

water & sanitation

Department: Water and Sanitation REPUBLIC OF SOUTH AFRICA



## Reserve determination study for selected Surface Water, Groundwater, Estuaries and Wetlands in the F60 and G30 Catchment within the Berg-Olifants Water Management Area

### PSC Meeting on MS Teams 23 November 2022



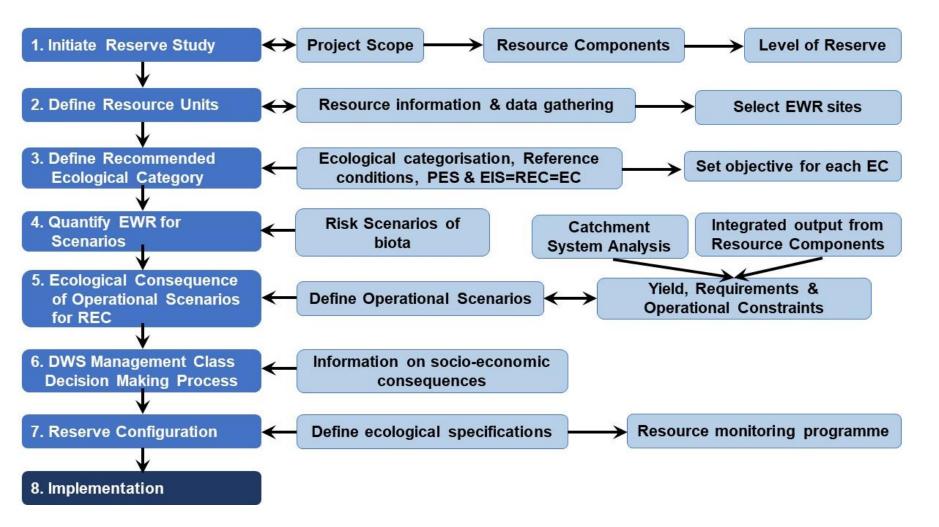
# **Project Progress**

- Finalised Surface and Groundwater Delineation Reports
- Drafted EcoClassification Report
- Cross-section surveys
- Hydraulic modelling
- Hydrological modelling
- Wet season survey in September
- Draft EWR Report





#### The Reserve Determination Process









- Rainfall data ending Sep 2021 sourced from SAWS for selected stations
- Will be used in the rainfall runoff modelling to extend the WR2012 hydrology to 2020/2021

#### Rainfall Data – WR2012 F60

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Name	*	F60	<b>.</b> , <b>T</b>	Updated in current study	S	Start 🔄	End 💌	MAP
SCHUINSKRAAL		F6A		Closed		1920	1952	172.9
<b>SWARTBOOISVLEI</b>		F6A		Closed		1952	1974	155.7
NUWERUS - POL		F6A		Extended 2010-2020		1925	2020	155.
RIETPOORT		F6A		Closed		1951	2010	134.3
KOEKENAAP - IRR		F6A		Extended 2010-2020		1920	2020	130.
	SCHUINSKRAAL SWARTBOOISVLEI NUWERUS - POL RIETPOORT	SCHUINSKRAAL SWARTBOOISVLEI NUWERUS - POL RIETPOORT	SCHUINSKRAAL F6A SWARTBOOISVLEI F6A NUWERUS - POL F6A RIETPOORT F6A	SCHUINSKRAAL F6A SWARTBOOISVLEI F6A NUWERUS - POL F6A RIETPOORT F6A	Name     F60     Vpdated in current study       SCHUINSKRAAL     F6A     Closed       SWARTBOOISVLEI     F6A     Closed       NUWERUS - POL     F6A     Extended 2010-2020       RIETPOORT     F6A     Closed	Name     F60     Y     Updated in current study         SCHUINSKRAAL     F6A     Closed       SWARTBOOISVLEI     F6A     Closed       NUWERUS - POL     F6A     Extended 2010-2020       RIETPOORT     F6A     Closed	SCHUINSKRAAL         F6A         Closed         1920           SWARTBOOISVLEI         F6A         Closed         1952           NUWERUS - POL         F6A         Extended 2010-2020         1925           RIETPOORT         F6A         Closed         1951	Name         F60         Ø         Updated in current study         Start         End         End           SCHUINSKRAAL         F6A         Closed         1920         1952           SWARTBOOISVLEI         F6A         Closed         1920         1952           NUWERUS - POL         F6A         Extended 2010-2020         1925         2020           RIETPOORT         F6A         Closed         1951         2010







### Rainfall Data - WR2012 G30 (dry)

Number -	Name	- GBOAEF T	Updated in current study	Start		End	- N	AP	*
0084558 W	ELANDSFONTEIN	G3B	Extended 2010-2020	1	900	20	20	499	9.5
0061766 W	DROMMELVLEI	G3B	Extension data 2009-2010, retain WR2012 MP file, consider patching 2010 values	1	900	20	09	314	4.2
0084059 W	<b>REDELINGHUYS - POL</b>	G3B	Not extended - closed?	1	900	20	07	270	D.1
0084701 W	CLANWILLIAM - POL	G3B	Not updated - closed. 0084671 close by but data no good. Use E1E004	1	920	20	01	210	0.1
0106880AW	VREDENDAL	G3B	Extended 2010-2020	1	958	20	20	149	9.5
0083515 W	LAMBERTSBAAI - POL	G3B	Extended 2010-2020	1	900	20	20	13	7.5



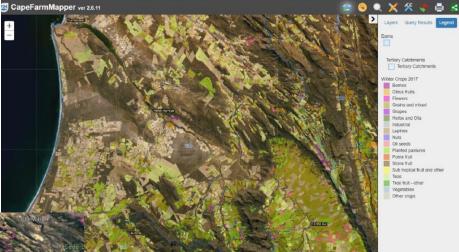
### Rainfall Data –WR2012 G30 (wet)

Number 💌	Name	- G30BCE -T	Updated in current study	-	Start	*	End		MAP	-
0084558 W	ELANDSFONTEIN	G3A	Extended 2010-2020		19	00		2020	49	99.5
0062444 W	PIKETBERG - POL	G3A	Extended 2010-2020		19	00		2020	4	58.6
0062671 W	EENDEKUIL - POL	G3A	Extended 2010-2020		19	00		2020	3(	02.7
0062768 W	MIDDELDEURVLEI	G3A	Extended 2010-2020		19	00		2020	29	99.1
0084059 W	REDELINGHUYS - POL	G3A	Not extended - closed?		19	00		2007	27	70.1





#### Land use data



### Land use data

Registered dams (DWS, 2019)

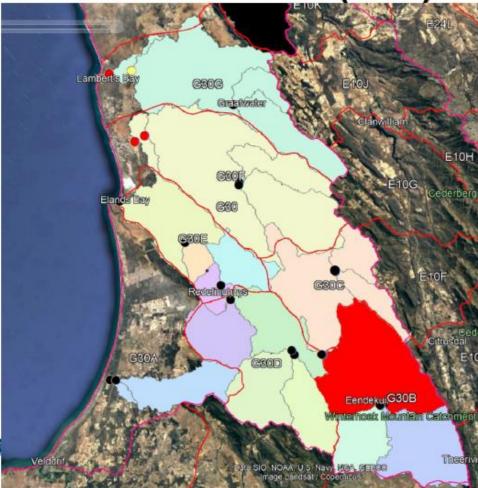
Fands Ba
PIETERSFONTEIN BALANCING DAM
MIDDERKRUISFONHEIN BOWENSTELANDS
MIEDIEDRAALDAM
HAMERKOP DAM MIDDELPOS DAM
VREDE DAM AASENDSFOF DAM NAMAQUASFONTEIN SKOOL DAN ROOIKLIP DAM BERDEKUIL D
NAMAQUASHON IEIN SKOOL DAM

Quaternary catchment	Combined capacity (million m3)	Combined surface area (km2)	Number of registered dams (DWS, 2019)
G30A	-	-	x <del>7</del> :
G30B	5.11	1.05	22
G30C	0.44	0.10	2
G30D	1.41	0.26	9
G30E	0.06	0.02	2
G30F	-	-	-
G30G	-		-
G30H	-	-	-
Total G30 (km2)	7.03	1.43	35

Quaternary catchment	Irrigated crop areas (km2)
G30A	10.3
G30B	9.3
G30C	15.0
G30D	18.3
G30E	5.6
G30F	26.0
G30G	7.8
G30H	3.3
Total G30 (km2)	95.7



## Catchment delineation (G30)



### **Catchment delineation (F60)**





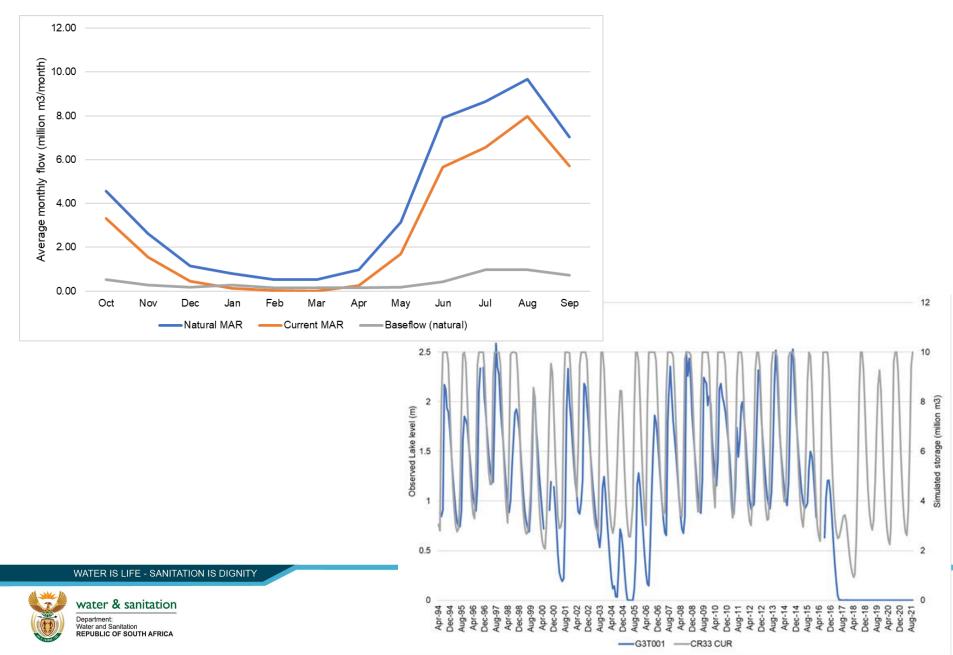
#### WATER IS LIFE - SANITA

water & sanitation Dependent Water and Sanitation Section of South Approx

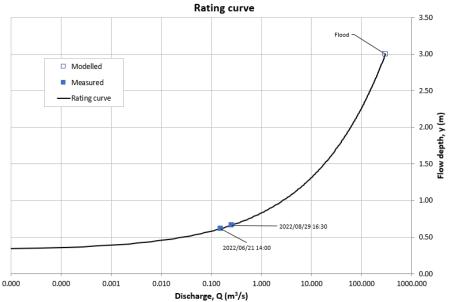
EWR Site	Description	Quaternary Catchment	Natural MAR (million m3/a)		Present Day as % Natural MAR
EWR1	Brak River	F60A	0.07	0.07	100
EWR2	Depression wetland	F60A		-	
EWR3	Groot Goerap River	F60B	0.11	0.11	100
EWR4	Sandlaagte River	G30H	1.36	1.36	100
EWR5	Jakkals River	G30G	1.63	1.60	98
EWR6	Langvlei River	G30F	6.53	6.31	97
EWR7	Wadrif Wetland	G30F	6.64	5.37	81
EWR8	Kruismans River	G30D	23.72	16.35	69
EWR9	Krom Antonies River	G30D	6.81	4.47	66
EWR10b	Verlorenvlei River	G30E	41.66	28.15	68
EWR11	Duneslack wetland	G30A		T	
EWR12	Rosherpan	G30A			
EWR13	Papkuils River	G30A	1.04	1.04	100
EWR14	Papkuilsvlei wetland	G30A			

### Flows into Verlorenvlei (million m3/month)

Hydroyear	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Average	2.386	0.750	0.043	0.000	0.000	0.000	0.187	1.494	5.221	5.853	7.326	4.885	28.145
Max	9.38	4.3	0.87	0	0	0	5.7	23.72	59.04	70.92	41.91	23.77	132.58
95%	5.68	2.78	0.28	0	0	0	0.22	9.02	24.68	24.14	29.03	13.73	90.29
75%	2.99	0.86	0	0	0	0	0	0.3	3.77	7.17	7.53	5.41	39.19
50%	1.96	0.44	0	0	0	0	0	0	1.27	2.52	3.96	3.7	15.9
25%	1.19	0.14	0	0	0	0	0	0	0.17	0.84	1.79	2.17	8.41
5%	0.32	0	0	0	0	0	0	0	0	0.07	0.73	0.88	3.88
Min	0	0	0	0	0	0	0	0	0	0	0	0	1.59

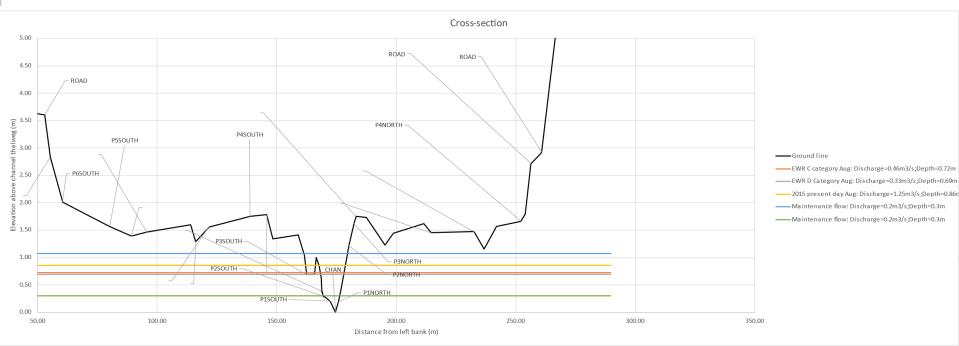


### **Cross-Section Surveys & Hydraulic Modelling**



					Month	ly average	flows in m	3/s					
Flows (m3/s)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Annual
Average	0.570	0.234	0.041	0.003	0.001	0.002	0.053	0.353	1.152	1.169	1.506	1.104	0.51
Max	2.098	1.157	0.332	0.052	0.049	0.090	1.335	4.798	13.029	13.534	8.341	5.228	2.24
0.95	1.352	0.718	0.131	0.030	0.000	0.000	0.166	2.035	5.027	4.861	6.683	2.909	1.59
0.75	0.698	0.255	0.045	0.000	0.000	0.000	0.004	0.146	0.910	1.475	1.546	1.289	0.67
0.5	0.463	0.174	0.026	0.000	0.000	0.000	0.000	0.049	0.320	0.515	0.889	0.833	0.32
0.25	0.273	0.112	0.011	0.000	0.000	0.000	0.000	0.004	0.127	0.239	0.399	0.471	0.19
0.05	0.138	0.035	0.000	0.000	0.000	0.000	0.000	0.000	0.019	0.101	0.209	0.228	0.09
Min	0.056	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.041	0.066	0.07
					Mon	thly averag	ge depth (m	1)					
Depth (m)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
0.750	0.650	0.520	0.420	0.380	0.400	0.530	0.690	0.850	0.850	0.890	0.840	0.740
0.950	0.850	0.690	0.530	0.530	0.570	0.870	1.120	1.390	1.400	1.260	1.140	0.960
0.870	0.780	0.600	0.500	Pool/Dry	Pool/Dry	0.620	0.940	1.130	1.120	1.200	1.010	0.900
0.780	0.660	0.520	Pool/Dry	Pool/Dry	Pool/Dry	0.420	0.610	0.810	0.890	0.890	0.860	0.770
0.720	0.620	0.490	Pool/Dry	Pool/Dry	Pool/Dry	Pool/Dry	0.530	0.680	0.740	0.810	0.800	0.680
0.670	0.590	0.460	Pool/Dry	Pool/Dry	Pool/Dry	Pool/Dry	0.420	0.600	0.650	0.710	0.730	0.630
0.600	0.510	Pool/Dry	Pool/Dry	Pool/Dry	Pool/Dry	Pool/Dry	Pool/Dry	0.480	0.580	0.640	0.650	0.580
0.540	0.470	Pool/Dry	Pool/Dry	Pool/Dry	Pool/Dry	Pool/Dry	Pool/Dry	Pool/Dry	0.440	0.520	0.550	0.550
	0.750 0.950 0.870 0.780 0.720 0.670 0.600	0.750         0.650           0.950         0.850           0.870         0.780           0.780         0.660           0.720         0.620           0.670         0.590           0.600         0.510	0.750         0.650         0.520           0.950         0.850         0.690           0.870         0.780         0.600           0.780         0.660         0.520           0.720         0.620         0.490           0.670         0.590         0.460           0.600         0.510         Pool/Dry	0.750         0.650         0.520         0.420           0.950         0.850         0.690         0.530           0.870         0.780         0.600         0.500           0.780         0.600         0.520         Pool/Dry           0.720         0.620         0.490         Pool/Dry           0.670         0.590         0.460         Pool/Dry           0.600         0.510         Pool/Dry         Pool/Dry	0.750         0.650         0.520         0.420         0.380           0.950         0.850         0.690         0.530         0.530           0.870         0.780         0.600         0.500         Pool/Dry           0.780         0.660         0.520         Pool/Dry         Pool/Dry           0.720         0.620         0.490         Pool/Dry         Pool/Dry           0.600         0.510         Pool/Dry         Pool/Dry         Pool/Dry           0.600         0.510         Pool/Dry         Pool/Dry         Pool/Dry	0.750         0.650         0.520         0.420         0.380         0.400           0.950         0.850         0.690         0.530         0.530         0.570           0.870         0.780         0.600         0.500         Pool/Dry         Pool/Dry           0.780         0.660         0.520         Pool/Dry         Pool/Dry         Pool/Dry           0.780         0.660         0.520         Pool/Dry         Pool/Dry         Pool/Dry           0.720         0.620         0.490         Pool/Dry         Pool/Dry         Pool/Dry           0.700         0.590         0.460         Pool/Dry         Pool/Dry         Pool/Dry           0.600         0.510         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry	0.750         0.650         0.520         0.420         0.380         0.400         0.530           0.950         0.850         0.690         0.530         0.530         0.570         0.870           0.870         0.880         0.600         0.500         Pool/Dry         Pool/Dry         0.620           0.780         0.660         0.520         Pool/Dry         Pool/Dry         Pool/Dry         0.420           0.720         0.620         0.490         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry           0.600         0.510         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry           0.600         0.510         Pool/Dry         <	0.750         0.650         0.520         0.420         0.380         0.400         0.530         0.690           0.950         0.850         0.690         0.530         0.530         0.570         0.870         1.120           0.870         0.780         0.600         0.500         Pool/Dry         Pool/Dry         0.620         0.940           0.780         0.660         0.520         Pool/Dry         Pool/Dry         0.420         0.610           0.720         0.620         0.490         Pool/Dry         Pool/Dry         Pool/Dry         0.420         0.610           0.720         0.620         0.490         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         0.530         0.530           0.700         0.590         0.460         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         0.420         0.420           0.600         0.510         Pool/Dry         Pool/Dry	0.750         0.650         0.520         0.420         0.380         0.400         0.530         0.690         0.850           0.950         0.850         0.690         0.530         0.530         0.570         0.870         1.120         1.390           0.870         0.780         0.660         0.500         Pool/Dry         Pool/Dry         0.620         0.940         1.130           0.780         0.660         0.520         Pool/Dry         Pool/Dry         Pool/Dry         0.620         0.940         1.130           0.720         0.620         0.490         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         0.530         0.680           0.720         0.620         0.490         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         0.530         0.680           0.670         0.590         0.460         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         0.420         0.600           0.600         0.510         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         0.480	0.750         0.650         0.520         0.420         0.380         0.400         0.530         0.690         0.850         0.850           0.950         0.850         0.690         0.530         0.530         0.570         0.870         1.120         1.390         1.400           0.870         0.780         0.660         0.520         Pool/Dry         Pool/Dry         0.620         0.940         1.130         1.120           0.780         0.660         0.520         Pool/Dry         Pool/Dry         Pool/Dry         0.420         0.610         0.880         0.740           0.720         0.620         0.490         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         0.530         0.680         0.740           0.750         0.590         0.460         Pool/Dry         Pool/Dry         Pool/Dry         0.420         0.600         0.650           0.600         0.510         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         0.420         0.600         0.650           0.600         0.510         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         0.400         0.580           0.600         0.510	0.750         0.650         0.520         0.420         0.380         0.400         0.530         0.690         0.850         0.880         0.890           0.950         0.850         0.690         0.530         0.570         0.870         1.120         1.390         1.400         1.260           0.870         0.780         0.660         0.500         Pool/Dry         Pool/Dry         0.620         0.940         1.130         1.120         1.200           0.780         0.660         0.520         Pool/Dry         Pool/Dry         Pool/Dry         0.620         0.940         1.130         1.120         1.200           0.780         0.660         0.520         Pool/Dry         Pool/Dry         Pool/Dry         0.610         0.810         0.890         0.890           0.720         0.620         0.490         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         0.530         0.680         0.740         0.890           0.720         0.620         0.490         Pool/Dry         Pool/Dry         Pool/Dry         Pool/Dry         0.530         0.680         0.740         0.810           0.670         0.590         0.460         Pool/Dry         Pool/Dry	0.750         0.650         0.520         0.420         0.380         0.400         0.530         0.690         0.850         0.850         0.890         0.840           0.950         0.850         0.690         0.530         0.530         0.570         0.870         1.120         1.390         1.400         1.260         1.140           0.870         0.780         0.660         0.520         Pool/Dry         Pool/Dry         0.620         0.940         1.130         1.120         1.200         1.010           0.780         0.660         0.520         Pool/Dry         Pool/Dry         0.420         0.610         0.810         0.890         0.880           0.720         0.620         0.490         Pool/Dry         Pool/Dry         Pool/Dry         0.530         0.580         0.740         0.810         0.890         0.860           0.720         0.620         0.490         Pool/Dry         Pool/Dry         Pool/Dry         0.530         0.680         0.740         0.810         0.800           0.670         0.590         0.460         Pool/Dry         Pool/Dry         Pool/Dry         0.420         0.600         0.650         0.710         0.730           0.600





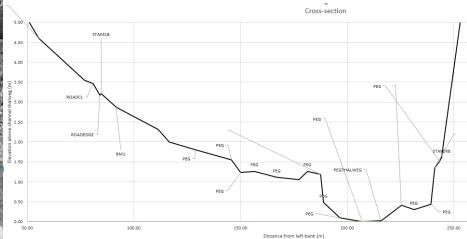
- 5-9 September 2022
- Surveys at selected EWR sites
- Hybrid river wetland
   assessments for 6 sites
- Wetland assessments at 3 additional sites

















# Wet Season Survey Report Verlorenvlei EWR transect @ Wittedrif: soil wetness data

Plotnumber	<b>Plot length</b>	Standing w	ater depth	Depth to v	vater table	Depth to	saturated	Notes
Plot number	(m)	Apr 2022	Sep 2022	Apr 2022	Sep 2022	Apr 2022	Sep 2022	Notes
P5-N	0.9	0	0	n/a	n/a	n/a	n/a	Rock layer at 5cm; non-wetland plot
P4-N	4.4	0	0	>35	>45	>35	25	Rock layer at 35-45cm depth
P3-N	7.8	0	60	>120	n/a	100	n/a	Dense clay from 120cm depth
P2-N	15.4	0	45	>120	n/a	>120	n/a	
P1-N	9.1	0	90	120	n/a	80	n/a	
PO	10.2	0	75	>120	n/a	100	n/a	
P1-S	7.9	0	60	>100	n/a	>100	n/a	Dense clay from 80 to >100cm depth
P2-S	7.5	0	0	>100	70	>100	50	Clay from surface to >120cm depth
P3-S	14.3	0	0	>100	45	>100	0	Clay from surface to >100cm depth
P4-S	10.4	0	0	>100	>120	>100	>120	Clay from ~35cm to >110cm depth
P5-S	6.5	0	0	>100	>85	>100	0	Clay from surface to >85cm depth; unsaturated from 75cm down in Sep 2022 (when top layer was saturated to the surface)
P6-S	4.4	0	0	>100	>100	>100	>100	Clay from ~80cm de pth
P7-S	17.1	0	0	>100	>100	>100	>100	Clay from ~90cm de pth
P8-S	44.1	0	0	>100	>100	>100	>100	





Alphabetic Floristic data for VERLORENVLE	- W						mouun	43		_	_	_			
Sample no. [VW=Verlorenvlei Wittedrif]	VWN5	VWN4	VWN3	VWN2	VWN1	0///0	VWS1	VWS2	VWS3	VWS4	2 SWV	9SWV	7 SWV	NWS8	No.ofsample plots=
Date of initial dry season 8 April with follow-up "wet" Spring season on 8 September 2022.	2022-04-08	2022-04-08	2022-04-08	2022-04-08	2022-04-08	2022-04-08	2022-04-08	2022-04-08	2022-04-08	2022-04-08	2022-04-08	2022-04-08	2022-04-08	2022-04-08	14
Grid ref plot start peg from Low point to Outer edge (South)	32°27'29.87"S	32°27'29.95"S	32°27'30.01"S	32°27'30.16"S	32°27'30.23"S	32°27'30.29"S	32°27'30.35"S	32°27'30.42"S	32°27'30.53"S	32°27'30.69"S	32°27'30.79"S	32°27'30.86"S	32°27'30.88"S	32°27'31.05"S	
Grid refplotstartpeg from Lowrpointto Outeredge (East)	18°31'4.98"E	18°31'4.79'E	18°31'4.48"E	18°31'3.94"E	18°31'3.54"E	18°31'3.37"E	18°31'3.15'E	18°31'2.90°E	18°31'2.59"E	18°31'2.13"E	18°31'1.70'E	18°31'1.48"E	18°31'1.33"E	18°31'0.75°E	
Plot length	0.93	4.37	77.77	15.35	9.1	10.2	7.88	7.45	14.3	10.35	6.5	4.35	17.05	44.1	
Moisture status (I=inundated, free water;W=wet,M=moist, D=Dry,S=seasonal condition)	SD	SM	SW	SM	SW	SI	SW	SW	SM	SD	SM	SM	SD	D	
Habitat	Slope step. Path. Grazed.	Steep cut bank. Grazed.	Side channel. Graz ed. Trampled. Cobbles.	Channel with Artificially raised area	ed often flooded. Heavy græzing.	ed often flooded. Heavy grazing.	ed often flooded. Heavy grazing.	Channel side. Dry clay.	F lattish regular ov erflow step	Raised area. Added bed materials.	Slight dip at higher ooverflow level.	Channel side	Upper flood flats. Cattle	Back floodplain. Cattle	No. of species
		te la	S.	ð	ē	e e e e e e e e e e e e e e e e e e e	l m	0	LL.	õ					in area =
No. of species in sample plot	9	7 Ste	ю. G	ڻ ء	а В В	2 Be	4 Be	2 C	1 1	5 R	5	9	8	6	in area = 28
Taxon (* = Listed in RDB)		2	ഗ einsa	- vo	е г	© ⊲ s = chai	m ⊸ nged va	~	5	5			~	6	28 No.of occurrences perspecies
Taxon (* = Listed in RDB) Aponogeton distachyos L.f.		2	9	- vo	е г	2 <sup>B</sup>	4 B	~	5	5			~	ை absent)	28 No. of occurrences per species 3
Taxon (* = Listed in RDB) Aponogeton distachyos L.f. Arctotheca calendula (L.) Lew ns		2	ഗ einsa	- vo	е г	© ⊲ s = chai	m ⊸ nged va	~	5	5			∞ ;0=a	ा absent) (<1)	28 No. of occurrences per species 3 1
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Taxon (* = Listed in RDB) Aponogeton distachyos L.f. Arctotheca calendula (L.) Lewns Atripiex nurmularia Lindi. Atripiex semibaccata R.Br. Bolboscherum maritimus (L.) Palla	% 000	⊳ curren c	د in sai	un mple (b	е г	© ⊲ s = chai	∞ → nged va (50)	⊳ lues n	₽ ecorde	ي d on 8	Septe 65(<1) 20	mber	∞ ; 0 = a (<1)	ा absent) (<1)	28 No. of occurrences per species 3 1 2 8 8 8
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Taxon (* = Listed in RDB) Aponogeton distachyos L.f. Arctotheca calendula (. ), Lew ns Miripex nummularia Lindi. Miripex semibaccata R.Br. Bolboschoerus martimus (L.) Palla Dotula coronopifola L. Dotula turbinata (L.) Pers. Zynodon dactylon (L.) Pers. Dyperus textilis Thunb. Zivoasinthemum floribundum (Haw.) Schwantes Exomis microphylia (Thunb.) A ellen var. axyrioides (Fenzl).	% occ	1 20(60)	د in san	40 mple (b 30 1	m racket	© ⊲ s = chai	∞ ••• •• (50) 15(75)	15(5) 15(35)	€ ecorde 25(1) 15(30)	d on 8	65(<1) 20 <1	2(1)	∞ ; 0 = a (<1) 1	ठ ab sent) (<1) (<1)	28 No. of occurrences per species 3 1 2 8 8 8 3 1 1 1 9 1 1
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Taxon (* = Listed in RDB) Aponogeton distachyos L.f. Arctothesa calendula (.) Lew ns Atripiex nummularia Lindi. Atripiex semibacata R.Br. Boliboschoerus mantimus (L.) Palla Zotula coronoptolia L. Zotula turbinata (L.) Pers. Zynodon dactylon (L.) Pers. Zynodon dactylon (L.) Pers. Zynodon dactylon (L.) Pers. Zynodan dactylon (L.) Pers. Zynodan dactylon (L.) Alein var. axyloides (Fenzi)). Frankenia repens (P.J. Bergius) Fourc. Beophyte (different species) Balenia africana L.	% occ	1 20(60)	د in san	40 mple (b 30 1	m racket	© ⊲ s = chai	∞ ••• •• (50) 15(75)	15(5) 15(35)	€ ecorde 25(1) 15(30) 25(0)	d on 8	65(<1) 20 <1	2(1)	0 = a (<1) 1 (1)	∞           (<1)	28 No. of occurrences 3 1 2 8 8 8 3 1 1 1 9 9 1 1 3 3
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Taxon (* = Listed in RDB) Aponogeton distachyos L.f. Arcotheca calendula (L.) Lewns Atripiex nurmularia Lindi. Atripiex vernibaccata R Br. Solboscheorus maritimus (L.) Patla Solusa toronopfolia L. Solutia turbinata (L.) Pers. Synedon dactylon (L.) Pers. Synedon dactylon (L.) Pers. Synedon dactylon (L.) Pers. Synedon dactylon (L.) Artistica (L.) Pers. Synedon dactylon (L.) Pers. Synedon dactylon (L.) Artistica (L.) Pers. Solegis antercica (L.) Roem, & Schult. Lincurs actures L. subsp. Reportiti (Parl ) Snogerup	% occ	► Curren C 1 20(60) 60(0)	د in sai	40 mple (b 30 1	m racket	© ⊲ s = chai	∞ ••• •• (50) 15(75)	15(5) 15(35)	₽ e corde 25(1) 15(30) 25(0) (<1) (1)	d on 8	65(<1) 20 <1 65(0) <1(1)	2(1)	© ; 0 = a (<1) 1 1 (1) <1(1) <1(1)	∞           (<1)	28 No. of occurrences perspecies 3 1 2 8 8 8 8 8 8 8 3 1 1 9 9 1 1 1 1 3 2 2 1 1 3 3 2 2
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Taxon (* = Listed in RDB) Aponogeton distachyos Lf. Arctotheca calendula (_) Lev ns Atriplex nummularia Lindi. Atriplex semibaccata R Br. Bolloscheerus maritimus (_) Pala Dottal coronopfola L Dottal turbinata (_) Pers. Dynerus textilis Thunb. Drosanthemum floribundum (Haw.) Schwantes Exomis microphylia (Thunb.) Aellen var. aryrioides (Fenzi). Tarikenia reposites (F.J.Berglus) F ourc. Baenia dricana L Hordeum caperse Thunb. Solepis antarctica (L) Neem. & Schult. Unicus acutus L subsp. Keopolitti (Parl.) Snogerup Loilum multiflourm Lam.	% occ	► Curren C 1 20(60) 60(0)	د in sai	40 mple (b 30 1	m racket	© ⊲ s = chai	∞ ••• •• (50) 15(75)	15(5) 15(35)	₽ e corde 25(1) 15(30) 25(0) (<1) (1)	d on 8	65(<1) 20 <1 65(0) <1(1)	2(1)	© ; 0 = a (<1) 1 1 (1) <1(1) <1(1)	5           (<1)	28 No. of Courrence 5 per species 3 1 2 8 8 8 3 1 1 1 1 3 3 1 1 3 3 3 2 4 4 2
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Taxon (* = Listed in RDB) Aponogeton distachyos L.f. Aponogeton distachyos L.f. Artoficea calendula (.) Lew ns Attrijex nurmataria Lindi. Attrijex semibaccata R Br. Boloscherus martimus (.) Palia Cotula coronopifolia L Cotula turbinata (.) Pers. Cynodon dactylon (.) Pers. Cynodon dactylon (.) Pers. Cynodon dactylon (.) Aeria. Scriis microphylia (Thunb.) Aellen var. aryrioides (Fenzi). Fankenia repens (P. J. Bergius) Fourc. Beophyle (different species) Balenia africana L Hordeum capense Thunb. Solejas antarctica (.) Roem & Schult. Juncus acutus L. subsp. keopolditi (Parl.) Snogerup Joulim mutifforum Lam. Varia pee-capnae L. Bapalum distribur.	% occ	Curren C 1 20(60) 60(0)	د in sai	40 mple (b 30 1	m racket	© ⊲ s = chai	∞ ••• •• (50) 15(75)	15(5) 15(35)	₽ e corde 25(1) 15(30) 25(0) (<1) (1)	d on 8	85(<1)	2(1)	© ; 0 = a (<1) 1 1 (1) <1(1) <1(1)	5           (<1)	28 No. of Courrence 5 per species 3 1 2 8 8 8 3 1 1 1 1 3 3 1 1 3 3 3 2 4 4 2
Taxon (* = Listed in RDB) Aponogeton distachyos L.f. Arctotheca calendula (L.) Lewins Attrijek nurmularia Lindi. Attrijek vermindaria Lindi. Attrijek vermindaria Lindi. Attrijek vermindaria Lindi. Ditula coronopifolia L. Dotula turbinata (L.) Pers. Dynodon dactylon (L.) Pers. Dynodon dactylon (L.) Pers. Dynodon dactylon (L.) Pers. Dynodon dactylon (Hanb.) Aclien var. axyrioides (Fenzi). Tankenia repense (P.J. Bergius) Fourc. Secphyte (different species) Jalenia africana L. subsp. keopoldtii (Parl.) Snogerup Loilum multiflorum Lam. Vedais peo-capitae L. Parkashites tearisidia (Nees) Stapf	% occ	Curren C 1 20(60) 60(0)	د in sai	30 1 30(0)	00 r) rracket 15(10) 15(0) 15(0)	00 N (50)	co v (50)	► lues n 15(5) 15(35) 15(35) 5 (5) 	25(1) 15(30) (<1) (1) (2)	20(1) 20(0) 1	Septe 65(<1) 20 <1 65(0) (1) (1) (2)	2(1)	© ; 0 = a (<1) 1 1 (1) <1(1) <1(1)	5           (<1)	28 No. of courrences perspecies 3 1 2 8 8 8 3 1 1 1 1 3 2 1 1 3 3 2 2 1 3 3 2 2 4 4 2 2 1 3 3
Taxon (* = Listed in RDB) Aponogeton distachyos L.f. Arctothesa calendul (.) Lewins Mirgiex nurmularia Lindi. Mirgiex nurmularia Lindi. Mirgiex nurmularia Lindi. Mirgiex nurmularia Lindi. Mirgiex nurmularia Lindi. Mirgiex nurmularia L.) Palaa 20tula coronopifolia L. 20tula curoinata (.) Pers. Synodon dactylon (.) Pers. Synodon dactylon (.) Pers. Synodon dactylon (.) Pers. Synodon dactylon (.) Bergius) Fourc. Beophyle (different space) Salenia africana L. Mordeum caperase Thunb. solepis antarctica (.) Reem. & Schult. Iunicus acutus L. subsp. leopolitii (Parl) Snogerup Jouliam mulfinoum Lam. Medicago polymorpha L. * Dotalis pee-capea L. Paspalum distichum L. Pertaschista densifolia (Nees) Stapf Prinagmitea australia (Cav.) Steud.	% occ	Curren C 1 20(60) 60(0)	6 in sau (30) 5 50(0) 5	30(0)	00 r) rracket 15(10) 15(0) 15(0)	00 N (50)	∞ ••• •• (50) 15(75)	15(5) 15(35)	₽ e corde 25(1) 15(30) 25(0) (<1) (1)	d on 8	85(<1)	2(1)	© ; 0 = a (<1) 1 1 (1) <1(1) <1(1)	5           (<1)	28 No. of occurrences per species 3 3 1 2 2 8 8 3 3 1 1 9 9 1 1 1 1 9 1 1 1 1 3 2 2 1 1 3 3 2 2 4 4 2 2 1 3 3 3 3 3 2 1 1 3 3 3 2 1 1 3 3 3 1 1 1 9 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
Taxon (* = Listed in RDB) Aponogeton distachyos L.f. Arcotheca calendula (L.) Levins Atripiex nummularia Lindi. Atripiex semibaccata R Br. Solboscheorus maritimus (L.) Palla Cotula turbinata (L.) Pers. Cynodin dactylon (L.) Pe	% occ	Curren C 20(60) 60(0) (30) (2)	6 in sau (30) 5 50(0) 5	30 1 30(0)	00 r) rracket 15(10) 15(0) 15(0)	00 N (50)	co v (50)	► lues n 15(5) 15(35) 15(35) 5 (5) 	25(1) 15(30) (<1) (1) (2)	20(1) 20(0) 1	Septe 65(<1) 20 <1 65(0) (1) (1) (2)	2(1)	© ; 0 = a (<1) 1 1 (1) <1(1) <1(1)	5           (<1)	28 No. of occurrences per species 3 3 3 3 1 1 2 8 8 8 3 3 1 1 1 9 9 1 1 1 3 3 2 2 1 1 3 3 2 2 4 4 2 2 1 3 3 7 7
Taxon (* = Listed in RDB) Aponogeton distachyos L.f. Arctotheca calendula (L.) Levyns Htrijex nurmularia Lindi. Htrijex vernibaccata R Br. Solboscheorus martimus (L.) Pala Cotula coronoptiolia L. Cotuta turbinata (L.) Pers. Synetrus textilis Thunb. Cosanthenum floribundum (Haw.) Schwartes Exomis micnophylia (Thunb.) Aellen var. axyrioides (Fenzi). Frankenia repens (P.J.Bergius) Fourc. Solophyla (different species) Salenia dricana L Hordeum caperase Thunb. Solopis antarctica (L.) Roem. & Schult. Iuncus acutus L. subsp. leopoidti (Parl) Snogerup Loium multifourm Lam. Hedicago polymopha L. * Coxalis pee-caprae L. Partaschists densifolia (Nees) Stapt Phragmites australis (Cav) Steud. Poaceae (amual juveniles)	% occ	Curren C 20(60) 60(0) (30) (2)	6 e in sau (30) 30 5 50(0) 5 5 5 5	30 1 30(0)	00 r) rracket 15(10) 15(0) 15(0)	00 N S = chai (50) 10(0)	co v (50)	► lues n 15(5) 15(35) 15(35) 5 (5) 	₽ 25(1) 15(30) 25(0) (<1) (<1) (1) (1) (1)	20(1) 20(0) 1	Septe 65(<1) 20 <1 65(0) (1) (1) (2)	2(1)	© ; 0 = a (<1) 1 1 ((1) (1) (1)	5           (<1)	28 No. of occurrences perspecies 3 1 2 8 8 8 8 3 1 1 1 1 3 3 2 1 1 3 3 2 2 1 1 3 3 2 2 4 4 2 2 1 3 3 3 3 2 2 1 1 3 3 3 3 2 2 1 1 3 3 3 3
Taxon (* = Listed in RDB) Aponogeton distachyos L.f. Arctotheca calendula (L.) Lewns Atriptex nurmularia Lindi. Atriptex semibaccata R Br. Bollosscheenus maritimus (L.) Pala Cotula coronopfolia L. Cotula tubinata (L.) Pers. Cynodon dactylon (L.) Pers. Cynodon dactylon (L.) Pers. Cynodon dactylon (L.) Pers. Cynodon dactylon (L.) Nettore (L.) Cosanthenum Iforibundum (Haw.) Schwartes Exomis microphylia (Thunb.) Aellen var. axyrioides (Fenzi). Frankenia repense (P.J. Berglus) Fourc. Geophyte (different species) Galenia africara L. Hordeum capense Thunb. Hordeum capense Th	% occ	► Surren C 1 20(60) 60(0) (30) (2) (20)	6 e in sau (30) 30 5 50(0) 5 5 5 5	30 1 30(0)	00 r) rracket 15(10) 15(0) 15(0)	00 N S = chai (50) 10(0)	00 	► lues n 15(5) 15(35) 15(35) 5 (5) 	₽ 25(1) 15(30) 25(0) (<1) (<1) (1) (2) 40(20)	20(1) 20(0) 1	85(<1)	2(1)	© ; 0 = a (<1) 1 1 (1) <1(1) <1(1)	5           (<1)	28     No. of occurrences     per species     per species     3     1     2     8     8     3     1     1     1     1     1     1     3     2     4     1     3     7     7     1     2     3     7     1     2     3     7     1     2     3     2
Taxon (* = Listed in RDB) Aponogeton distachyos L.f. Aponogeton distachyos L.f. Artototheca calendul () Levy ns Attriptex nurmularia Lindi. Attriptex semibaccata R Br. Bolboscheorus martimus () Pala Cotuta coronopifolia L Cotuda turbinata () Pers. Cyperus textilis Thunb. Corosanthenum floribundum (Haw) Schwartes Exomis microphylia (Thunb.) A ellen var. axyrioides (Fenzi). Farikenia repens (P.J. Berglus) Fourc. Beophyte (afferent species) Galenia africana L Hordeum caperise Thunb. Isolepis antarctica (L.) Reem. & Schult. Iuncus acutus L subsp. leopolitii (Parl) Snogerup Lolium mutifrom La Paspalum distichum L. Paspalum distichum L. Partaschists densifolia (Nees) Stapf Phragmites austrials (Cav.) Steud. Poacea (amual juveniles) Poacea (amual juveniles) Partacchists.	% occ	► Surren C 1 20(60) 60(0) (30) (2) (20)	6 e in sau (30) 30 5 50(0) 5 5 5 5	30 1 30(0)	00 r) rracket 15(10) 15(0) 15(0)	00 N S = chai (50) 10(0)	co v (50)	► lues n 15(5) 15(35) 15(0) 5 (5)	♀ e corde 25(1) 15(30) 25(0) (<1) (<1) (<1) (<1)	20(1) 20(0) 1	Septe 65(<1) 20 <1 65(0) (1) (1) (2) (3)	2(1)	© ; 0 = c (<1) 1 1 ((1) (1) (1)	σ           (<1)	28 No. of occurrences per species 3 1 2 8 8 8 3 1 1 1 9 9 1 1 1 3 3 2 1 1 3 3 2 2 1 1 3 3 3 2 2 4 4 2 1 1 3 3 3 2 2 2 2 2 2 2 2
Taxon (* = Listed in RDB) Aponogeton distachyos L.f. Arctotheca calendula (L) Lewns Attrijex nurmufaria Lindi. Attrijex semibaccata R Br. Bolboscheenus maritimus (L) Palla Cotula coronopfolia L. Cotula turbinata (L) Pers. Cynodon dactylon (L) Pers. Cynodon service (L) Pers. Cynodon dactylon	% occ	► Surren C 1 20(60) 60(0) (30) (2) (20)	6 e in sau (30) 30 5 50(0) 5 5 5 5	30 1 30(0)	00 r) rracket 15(10) 15(0) 15(0)	00 N S = chai (50) 10(0)	00 	► lues n 15(5) 15(35) 15(35) 5 (5) 	₽ 25(1) 15(30) 25(0) (<1) (<1) (1) (1) (1)	20(1) 20(0) 1	85(<1)	2(1)	© ; 0 = a (<1) 1 1 ((1) (1) (1)	σ           (<1)	28 No. of Contrements perspecies 3 1 2 8 8 3 3 1 1 1 3 3 1 1 1 3 3 2 1 1 3 3 2 2 4 4 2 2 1 3 3 3 2 2 4 2 2 2 2 2 2 2 6 6
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#### Notes

Sarcocorria pillansii has remained stable or has increased on the flats (September survey). Good conditions for seedling germination and initial establishment have occurred this winter.

More Phragmites australis found in September but sprouting.

Annuals and annual grasses common in wet late winter particularly on steep bank (disturbance?).

Bolboschoenus martimus wrongly identifued as Cyperus textilis in April. B m seems to be more abundant under wetter saline conditions nearer Vertorenviel Approgetor distachypes & Potamogetor pusillus not seen under dry season conditions as no free water compared to them being abundant in free water conditions in September.

#### Macroinvertebrate Sampling :

April 2022 - No sampling – dry September 2022 - SASS5 score was 68 and ASPT 5.2. Invertebrate Habitat Assessment System was 56%.

Fish sampling upstream of Verlorenvlei EWR site: Verlorevlei redfin - 16 adults and 52 juveniles Cape kurper - 3 adults



Verlorenvlei redfin Pseudobarbus verloreni



Cape Galaxias lineage Galaxias sp. "zebratus verlorenvlei"





Cape kurper lineage Sandelia sp. 'capensis west coast'

No conservation status at present, in Verlorenvlei, Langvlei, Berg and Diep River systems

Water Quality Variable	Results
pH (at 25°C)	7.62
Electrical Conductivity (mS/m)	194
Total Dissolved Solids (mg/l)	1300
Turbidity (NTU)	4.4
Total Suspended Solids (mg/l)	7
Ortho Phosphate (mg/l as P)	<.20
Ammonia Nitrogen (mg/I N)	<.10
Nitrate Nitrogen (mg/l N)	<.20
Nitrite Nitrogen (mg/l N)	<.20
Total Inorganic Nitrogen mg/I N) Calculated	<.50

(endemic, Endangered)

#### Water quality in situ measures taken with a YSI :

Temperature (°C)	12.7
pH (pH units)	7.45
Dissolved oxygen (mg/l)	8.94
Conductivity (mS/m)	187.3



## **Capacity Building**

#### Wet season survey week (5-9 Sept 2022):

- > Intro to EWR determinations and the study area; hydrology and case studies (5 September)
- Groundwater workshop: Hydrogeological setting West Coast; Groundwater contribution to surface water; groundwater contamination, borehole drilling and yield testing, monitoring, data analysis
- Surface water Fieldwork in the Verlorenvlei, Langvlei, Jakkals and Papkuilsvlei (6 9 September)

#### Surface water/groundwater Integration workshop 27 - 28 September 22

- Hydrology and groundwater; Hydraulics; Water quality; Wetlands; Vegetation; Macroinvertebrates; Fish
- Integration and input into EWR recommendations and scenarios

#### Estuary workshop: 22 November 22 (Estuary EWR Workshop 23-24 November)

#### **Regulatory and Implementation Workshop (24 November 2022)**

EWR Recommendations and Scenario Workshop (early December 2022)





## **Future Project Deliverables**

- End November Regulatory and Estuarine Workshops
- 12 Dec EWR Report
- 27 Jan Scenario Report
- February stakeholder meeting (in study area)
- February Final Report and Implementation Plan









# Thank you









