

Monthly water quality monitoring results Cabbage Tree Road sand quarry January 2021 Water Monitoring Event

NCA21R121479
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Williamstown Sand Syndicate
PO Box 898
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Attention: Darren Williams

Subject: Monthly water quality monitoring results
Cabbage Tree Road sand quarry
January 2021 Water Monitoring Event

Please find enclosed the monthly water monitoring results at Cabbage Tree Road Sand Quarry for the January 2021 water monitoring event

1 SCOPE OF SERVICE

The scope of work includes the quarterly surface and groundwater monitoring as part of the monthly monitoring requirements. **Figure 1 (Attachment: 1)** presents the surface water and groundwater sampling locations.

The scheduled January monitoring was a monthly monitoring event to include gauging of all available monitoring wells (a total of 14 wells) and sampling from 11 monitoring wells and four surface water locations.

2 SITE WORK

The monthly monitoring round was conducted on 14 January 2021.

Each well location was gauged using a water level meter to determine groundwater depth (relative to the top of the well casing) and the total depth of the well, in order to determine potential sand/silt inundation and or root penetration. Following the gauging a HydraSleeve was then placed into the well ensuring the top of the sleeve was located under the water and suspended in place while all remaining wells were gauged. Following gauging, each of the HydraSleeves were removed and samples taken.

The January 2021 monitoring round included:

- Gauging of 14 monitoring wells (BH1, BH2, BH4, BH5, BH6, BH7, BH8, BH9, BH9A, BH10, BH11, BH12, MW239S & MW239D);
- Groundwater sampling from 10 monitoring wells as summarised in **Table 5** and detailed in **Attachment 2** (BH9 has been superseded by BH9A and BH10 was dry); and
- Surface water sampling from three locations as summarised in **Table 5** and detailed in **Attachment 2** (SW2 was dry at the time of sampling)

Water samples were collected into laboratory supplied containers and placed into an ice chilled esky. The samples were then submitted to a NATA accredited laboratory under a chain of custody (COC) for the analytical schedule as per **Table 1**.

Table 1: Summary of Monthly Water Quality Analysis

Analysis	Number of Samples				
	Primary	Intra-lab (Duplicate)	Inter-lab (Triplicate)	Transport Blank	Rinsate Blank
Hydrocarbons*	13	1	1	1	1
Metals**	12	1	1	1	1
Iron (dissolved)	12	1	1	1	1
General Water Quality Suite***	12	0	0	0	0
Total Dissolved Solids (TDS)	12	0	0	0	0



Total Suspended Solids (TSS)	12	0	0	0	0
PFAS (28 analytes, standard level)	10	2	2	1	1

* TRH (C6 – C40), BTEXN (Silica Gel)

** NEPM Metals Suite (dissolved) - Arsenic (As), Barium (Ba), Beryllium (Be), Boron (B), Cadmium (Cd), Chromium (Cr), Cobalt (Co), Copper (Cu), Iron (Fe), Lead (Pb), Manganese (Mn), Mercury (Hg), Nickel (Ni), Selenium (Se), Vanadium (V), Zinc (Zn).

*** General Water Quality Suite - Ca, Mg, Na, K, pH, EC, Cl, SO₄, Alkalinity, Fluoride, Hardness & TDS (Calc')

3 SAMPLING RESULTS

Table 2 provides a summary of the gauging data. The full set of gauging data and field parameters for each monitoring location are provided in **Attachment 2**. Additionally, Watershed HydroGeo (2019) outlined a Trigger Action and Response Plan (TARP) to mitigate potential impacts to groundwater associated with quarry operations at Williamstown Sand. Based on these recommendations groundwater elevation has been shaded to correspond to triggers and actions outlined in **Table 3**.

Table 2: Summary of gauging data

Borehole	Top of Casing (mAHD)	Depth to Water (mBTOC)	Groundwater Elevation (mAHD)	Well Total Depth Current (mBTOC)	Well Total Depth 2014 (mBTOC)	Inferred Max GW Level (mAHD) ¹	Comment
BH1	8.64	5.984	2.656	8.411	9.45	4.5	Clear, sulphur odour
BH2	7.79	5.293	2.497	8.804	9.45	3.8	Light brown, sulphur odour
BH3	-	-	-	-	-	3.4	Well decommissioned
BH4	3.06	1.132	1.928	5.925	6.45	3.0	Clear, sulphur odour
BH5	7.36	5.404	1.956	8.650	9.28	4.0	No sample taken
BH6	3.62	1.171	2.449	4.420	4.95	4.4	Clear, sulphur odour
BH7	2.98	1.235	1.745	4.420	4.95	3.7	Light brown, sulphur odour.
BH8	3.88	1.900	1.98	6.039	6.28	4.0	Light brown, sulphur odour
BH9	-	-	-	-	-	3.0	Well decommissioned
BH9A	10.25	8.761	1.489	12.500	16.16	3.0 ²	Dark brown, sulphur odour
BH10	6.69	Dry	-	3.68	5.45	4.9	Well was dry.
BH11	6.63	3.246	3.384	5.210	5.95	5.5	Light brown, sulphur odour
BH12	8.67	6.441	2.229	8.190	8.39	4.0	Clear, sulphur odour
MW239S	3.04	0.998	2.042	3.830	4.0	3.9	Dark brown, sulphur odour
MW239D	3.04	0.984	2.056	20.49	20.49	3.9 ³⁻	No sample taken
SW01*	N/A	0.5	N/A	N/A	N/A	N/A	Clear, no odour
SW02*	N/A	Dry	N/A	N/A	N/A	N/A	Location was dry



SW03*	N/A	0.50	N/A	N/A	N/A	N/A	Clear, no odour
SW04*	N/A	>0.60	N/A	N/A	N/A	N/A	Natural sheen, no odour

* Surface water levels measured from measuring tape installed (When dry number is ground elevation AHD).

¹ – Sourced from Watershed HydroGeo, 2019, *Maximum Extraction Depth Management Plan, Cabbage Tree Road Sand Quarry*, May 2019.

² – Inferred Max Groundwater level based on adjacent wells (BH4 & BH9).

³ – Inferred Max Groundwater level based on adjacent well (MW239S).

N/A – Not applicable

Table 3: Groundwater level monitoring TARP rules (Watershed HydroGeo, 2019)

Level	Trigger	Action and Response	Report to
0	Groundwater levels more than 0.5 m below <i>inferred</i> maximum historical level at BH1 and BH10. (Table 2).	Standard operations – monthly dipping of operational on-site monitoring bores.	n/a
1	Groundwater levels within 0.5 m below <i>inferred</i> maximum historical level (Table 2) at any on-site bore.	Weekly (or more frequent) monitoring (dipping) of groundwater levels until water level declines to below high frequency level bores listed in Table 2 .	Internal and environmental consultant. Include note in Annual Report.
2	Groundwater levels within 0.25 m of <i>inferred</i> maximum historical level (Table 2) at any on-site bore.	Weekly (or more frequent) monitoring (dipping) of groundwater levels. Re-analysis and review of MEL.	WSS to issue letter to DPIE, documenting groundwater level and rainfall trends, and review and recommendations regarding of Minimum Extraction Level (MEL) outlined in Watershed HydroGeo, 2019.
3	Groundwater levels within resource area rise above previously <i>inferred</i> maximum groundwater level (Table 2).	Analysis of recent data by hydrogeologist, including site data and data from local HWC wells and local Defence wells (if available). Revision of MEL. Remediation of earlier excavations to revised MEL if required by DPIE.	WSS to issue letter to DPIE, DoI Water and HWC, documenting groundwater level trends, and revision (if necessary) of MEL. Letter to outline remedial options, considering access, vegetation condition in previously rehabilitated areas. Re-grading of previously rehabilitated areas if required by DPIE.

Table 4 provides a summary of the field parameters taken during the January monitoring event. All gauging data and field parameters for each monitoring location are provided in **Attachment 2**.

Table 4: Summary of Field Measurements

Borehole	Turbidity (NTU)	Temp (°C)	DO (mg/L)	EC (µc/cm)	TDS (mg/L)	PH	Redox (mV)
BH1	1411	21.6	3.31	308	198	6.10	-65.1
BH2	1757	23.5	6.37	229	148	5.69	232.1
BH4	1282	23.3	3.22	683	443	5.88	230.5
BH5	ND	ND	ND	ND	ND	ND	ND
BH6	1245	24.2	3.84	859	562	4.96	-94.8
BH7	1929	24.3	3.01	810	525	4.76	-67.2
BH8	1015	22.7	2.08	846	549	4.97	-114.0



Borehole	Turbidity (NTU)	Temp (°C)	DO (mg/L)	EC (µc/cm)	TDS (mg/L)	PH	Redox (mV)
BH9A	2652	22.0	4.73	562	365	5.65	52.6
BH11	1747	22.6	3.05	668	434	5.23	-73.3
BH12	1671	21.9	3.76	282	182	5.53	43.7
MW239S	1792	23.6	3.66	1221	793	5.08	-127.7
SW01	2474	25.1	2.19	594	386	6.77	67.2
SW03	1211	22.1	0.36	1056	685	5.31	147.2
SW04	1106	21.7	1.57	1311	856	7.24	-226.5

ND: No Data – no sample taken

Table 5 and **Table 6** presents a summary of the water monitoring results for key analytes found to be elevated above the LOR for groundwater and surface water. Groundwater and surface water criteria outlined in the baseline water quality summary (BWQS) report, developed by Kleinfelder (KLF 2020), has been applied to the monthly report including a comment comparing results with previous data. It should be noted that since undertaking the BWQS report increased rainfall has occurred throughout 2020 (compared to 2019) which may influence baseline concentrations across the site, most notably in metals, inorganics and general water quality parameters.

Non detect for analytes BTEXN, TRH, TPH and PFAS were reported at the majority of locations and are therefore not included in the below summary tables with exception to SW4 which reported concentrations of PFOS above the Baseline Trigger Values and is therefore included in the summary table (Table 6). Full results tables are provided in the **Attachment 2**. Full Laboratory results, including copies of the COC are provided in **Attachment 3**.



Table 5: Groundwater screening levels

Analyte	Metals								Relative to previous monitoring (details on specific data trends provided in Section 5 below)
	Barium	Chromium**1	Copper**	Cobalt	Iron	Manganese**	Nickel	Zinc**	
LOR	0.001	0.001	0.001	0.001	0.05	0.001	0.001	0.005	
Units	mg/L	mg/L	mg/L	Mg/L	mg/L	mg/L	mg/L	mg/L	
Baseline Trigger Values (KLF 2020)	0.035	0.004	0.013 (0.051 for BH4)	-	4.1 ² / 1.0 ³	1.9	0.022 (0.037 for BH11)	0.085	
NHMRC ADWG (2018)	-	0.05	2	-	-	0.5	0.02	-	
Sample ID	Groundwater								
BH1	0.002	0.002	0.001	<0.001	5.21 ⁴	0.013	<0.001	0.032	Concentrations of metals were generally consistent with historical results and below adopted criteria. Iron concentrations (5.21 mg/L) are within historical variations and will continue to be closely monitored during subsequent monthly monitoring rounds to confirm trends. BH1 is up hydraulic gradient of current quarry operations.
BH11	0.008	0.001	0.025	<0.001	0.56	0.006	0.004	0.018	Metal concentrations were generally consistent with historical results and below adopted criteria. Copper concentrations (0.025mg/L) spiked above the Baseline Trigger Values (0.013mg/L) and is the highest concentration since reporting began in February 2019. The spike is likely to be a result of above average rainfall in the region for January. Copper concentrations will be closely monitored during subsequent monthly monitoring rounds to confirm trends.
BH12	NS	NS	NS	NS	NS	NS	NS	NS	Metals for BH12 were not analysed.
BH2	0.002	<0.001	0.006	<0.001	<0.05	0.016	<0.001	<0.005	Metal concentration were generally consistent with historical results and remain below adopted criteria. BH2 is down hydraulic gradient from the current quarry operations footprint.
BH4	0.010	<0.001	0.012	<0.001	0.27	0.012	0.002	0.006	Metal concentration were generally consistent with historical results and remain below adopted criteria. BH4 is down hydraulic gradient from



Analyte	Metals								Relative to previous monitoring (details on specific data trends provided in Section 5 below)
	Barium	Chromium**1	Copper**	Cobalt	Iron	Manganese**	Nickel	Zinc**	
LOR	0.001	0.001	0.001	0.001	0.05	0.001	0.001	0.005	
Units	mg/L	mg/L	mg/L	Mg/L	mg/L	mg/L	mg/L	mg/L	
Baseline Trigger Values (KLF 2020)	0.035	0.004	0.013 (0.051 for BH4)	-	4.1 ² / _{1.0³}	1.9	0.022 (0.037 for BH11)	0.085	
NHMRC ADWG (2018)	-	0.05	2	-	-	0.5	0.02	-	
Sample ID	Groundwater								
									current quarry operations and on the southernmost boundary of the site.
BH6	0.054	<0.001	0.011	<0.001	1.06	0.014	0.002	0.025	Generally metal concentrations were consistent with historical results. Barium concentrations (0.054 mg/L) remain elevated above the Baseline Trigger Values (0.035mg/L) although showing a downward trend, Increased metal concentrations are most likely a result of above average rainfall in the region. Concentrations will continue to be closely monitored during subsequent monthly monitoring rounds to confirm trends. BH6 is generally up hydraulic gradient from current quarry operations and at the north eastern most point of the Site.
BH7	0.004	0.002	0.004	0.002	1.65	0.025	0.004	0.017	Metal concentrations were generally consistent with historical results and below adopted criteria. BH7 is located east of the current quarry operations.
BH8	0.007	0.001	0.002	<0.001	2.71	0.010	0.005	0.009	Metal concentrations were consistent with historical results and below adopted criteria. BH8 is located to the east of the current quarry operations on the eastern most boundary of the Site
BH9A	0.002	0.001	0.017	<0.001	0.14	0.025	0.004	0.011	Metal concentrations were generally consistent with historical results and below adopted criteria. BH9A is down gradient for current quarry



Analyte	Metals								Relative to previous monitoring (details on specific data trends provided in Section 5 below)
	Barium	Chromium** ¹	Copper**	Cobalt	Iron	Manganese**	Nickel	Zinc**	
LOR	0.001	0.001	0.001	0.001	0.05	0.001	0.001	0.005	
Units	mg/L	mg/L	mg/L	Mg/L	mg/L	mg/L	mg/L	mg/L	
Baseline Trigger Values (KLF 2020)	0.035	0.004	0.013 (0.051 for BH4)	-	4.1 ² / 1.0 ³	1.9	0.022 (0.037 for BH11)	0.085	
NHMRC ADWG (2018)	-	0.05	2	-	-	0.5	0.02	-	
Sample ID	Groundwater								
									operations and is on the southernmost boundary of the Site.
MW239S	0.011	0.001	0.005	<0.001	0.77	0.012	0.004	0.011	Metal concentrations were generally consistent with historical results and below adopted criteria. MW239S is located east of the current quarry operations.

Notes:

< - Less than laboratory limit of reporting

** 95% Level of protection in freshwater

¹ value for CR VI

² Northern half of site – BH6, BH7, BH8, BH11 & MW239S

³ Southern half of site - BH2, BH4 & BH9

⁴ BH1, BH5 & BH12 – Baseline Trigger Values do not apply. Data assessed against historical variations (since monitoring began in February 2019).

NS – No Sample



Table 6: Surface water screening levels

Analyte	Metals									PFAS	Relative to previous monitoring (details on specific data trends provided in Section 5 below)
	Arsenic	Barium	Chromium**1	Copper**	Cobalt	Iron	Manganese**	Nickel	Zinc**	PFOS	
LOR	0.001	0.001	0.001	0.001	0.001	0.05	0.001	0.001	0.005	0.01	
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	
Baseline Trigger Values (KLF 2020)	0.001	0.08	0.002	0.013	0.017	9.26	0.841 (SW1)/0.048 (SW3 & SW4)	0.022	0.535 (SW1) / 0.085 (SW3 & SW4)	0.01 ²	
NHMRC ADWG 6	0.01	-	0.05	2	-	-	0.5	0.02	-	-	
Sample Name	Surface Water Screening Levels										
SW1	<0.001	0.012	<0.001	0.02	<0.001	0.35	0.04	0.006	0.037	<0.01	Metal concentrations were generally consistent with historical variations. Concentrations of Copper were reported above the Baseline Trigger Value (0.013mg/L). Concentrations of copper are consistent across the site and likely a result of above average rainfall. Copper will continue to be closely monitored following subsequent monthly sampling event. SW1 is located on the southernmost boundary adjacent to Cabbage Tree Road.
SW3	0.002	0.015	<0.001	0.02	0.004	8.28	0.026	0.010	0.025	<0.01	Metal concentrations are generally consistent with historical data. Concentrations of Arsenic (0.002 mg/L) are marginally above the baseline trigger values (0.001 mg/L). Concentrations of Copper (0.02 mg/L) are also marginally elevated above the baseline trigger value (0.013 mg/L). These concentrations are consistent across the site and most likely a result of above average rainfall. Concentrations will continue to be closely monitored during subsequent monthly monitoring rounds to confirm trends. SW3 is located within a drainage channel that travels from west to



Analyte	Metals									PFAS	Relative to previous monitoring (details on specific data trends provided in Section 5 below)
	Arsenic	Barium	Chromium**1	Copper**	Cobalt	Iron	Manganese**	Nickel	Zinc**	PFOS	
LOR	0.001	0.001	0.001	0.001	0.001	0.05	0.001	0.001	0.005	0.01	
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	
Baseline Trigger Values (KLF 2020)	0.001	0.08	0.002	0.013	0.017	9.26	0.841 (SW1)/0.048 (SW3 & SW4)	0.022	0.535 (SW1) / 0.085 (SW3 & SW4)	0.01 ²	
NHMRC ADWG 6	0.01	-	0.05	2	-	-	0.5	0.02	-	-	
Sample Name	Surface Water Screening Levels										
											east along the south eastern perimeter of the Site. SW3 is east of the current quarry operations.
SW4	0.002	0.028	0.002	0.026	0.003	20	0.171	0.005	0.013	0.04	Metal concentrations at SW4 generally increased across most analytes with exception to iron which reported a decrease in concentrations compared to the previous months results. Concentrations of Arsenic (0.002mg/L), Chromium (0.002 mg/L), Copper (0.026mg/L), Iron (20 mg/L), and Manganese (0.171 mg/L) were all above their respective baseline trigger values, likely due to above average rainfall in the region. Concentrations will continue to be closely monitored during subsequent monthly monitoring rounds to confirm trends. PFOS (0.04 µg/L) and PFHxS (0.03 µg/L) was reported above criteria for the third month in a row..

Notes:
 < - Less than laboratory limit of reporting
 ** 95% Level of protection in freshwater
¹ value for CR VI
² HEPA NEMP 2018 – Recreational Water



4 RAINWATER DATA

Table 7 presents the rainfall data from Williamstown RAAF base (Station Number: 061078, Latitude: 32.79°S; Longitude: 151.84°E; Elevation: 8 m) for the period 2020/21. The mean monthly rainfall for the month of December/January period indicates that there was an above average rainfall for the remainder of December and tracking to receive above average rainfall within January. Based on current rainfall data (mean and monthly totals) for January 2021 it is expected that surface and groundwater elevations will generally increase in elevation compared to previous months.

Table 7: 2020-2010 Rainfall data

2020	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan (21)
1st	0	0	0	6.4	0	0	0	0	0.4	0.2	0	7.0
2nd	0	0	0.2	0	0	0.2	0	0	0	3.2	12	21.2
3rd	0.4	1.4	9.2	0	0.6	0	0	0	0	0	0	2.2
4th	0.2	6.8	12.4	0	0.2	1.6	0	0	0	0	0	0.2
5th	0	0.2	4.2	5.6	0	0	0	3	0	0	0	41.6
6th	0.2	24.6	0	5.6	0	0	0	0	0	30.2	12	0
7th	25	8.2	0	0.2	0	0	0	0	0	0	0	5.8
8th	28	0.2	0	0	0.4	4	3	0	0	0.4	0	4.0
9th	66.2	0	0.8	0	26.8	0	2.8	0	0	0	0	12.0
10th	16.2	0	0	0	14	0	8.4	12.6	0	0	0	0.2
11th	5.6	0.2	4	0	11.4	0.6	18.4	0	0	0	1	0
12th	0.2	1.6	0	0	1.4	1.8	0	0	0	0	0	0
13th	1.8	0.2	0	0	0.2	17	1.2	0	0	4.4	0	0
14th	3.2	0	0	0.2	11.2	24.6	0	0	0	13.6	0	0
15th	0	5.8	0	9.2	0	4	5	0	0	0	5.4	
16th	0.2	2.6	0	3.4	0	0	0	0	0	0	14.8	
17th	0.2	0	0	0	0	0	0	0	0	5.8	0	
18th	5.8	3.2	0	6.2	4.2	7.8	0	0.4	0.2	0	13.6	
19th	4.6	0	0	2.2	0	0	0	0	18.0	0	8.0	
20th	0.2	0	0	0.2	0	0	0	2.2	1.0	0	5.0	
21st	0	0	0	0.8	0.4	0	0	8.8	0	0	3.0	
22nd	0	0	0	12	10.2	0	0	0.4	0	0	48.6	
23rd	0.4	0.6	0	0.2	0.2	0	0	0	0	0	0.2	
24th	0.2	0.6	0	0.2	0	0	0	0	9.4	0	0	
25th	0	0	0	0	0	0	0	0	14.0	0.4	0	
26th	0	21.2	0	38.8	0	23.4	0	0.6	128.8	0	0	
27th	13	19.6	17.2	0	0.2	133	0	0	76.2	0	1.8	
28th	0	0	4.6	0	0	16.2	0	0	0	0	0.2	
29th	0	8.4	1	1.6	0	8.4	0	0	4.0	0	24.0	



2020	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan (21)
30th	-	0	0	12.6	0.2	0	0	0	0	0	0.2	
31st	-	0.8	-	0.2	-	0	0	-	-	-	6.4	
Total	171.6	106.2	53.6	105.6	70.4	242.6	38.8	28	252.0	58.2	156.2	
Mean	117.8	120.7	109.8	108.6	124.6	72.6	72.8	60.6	75.9	81.9	77.5	98.3

5 DATA TRENDS

Data trends, taken from analyses undertaken throughout the duration of the sampling program (January 2019 – current), are provided as **Appendix 4**. Generally, the trends indicate an increase in groundwater elevation across the site relative to average rainfall recorded in the December 2020 to January 2021 period.

Notable changes in data trends were observed for the following analytes:

- Iron – generally remained stable across the site with the expectation of a notable increase in concentration at BH1 and a decrease at SW4;
- Barium – concentrations of barium remain generally consistent across the site, however BH6 concentration levels remain elevated above the Baseline Trigger Value;
- Nickel – concentrations of nickel are generally within historical variations;
- Cobalt – concentrations of cobalt are generally within historical variations;
- Copper – concentrations of copper are generally elevated across all surface water monitoring locations including a notable increase in concentration at BH11. It should be noted that BH11 is up gradient from the current quarry operations, including all other monitoring locations, indicating that background concentrations in the region are generally increasing, most likely due to recent above average rainfall;
- Calcium – generally calcium concentrations across the site have remained stable or marginally decreased however location SW4 has reported a notable increase since recent monitoring event;
- Zinc – concentration of zinc are generally within historical variations
- PFAS – notable increase in concentration of PFAS and PFHxS levels at SW4 were detected. Concentrations of PFOS have been detected at SW4 following the last three monitoring events.

6 THANK YOU

Overall, the results suggest that since quarry operations began in August 2019 there has been no immediate change in analytical results.

We trust the information presented is acceptable. If you have any questions, please do not hesitate in contacting the undersigned.

Sincerely,

Kleinfelder Australia Pty Ltd

Daniel Kousbroek

Environmental Consultant
Contaminated Land Management
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Attachments

- Attachment 1: Figures
- Attachment 2: Results tables and field records
- Attachment 3: Lab results
- Attachment 4: Data Trends



ATTACHMENT: 1 FIGURES





ATTACHMENT 2: RESULTS TABLES AND FIELD RECORDS





ATTACHMENT 3: LAB RESULTS





ATTACHMENT 4: DATA TRENDS

