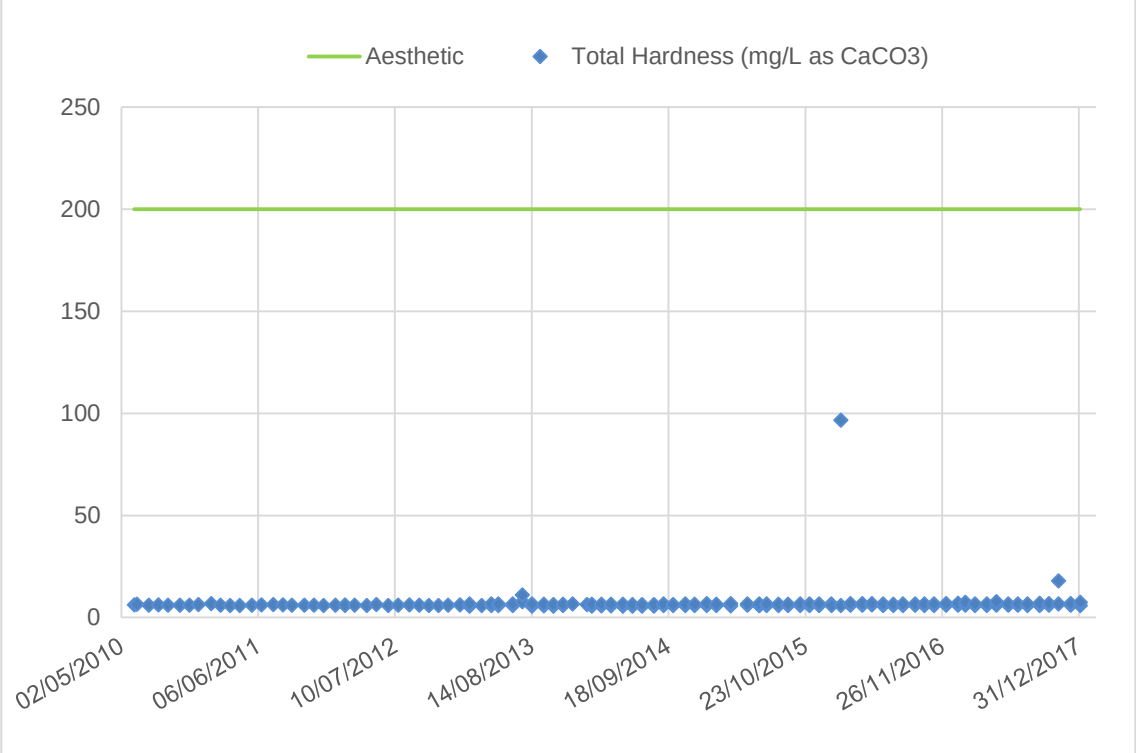


Figure 3.109 Muttaburra - Silica

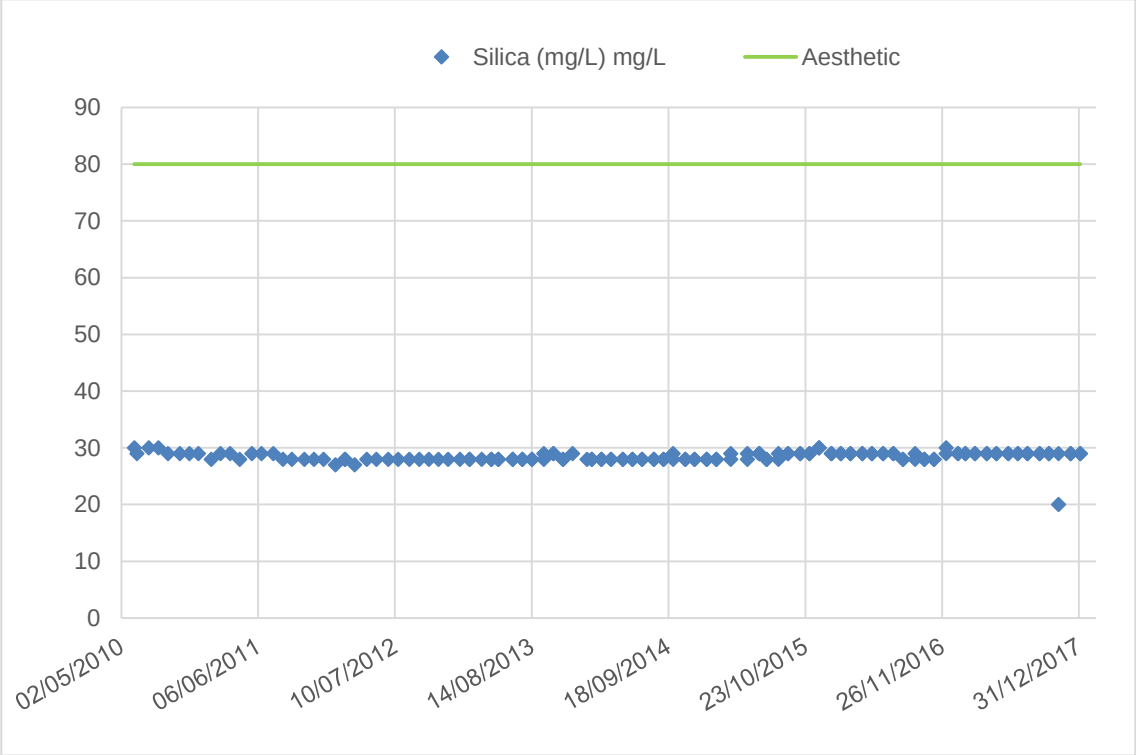


Figure 3.110 Muttaburra - Total Dissolved Solids

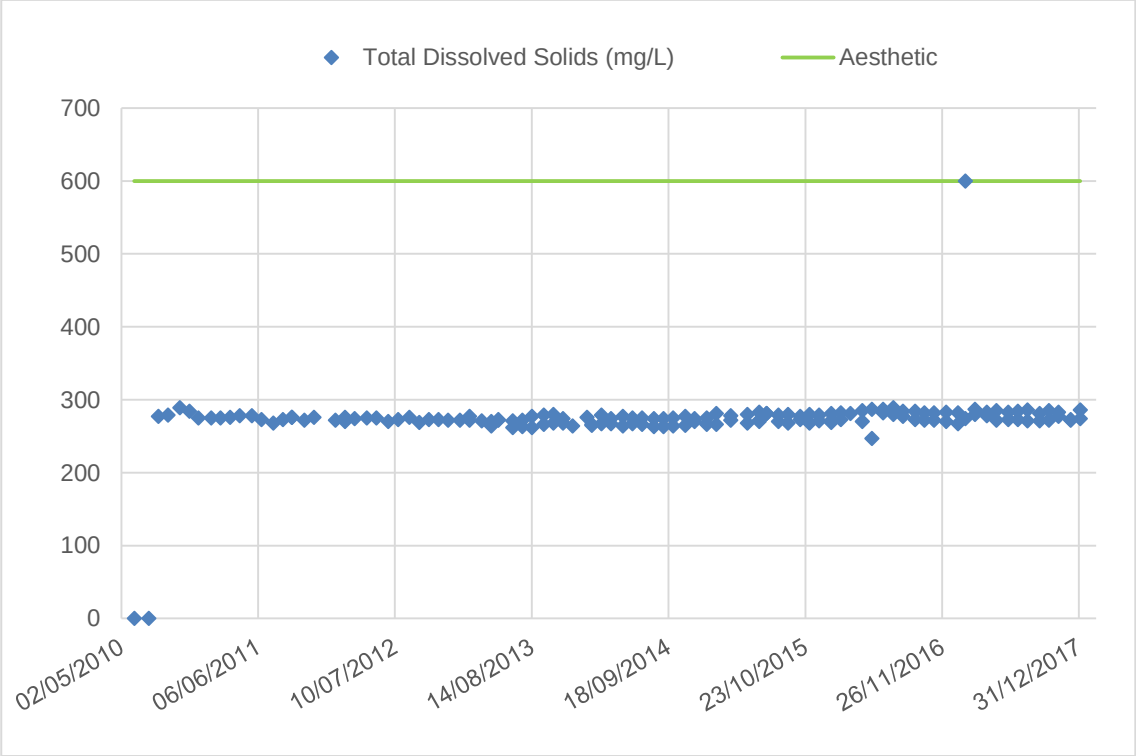


Figure 3.111 Muttaburra - True Colour

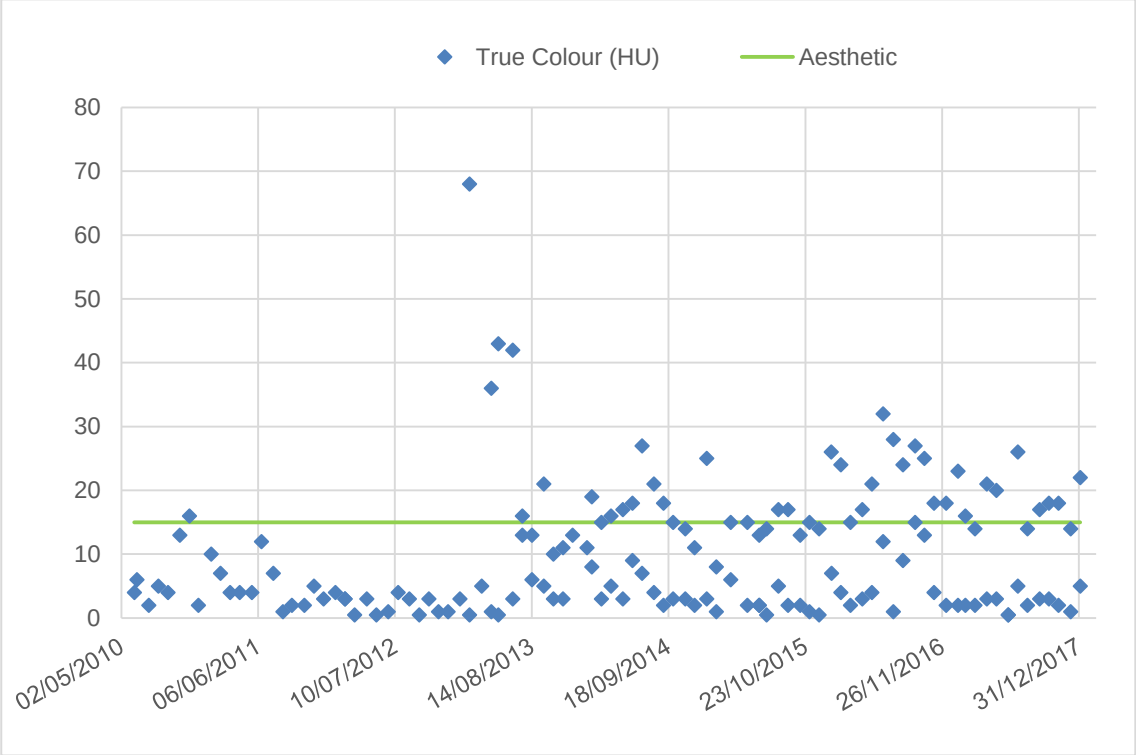


Figure 3.112 Muttaburra - Turbidity

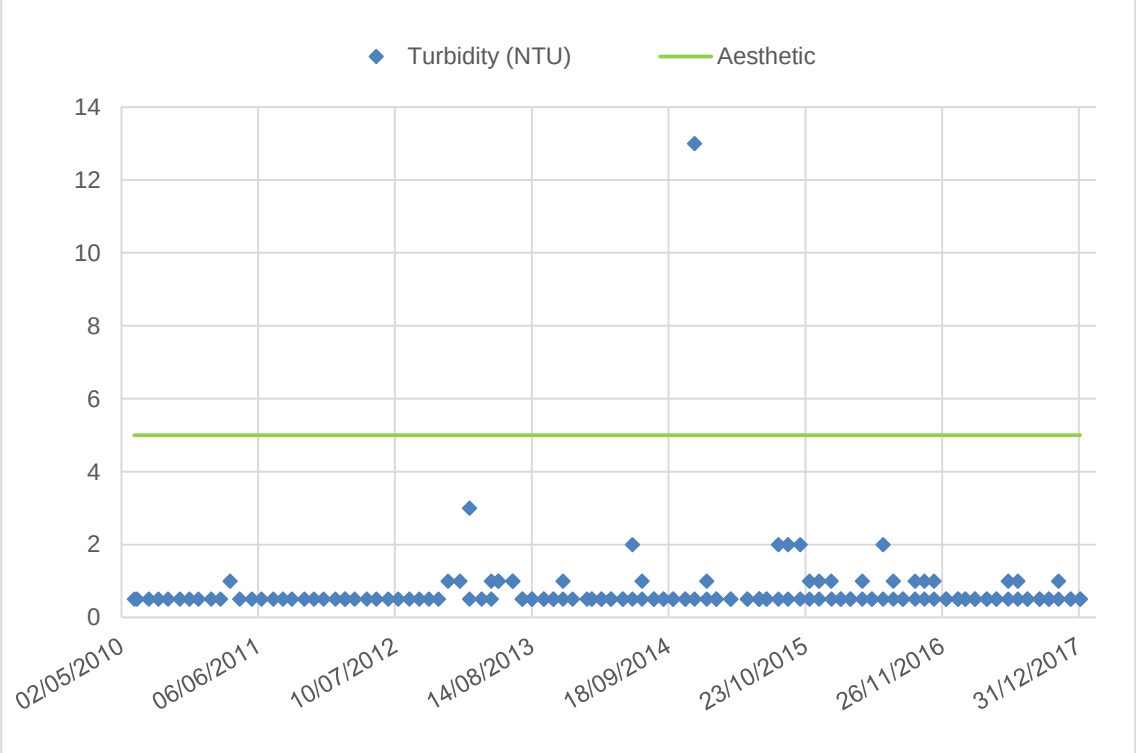


Figure 3.113 Muttaburra - Sodium

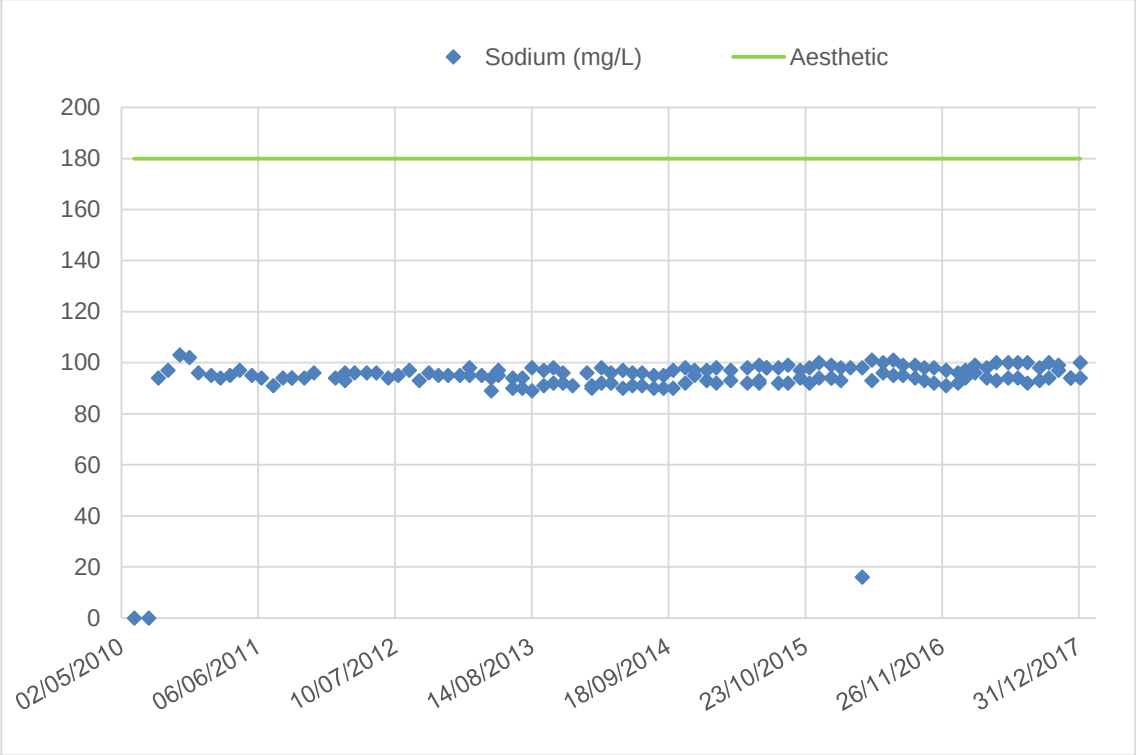


Figure 3.114 Muttaburra - Chloride

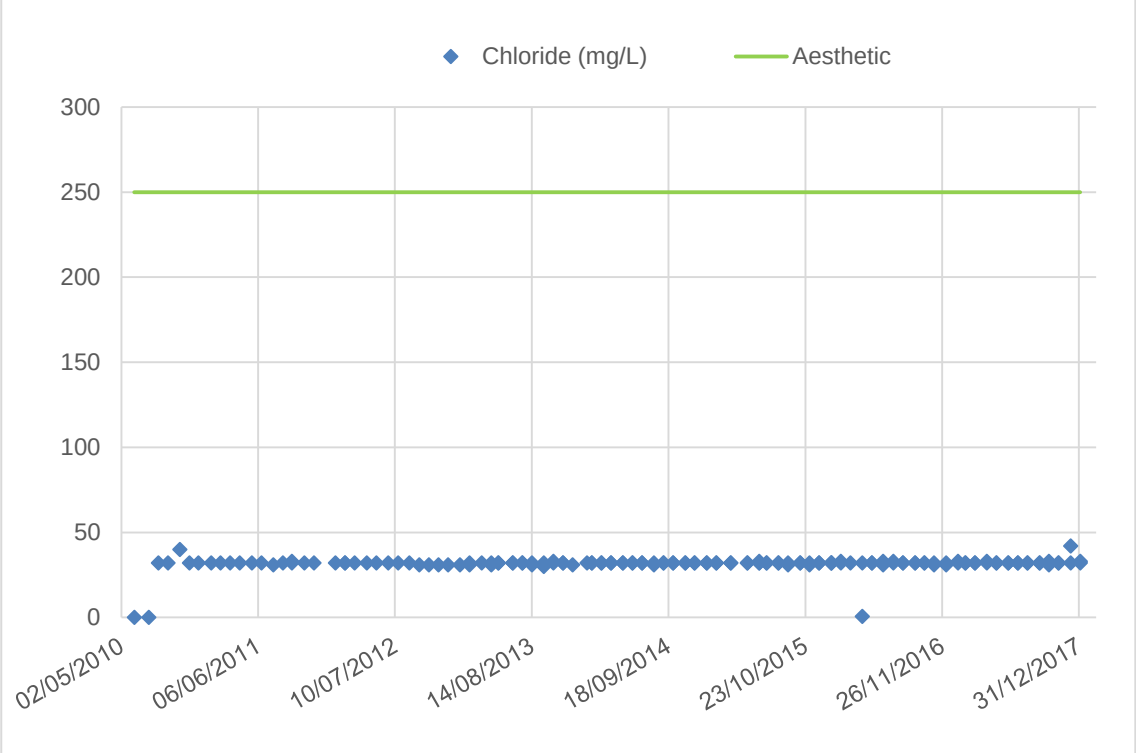


Figure 3.115 Muttaburra - Fluoride

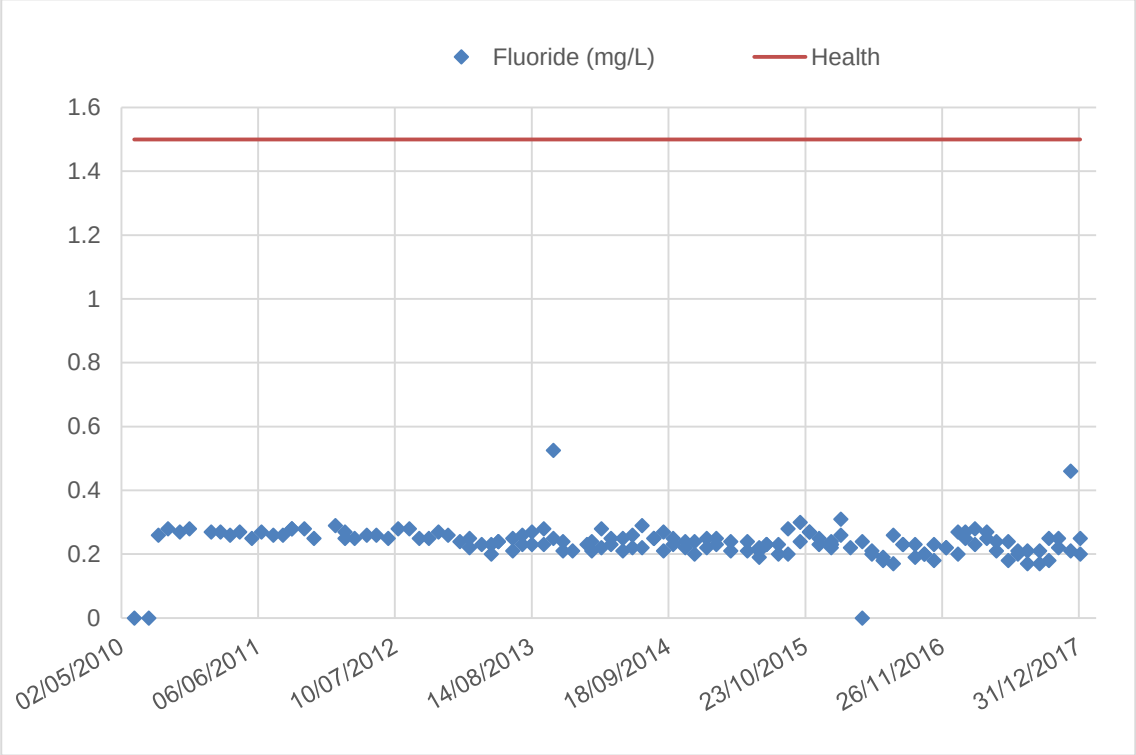


Figure 3.116 Muttaburra - Nitrate

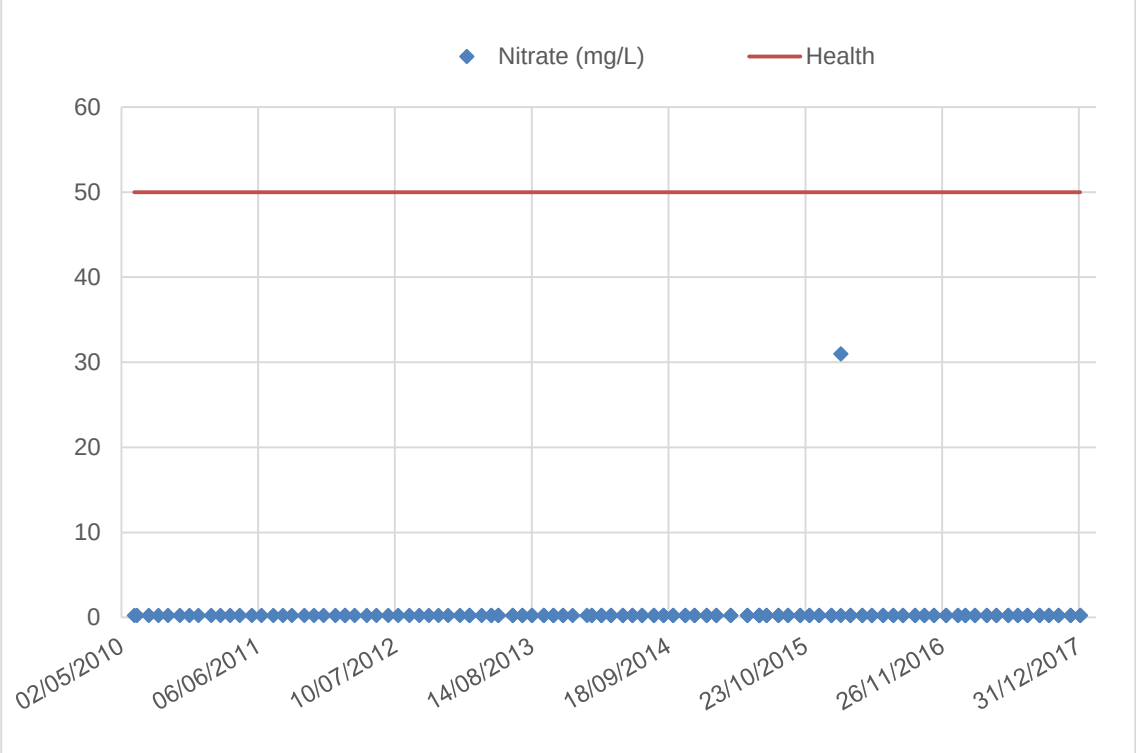


Figure 3.117 Muttaburra - Sulphate

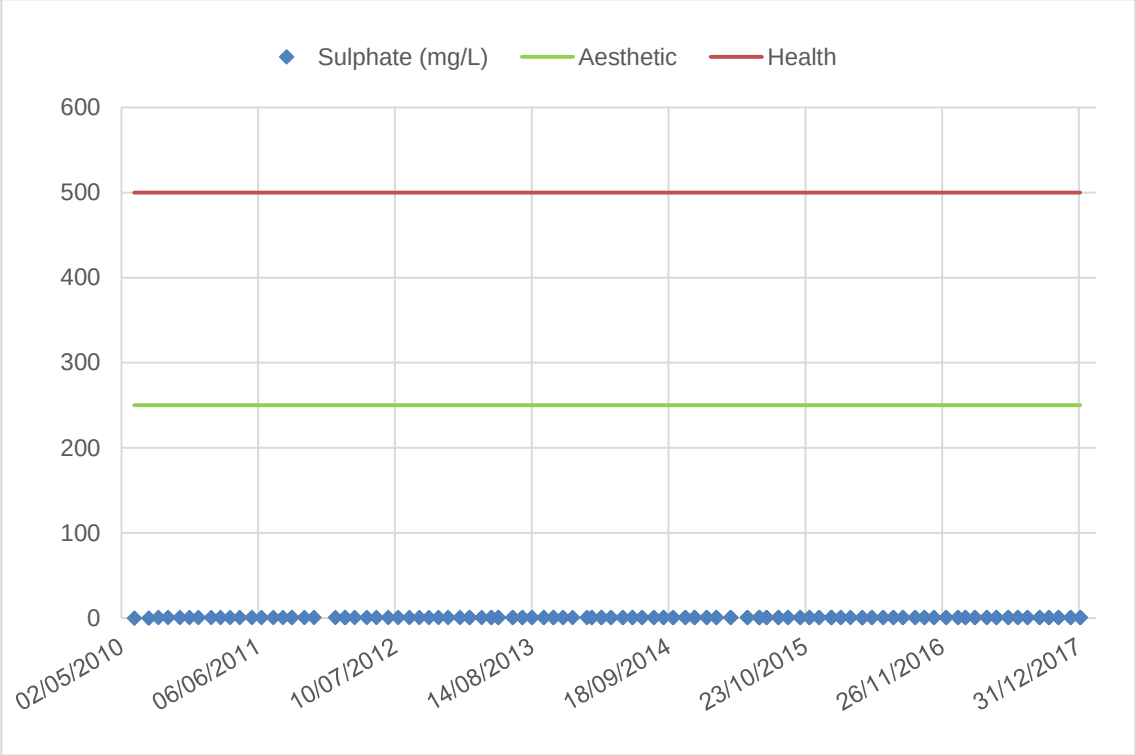


Figure 3.118 Muttaburra - Iron

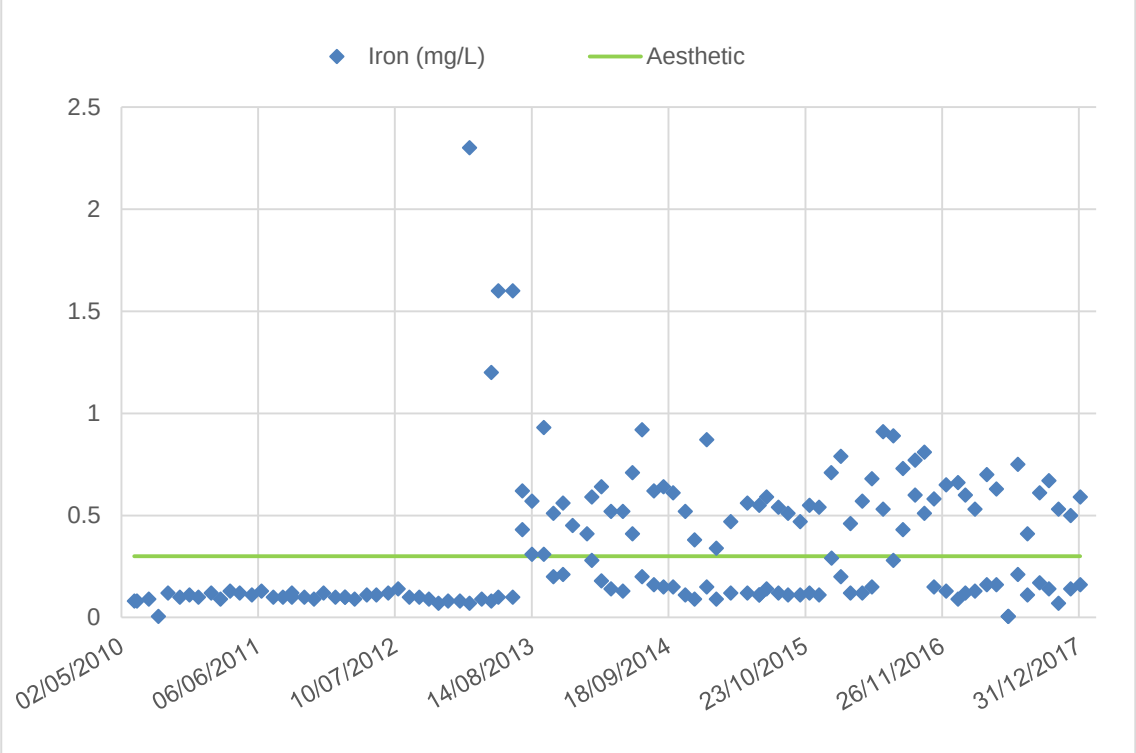


Figure 3.119 Muttaburra - Manganese

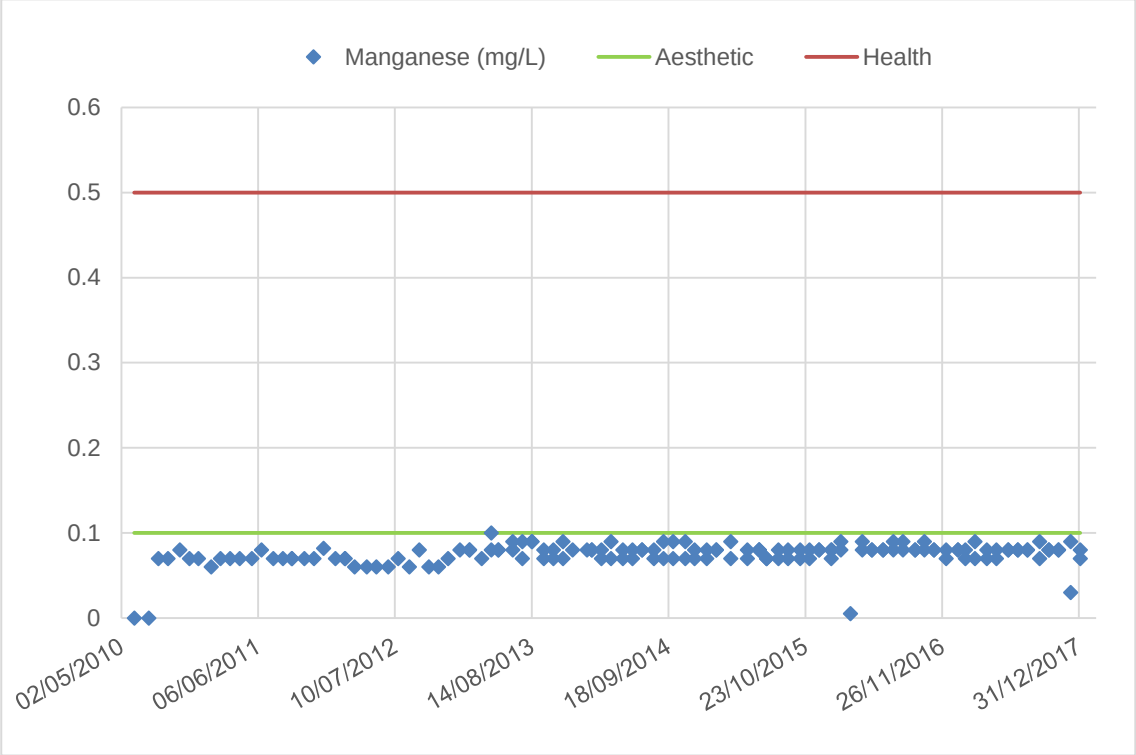


Figure 3.120 Muttaburra - Zinc

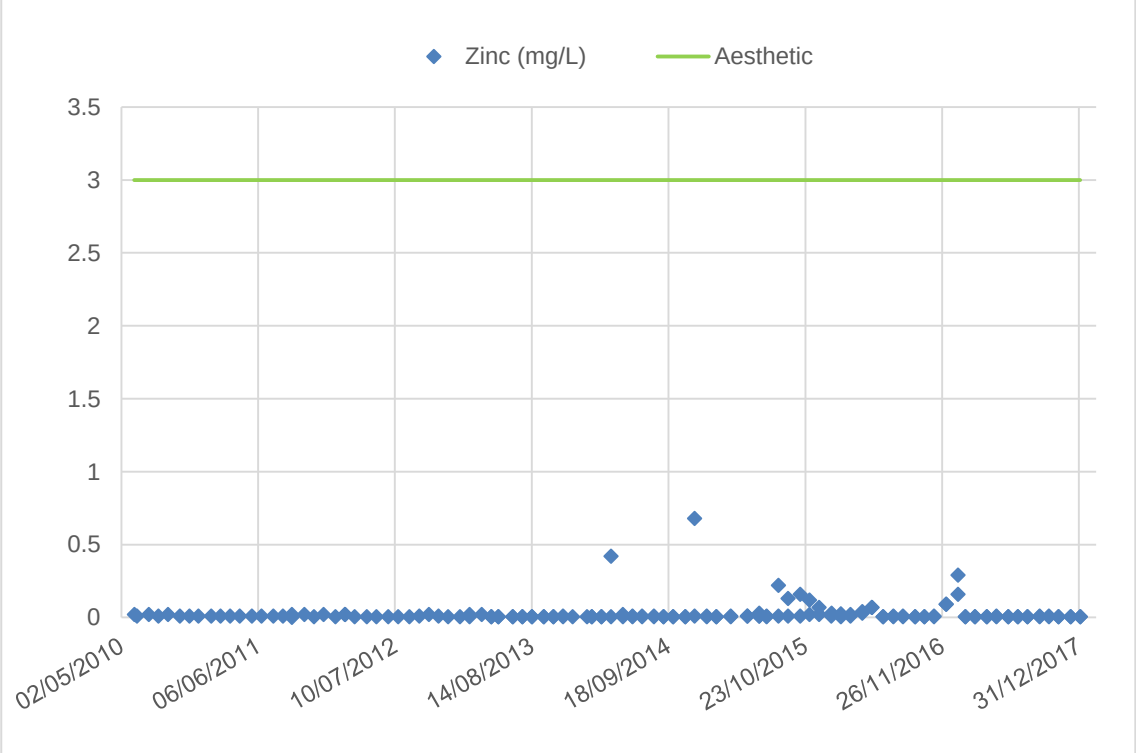


Figure 3.121 Muttaburra - Aluminium

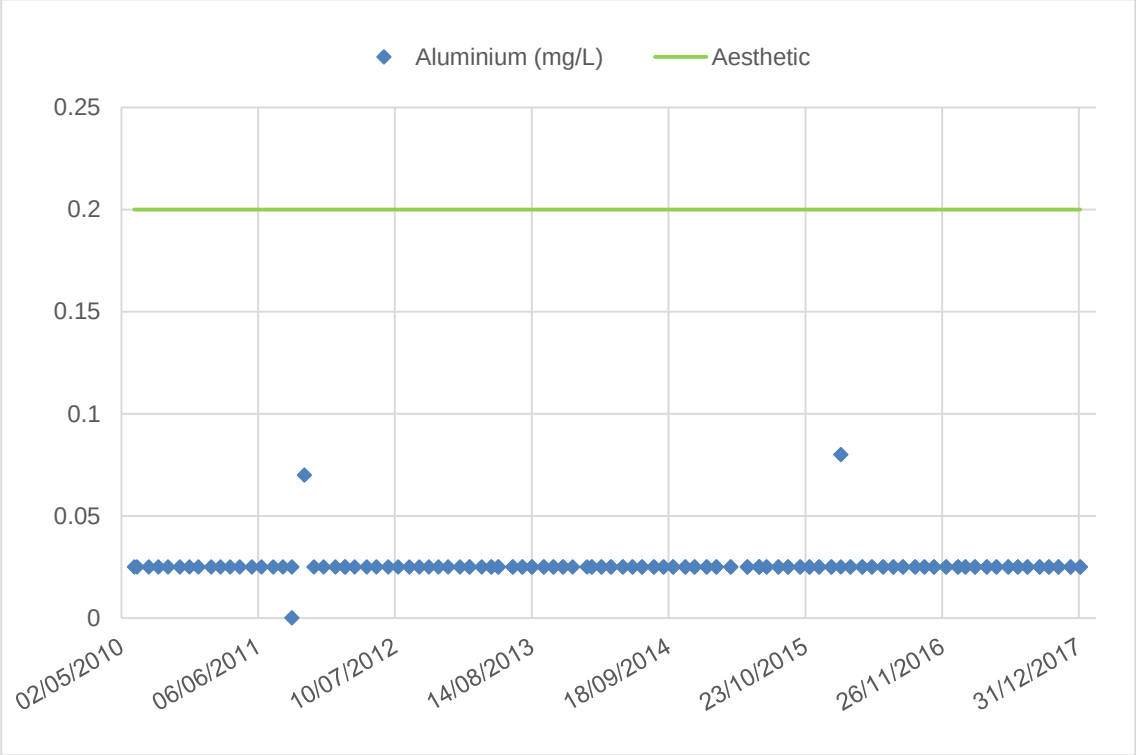


Figure 3.122 Muttaburra - Boron

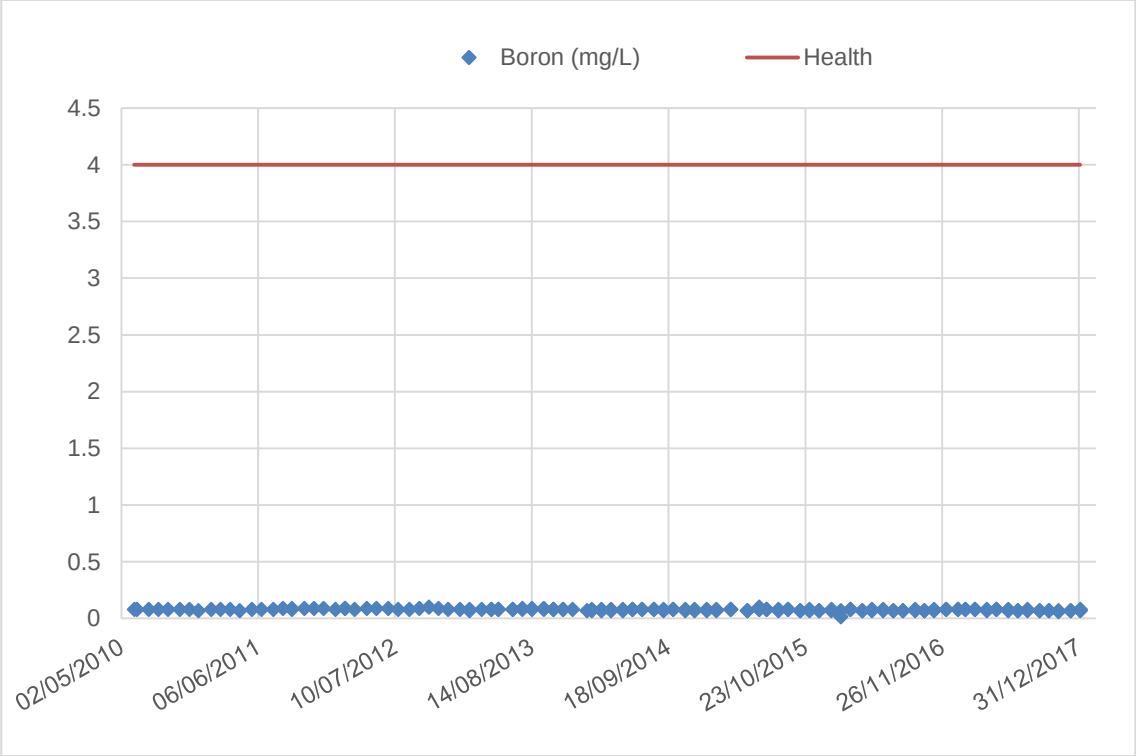


Figure 3.123 Muttaburra - Copper

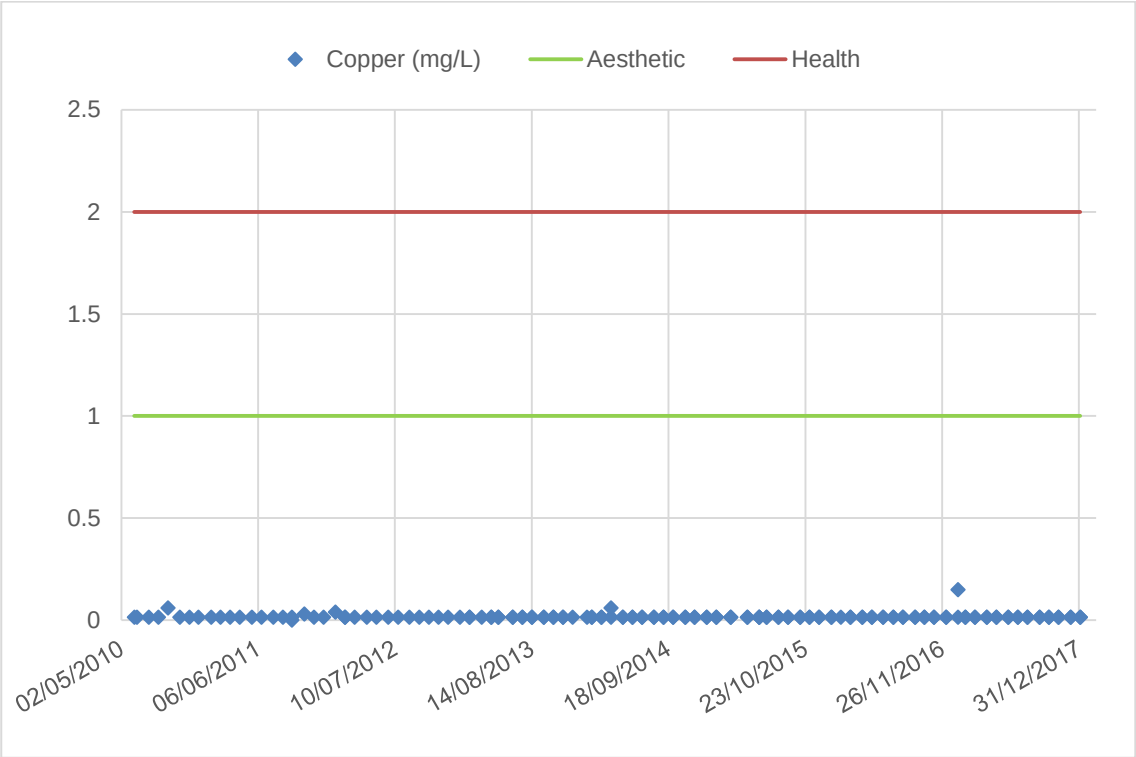
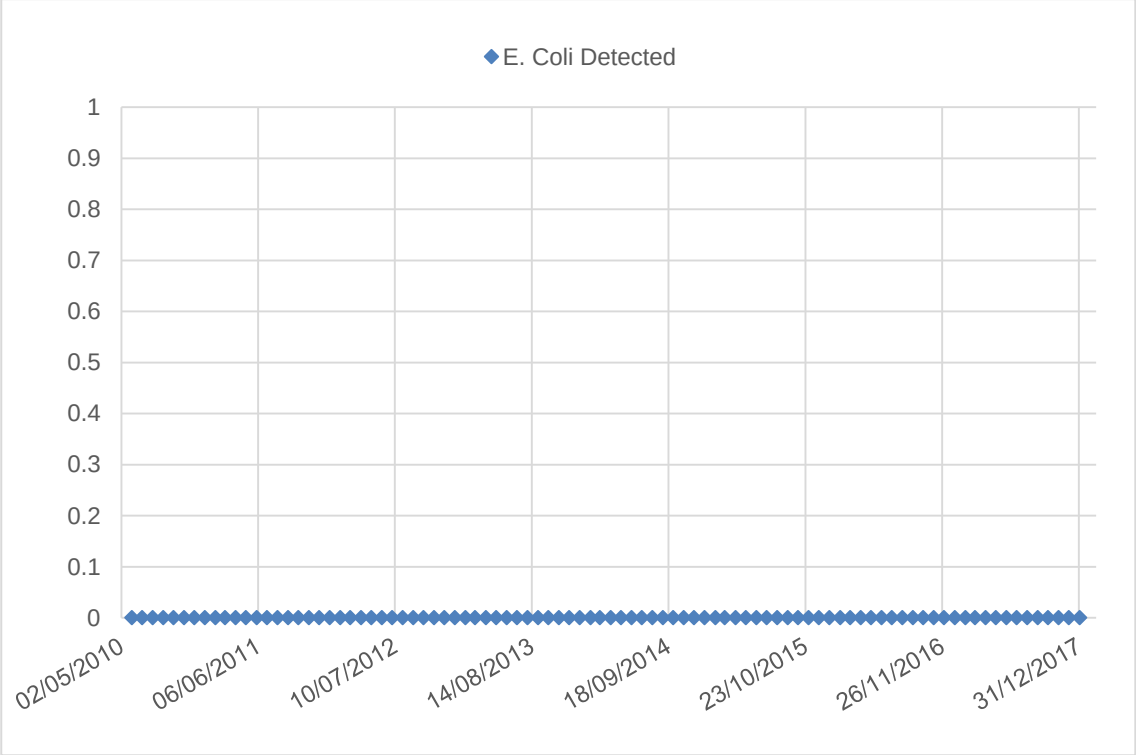


Figure 3.124 Muttaburra – E-Coli



3.5.1 (b) Interpretation

Table 3.20 above shows aesthetic guideline value exceedances[22] for true colour and iron.

The following aesthetic characteristics were detected (highlighted show exceedances):

- pH
- Silica
- TDS
- **True Colour**
- Turbidity
- Sodium
- Chloride
- Fluoride
- **Iron**
- Manganese
- Copper

The following health characteristics were detected (highlighted shows exceedances):

- Fluoride
- Manganese
- Copper

Figure 3.111 provides a trend for the analysis of true colour, there was thirty-seven exceedances. The aesthetic guideline value is 15 HU. For true colour no health based guideline value is considered necessary. A maximum value of 68 HU, average value of 10 HU and a 95th percentile of 26.6 HU were determined. Up to 25 HU is acceptable were turbidity is low, while 15 HU is just noticeable in a glass.

Figure 3.111 provides a trend for the analysis of iron; there was sixty-five exceedances. A maximum value of 2.3 mg/l, average value of 0.352 mg/l and a 95th percentile value of 0.880mg/l have been determined. The aesthetic guideline value is 0.3mg/l. For iron there is insufficient data to set a guideline value based on health considerations. Iron occurs naturally in water, < 1mg/l but up to 100mg/l in oxygen depleted groundwater. The taste threshold is 0.3mg/l. High concentrations of iron may stain laundry and fittings with iron bacteria causing blockages, taste / odour and corrosion. Due to the high number of exceedances, iron bacteria could potentially pose an issue to the water supply.

While there was an aesthetic guideline value exceedance, there were no health guideline value exceedances[22] recorded during the period summarised in Table 3.20.

Of one-hundred and sixty-five (165) samples analysed for E. coli there have been zero (0) E. coli colonies detected (see Figure 3.124).

[22] As per the Australian Drinking Water Guidelines (2011)

3.5.2 Catchment Characteristics

Muttaburra is located 119 km north of Longreach and 85 km northwest of Aramac. Muttaburra is located on the western side of the Thompson River and in the Thompson River catchment. Muttaburra is located on gently undulating black soil terrain and is prone to flooding.

Muttaburra is located in the prominent Central Western Queensland beef and wool producing area. Whilst cattle and sheep grazing are the main industries, road infrastructure construction and maintenance also contributes significantly to provide a stable employment base for the area. Tourism is also a significant industry within the town with Muttaburra hosting the Flock Eye Show. Muttaburra is also home to the Doctor Arratha Memorial Museum,

The average annual rainfall for Muttaburra is 424.6mm[23]. With the majority of the rain falling between late December and late March with little or no rainfall during any other period. The mean maximum temperature is 31.5°C[23] although temperatures often exceed the 40°C mark during the summer months. Muttaburra has a current population of 88 permanent residents and has a current demand of 0.624 Ml/day. The town and water infrastructure is not prone to flooding.

The Great Artesian Basin (GAB) covers approximately one-fifth of the Australian continent and contains 8.7 x 10^6 GL of groundwater in the Jurassic sandstone aquifers. It is the largest groundwater and artesian basin in the world. The basin is located under mostly arid and semi-arid landscapes to the west of the Great Dividing Range. The GAB supports a wide array of activities such as pastoral, agriculture and mining as well as the rural communities, cultural and tourism activities. In the Barcaldine regional area the capping of existing free flowing aquifers has improved the pressure in the main town aquifers.

The GAB is recharged by rainfall and stream flow infiltrating into the exposed sandstone on the edges of the basin. One of the first drilling of the GAB occurred in 1887 in Barcaldine, comprising of a free flowing artesian Bore. Currently there are two supply bores in Muttaburra. Bore No 1 (RN 308) and Bore No 2 (RN146624) . Figure 3.54 above shows the recharge, discharge and flow of the GAB and Barcaldine's relative location in relation to the GAB.

The Town Bores are located within close proximity and are located at the western end of Sword Street, Bore No1 was put down in November 1901 and Bore No 2 in 2013. The bores are 825.1m deep and 834 respectfully. Bore No 1 was reconditioned in 1950 restoring the flow to 18.7 l/s.. The bores has a free flowing yield of 18.7 l/s and 29l/s respectfully. The bores deliver water directly into reticulation without pumping. Access to the bores is limited to authorised personnel only by way of security fencing and the bore headwork's are sealed against the possibility of deliberate contamination. Appendix B Figure M-2012-007 shows the bore location and water reticulation layout on an aerial photo of the town. Appendix C contains a copy of the bore card reports obtained from Department of Environmental & Resource Management.

Muttaburra sewerage collection scheme is comprised of a conventional gravity mains collection system with pumped rising main to a trickling filter treatment plant. The treatment plant is comprised of one imhoff tank, four effluent holding lagoons, sludge drying beds and an artificial wetland. The ground water sources show no indication of contamination from the sewage treatment plant. The artesian bore has been annuli sealed off to prevent contamination from surface water leachate. Currently effluent is not reused however this may be reviewed in the future.

[23] 30 year mean at Longreach Aerodrome (nearest available climate statistics)

3.5.3 Hazard Identification

The hazards and hazardous events and their sources that adversely affect water quality are documented in Table 3.22 below and include those affecting:

- Catchment
- Sourcing infrastructure
- Treatment plants (where applicable)
- Disinfection process(es) (where applicable)
- Distribution system

3.5.3 (a) Identifying and documenting hazards and hazardous events

The hazards and hazardous events were identified using data contained in the plan and following site visits and a risk assessment workshop which was conducted on 8 and 9 November 2011. A recent risk assessment workshop was conducted in December 2017 prior to amendment of the plan;

- Section 2.5 Muttaburra Water Supply Scheme
- Section 3.5.1 Water quality information
- Section 3.5.2 Catchment Characteristics

Table 3.22 Muttaburra Hazard Identification, Risk Assessment and Uncertainty

Scheme Component / Sub-component	Hazardous Event	Hazard	Maximum Risk			Existing Preventive Measures / Barriers.	Residual risk			Uncertainty	Comments/ Proposed Further Risk Reduction Actions
			Consequence	Likelihood	Risk level		Consequence	Likelihood	Risk level		
Bore	Sewage and septic system discharges, agricultural run-off	Bacteria	Moderate	Rare	Low (3)	Nil	Moderate	Rare	Low (3)	Reliable	Acceptable risk, continue to monitor for exceedances
	Hazard that arises from the natural geological processes in the aquifer.	True Colour	Insignificant	Rare	Low (1)	Nil	Insignificant	Rare	Low (1)	Reliable	
		Iron	Insignificant	Rare	Low (1)	Nil	Insignificant	Rare	Low (1)	Reliable	
Sourcing Infrastructure	Accidental or intentional contamination	Harmful substances (not identified)	Catastrophic	Rare	Medium (6)	Nil	Catastrophic	Rare	Medium (6)	Uncertain	**ABM1** Operational & Maintenance Procedures
	Reliability of supply	Loss of pressure in reticulation	Moderate	Rare	Low (3)	Nil	Moderate	Rare	Low (3)	Uncertain	Acceptable risk
Treatment Plant	Reticulated Water Untreated										
Disinfection Process	Reticulated Water Not Disinfected										
Distribution System	Reticulation maintenance and repair	Bacteria	Moderate	Rare	Low (3)	Mains repair procedure and Monitoring	Moderate	Rare	Low (3)	Uncertain	**ABM1** Operational & Maintenance Procedures
	Expired Mains	Bacteria	Catastrophic	Unlikely	High (10)	Mains replacement priority layout plan to replace expired mains.	Catastrophic	Unlikely	High (10)	Uncertain	**ABM2** Replace ageing mains in accordance with asset replacement program. Continue to apply for internal & external funding.
Whole of System	Flights carrying samples to lab delayed/cancelled	Logistical	Insignificant	Possible	Low (3)	Nil	Insignificant	Possible	Low (3)	Confident	Acceptable risk

3.5.3 (b) Hazard Identification (And Risk Assessment) Team

The personnel responsible for the hazard identification and risk assessment process, their roles and responsibilities are detailed in the Table below.

Table 3.23 Hazard Identification and Risk Assessment Team

Typical Job Title for Key Personnel	What Role Did Each Person Play On the Team?	What Expertise and System Knowledge Did The Person Bring?
Manager of Engineering Services	Management of DWQMP Process, Risk Assessment Procedure & Chairing Risk Assessment Workshop	High level knowledge, risk assessment and identification, general engineering experience in the management of the systems
Engineer (Internal / External)	Author, Risk Assessment, Risk Assessment Workshop	Detailed knowledge of the system, water risk assessment and identification
Water Engineer (Internal / External)	Risk Assessment Workshop	Detailed knowledge of drinking water quality management, outside perspective, risk assessment and identification
Water / Technical Officers	Risk Assessment Workshop	Detailed knowledge of individual schemes, risk identification

4 Assessment of Risks

The plan details the risk assessment methodology used for the scheme in Section 4.1 below. Section 4.2 explains how the risks were assessed. Section 4.3 tabulates the relevant stakeholders in the risk assessment process.

4.1 Methodology

The methodology adopted for the risk assessment is described below. The methodology is based on the methodology exampled in the document “Preparing a Drinking Water Quality Management Plan Guideline Supporting Information” (September 2010).

Table 4.1 below shows the qualitative measures of likelihood that was adopted in the risk assessment.

Table 4.1 Measures of Likelihood Utilised in the Risk Assessment

Likelihood	Descriptors
Rare	Occurs less than or equal to once every 5 years
Unlikely	Occurs more often than once every 5 years and up to once per year
Possible	Occurs more often than once per year and up to once a month (12/yr.)
Likely	Occurs more often than once per month (12/yr.) and up to once per week (52/yr.)
Almost Certain	Occurs more often than once per week (52/yr.)

Table 4.2 below shows the qualitative measures of consequence that was adopted in the risk assessment.

Table 4.2 Measures of Consequences Utilised in the Risk Assessment

Consequence	Descriptors
Insignificant	Isolated exceedance of aesthetic parameter with little or no disruption to normal operation
Minor	Potential local aesthetic, isolated exceedance of chronic health parameter
Moderate	Potential widespread aesthetic impact or repeated breach of chronic health parameter
Major	Potential acute health impact, no declared outbreak expected
Catastrophic	Potential acute health impact, declared outbreak expected

Table 4.3 below shows the degrees of uncertainty adopted for the risk assessment. The degree of uncertainty for the scheme varies from confident for Barcaldine Water Supply Scheme to Reliable for Alpha, Aramac, Jericho and Muttaburra Water Supply Schemes. Some of the risks assessed for all the Water Supply Schemes remain an estimate or uncertain.

Table 4.4 below shows the risk analysis matrix utilised, detailing the various levels of risk that was adopted in the risk assessment.

Table 4.3 Degrees of Uncertainty

Level of Uncertainty	Definition
Certain	There is 5 years of continuous monitoring data, which has been trended and assessed, with at least daily monitoring; or The processes involved are thoroughly understood.
Confident	There is 5 years of continuous monitoring data, which has been collated and assessed, with at least weekly monitoring or for the duration of seasonal events; or There is a good understanding of the processes involved.
Reliable	There is at least a year of continuous monitoring data available, which has been assessed; or There is reasonable understanding of the processes involved.
Estimate	There is limited monitoring data available; or There is limited understanding of the processes involved.
Uncertain	There is limited or no monitoring data available; or The processes are not well understood.

Table 4.4 Risk Analysis Matrix – Level of Risk

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Medium (6)	High (10)	High (15)	Extreme (20)	Extreme (25)
Likely	Medium (5)	Medium (8)	High (12)	High (16)	Extreme (20)
Possible	Low (3)	Medium (6)	Medium (9)	High (12)	High (15)
Unlikely	Low (2)	Low (4)	Medium (6)	Medium (8)	High (10)
Rare	Low (1)	Low (2)	Low (3)	Medium (5)	Medium (6)

Table 4.5 Defined Acceptable Risk Levels

Low risk	acceptable	manage for continuous improvement
Moderate risk	unacceptable	Implement short term measures, longer term risk reduction measures may be implemented within a reasonable timeframe
High risk	unacceptable	Implement short term measures immediately, longer term risk reduction measures need to be a priority
Very high	unacceptable	Implement short term measures immediately, implementation of longer term risk reduction measures given top priority

Table 4.5 above details the acceptable risk levels for the water supply schemes.

4.1.1 Site Visits, Interviews and Risk Assessment Workshop

On 8 November site visits to Aramac and Muttaburra Water Supply Schemes were conducted and attended by Mike Donald, Manager of Engineering Services – BRC, Patrick Cullivan – George Bourne & Associates and Peter Robinson – Wide Bay Water. Bob Trueman – Technical Officer Aramac gave a site tour and was interviewed in Aramac. Due to the distances involved Bob was not requested to attend the Risk Assessment Workshop however his input from the interview was included in the Risk Assessment Workshop. Gary Ballard – Water Officer Muttaburra gave a site tour and was interviewed in Muttaburra. Due to the distances involved Gary was not requested to attend the Risk Assessment Workshop however his input from the site tour and interview was included in the Risk Assessment Workshop.

On 9 November site visits to Alpha and Jericho Water Supply Schemes were conducted and attended by Mike Donald, Manager of Engineering Services – BRC, Patrick Cullivan – George Bourne & Associates and Peter Robinson – Wide Bay Water. Des Lamb – Technical Officer Alpha and Jericho gave a site tour and was interviewed in Alpha and Jericho. On 10 November 2012 Des attended the Risk Assessment Workshop held at the Offices of Barcaldine Regional Council and gave his input to the Risk Assessment Team.

On 10 November a site visit to Barcaldine Water Supply Scheme was conducted and attended by Mike Donald, Manager of Engineering Services – BRC, Patrick Cullivan – George Bourne & Associates and Peter Robinson – Wide Bay Water. Brett Harvey – Water Officer Barcaldine gave a site tour and was interviewed in Barcaldine. On 10 November 2012 Brett attended the Risk Assessment Workshop held at the Offices of Barcaldine Regional Council and gave his input to the Risk Assessment Team.

On the 7 December 2017 a Risk Assessment Workshop was conducted for the drinking water supply schemes within the region. Attendees of the Risk Assessment Workshop included Councils Manager of Engineering Services , the Technical Officers from each scheme and Consultant Engineer and Environmental Scientist from GBA. The Risk Assessment Workshop was conducted in collaboration with the DWQMP Regular Review process due prior to 31 December 2017. In addition to the Regular Review a Third Party Audit was conducted on the DWSP DWQMP which was completed by Bligh Tanner on the 12 October 2017. The Third Party Audit provided information for the risk assessment process, providing an independent appraisal of the DWQMP and the schemes, as such the findings of the Third Party Audit were taken into consideration in the Risk Assessment Workshop.

The methodology chosen is relevant to the public health risks associated with drinking water supplies. Every effort has been made to apply the chosen methodology consistently across the five drinking water services.

4.2 Assessment of Risk

Details of the risk assessment results for each scheme's identified hazards and hazardous events include:

- maximum risk level or equivalent process (i.e. without existing barriers in place, eg: no treatment and/or disinfection);
- existing preventive measures including multiple barriers (i.e. treatment process steps)
- residual risk level (i.e. with existing barriers in place for example, treatment and/or disinfection); and
- any uncertainties.

The following sections will discuss each of these dot points in further detail.

4.2.1 Assessment of Maximum Risk

For all hazards, maximum risk (e.g.: the risk from an uncontrolled hazard) was first assessed. Where there was insufficient data or information to complete a reliable assessment, this was highlighted as an uncertainty and discussed further in the Risk Management Improvement Program in Section 5.4 below.

4.2.2 Existing preventative measures/barriers

All existing preventative measures are listed in the Risk Assessment. Existing preventative measures include all actions, barriers or measures currently in place to reduce the maximum risk. They include all treatment steps, active measures that protect raw water quality prior to treatment and measures to protect treated water quality.

4.2.3 Residual risk

The residual risk is determined once existing preventive measures have been applied. Residual risk is the level of risk a particular hazard is assessed as posing to the safety of the drinking water once the existing preventative measure/s have been applied.

Residual risk is determined using the same methodology (eg: likelihood and consequence descriptors) as the initial maximum risk assessment; however changes to the assessed likelihood (or consequence) should result in a lower resultant risk level.

4.3 Key Stakeholders

Table 4.6 Stakeholders – Risk Assessment

Stakeholder	Contact Name and Details	Rationale for engagement and how engagement occurred
Barcaldine Regional Council	Rick Rolfe, Manager of Engineering Services P (07) 4651 5625 E: meng@barc.qld.gov.au	Responsible for managing Engineering Services for Barcaldine Regional Council Site Visits & Risk Assessment Workshop Management of DWQMP Preparation
	Des Lamb, Technical Officer Alpha & Jericho Water Supplies	Site Visits & Risk Assessment Workshop
	TBA, Technical Officer Aramac Water Supply	Site Visits & Risk Assessment Workshop
	Brett Harvey, Water Officer Barcaldine Water Supply	Site Visits & Risk Assessment Workshop
	Nick Ballard, Water Officer Muttaburra Water Supply	Site Visits & Risk Assessment Workshop
Consultants	Patrick J Cullivan George Bourne & Associates P (07) 4651 5177 E pcullivan@gbassoc.com.au	Author of Barcaldine DWQMP Site Visits & Risk Assessment Workshop

Stakeholder	Contact Name and Details	Rationale for engagement and how engagement occurred
	Peter Robinson Widebay Water peter@widebaywater.qld.gov.au William Green George Bourne & Associates P (07) 4651 5177 E wgreen@gbassoc.com.au	External Expertise Site Visits & Risk Assessment Workshop Amendment of DWQMP

5 Managing Risks

Alpha and Jericho's raw water requires treatment prior to reticulation and both schemes undergo similar treatment processes. Aramac, Barcaldine and Muttaburra source their water from relatively deep artesian bores and the water quality is suitable for reticulation without treatment.

Due to the similarities and differences in the scheme types Alpha and Jericho are considered separately to Aramac, Barcaldine and Muttaburra for the purpose of managing risks.

Managing risks are discussed in the following sections below:

- 5.1 Risk Management Measures
- 5.2 Operation and maintenance procedures
- 5.3 Management of Incidents and Emergencies
- 5.4 Risk Management Improvement Program
- 5.5 Information Management

5.1 Risk Management Measures

Existing and proposed preventative risk management measures are detailed in 5.1.1 for Alpha and Jericho and 5.1.2 below for Aramac, Barcaldine and Muttaburra.

5.1.1 Alpha and Jericho Existing and Proposed Preventative Measures

Table 5.1 and Table 5.2 below provide details of the existing and proposed preventative measures for Alpha and Jericho. Proposed measures are included in the Risk Management Improvement Program (RMIP) in Table 5.9 and Table 5.10 for Alpha and Jericho below.

Table 5.1 Alpha Existing and Proposed Preventative Measures

Scheme Component / Sub-component	Hazard	Hazardous event/s	What is/are the existing preventative measure/s?	Which risk factor/s does the existing preventative measure/s impact on	How effective is/are the existing preventative measure/s & on what basis has this been determined?	Is the level of residual risk acceptable	Proposed measures to reach an acceptable level or residual risk	Responsible Organisations
Source	Bacteria	Septic system discharges	Chlorination, Flocculation, Clarification and filtration Automated Chlorine monitoring Telemetry alarms for dosing failure	Likelihood & Consequence	Effective. Determined by the fact that E-coli has not been detected within the system since monitoring begun and recent improvements in treatment process reflected in monitoring results	Yes – low risk	Continue to monitor for E.coli. **AL1**: Draft standard operating procedures and / or manual of operations. **AL2** Commence sampling source water in addition to treated water.	Barcaldine Regional Council
	Substances (not identified)	Flood event	Chlorination, Aeration, Flocculation, Clarification and filtration Automated, Turbidity and pH monitoring Telemetry alarms for critical level exceedance	Consequence	Effective, however it is uncertain what the effect of flooding will have on private bores and if this will affect council bores. Spikes in colour and turbidity levels have been observed during flooding.	No – medium risk	**AL3** Identify effect of flooding on bore water quality considering private bores which exist on the flood plain which may not be capped. **AL 4** Identify uncapped bores under councils jurisdiction and cap bores to reduce risk of pathogenic ingress. **AL1**: Draft and implement procedure for flood event monitoring of source water to detect bacterial contaminants.	
	Hazard that arises from the natural geological processes in the aquifer.	True Colour	Chlorination, Aeration, Flocculation, Clarification and filtration	Likelihood	Effective as True Colour and Turbidity is generally within a suitable range (for effective disinfection)	Yes – low risk	Acceptable risk, continue to monitor for exceedances. **AL2** Commence testing source water in addition to treated water.	
		Turbidity						
		Nitrates	Nil	N.A.	N.A.	No – medium risk		
Sourcing infrastructure	Disruption to supply	Power outage	Elevated reservoir (limited backup) and Backup generator	Consequence	Effective	No – low risk	Acceptable risk	
	Loss of Infrastructure	Loss of infrastructure	Critical Infrastructure constructed above flood level	Consequence	Effective	No – low risk	Acceptable risk	
	Bacteria	Ingress contaminated run-off from nearby uncapped bores	Chlorination, Aeration, Flocculation, Clarification and filtration	Consequence	Effective, however town water supply is at risk to contamination with current status	No - high risk	**AL 4** Identify uncapped bores under councils jurisdiction and cap bores to reduce risk of pathogenic ingress.	
	Bacteria	Maintenance and repair of raw water main	Mains flushing and Chlorination, Aeration, Flocculation, Clarification and filtration	Likelihood & Consequence	Effective, however current procedures are inadequate	Yes – low risk	**AL1** Draft procedure for reticulation repair. Current procedures are inadequate.	
Treatment Plant & Reservoirs	Disruption to supply	Power outage	Elevated reservoir (limited backup) and Backup generator	Consequence	Effective	No – low risk	Acceptable risk	
	Loss of Infrastructure	Flood event	Critical Infrastructure constructed above flood level	Consequence	Effective	No – low risk	Acceptable risk	
	True Colour, Turbidity and Bacteria	Bypass treatment plant	On-site drawings showing valve numbering, training and valve maintenance. Procedure for plant operations and maintenance and backwash.	Likelihood & Consequence	Effective, however current procedures are inadequate	Yes – low risk	**AL1**: Draft and implement standard operating procedures and / or manual of operations. Current Procedures are inadequate and do not cover specific operations.	

Scheme Component / Sub-component	Hazard	Hazardous event/s	What is/are the existing preventative measure/s?	Which risk factor/s does the existing preventative measure/s impact on	How effective is/are the existing preventative measure/s & on what basis has this been determined?	Is the level of residual risk acceptable	Proposed measures to reach an acceptable level or residual risk	Responsible Organisations
							AL5 Operator requires training and handover process to be implemented.	
	True Colour, Turbidity and Bacteria Alum	Chemical over / under dose affecting treatment Alum under dose / Failure of Alum Dosing Equipment Alum over dosing	Operational monitoring, manual adjustment. Automated, Turbidity and pH monitoring Telemetry alarms for critical level exceedance	Likelihood & Consequence	Effective however reliant on manual intervention. Determined by the fact that E-coli has not been detected within the system since monitoring. Current procedures are inadequate	No – low risk	**AL1** Draft standard operating procedures and / or manual of operations. Current Procedures are inadequate. **AL5** Operator requires training and handover process to be implemented.	
	Hydrochloric Acid	Hydrochloric over / under dosing	Nil	N.A.	N.A.	No – low risk		
	Substances (not identified)	Accidental Contamination	Restricted access, operator training.	Consequence	Current procedures are inadequate	No – low risk		
Disinfection Process	Chlorine	Over Chlorination	Automated Chlorine monitoring Telemetry alarms for dosing failure	Likelihood	Effective Upgrading of disinfection system and improved management has provided consistent results	No – Low Risk		
	Bacteria	Under Chlorination Failure of disinfectant dosing pumps		Likelihood		No – Medium Risk		
	Chlorine	Low residual chlorine in Elevated Reservoir	Tank automatically refills at 70% full in order to turn water over	Likelihood	Uncertain as chlorine residual is not monitored.	No – Low Risk (uncertain)		
	Disruption to supply	Power outage	Elevated reservoir (limited backup) and Backup generator	Consequence	Effective	Yes – low risk	Acceptable risk	
	Chlorate	Disinfection by-products	Installation of calcium hypochlorite system Verification monitoring of Chlorates Automated chlorine monitoring	Likelihood & Consequence	Effective Upgrading of disinfection system has decreased chlorate levels	No – Medium Risk	**AL1** Draft standard operating procedures and / or operations manual.	
	Chlorine	pH >8	Automated pH, Chlorine monitoring	Likelihood	Effective	Yes – Low risk	Acceptable Risk	
	Bacteria	Insufficient contract time	Automated pH, Chlorine monitoring Telemetry alarms for dosing failure	Likelihood & Consequence	Currently there is no operational monitoring of chlorine residual and current procedures are inadequate.	Yes – Low risk	Acceptable Risk	
Distribution System	Bacteria	Reticulation maintenance and repair	Mains flushing procedure and Monitoring	Likelihood & Consequence	Effective, however current procedures are inadequate	No – low risk (Uncertain)	**AL1** Draft revised procedure for reticulation repair and monitor	

Table 5.2 Jericho Existing and Proposed Preventative Measures

Scheme Component / Sub-component	Hazard	Hazardous event/s	What is/are the existing preventative measure/s?	Which risk factor/s does the existing preventative measure/s impact on	How effective is/are the existing preventative measure/s & on what basis has this been determined?	Is the level of residual risk acceptable	Proposed measures to reach an acceptable level or residual risk	Responsible Organisations
Source	Bacteria	Septic system discharges	Chlorination, Flocculation, Clarification and filtration	Likelihood & Consequence	Effective however reliant on manual intervention. Determined by the fact that E-coli has not been detected within the system since monitoring begun.	Yes – low risk	Continue to monitor for E.coli. **J 1**: Draft standard operating procedures and / or manual of operations. **J 2** Commence sampling source water in addition to treated water.	Barcaldine Regional Council
	Substances (not identified)	Flood event	Chlorination, Aeration, Flocculation, Clarification and filtration	Consequence	Effective, however it is uncertain what the effect of flooding will have on private bores and if this will affect council bores. Spikes in colour and turbidity levels have been observed during flooding.	No – medium risk	**J 3** Identify effect of flooding on bore water quality considering private bores which exist on the flood plain which may not be capped. **J 1**: Draft and implement procedure for sample collection to include climate data during sample collection	
	Hazard that arises from the natural geological processes in the aquifer.	True Colour Turbidity	Chlorination, Aeration, Flocculation, Clarification and filtration	Likelihood	Effective as True Colour and Turbidity is generally within a suitable range (for effective disinfection)	Yes – low risk	Acceptable risk, continue to monitor for exceedances. **J2** Commence testing source water in addition to treated water.	
Sourcing infrastructure	Disruption to supply	Power outage	Elevated reservoir (limited backup) and Backup portable generator	Consequence	Effective	No – low risk	Acceptable risk	
	Loss of Infrastructure	Flood event	Critical Infrastructure constructed inside levee (flood mitigation)	Consequence	Effective	No – low risk	Acceptable risk	
	Bacteria	Maintenance and repair of raw water main	Mains flushing and Chlorination, Aeration, Flocculation, Clarification and filtration	Likelihood & Consequence	Effective, however current procedures are inadequate	Yes – low risk	**J 1** Draft procedure for reticulation repair. Current procedures are inadequate.	
Treatment Plant & Reservoirs	Disruption to supply	Power outage	Elevated reservoir (limited backup) and Backup generator	Consequence	Effective	No – low risk	Acceptable risk	
	Loss of Infrastructure	Flood event	Critical Infrastructure constructed inside levee (flood mitigation)	Consequence	Effective	No – low risk	Acceptable risk	
	True Colour, Turbidity and Bacteria	Bypass treatment plant	On-site drawings showing valve numbering, training and valve maintenance. Procedure for plant operations and maintenance and backwash.	Likelihood & Consequence	Effective, however current procedures are inadequate	Yes – low risk	**J 1**: Draft and implement standard operating procedures and / or manual of operations. Current Procedures are inadequate and do not cover specific operations. **J 4** Operator requires training and handover process to be implemented.	
	True Colour, Turbidity and Bacteria Alum	Chemical over / under dose affecting treatment Alum over dosing	Operational monitoring, manual adjustment. Automated Turbidity and pH monitoring Telemetry alarms for critical level exceedance	Likelihood & Consequence	Effective however reliant on manual intervention. Determined by the fact that E-coli has not been detected within the system since monitoring begun. Current procedures are inadequate	No – low risk	**J 1** Draft standard operating procedures and / or manual of operations. Current Procedures are inadequate. **J 4** Operator requires training and handover process to be implemented.	

Scheme Component / Sub-component	Hazard	Hazardous event/s	What is/are the existing preventative measure/s?	Which risk factor/s does the existing preventative measure/s impact on	How effective is/are the existing preventative measure/s & on what basis has this been determined?	Is the level of residual risk acceptable	Proposed measures to reach an acceptable level or residual risk	Responsible Organisations
	Hydrochloric Acid	Hydrochloric over / under dosing	Automated pH monitoring Telemetry alarms for critical level exceedance	N.A.	N.A.	No – low risk		
	Low chlorine reserve in reservoir	Contamination	Vermin proofing	Likelihood	Effective	Yes – low risk		
	Substances (not identified)	Accidental Contamination	Restricted access, operator training.	Consequence	Current procedures are inadequate	No – low risk		
Disinfection Process	Chlorine	Over Chlorination	Automated Chlorine monitoring Telemetry alarms for dosing failure	Likelihood	Effective Upgrading of disinfection system and improved management has provided consistent results.	No – Low Risk		
	Bacteria	Under Chlorination Failure of disinfectant dosing pumps		Likelihood		No – Medium Risk		
	Chlorine	Low residual chlorine in Elevated Reservoir	Tank automatically refills at 70% full in order to turn water over	Likelihood	Uncertain as chlorine residual is not monitored.	No – Low Risk (uncertain)		
	Disruption to supply	Power outage	Elevated reservoir (limited backup) and Backup generator	Consequence	Effective	No – low risk	Acceptable risk	
	Chlorate	Disinfection by-products	Installation of calcium hypochlorite system Verification monitoring of Chlorates Automated chlorine monitoring	Likelihood & Consequence	Effective Upgrading of disinfection system has decreased chlorate levels	No – Medium Risk	**J 1** Draft standard operating procedures and / or operations manual.	
	Chlorine	pH >8	Automated pH, Chlorine monitoring Telemetry alarms for dosing failure	Likelihood	Effective	Yes – Low risk	Acceptable Risk	
	Bacteria	Bacterial contamination	Automated monitoring, Operational monitoring,Disinfection	Likelihood & Consequence	Effective	No – low risk (Estimate)	Acceptable Risk	
Distribution System	Bacteria	Reticulation maintenance and repair	Mains flushing procedure and Monitoring	Likelihood & Consequence	Effective, however current procedures are inadequate	No – low risk (Uncertain)	**J 1** Draft revised procedure for reticulation maintenance and repair.	

5.1.2 Aramac, Barcaldine and Muttaburra Proposed Preventative Measures

Table 5.3 provides details of the existing and proposed preventative measures for Barcaldine, Aramac and Muttaburra. Proposed measures are included in the RMIP in Table 5.11 below.

Table 5.3 Aramac Existing and Proposed Preventative Measures[24]

Scheme Component / Sub-component	Affected Scheme	Hazard	Hazardous event/s	What is/are the existing preventative measure/s?	Which risk factor/s does the existing preventative measure/s impact on	How effective is/are the existing preventative measure/s & on what basis has this been determined?	Is the level of residual risk acceptable	Proposed measures to reach an acceptable level or residual risk	Responsible Organisations
Sourcing Infrastructure	Barcaldine Muttaburra	Harmful substances (not identified)	Accidental or intentional contamination	Chain-link fencing and locked gates. Reservoir roof lids.	N.A.	Uncertain – current procedures are inadequate.	No – medium risk	**ABM1** Operational & Maintenance Procedures	Barcaldine Regional Council
	Barcaldine Muttaburra Aramac	Disruption to supply[25]	Power outage	Back-up generator (Barcaldine)	Consequence & Likelihood	Effective during short power outages	Yes – low risk	**N/A**	
Distribution System	Aramac Barcaldine Muttaburra	Bacteria	Reticulation maintenance and repair	Mains flushing procedure and Monitoring	Consequence	Effective however current procedures are inadequate. Determined by the fact that E-coli has not been detected within the system since monitoring begun	No – medium risk	**ABM1** Operational & Maintenance Procedures	
	Aramac Muttaburra	Bacteria	Expired Mains	Mains replacement priority layout plan to replace expired mains.	Likelihood	Uncertain condition of pipes is not fully understood	No – high risk	**ABM2** Replace ageing mains in accordance with asset replacement program. Continue to apply for internal & external funding.	
	Aramac	Bacteria	Dead ends	Routine flushing.	Likelihood	Effective however current procedures are inadequate.	No – Medium Risk	**ABM3** Create flushing schematic layout to go with the SOP Air scouring every 5 years. Investigate reconfiguration of mains layout to improve flow.	

[24] In Aramac during power outage natural pressure in the artesian bores provides sufficient pressure.

5.2 Operation and Maintenance Procedures

Table 5.4 below lists the current operation and maintenance procedures for Alpha and Jericho Table 5.5 below list the current operation and maintenance procedures for Aramac, Barcaldine and Muttaburra.

During the risk assessment it was identified that a large number of procedures are out-dated or in many cases procedures are non-existent. As part of the Risk Management Improvement Program out-dated procedures will be updated and new procedures will need to be developed.

New and updated procedures will be given a procedure number, title, revision date, process used for maintaining the documented procedure and the process for implementing the procedure.

Table 5.4 Alpha and Jericho Operation and Maintenance Procedure Documentation

Scheme Component / Sub-component	Preventive measure managed (where applicable)	Documented procedure	Version date	Position responsible	Process for implementing the procedure (Activity and Frequency)	Comments (including where procedures are inadequate or need updating)
Sourcing Infrastructure & Distribution System	Mains repair procedure	Procedure for Mains repair	None	Manager of Engineering Services	Currently no process for implementing.	Procedure out-dated and inadequate refer to RMIP for improvements to procedures
		Procedure for new water service				
		Procedure for new water main relocation				
Treatment Plant & Reservoirs	General operations and maintenance procedures.	Alpha Water Treatment Plant[26] Operation Manual	09/05	Manager of Engineering Services	Currently no process for implementing	Procedure adequate
		Jericho Water Treatment Plant Operation Manual[25]	07/02	Manager of Engineering Services	Currently no process for implementing	Procedure out-dated and inadequate refer to RMIP for improvements to procedures

[25]Originally developed for Jericho WTP, have been adopted for Alpha (identical package plants)

Table 5.5 Aramac, Barcaldine and Muttaburra Operation and Maintenance Procedure Documentation

Scheme Component / Sub-component	Preventive measure managed (where applicable)	Documented procedure	Version date	Position responsible	Process for implementing the procedure (Activity and Frequency)	Comments (including where procedures are inadequate or need updating)
Sourcing Infrastructure & Distribution System	Mains repair procedure	Procedure for Mains repair Procedure for new water service Procedure for new water main relocation	None	Manager of Engineering Services	Currently no process for implementing.	Procedure out-dated and inadequate refer to RMIP for improvements to procedures

The procedures outlined above were developed before amalgamation of the three shires (Aramac, Barcaldine and Jericho). Currently there is no formal process to ensure documented procedures are accepted and implemented by staff and for documentation review, update and distribution to relevant staff other than open access through Council servers for water / technical officers and other relevant parties.

5.3 Management of Incidents and Emergencies

Table 5.6 shows the different levels of incidents for the entire drinking water service. There are five levels of incidents and emergencies ranging from Level 5 (most severe) to Level 1 (least severe). Barcaldine Regional Council has developed a Local Disaster Management Plan (current version dated 25/06/2014). Levels 5 incidents and emergencies should be handled under the Barcaldine Regional Council Local Disaster Management Plan and are likely to be the result or cause of other emergencies that are covered under the plan. Barcaldine Regional Council is separated into Local Disaster Management Groups.

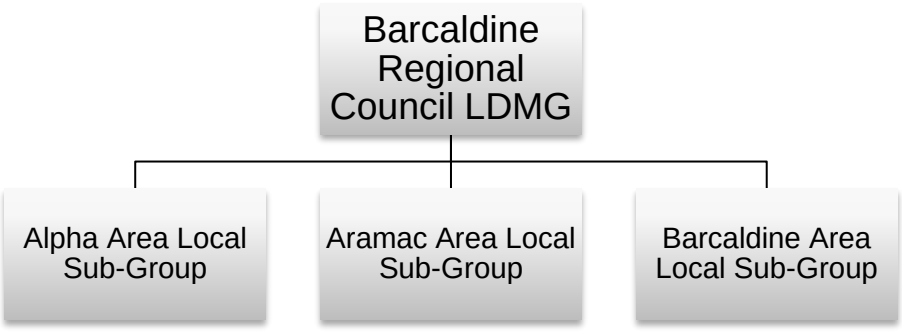


Table 5.7 shows how incidents and emergencies are managed relevant to drinking water quality. Table 5.8 details the emergency contact details for and protocols to be followed when a particular emergency or incident occurs. All other contact details for incident and emergency management are included in Barcaldine Regional Councils Local Disaster Management Plan.

The Barcaldine Regional Council is required to notify customers when an incident occurs. Notification will occur primarily through the council maintained email distribution list that will reach most/all of the key customers. Additional notification will occur through social media outlets such as the local Council Facebook page and local media outlets such as the BRC website. Furthermore, aged care programs such as Home and Community Care (HACC) will assist in informing the elderly community members. Sensitive users, such as hospitals, that will be severely affected by major incidents (level 3-5) will be directly contacted by the council immediately.

Table 5.6 Incident / Emergency levels

Incident / Emergency level	Description of level
Level 5	• Widespread outbreak of waterborne disease • Declared disaster • Supply unable to be maintained • Gross exceedances of ADWG health guideline values for a chemical parameter (> five times the ADWG health guideline limit).
Level 4	• High level of E. coli (> 5 CFU/ 100 mL) or any pathogens detected in reticulation • Failure of infrastructure (severe or emergency level supply restrictions required to ensure continuity of supply)
Level 3	• Detection of 1-5 CFU/100 mL E. coli in reticulation • Failure of infrastructure (ability to supply water compromised – short term water restrictions may be required) • Minor exceedances of ADWG health guideline value for chemical parameter (determined value is close to guideline value).
Level 2	• Failure of infrastructure or source supply (water quality or supply unlikely to be compromised) • Exceedances of ADWG aesthetic guideline (customer complaints possible)
Level 1	• Exceedances of operational limit managed through operational and maintenance procedures

Table 5.7 Management of Incidents and Emergencies

Level	Incident or emergency	Summary of actions to be taken (with documented procedure listed)	Position/s responsible for Action/s
5	Disaster levels - Implement Barcaldine Regional Council Local Disaster Management Plan Report to the OWSR by phone and written incident report		
4	High level of E. coli (> 5 CFU/ 100 mL) or any pathogens detected in reticulation	1. Alert Manager of Engineering Services and Chief Executive Officer 2. Determine potentially affected area, isolate if possible. Issue Boil Water alert. Escalate emergency further if situation worsens. 3. Report detection to OWSR by phone (Immediately by phone, written incident report – Part 1 incident form - within 24 hours) 4. Resample for E. coli and disinfectant residual in potentially affected infrastructure 5. Undertake comprehensive contamination investigation 6. Undertake necessary corrective actions 7. Upon resolution, provide written report to regulator (Part 2 incident form) and Chief Executive Officer 8. Non-compliance will be raised and will require signing off by the Manager of Engineering Services and the Chief Executive Officer after corrective actions have taken place.	1. Technical / Water Officer 2. Manager of Engineering Services 3. Manager of Engineering Services 4. Technical / Water Officer 5. Manager of Engineering Services 6. As appropriate 7. Manager of Engineering Services 8. Manager of Engineering Services / Chief Executive Officer
4	Failure of infrastructure (severe or emergency level supply restrictions required to ensure continuity of supply)	1. Alert Manager of Engineering Services and Chief Executive Officer 2. Determine reason for failure, isolate if possible. Consider options to recommence supply. 3. Report to OWSR by phone (Immediately by phone, written incident report – Part 1 incident form - within 24 hours) 4. Undertake comprehensive failure investigation 5. Undertake necessary corrective actions to recommence supply and provide an estimate of when the supply can be recommenced 6. Implement severe or emergency level supply restrictions. Consider escalating to a Level 1 incident. Notify the public. 7. Upon resolution, provide written report to regulator (Part 2 incident form). Provide written report to the Chief Executive Officer 8. Non-compliance will be raised and will require signing off by the Manager of Engineering Services and the Chief Executive Officer after corrective actions have taken place.	1. Technical / Water Officer 2. Manager of Engineering Services 3. Manager of Engineering Services 4. Manager of Engineering Services 5. As appropriate 6. Manager of Engineering Services / Chief Executive Officer 7. Manager of Engineering Services 8. Manager of Engineering Services / Chief Executive Officer

Level	Incident or emergency	Summary of actions to be taken (with documented procedure listed)	Position/s responsible for Action/s
3	Detection of 1-5 CFU/100mL E.coli in reticulation	1. Alert Manager of Engineering Services and Chief Executive Officer 2. Determine potentially affected area, isolate if possible. Consider Boil Water alert. Escalate emergency further if situation worsens. 3. Report detection to OWSR by phone (Immediately by phone, written incident report – Part 1 incident form - within 24 hours) 4. Resample for E. coli and disinfectant residual in potentially affected infrastructure 5. Undertake comprehensive contamination investigation 6. Undertake necessary corrective actions 7. Upon resolution, provide written report to regulator (Part 2 incident form) 8. Non-compliance will be raised and will require signing off by the Manager of Engineering Services and the Chief Executive Officer after corrective actions have taken place.	1. Technical / Water Officer 2. Manager of Engineering Services 3. Manager of Engineering Services 4. Technical / Water Officer 5. Manager of Engineering Services 6. As appropriate 7. Manager of Engineering Services 8. Manager of Engineering Services / Chief Executive Officer
3 2	Failure of infrastructure (ability to supply water compromised – short term water restrictions may be required) Failure of infrastructure or source supply (water quality or supply unlikely to be compromised)	1. Alert Manager of Engineering Services and Chief Executive Officer 2. Determine reason for failure, isolate if possible. Consider options to recommence supply. 3. Undertake comprehensive failure investigation 4. Undertake necessary corrective actions to recommence supply and provide an estimate of when the supply can be recommenced 5. Implement Short Term Water restrictions if required 6. Provide written report to the Chief Executive Officer 7. Non-compliance to be raised and will require signing off by the Manager of Engineering Services and the Chief Executive Officer after corrective actions have taken place.	1. Technical / Water Officer 2. Manager of Engineering Services 3. Manager of Engineering Services 4. As appropriate 5. Manager of Engineering Services 6. Manager of Engineering Services 7. Manager of Engineering Services / Chief Executive Officer
2	Minor exceedances of ADWG health guideline value for chemical parameter (determined value is close to guideline value).	1. Alert Manager of Engineering Services and Chief Executive Officer 2. Determine potentially affected area, isolate if possible (i.e. individual bore). Consider Water alert. Escalate emergency further if situation worsens. 3. Report detection to OWSR by phone (Immediately by phone, written incident report – Part 1 incident form - within 24 hours) 4. Resample for detected health parameter for all bores and combined bores (if possible) 5. Undertake comprehensive contamination investigation	1. Technical / Water Officer 2. Manager of Engineering Services 3. Manager of Engineering Services 4. Technical / Water Officer 5. Manager of Engineering Services

Level	Incident or emergency	Summary of actions to be taken (with documented procedure listed)	Position/s responsible for Action/s
		6. Undertake necessary corrective actions *7.* Upon resolution, provide written report to regulator (Part 2 incident form). Provide Report to Chief Executive Officer also. *8.* Non-compliance will be raised and will require signing off by the Manager of Engineering Services and the Chief Executive Officer after corrective actions have taken place.	6. Manager of Engineering Services 7. Manager of Engineering Services 8. Manager of Engineering Services / Chief Executive Officer
1	Exceedances of operational limit managed through operational and maintenance procedures	1. Alert Manager of Engineering Services 2. Review operational procedures. 3. Rectify exceedance and bring parameter within operational limits. Parameter shall be corrected same day. 4. Non-compliance to be raised and will require signing off by the Manager of Engineering Services and the Chief Executive Officer after corrective actions have taken place.	1. Technical / Water Officer 2. Manager of Engineering Services 3. Technical / Water Officer 4. Manager of Engineering Services / Chief Executive Officer

Table 5.8 Emergency Contact Details and Protocols

Description of Incident/ Emergency	Level	Business Unit / Organisation	Contact person(s) details	Communication protocols
All	5	Refer to Barcaldine Regional Council Local Disaster Management Plan		
All	All levels	Barcaldine Regional Council	Chief Executive Officer Steven Boxall 71 Ash Street, Barcaldine QLD 4725 Phone 07 4651 5626 Fax 07 4651 1778 CEO@barc.qld.gov.au	Phone Email Written Reports
		Barcaldine Regional Council – Alpha Area	District Manager Clint Swadling 43 Dryden Street (PO Box 11), Alpha, QLD 4724 Phone 07 4685 1101 Fax 07 4685 1162 emalpha@barc.qld.gov.ay	Phone Email Written Reports
		Barcaldine Regional Council – Aramac Area	District Manager Ian Kuhn 35 Gordan Street (PO Box 65), Aramac, QLD 4726 Phone 07 4651 5600 Fax 07 4652 9990 emaramac@barc.qld.gov.au	Phone Email Written Reports
		Barcaldine Regional Council – Barcaldine Area	District Manager Brett Walsh 71 Ash Street, Barcaldine, Barcaldine, QLD 4725 Phone 07 4651 5600 Fax 07 4651 1778 BrettW@barc.qld.gov.au	Phone Email Written Reports
	All levels	Barcaldine Regional Council	Manager of Engineering Services Rick Rolfe 71 Ash Street, Barcaldine, Barcaldine, QLD 4725 Phone 07 4651 5623 Fax 07 4651 1778 meng@barc.qld.gov.au	Phone Email Written Reports
	All levels	Barcaldine Regional Council	Technical / Water Officer	Phone Email Written Reports
All in Table 5.7	5, 4, 3, 2 Where outlined in Table 5.7	OWSR Office of the Water Supply Regulator GPO Box 2454 Brisbane Q 4001		Phone Written Report (email and post)

Description of Incident/ Emergency	Level	Business Unit / Organisation	Contact person(s) details	Communication protocols
		drinkingwater.reporting@dnrme.qld.gov.au Phone – Water 13 74 68 or Emergency 13 25 00		
All health related	5, 4, 3	Central QLD Public Health Unit 82-86 Bolsover Street Rockhampton Queensland 4700 Phone 07 4920 6989		Phone Written Email
For all other contacts and contact numbers refer to the Local Disaster Management Plan contact list, a copy of which is contained in Appendix E.				

5.4 Risk Management Improvement Program

Unacceptable residual risks or risks identified in the plan have been included in the Risk Management Improvement Program (RMIP) below for Alpha and Jericho in 5.4.1 and Aramac, Barcaldine and Muttaburra in 5.4.2 below.

The RMIP also include for improvements to parts of the plan where deficiencies in information or uncertainties exist. Priorities of the improvements and target dates for completion have also been included.

5.4.1 Alpha and Jericho RMIP

Table 5.9 below outlines the proposed RMIP to be implemented for Alpha. Table 5.10 below outlines the proposed RMIP to be implemented for Jericho.

As Alpha and Jericho's raw water requires treatment prior to reticulation these schemes are generally more complex and therefore their RMIP is larger than the other three schemes. Improvements include drafting and implementing operational procedures, operator training and reducing the risk of contamination to the relatively shallow aquifers.

Table 5.9 Alpha Risk Management Improvement Program

Code	Improvement	Scheme Component / Sub-component	Hazard/ Hazardous event	Priority	Action(s)			Target date/s	Responsibility
					interim	short-term	long-term		
AL1	Operational & Maintenance Procedures / Operations Manual[27]	• Source, • Sourcing Infrastructure, • Treatment Plant & Reservoirs, • Disinfection Process, • Distribution System	• Septic system discharges • flood events • maintenance and repair of raw water main • treatment plant bypasses • alum over / under dosing • alum over dosing, hydrochloric over / under dosing • walkway access • over / under chlorination.	High (based on large number of out-dated / non-existent procedures)	Identify out-dated procedures, update and obtain approval and implement. Assign procedure and revision number.	Identify new procedures needed, develop and obtain approval and implement. Assign procedure and revision number.	N.A.	Interim: Nov-2018 Short-term: June-2019	
AL2	Commence raw water sampling in addition to treated water	• Source	• Septic system discharges. • Hazard that arises from the natural geological processes in the aquifer. • Flood event • Maintenance and repair of raw water main	Medium (to assess the effectiveness of the treatment process & determine certainty of the risk level associated with bypassing the water treatment plant)	Commence operational monitoring of combined raw water quality.	N.A.	If operational monitoring of raw water quality identifies issues with raw water quality, monitor individual bores to determine the effect is caused by one bore in isolation or a combination of bores.	Interim Oct-2018 Long-term: Implement raw water monitoring Oct 2018. With ongoing characterisation bore source water.	Manager of Engineering Services
AL3	Catchment Characterisation – Determine the effect of flooding on bore water	• DWQMP, • Source, • Sourcing Infrastructure	• Flood event	Medium (Based on uncertainties of the risk of flooding on water quality in the risk assessment)	N.A.	N.A.	Identify the effect of flooding on bore water quality considering private bores which may not be capped or correctly constructed.	Oct-18	
AL4	Seal uncapped bores	• Bores	• Contamination of source water	High	N.A	Determine bore seal design and cost	Seal bores which are abandoned under council jurisdiction.	Short-term: Oct - 2018 Long-term: Jun-19	
AL5	Operator Training and handover process	• Treatment Plant & Reservoirs	• Chemical over / under dose (true colour, turbidity, bacteria). • Over chlorination, under chlorination, • low residual in elevated reservoir, • pH >8, insufficient contact time	Medium (Based on uncertainties of the effectiveness of the treatment processes)	N.A.	Allow for peer training approximately 5 days, source operator from other DWSP to train operator	Based on peer training prepare hand over document so that new operators can pick up operations.	Short-term: Jun-18 Long Term: Aug-18	

Table 5.10 Jericho Risk Management Improvement Program

Code	Improvement	Scheme Component / Sub-component	Hazard/ Hazardous event	Priority	Action(s)			Target date/s	Responsibility
					interim	short-term	long-term		
J1	Operational & Maintenance Procedures / Operations Manual[28]	• Source, • Sourcing Infrastructure, • Treatment Plant & Reservoirs, • Disinfection Process, • Distribution System	• Septic system discharges • flood events • maintenance and repair of raw water main • treatment plant bypasses • alum over / under dosing • alum over dosing, hydrochloric over / under dosing • walkway access • over / under chlorination.	High (based on large number of out-dated / non-existent procedures)	Identify out-dated procedures, update and obtain approval and implement. Assign procedure and revision number.	Identify new procedures needed, develop and obtain approval and implement. Assign procedure and revision number.	N.A.	Interim: Nov-2018 Short-term: June -2019	Manager of Engineering Services
J2	Commence Monitoring of raw water quality - refer to operational monitoring program.	• Source	• Septic system discharges. • Hazard that arises from the natural geological processes in the aquifer. • Flood event • Maintenance and repair of raw water main	Medium (to assess the effectiveness of the treatment process & determine certainty of the risk level associated with bypassing the water treatment plant)	Commence operational monitoring of combined raw water quality.	N.A.	If operational monitoring of raw water quality identifies issues with raw water quality, monitor individual bores to determine the effect is caused by one bore in isolation or a combination of bores.	Interim Oct-2018 Long-term: Implement raw water monitoring Oct 2018. With ongoing characterisation bore source water.	
J3	Catchment Characterisation	• DWQMP, • Source, • Sourcing Infrastructure	• Flood event	Medium (Based on uncertainties of the risk of flooding on water quality in the risk assessment)	N.A.	N.A.	Identify the effect of flooding on bore water quality considering private bores which may not be capped or correctly constructed.	Oct-2018	
J4	Operator Training and handover process	• Treatment Plant & Reservoirs	• Chemical over / under dose (true colour, turbidity, bacteria). • Over chlorination, under chlorination, • low residual in elevated reservoir, • pH >8, insufficient contact time	Medium (Based on uncertainties of the effectiveness of the treatment processes)	N.A.	Allow for peer training approximately 5 days, source operator from other DWSP to train operator	Based on peer training prepare hand over document so that new operators can pick up operations.	Short-term: Jun-18 Long Term: Aug-18	

5.4.2 Aramac, Barcaldine and Muttaburra RMIP

Table 5.11 below outlines the proposed RMIP to be implemented for Aramac, Barcaldine and Muttaburra.

All three schemes source their water from relatively deep artesian bores and the water quality is suitable for reticulation without treatment. Improvements include drafting and implementing operational procedures and restricting access to the bore water sites.

Table 5.11 Aramac, Barcaldine and Muttaburra Risk Management Improvement Program

Code	Improvement	Scheme Component / Sub-component	Hazardous event	Priority	Action(s)			Target date/s	Responsibility
					interim	short-term	long-term		
ABM1	Operational & Maintenance Procedures	• Bores, • Sourcing Infrastructure, • Distribution System	• Sewage and septic system discharges, agricultural run-off • Hazard that arises from the natural geological processes in the aquifer • Accidental or intentional contamination • Reticulation maintenance and repair	High (based on large number of out-dated / non-existent procedures)	Identify out-dated procedures, update and obtain approval and implement. Assign procedure and revision number.	Identify new procedures needed, develop and obtain approval and implement. Assign procedure and revision number.		Interim: Oct-2018 Short-term: June-2019	Manager of Engineering Services
ABM2	Replace ageing mains in accordance with asset replacement program. Continue to apply for internal & external funding	• Distribution System	• Septic system discharges. • Ingress of pathogens • Maintenance and repair of raw water main	High	N.A	Replace high priority areas with greatest susceptivity for breakage.	Replacement of ageing mains in accordance with asset replacement program. Replace all expired mains. Approximately 1.9km in Aramac and 3.5km in Muttaburra.	Short term: June 2019 Long term: June 2021.	
ABM3	Create flushing schematic layout to go with the SOP Air scouring every 5 years. Implement reconfiguration of mains layout to improve flow.	• Distribution System	• Pathogen ingress • Reduced water quality	High	Create flushing schematic to go with operations and maintenance procedures.	Implement improved configuration of mains in Aramac to avoid dead spots	Air scoring every 5 years	Short term: December 2018 Long Term: Air Scouring June 2022	

5.5 Information Management

Barcaldine Regional Council has an information management plan developed for the individual shires and contained in their Total Management Plans. The current system was developed to record all relevant static and dynamic data for all system components, to summarise the data at set times in each financial year and formulate useable information reports on the condition and performance of system components and to integrate this information into the strategic, financial, asset and operational management plans.

Static and dynamic data is recorded for each component of the water supplies by the various Officers (Water / Technical / Works), Administrative Officers and Manager of Engineering Services and this data is kept on file at Barcaldine Regional Council or on site at the Water Treatment Plants. Where necessary the Manager of Engineering Services prepares a summary report of the data for inclusion in the Council's monthly meeting agendas. Council have set up electronic storage of data to enable formulation of reports.

However not all information gets reported to Council formally or directly and often the operations people are approached by members of the community. In future Council employees will be required to lodge formally any requests or complaints made by the community to them directly.

Table 5.12 contains a summary of the Water Quality Management Information currently recorded by Barcaldine Regional Council.

Table 5.12 Summary of Water Quality Management Information[29]

Information/ Document	Format (hardcopy / electronic)	Currency	Where stored (at WTP / on electronic system / other)	Position Responsible	Comments
Customer Service Request Form	Hardcopy Electronic	Live document	Filed at Barcaldine Regional Council (Electronic on Server)	Administrative Officer Manager of Engineering Services	To record individual customer details and complaints. This form enables customer complaints to be dealt with expediently and enables identification of recurring problems. It also helps facilitate corrective and preventative actions and improvements to operations as part of the continual improvement process within Councils QES Management Systems.
Reactive / Planned Maintenance / Register	Hardcopy Electronic	Live document	Filed at Barcaldine Regional Council (Electronic on Server)	Administrative Officer Town Foreman	Records the type of work, its location within the water supply system.
Planned Operational and Maintenance Programme	Hardcopy SAMP Electronic	SAMP review 2012	Filed at Barcaldine Regional Council (Electronic on Server)	Administrative Officer Manager of Engineering Services Water / technical / works officers	This form details planned maintenance procedures that the Officers (works / technical / water) complete at weekly, monthly, bi-annually or annually. The form also serves as a report sheet recommending further immediate corrective action. Details are also transferred to the Reactive and Planned Maintenance form.
Water Consumption and Pump Records	Hardcopy Electronic	Live document	Filed at Barcaldine Regional Council (Electronic on Server)	Administrative Officer Water / Technical Officer	Electrical power consumption and volume of water pumped from each bore. Analysis of this data provides information on the performance of the pumping units and allows the total water consumed to be compared with previous water consumption figures for similar time periods for previous years.
Operational Monitoring Database	Electronic Hardcopy	Annual	Filed at Barcaldine Regional Council (Electronic on Server)		All verification monitoring is captured in QLD Water database (SWIM). This database is a central point for all stakeholders allowing remote access and allows operators to enter data when required. The spreadsheet also records and identifies exceedances. Trends are automatically created based on the inputted data. Refer to Verification Monitoring Program.

Information/ Document	Format (hardcopy / electronic)	Currency	Where stored (at WTP / on electronic system / other)	Position Responsible	Comments
Chemical Supply Register • Chlorine (Sodium Hypochlorite) • Alum (Alum Sulphate) • Hydrochloric Acid • New Chemicals (new log for each new chemical)	Electronic Hardcopy	Live document	WTP Filed at Barcaldine Regional Council (Electronic on Server)	Water / Technical Officer	

6 Operational and Verification Monitoring Programs

Details of the operational monitoring programs are tabulated below for Alpha and Jericho in Table 6.1 and for Aramac, Barcaldine and Muttaburra in Table 6.2.

Details of the verification monitoring programs for Alpha, Aramac, Barcaldine, Jericho and Muttaburra are tabulated in Table 6.3 to Table 6.4.

6.1 Operational Monitoring

6.1.1 Alpha and Jericho Operational Monitoring

Operational monitoring conducted for Alpha and Jericho water supply schemes are tabulated in Table 6.1 below detailing monitoring locations, parameters measured, target and critical levels and actions to be taken in the event the levels are exceeded.

The persons responsible for operational monitoring include the Chief Executive Officer, Manager of Engineering Services and the Technical Officer (Alpha area). The Technical Officer is responsible for conducting operational monitoring. The Technical officer (Alpha area) manages day to day operations of the schemes in Alpha and Jericho.

Any exceedances of target limits shall be reported to the Manager of Engineering Services. The non-compliance shall be dealt with during the same working day and brought below the target limit level. Non-compliance will be raised and will require signing off by the Manager of Engineering Services after corrective actions are taken. Corrective actions will generally be determined by the non-compliance.

Any exceedances of critical limits shall be reported to the Manager of Engineering Services. The non-compliance shall be dealt with during the same working day and brought below the critical and action limits. Non-compliance will be raised and will require signing off by the Manager of Engineering Services and the Chief Executive Officer after corrective actions have taken place. Corrective actions will generally be determined by the non-compliance. A determination shall be made as to the cause of the exceedance and logged and the Manager of Engineering Services shall review current procedures to determine if they are applicable.

The Technical Officer will be required to log all maintenance issues in an operations log and a copy of this shall be sent fortnightly to the Manager of Engineering Services. While the Technical Officer will be encouraged to maintain informal lines of communication, formal communications shall also be required so as to enable a means for improved record keeping.

The operational monitoring program for Alpha and Jericho has been determined based on the complexity of the treatment systems and size of the scheme. Currently the DWSP does not sample the raw water quality prior to treatment. In order to determine the effectiveness of the treatment processes the DWSP will commence sampling the combined raw water quality. If the monitoring highlights any issues with the combined raw water quality, then the DWSP will commence sampling the individual bores to determine if the problem is associated with a single bore or multiple bores. This is particularly the case in Alpha where there is multiple bores in various locations throughout the town. In the case of Jericho both bores are located on the same site and the water quality from both bores is likely to be similar.

Online automated monitoring equipment is currently in use at the Alpha and Jericho water treatment plants, measuring pH, turbidity and chlorine residual, providing realtime water quality data and automated critical control point alarms for DWSP operators and managers. Operational monitoring samples are also taken after storage and in the reticulation system at designated sampling points as described below in Table 6.1.

Table 6.1 Alpha and Jericho Operational Monitoring

Location in System	Parameter	Associated Hazard	Sampling				Target limit	Action if target limit exceeded	Critical limit	Action if critical limit exceeded	Positions Responsible
			Frequency	Method	Location						
					Alpha	Jericho					
Combined Raw Water	E. coli	Bacteria	Monthly	Grab Sample	Inlet to WTP at No. 9 Mackeller Street.	Inlet to WTP at No. 2 Darwin Street.	0	Ensure target residual Chlorine levels are being achieved in reticulation	>1	Test individual bore to determine if exceedances are linked to individual bores. Investigate cause or origin of exceedance consider reducing or cease supply of poorer quality bores if issue cannot be addressed immediately.	**Overall Responsibility:** Chief Executive Officer **Implementation, review and actions:** Manager of Engineering Services **Operations:** Technical Officer
	Total Coliforms	Bacteria					0		25		
	Turbidity	Turbidity, Bacteria					< 1 NTU		5 NTU		
	pH	pH					7	Adjust pH Adjustment	≥ 5 & ≤ 8		
Treatment Plant & Reticulation system at designated sampling points	Coliform Colony Counts	Bacteria	Weekly		2 locations from: Alpha Hospital, Council depot swimming pool, information centre, hotel, or council office and ground level reservoir outlet	2 locations from: Bush nursing building, Council depot, swimming pool, information centre, hotel and ground level reservoir outlet	0	Check Chlorine residual. Adjust chlorination dose	1	Report to Engineering Services Manager. Check Chlorine residual adjust dosage rate if needed. Notify OWSR and complete incident reporting forms.	
	E. coli	Bacteria					0		1	Check Chlorine residual adjust dosage rate if needed. Notify OWSR and complete incident reporting forms.	
	Chlorine Residual	Chlorine	Automated Monitoring & Monthly Grab Sample from Distribution	Automated Monitoring & Monthly Grab Sample from Distribution			0.5 mg/L	Adjust chlorination dose	< 0.2 & >3mg/l	Report to Engineering Services Manager. Engineering Services Manager to review procedures. If required Notify OWSR and complete incident reporting forms	
	Turbidity	Turbidity, Bacteria					< 0.5 NTU	Adjust Alum dose	5 NTU	Report to Engineering Services Manager to review procedures. Ensure mixing tank is mixing. Adjust Alum dosing rate. Ensure Filters are backwashed. Adjust flow rate. Re-analysis turbidity. Parameter needs to be corrected same day. If not report non-compliance to Engineering Services Manager by phone and email.	
	pH	pH					7	Adjust pH Adjustment	≥ 5 & ≤ 8	Report to Engineering Services Manager to review procedures. Readjust pH adjustment. Re-analysis pH. Parameter needs to be corrected same day. If not report non-compliance to Engineering Services Manager by phone and email.	
Water Treatment Plant	Bypass of WTP	Hazards associated with bypassing the WTP	3 Times Weekly	Visual	N/A	N/A	N/A	N/A	N/A	The Technical Officer is required to visually inspect valves and ensure the WTP is not bypassed. Valves shall be correctly aligned as per the site as built drawings so as to disable the bypass. The valves shall be in good working condition. Any non-compliances shall be immediately raised to the Manager of Engineering Services Under normal operating conditions the WTP shall not be bypassed. Verbal followed by written permission will be required in order to bypass the WTP.	
Water Treatment Plant	General Maintenance	Hazards associated with maintenance of the WTP	3 Times Weekly				N/A	N/A	N/A	The Technical Officer is required to log all maintenance issues encountered on a day to day basis. Three times weekly the Technical Officer is required to visually inspect the plant for maintenance issues. A copy of the maintenance log is sent to the Manager of Engineering Services fortnightly. This shall include visual checks to ensure all barriers such as roof hatches or doors remain closed.	

6.1.2 Aramac, Barcaldine and Muttaburra Operation Monitoring

Operational monitoring for Aramac, Barcaldine and Muttaburra water supply schemes is tabulated in Table 6.2 below detailing monitoring locations, parameters measured, target and critical levels and actions to be taken in the event the levels are exceeded.

The persons responsible for operational monitoring include the Chief Executive Officer, Manager of Engineering Services and the Technical Officer (Aramac) and the Water Officers (Barcaldine and Muttaburra). The Technical / Water Officers are responsible for conducting operational monitoring. In Aramac the Technical Officer and in Barcaldine and Muttaburra the Water Officers are responsible for the day to day operations of the plant.

Any exceedances of target limits shall be reported to the Manager of Engineering Services. The non-compliance shall be dealt with during the same working day and brought below the target limit level. Non-compliance will be raised and will require signing off by the Manager of Engineering Services / Executive Manager / Chief Executive Officer after corrective actions are taken. Corrective actions will generally be determined by the non-compliance.

Any exceedances of critical limits shall be reported to the Manager of Engineering Services. The non-compliance shall be dealt with during the same working day and brought below the critical and action limits. Non-compliance will be raised and will require signing off by the Manager of Engineering and the Chief Executive Officer after corrective actions have taken place. Corrective actions will generally be determined by the non-compliance. A determination shall be made as to the cause of the exceedance and logged and the Manager of Engineering Services shall review current procedures to determine if they are applicable.

The Technical Officer will be required to log all maintenance issues in an operations log and a copy of this shall be sent fortnightly to the Manager of Engineering Services. While the Technical Officer will be encouraged to maintain informal lines of communication, formal communications shall also be required so as to enable a means for improved record keeping. Maintenance monitoring shall include but not limited to visual inspections to ensure that roof covers at the reservoirs are closed and that access to the sites is limited.

Table 6.2 Aramac, Barcaldine and Muttaburra Operational Monitoring

Location in System	Parameter	Associated Hazard	Sampling					Target limit	Action if target limit exceeded	Critical limit	Action if critical limit exceeded	Positions Responsible
			Frequency	Method	Location							
					Aramac	Barcaldine	Muttaburra					
Reticulation system at designated sampling points	E. coli	Bacteria	Barcaldine Weekly ——— Aramac & Muttaburra Monthly	Grab sample	2 Locations from the following: Hospital (mandatory), Council Depot, Road House or General Store	3 Locations from the following: Hospital (mandatory), Council Depot, Council Office, Show Grounds or Information centre	2 Locations from the following: Council Depot, Council Office, Town Clinic or Roadhouse	0	Determine potentially affected area, isolate if possible. Implement system flushing. Consider Boil Water alert.	1	Determine potentially affected area, isolate if possible. Implement system flushing. Report to Engineering Services Manager. Notify OWSR and complete incident reporting forms. Consider Boil Water alert.	**Overall Responsibility:** Chief Executive Officer
	Turbidity	Turbidity, Bacteria						< 0.5 NTU	Check bore pressure and integrity. Check reservoir levels. Conduct follow up monitoring.	≤1.0 NTU	Report to Engineering Services Manager to review procedures. Identify source and rectify, parameter needs to be corrected same day. If not report non-compliance to Engineering Services Manager by phone and email.	
Bores, System Wide	General Maintenance	Hazards associated with maintenance bores, reservoirs and reticulation system	Weekly	Visual	N/A	N/A	N/A	N/A	See critical limit	N/A	The Water / Technical Officers are required to log all maintenance issues encountered on a day to day basis. Three times weekly the Water / Technical Officer is required to visually inspect the scheme for maintenance issues. A copy of the maintenance log shall be sent to the Manager of Engineering Services Monthly. This shall include visual checks to ensure all barriers such as roof hatches or doors remain closed for the Reservoirs in Barcaldine.	**Implementation, review and actions:** Manager of Engineering Services **Operations:** Technical Officer

6.2 Verification Monitoring

Table 6.3. in section 6.2.1 below tabulates the parameters to be monitored, monitoring locations and frequency of monitoring for Alpha and Jericho.

Table 6.4 in section 6.2.2 below tabulate the parameters to be monitored, monitoring locations and frequency of monitoring for Aramac, Barcaldine and Muttaburra.

6.2.1 Alpha and Jericho Verification monitoring

Alpha and Jericho both have shallow sub artesian bores with raw water quality requiring treatment prior to reticulation. Table 6.3 in 6.2.1 above tabulates the parameters to be monitored, monitoring locations and frequency of monitoring.

For Alpha and Jericho microbial, physical and inorganic verification monitoring will be conducted at designated points in the reticulation system. These points will generally include public buildings to facilitate access.

Source water monitoring is programed to take place from all source water bores on an annual basis. Annual source water monitoring has been designed to analyse for potential contaminants not previously tested on a replicated basis. Anolytes to be tested include those either naturally present in the underlying geology or chemicals which may be present as a result of previous anthropogenic activities in the catchment.

Currently, data on water quality complaints are limited. Generally lines of communication are informal and complaints in towns are made directly to the Technical Officer or works supervisor and currently are not logged formally. Where complaints are lodged formally with council they are filed to a file associated with the property where the complaint originated. As an improvement complaints made informally to council staff will be required to be lodged formally to the Manager of Engineering Services in writing. This will then be added to the SWIM water database under Water Quality Complaints and the data from each complaint entered.

Table 6.3 Alpha and Jericho Verification Monitoring

Characteristic	Parameter	ADWG &/or Regulation Value	Sampling				Analysing Authority	Response to Exceedances
			Frequency		Location			
			Source Water	Distribution	Alpha	Jericho		
Microbial quality	E.coli	*Nil detect*	*Annually*	*Quarterly*	*Alpha Hospital, swimming pool and ground level reservoir outlet*	*Bush nursing building, swimming pool and ground level reservoir outlet*	*QHFSS*	*Refer to Incident Management Plan* *Notify OWSR and complete incident reporting forms* *Follow operational procedure for flushing mains for E.coli exceedance*
	Total Coliforms	*N/A*						
Disinfection By-Products	Chlorate	*0.8mg/l - Health*	*N/A*					*Acceptable risk, continue to monitor*
	Trihalomethanes	*.25mg/L - Health*						
Water Treatment Chemicals	Aluminium	*0.2mg/l - Aesthetic*						
Physical	pH	pH 6.5–8.5						
Physical Inorganics	Turbidity	5 NTU - Aesthetic						
	Dissolved Oxygen	> 85% - Aesthetic						
	Iron	0.3mg/l - Aesthetic						
Inorganics Physical	Soluble Iron	N/A						
	Manganese	0.5mg/l - Health						
	Soluble Manganese	N/A						
	Fluoride	1.5mg/l - Health						
	Iodide	0.5mg/l - Health	*Annually*	*N/A*	*At all supply bore headworks*			*Refer to Incident Management Plan* *Notify OWSR and complete incident reporting forms*
	Nitrate	50mg/l - Health						
	Nitrite	3mg/l - Health						
	Sulfate	500mg/l - Health						
	Antimony	0.003mg/l - Health						
	Arsenic	0.01mg/l - Health						
	Barium	2mg/l - Health						
	Beryllium	0.06mg/l - Health						
	Boron	4mg/l - Health						
	Cadmium	0.002mg/l - Health						
	Chromium	0.05mg/l - Health						
	Copper	2mg/l - Health						
	Cyanide	0.08mg/l - Health						
	Lead	0.01mg/l - Health						
	Mercury	0.001mg/l - Health						
	Molybdenum	0.05mg/l - Health						
	Nickel	0.02mg/l - Health						
	Selenium	0.01mg/l - Health						
	Silver	0.1mg/l - Health						
	Uranium	0.017mg/l - Health						
	Dissolved Organic Carbon	N/A						

6.2.2 Aramac, Barcaldine and Muttaburra Verification Monitoring

Aramac, Barcaldine and Muttaburra have deep artesian bores. In Aramac and Muttaburra bore water is supplied directly to reticulation without pumping and storage. In Barcaldine raw water is pumped from the bores and stored in ground level reservoirs prior to being pumped into reticulation. All three towns have a water quality sufficient to be reticulated without treatment.

For Aramac, Barcaldine and Muttaburra microbial, physical and inorganics verification monitoring will be conducted at various points in the reticulation system.

Data from verification monitoring shall be recorded in SWIM Local which when each new analysis suite is added, trends will be automatically updated based on the date and each data set. The trends for each scheme and each parameter sampled are enclosed in section 3 above. The Water / Technical Officer will be required to record in a log the weather conditions when sampling and this log shall be sent to the Manager of Engineering Services for inclusion in the spread sheet.

Currently, data on water quality complaints are limited. Generally lines of communication are informal and complaints in towns are made directly to the Water / Technical Officer or works supervisor and currently are not logged formally. Where complaints are lodged formally with council they are filed to a file associated with the property where the complaint originated. As an improvement complaints made informally to council staff will be required to be lodged formally to the Manager of Engineering Services in writing. This will be filed under Water Quality Complaints and the data from each complaint logged in a Water Quality complaint spread sheet.

Table 6.4 Aramac, Barcaldine and Muttaburra Verification Monitoring

Characteristic	Parameter	ADWG &/or Regulation Value	Testing					Analysing Authority	Response to Exceedances
			Frequency		Location				
			Source Water	Distribution	Aramac	Barcaldine	Muttaburra		
Microbial quality	*E.coli*	*Nil detect*	*N/A*	*Quarterly*	2 Sites from the following: Hospital (mandatory), Council Depot, Road House or General Store	3 Sites from the following: Hospital (mandatory), Council Depot Council Office Showgrounds or Information Centre	2 Sites from the following: Council Depot Council Office Town Clinic or Roadhouse	*QHFSS*	*Refer to Incident Management Plan* *Notify OWSR and complete incident reporting forms* *Follow operational procedure for flushing mains*
Physical	*pH*	*pH 6.5–8.5*							*Acceptable risk, continue to monitor for exceedances*
	Colour	*15 HU - Aesthetic*							
	Turbidity	*5 NTU - Aesthetic*							
	Dissolved Oxygen	*> 85% - Aesthetic*							
Inorganics	*Iron*	*0.3mg/l - Aesthetic*							
	Dissolved Iron	*N/A*							
	Manganese	*0.5mg/l - Health*							
	Dissolved Manganese	*N/A*							
	Fluoride	*1.5mg/l - Health*	*Annually*	*N/A*	*At all supply bore headworks*				*Refer to Incident Management Plan* *Notify OWSR and complete incident reporting forms*
	Antimony	*0.003mg/l - Health*							
	Arsenic	*0.01mg/l - Health*							
	Barium	*2mg/l - Health*							
	Beryllium	*0.06mg/l - Health*							
	Boron	*4mg/l - Health*							
	Cadmium	*0.002mg/l - Health*							
	Chromium	*0.05mg/l - Health*							
	Copper	*2mg/l - Health*							
	Cyanide	*0.08mg/l - Health*							
	Lead	*0.01mg/l - Health*							
	Mercury	*0.001mg/l - Health*							
	Molybdenum	*0.05mg/l - Health*							
	Nickel	*0.02mg/l - Health*							
	Selenium	*0.01mg/l - Health*							
	Silver	*0.1mg/l - Health*							
	Uranium	*0.017mg/l - Health*							
Physical	*Dissolved Organic Carbon*	*N/A*							

Appendix A

Drinking Water Quality Management Plan Approval Application

Drinking Water Quality Management Plan Approval Application

Queensland Government

Water Supply (Safety and Reliability) Act 2008, section 95

Privacy Disclaimer: Collection of information provided in this approved form and any attachments is authorised under the *Water Supply (Safety and Reliability) Act 2008* and is being used for the purpose of applying to the Office of the Water Supply Regulator for approval of a drinking water quality management plan. The Department of Environment and Resource Management will endeavour to maintain any confidentiality of information relating to your form. However, consideration of your form may involve consultation and if so, details of your form may be disclosed to third parties. This information will not otherwise be disclosed outside of the department unless required or authorised by law (for example as under the *Right to Information Act 2009*).

Note: This is an approved form under the *Water Supply (Safety and Reliability) Act 2008*, to be used by the drinking water service provider, to apply to the regulator for approval of a drinking water quality management plan (DWQMP).

Before submitting this approved form, please be fully aware of your rights and obligations under the *Water Supply (Safety and Reliability) Act 2008*.

1. Drinking Water Service Provider Details

Drinking water service provider	SPID
Barcaldine Regional Council	473

2. Contact Details

Principal Contact

Family name	Given name(s)	Position
Howard	Des	CEO

Postal address

PO Box 191

Barcaldine Postcode 4725

Telephone number	Fax number	Mobile number
(07) 4651 5600	(07) 4651 1778	

Email address

desh@barcaldinerc.qld.gov.au

3. Drinking Water Scheme Details

Please list the drinking water scheme(s) to which this plan applies

Alpha
Aramac
Jericho
Muttaburra
Barcaldine

(If space provided is insufficient, additional information may be attached)

Form WSR505 V01 Jan 2010 SSA Multimedia Services Page 1 of 2

Drinking Water Quality Management Plan Approval Application continued... page 2 of 2

4. Relevant Documents

List below all supporting documentation attached to this application that form part of the DWQMP. Where a document applies to a specific scheme or schemes please state this (e.g. scheme name).

	Document Name(s)
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	

(If space provided is insufficient, additional information may be attached)

5. Declaration

I/we declare and warrant that I/we have all the necessary and appropriate authority on behalf of the drinking water service provider to declare the information in this approved form, including any attachments or supporting information provided, are true and accurate to the best of my/our knowledge.

Family name	Given name(s)	
Howard	Des	
Position	**Signature**	**Date** (dd/mm/yyyy)
CEO		26/03/12
Family name	**Given name(s)**	
Position	**Signature**	**Date** (dd/mm/yyyy)
		/ /

6. Submission

Please complete and sign the form and send one (1) printed copy of all relevant materials, along with all materials saved on to CD (or equivalent electronic device) to:

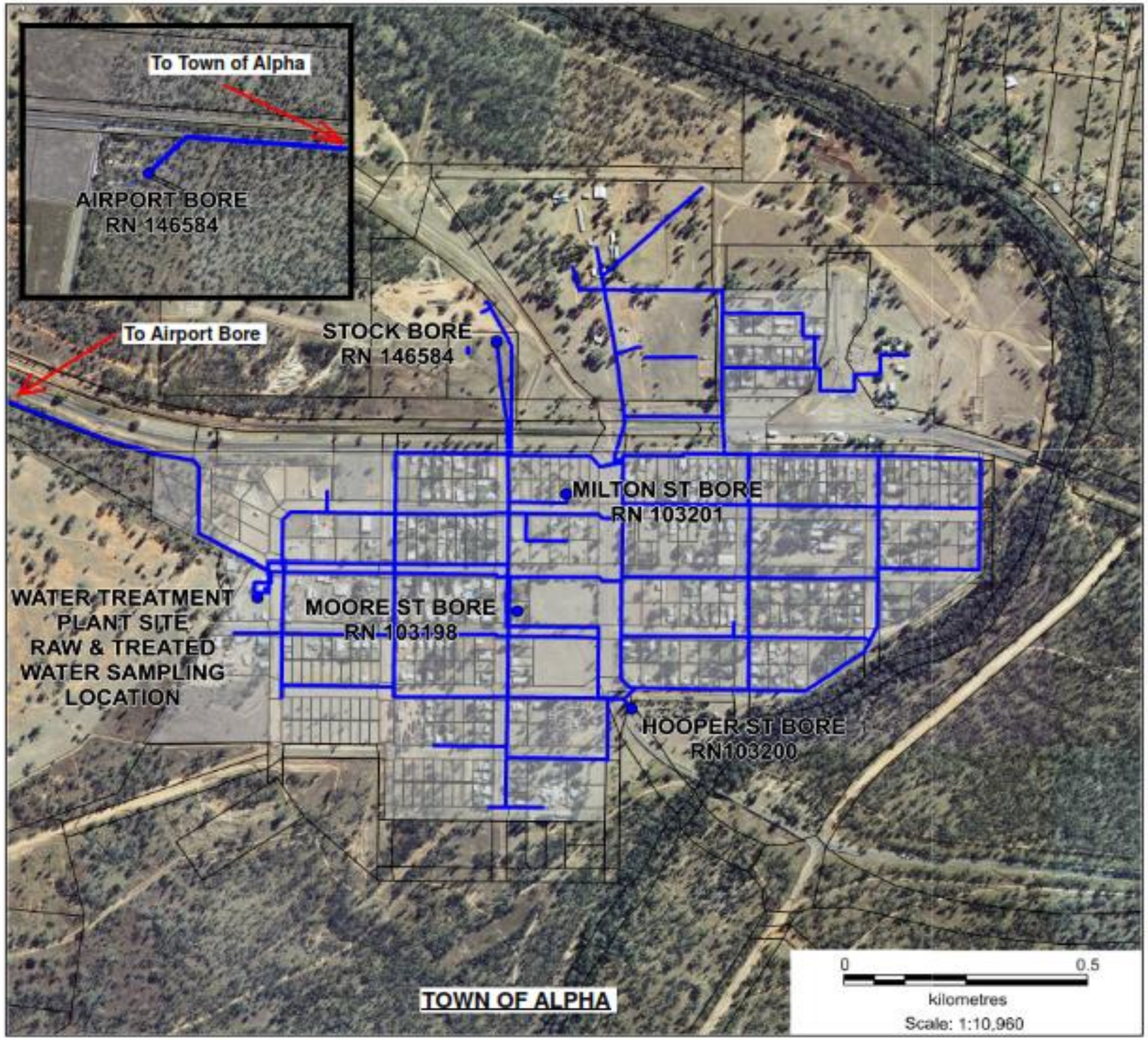
Director
Water Industry Asset Management and Standards
Office of the Water Supply Regulator
Department of Environment and Resource Management
GPO Box 2454
Brisbane Qld 4001

Form WSR505 V01 Jan 2010 SSA Multimedia Services Page 2 of 2

Appendix B

Water Supply Layouts Superimposed on Aerial Photos

170199-MAP1/01	Alpha Water Supply Scheme
M-2012-004	Aramac Water Supply Scheme
M-2012-005	Barcaldine Water Supply Scheme
M-2012-006	Jericho Water Supply Scheme
170199-MAP1/05	Muttaburra Water Supply Scheme



BARCALDINE REGIONAL COUNCIL

ALPHA_WATER_AREA Legend

Region

BARCALDINE REGIONAL COUNCIL

PRIORITY INFRASTRUCTURE AREA

TOWN OF ALPHA WATER SUPPLY

GBA CONSULTING ENGINEERS

170199-MAP1/01

Drawn By: P.J.A
Date: 27/04/11

Updated By: Z.R.
Date: 10/04/18

BARCALDINE REGIONAL COUNCIL

LEGEND

Water Main

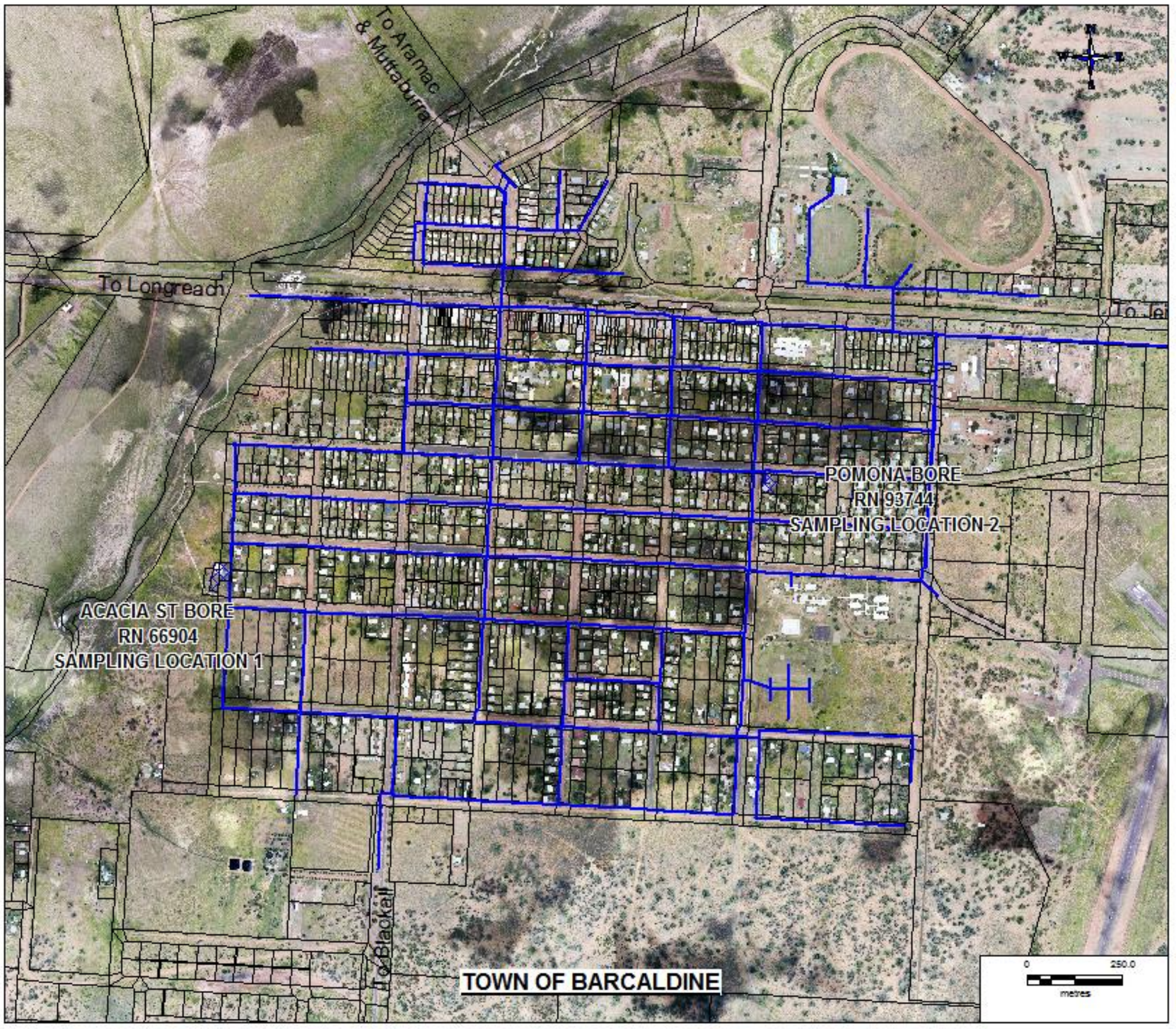
BARCALDINE REGIONAL COUNCIL PRIORITY INFRASTRUCTURE AREA

TOWN OF ARAMAC WATER SUPPLY

GBA CONSULTING ENGINEERS

M-2012-004

Drawn by: P.J.C.
Date: 21-02-2012



BARCALDINE REGIONAL COUNCIL

LEGEND

Water Main

BARCALDINE REGIONAL COUNCIL

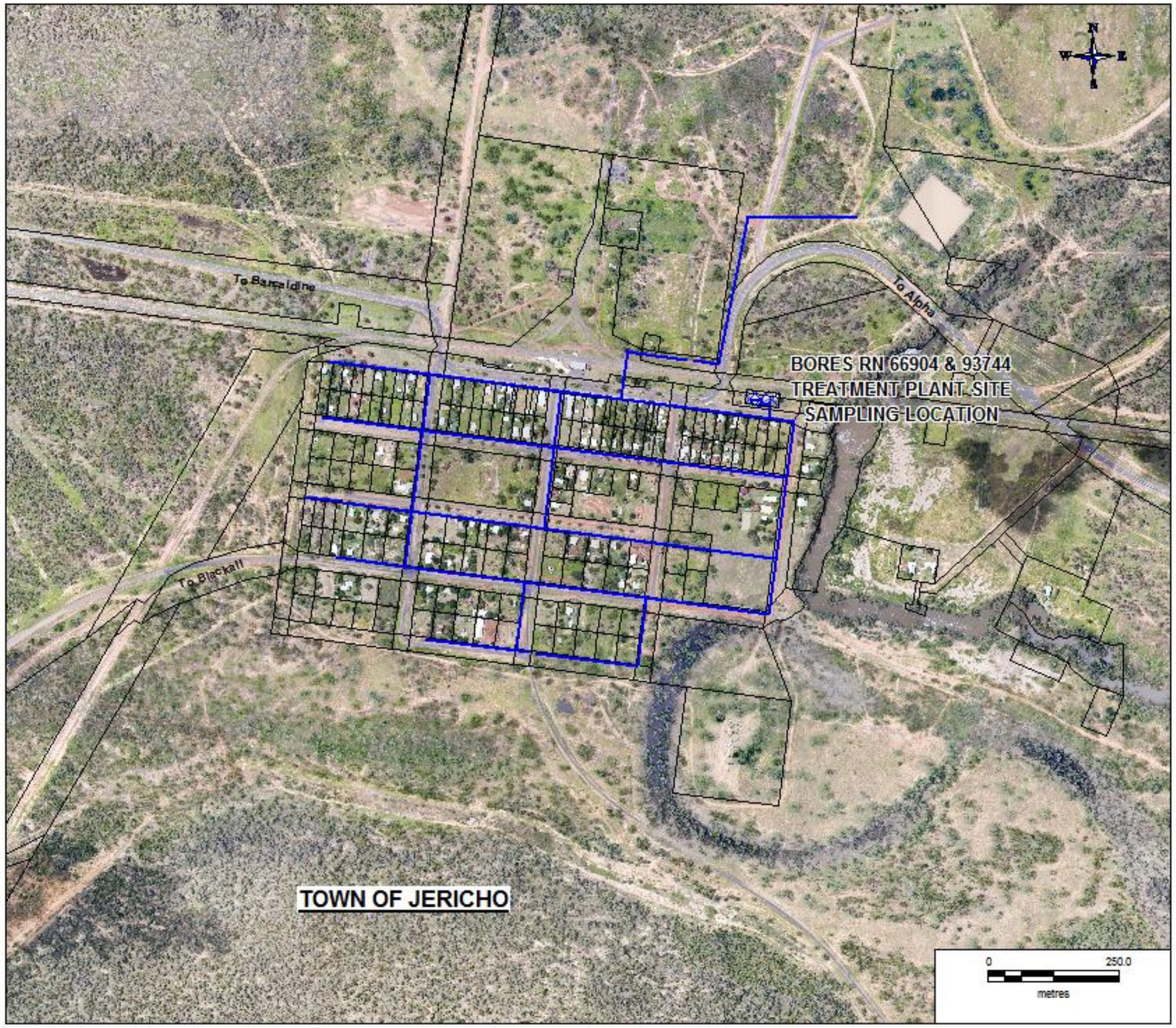
TOWN OF BARCALDINE
WATER SUPPLY

GBA CONSULTING ENGINEERING

M-2012-005

Drawn by: P.J.C.
Date: 22-02-2012

"Based on or contains data provided by the State of Queensland (Department of Natural Resources and Water) [2011]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws."



BARCALDINE REGIONAL COUNCIL

LEGEND

Water Main

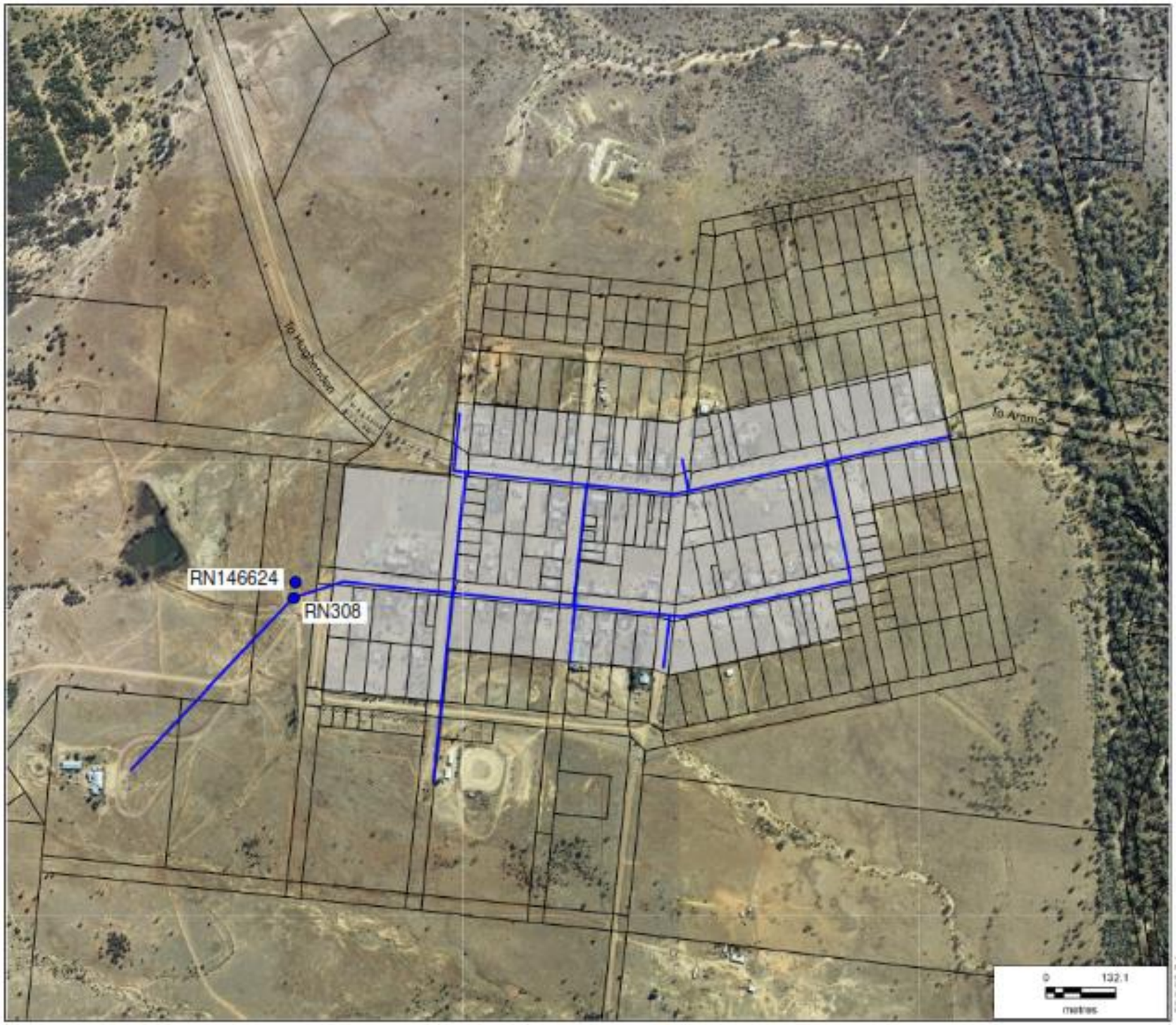
BARCALDINE REGIONAL COUNCIL

TOWN OF JERICHO WATER SUPPLY

GBA CONSULTING ENGINEERS

M-2012-006

Drawn by: P.J.C.
Date: 22-02-2012



BARCALDINE REGIONAL COUNCIL

MUTTABURRA_WATER_AREA Legend

Region

BARCALDINE REGIONAL COUNCIL

PRIORITY INFRASTRUCTURE AREA

TOWN OF MUTTABURRA WATER SUPPLY

GBA CONSULTING ENGINEERS

Drawn by: P.J.A.
Date: 27/04/11

Last Updated by: Z.R
Date: 09/04/18

170199-MAP1/05

Appendix C

Bore Water Report Cards

DATE 22/02/2012

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 103198

REGISTRATION DETAILS

		BASIN	1203	LATITUDE	23-39-53	MAP-SCALE	254
OFFICE	Emerald	SUB-AREA		LONGITUDE	146-38-11	MAP-SERIES	M
DATE LOG RECD		SHIRE	410-BARCALDINE REGION	EASTING	462931	MAP-NO	8250
D/O FILE NO.		LOT	1	NORTHING	7384311	MAP NAME	ALPHA
R/O FILE NO.		PLAN	SP104443	ZONE	55	PROG SECTION	
H/O FILE NO.		ORIGINAL DESCRIPTION		ACCURACY	SKET	PRES EQUIPMENT	
				GPS ACC			
GIS LAT	-23.6514819	PARISH NAME	91-ALPHA			ORIGINAL BORE NO	MOORE ST BORE
GIS LNG	146.6365229	COUNTY	BELYANDO			BORE LINE	-
CHECKED	Y	PROPERTY NAME					
		FIELD LOCATION				POLYGON	
						RN OF BORE REPLACED	
FACILITY TYPE	SF	DATE DRILLED	08/05/2002			DATA OWNER	DNR
STATUS	EX	DRILLERS NAME	TYNDALL, ROY MARTIN			CONFIDENTIAL	N
ROLES	WS	DRILL COMPANY	AFRAC DRILLING				
		METHOD OF CONST.					

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM	TOP (m)	BOTTOM (m)
A	08/05/2002	1	Stainless Steel	9.500	WT	510	0.00	26.20
A	08/05/2002	2	Acrylonitrile Butadiene Styrene			315	0.00	25.00
A	08/05/2002	3	Stainless Steel			275	25.00	51.00
A	08/05/2002	4	Screen	0.400	AP	275	27.50	29.25
A	08/05/2002	5	Screen	0.400	AP	275	32.00	34.80
A	08/05/2002	6	Screen	0.400	AP	275	45.30	48.30
A	08/05/2002	7	Grout			275	0.00	24.00
A	08/05/2002	8	Grout			510	0.00	26.00
A	08/05/2002	9	Gravel Pack				25.00	53.00
A	08/05/2002	10	Bentonite Seal	118.000	WT		24.50	25.00

STRATA LOG DETAILS

1	0.00	2.00	RED SANDY CLAY

DATE 22/02/2012

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 103198

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
2	2.00	3.00	BROWN CLAY
3	3.00	10.00	VERY FINE LIGHT BROWN SAND
4	10.00	12.00	VERY TIGHT, CLAY-BOUND GRAVEL
5	12.00	21.00	LIGHT GREY & BROWN CLAY
6	21.00	23.00	SILTY SAND
7	23.00	24.00	SAND CLAY
8	24.00	25.00	LGHT BROWN AND GREY CLAY
9	25.00	27.00	GREY CLAY
10	27.00	28.00	BROWN SAND
11	28.00	32.00	LGHT GREY AND CREAM CLAY
12	32.00	35.00	SILTY YELLOW SAND
13	35.00	44.00	LGHT GREY AND CREAM CLAY
14	44.00	48.00	VERY FINE SAND
15	48.00	56.00	LGHT GREY CLAY
16	56.00	60.00	GREY GREEN CLAY

STRATIGRAPHY DETAILS

**** NO RECORDS FOUND ****

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	32.00	34.00	SAND						N	SC	TERTIARY - UNDEFINED
2	45.00	48.00	SAND						Y	SC	TERTIARY - UNDEFINED

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

DATE 22/02/2012

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 103198

BORE CONDITION

**** NO RECORDS FOUND ****

ELEVATION DETAILS

**** NO RECORDS FOUND ****

WATER ANALYSIS PART1

**** NO RECORDS FOUND ****

WATER ANALYSIS PART 2

**** NO RECORDS FOUND ****

WATER LEVEL DETAILS

**** NO RECORDS FOUND ****

WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

**** NO RECORDS FOUND ****

SPECIAL WATER ANALYSIS

**** NO RECORDS FOUND ****

VALIDATION LOG - PART 1

REGDET	CASING	STRLOG	AQUIFR	PUMTES	ELVDET	WLVDET	FIELDQ
N 17/10/2005							

VALIDATION LOG - PART 2

WATANL	SAMPLE	STRTIG	WIRLOG	MULCND	BRCOND	FPREAD	GNOTES

GENERAL NOTES

**** NO RECORDS FOUND ****

DATE 08/05/2018

GROUNDWATER DATABASE

Page 1 of 4

BORE REPORT

REG NUMBER 103199

REGISTRATION DETAILS

		BASIN	1203	LATITUDE	23-38-47	MAP-SCALE	
OFFICE	Emerald	SUB-AREA		LONGITUDE	146-38-9	MAP-SERIES	
DATE LOG RECD		SHIRE	410-BARCALDINE REGIC	EASTING	462857	MAP-NO	
D/O FILE NO.		LOT	39	NORTHING	7384873	MAP NAME	
R/O FILE NO.		PLAN	A30115	ZONE	55	PROG SECTION	
H/O FILE NO.		ORIGINAL DESCRIPTION		ACCURACY		PRES EQUIPMENT	
				GPS ACC			
GIS LAT	-23.6464045	PARISH NAME	91-ALPHA			ORIGINAL BORE NO	
GIS LNG	146.6358071	COUNTY	BELYANDO			BORE LINE	-
CHECKED	Y						
						POLYGON	
						RN OF BORE REPLACED	
FACILITY TYPE	Sub-Artesian Facility	DATE DRILLED				DATA OWNER	
STATUS	Existing	DRILLERS NAME					
ROLES	WS	DRILL COMPANY					
		METHOD OF CONST.					

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM (mm)	TOP (m)	BOTTOM (m)
A	07/05/2002	1	Fibreglass Reinforced Plastic	9.500	WT	510	0.00	18.00
A	07/05/2002	2	Acrylonitrile Butadiene Styrene			275	0.00	17.00
A	07/05/2002	3	Stainless Steel			275	17.00	34.50
A	07/05/2002	4	Screen	0.400	AP	275	21.00	26.00
A	07/05/2002	5	Screen	0.400	AP	275	30.00	33.20
A	07/05/2002	6	Grout			275	0.00	17.00
A	07/05/2002	7	Grout			510	0.00	18.40
A	07/05/2002	8	Gravel Pack				17.00	36.00
A	07/05/2002	9	Bentonite Seal				17.50	18.00

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION

DATE 08/05/2018

GROUNDWATER DATABASE

BORE REPORT

REG NUMBER 103199

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	2.00	RED BROWN CLAY
2	2.00	3.00	BROWN SILTY CLAY
3	3.00	7.00	VERY FINE SAND & GRAVEL
4	7.00	9.00	LGHT GREY SANDY CLAY
5	9.00	10.00	ORANGE SILTY CLAY
6	10.00	13.00	GREY AND ORANGE CLAY
7	13.00	16.00	ORANGE SILTY SAND
8	16.00	17.00	LGHT GREY SILTY CLAY
9	17.00	20.00	BROWN AND GREY CLAY
10	20.00	26.00	BROWN AND YELLOW SAND
11	26.00	31.00	GREY SILTY CLAY
12	31.00	33.00	CREAM SAND
13	33.00	36.00	GREY & BROWN SANDY CLAY

STRATIGRAPHY DETAILS

**** NO RECORDS FOUND ****

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	21.00	26.00	SAND						Y	SC	TERTIARY - UNDEFINED
2	30.00	33.00	SAND						Y	SC	TERTIARY - UNDEFINED

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

BORE CONDITION

**** NO RECORDS FOUND ****

DATE 08/05/2018

GROUNDWATER DATABASE

BORE REPORT

REG NUMBER 103199

ELEVATION DETAILS

**** NO RECORDS FOUND ****

WATER ANALYSIS PART1

**** NO RECORDS FOUND ****

WATER ANALYSIS PART 2

**** NO RECORDS FOUND ****

WATER LEVEL DETAILS

**** NO RECORDS FOUND ****

WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

**** NO RECORDS FOUND ****

SPECIAL WATER ANALYSIS

**** NO RECORDS FOUND ****

DATE 17/01/2012

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 51968

REGISTRATION DETAILS

		BASIN	1203	LATITUDE	23-38-57	MAP-SCALE	104
OFFICE	Emerald	SUB-AREA		LONGITUDE	146-38-14	MAP-SERIES	M
DATE LOG RECD		SHIRE	410-BARCALDINE REGION	EASTING	462997	MAP-NO	8250
D/O FILE NO.	50-2003	LOT	315	NORTHING	7384549	MAP NAME	ALPHA
R/O FILE NO.	L028-068200C	PLAN	A3011	ZONE	55	PROG SECTION	
H/O FILE NO.	L7634B	ORIGINAL DESCRIPTION	A16 SEC 3	ACCURACY	SKET	PRES EQUIPMENT	NE
				GPS ACC			
GIS LAT	-23.649335723	PARISH NAME	91-ALPHA			ORIGINAL BORE NO	NEW MILTON ST BORE
GIS LNG	146.63717535	COUNTY	BELYANDO			BORE LINE	-
CHECKED	Y	PROPERTY NAME					
		FIELD LOCATION				POLYGON	
						RN OF BORE REPLACED	103201
FACILITY TYPE	SF	DATE DRILLED	22/01/1984			DATA OWNER	
STATUS	AU	DRILLERS NAME	BALKE W			CONFIDENTIAL	
ROLES	WS	DRILL COMPANY	LONGREACH WELL DRILLING CO.				
		METHOD OF CONST.	CABLE TOOL				

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM	TOP (m)	BOTTOM (m)
A	22/01/1984	1	Steel Casing (unspecified)	8.000	WT	219	0.00	27.00
A	22/01/1984	2	Steel Casing (unspecified)	8.000	WT	219	29.00	33.00
A	22/01/1984	3	Steel Casing (unspecified)	8.000	WT	219	34.00	36.90
A	22/01/1984	4	Screen	1.270	AP	219	27.00	29.00
A	22/01/1984	5	Screen	1.270	AP	209	33.00	34.00
A	22/01/1984	6	Gravel Pack	9.525	GR	406	0.00	39.00

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	1.00	TOP SOIL
2	1.00	4.00	SANDY CLAY
3	4.00	5.00	SAND AND GRAVEL

DATE 17/01/2012

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 51968

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
4	5.00	8.00	RED SANDY CLAY
5	8.00	17.00	YELLOW SANDY CLAY
6	17.00	19.00	REDDISH CLAY
7	19.00	20.00	SAND AND CLAY
8	20.00	23.00	SAND
9	23.00	25.00	SAND AND CLAY
10	25.00	29.00	SAND
11	29.00	32.00	TIGHT CLAY
12	32.00	33.00	SANDY CLAY
13	33.00	35.00	SAND
14	35.00	37.00	SANDY CLAY
15	37.00	39.00	CLAY

STRATIGRAPHY DETAILS

SOURCE	RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
DNR	1	12.00		TERTIARY SEDIMENTS
DNR	2	12.00		TERTIARY SEDIMENTS
DNR	3	12.00		TERTIARY SEDIMENTS

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	20.00	23.00	SAND	28/01/1984	-16.51	N	SUITABLE	5.00	Y	UC	TERTIARY - UNDEFINED
2	25.00	29.00	SAND	28/01/1984	-16.51	N	SUITABLE	5.00	Y	UC	TERTIARY - UNDEFINED
3	33.00	35.00	SAND	28/01/1984	-16.51	N	SUITABLE	5.00	Y	UC	TERTIARY - UNDEFINED

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

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PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

BORE CONDITION

**** NO RECORDS FOUND ****

ELEVATION DETAILS

PIPE	DATE	ELEVATION	PRECISION	DATUM	MEASUREMENT POINT	SURVEY SOURCE
A	22/JAN/84	349.63	SVY	AHD	R	JSC
X	22/JAN/84	349.03	SVY	AHD	N	JSC

WATER ANALYSIS PART1

PIPE	DATE	RD	ANALYST	QAN	DEPTH (m)	RMK	SRC	COND (uS/cm)	pH	Si (mg/L)	TOTAL IONS	TOTAL SOLIDS	HARD	ALK	FIG. OF MERIT	SAR	RAH
A	19/03/1981	2	GCL	W1941		PU	GB	1600	7.1	90	897.42	898.47	270	144	0.6	5.2	
A	24/01/1984	1	GCL	W1536		PU	GB	1950	6.8	66	1116.46	1065.55	288	189	0.5	6.9	
A	25/01/1984	1	GCL	W1534		PU	GB	1950	6.7	67	1107.86	1060.49	285	185	0.5	7.0	
A	25/01/1984	2	GCL	W1535		PU	GB	2050	6.9	64	1160.36	1107.45	314	189	0.5	6.7	
A	26/01/1984	1	GCL	W1580		PU	GB	1900	6.7	67	1104.36	1054.45	270	189	0.5	7.2	
A	27/01/1984	1	GCL	W1578		PU	GB	1900	6.5	68	1127.36	1078.45	270	189	0.5	7.2	
A	28/01/1984	1	GCL	W1579		PU	GB	1850	6.7	67	1101.36	1051.45	270	189	0.5	6.9	
A	14/06/1985	1	GCL	W2076		PU	GB	1700	6.7	64	1068.02	1007.49	239	201	0.4	7.2	
A	21/01/1986	1	GCL	W1281		PU	GB	1800	7.1	63	1138.72	1069.56	235	214	0.4	7.9	
A	30/09/1987	1	GCL	W542		PU	GB	1700	7.2	67	1090.74	1033.21	236	201	0.4	7.6	
A	29/05/1990	1	GCL	W2122		PU	GB	365	8.0	40	286.32	250.07	131	123	2.6	0.9	
A	12/06/1990	1	GCL	W2224		PU	GB	500	7.4	47	360.50	326.17	134	132	1.2	1.9	
A	14/11/1990	1	GCL	W1156		PU	GB	1550	7.2	70	958.70	911.79	228	189	0.5	6.3	
A	19/03/1991	1	GCL	W1940		PU	GB	1550	7.7	75	951.82	909.91	240	190	0.5	5.9	
A	19/03/1991	2	GCL	W1941		PU	GB	1600	7.1	90	897.78	898.83	270	144	0.6	5.2	
A	14/10/1991	1	GCL	W950		PU	GB	1600	7.7	70	1048.24	993.71	227	202	0.4	7.4	
A	10/12/1991	1	GCL	W		PU	GB	1700	8.0	70	1102.14	1042.52	240	212	0.4	7.6	
A	20/01/1992	1	GCL	603-6		PU	GB	1650	7.3	70	1042.34	990.35	221	197	0.4	7.6	
A	09/03/1992	1	GCL	W2270		PU	GB	1750	7.2	70	1052.54	1000.55	232	197	0.4	7.6	
A	27/04/1992	1	GCL	W		PU	GB	1150	7.6	65	736.21	689.38	125	181	0.3	7.4	1.13
A	07/07/1992	1	GCL	W		PU	GB	1700	7.2	80	1073.82	1024.20	222	210	0.4	7.9	

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PIPE	DATE	RD	ANALYST	QAN	DEPTH (m)	RMK	SRC	COND (uS/cm)	pH	Si (mg/L)	TOTAL IONS	TOTAL SOLIDS	HARD	ALK	FIG. OF MERIT	SAR	RAH
A	24/08/1992		1 GCL	W562		PU	GB	1700	7.9	7575	1044.75	8490.13	220	211	0.4	7.6	
A	01/12/1992		1 GCL	W1603		PU	GB	1650	8.1	80	989.68	947.69	210	200	0.4	7.2	
A	12/10/1993		1 GCL	W788		PU	GB	1600	7.8	70	1023.77	974.32	217	194	0.4	7.5	
A	22/07/1996		1 GCL	192934			GB	1950	7.0	70	1202.32	1140.16	280	214	0.4	7.7	
A	17/02/1997		1 GCL	W1682		PU	GB	1800	7.1	65	1169.10	1104.48	272	209	0.4	7.4	
A	01/07/1998		1 GCL	JER013		PU	GB	1850	7.2		1169.26	1026.94	250	230	0.4	8.0	
A	13/02/2001		1 GCL	JER002	34.00	PU	GB	1800	7.3	70	1152.59	1082.81	251	227	0.4	8.0	

WATER ANALYSIS PART 2

PIPE	DATE	RD	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	19/03/1981	2	195.0	7.0	44.0	39.0	0.01	175.0	0.01	0.2	365.0	0.20	40.0	32.0				
A	24/01/1984	1	270.0	11.0	46.0	42.0	0.01	230.0	0.05	0.1	420.0	0.30	95.0	2.0				
A	25/01/1984	1	270.0	10.5	45.0	42.0	0.01	225.0	0.05	0.1	425.0	0.20	88.0	2.0				
A	25/01/1984	2	275.0	12.0	50.0	46.0	0.01	230.0	0.05	0.1	440.0	0.20	105.0	2.0				
A	26/01/1984	1	270.0	11.0	42.0	40.0	0.01	230.0	0.05	0.1	400.0	0.20	81.0	30.0				
A	27/01/1984	1	270.0	11.0	42.0	40.0	0.01	230.0	0.05	0.1	395.0	0.20	80.0	59.0				
A	28/01/1984	1	260.0	11.0	42.0	40.0	0.01	230.0	0.05	0.1	390.0	0.20	74.0	54.0				
A	14/06/1985	1	255.0	9.6	38.0	35.0	0.01	245.0	0.01	0.1	360.0	0.30	69.0	56.0				
A	21/01/1986	1	280.0	11.0	38.0	34.0	0.01	260.0	0.01	0.3	385.0	0.40	78.0	52.0				
A	30/09/1987	1	270.0	10.0	37.0	35.0	0.01	245.0	0.03	0.3	385.0	0.40	66.0	42.0				
A	29/05/1990	1	23.0	12.0	31.0	13.0	0.01	150.0	0.01	0.1	43.0	0.20	5.5	8.5				
A	12/06/1990	1	50.0	13.0	29.0	15.0		160.0		0.2	66.0	0.30	16.0	11.0				
A	14/11/1990	1	220.0	11.5	34.5	34.5		230.0		0.3	320.0	0.40	68.0	39.5				
A	19/03/1991	1	210.0	8.7	40.0	34.0	0.01	230.0	0.01	0.8	320.0	0.30	68.0	40.0				
A	19/03/1991	2	195.0	7.0	44.0	39.0	0.01	175.0	0.01	0.2	365.0	0.20	40.0	32.0	0.03	0.05	0.20	0.08
A	14/10/1991	1	255.0	13.5	35.5	33.5	0.02	245.0	0.02	0.9	335.0	0.30	84.0	45.5				
A	10/12/1991	1	270.0	12.0	37.5	35.5	0.02	255.0	0.02	1.7	345.0	0.40	98.0	47.0				
A	20/01/1992	1	260.0	11.5	34.0	33.0	0.02	240.0	0.02	0.4	335.0	0.40	82.0	46.0				
A	09/03/1992	1	265.0	11.3	36.0	34.5	0.02	240.0	0.02	0.3	330.0	0.40	88.0	47.0				
A	27/04/1992	1	190.0	13.0	17.0	20.0	0.02	220.0	0.09	0.6	195.0	0.50	49.0	31.0				
A	07/07/1992	1	270.0	11.0	34.5	33.0	0.02	255.0	0.10	0.3	340.0	0.40	85.0	44.5				

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PIPE	DATE	RD	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	24/08/1992	1	260.0	11.5	33.0	33.5	0.02	255.0	0.10	1.4	325.0	0.30	81.0	43.5	0.03	0.05	0.30	0.05
A	01/12/1992	1	240.0	10.0	32.0	31.5	0.02	240.0	0.02	1.9	315.0	0.30	75.0	43.5	0.04	0.05	0.30	0.05
A	12/10/1993	1	255.0	11.5	35.0	31.5	0.02	235.0	0.03	1.0	340.0	0.30	69.0	45.0	0.02	0.05	0.30	0.05
A	22/07/1996	1	295.0	12.5	43.0	42.0		260.0		0.2	425.0	0.30	71.0	53.0	0.02		0.30	
A	17/02/1997	1	280.0	13.0	41.5	41.0		255.0		0.2	420.0	0.40	67.0	51.0				
A	01/07/1998	1	290.0	12.0	39.0	37.0	0.02	280.0	0.02	0.3	390.0	0.40	67.0	53.0	0.02	0.05	0.40	0.05
A	13/02/2001	1	290.0	12.5	37.5	38.0	< 0.02	275.0	0.04	0.4	375.0	0.40	70.0	53.0	0.19	< 0.05	0.44	< 0.05

WATER LEVEL DETAILS

PIPE	DATE	MEASURE (m)	N/R	RMK	LOG	PIPE	DATE	MEASURE	N/R	RMK	LOG	PIPE	DATE	MEASURE	N/R	RMK	LOG
A	24/01/1984	-15.91		R													

WIRE LINE LOG DETAILS

DATE	RUN	OPERATOR	TYPE	SOURCE	TOP	BOTTOM	COMMENTS
14/05/2001	1	B ISBISTER	CALU	ALPHA	-1.44	28.56	

FIELD MEASUREMENTS

**** NO RECORDS FOUND ****

SPECIAL WATER ANALYSIS

PIPE A DATE 20/03/2001 REC 1

VARIABLE ********** Electrical Conductivity @ 25C

MEASUREMENT 1626.00000 UNITS Microsiemens/cm

DEPTH 34.00

WR ANAL NO 1 METHOD PU PRESERVATIVES PROJECTS

BOTTLE 1 ANALYST XXX NL PR

COL AUTH PR

RECD AT LAB SOURCE GB

COMMENT

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REG NUMBER 51968

PIPE A DATE 20/03/2001 REC 1
VARIABLE ********** Nitrate as NO3
MEASUREMENT 29.00000 UNITS Milligrams/Litre
DEPTH 34.00
WR ANAL NO 1 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 1 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

PIPE A DATE 20/03/2001 REC 2
VARIABLE ********** Electrical Conductivity @ 25C
MEASUREMENT 1821.00000 UNITS Microsiemens/cm
DEPTH 34.00
WR ANAL NO 2 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 2 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

PIPE A DATE 20/03/2001 REC 2
VARIABLE ********** Nitrate as NO3
MEASUREMENT 53.00000 UNITS Milligrams/Litre
DEPTH 34.00
WR ANAL NO 2 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 2 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

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BORE CARD REPORT - PUBLISHABLE

REG NUMBER 51968

PIPE A DATE 20/03/2001 REC 3
VARIABLE ********** Electrical Conductivity @ 25C
MEASUREMENT 1848.00000 UNITS Microsiemens/cm
DEPTH 34.00
WR ANAL NO 3 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 3 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

PIPE A DATE 20/03/2001 REC 3
VARIABLE ********** Nitrate as NO3
MEASUREMENT 61.00000 UNITS Milligrams/Litre
DEPTH 34.00
WR ANAL NO 3 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 3 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

PIPE A DATE 21/03/2001 REC 1
VARIABLE ********** Electrical Conductivity @ 25C
MEASUREMENT 1903.00000 UNITS Microsiemens/cm
DEPTH 34.00
WR ANAL NO 4 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 4 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

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REG NUMBER 51968

PIPE A DATE 21/03/2001 REC 1
VARIABLE ********** Nitrate as NO3
MEASUREMENT 59.00000 UNITS Milligrams/Litre
DEPTH 34.00
WR ANAL NO 4 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 4 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

PIPE A DATE 21/03/2001 REC 1
VARIABLE ********** Electrical Conductivity @ 25C
MEASUREMENT 1905.00000 UNITS Microsiemens/cm
DEPTH 34.00
WR ANAL NO 5 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 5 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

PIPE A DATE 21/03/2001 REC 1
VARIABLE ********** Nitrate as NO3
MEASUREMENT 57.00000 UNITS Milligrams/Litre
DEPTH 34.00
WR ANAL NO 5 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 5 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

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BORE CARD REPORT - PUBLISHABLE

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PIPE A DATE 21/03/2001 REC 1

VARIABLE ********** Electrical Conductivity @ 25C
MEASUREMENT 1916.00000 UNITS Microsiemens/cm
DEPTH 34.00
WR ANAL NO 6 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 6 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

PIPE A DATE 21/03/2001 REC 1

VARIABLE ********** Nitrate as NO3
MEASUREMENT 61.00000 UNITS Milligrams/Litre
DEPTH 34.00
WR ANAL NO 6 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 6 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

VALIDATION LOG - PART 1

REGDET	CASING	STRLOG	AQUIFR	PUMTES	ELVDET	WLVDET	FIELDQ
Y 05/04/1993	Y 05/04/1993	Y 05/04/1993	Y 05/04/1993	Y 05/04/1993	Y 05/04/1993	Y 05/04/1993	Y 05/04/1993

VALIDATION LOG - PART 2

WATANL	SAMPLE	STRTIG	WIRLOG	MULCND	BRCOND	FPREAD	GNOTES
Y 19/04/2001		Y 05/04/1993		Y 05/04/1993			

GENERAL NOTES

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**** NO RECORDS FOUND ****

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REG NUMBER 51402

REGISTRATION DETAILS

		BASIN	1203	LATITUDE	23-39-12	MAP-SCALE	104
OFFICE	Emerald	SUB-AREA		LONGITUDE	146-38-20	MAP-SERIES	M
DATE LOG RECD		SHIRE	410-BARCALDINE REGION	EASTING	463167	MAP-NO	8250
D/O FILE NO.	50-2003	LOT	132	NORTHING	7384105	MAP NAME	ALPHA
R/O FILE NO.	L028-068200C	PLAN	BEL12415	ZONE	55	PROG SECTION	
H/O FILE NO.	07229	ORIGINAL DESCRIPTION	TOWN OF ALPHA	ACCURACY	SKET	PRES EQUIPMENT	TE
				GPS ACC			
GIS LAT	-23.653356909	PARISH NAME	91-ALPHA			ORIGINAL BORE NO	ALPHA TOWN NO. 2
GIS LNG	146.638834857	COUNTY	BELYANDO			BORE LINE	-
CHECKED	Y	PROPERTY NAME					
		FIELD LOCATION				POLYGON	
						RN OF BORE REPLACED	103200
FACILITY TYPE	SF	DATE DRILLED	26/05/1980			DATA OWNER	
STATUS	AU	DRILLERS NAME				CONFIDENTIAL	
ROLES	WS	DRILL COMPANY	LONGREACH WELL DRILLING CO.				
		METHOD OF CONST.	CABLE TOOL				

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM	TOP (m)	BOTTOM (m)
A	26/05/1980	1	Steel Casing (unspecified)	6.350	WT	219	0.00	29.30
A	26/05/1980	2	Screen	1.270	AP	219	29.30	31.30
A	26/05/1980	3	Steel Casing (unspecified)	6.350	WT	219	31.30	35.50
A	26/05/1980	4	Screen	1.270	AP	219	35.50	37.50
A	26/05/1980	5	Gravel Pack	4.750	GR		0.00	39.90

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	1.20	SOIL
2	1.20	2.70	SANDY CLAY
3	2.70	6.00	CLAY SAND & GRAVEL
4	6.00	7.90	SAND & SMALL GRAVEL

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RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
5	7.90	8.80	SOFT WHITE SANDSTONE
6	8.80	11.80	CLAY & SAND
7	11.80	20.10	SANDY CLAY
8	20.10	22.20	SOFT SANDSTONE
9	22.20	22.80	SAND - WATER
10	22.80	24.00	SANDSTONE
11	24.00	24.60	SAND - WATER
12	24.60	25.60	CLAY
13	25.60	28.90	SANDY CLAY
14	28.90	31.00	SANDSTONE - WATER
15	31.00	33.20	SAND - WATER
16	33.20	34.40	SANDSTONE
17	34.40	35.60	SOFT SANDSTONE
18	35.60	38.70	SAND - WATER
19	38.70	39.90	SOFT SANDSTONE

STRATIGRAPHY DETAILS

SOURCE	RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
DNR	1	20.00		UNDIFF TERT

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	36.00	39.00	SDST	26/05/1980	-17.20	N	POTABLE	16.40	Y	SC	TERTIARY - UNDEFINED

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

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REG NUMBER 51402

BORE CONDITION

**** NO RECORDS FOUND ****

ELEVATION DETAILS

PIPE	DATE	ELEVATION	PRECISION	DATUM	MEASUREMENT POINT	SURVEY SOURCE
A	26/MAY/80	351.50	SVY	AHD	R	JSC
X	26/MAY/80	350.30	SVY	AHD	N	JSC

WATER ANALYSIS PART1

PIPE	DATE	RD	ANALYST	QAN	DEPTH (m)	RMK	SRC	COND (uS/cm)	pH	Si (mg/L)	TOTAL IONS	TOTAL SOLIDS	HARD	ALK	FIG. OF MERIT	SAR	RAH
A	26/05/1980	1	GCL	86250	39.00	PU	GB	1890	7.9	80	1104.00	1099.62	314	137	0.6	6.2	
A	27/05/1980	1	GCL	86252	39.00	PU	GB	1780	7.2	85	1153.40	1153.51	314	137	0.6	6.1	
A	10/04/1981	1	GCL	2502		PU	GB	1700	6.6	85	1094.17	1098.35	316	132	0.6	5.7	
A	11/04/1981	1	GCL	2499		PU	GB	1650	6.7	85	1041.36	1039.44	299	142	0.6	5.6	
A	12/04/1981	1	GCL	2501		PU	GB	1630	6.8	85	1034.26	1034.88	294	138	0.6	5.7	
A	13/04/1981	1	GCL	2553		PU	GB	1650	6.6	85	1035.16	1035.27	298	139	0.6	5.7	
A	20/12/1983	1	GCL	W1344		PU	GB	1850	6.5	73	1088.26	1072.31	308	144	0.6	6.1	
A	11/02/1984	1	GCL	W1632		PU	GB	1750	6.7	75	1025.36	1013.95	280	140	0.5	6.1	
A	03/04/1984	1	GCL	W2074		PU	GB	1750	6.6	77	1041.36	1021.78	280	156	0.5	6.1	
A	26/06/1984	1	GCL	W2511		PU	GB	1750	6.5	83	1023.26	1019.85	287	139	0.6	6.0	
A	11/12/1984	1	GCL	W1100		PU	GB	2000	6.6	77	1192.91	1147.92	326	197	0.6	6.5	
A	14/06/1985	1	GCL	W2077		PU	GB	1750	7.9	64	1134.47	1051.06	269	240	0.5	6.9	
A	30/09/1987	1	GCL	W541		PU	GB	1550	6.7	74	925.48	913.07	246	140	0.5	6.0	
A	29/05/1990	1	GCL	W2121		PU	GB	1050	7.5	65	729.95	667.88	310	206	1.4	2.6	
A	29/06/1990	1	GCL	W2229		PU	GB	990	7.3	65	712.62	650.54	308	206	1.4	2.5	
A	14/11/1990	1	GCL	W1155		PU	GB	1650	7.4	65	1009.90	937.66	438	222	1.4	2.9	
A	14/10/1991	1	GCL	W949		PU	GB	1550	6.9	80	938.84	929.89	253	144	0.5	6.0	
A	10/12/1991	1	GCL	W		PU	GB	1650	7.2	85	949.45	942.96	262	148	0.5	6.1	
A	20/01/1992	1	GCL	W1858		PU	GB	1650	7.0	80	964.84	955.89	257	144	0.5	6.2	
A	09/03/1992	1	GCL	W2269		PU	GB	1650	6.8	85	956.84	955.43	255	140	0.5	6.3	
A	27/04/1992	1	GCL	W2635		PU	GB	1600	6.8	85	950.37	946.42	241	144	0.5	6.7	
A	07/07/1992	1	GCL	W		PU	GB	1550	7.0	90	926.92	925.43	241	148	0.5	6.3	
A	24/08/1992	1	GCL	W558		PU	GB	1650	7.2	90	924.34	925.39	248	144	0.5	6.1	
A	01/12/1992	1	GCL	W1602		PU	GB	1650	7.9	90	946.96	950.55	255	141	0.5	6.0	

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REG NUMBER 51402

PIPE	DATE	RD	ANALYST	QAN	DEPTH (m)	RMK	SRC	COND (uS/cm)	pH	Si (mg/L)	TOTAL IONS	TOTAL SOLIDS	HARD	ALK	FIG. OF MERIT	SAR	RAH
A	22/07/1996	1	GCL	192933			GB	1500	6.8	80	905.00	896.05	232	144	0.5	6.3	
A	17/02/1997	1	GCL	W1683		PU	GB	1400	6.9	65	854.70	818.04	209	164	0.5	6.3	
A	01/07/1998	1	GCL	JER011		PU	GB	1450	6.7		866.84	775.35	220	148	0.5	6.0	
A	20/10/1999	1	GCL	201750		PU	GB	1594	7.7	79	983.56	966.50	265	156	0.5	6.2	0.00
A	13/03/2001	1	GCL	JER005		PU	GB	1350	6.8	85	769.90	773.57	207	132	0.5	5.6	

WATER ANALYSIS PART 2

PIPE	DATE	RD	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	26/05/1980	1	252.0	12.0	50.0	46.0		166.0		0.8	437.0	0.20	104.0	36.0				
A	27/05/1980	1	248.0	12.0	50.0	46.0		167.0		0.2	424.0	0.20	172.0	34.0				
A	10/04/1981	1	234.0	12.0	49.0	47.0	0.02	159.0	0.05	1.0	440.0	0.10	110.0	42.0				
A	11/04/1981	1	224.0	12.0	47.0	44.0	0.01	171.0	0.05	1.0	420.0	0.30	85.0	37.0				
A	12/04/1981	1	224.0	12.0	45.0	44.0	0.01	166.0	0.05	1.0	420.0	0.20	85.0	37.0				
A	13/04/1981	1	226.0	12.0	45.0	45.0	0.01	167.0	0.05	1.0	423.0	0.10	80.0	36.0				
A	20/12/1983	1	245.0	12.0	49.0	45.0	0.01	175.0	0.05	0.0	425.0	0.20	94.0	43.0				
A	11/02/1984	1	235.0	11.0	43.0	42.0	0.01	170.0	0.05	0.1	420.0	0.20	69.0	35.0				
A	03/04/1984	1	235.0	11.0	43.0	42.0	0.01	190.0	0.05	0.1	420.0	0.20	65.0	35.0				
A	26/06/1984	1	235.0	11.0	44.0	43.0	0.01	170.0	0.05	0.0	420.0	0.20	60.0	40.0				
A	11/12/1984	1	270.0	13.5	46.5	51.0	0.01	240.0	0.10	0.1	480.0	0.20	53.0	38.5				
A	14/06/1985	1	260.0	9.4	55.0	32.0	0.03	290.0	0.14	1.6	365.0	0.30	67.0	54.0				
A	30/09/1987	1	215.0	10.0	39.0	36.0	0.01	170.0	0.17	0.1	380.0	0.20	46.0	29.0				
A	29/05/1990	1	105.0	24.0	60.0	39.0	0.03	250.0	0.02	0.5	215.0	0.40	13.0	23.0				
A	29/06/1990	1	100.0	26.0	59.0	39.0	0.01	250.0	0.01	0.3	205.0	0.40	9.9	23.0				
A	14/11/1990	1	140.0	27.5	70.0	64.0		270.0		0.5	350.0	0.40	40.0	47.5				
A	14/10/1991	1	220.0	14.0	38.5	38.0	0.02	175.0	0.02	0.1	375.0	0.20	46.0	32.0				
A	10/12/1991	1	225.0	12.0	40.5	39.0	0.02	180.0	0.03	0.2	375.0	0.20	46.5	31.0				
A	20/01/1992	1	230.0	12.0	39.5	38.5	0.02	175.0	0.02	0.1	385.0	0.20	50.0	34.5				
A	09/03/1992	1	230.0	11.0	39.5	38.0	0.02	170.0	0.02	0.1	385.0	0.20	49.5	33.5				
A	27/04/1992	1	240.0	12.0	39.0	35.0	0.04	175.0	0.03	0.1	370.0	0.20	43.0	36.0				
A	07/07/1992	1	225.0	11.0	37.0	36.0	0.02	180.0	0.10	0.1	360.0	0.20	47.0	30.5				
A	24/08/1992	1	220.0	11.5	37.5	37.5	0.02	175.0	0.10	0.2	365.0	0.20	47.0	30.0	0.02	0.05	0.20	0.05

GROUNDWATER DATABASE

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REG NUMBER 51402

PIPE	DATE	RD	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	01/12/1992	1	220.0	10.5	38.5	38.5	0.02	170.0	0.02	0.9	385.0	0.20	50.0	33.0	0.02	0.05	0.20	0.05
A	22/07/1996	1	220.0	10.5	36.0	34.5		175.0		0.1	355.0	0.20	42.5	31.0			0.20	
A	17/02/1997	1	210.0	9.8	33.5	30.5		200.0		0.1	330.0	0.30	12.0	28.5				
A	01/07/1998	1	205.0	9.6	35.5	32.0	0.02	180.0	0.02	0.1	330.0	0.20	43.0	31.0	0.10	0.05	0.20	0.05
A	20/10/1999	1	232.1	10.3	41.3	39.4	0.00	189.0	0.00	0.7	387.3	0.23	46.9	36.4	0.03	0.02	0.20	0.01
A	13/03/2001	1	185.0	8.7	31.5	31.0	0.03	160.0	0.03	0.1	300.0	0.20	28.5	24.5	0.02	< 0.05	0.22	< 0.05

WATER LEVEL DETAILS

PIPE	DATE	MEASURE	N/R	RMK	LOG	PIPE	DATE	MEASURE	N/R	RMK	LOG	PIPE	DATE	MEASURE (m)	N/R	RMK	LOG
A	26/05/1980	-17.10	R			A	09/03/2000	-19.45	R			A	28/02/2002	-19.48	R		
A	31/08/2005	-20.70	R			A	30/09/2005	-20.30	R			A	31/10/2005	-20.70	R		
A	30/11/2005	-20.30	R			A	31/12/2005	-20.70	R			A	28/02/2006	-19.75	R		
A	31/03/2006	-19.25	R			A	31/05/2006	-19.65	R			A	31/07/2006	-19.65	R		
A	31/08/2006	-19.75	R			A	30/09/2006	-19.95	R			A	31/10/2006	-20.06	R		
A	30/11/2006	-19.55	R			A	31/01/2007	-19.65	R			A	31/03/2007	-19.65	R		
A	30/04/2007	-19.75	R			A	31/07/2007	-19.65	R								

WIRE LINE LOG DETAILS

DATE	RUN	OPERATOR	TYPE	SOURCE	TOP	BOTTOM	COMMENTS
15/05/2001	1	B ISBISTER	CALU	ALPHA	24.14	30.99	
15/05/2001	2	B ISBISTER	CALU	ALPHA	-.46	30.84	
15/05/2001	1	B ISBISTER	GR	ALPHA	-1.04	30.86	

FIELD MEASUREMENTS

**** NO RECORDS FOUND ****

SPECIAL WATER ANALYSIS

VALIDATION LOG - PART 1

REGDET	CASING	STRLOG	AQUIFR	PUMTES	ELVDET	WLVDET	FIELDQ

DATE 17/01/2012

GROUNDWATER DATABASE

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BORE CARD REPORT - PUBLISHABLE

REG NUMBER 51402

PIPE A DATE 20/03/2001 REC 1
VARIABLE ********** Electrical Conductivity @ 25C
MEASUREMENT 1435.00000 UNITS Microsiemens/cm
DEPTH 38.70
WR ANAL NO 1 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 1 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

PIPE A DATE 20/03/2001 REC 1
VARIABLE ********** Nitrate as NO3
MEASUREMENT 35.00000 UNITS Milligrams/Litre
DEPTH 38.70
WR ANAL NO 1 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 1 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

PIPE A DATE 20/03/2001 REC 1
VARIABLE ********** Electrical Conductivity @ 25C
MEASUREMENT 1474.00000 UNITS Microsiemens/cm
DEPTH 38.70
WR ANAL NO 2 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 2 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

DATE 17/01/2012

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 51402

PIPE A DATE 20/03/2001 REC 1

VARIABLE ********** Nitrate as NO3
MEASUREMENT 40.00000 UNITS Milligrams/Litre
DEPTH 38.70
WR ANAL NO 2 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 2 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

PIPE A DATE 21/03/2001 REC 1

VARIABLE ********** Electrical Conductivity @ 25C
MEASUREMENT 1608.00000 UNITS Microsiemens/cm
DEPTH 38.70
WR ANAL NO 3 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 3 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

PIPE A DATE 21/03/2001 REC 1

VARIABLE ********** Nitrate as NO3
MEASUREMENT 41.00000 UNITS Milligrams/Litre
DEPTH 38.70
WR ANAL NO 3 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 3 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

DATE 17/01/2012

GROUNDWATER DATABASE

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BORE CARD REPORT - PUBLISHABLE

REG NUMBER 51402

PIPE A DATE 21/03/2001 REC 1
VARIABLE ********** Electrical Conductivity @ 25C
MEASUREMENT 1632.00000 UNITS Microsiemens/cm
DEPTH 38.70
WR ANAL NO 4 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 4 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

PIPE A DATE 21/03/2001 REC 1
VARIABLE ********** Nitrate as NO3
MEASUREMENT 38.00000 UNITS Milligrams/Litre
DEPTH 38.70
WR ANAL NO 4 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 4 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

PIPE A DATE 21/03/2001 REC 1
VARIABLE ********** Electrical Conductivity @ 25C
MEASUREMENT 1635.00000 UNITS Microsiemens/cm
DEPTH 38.70
WR ANAL NO 5 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 5 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

DATE 17/01/2012

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 51402

PIPE A DATE 21/03/2001 REC 1

VARIABLE ********** Nitrate as NO3
MEASUREMENT 40.00000 UNITS Milligrams/Litre
DEPTH 38.70
WR ANAL NO 5 METHOD PU PRESERVATIVES PROJECTS
BOTTLE 5 ANALYST XXX NL PR
COL AUTH PR
RECD AT LAB SOURCE GB
COMMENT

Y 15/04/1993	Y 15/04/1993	Y 15/04/1993	Y 15/04/1993	Y 15/04/1993	Y 15/04/1993	Y 15/04/1993	Y 15/04/1993

VALIDATION LOG - PART 2

WATANL	SAMPLE	STRTIG	WIRLOG	MULCND	BRCOND	FPREAD	GNOTES
Y 15/04/1993	Y 19/04/2001	Y 15/04/1993		Y 15/04/1993			

GENERAL NOTES

**** NO RECORDS FOUND ****

DATE 08/05/2018

GROUNDWATER DATABASE

BORE REPORT

REG NUMBER 146584

REGISTRATION DETAILS

OFFICE	Longreach	BASIN	1203	LATITUDE	23-38-40
DATE LOG RECD	23-NOV-12	SUB-AREA		LONGITUDE	146-35-13
D/O FILE NO.	140/007/0003	SHIRE	410-BARCALDINE REGIC	EASTING	457886
R/O FILE NO.		LOT	108	NORTHING	7385064
H/O FILE NO.		PLAN	BE78	ZONE	55
		ORIGINAL DESCRIPTION		ACCURACY	
				GPS ACC	
GIS LAT	-23.64455905	PARISH NAME	91-ALPHA		
GIS LNG	146.587076	COUNTY	BELYANDO		
CHECKED	Y				

MAP-SCALE			
MAP-SERIES			
MAP-NO			
MAP NAME			
PROG SECTION			
PRES EQUIPMENT			
ORIGINAL BORE NO	AERODROME BORE		
BORE LINE	-		
POLYGON			
RN OF BORE REPLACED			
DATA OWNER	DNR		

FACILITY TYPE	Sub-Artesian Facility	DATE DRILLED	12/11/2012
STATUS	Existing	DRILLERS NAME	JANZ, DREW
ROLES		DRILL COMPANY	S & K DRILLING
		METHOD OF CONST.	ROTARY MUD

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM (mm)	TOP (m)	BOTTOM (m)
A	12/11/2012	2	Steel Casing	4.800	WT	168	0.00	108.00
A	12/11/2012	3	Perforated or Slotted Casing				72.00	96.00
A	12/11/2012	4	Gravel Pack	3.500	GR	285	40.00	115.00
X	12/11/2012	1	Polyvinyl Chloride	15.500	WT	315	0.00	6.00
X	12/11/2012	5	Grout			285	6.00	40.00
X	12/11/2012	6	Grout			375	0.00	6.00

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	1.00	SOIL, WEATHERED
2	1.00	4.00	CLAY, WEATHERED
3	4.00	21.00	SILTSTONE, WEATHERED

DATE 08/05/2018

GROUNDWATER DATABASE

BORE REPORT

REG NUMBER 146584

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
4	21.00	42.00	CLAY, WEATHERED
5	42.00	64.00	SILTSTONE, WEATHERED
6	64.00	98.00	SAND, WEATHERED
7	98.00	104.00	CLAY, WEATHERED
8	104.00	115.00	CLAYSTONE

STRATIGRAPHY DETAILS

**** NO RECORDS FOUND ****

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	64.00	98.00	SAND			N	"POTABLE"	7.60	Y	UC	TERTIARY - UNDEFINED

PUMP TEST DETAILS PART 1

PIPE	DATE	REC NO.	RN OF PUMP-BORE	TOP (m)	BOTTOM (m)	DIST (m)	METH	TEST TYPES	PUMP TYPE	SUCTION SET (m)	Q PRIOR TO TEST (l/s)	DUR OF Q PR (min)	PRES ON ARRIV (m)	Q ON ARRIV (l/s)
A	12/11/2012	1	146584	64.00	98.00		PUM		AIR	70.00				

PUMP TEST DETAILS PART 2

PIPE	DATE	REC	TEST DUR (mins)	SWL (m)	RECOV. TIME (mins)	RESID. DD (m)	MAX DD or P RED (m)	Q at MAX DD (l/s)	TIME TO MAX DD (mins)	Max Q (l/s)	CALC STAT HD (m)	DESIGN YIELD (l/s)	DESIGN BP (m)	SUCT. SET (m)	TMSY (m2/DAY)	STOR
A	12/11/2012	1	600	-64.00				7.60						70.00		

BORE CONDITION

**** NO RECORDS FOUND ****

ELEVATION DETAILS

**** NO RECORDS FOUND ****

WATER ANALYSIS PART1

DATE 08/05/2018

GROUNDWATER DATABASE

BORE REPORT

REG NUMBER 146584

**** NO RECORDS FOUND ****

WATER ANALYSIS PART 2

**** NO RECORDS FOUND ****

WATER LEVEL DETAILS

**** NO RECORDS FOUND ****

WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

**** NO RECORDS FOUND ****

SPECIAL WATER ANALYSIS

**** NO RECORDS FOUND ****

DATE 21/12/2011

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 7121

REGISTRATION DETAILS

		BASIN	0032	LATITUDE	22-58-08	MAP-SCALE	254
OFFICE	Longreach	SUB-AREA		LONGITUDE	145-14-49	MAP-SERIES	M
DATE LOG RECD		SHIRE	410-BARCALDINE REGION	EASTING	320291	MAP-NO	SF55-9
D/O FILE NO.	25/02/A/01	LOT	29	NORTHING	7458853	MAP NAME	MUTTABURRA
R/O FILE NO.		PLAN	A1847	ZONE	55	PROG SECTION	
H/O FILE NO.	L6200B	ORIGINAL DESCRIPTION	ARAMAC TOWN	ACCURACY		PRES EQUIPMENT	
				GPS ACC			
GIS LAT	-22.9688763	PARISH NAME	3059-MARATHON			ORIGINAL BORE NO	ARAMAC TOWN BORE NO 1
GIS LNG	145.2470147	COUNTY	RODNEY			BORE LINE	-
CHECKED	Y	PROPERTY NAME					
		FIELD LOCATION				POLYGON	
						RN OF BORE REPLACED	
FACILITY TYPE	AF	DATE DRILLED	16/05/1933			DATA OWNER	
STATUS	EX	DRILLERS NAME				CONFIDENTIAL	N
ROLES		DRILL COMPANY					
		METHOD OF CONST.					

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM	TOP (m)	BOTTOM (m)
A	01/01/1933	1	Steel Casing (unspecified)				0.00	33.80
A	01/01/1933	2	Steel Casing (unspecified)				0.00	296.90
A	01/01/1933	3	Open End				296.90	296.90
A	01/01/1933	4	Open Hole				296.90	365.80
X	01/01/1933	1	Grout			203	0.00	33.80
X	01/01/1933	2	Grout			152	0.00	296.90

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	1.83	CLAY DRILLER UNKNOWN
2	1.83	20.12	YELLOW SHALE (SOAK AT 12.2 M - BRACK)
3	20.12	197.21	GREY SHALE (SALT WATER AT 28.7 M)

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REG NUMBER 7121

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
4	197.21	198.43	SAND (WATER BED)
5	198.43	204.22	CHOCOLATE PUG (WATER BED - FLOW)
6	204.22	217.02	MIXED WHITE SANDY PIPE CLAY
7	217.02	238.36	SHALE-ALL COLOURS AND PUG
8	238.36	281.03	CHOCOLATE SHALE AND PIPE CLAY
9	281.03	297.49	STICKY PUG - TRACE OF SAND
10	297.49	298.10	CHOCOLATE PUG (WATER BED - FLOW)
11	298.10	304.80	SANDSTONE (WATER BED - FLOW)
12	304.80	359.67	MIXED SANDSTONE (WATER BED - FLOW)
13	359.67	365.76	MIXED SANDY PIPE CLAY
14	304.80	359.67	MIXED SANDSTONE ESTIMATED FLOWS 1030-
16			1056 50000 GPD 1070-1120 70000 GPD ME
17			ASURED FLOW AT 1153-1178 622000 GPD
18	359.67	365.76	MIXED SANDY PIPE CLAY
903			00/05/1933 DISCH 2828.0 M3D
910	16.40	28.60	QUALITY DESCRIP/CONDUCT: SALTY

STRATIGRAPHY DETAILS

**** NO RECORDS FOUND ****

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	16.40	28.60								XX	
2	297.00	366.00	SDST							PS	

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

DATE 21/12/2011

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 7121

BORE CONDITION

**** NO RECORDS FOUND ****

ELEVATION DETAILS

**** NO RECORDS FOUND ****

WATER ANALYSIS PART1

PIPE	DATE	RD	ANALYST	QAN	DEPTH (m)	RMK	SRC	COND (uS/cm)	pH	Si (mg/L)	TOTAL IONS	TOTAL SOLIDS	HARD	ALK	FIG. OF MERIT	SAR	RAH
A	20/03/1987	1	GCL	119174	365.00	PU	GB	445	8.1	19	350.00	260.00	15	170	0.1	10.3	3.10

WATER ANALYSIS PART 2

PIPE	DATE	RD	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	20/03/1987	1	92.0	6.0	6.0	0.0	0.00	205.0	0.04	1.5	36.0	0.50	0.9	0.0				

WATER LEVEL DETAILS

PIPE	DATE	MEASURE (m)	N/R	RMK	LOG	PIPE	DATE	MEASURE (m)	N/R	RMK	LOG	PIPE	DATE	MEASURE (m)	N/R	RMK	LOG
A	03/04/1977	11.18	R			A	26/08/1981	11.85	R								

WIRE LINE LOG DETAILS

DATE	RUN	OPERATOR	TYPE	SOURCE	TOP	BOTTOM	COMMENTS
19/11/2003	1	B ISBISTER	GR	ARAMAC SHIRE COUNCI	-.99	355.41	

FIELD MEASUREMENTS

PIPE	DATE	DEPTH (m)	COND (uS/cm)	pH	TEMP (C)	NO3 (mg/L)	DO (mg/L)	Eh (mV)	ALK	METH	SOURCE
A	19/03/1987				40.0					PU	GB
A	19/04/1987				40.0					PU	GB

SPECIAL WATER ANALYSIS

**** NO RECORDS FOUND ****

VALIDATION LOG - PART 1

DATE 21/12/2011

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 7121

REGDET	CASING	STRLOG	AQUIFR	PUMTES	ELVDET	WLVDET	FIELDQ
		Y 03/10/2000					

VALIDATION LOG - PART 2

WATANL	SAMPLE	STRTIG	WIRLOG	MULCND	BRCOND	FPREAD	GNOTES

GENERAL NOTES

**** NO RECORDS FOUND ****

DATE 21/12/2011

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 51753

REGISTRATION DETAILS

		BASIN	0032	LATITUDE	22-58-02	MAP-SCALE	254
OFFICE	Longreach	SUB-AREA		LONGITUDE	145-14-23	MAP-SERIES	M
DATE LOG RECD		SHIRE	410-BARCALDINE REGION	EASTING	319533	MAP-NO	SF55-9
D/O FILE NO.	25/02/A/01	LOT	31	NORTHING	7459034	MAP NAME	MUTTABURRA
R/O FILE NO.		PLAN	RY40	ZONE	55	PROG SECTION	
H/O FILE NO.	L6200B	ORIGINAL DESCRIPTION	31 R 70	ACCURACY	SKET	PRES EQUIPMENT	
				GPS ACC			
GIS LAT	-22.96716	PARISH NAME	3059-MARATHON			ORIGINAL BORE NO	ARAMAC TOWN BORE NO 2
GIS LNG	145.2396478	COUNTY	RODNEY			BORE LINE	-
CHECKED	Y	PROPERTY NAME					
		FIELD LOCATION				POLYGON	
						RN OF BORE REPLACED	
FACILITY TYPE	AF	DATE DRILLED	10/06/1983			DATA OWNER	
STATUS	EX	DRILLERS NAME				CONFIDENTIAL	N
ROLES		DRILL COMPANY					
		METHOD OF CONST.	CABLE TOOL				

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM	TOP (m)	BOTTOM (m)
A	10/06/1983	1	Steel Casing (unspecified)	6.400	WT	219	0.00	60.00
A	10/06/1983	2	Steel Casing (unspecified)	6.400	WT	162	0.00	339.00
A	10/06/1983	3	Perforated or Slotted Casing	13.000	AP	162	275.00	335.00
A	10/06/1983	4	Open End			162	339.00	
A	10/06/1983	5	Open Hole			188	339.00	362.00
X	10/06/1983	1	Grout			266	0.00	60.00
X	10/06/1983	2	Grout			188	0.00	148.00

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	1.00	TOPSOIL DRILLER K L & B C SHELLEY
5	1.00	8.00	YELLOW & GREY CLAY

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GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 51753

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
10	8.00	9.00	YELLOW SANDSTONE
15	9.00	20.00	YELLOW & GREY SANDY MUDSTONE
20	20.00	187.00	GREY MUDSTONE * SALTY
25	187.00	188.00	MUDDY SANDSTONE
30	188.00	190.00	SANDSTONE * NO SUPPLY
35	190.00	195.00	SANDY MUDSTONE
40	195.00	196.00	ROCK
45	196.00	199.00	SANDY MUDSTONE
50	199.00	201.50	SANDSTONE *
55	201.50	202.00	ROCK
60	202.00	204.00	GREY MUDSTONE
65	204.00	209.00	SANDSTONE
70	209.00	212.00	SANDY MUDSTONE
75	212.00	227.00	MUDDY SANDSTONE
80	227.00	228.00	ROCK
85	228.00	232.00	SANDY MUDSTONE
90	232.00	233.00	ROCK
95	233.00	234.00	SANDY MUDSTONE
100	234.00	244.00	WHITE SANDSTONE
105	244.00	245.00	ROCK
110	245.00	249.00	GREY MUDSTONE
115	249.00	262.00	WHITE SANDSTONE
120	262.00	265.00	GREY MUDSTONE & ROCK BANDS
125	265.00	289.00	SANDSTONE
130	289.00	293.00	GREY SANDY MUDSTONE
135	293.00	293.50	HARD SANDSTONE
140	293.50	298.00	SANDSTONE
145	298.00	300.00	SANDY MUDSTONE
150	300.00	302.50	MUDDY SANDSTONE
155	302.50	310.00	SANDSTONE
160	310.00	313.00	SANDSTONE & MUDDY SEAMS *

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GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 51753

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
165	313.00	322.00	FINE SANDSTONE *
170	322.00	332.00	MEDIUM SANDSTONE *
175	332.00	338.00	SANDSTONE & CLAY SEAMS
180	338.00	360.00	FINE & MEDIUM SANDSTONE *
185	360.00	361.75	FIRM FINE SANDSTONE *
190	361.75	362.00	GREY SANDY MUDSTONE
902			16/06/1983 SWL 17.87 M TMP 037 C
903			16/06/1983 DISCH 2518.0 M3D
910	45.00	46.00	QUALITY DESCRIP/CONDUCT: SALTY
911	188.00	190.00	QUALITY DESCRIP/CONDUCT: POTABLE
912	310.00	332.00	QUALITY DESCRIP/CONDUCT: POTABLE

STRATIGRAPHY DETAILS

**** NO RECORDS FOUND ****

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	45.00	46.00	MDST							PS	
2	188.00	190.00	SDST							PS	
3	199.00	201.50	SDST							PS	
4	310.00	332.00	SDST							PS	

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

BORE CONDITION

**** NO RECORDS FOUND ****

DATE 21/12/2011

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 51753

ELEVATION DETAILS

**** NO RECORDS FOUND ****

WATER ANALYSIS PART1

PIPE	DATE	RD	ANALYST	QAN	DEPTH (m)	RMK	SRC	COND (uS/cm)	pH	Si (mg/L)	TOTAL IONS	TOTAL SOLIDS	HARD	ALK	FIG. OF MERIT	SAR	RAH
A	10/06/1983	1	GCL	097518	350.00		GB	465	7.9	20	381.90	290.08	19	182	0.1	9.9	3.24
A	10/06/1983	2	GCL	097519	340.00		GB	470	8.0	23	375.60	289.32	22	178	0.1	9.0	3.11
A	10/06/1983	3	GCL	097520	345.00		GB	475	8.0	20	373.10	283.82	19	178	0.1	9.8	3.18
A	10/06/1983	4	GCL	097546	190.00		GB	3250	8.0	7	1854.40	1721.62	56	229	0.0	38.2	3.44
A	15/06/1983	1	GCL	097786		MA	GR	490	8.2	20	358.40	274.20	26	171	0.1	7.7	2.91
A	18/03/1987	1	GCL	119215	362.00	PU	GB	455	7.6	19	360.00	270.00	16	175	0.1	10.1	3.20

WATER ANALYSIS PART 2

PIPE	DATE	RD	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	10/06/1983	1	100.0	5.5	6.8	0.6		220.0		0.8	45.0	0.40	0.0	2.8				
A	10/06/1983	2	97.0	5.2	7.2	1.0		215.0		1.0	46.0	0.40	0.0	2.8				
A	10/06/1983	3	98.0	5.5	6.6	0.6		215.0		1.2	43.0	0.40	0.0	2.8				
A	10/06/1983	4	660.0	6.0	16.0	4.0		275.0		1.8	880.0	0.60	0.0	11.0				
A	15/06/1983	1	90.0	5.3	7.6	1.6		205.0		1.8	40.0	0.50	0.6	6.0				
A	18/03/1987	1	95.0	5.9	6.3	0.2	0.11	210.0	0.02	0.5	42.0	0.50	0.0	0.0				

WATER LEVEL DETAILS

PIPE	DATE	MEASURE	N/R	RMK	LOG	PIPE	DATE	MEASURE	N/R	RMK	LOG	PIPE	DATE	MEASURE (m)	N/R	RMK	LOG
A	15/06/1983	17.87	R														

WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

PIPE	DATE	DEPTH (m)	COND (uS/cm)	pH	TEMP (C)	NO3 (mg/L)	DO (mg/L)	Eh (mV)	ALK	METH	SOURCE
A	19/03/1987				46.0					PU	GB

DATE 21/12/2011

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

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SPECIAL WATER ANALYSIS

**** NO RECORDS FOUND ****

VALIDATION LOG - PART 1

REGDET	CASING	STRLOG	AQUIFR	PUMTES	ELVDET	WLVDET	FIELDQ
Y 23/08/1991	Y 23/08/1991	Y 23/08/1991	Y 23/08/1991	Y 23/08/1991	Y 23/08/1991	Y 23/08/1991	Y 23/08/1991

VALIDATION LOG - PART 2

WATANL	SAMPLE	STRTIG	WIRLOG	MULCND	BRCOND	FPREAD	GNOTES
Y 23/08/1991		Y 23/08/1991		Y 23/08/1991			

GENERAL NOTES

**** NO RECORDS FOUND ****

DATE 21/12/2011

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 93744

REGISTRATION DETAILS

		BASIN	0033	LATITUDE	23-33-24	MAP-SCALE	254
OFFICE	Longreach	SUB-AREA		LONGITUDE	145-17-36	MAP-SERIES	M
DATE LOG RECD		SHIRE	410-BARCALDINE REGION	EASTING	325795	MAP-NO	
D/O FILE NO.	140/007/0003	LOT	9	NORTHING	7393824	MAP NAME	
R/O FILE NO.		PLAN	RY182	ZONE	55	PROG SECTION	
H/O FILE NO.		ORIGINAL DESCRIPTION		ACCURACY		PRES EQUIPMENT	
				GPS ACC			
GIS LAT	-23.5566147	PARISH NAME	293-BARCALDINE			ORIGINAL BORE NO	NEW POMONA BORE YEW ST
GIS LNG	145.293222	COUNTY	RODNEY			BORE LINE	-
CHECKED	Y	PROPERTY NAME					
		FIELD LOCATION				POLYGON	
						RN OF BORE REPLACED	314
FACILITY TYPE	SF	DATE DRILLED	19/11/2002			DATA OWNER	
STATUS	EX	DRILLERS NAME	R TYNDALL			CONFIDENTIAL	N
ROLES		DRILL COMPANY	AFRAC DRILLING P/L				
		METHOD OF CONST.	ROTARY MUD				

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM	TOP (m)	BOTTOM (m)
A	19/11/2002	1	Steel Casing (unspecified)	9.530	WT	406	0.00	21.00
A	19/11/2002	2	Steel Casing (unspecified)	9.530	WT	324	0.00	140.00
A	19/11/2002	3	Steel Casing (unspecified)	7.790	WT	273	0.00	137.80
A	19/11/2002	4	Steel Casing (unspecified)	6.400	WT	168	137.80	462.00
A	19/11/2002	5	Grout			324	0.00	140.00
A	19/11/2002	6	Grout			273	0.00	137.80
A	19/11/2002	7	Grout			168	137.80	328.50
A	19/11/2002	8	Perforated or Slotted Casing				343.00	429.00
A	19/11/2002	9	Perforated or Slotted Casing				435.00	441.00
A	19/11/2002	10	Perforated or Slotted Casing				447.00	453.00

STRATA LOG DETAILS

1	0.00	3.00	SAND & BACKFILL

DATE 21/12/2011

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 93744

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
2	3.00	21.00	WEATHERED SDST, YELLOW & WHITE
3	21.00	180.00	SHALE, GREY, FINE AND HARD
4	180.00	220.00	SANDSTONE, GREY, FINE
5	220.00	343.00	SHALE, GREY, FINE, HARD
6	343.00	460.00	SANDSTONE, LIGHT GREY, FINE
7	460.00	462.00	MUDSTONE, BROWN, FINE, HARD

STRATIGRAPHY DETAILS

**** NO RECORDS FOUND ****

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	178.00		SDST			N			N	PS	
2	346.00		SDST	19/11/2002	-3.83	N			Y	PS	HUTTON SANDSTONE

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

BORE CONDITION

DATE	DRAIN DETAILS TOT LEN (km)	MAX RUN (km)	C D N	HEADWORKS RET LEN (km)	C D N	C T L	LEAK	FLOW IRREGULARITY	PRECIPITATE	EST USE (ML/yr)	STOCK CATTLE	STOCK SHEEP	COMMENT
28/05/2003													Pumping test by Ayr Boring Co Pty Ltd for George Bourne & Associates

ELEVATION DETAILS

**** NO RECORDS FOUND ****

DATE 21/12/2011

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 93744

WATER ANALYSIS PART1

PIPE	DATE	RD	ANALYST	QAN	DEPTH (m)	RMK	SRC	COND (uS/cm)	pH	Si (mg/L)	TOTAL IONS	TOTAL SOLIDS	HARD	ALK	FIG. OF MERIT	SAR	RAH
A	29/05/2003	1	GCL	BAR301				370	8.2	24	295.26	235.39	11	138	0.1	10.6	2.54

WATER ANALYSIS PART 2

PIPE	DATE	RD	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	29/05/2003	1	79.0	3.3	3.7	0.3	0.03	165.0	0.02	1.5	38.0	0.20	< 0.5	3.6	< 0.01	< 0.05	< 0.02	< 0.03

WATER LEVEL DETAILS

**** NO RECORDS FOUND ****

WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

**** NO RECORDS FOUND ****

SPECIAL WATER ANALYSIS

**** NO RECORDS FOUND ****

VALIDATION LOG - PART 1

**** NO RECORDS FOUND ****

VALIDATION LOG - PART 2

**** NO RECORDS FOUND ****

GENERAL NOTES

**** NO RECORDS FOUND ****

DATE 21/12/2011

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 69904

REGISTRATION DETAILS

		BASIN	0033	LATITUDE	23-33-32	MAP-SCALE	
OFFICE	Longreach	SUB-AREA		LONGITUDE	145-16-44	MAP-SERIES	
DATE LOG RECD		SHIRE	410-BARCALDINE REGIOI	EASTING	324320	MAP-NO	
D/O FILE NO.	140/007003	LOT	80	NORTHING	7393555	MAP NAME	
R/O FILE NO.	28-402101	PLAN	CP860113	ZONE	55	PROG SECTION	
H/O FILE NO.		ORIGINAL DESCRIPTION	TOWN COMMON - TOWN OF BARCALDINE	ACCURACY		PRES EQUIPMENT	
				GPS ACC			
GIS LAT	-23.5588822	PARISH NAME	293-BARCALDINE			ORIGINAL BORE NO	ACACIA STREET
GIS LNG	145.2787535	COUNTY	RODNEY			BORE LINE	-
CHECKED	Y	PROPERTY NAME					
		FIELD LOCATION				POLYGON	
						RN OF BORE REPLACED	
FACILITY TYPE	SF	DATE DRILLED				DATA OWNER	
STATUS	EX	DRILLERS NAME				CONFIDENTIAL	N
ROLES		DRILL COMPANY					
		METHOD OF CONST.					

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM	TOP (m)	BOTTOM (m)
A	29/08/1996	1	Steel Casing (unspecified)	9.530	WT	324	0.00	140.00
A	29/08/1996	2	Steel Casing (unspecified)	7.900	WT	273	0.00	140.00
A	29/08/1996	3	Steel Casing (unspecified)	6.400	WT	168	140.00	464.45
A	29/08/1996	4	Perforated or Slotted Casing		AP		332.00	464.45

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	1.00	SAND
2	1.00	12.00	YELLOW CLAY
3	12.00	54.00	GREY CLAY
4	54.00	56.00	HARD BAND
5	56.00	72.00	GREY SHALE & CLAY

DATE 21/12/2011

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 69904

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
6	72.00	73.00	HARD BAND
7	73.00	111.00	GREY SHALE & CLAY
8	111.00	170.00	HARD SHALE
9	170.00	175.00	BROWN SHALE
10	175.00	178.00	QUARTZ & FINE SANDSTONE *
11	178.00	202.00	SHALE & LIMESTONE
12	202.00	223.00	GRITTY SHALE
13	223.00	231.00	SANDSTONE *
14	231.00	298.00	SANDSTONE OR QUARTZ *
15	298.00	309.00	BROWN SANDY CLAY
16	309.00	335.00	FINE SANDSTONE *
17	335.00	462.00	SANDSTONE *
18	462.00	464.45	HARD SANDSTONE
901	309.00		FLOW APPROX 400000 GPD,TEMP 47 DEG C
902			QUALITY POTABLE
903			DRILLER A B HOWSE LIC NO 2742

STRATIGRAPHY DETAILS

**** NO RECORDS FOUND ****

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	223.00	462.00	SDST			Y		20.80	Y	PS	HUTTON SANDSTONE

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

DATE 21/12/2011

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 69904

BORE CONDITION

**** NO RECORDS FOUND ****

ELEVATION DETAILS

**** NO RECORDS FOUND ****

WATER ANALYSIS PART1

PIPE	DATE	RD	ANALYST	QAN	DEPTH (m)	RMK	SRC	COND (uS/cm)	pH	Si (mg/L)	TOTAL IONS	TOTAL SOLIDS	HARD	ALK	FIG. OF MERIT	SAR	RAH
A	07/08/1997	1	GCL	970512			GR	860	8.0		707.51	494.02	9	344		30.0	6.71

WATER ANALYSIS PART 2

PIPE	DATE	RD	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	07/08/1997	1	203.0	1.4	3.3	0.1		420.0	0.01	0.0	75.0	1.50	0.3	2.9				

WATER LEVEL DETAILS

**** NO RECORDS FOUND ****

WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

**** NO RECORDS FOUND ****

SPECIAL WATER ANALYSIS

**** NO RECORDS FOUND ****

VALIDATION LOG - PART 1

**** NO RECORDS FOUND ****

VALIDATION LOG - PART 2

**** NO RECORDS FOUND ****

GENERAL NOTES

**** NO RECORDS FOUND ****

DATE 17/01/2012

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 103202

REGISTRATION DETAILS

		BASIN	0033	LATITUDE 23-36-10	MAP-SCALE
OFFICE	Emerald	SUB-AREA		LONGITUDE 146-07-47	MAP-SERIES
DATE LOG RECD		SHIRE	410-BARCALDINE REGIOI	EASTING 411203	MAP-NO
D/O FILE NO.	50-2002	LOT	82	NORTHING 7389458	MAP NAME
R/O FILE NO.		PLAN	SP108318	ZONE 55	PROG SECTION
H/O FILE NO.		ORIGINAL DESCRIPTION		ACCURACY	PRES EQUIPMENT
				GPS ACC	
GIS LAT	-23.602979246	PARISH NAME	2485-JERICHO		ORIGINAL BORE NO JERICHO TOWN BORE NO 1
GIS LNG	146.129638589	COUNTY	MEXICO		BORE LINE -
CHECKED	Y	PROPERTY NAME			
		FIELD LOCATION			POLYGON
					RN OF BORE REPLACED
FACILITY TYPE	SF	DATE DRILLED	09/05/2000		DATA OWNER
STATUS	EX	DRILLERS NAME	BEALE W		CONFIDENTIAL
ROLES	WS	DRILL COMPANY	WATER DRILL		
		METHOD OF CONST.	ROTARY		

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM	TOP (m)	BOTTOM (m)
A	09/05/2000	1	Steel Casing (unspecified)	6.400	WT	501	0.00	6.00
A	09/05/2000	2	Steel Casing (unspecified)	9.500	WT	355	0.00	103.00
A	09/05/2000	3	Acrylonitrile Butadiene Styrene	8.500	WT	220	0.00	101.00
A	09/05/2000	4	Stainless Steel			168	101.00	103.00
A	09/05/2000	5	Screen	0.580	AP	168	104.40	108.40
A	09/05/2000	6	Stainless Steel			168	108.40	116.30
A	09/05/2000	7	Screen	0.580	AP	168	116.30	119.30
A	09/05/2000	8	Grout				0.00	103.00
A	09/05/2000	9	Gravel Pack				103.00	119.30

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION

DATE 17/01/2012

GROUNDWATER DATABASE

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 103202

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
19	70.20	74.60	WHITE SHALE AND SILTSTONE
20	74.60	77.10	SHALE WITH OILY BANDS
21	77.10	87.30	DARK GRAY SHALE
22	87.30	87.60	HARD CEMENTED ROCK
23	87.60	89.30	GRAY SHALE
24	89.30	95.60	SILTSTONE
25	95.60	98.00	PINK SHALE WITH SANDSTONE LENS
26	98.00	99.00	PINK SHALE WITH CLAYEY SANDSTONE LENS
27	99.00	102.00	WHITE SHALE & BANDS COARSE SANDSTONE
28	102.00	104.00	DIRTY SANDSTONE
1	0.00	5.50	SANDY CLAY
2	5.50	7.00	CLAY
3	7.00	19.80	SANDY CLAY
4	19.80	20.00	HARD CEMENTED ROCK
5	20.00	22.20	CLAYEY SAND
6	22.20	22.50	HARD CEMENTED ROCK
7	22.50	23.50	SAND
8	23.50	23.80	HARD CEMENTED ROCK
9	23.80	24.40	SANDY CLAY
10	24.40	28.00	FINE SAND WATER
11	28.00	33.80	RED FINE SANDY SILT
12	33.80	34.00	HARD CEMENTED ROCK
13	34.00	40.80	YELLOW AND BROWN CLAY
14	40.80	43.80	PALE STICKY CLAY
15	43.80	54.50	GRAY SHALE
16	54.50	54.80	HARD CEMENTED ROCK
17	54.80	70.00	GRAY SHALE
18	70.00	70.20	HARD CEMENTED ROCK
29	104.00	107.50	FINE TO COARSE CLEAN SANDSTONE
30	107.50	107.70	HARD CEMENTED ROCK
31	107.70	108.40	MUDSTONE

GROUNDWATER DATABASE

DATE 17/01/2012

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 103202

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
32	108.40	109.20	HARD CEMENTED ROCK
33	109.20	110.00	SILTSTONE
34	110.00	113.70	SHALE
35	113.70	116.00	DIRTY SANDSTONE
36	116.00	117.00	FINE TO COARSE SANDSTONE WATER
37	117.00	118.00	VERY FINE SANDSTONE
38	118.00	119.00	MEDIUM TO COARSE SANDSTONE WATER
39	119.00	119.80	SANDSTONE & SHALE

STRATIGRAPHY DETAILS

**** NO RECORDS FOUND ****

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	104.40	108.40	SDST	09/05/2000	-36.50	N	COND 830		Y	PS	TERTIARY - UNDEFINED
2	116.30	119.30	SDST	09/05/2000	-36.50	N	COND 830	16.20	Y	PS	TERTIARY - UNDEFINED

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

BORE CONDITION

**** NO RECORDS FOUND ****

ELEVATION DETAILS

**** NO RECORDS FOUND ****

WATER ANALYSIS PART1

A	06/05/2000	1 GCL	201779	PU	GB	885	6.8	12	487.07	472.18	87	44	0.3	6.4	0.00

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PIPE	DATE	RD	ANALYST	QAN	DEPTH (m)	RMK	SRC	COND (uS/cm)	pH	Si (mg/L)	TOTAL IONS	TOTAL SOLIDS	HARD	ALK	FIG. OF MERIT	SAR	RAH
A	06/05/2000		2 GCL	201779		PU	GB	890	6.7	12	487.96	473.02	87	44	0.3	6.6	
A	07/05/2000		1 GCL	201778		PU	GB	890	6.7	12	487.86	472.92	86	44	0.3	6.3	
A	07/05/2000		2 GCL	201778		PU	GB	888	6.7	12	488.33	473.57	87	44	0.3	6.4	0.00
A	08/05/2000		1 GCL	201780		PU	GB	890	6.7	12	486.42	472.50	88	42	0.3	6.5	
A	08/05/2000		3 GCL	201780		PU	GB	888	6.7	12	483.29	469.58	87	42	0.3	6.4	0.00
A	09/05/2000		1 S&B	46994/	119.00	PU	GB	900	5.9		481.39	461.57	86	32	0.3	6.6	
A	09/05/2000		2 GCL	201777		PU	GB	900	6.7	12	488.34	473.40	88	44	0.3	6.5	
A	09/05/2000		4 GCL	201777		PU	GB	900	6.7	12	485.63	471.18	88	43	0.3	6.4	0.00

WATER ANALYSIS PART 2

PIPE	DATE	RD	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	06/05/2000	1	137.9	8.1	6.5	17.2	0.03	53.5	0.00	0.0	226.5	0.20	0.2	37.0	0.41	0.00	0.10	0.00
A	06/05/2000	2	140.0	8.1	6.5	17.0	0.03	53.0	< 0.02	0.0	225.0	0.20	< 0.5	37.0	0.41	< 0.05	0.10	< 0.05
A	07/05/2000	1	135.0	8.1	6.4	17.0	0.03	53.0	< 0.02	0.0	230.0	0.20	< 0.5	37.0	0.41	< 0.05	0.10	< 0.05
A	07/05/2000	2	136.9	8.1	6.4	17.2	0.03	53.2	0.00	0.0	228.9	0.20	0.3	37.1	0.41	0.00	0.10	0.00
A	08/05/2000	1	140.0	8.3	6.3	17.5	0.03	51.0	< 0.02	0.0	225.0	0.20	< 0.5	37.0	0.37	< 0.05	0.10	< 0.05
A	08/05/2000	3	137.6	8.3	6.3	17.4	0.03	51.0	0.00	0.0	225.3	0.20	0.2	37.1	0.37	0.00	0.10	0.00
A	09/05/2000	1	140.0	7.0	8.0	16.0	0.03	39.0	0.16		240.0		0.2	31.0				
A	09/05/2000	2	140.0	8.2	6.3	17.5	0.03	53.0	< 0.02	0.0	225.0	0.20	< 0.5	37.0	0.39	< 0.05	0.10	< 0.05
A	09/05/2000	4	138.3	8.2	6.3	17.6	0.03	52.6	0.00	0.0	225.3	0.21	0.0	37.1	0.39	0.00	0.10	0.00

WATER LEVEL DETAILS

**** NO RECORDS FOUND ****

WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

PIPE	DATE	DEPTH (m)	COND (uS/cm)	pH	TEMP (C)	NO3 (mg/L)	DO (mg/L)	Eh (mV)	ALK	METH	SOURCE
A	07/05/2000	119.00	925							PU	GB

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PIPE	DATE	DEPTH (m)	COND (uS/cm)	pH	TEMP (C)	NO3 (mg/L)	DO (mg/L)	Eh (mV)	ALK	METH	SOURCE
A	08/05/2000	119.00	916							PU	GB
A	09/05/2000	119.00	918							PU	GB

SPECIAL WATER ANALYSIS

**** NO RECORDS FOUND ****

VALIDATION LOG - PART 1

REGDET	CASING	STRLOG	AQUIFR	PUMTES	ELVDET	WLVDET	FIELDQ
Y 22/06/2000	Y 22/06/2000	Y 22/06/2000	Y 22/06/2000	Y 30/05/2000			

VALIDATION LOG - PART 2

WATANL	SAMPLE	STRTIG	WIRLOG	MULCND	BRCOND	FPREAD	GNOTES
Y 23/06/2000							

GENERAL NOTES

**** NO RECORDS FOUND ****

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GROUNDWATER DATABASE

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REG NUMBER 103203

REGISTRATION DETAILS

		BASIN	0033	LATITUDE	23-36-09	MAP-SCALE	
OFFICE	Emerald	SUB-AREA		LONGITUDE	146-07-45	MAP-SERIES	
DATE LOG RECD		SHIRE	410-BARCALDINE REGIC	EASTING	411154	MAP-NO	
D/O FILE NO.	50-2002	LOT	1	NORTHING	7389511	MAP NAME	
R/O FILE NO.		PLAN	SP136855	ZONE	55	PROG SECTION	
H/O FILE NO.		ORIGINAL DESCRIPTION	ROAD RESERVE ADJ TO WATER TREATMENT TOWI	ACCURACY		PRES EQUIPMENT	
				GPS ACC			
GIS LAT	-23.6025	PARISH NAME	6000-NO LONGER USED			ORIGINAL BORE NO	JERICHO STANDBY BORE
GIS LNG	146.12916667	COUNTY				BORE LINE	-
CHECKED	Y						
						POLYGON	
						RN OF BORE REPLACED	
FACILITY TYPE	Sub-Artesian Facility	DATE DRILLED	11/06/2000			DATA OWNER	
STATUS	Existing	DRILLERS NAME	BEALE W				
ROLES	WS	DRILL COMPANY	WATER DRILL				
		METHOD OF CONST.	ROTARY				

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM (mm)	TOP (m)	BOTTOM (m)
A	11/06/2000	1	Steel Casing	6.400	WT	501	0.00	6.00
A	11/06/2000	2	Steel Casing	9.500	WT	355	0.00	102.50
A	11/06/2000	3	Acrylonitrile Butadiene Styrene	8.500	WT	220	0.00	101.10
A	11/06/2000	4	Stainless Steel			168	101.10	104.40
A	11/06/2000	5	Screen	0.580	AP	168	104.40	107.40
A	11/06/2000	6	Stainless Steel			168	107.40	119.40
A	11/06/2000	7	Screen	0.580	AP	168	119.40	123.40
A	11/06/2000	8	Grout			220	0.00	101.00

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	1.50	LOAMY CLAY

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RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
2	1.50	7.00	CLAY SILTY IN PLACES
3	7.00	13.70	WHITE CLAY
4	13.70	14.00	HARD ROCK
5	14.00	18.60	SANDY CLAY
6	18.60	24.40	BROWN CLAY
7	24.40	24.90	HARD ROCK
8	24.90	29.00	SANDY CLAY
9	29.00	32.00	CLAY
10	32.00	32.30	HARD ROCK
11	32.30	36.00	SANDY CLAY
12	36.00	36.30	HARD ROCK
13	36.30	37.80	SANDY CLAY
14	37.80	38.10	VERY HARD ROCK
15	38.10	43.00	MUDSTONE
16	43.00	43.30	HARD ROCK
17	43.30	45.00	MUDSTONE
18	45.00	53.30	SHALE
19	53.30	55.50	SANDSTONE
20	55.50	65.30	SHALE
21	65.30	67.00	CARBONACEOUS SHALE
22	67.00	78.00	SANDSTONE WITH MUDSTONE LENS
23	78.00	80.70	CARBONACEOUS SHALE
24	80.70	86.80	SANDSTONE AND COAL
25	86.80	93.90	SHALE & SILTSTONE LENS
26	93.90	94.90	HARD SANDSTONE
27	94.90	97.00	SOFT WHITE SILTSTONE
28	97.00	102.00	SANDSTONE WITH SILTSTONE LENS
29	102.00	104.00	DIRTY FINE TO COARSE SANDSTONE
30	104.00	104.20	SILTSTONE
31	104.20	106.20	MEDIUM TO COARSE SANDSTONE WATER
32	106.20	107.00	SOFT MUDSTONE

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RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
33	107.00	109.00	DIRTY SANDSTONE
34	109.00	110.50	SHALE & MUDSTONE
35	110.50	112.00	FINE TO COARSE SANDSTONE WATER
36	112.00	114.00	DIRTY SANDSTONE
37	114.00	123.00	FINE TO COARSE SANDSTONE WATER
38	123.00	124.00	SANDSTONE WITH MUDSTONE LENS

STRATIGRAPHY DETAILS

**** NO RECORDS FOUND ****

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	104.00	106.00	SDST	11/06/2000	-36.64	N			Y	PS	
2	110.00	123.00	SDST	11/06/2000	-36.60	N		23.00	Y	PS	

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

BORE CONDITION

**** NO RECORDS FOUND ****

ELEVATION DETAILS

**** NO RECORDS FOUND ****

WATER ANALYSIS PART1

PIPE	DATE	RD ANALYST	QAN	DEPTH (m)	RMK	SRC	COND (uS/cm)	pH	Si (mg/L)	TOTAL IONS (mg/L)	TOTAL SOLIDS (mg/L)	HARD	ALK	FIG. OF MERIT	SAR	RAH

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GROUNDWATER DATABASE

BORE REPORT

REG NUMBER 103203

PIPE	DATE	RD	ANALYST	QAN	DEPTH (m)	RMK	SRC	COND (uS/cm)	pH	Si (mg/L)	TOTAL IONS (mg/L)	TOTAL SOLIDS (mg/L)	HARD	ALK	FIG. OF MERIT	SAR	RAH
A	07/06/2000	1	GCL	201781		PU	GB	960	6.6	12	542.57	514.92	116	64	0.4	5.9	
A	08/06/2000	1	GCL	201781		PU	GB	960	6.7	12	535.52	508.24	115	64	0.4	5.8	0.00
A	08/06/2000	2	GCL	201782		PU	GB	910	6.8	12	503.98	482.02	95	55	0.3	6.2	0.00
A	09/06/2000	1	GCL	201784		PU	GB	900	6.6		497.04	469.08	92	46	0.3	6.4	
A	09/06/2000	3	GCL	201783		PU	GB	895	6.7	12	493.19	475.63	90	48	0.3	6.3	0.00
A	09/06/2000	4	GCL	201784		PU	GB	896	6.6	12	492.23	476.33	92	45	0.3	6.3	0.00
A	10/06/2000	1	GCL	201783		PU	GB	900	6.7	12	495.16	477.68	91	48	0.3	6.4	

WATER ANALYSIS PART 2

PIPE	DATE	RD	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	07/06/2000	1	145.0	8.4	17.5	17.5	0.15	78.0	< 0.02	0.0	235.0	0.30	0.5	36.0	4.00	< 0.05	0.10	< 0.05
A	08/06/2000	1	142.5	8.4	17.3	17.4	0.15	78.1	0.00	0.0	235.3	0.26	0.5	35.8	4.00	0.00	0.10	0.00
A	08/06/2000	2	139.9	8.2	9.8	17.2	0.12	67.2	0.00	0.0	224.7	0.24	0.0	36.8	1.87	0.00	0.10	0.00
A	09/06/2000	1	140.0	8.1	7.8	17.5	< 0.02	55.0	< 0.02	0.0	230.0	0.20	0.5	37.0	0.70	< 0.05	0.10	< 0.05
A	09/06/2000	3	137.7	8.3	7.5	17.3	0.04	58.2	0.00	0.0	227.0	0.21	0.2	36.8	0.85	0.00	0.10	0.00
A	09/06/2000	4	137.9	8.1	7.8	17.7	0.00	54.9	0.00	0.0	228.3	0.21	0.5	36.8	0.65	0.00	0.10	0.00
A	10/06/2000	1	140.0	8.3	7.5	17.5	0.04	58.0	< 0.02	0.0	225.0	0.20	< 0.5	37.0	0.90	< 0.05	0.10	< 0.05

WATER LEVEL DETAILS

**** NO RECORDS FOUND ****

WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

**** NO RECORDS FOUND ****

SPECIAL WATER ANALYSIS

**** NO RECORDS FOUND ****

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REG NUMBER 308

REGISTRATION DETAILS

		BASIN	0032	LATITUDE	22-35-43	MAP-SCALE	254
OFFICE	Longreach	SUB-AREA		LONGITUDE	144-32-30	MAP-SERIES	M
DATE LOG RECD		SHIRE	410-BARCALDINE REGION	EASTING	247266	MAP-NO	SF55-9
D/O FILE NO.	25/02/M/01	LOT	55	NORTHING	7499198	MAP NAME	MUTTABURRA
R/O FILE NO.	25/2/M/1	PLAN	CM174	ZONE	55	PROG SECTION	
H/O FILE NO.	06609	ORIGINAL DESCRIPTION	TOWN RESERVE MUTTABURRA	ACCURACY	SKET	PRES EQUIPMENT	HW
				GPS ACC			
GIS LAT	-22.5952761	PARISH NAME	3469-MUTTABURRA			ORIGINAL BORE NO	MUTTABURRA TOWN BORE
GIS LNG	144.5416657	COUNTY	CUMBERLAND			BORE LINE	-
CHECKED	Y	PROPERTY NAME					
		FIELD LOCATION				POLYGON	
						RN OF BORE REPLACED	
FACILITY TYPE	AF	DATE DRILLED	30/04/1901			DATA OWNER	
STATUS	EX	DRILLERS NAME	BROWN, ROBERT			CONFIDENTIAL	N
ROLES		DRILL COMPANY	JAMES BROWN				
		METHOD OF CONST.	CABLE TOOL				

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM	TOP (m)	BOTTOM (m)
A	01/01/1901	1	Steel Casing (unspecified)		WT	152	143.70	518.20
A	01/01/1901	2	Steel Casing (unspecified)		WT	127	518.20	825.10
A	01/08/1951	1	Steel Casing (unspecified)			254	0.00	31.20
A	01/08/1951	2	Steel Casing (unspecified)			127	0.00	183.90
A	01/08/1951	3	Grout			254		
A	01/08/1951	4	Grout			127		

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	825.10	NO STRATA INFO
902			00/00/1901 SWL " M TMP 059 C
903			00/00/1901 DISCH 4504.5 M3D

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RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
910	823.00		QUALITY DESCRIP/CONDUCT: 570

STRATIGRAPHY DETAILS

SOURCE	RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
DNR	1			WALLUMBILLA FORMATION
DNR	2			HUTTON SANDSTONE
DNR	3			CLEMATIS GROUP

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	530.00		SDST							PS	WALLUMBILLA FORMATION
2	756.00		SDST							PS	HUTTON SANDSTONE
3	823.00		SDST							PS	CLEMATIS

PUMP TEST DETAILS PART 1

**** NO RECORDS FOUND ****

PUMP TEST DETAILS PART 2

**** NO RECORDS FOUND ****

BORE CONDITION

DATE	DRAIN DETAILS TOT LEN (km)	MAX RUN (km)	C D N	HEADWORKS RET LEN (km)	C D N	C T L	LEAK	FLOW IRREGULARITY	PRECIPITATE	EST USE (ML/yr)	STOCK CATTLE	STOCK SHEEP	COMMENT
20/12/1957													
15/12/1972	1.6				F	F	C						Small leak from centre of concrete around bore. 2" x 4m outlet to drain.
25/05/1975	0.6				G	P							

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ELEVATION DETAILS

PIPE	DATE	ELEVATION	PRECISION	DATUM	MEASUREMENT POINT	SURVEY SOURCE
X	01/JAN/01	236.30	SVY	STD	N	

WATER ANALYSIS PART1

PIPE	DATE	RD	ANALYST	QAN	DEPTH (m)	RMK	SRC	COND (uS/cm)	pH	Si (mg/L)	TOTAL IONS	TOTAL SOLIDS	HARD	ALK	FIG. OF MERIT	SAR	RAH
A	15/12/1972	1	GCL	55264		PU	GB	520	8.3		433.50	309.47	26	223	0.1	10.3	3.95
A	13/06/1975	1	GCL	65316		PU	GB	570	7.7		413.40	283.78	7	209		18.1	4.03
A	27/09/1988	1	GCL	127068			GB	420	8.4	27	362.12	277.29	6	187		16.5	3.62
A	08/08/1990	1	GCL	134969			GB	449	8.1	29	374.33	289.80	7	185	0.0	15.9	3.56
A	08/08/1991	1	GCL	134969	825.00		GB	450	8.1	29	374.97	292.14	7	183		16.0	3.52

WATER ANALYSIS PART 2

PIPE	DATE	RD	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	15/12/1972	1	120.0		7.0	2.0		244.0		14.0	46.0	0.50		0.0				
A	13/06/1975	1	112.0	7.8	2.4	0.3		255.0			35.0	0.50	0.0	0.4				
A	27/09/1988	1	92.0	8.0	2.2	0.1	0.06	220.0	0.06	3.9	33.0	0.30	0.5	2.0				
A	08/08/1990	1	96.5	15.6	2.3	0.3	0.06	222.4	0.00	1.6	35.4	0.24	0.0	0.0				
A	08/08/1991	1	97.0	15.5	2.3	0.3	0.06	220.0	0.01	1.6	35.5	0.20	0.5	2.0				

WATER LEVEL DETAILS

**** NO RECORDS FOUND ****

WIRE LINE LOG DETAILS

DATE	RUN	OPERATOR	TYPE	SOURCE	TOP	BOTTOM	COMMENTS
23/07/2007	1		CAL	DNR	0	549	5" CASING TO 182M, 182M-507M 6" CASING?, 507-517M OLD 5" CASING, 517-549M POSSIBLY OPEN HOLE.
23/07/2007	1	B ISBISTER	CALU	MUTTABURRA S C	-1.81	549.24	
23/07/2007	1		CCL	DNR	0	514	RUST 11-12, 31-55, 79-84, 184; SURFACE RUST 90-115, 120-126, 150-162;266-285; POSSIBLE PIN HOLE 292M; 506-508M CORRODED.

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DATE	RUN	OPERATOR	TYPE	SOURCE	TOP	BOTTOM	COMMENTS
23/07/2007	1	B ISBISTER	GR	MUTTABURRA S C	-1.7	514.25	
23/07/2007	2		GR	DNR	0	514	POSSIBLE OUTER CASING TO 32M. DROP IN GAMMA AT 143M. NO REAL SDST BEDS TO 514M.

FIELD MEASUREMENTS

PIPE	DATE	DEPTH (m)	COND (uS/cm)	pH	TEMP (C)	NO3 (mg/L)	DO (mg/L)	Eh (mV)	ALK	METH	SOURCE
A	30/03/1965				50.0					PU	GB
A	15/12/1972				59.0						
A	25/05/1975				60.0					PU	GB
A	26/09/1988				60.0					PU	GB
A	27/09/1988		420							PU	GB
A	08/08/1990		450							PU	GB

SPECIAL WATER ANALYSIS

**** NO RECORDS FOUND ****

VALIDATION LOG - PART 1

REGDET	CASING	STRLOG	AQUIFR	PUMTES	ELVDET	WLVDET	FIELDQ
Y 31/01/1991	Y 31/01/1991	Y 20/11/2000	Y 31/01/1991	Y 31/01/1991		Y 31/01/1991	Y 31/01/1991

VALIDATION LOG - PART 2

WATANL	SAMPLE	STRTIG	WIRLOG	MULCND	BRCOND	FPREAD	GNOTES
Y 31/01/1991							

GENERAL NOTES

PIPE	DATE	REC	NOTES
A	30/04/1901	1	Original Drilled: Casing 20m x 200mm, 518.2m x 152mm, 518.2-825.1m x 127mm.
A	11/08/1951	1	Bore reconditioned by Intercolonial Boring Co. Driller H Preddy. Inserted 31.2m of 254mm, withdrew existing 8", 6" and 4". Inserted 183.9m of 127mm, cemented the 254mm and 127mm casings. Restored flow 20.2 lps.

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BORE REPORT

REG NUMBER 146624

REGISTRATION DETAILS

OFFICE	Longreach	BASIN	0032	LATITUDE	22-35-42	MAP-SCALE	254
DATE LOG RECD	05-FEB-13	SUB-AREA		LONGITUDE	144-32-31	MAP-SERIES	M
D/O FILE NO.	140/002/0004	SHIRE	410-BARCALDINE REGIC	EASTING	247283	MAP-NO	SF55-9
R/O FILE NO.	25/2/M/1	LOT	55	NORTHING	7499219	MAP NAME	MUTTABURRA
H/O FILE NO.		PLAN	CM174	ZONE	55	PROG SECTION	
		ORIGINAL DESCRIPTION		ACCURACY		PRES EQUIPMENT	
				GPS ACC			
GIS LAT	-22.59508776	PARISH NAME	3469-MUTTABURRA			ORIGINAL BORE NO	MUTTABURRA TOWN BORE
GIS LNG	144.5418328	COUNTY	CUMBERLAND			BORE LINE	-
CHECKED	Y						
						POLYGON	
						RN OF BORE REPLACED	308
FACILITY TYPE	Artesian - Controlled Flow	DATE DRILLED	20/01/2013			DATA OWNER	DNR
STATUS	Existing	DRILLERS NAME	TAYLER, STEPHEN CHARLES				
ROLES		DRILL COMPANY	DALY BROS				
		METHOD OF CONST.	ROTARY MUD				

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM (mm)	TOP (m)	BOTTOM (m)
A	20/01/2013	2	Steel Casing	6.350	WT	168	0.00	744.50
A	20/01/2013	3	Steel Casing	4.800	WT	141	738.00	834.00
A	20/01/2013	5	Perforated or Slotted Casing				756.00	834.00
X	20/01/2013	1	Steel Casing	6.350	WT	219	0.00	60.00
X	20/01/2013	4	Centraliser				0.00	60.00
X	20/01/2013	6	Grout			279	0.00	60.00
X	20/01/2013	7	Grout			200	0.00	744.50

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	1.00	TOPSOIL
2	1.00	5.00	CLAY, SANDY, YELLOW

DATE 08/05/2018

GROUNDWATER DATABASE

BORE REPORT

REG NUMBER 146624

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
3	5.00	18.00	CLAY, YELLOW
4	18.00	30.50	CLAY, GREY
5	30.50	549.00	SHALE
6	549.00	579.00	SANDSTONE; SHALE
7	579.00	597.00	SILTSTONE
8	597.00	639.00	SILTSTONE; SHALE
9	639.00	705.00	SHALE
10	705.00	735.00	SILTSTONE
11	735.00	741.00	SANDSTONE
12	741.00	756.00	SHALE
13	756.00	834.00	SANDSTONE

STRATIGRAPHY DETAILS

**** NO RECORDS FOUND ****

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	756.00		SDST	20/01/2013	23.24	Y	"POTABLE"	33.00	Y	PS	HUTTON SANDSTONE

PUMP TEST DETAILS PART 1

PIPE	DATE	REC NO.	RN OF PUMP-BORE	TOP (m)	BOTTOM (m)	DIST (m)	METH	TEST TYPES	PUMP TYPE	SUCTION SET (m)	Q PRIOR TO TEST (l/s)	DUR OF Q PR (min)	PRES ON ARRIV (m)	Q ON ARRIV (l/s)
A	20/01/2013	1	146624	756.00	834.00		ART							
A	04/09/2013	1	146624			1.75	ART	AC ST FR ST DT					27.39	

PUMP TEST DETAILS PART 2

A	20/01/2013	1	23.24			33.00				30.00	24.75		300	
A	04/09/2013	1 380	29.34	120		27.07	29.25	120	32.52					

DATE 08/05/2018

GROUNDWATER DATABASE

BORE REPORT

REG NUMBER 146624

BORE CONDITION

DATE	DRAIN DETAILS TOT LEN (km)	MAX RUN (km)	C D N	RET LEN (km)	HEADWORKS C D N	C T L	LEAK	FLOW IRREGULARITY	PRECIPITATE	EST USE (ML/yr)	STOCK CATTLE	STOCK SHEEP	COMMENT
04/09/2013					G	F							

ELEVATION DETAILS

PIPE	DATE	ELEVATION	PRECISION	DATUM	MEASUREMENT POINT	SURVEY SOURCE
X	20/01/2013	216.00	EST	AHD	N	GOOGLE EARTH
X	04/09/2013	222.00	GPS	ASD	N	

WATER ANALYSIS PART1

PIPE	DATE	RD	ANALYST	QAN	DEPTH (m)	RMK	SRC	COND (uS/cm)	pH	Si (mg/L)	TOTAL IONS (mg/L)	TOTAL SOLIDS (mg/L)	HARD	ALK	FIG. OF MERIT	SAR	RAH
A	14/09/2013	1	GCL	314427		PU	GB	448	8.0	29	343.00	265.00	6	173	0.0	15.0	3.30

WATER ANALYSIS PART 2

PIPE	DATE	RD	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	14/09/2013	1	90.0	8.9	2.2	0.2	0.08	209.0	0.21	1.2	32.0	0.17	< 0.5	< 1.0	0.01	< 0.05	0.08	< 0.03

WATER LEVEL DETAILS

**** NO RECORDS FOUND ****

WIRE LINE LOG DETAILS

**** NO RECORDS FOUND ****

FIELD MEASUREMENTS

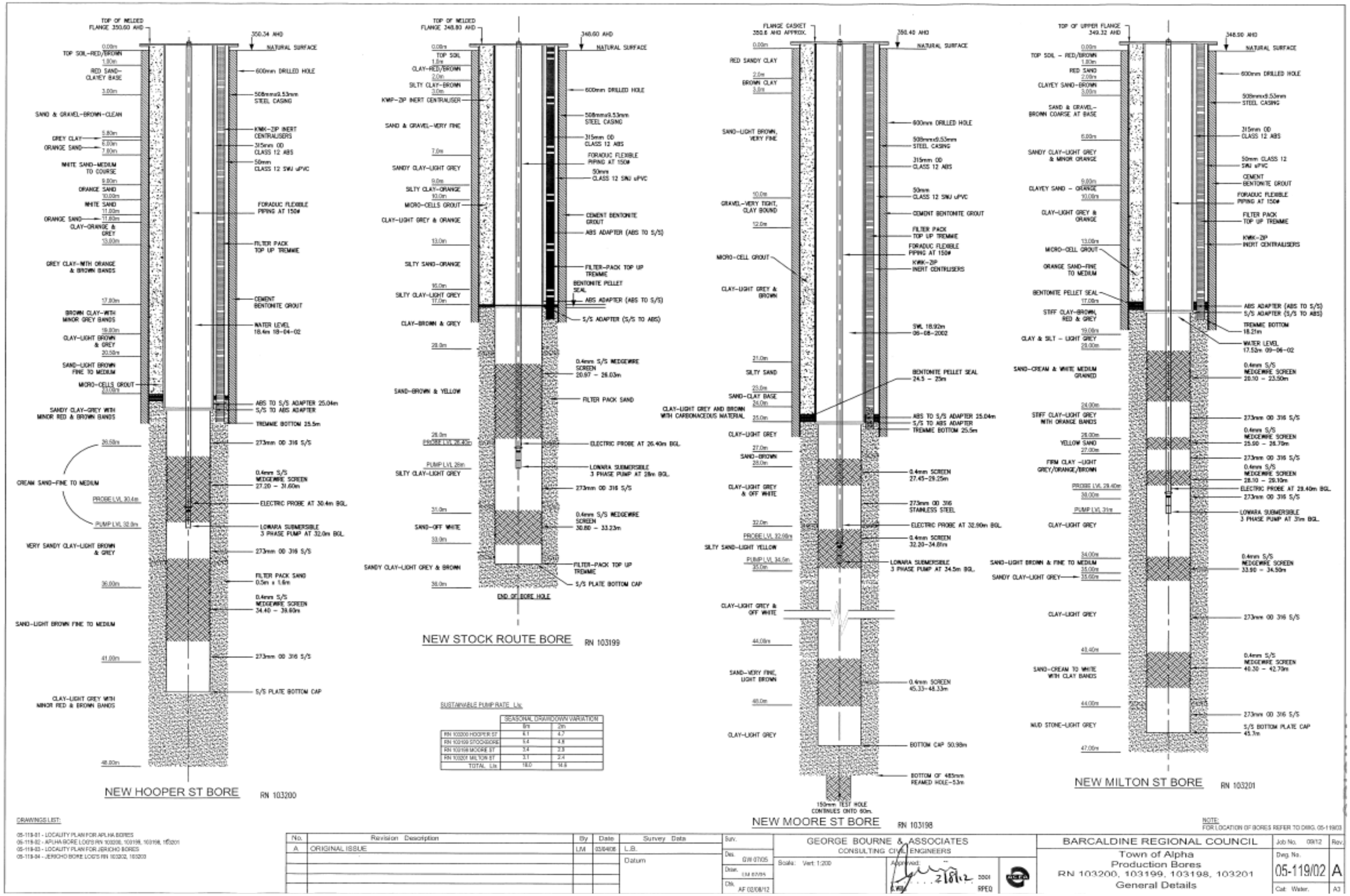
PIPE	DATE	DEPTH (m)	COND (uS/cm)	pH	TEMP (C)	NO3 (mg/L)	DO (mg/L)	Eh (mV)	ALK (mEq)	METH	SOURCE
A	04/09/2013		440	7.0	61.0					PU	GB

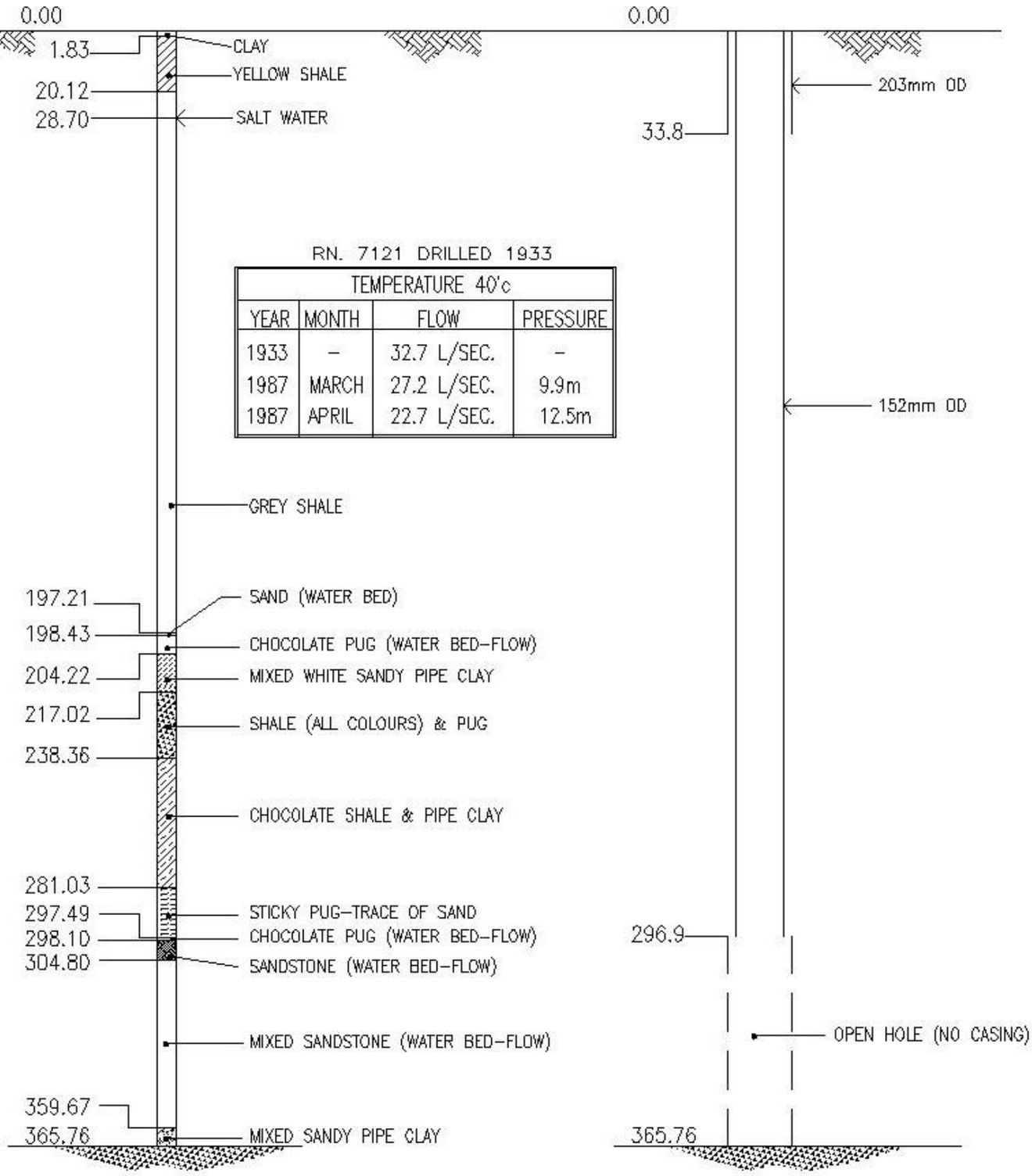
SPECIAL WATER ANALYSIS

**** NO RECORDS FOUND ****

Appendix D

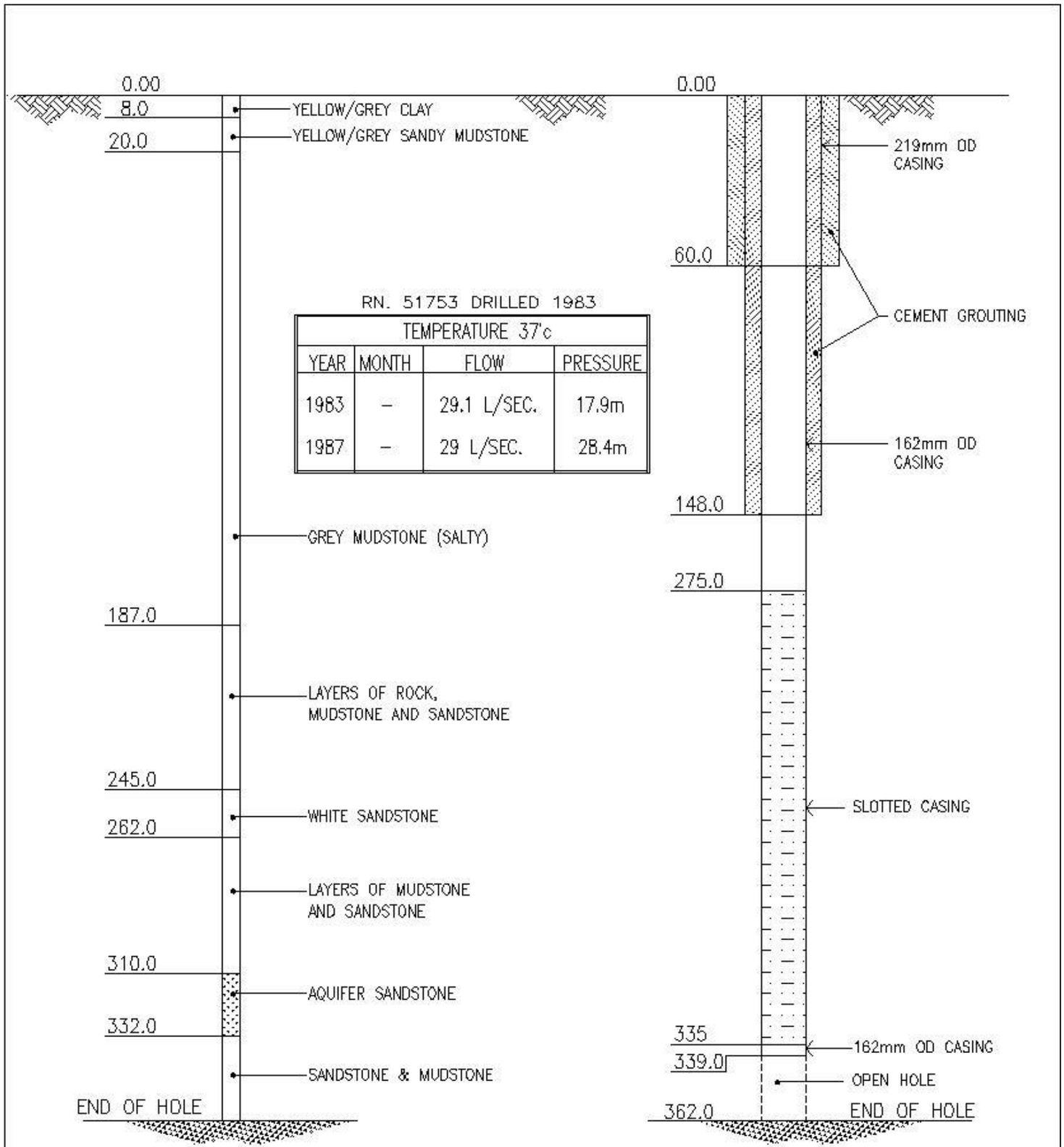
Bore Casing and Stratification Details


NEW HOOPER ST BORE RN 103200
NEW STOCK ROUTE BORE RN 103199
NEW MOORE ST BORE RN 103198
NEW MILTON ST BORE RN 103201
SUSTAINABLE PUMP RATE L/s
SEASONAL DRAWDOWN VARIATION
8m 28m
RN 103200 HOOPER ST 6.1 4.2
RN 103199 STOCKBORE 5.4 4.8
RN 103198 MOORE ST 3.4 2.3
RN 103201 MILTON ST 3.1 2.4
TOTAL L/s 18.0 14.6
DRAWINGS LIST:
05-119-01 - LOCALITY PLAN FOR APLHA BORES
05-119-02 - APLHA BORE LOGS RN 103200, 103199, 103198, 103201
05-119-03 - LOCALITY PLAN FOR JERICHO BORES
05-119-04 - JERICHO BORE LOGS RN 103202, 103203
NOTE: FOR LOCATION OF BORES REFER TO DWG. 05-119/03
No. Revision Description By Date
A ORIGINAL ISSUE LM 03/04/08
Survey Data
Datum
Surv.
Des. GW 07/05
Draw. LM 07/05
Chk. AF 02/08/12
GEORGE BOURNE & ASSOCIATES
CONSULTING CIVIL ENGINEERS
Scale: Vert 1:200
Approved: 2/08/12
3001
RPEQ
BARCALDINE REGIONAL COUNCIL
Town of Alpha
Production Bores
RN 103200, 103199, 103198, 103201
General Details
Job No. 09/12
Dwg. No. 05-119/02
Rev. A
Cat. Water.
A3



ARAMAC TOWN BORE NO.1

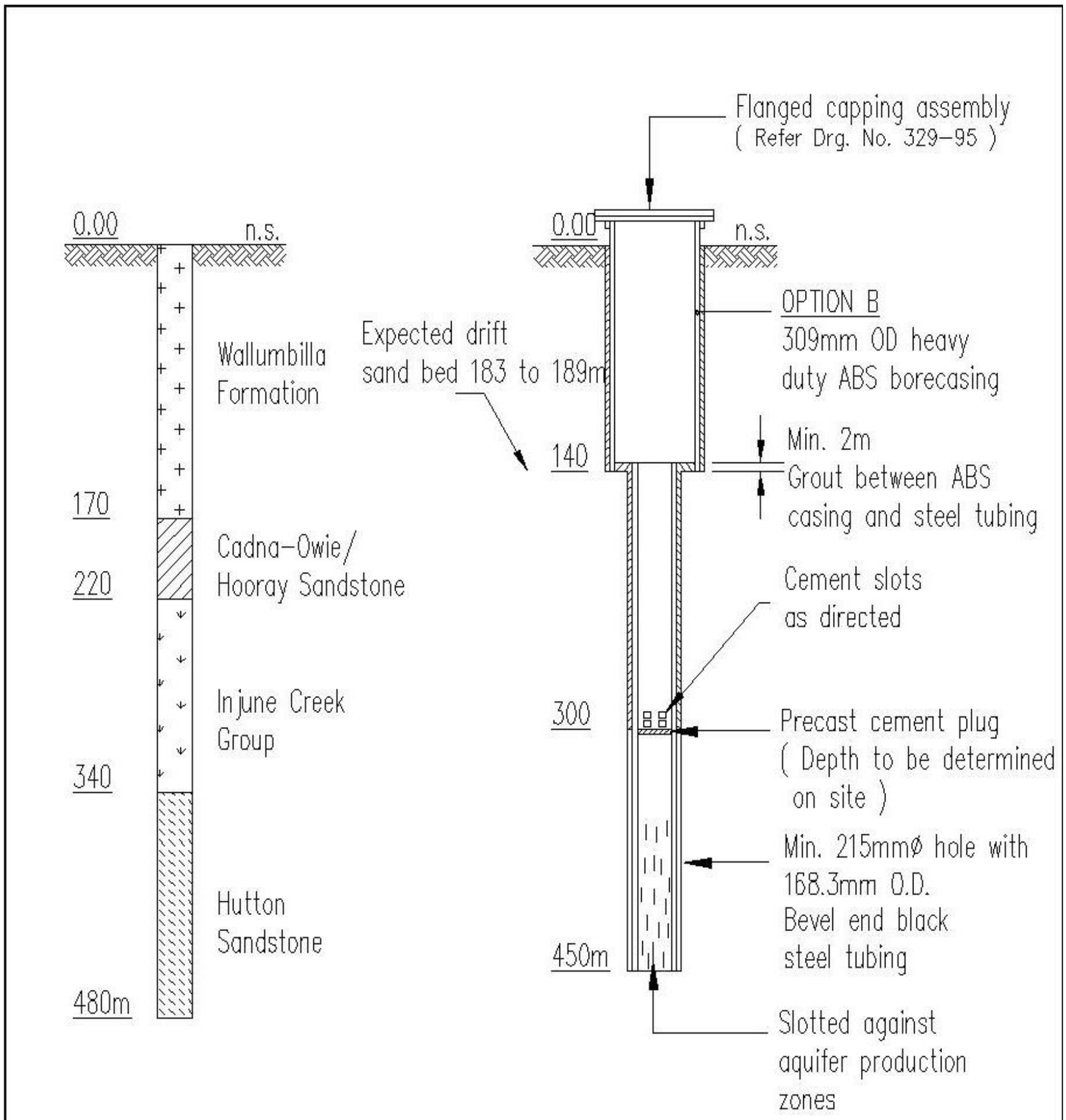
GEORGE BOURNE & ASSOCIATES CONSULTING CIVIL ENGINEERS			Assoc. Dwgs:	Size: A4
Surv.	Approved:	ACEA	ARAMAC SHIRE COUNCIL	Dwg No. 80-00A
Des.			ARAMAC TOWN BORE NO.1	
Drw. H.A 04/00	Scale:		RN. 7121 DRILLED 1933	No. 1 of 1
Chk.				



ARAMAC TOWN BORE NO.2

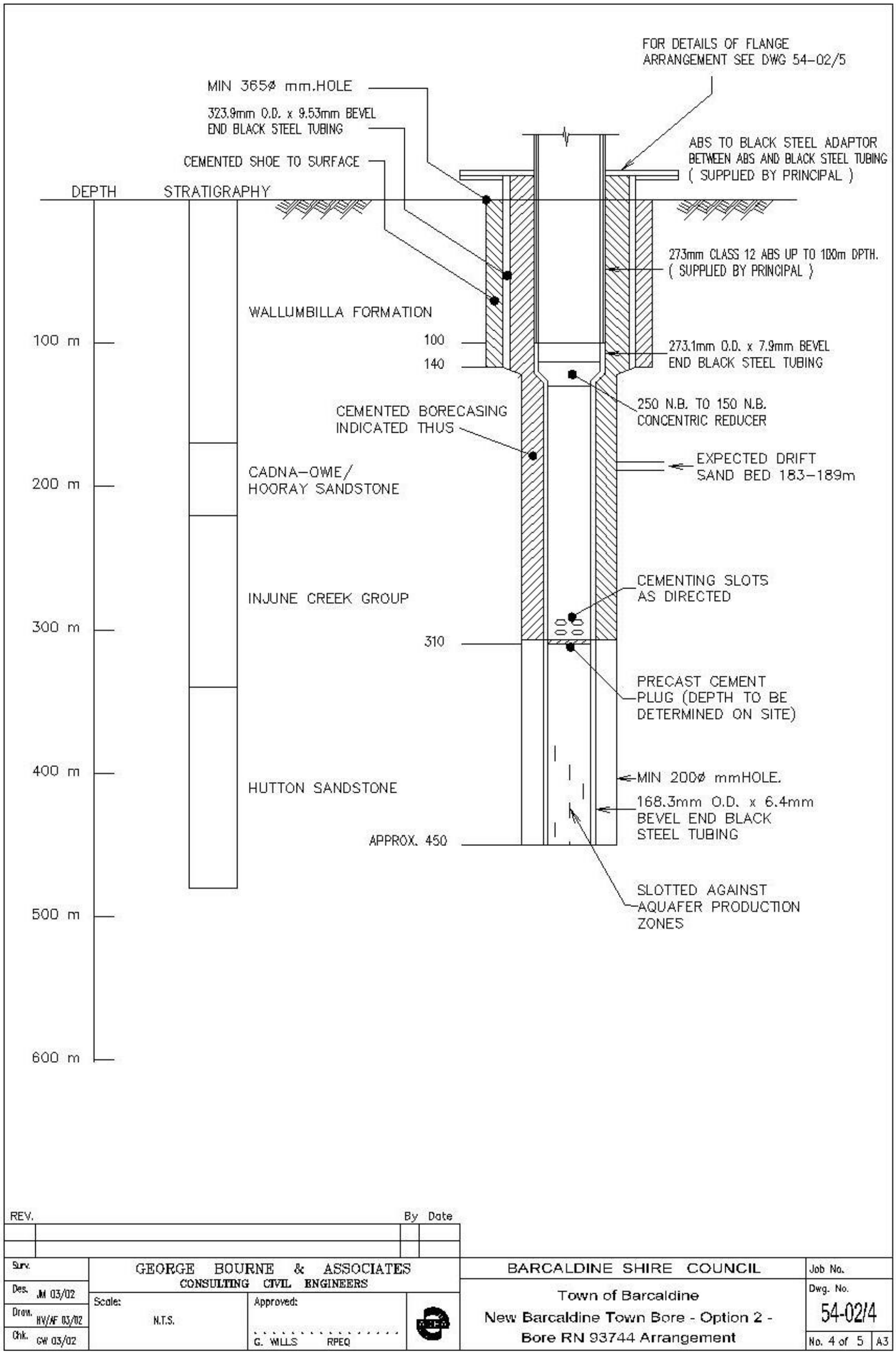
RN 51753 DRILLED 1983

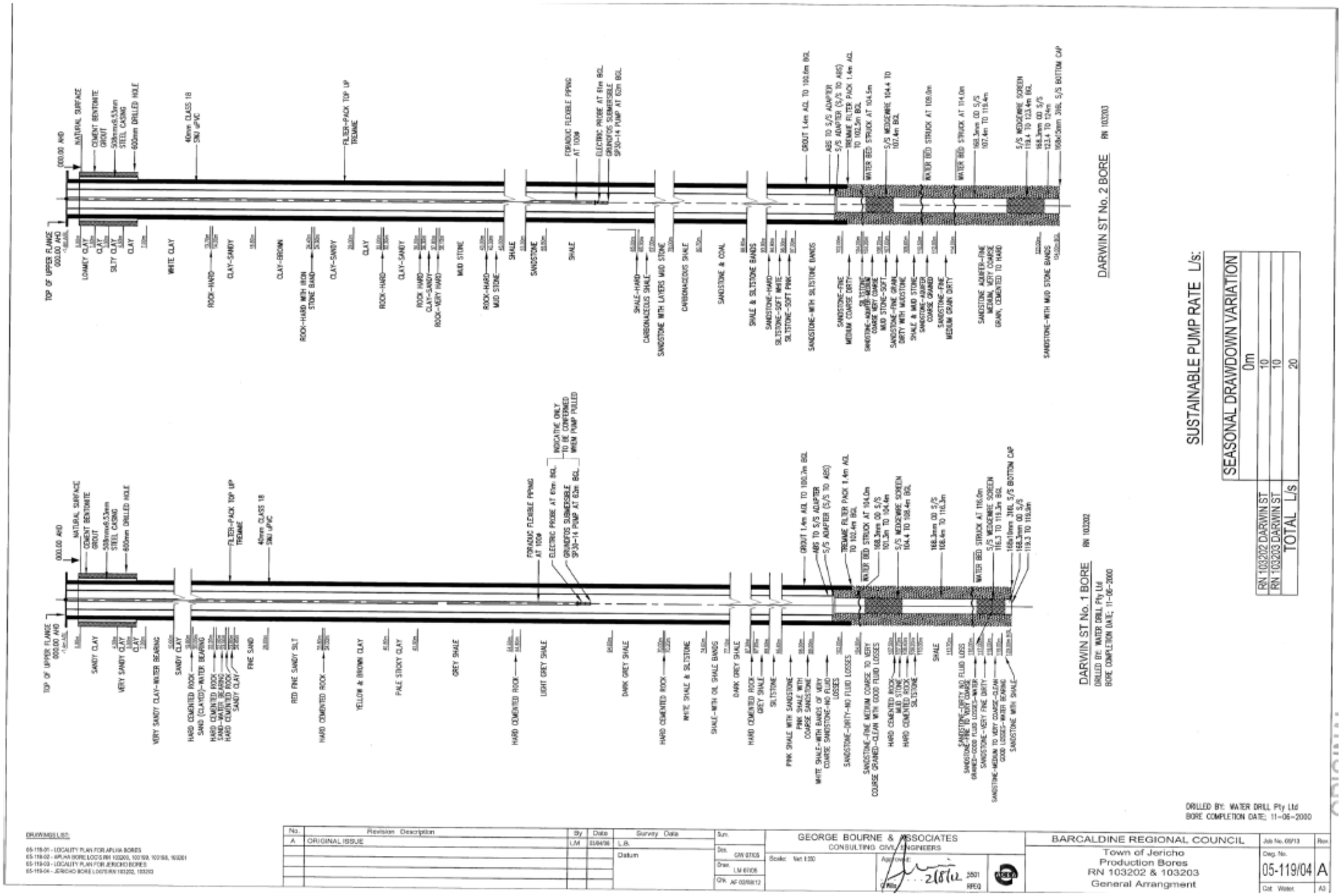
GEORGE BOURNE & ASSOCIATES CONSULTING CIVIL ENGINEERS		Assoc. Dwgs:	Size: A4
Surv. / Des. / Drw. H.A 06/01 / Chk.	Approved: / Scale: N.T.S.	ACEA	ARAMAC SHIRE COUNCIL ARAMAC TOWN BORE NO.2 RN 51753 DRILLED 1983	Dwg No. 105-01 No. 1 of 1

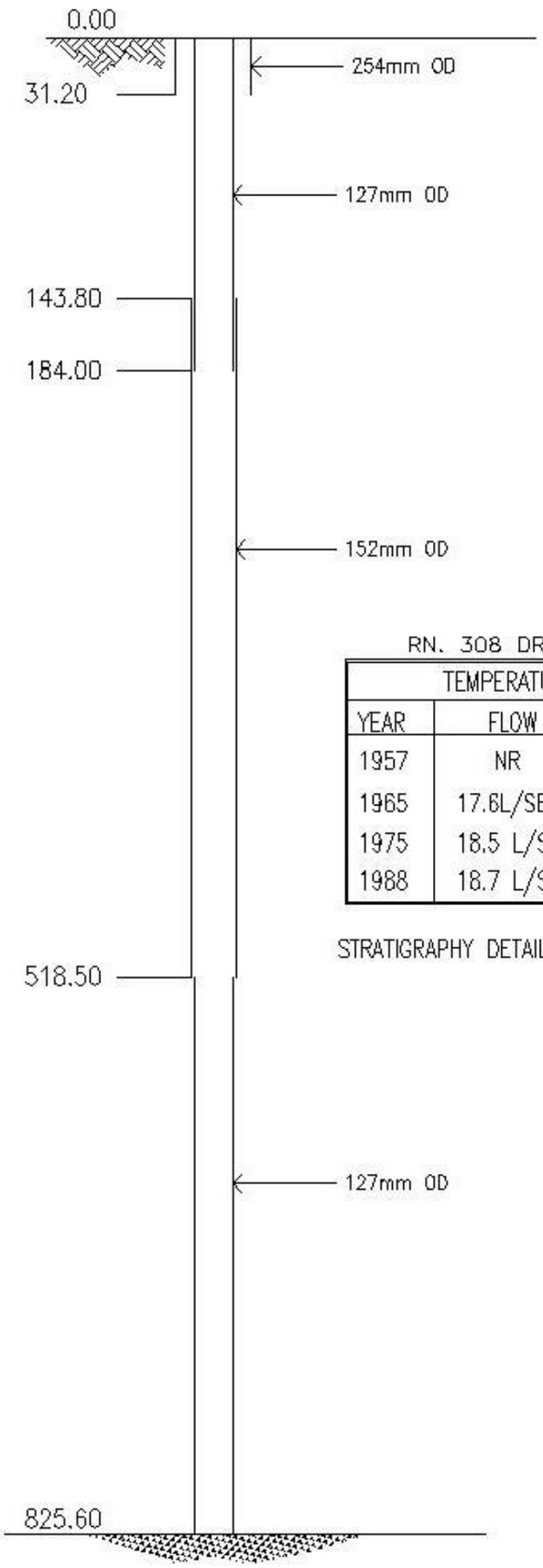


REVISION A: CHANGED DIAMETER OF HOLE FROM 200mm TO 215mm. BY M.W, 10/95.
REVISION B: ADDED NOTE REGARDING GROUTING BEWTWEEN ABS CASING AND STEEL TUBING

GEORGE BOURNE & ASSOCIATES CONSULTING CIVIL ENGINEERS			ASSOC. DWGS:	SIZE A4
DES AF 08/95 DRW AF 08/95 CHK LP 08/95	APPROVED: SCALE: N.T.S.	ACEA	BARCALDINE OPTIONAL A.B.S. CASING BORE ARRANGEMENT FOR BARCALDINE TOWN BORE No. 69904	DWG NO. 227–95 B NO1 OF 1


FOR DETAILS OF FLANGE ARRANGEMENT SEE DWG 54-02/5
MIN 365ø mm.HOLE
323.9mm O.D. x 9.53mm BEVEL END BLACK STEEL TUBING
CEMENTED SHOE TO SURFACE
ABS TO BLACK STEEL ADAPTOR BETWEEN ABS AND BLACK STEEL TUBING (SUPPLIED BY PRINCIPAL)
DEPTH
STRATIGRAPHY
273mm CLASS 12 ABS UP TO 100m DPTH. (SUPPLIED BY PRINCIPAL)
WALLUMBILLA FORMATION
100 m
100
140
273.1mm O.D. x 7.9mm BEVEL END BLACK STEEL TUBING
250 N.B. TO 150 N.B. CONCENTRIC REDUCER
CEMENTED BORECASING INDICATED THUS
EXPECTED DRIFT SAND BED 183-189m
200 m
CADNA-OWIE/ HOORAY SANDSTONE
CEMENTING SLOTS AS DIRECTED
INJUNE CREEK GROUP
300 m
310
PRECAST CEMENT PLUG (DEPTH TO BE DETERMINED ON SITE)
400 m
HUTTON SANDSTONE
MIN 200ø mmHOLE.
168.3mm O.D. x 6.4mm BEVEL END BLACK STEEL TUBING
APPROX. 450
SLOTTED AGAINST AQUAFER PRODUCTION ZONES
500 m
600 m
REV.
By Date
Surv.
Des. JM 03/02
Drwn. HV/AF 03/02
Chk. GW 03/02
GEORGE BOURNE & ASSOCIATES
CONSULTING CIVIL ENGINEERS
Scale: N.T.S.
Approved:
G. WILLS RPEQ
BARCALDINE SHIRE COUNCIL
Town of Barcaldine
New Barcaldine Town Bore - Option 2 -
Bore RN 93744 Arrangement
Job No.
Dwg. No. 54-02/4
No. 4 of 5 A3


DARWIN ST No. 2 BORE RN 103203
SUSTAINABLE PUMP RATE L/s:
SEASONAL DRAWDOWN VARIATION
0m
10
10
20
RN 103202 DARWIN ST
RN 103203 DARWIN ST
TOTAL L/s
DARWIN ST No. 1 BORE RN 103202
DRILLED BY: WATER DRILL Pty Ltd
BORE COMPLETION DATE: 11-06-2000
DRILLED BY: WATER DRILL Pty Ltd
BORE COMPLETION DATE: 11-06-2000
DRAWINGS LIST:
05-119-01 - LOCALITY PLAN FOR APLHA BORES
05-119-02 - APLHA BORE LOGS RN 103200, 103159, 103160, 103201
05-119-03 - LOCALITY PLAN FOR JERICHO BORES
05-119-04 - JERICHO BORE LOGS RN 103202, 103203
No. Revision Description By Date Survey Data
A ORIGINAL ISSUE LM 01/04/98 L.B.
Datum
Sun.
Des. GW 97/05
Draw. LM 97/06
Chk. AF 02/08/12
GEORGE BOURNE & ASSOCIATES
CONSULTING CIVIL ENGINEERS
Scales: Vert 1:200
Approved:
2501
RPEQ
BARCALDINE REGIONAL COUNCIL
Town of Jericho
Production Bores
RN 103202 & 103203
General Arrangment
Job No. 05/13
Dwg. No.
05-119/04
Rev.
A
Cat. Water
A3



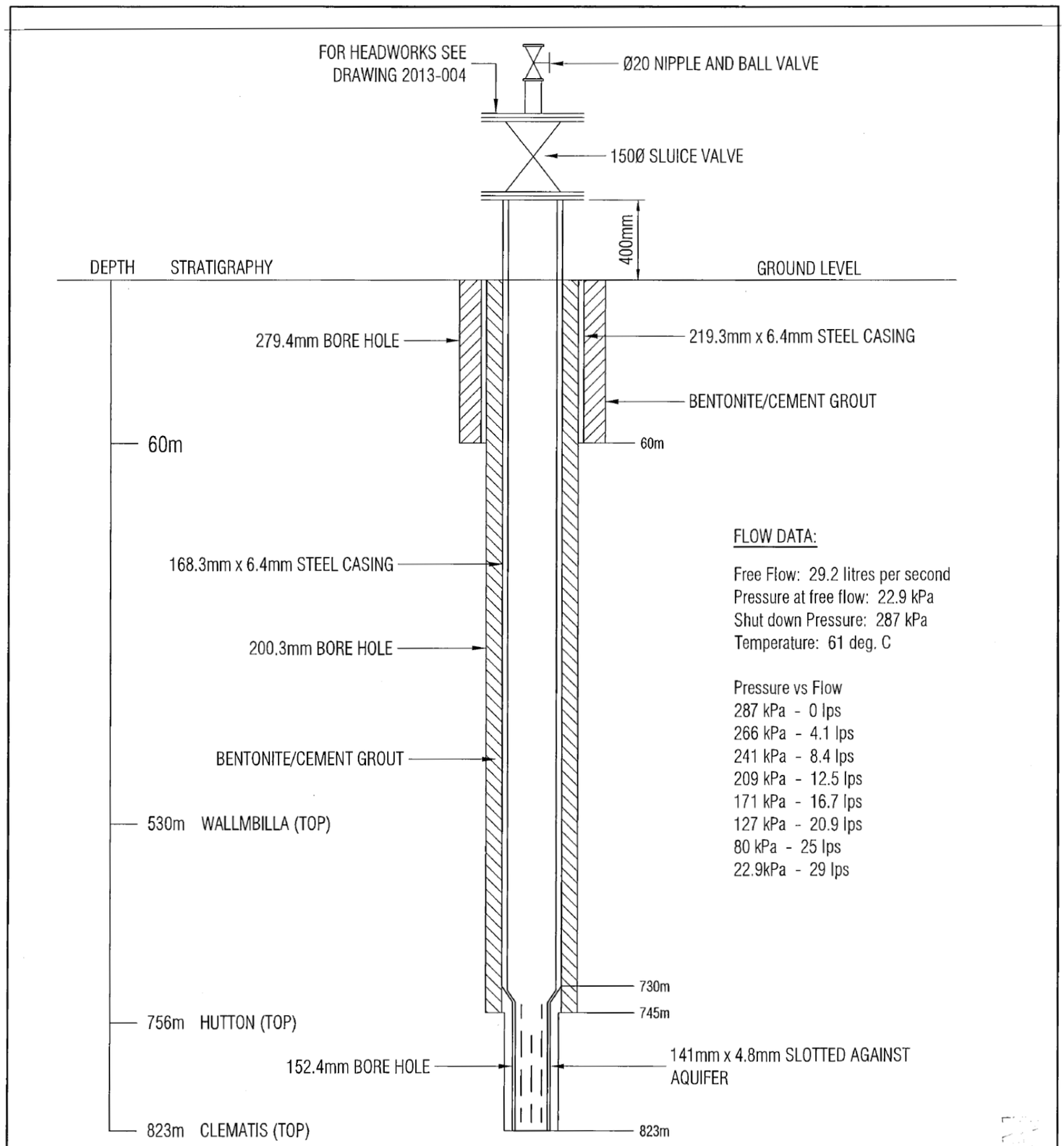
RN. 308 DRILLED 1901

TEMPERATURE 60'c		
YEAR	FLOW	PRESSURE
1957	NR	26.0m
1965	17.6L/SEC.	NR
1975	18.5 L/SEC.	25.5m
1988	18.7 L/SEC.	24.5m

STRATIGRAPHY DETAILS – NOT AVAILABLE

MUTTABURRA TOWN BORE

GEORGE BOURNE & ASSOCIATES CONSULTING CIVIL ENGINEERS			Assoc. Dwgs:	Size: A4
Surv.	Approved:	ACEA	ARAMAC SHIRE COUNCIL	Dwg No.
Des.			MUTTABURRA TOWN BORE	79-00
Drw. H.A 04/00	Scale:		RN. 308 DRILLED 1901	No. 1 of 1
Chk.				



FLOW DATA:

Free Flow: 29.2 litres per second
Pressure at free flow: 22.9 kPa
Shut down Pressure: 287 kPa
Temperature: 61 deg. C

Pressure vs Flow
287 kPa - 0 lps
266 kPa - 4.1 lps
241 kPa - 8.4 lps
209 kPa - 12.5 lps
171 kPa - 16.7 lps
127 kPa - 20.9 lps
80 kPa - 25 lps
22.9kPa - 29 lps

No.	Revision Description	By	Date
F	FLOW DATA ADDED	DB	09/10/2013
E	AS CONSTRUCTED MODIFICATIONS	DB	19/02/2013
D	BOTTOM CASING MODIFIED	DB	07/11/2012
C	ADDED STRATIGRAPHY	ZR	18/09/2012
B	DEPTHS AMENDED	WW	10/05/2010
A	ORIGINAL ISSUE	WW	16/07/2009

NOTES:

1. FOR STRATA DETAIL SEE BORE LOG No. 096567 DATED 23/01/2013.
2. FOR HEADWORKS DETAIL SEE DRAWING 2013-004.

GEORGE BOURNE & ASSOCIATES
Consulting Civil Engineers

Scale: NOT TO SCALE

Approved: 1513
SLJ Bourne RPEQ

ACEA

BARCALDINE REGIONAL COUNCIL

TOWN OF MUTTABURRA
ARTESIAN BORE No. 2
CONSTRUCTION DESIGN

Job No. 01/13 | Rev.
Drawing No. 2009-080/01 | F
CATEGORY: WATER | A4

Appendix E

Local Disaster Management Plan Contact Details[30]

[30] List refers to contacts contained within Barcaldine RC LGDMP. For current list refer to the online version of this document.

LDMG Members

Organisation/Role	Name & Address	Phone	Email and Fax
Barcaldine Regional Council - Chair	Cr Rob Chandler 72 Box Street, Barcaldine	4651 5622 0427 512 314	chandler@barcaldinerc.qld.gov.au 4651 1778
Barcaldine Regional Council - Deputy Chair	Cr Jenni Gray "Abrach" Longreach	4658 7145 0428 587 145	gray@barcaldinerc.qld.gov.au 4658 7237
Barcaldine Regional Council - Local Disaster Coordinator	Brett Walsh 57 Yew Street, Barcaldine	4651 5626 0429 496 570	desh@barcaldinerc.qld.gov.au 4651 1778
QFRS - Rural	Larry Lewis Ash Street, Barcaldine	4651 1190 0427 870 433	larry.lewis@dcs.qld.gov.au 4651 1803
Barcaldine Police - OIC	Sgt Barcaldine Police Ash Street, Barcaldine	4651 1322	Misson.TimotyJ@police.qld.gov.au
Barcaldine Regional Council - Manager, Engineering Services	Rick Rolfe 71 Ash Street, Barcaldine	4651 5600 0427 511 087	meng@barcaldinerc.qld.gov.au 4651 1778
Emergency Management Queensland	Zoy Green Longreach Airport, Longreach	4658 1308 0427 797 392	zgreen@emergency.qld.gov.au

Barcaldine

Organisation/Role	Name & Address	Phone	Email and Fax
Barcaldine Regional Council - Chair Sub Group	Cr Garry Bettiens	4651 1013 0428 719 754	garry@capplumbing.qld.gov.au
Barcaldine Regional Council - Executive Manager	Brett Walsh 71 Ash Street Barcaldine	4651 5600 0427 511 748	brettw@barcaldinerc.qld.gov.au 4651 1778
QFRS Captain Barcaldine Station	Athol Hite 20 Pine Street, Barcaldine	4651 1841	
Queensland Police Services	Officer in Charge Barcaldine Station Ash Street, Barcaldine	4651 1322	Misson.TimothyJ@police.qld.gov.au
Queensland Ambulance Services	Officer in Charge Barcaldine Station Ash Street, Barcaldine	4651 2304	
Barcaldine Group - SES	Eric Hindmarsh Willow Street, Barcaldine	4651 1436	
Barcaldine Hospital	DON	4650 4000	

Aramac/ Muttaburra

Organisation/Role	Name & Address	Phone	Email and Fax
Barcaldine Regional Council - Deputy Chair Sub Group	Cr Jenni Gray	4658 7145 0427 587 145	gray@barc.qld.gov.au
Aramac Executive Manager	Ian Kuhn 35 Gordon Street Aramac	4651 3311 0419 661 031	emaramac@barc.qld.gov.au 4651 3156
QFRS Captain, Aramac Station	Officer in Charge Doug Churchill	4651 3170	
Muttaburra Rural Fire Brigade	First Officer Rodney Little	0427 587 191	
QAS Aramac Station	Officer in Charge Adam Russell	000	
Muttaburra PHC/Ambulance	DON		
Aramac Police Station	David Thompson	4651 3120	thompson.david@police.qld.gov.au
Muttaburra Police Station	Officer in Charge		Smith.LindaM@police.qld.gov.au
Aramac Group - SES	Doug Churchill	132 500 0428 725 017	
Aramac Hospital	DON Faye McLure	4652 9000	

Alpha/Jericho

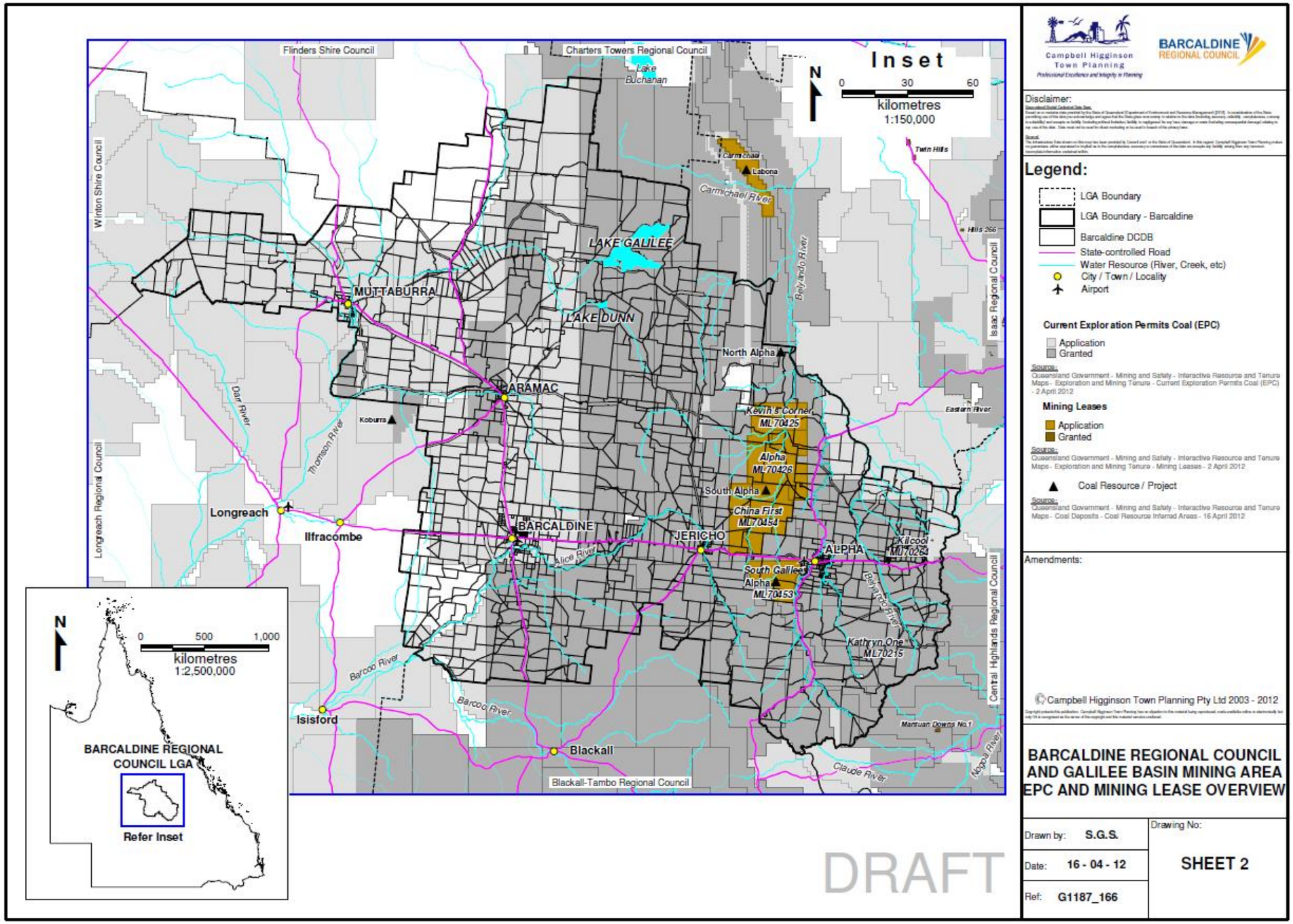
Organisation/Role	Name & Address	Phone	Email and Fax
Barcaldine Regional Council - Deputy Chair Sub Group	Cr Sean Dillon	4983 5083 0427 700 958	dillon@barc.qld.gov.au
Alpha Executive Manager	TBA 43 Dryden Street, Alpha	4985 1166 0429 851 166	emalpha@barc.qld.gov.au
QFRS Captain, Alpha	John Mahon	4985 1624	
Jericho Rural Fire	First Officer Greg Pearce	4651 4237	
QAS / Alpha Hospital	DON-Alpha Hospital Leona Bowers	4809 7000	
Alpha Police Station	Officer in Charge Mick Lingard	07 4985 1200	lingard.michaelJ@police.qld.gov.au
Jericho Police Station	Officer in Charge Joel Williams	4651 4120	
Alpha Group - SES	Local Controller Narelle Trilford	0427 745 082	

Supporting Agencies

Organisation/Role	Name & Address	Phone	Email and Fax
Power	Ergon Energy Myall Street Barcaldine	13 10 46	
Communications	Telstra Beech Street, Barcaldine	1800 331 286	
Health	Royal Flying Doctor Service 137b Eagle Street, Longreach	1300697337	
Local Media	Longreach Leader 124 Magpie Lane, Longreach	4658 3855	advertising@longreachleader.com.au 4658 2396
	ABC Duck Street, Longreach	4658 4011	westqld@yourabc.net.au 4658 4099
	4LG Gallah Street, Longreach	4658 3333	
	West FM Gallah Street, Longreach		
Rebel FM		5541 4222	info@rebelfm.com.au

Appendix F

Existing Mining Leases and Exploration Areas


Flinders Shire Council
Charters Towers Regional Council
Winton Shire Council
Longreach Regional Council
Isaac Regional Council
Central Highlands Regional Council
Blackall-Tambo Regional Council
Lake Buchanan
Carmichael
Labona
Carmichael River
Twin Hills
Hills 266
LAKE GALILEE
MUTTABURRA
LAKE DUNN
Belyando River
North Alpha
CLARAMAC
Koburra
Dair River
Thomson River
Eastern River
Kevin's Corner
ML70425
Alpha
ML70426
South Alpha
China First
ML70454
BARCALDINE
JERICHO
ALPHA
Kilcool
ML70284
South Galilee
Alpha
ML70453
Barcoo River
Kathryn One
ML70215
Mantuan Downs No.1
Claude River
Nogoa River
Longreach
Ilfracombe
Isisford
Blackall
Alice River
Barcoo River
Inset
N
0 30 60
kilometres
1:150,000
N
0 500 1,000
kilometres
1:2,500,000
BARCALDINE REGIONAL COUNCIL LGA
Refer Inset
DRAFT
Campbell Higginson Town Planning
Professional Excellence and Integrity in Planning
BARCALDINE REGIONAL COUNCIL
Disclaimer:
Legend:
LGA Boundary
LGA Boundary - Barcaldine
Barcaldine DCDB
State-controlled Road
Water Resource (River, Creek, etc)
City / Town / Locality
Airport
Current Exploration Permits Coal (EPC)
Application
Granted
Source:
Queensland Government - Mining and Safety - Interactive Resource and Tenure Maps - Exploration and Mining Tenure - Current Exploration Permits Coal (EPC) - 2 April 2012
Mining Leases
Application
Granted
Source:
Queensland Government - Mining and Safety - Interactive Resource and Tenure Maps - Exploration and Mining Tenure - Mining Leases - 2 April 2012
Coal Resource / Project
Source:
Queensland Government - Mining and Safety - Interactive Resource and Tenure Maps - Coal Deposits - Coal Resource Informed Areas - 16 April 2012
Amendments:
Campbell Higginson Town Planning Pty Ltd 2003 - 2012
BARCALDINE REGIONAL COUNCIL AND GALILEE BASIN MINING AREA EPC AND MINING LEASE OVERVIEW
Drawn by: S.G.S.
Date: 16 - 04 - 12
Ref: G1187_166
Drawing No:
SHEET 2