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QUARTERLY WATER QUALITY SURVEY ON THE LOWER ORANGE RIVER

DECEMBER 2020 SURVEY

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EXECUTIVE SUMMARY: DECEMBER 2021 SURVEY

Three new monitoring localities were included by Vaalharts Water during the December 2020 survey. The lower Vaal River was found to be the main contributor of salinity towards the lower Orange River and is also associated with bacteriological contamination during periods of high flow. This extension of the quarterly water monitoring program will provide vital information for the conceptualization of strategies for the mitigation and management of poor water quality.

It is recommended that the Orange-Vaal WUA should include one additional sampling locality where the R357 crosses over the Riet River. The Riet River enters the Vaal River just up-stream from the Douglas Weir and no information is available for this important tributary.

Salinity generally decreased since the previous survey. The drivers of salinity in the lower Orange River are the Vaal Rivers very saline contribution, dilution from the Orange River, evaporation and irrigation return flows. A detailed and integrated statistical analysis of all related data including flow, will be required to formulate a salt management strategy for the lower Orange River.

Bacteriological counts spiked at most sampling localities during December 2020. Point sources of pollution have been investigated during November 2020 and it is safe to assert that the untreated sewerage discharges from Hopetown (Thembelihle Local Municipality) is a major contributor to the contamination of the water supply of Douglas and Prieska.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Various water users in the lower Orange River region became concerned about the rivers water quality and its fitness for use. This concern was precipitated by observations of municipal infrastructure failure at sewerage water treatment and sewerage conveying facilities as well as raised bacteriological recordings in ad-hoc river water samples as collected by local role-players.

Many of the water users united to establish Gariep Watch, which is a non-government organization aiming to improve the rivers water quality. The SA constitution and recent high court rulings make provision for a situation where citizens can and should take parallel control of failing government institutions. A detailed quarterly water quality monitoring program was designed by Clean Stream Environmental Services for the Orange River with the first survey completed in November 2017. This program has since been extended to include the middle Orange River from below the Vanderkloof Dam and the Vaal River down-stream from the Bloemhof Dam. This quarterly report is the first to include the extended Vaal- and Harts Rivers areas.

Special care was taken to assure the scientific integrity of this logistically challenging river monitoring program. Personnel at the various water user associations were trained in water monitoring. The correct water quality variables of concern are carefully selected for each locality, samples are preserved according to prescribed procedures and it is analysed by SANAS accredited laboratories.

The completed surveys are shown in Table 1 and the monitoring localities are described in Table 2.

Table 1: Completed surveys and reports.

SURVEY DATE	REPORT REFERENCE	FINAL REPORT DATE	STATUS
November 2017	ORANGE/A/2018	January 2018	Completed
November 2018	ORANGE/A/2019	January 2019	Completed
February 2019	ORANGE/B/2019	April 2019	Completed
June 2019	ORANGE/C/2019	July 2019	Completed
September 2019	ORANGE/D/2019	October 2019	Completed
November 2019	ORANGE/A/2020	January 2020	Completed
March 2020	ORANGE/B/2020	May 2020	Completed
June 2020	ORANGE/C/2020	August 2020	Completed
September 2020	ORANGE/D/2020	October 2020	Completed
December 2020	ORANGE/A/2021	January 2021	**This report**

This concise electronic reporting format has been designed to facilitate the quick interpretation of quarterly water quality information. Quarterly data will be added and discussed along with spatial and long-term trends as the monitoring program progresses. Quarterly reports are designed to be stand-alone reports and some information must therefore be repeated with every survey.

2. SAMPLING LOCALITIES

Ten monitoring localities have now been selected in the Orange River and five in the Vaal River up-stream from its confluence with the Orange River (15 in total). Some of the monitoring localities were selected to be at the same site as the DWS monitoring localities but will be referred to by the name that relates to their geographical position as shown in Table 2. The sampling localities and their coordinates are shown in Table 2 and on the satellite maps in Figures 1 and 2.

Table 2: Sampling locality names, description and coordinates

SITE NUMBER	DESCRIPTION	CO-ORDINATES
VAAL RIVER		
Vaal - BHD	Vaal River just down-stream from Bloemhof Dam	-27.666022,25.617573
Vaal - VH	Vaalharts irrigation water at Vaal River extraction point downstream from Vaalharts Dam	-28.112793,24.925557
Harts - SPD	Harts River down-stream from the Spitskop Dam	-28124565,24.501984
Vaal Casa	Vaal River locality down-stream from Douglas.	-29.075268,23.730773
ORANGE RIVER		
VDK	Downstream from Vanderkloof Dam wall at the road bridge.	-29.991511,24.724279
Orania	Road bridge downstream from Orania.	-29.789603,24.410790
De Bron	Road bridge downstream from Hopetown at De Bron.	-29.571154,24.072838
Vaal DW	This locality is at Douglas Weir. Orange River water from Marksdrift is channelled towards Douglas Weir for irrigation purposes.	-29.043802,23.836436
Marksdrift	Orange River at the R357 road bridge.	-29.161711,23.694480
Prieska	Orange River at the R386 road bridge close to Prieska. This is the first sampling site in the Orange River down-stream of the Vaal River confluence.	-29.656655,22.745639
Boegoeberg	Orange River just below Boegoeberg Dam. The sample is taken at Zeekoebaard but now named Boegoeberg.	-29.027589,22.185203
Upington	Orange River at Upington on the road bridge leading to the Eiland Resort and Groblershoop.	-28.464497,21.242210
Kanoneiland	Northern tributary of the Orange River at Kanoneiland.	-28.635716,21.089755
Kakamas	Orange River at the Kakamas road bridge close to Lutzburg and in the Kakamas irrigation area.	-28.755655,20.622182
Onseepkans	Orange River at the Onseepkans border post.	-28.736002,19.304841

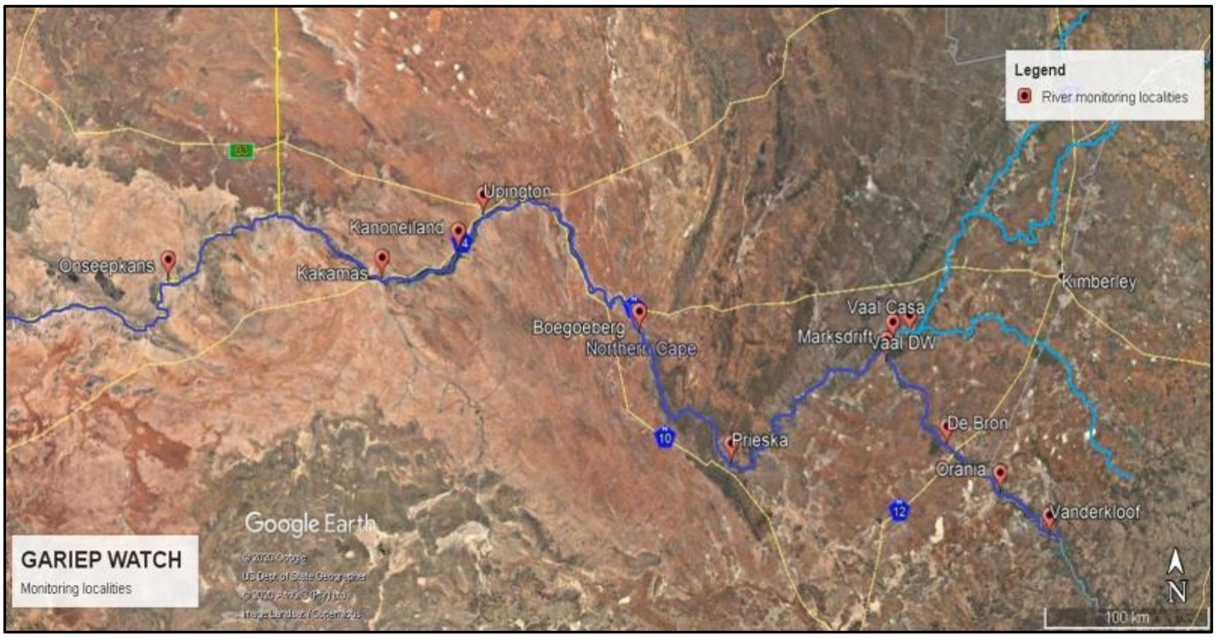

Figure 1: Map showing the lower Orange River sampling localities.

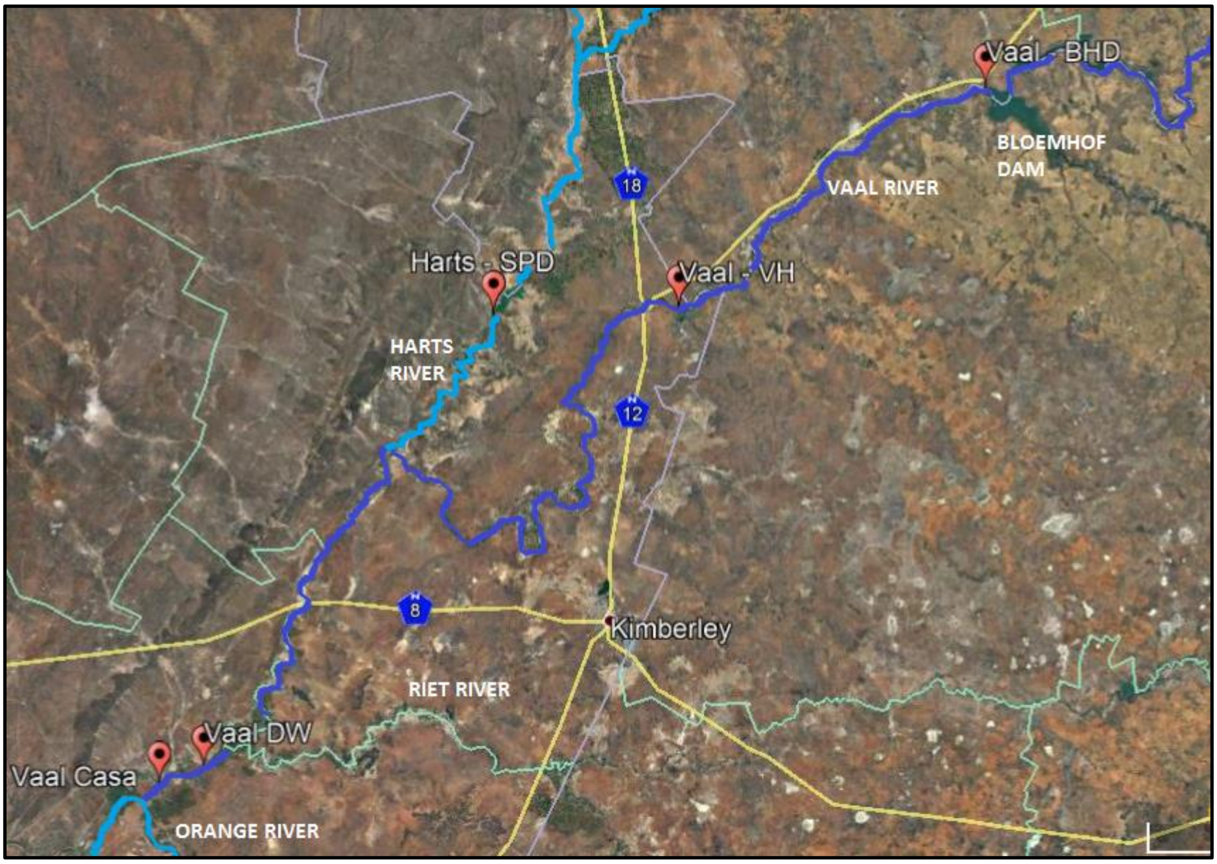

Figure 2: Map showing the Vaal River and Harts River sampling localities.

3. DECEMBER 2020 WATER QUALITY RESULTS

The December 2020 water quality data as analysed by Bemlab and Pathcare is presented in Table 3. The recorded values are evaluated against three standards, which are the Target Water Quality Guidelines for Domestic use (DWAF: Volume 1, 1996), TWQG for Irrigation (DWAF: Volume 4, 1996) as well as the SANS 241-1 drinking water guideline (SABS, 2015). Variables that exceed any one of these standards are highlighted in Tables 3.1 to 3.4.

Table 3.1: Evaluation of the December 2020 river monitoring results.

RIVER SAMPLING LOCALITIES	pH	Alk mg/l	EC mS/m	SS mg/l	Na mg/l	K mg/l	Ca mg/l	Mg mg/l	B µg/l	NH_4-N mg/l	NO_3-N mg/l	NO_2-N mg/l
TWQ Guideline (1996) Domestic use	6-9	n/a	70	n/a	100	50	32	30	n/a	1.0	6	6
SANS 241-1 Drinking water guideline	5.0-9.7	n/a	170	n/a	200	< 25	< 80	< 30	2400	1.5	10	<0.9
Agricultural use	6.5-8.4	n/a	< 40	0-50	2000	-	1000	500	500	-	100	10
VAAL RIVER LOCALITIES												
Vaal BHD	8.2	126	67.7	<5.0	52	9.6	44.6	20.6	120	0.2	<0.18	0
Vaal VH	8.0	124	68.1	<5.0	52	9.6	43.0	20.3	130	0.1	<0.18	0
Harts SPD	8.5	178	126	<5.0	115	11.8	48.6	52.1	220	0.1	<0.18	0
Vaal DW	8.4	144	97.1	<5.0	88.7	6.9	45	33.2	0.18	0.1	<0.18	<0.03
Vaal Casa	8.8	136	80.1	<5.0	68.9	5.6	40.2	27.8	0.11	0.1	<0.18	<0.03
ORANGE RIVER LOCALITIES												
Vanderkloof	8.2	81	18.9	<5.0	8.1	1.3	19.6	6.8	<0.08	0.1	0.55	<0.03
Orania	8.2	85	20.6	11	8.6	1.4	20	7.2	<0.08	0.13	0.59	<0.03
De Bron	8.2	85	20.2	12	8.8	1.6	20.4	7.5	<0.08	0.1	0.45	<0.03
Marksdrift	8.1	93	23	<5.0	10.4	1.5	21.4	8.9	<0.08	0.08	0.61	<0.03
Prieska	7.9	94	25.3	<5.0	12	1.5	22.2	9	<0.08	0.1	0.56	0
Boegoeberg	8.3	100	30	<5.0	17	1.9	24.8	10.2	<0.08	0.1	0.45	0
Upington	8.1	99	27.7	<5.0	15	1.8	21.9	9.7	<0.08	0.1	0.59	0
Kanoneiland	8.0	101	29.7	<5.0	18	1.8	22	10	<0.08	0.1	0.38	0
Kakamas	8.2	118	35.3	<5.0	22	2.0	25.7	12.1	<0.08	0.1	0.24	0
Onseepkans	8.1	141	41	<5.0	28	1.8	28.9	13.9	<0.08	0.5	0.79	0

Table 3.2: Evaluation of the December 2020 river monitoring results (continued).

RIVER SAMPLING LOCALITIES	Cl^- Free mg/l	F mg/l	COD mg/l	TDS mg/l	PO_4 mg/l	SAR	SO_4 mg/l	Tot N mg/l
TWQ Guideline (1996) Domestic use	100	1	n/a	450	n/a	n/a	200	n/a
SANS 241-1 Drinking water guideline	300	1.5	< 75	1200	0.05-0.1	-	< 250	0-11
Agricultural use	100	0-2	-	< 260	-	0-1.5	1000	< 5
VAAL RIVER LOCALITIES								
Vaal BHD	52	0.6	<13	440	<0.12	1.6	125	<10
Vaal VH	53	0.6	<13	443	<0.12	1.7	121	<10
Harts SPD	139	1.1	<13	820	<0.12	2.7	244	<10
Vaal DW	112	0.7	25	631	<0.12	2.4	161	<10
Vaal Casa	86.5	0.64	24	521	<0.12	2.0	124	<10
ORANGE RIVER LOCALITIES								
Vanderkloof	<4.8	<0.2	<13	123	<0.12	0.4	8.2	<10
Orania	5.5	0.21	14	134	<0.12	0.4	9.8	<10
De Bron	5.6	0.25	<13	131	<0.12	0.4	10.8	<10
Marksdrift	7.2	0.3	18	150	<0.12	0.5	12.6	<10
Prieska	10	<0.2	<13	164	<0.12	0.5	15	<10
Boegoeberg	15	<0.2	<13	195	<0.04	0.7	22	<10
Upington	12	<0.2	<13	180	<0.04	0.7	16	<10
Kanoneiland	15	<0.2	19	193	<0.04	0.8	18	<10
Kakamas	19	<0.2	<13	229	<0.04	0.9	24	<10
Onseepkans	23	0.4	<13	266	<0.04	1.1	28	<10

Table 3.3: Evaluation of the December 2020 river monitoring results (continued).

RIVER SAMPLING LOCALITIES	Al µg/l	As µg/l	Cd µg/l	Hg µg/l	Pb µg/l	Fe (total) µg/l	Mn (total) µg/l	Cr µg/l	Cu µg/l	Zn mg/l
TWQ Guideline (DWS, 1996) Domestic use	150 µg/l	10 µg/l	5 µg/l	1.0 µg/l	10 µg/l	100 µg/l	50 µg/l	50 µg/l	1000 µg/l	0-3 mg/l
SANS 241-1 Drinking water guideline	300 µg/l	10 µg/l	3 µg/l	6 µg/l	10 µg/l	300 µg/l	100 µg/l	50 µg/l	2000 µg/l	<5 mg/l
Agricultural use	5000 µg/l	100 µg/l	10 µg/l	n/a	100 µg/l	5000 µg/l	20 µg/l	1000 µg/l	200 µg/l	<1 mg/l
VAAL RIVER LOCALITIES										
Vaal BHD	109	<7	<1	-	<6	130	<40	<2	<40	<0.17
Vaal VH	130	<7	<1	-	<6	130	<40	<2	<40	<0.17
Harts SPD	234	<7	<1	-	<6	200	<40	<2	220	<0.17
Vaal DW	44.4	<7	<0.79	<2.0	<5.9	110	40	<1.6	<40	<0.17
Vaal Casa	50.8	<7	<0.79	<2.0	<5.9	<60	<40	<1.6	<40	<0.17
ORANGE RIVER LOCALITIES										
Vanderkloof	271	<7	<0.79	<2.0	<5.9	180	<40	<1.6	<40	<0.17
Orania	285	<7	<0.79	<2.0	<5.9	180	<40	<1.6	<40	<0.17
De Bron	209	<7	<0.79	<2.0	<5.9	150	<40	<1.6	<40	<0.17
Marksdrift	515	<7	<0.79	<2.0	<5.9	370	<40	<1.6	<40	<0.17
Prieska	292	<7	<1	<2.0	<6	170	<40	<2	<40	<0.17
Boegoeberg	900	<7	<1	<2.0	<6	550	<40	<2	<40	<0.17
Upington	374	<7	<1	<2.0	<6	280	<40	<2	<40	<0.17
Kanoneiland	278	<7	<1	<2.0	<6	260	<40	<2	<40	<0.17
Kakamas	104	<7	<1	<2.0	<6	70	<40	<2	<40	<0.17
Onseepkans	20	<7	<1	<2.0	<6	<60	<40	<2	<40	<0.17

Table 3.4: Evaluation of the December 2020 river monitoring results (continued).

RIVER SAMPLING LOCALITIES	*E. coli* cfu/100ml	Faecal Coliforms cfu/100ml	Total Coliforms cfu/100ml
TWQ Guideline (1996) Domestic use	0	0 - 150	5
SANS 241-1 Drinking water guideline	0	0	<10
Agricultural use	<1	< 1	n/a
VAAL RIVER LOCALITIES			
Vaal BHD	7	7	>2420
Vaal VH	15	19	>2420
Harts SPD	35	46	>2420
Vaal DW	3	10	>2420
Vaal Casa	10	98	>2420
ORANGE RIVER LOCALITIES			
Vanderkloof	36	55	>2420
Orania	130	189	>2420
De Bron	435	416	>2420
Marksdrift	147	575	>2420
Prieska	96	166	>2420
Boegoeberg	9	19	1414
Upington	62	91	>2420
Kanoneiland	25	59	>2420
Kakamas	*	*	*
Onseepkans	70	88	>2420

**Laboratory error-not analysed.*
***Database average used in report.*

4. GRAPHICAL PRESENTATION OF RESULTS

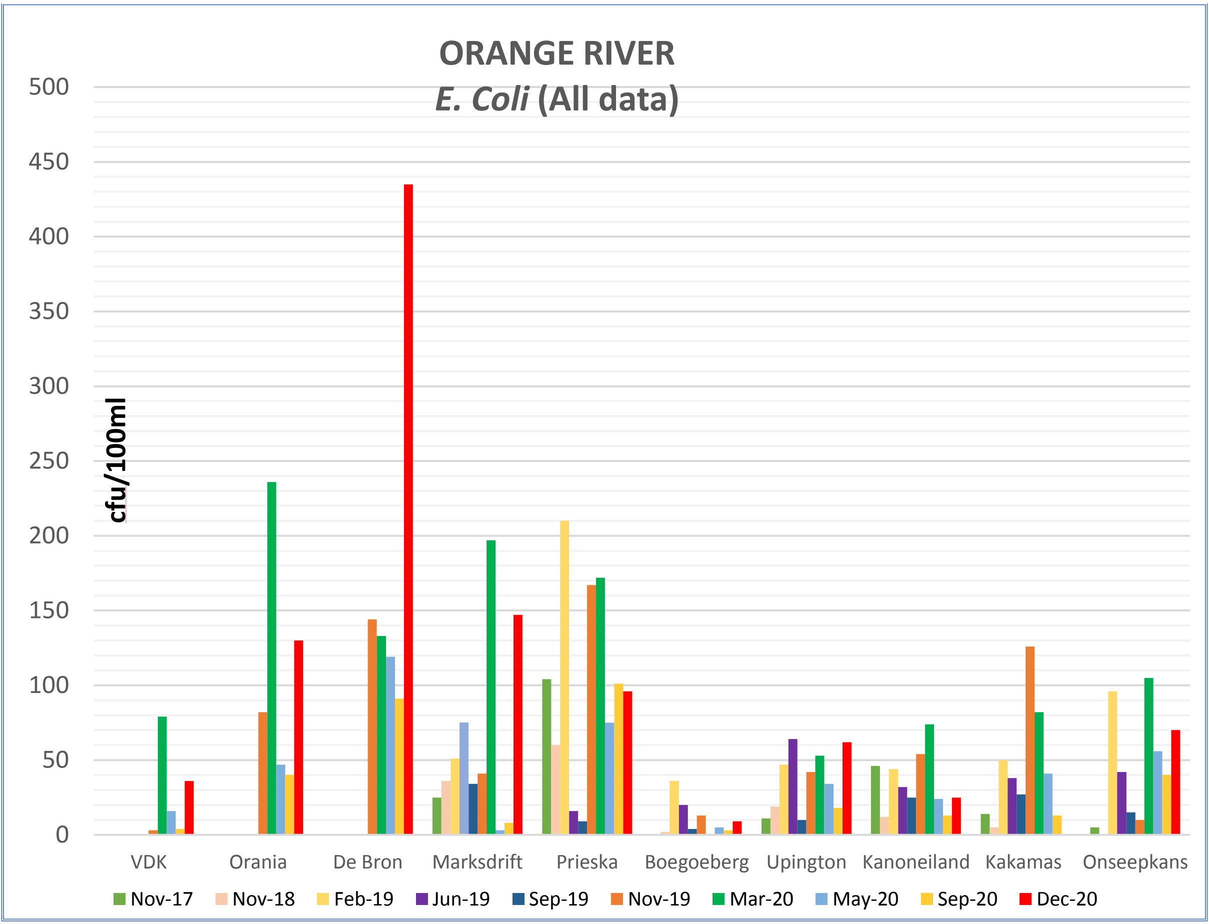

Figure 3: Recorded *E. coli* – all data.

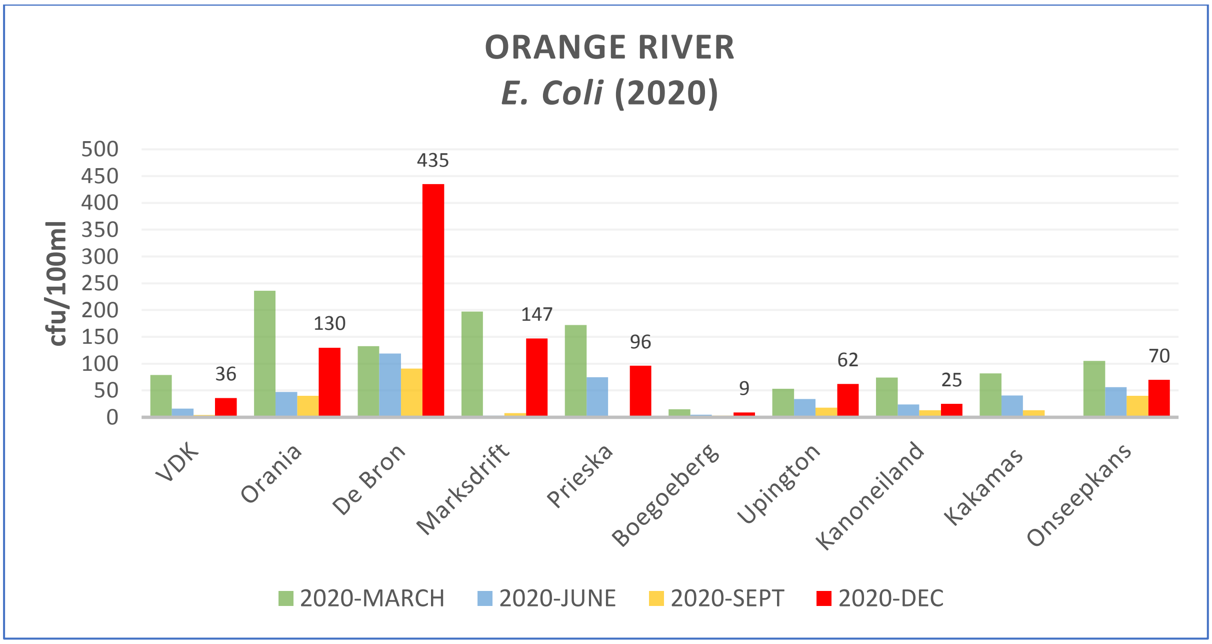

Figure 4: Recorded *E. coli* – 2020 data.

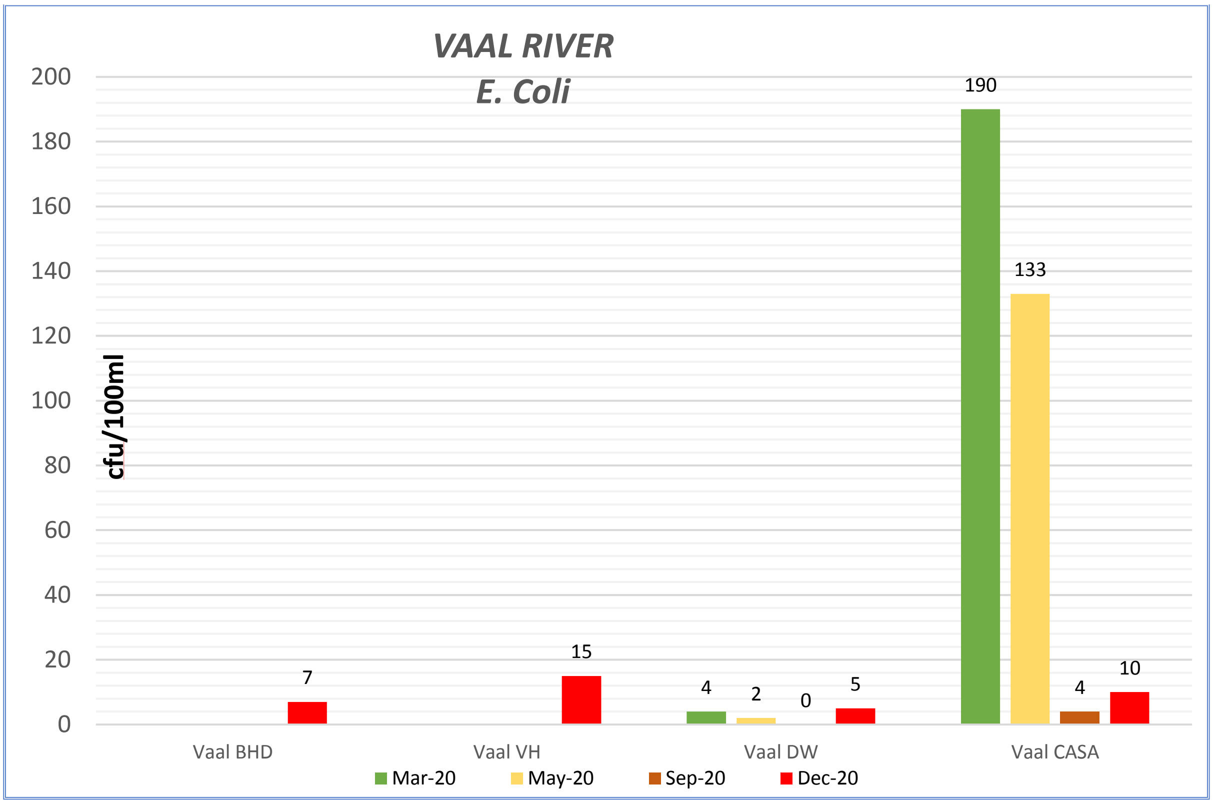

Figure 5: Recorded *E. coli* for the Vaal River localities - 2020 data.

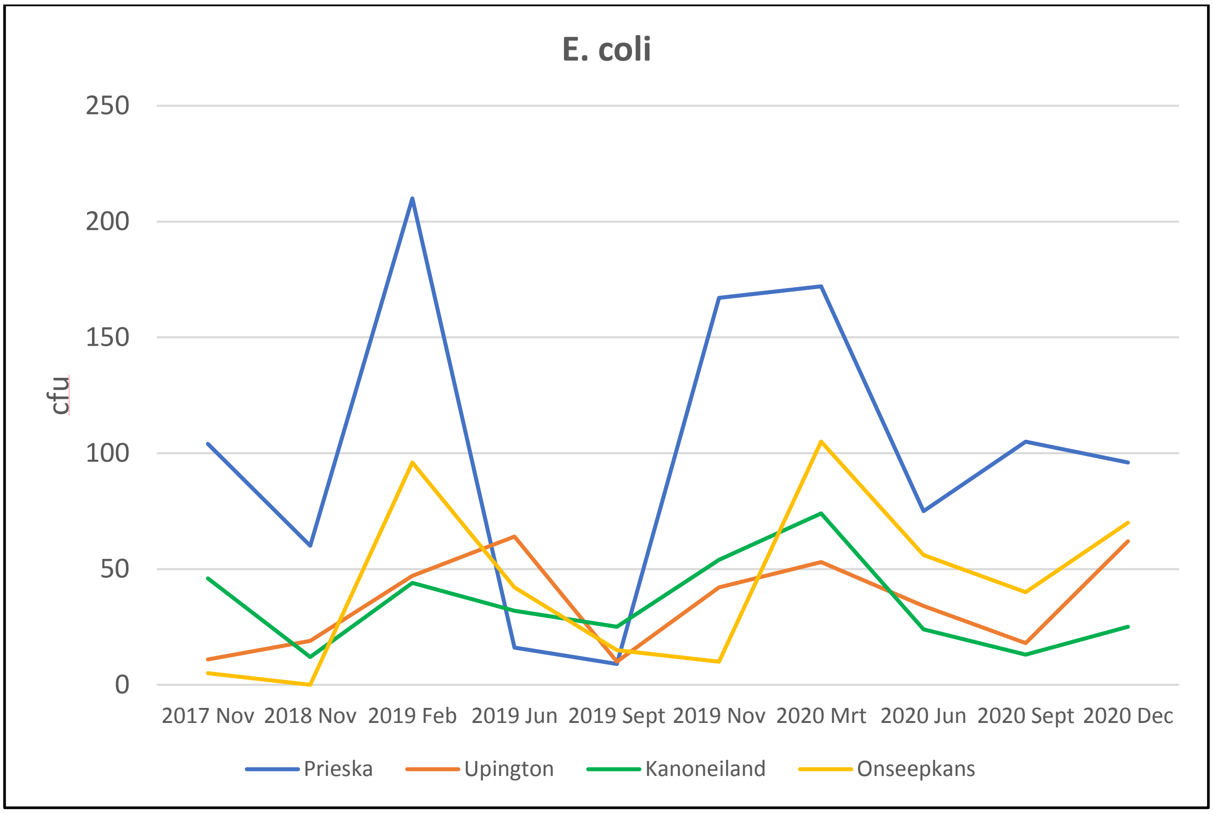

Figure 6: Temporal E. coli recordings at some Orange River localities

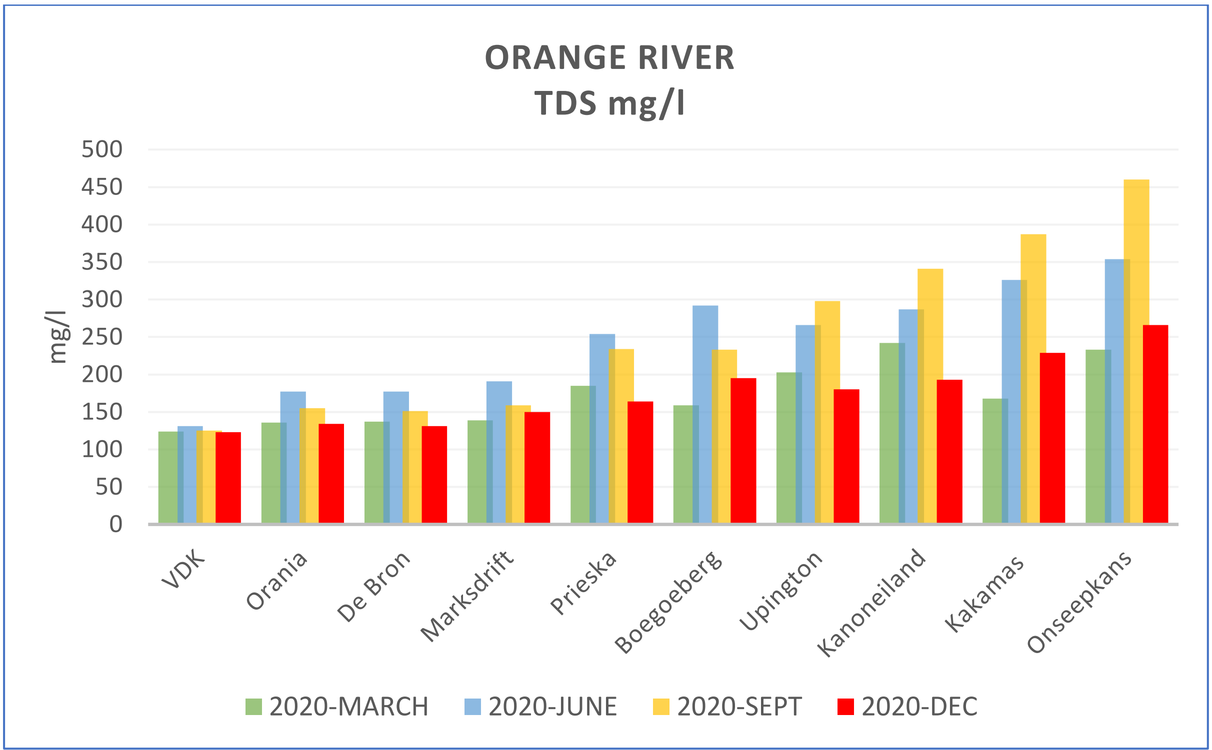

Figure 7: Salinity – 2020 data

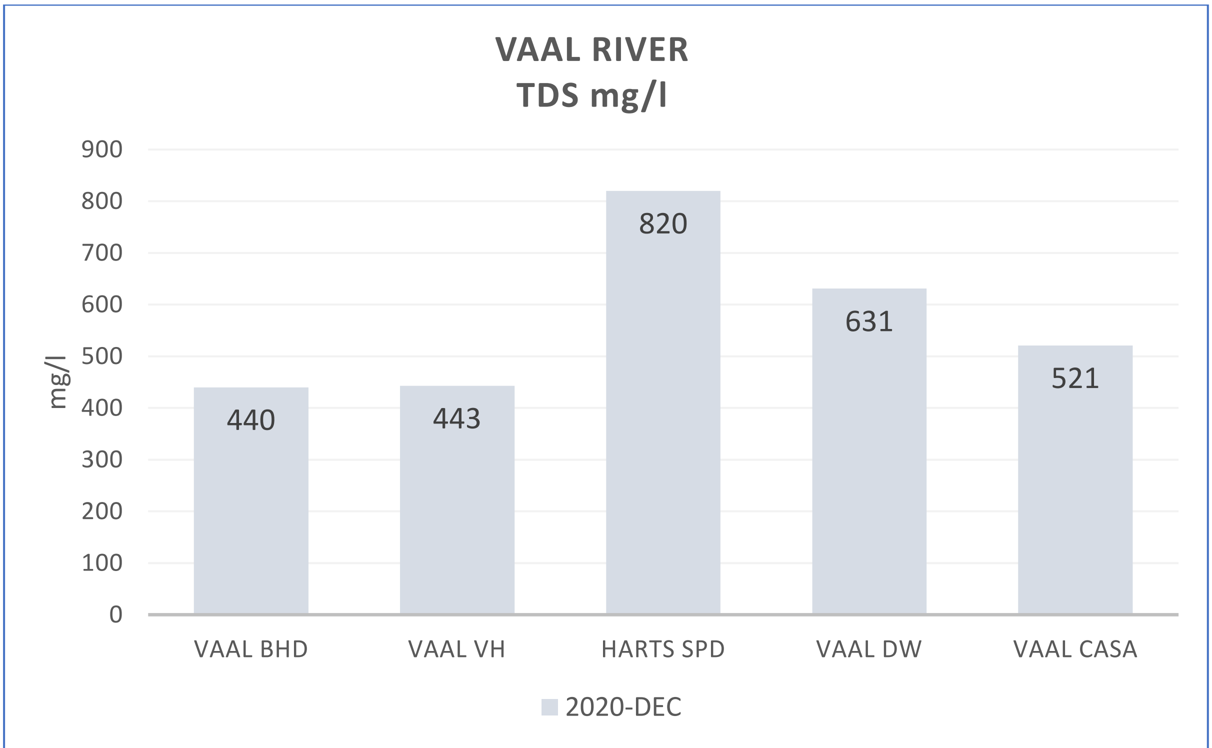

Figure 8: Vaal River catchment TDS recordings

5. DISCUSSION OF THE DECEMBER 2020 SURVEY RESULTS

5.1 Vaalharts Water

Three monitoring localities were included for Vaalharts Water during the December 2020 survey. Two localities are situated in the Vaal River just below Bloemhof Dam (Vaal-BHD) and at the Vaalharts Dam (Vaal-VH). A third locality is in the Harts River just below the Spitskop Dam (Vaal-SPD).

The two Vaal River sites displayed a fairly similar water quality profile with an alkaline pH, raised salinity, high iron and high bacteriological concentrations. A source of sewerage pollution is apparent between the Bloemhof Dam and the Vaalharts Dam with increases of E. coli and faecal coliform counts between these two localities (Table 3.4 and Figure 5). Google images show sewerage pollution emanating from the wastewater treatment works at the town of Christiana in the North West Province, which is the most probable source of contamination.

The irrigation water quality as recorded at Vaal-VH during December 2020 exceeded several guideline values, which include TDS (agricultural use), SAR (agricultural use), iron (domestic use), calcium (domestic use) and bacteriological concentrations (domestic and agricultural use). A 95% yield of moderately sensitive crops such as barley, grape and wheat can still be maintained with the recorded TDS (salinity) of 443 mg/l. A leaching fraction of 0.1 may be required. This is the amount of extra irrigation water that must be applied to maintain an acceptable root zone salinity. Wetting of the foliage of sensitive crops such as apricots, almonds, peaches and citrus should be avoided (DWAF, 1996).

The Harts River water quality is alkaline with a pH of 8.5 and a high salinity of 820 mg/l/TDS. The pH, sodium, calcium, magnesium, chloride, fluoride, TDS, SAR, sulphate, aluminium, iron, copper and bacteriological counts exceed one or more of the water quality guideline values (Tables 3.1 – 3.4). A 90% relative yield of moderately salt-tolerant crops can still be maintained by using a low-frequency application system when irrigating with this saline water. A leaching fraction of 1.5 may be required and wetting of the foliage of sensitive crops should be avoided (DWAF, 1996).

The chloride (139 mg/l) concentration as recorded at Vaal-VH, exceed guideline values for agricultural use. However, at the recorded concentration, only the most sensitive plants may be affected by chloride accumulation when the water is applied on the soil and not on the leaves. The recorded copper concentration of 220 ųg/l at Harts SPD is acceptable when irrigated on fine textured neutral to alkaline soils. The presence of raised sulphate (244 mg/l) may be indicative of mine-related pollution in the Harts River catchment.

pH affects the solubility and bioavailability of plant nutrients as well as soil microbial populations. The alkaline pH of 8.5 may therefore have an indirect adverse effect on crop production. DWAF (1996) states that there may be an increasing unavailability of several micro- and macro nutrients in the long run when irrigation water exceeds a pH of 8.4. Foliar damage and the corrosion/scaling of irrigation equipment may also occur at a raised pH.

Bacteriological counts were slightly higher in the Harts River (Harts-SPD) than in the Vaal River at Vaal-VH. There is a probability of contamination when vegetables and other crops are consumed raw when the irrigation water is contaminated with bacteria. December 2020 recordings of E. coli and faecal coliform counts exceeded the guideline values for drinking water, domestic use and agricultural use. Raised faecal coliforms and E. coli may also be indicative of the presence of other pathogens such as fungi, viruses, bacteria and parasites.

5.2 Vanderkloof Water Users Association

The Vanderkloof WUA is responsible for the quarterly monitoring of localities VDK, Orania and De Bron. These localities were selected to isolate potential impacts from the Vanderkloof township, the Orania settlement and Hopetown. A pollution source survey was performed during November 2020, which revealed significant sources of sewerage pollution, especially from Hopetown (Thembelihle Local Municipality). A separate report will be prepared with the findings of this survey.

Figures 3 and 4 illustrate the E. coli recordings for the entire database period and for 2020 respectively. Database high E. coli values were recorded at De Bron downstream from Hopetown during December 2020. The Orange River section between Orania and Prieska is undoubtedly heavily contaminated with untreated sewerage effluent and the main source is from the Hopetown sewerage works.

Salinity was low at these three localities but naturally raised aluminium and iron concentrations were again recorded.

5.3 Orange-Vaal Water Users Association

The Orange-Vaal Water Users Association is responsible for monitoring localities Vaal-DW, Vaal-Casa and Marksdrift. It is recommended that the Orange-Vaal WUA should consider including one additional sampling locality where the R357 crosses the Riet River. The Riet River enters the Vaal River just up-stream from the Douglas Weir (Vaal-DW) and no information is available for this important tributary.

Apart from bacteriological counts, aluminium and iron, the other water quality variables complied with guideline values as shown in Tables 3.1 – 3.4. The aluminium concentrations ranged between 203 and 285 ųg/l at De Bron and Orania, respectively. The DWAF target guideline range for domestic use is 0 - 150 ųg/l/Al. Adverse aesthetic effects may occur when Al is present in association with Fe, which it is in the lower Orange River. Raised Al and Fe are a natural occurrence in the Orange River and water treatment should reduce the risk of adverse effects.

A noteworthy reduction in E. coli value was recorded at Vaal Casa during December 2020. Counts decreased from 190 counts in March 2020 and 133 counts in May 2020 to 10 cfu in December 2020, as shown in Figure 3. A specific point source of sewerage pollution between Vaal DW and Vaal Casa was not noted during the November 2020 pollution source survey. Signs of previous discharges from sewerage pump stations next to the river were evident. This problem seems to have been resolved.

Apart from bacteriological determinants, the variables that exceed target water quality guidelines at Vaal DW or Vaal Casa are chloride, TDS (salinity), SAR, iron, manganese, pH, calcium and magnesium. These exceedances may, without treatment, marginally influence the water's suitability for agricultural use (pH, salinity) and domestic use (aesthetic acceptability).

Water quality at Marksdrift is important as this water comprises much of the irrigation and potable water that is used in the Douglas area. An E. coli count of 147 cfu was recorded during December 2020 as shown in Figures 3 and 4. A significant source of bacteriological contamination was found upstream from Marksdrift at Hopetown during the November 2020 pollution source survey. This is the most significant point source of contamination in the lower Orange River catchment and should be resolved as soon as possible.

5.4 Prieska

Prieska is the first downstream monitoring locality after the Orange- and Vaal River confluence. Figures 3 and 4 show that the Prieska sampling locality mirrors the raised bacteriological counts from the upstream Hopetown area.

The Prieska WWTW was found to intermittently discharge semi-treated effluent into the Orange River but no flow was noted during November 2020. After investigating all point sources, it is safe to assert that the untreated sewerage discharges from the Hopetown municipality is responsible for the contamination of the Douglas, Prieska, Boegoeberg and Upington bulk water supplies.

Apart from the bacteriological indicators, Al and Fe, the other variables at Prieska were compliant with water quality guidelines during December 2020.

5.5 Boegoeberg Water Users Association

There is a long and fairly uninhabited stretch of river between Prieska and Boegoeberg. Natural treatment processes in the river reduces the bacteriological concentrations significantly as observed in Figures 3 and 4.

A temporal improvement in E. coli counts was noted at Boegoeberg before the December 2020 survey. This was made undone by a slight increase in E. coli, which can probably be attributed to the upstream sewerage discharge at Hopetown.

Chemical water quality at Boegoeberg, as sampled at the Zeekoebaard locality, was good during December 2020 apart from the naturally raised Al and Fe. The aluminium concentration of 900 ųg/l is a database-high recording that exceed the SANS drinking water guideline. There is some evidence that Al may be neurotoxic at high concentrations, but this will only be an issue if turbid untreated water is consumed.

5.6 Upington Water Users Association

Salinity was lower at the Upington locality during the December 2020 survey (180 mg/l TDS as compared to 298 mg/l TDS during September 2020). The other variables apart from bacteria counts, aluminium and iron were below threshold values as shown in Tables 3.1 to 3.4. The correlation between salinity, river flow rate and seasonal irrigation activities should be investigated when sufficient data is available.

There has been a marked decline in E. coli counts at most lower Orange River localities during the first three surveys of 2020 as shown in Figure 4. Figure 3 also show a temporal decline in E. coli counts at Orania, De Bron and Boegoeberg since the inception of this monitoring programme. This trend was reversed during December 2020 with raised E. coli throughout the lower Orange River including Upington where a high E. coli count of 62 cfu was recorded.

An intermittent discharge of untreated sewerage effluent from the Dawid Kruiper local municipality has been identified up-stream from the Upington road bridge monitoring locality behind the Kalahari Mall. The December 2020 increase in E. coli counts may be attributed to construction activities on the sewerage pipeline close to the Kameelmond WWTW.

It is important to note that Figure 5 shows that the source of bacteria was not from the Vaal River. The November 2020 pollution source survey revealed discharges of untreated sewerage from several local municipalities, which is undoubtedly the major source of contamination when the Vaal River is not in flood.

A raised mercury concentration of 2.0 ɥg/l Hg was recorded in September 2020. The December 2020 recording was < 2.0 ɥg/l Hg. All other up-stream and down-stream mercury recordings were also below the laboratory's detection limit during December.

5.7 Kanoneiland Water Users Association
The Kanoneiland monitoring locality is situated approximately 22.5 km down-stream from the Kameelmond wastewater treatment works. Fewer fluctuations in E. coli counts are noted at this locality when compared with other sites (Figure 3). The reason for this observation may be the continuous up-stream discharge of semi-treated sewerage water from the Kameelmond WWTW. An average E. coli count of 35 cfu was recorded at Kanoneiland since monitoring commenced in 2017.

During December 2020, salinity at the Kanoneiland locality improved to 193 mg/l as compared to a TDS of 341 mg/l during September 2020.

A raised mercury concentration of 3.0 ɥg/l Hg was recorded in September 2020, but this value decreased to below the detection limit in December 2020. Aluminium and iron concentrations were again raised as usually experienced at many Orange River localities. The lead concentration was below the detection limit of <6 ɥg/l Pb during December 2020. Intermittently raised lead and mercury concentrations at Kanoneiland is undoubtedly associated with the Kameelmond WWTW. A high recording of 9 ɥg/l Pb was made in September 2020.

5.8 Kakamas Water Users Association
The Kanoneiland water was less saline at 229 mg/l TDS as compared with 387 mg/l TDS during September 2020. The sodium adsorption rate (SAR) was 0.9, which is below the target water quality range of 1.5.

No December 2020 bacteriological data was received from the laboratory. It is a recurring problem that Pathcare Upington omits to analyse one or more samples, as instructed.

The raised mercury concentration of 3.0 ɥg/l Hg as recorded in September 2020 was not replicated in December 2020 with a recording below the detection limit of < 2 ɥg/l Hg.

Aluminium and iron concentrations were below threshold values during December 2020.

5.9 Onseepkans
Salinity improved at Onseepkans with a TDS of 266 mg/l recorded in December 2020 as compared with 460 mg/l TDS in September 2020. The drivers of salinity at this locality are Vaal River flow, evaporation and irrigation return flows. A detailed statistical analysis of all related data will be required to formulate a salt management plan for the lower Orange River.

The E. coli count increased to 70 cfu as compared with 40 cfu during September 2020. This increase was noted throughout the lower Orange River as shown in Figures 3 and 4.

Previous site visits showed that the bacteriological contamination at Onseepkans is often associated with local discharges of affected water from several diffuse sources. These diffuse sources include overflows from septic tanks and settlements close to the river. The trend of lower aluminium and iron concentrations further downstream in the Orange River system continued and may be associated with the settlement of naturally occurring fine particles from the water into the river sediments.

The mercury recording was below the detection limit of < 2 ɥg/l Hg.

6. REFERENCES

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