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Water and Sanitation
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2030 NDP
NATIONAL DEVELOPMENT PLAN
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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



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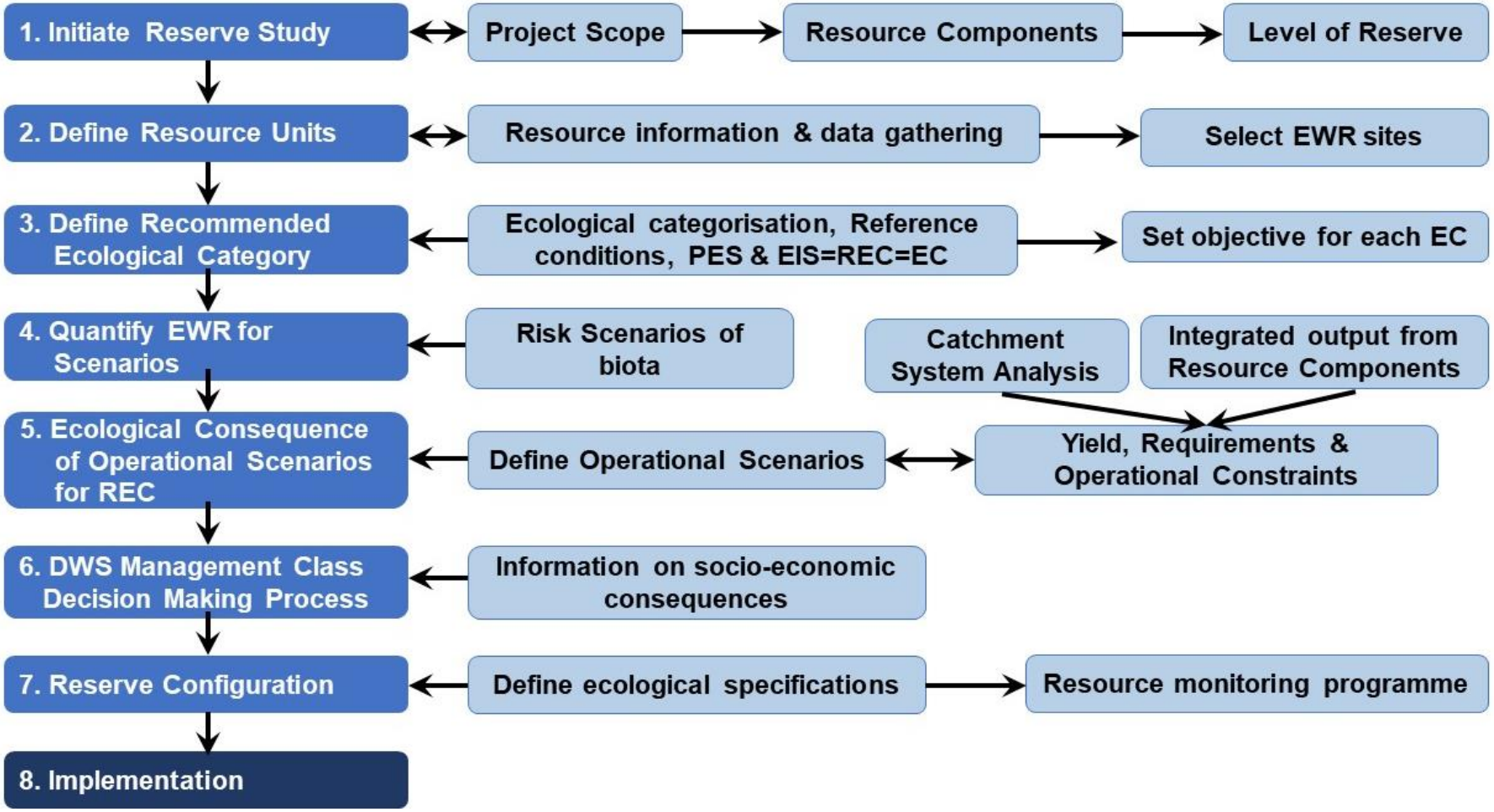
Project Progress

- 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



Hydrological Modelling

- 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

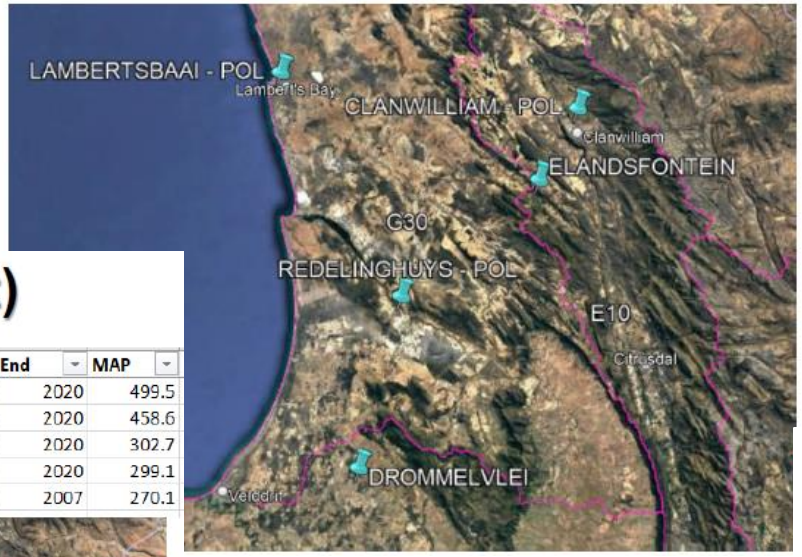
Rainfall Data – WR2012 F60

Number	Name	F60	Updated in current study	Start	End	MAP
0157753 W	SCHUINSKRAAL	F6A	Closed	1920	1952	172.9
0131170 W	SWARTBOOISVLEI	F6A	Closed	1952	1974	155.7
0131639 W	NUWERUS - POL	F6A	Extended 2010-2020	1925	2020	155.7
0158087 W	RIETPOORT	F6A	Closed	1951	2010	134.7
0106512 W	KOEKENAAP - IRR	F6A	Extended 2010-2020	1920	2020	130.5

Hydrological Modelling

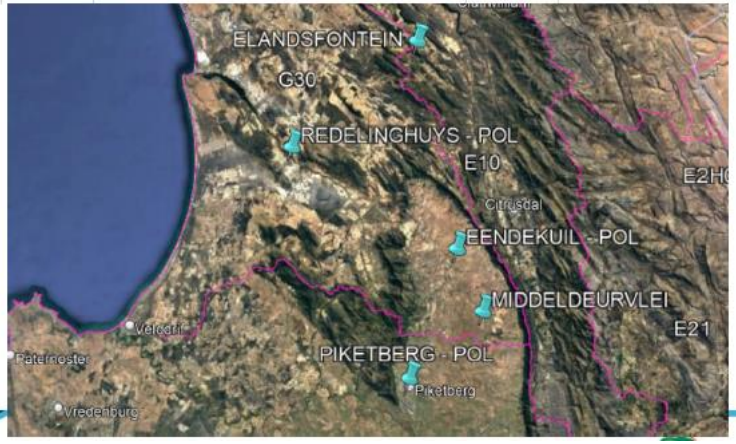
Rainfall Data – WR2012 G30 (dry)

Number	Name	G30AEF	Updated in current study	Start	End	MAP
0084558 W	ELANDSFONTEIN	G3B	Extended 2010-2020	1900	2020	499.5
0061766 W	DROMMELVLEI	G3B	Extension data 2009-2010, retain WR2012 MP file, consider patching 2010 values	1900	2009	314.2
0084059 W	REDELINGHUYS - POL	G3B	Not extended - closed?	1900	2007	270.1
0084701 W	CLANWILLIAM - POL	G3B	Not updated - closed. 0084671 close by but data no good. Use E1E004	1920	2001	210.1
0106880AW	VREDENDAL	G3B	Extended 2010-2020	1958	2020	149.5
0083515 W	LAMBERTSBAAI - POL	G3B	Extended 2010-2020	1900	2020	137.5



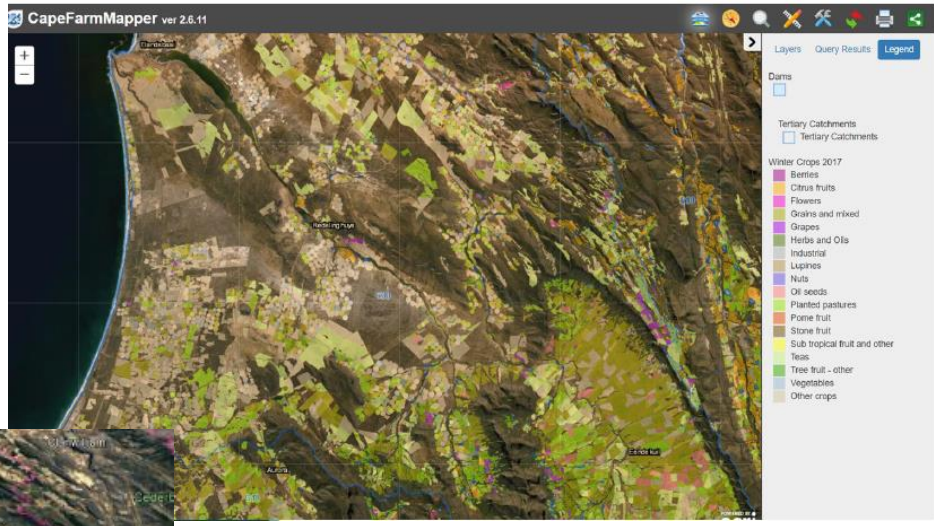
Rainfall Data –WR2012 G30 (wet)

Number	Name	G30BCD	Updated in current study	Start	End	MAP
0084558 W	ELANDSFONTEIN	G3A	Extended 2010-2020	1900	2020	499.5
0062444 W	PIKETBERG - POL	G3A	Extended 2010-2020	1900	2020	458.6
0062671 W	EENDEKUIL - POL	G3A	Extended 2010-2020	1900	2020	302.7
0062768 W	MIDDELDEURVLEI	G3A	Extended 2010-2020	1900	2020	299.1
0084059 W	REDELINGHUYS - POL	G3A	Not extended - closed?	1900	2007	270.1



Hydrological Modelling

Land use data



Land use data

- Registered dams (DWS, 2019)

Quaternary catchment	Combined capacity (million m3)	Combined surface area (km2)	Number of registered dams (DWS, 2019)
G30A	-	-	-
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**

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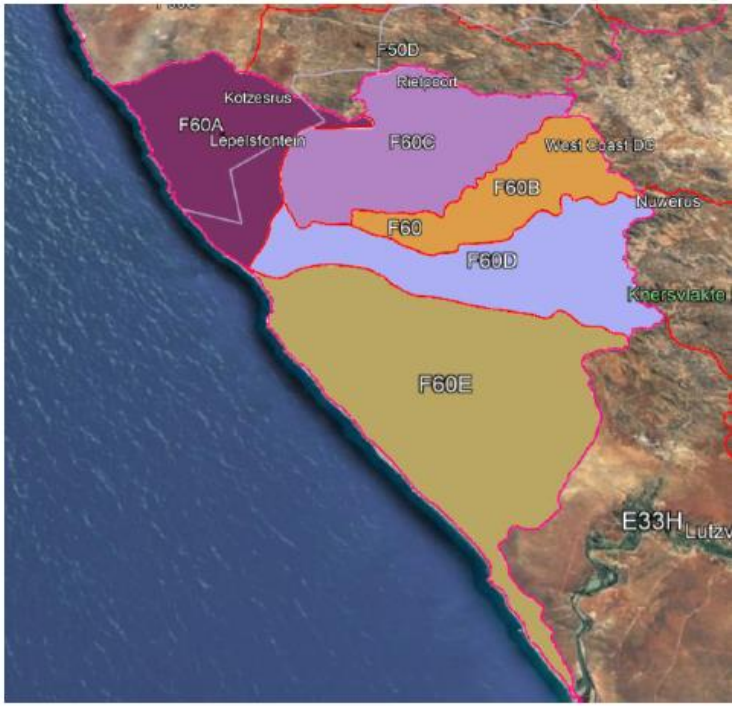
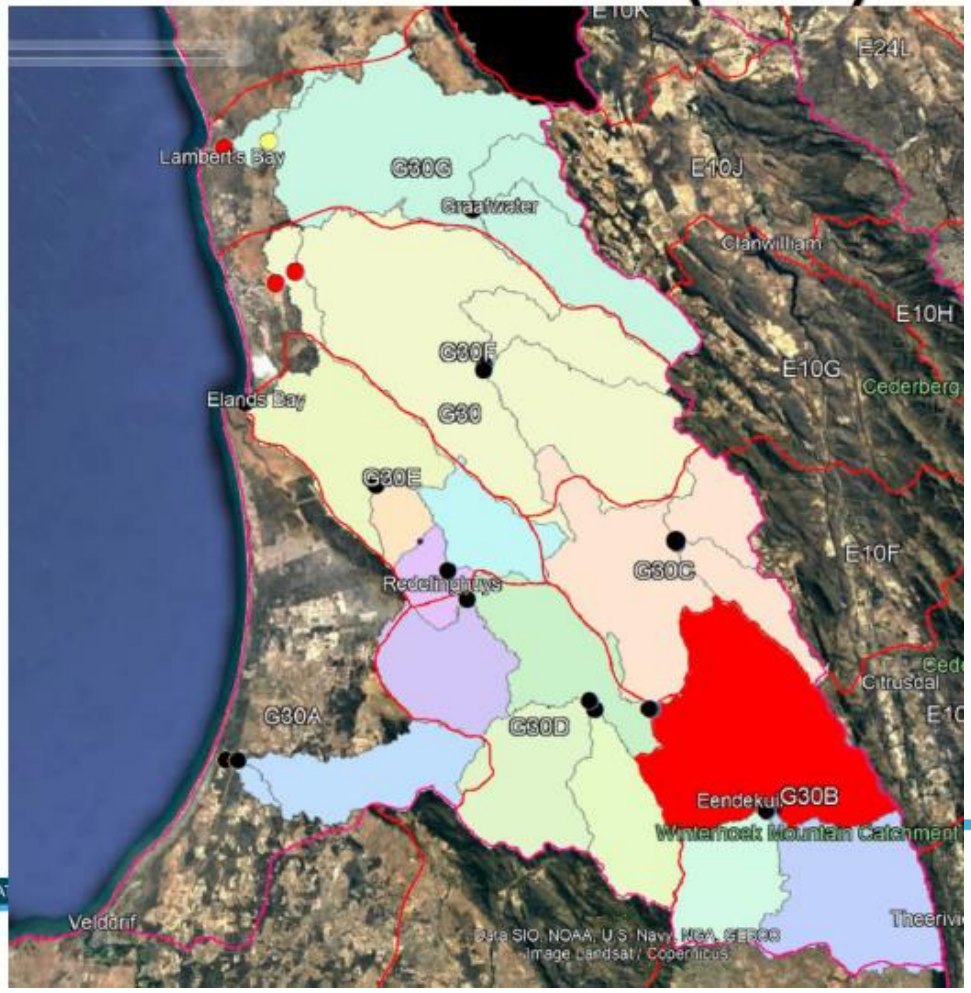
Hydrological Modelling

Catchment delineation (F60)



Catchment delineation (G30)



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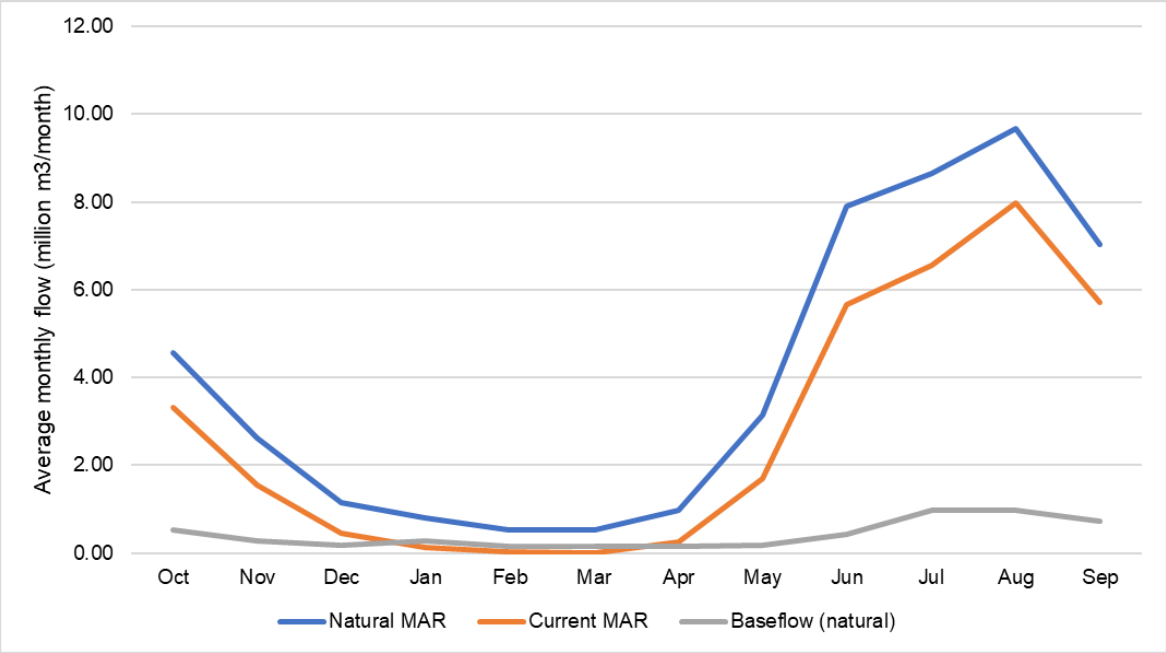
Hydrological Modelling

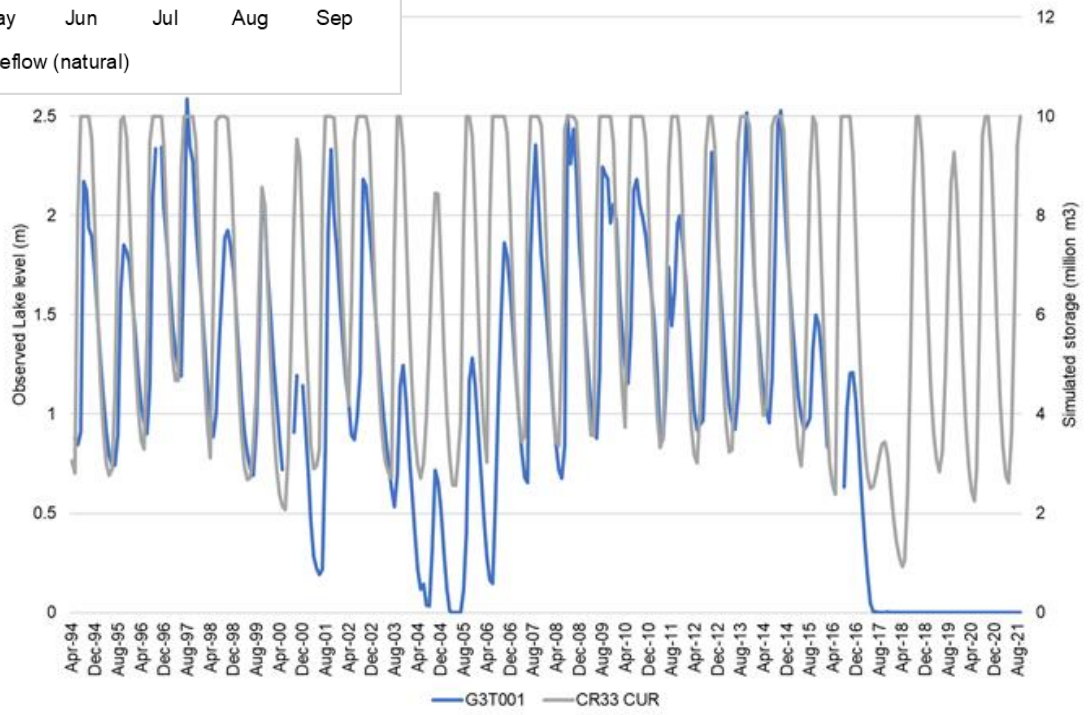
EWR Site	Description	Quaternary Catchment	Natural MAR (million m3/a)	Current MAR (million m3/a)	Present Day as % Natural MAR
EWR1	Brak River	F60A	0.07	0.07	100
EWR2	Depression wetland	F60A		-	
EWR3	Groot Goerap River	F60B	0.11	0.11	100
EWR4	Sandlaagte River	G30H	1.36	1.36	100
EWR5	Jakkals River	G30G	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			
EWR12	Rosherpan	G30A			
EWR13	Papkuils River	G30A	1.04	1.04	100
EWR14	Papkuilsvlei wetland	G30A			

Flows into Verlorenvlei (million m3/month)

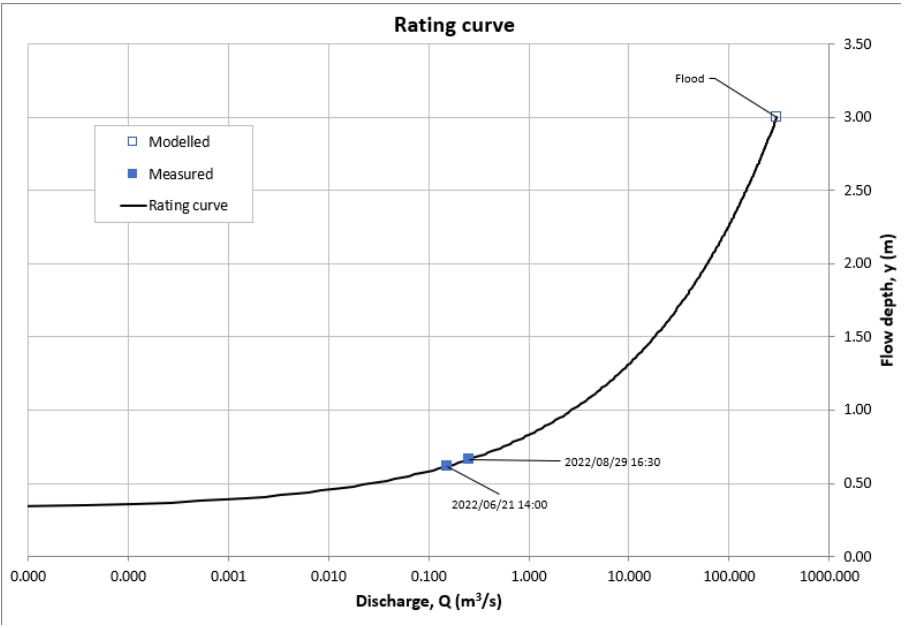
Hydroyear	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Average	2.386	0.750	0.043	0.000	0.000	0.000	0.187	1.494	5.221	5.853	7.326	4.885	28.145
Max	9.38	4.3	0.87	0	0	0	5.7	23.72	59.04	70.92	41.91	23.77	132.58
95%	5.68	2.78	0.28	0	0	0	0.22	9.02	24.68	24.14	29.03	13.73	90.29
75%	2.99	0.86	0	0	0	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

Hydrological Modelling



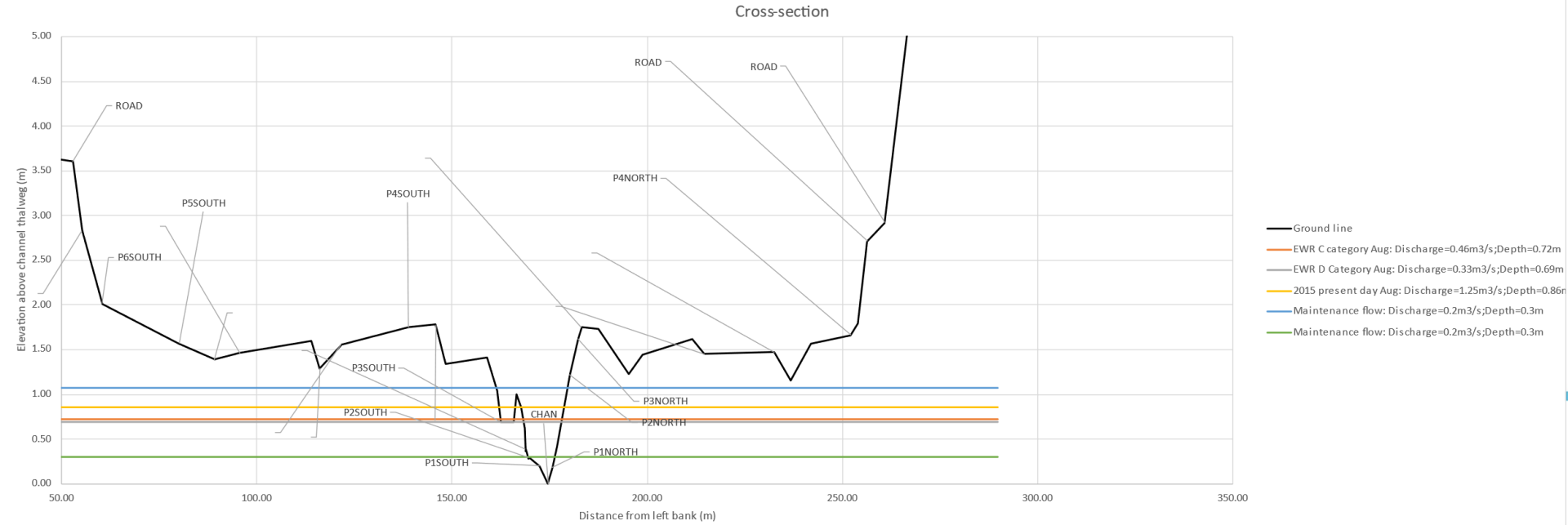


Cross-Section Surveys & Hydraulic Modelling



Monthly average flows in m3/s													
Flows (m3/s)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	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	0.518
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	2.244
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	1.597
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	0.679
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	0.327
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	0.190
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	0.099
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	0.070

Monthly average depth (m)													
Depth (m)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
Average	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
Max	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
0.95	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
0.75	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
0.5	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
0.25	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
0.05	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
Min	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



Wet Season Survey Report

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

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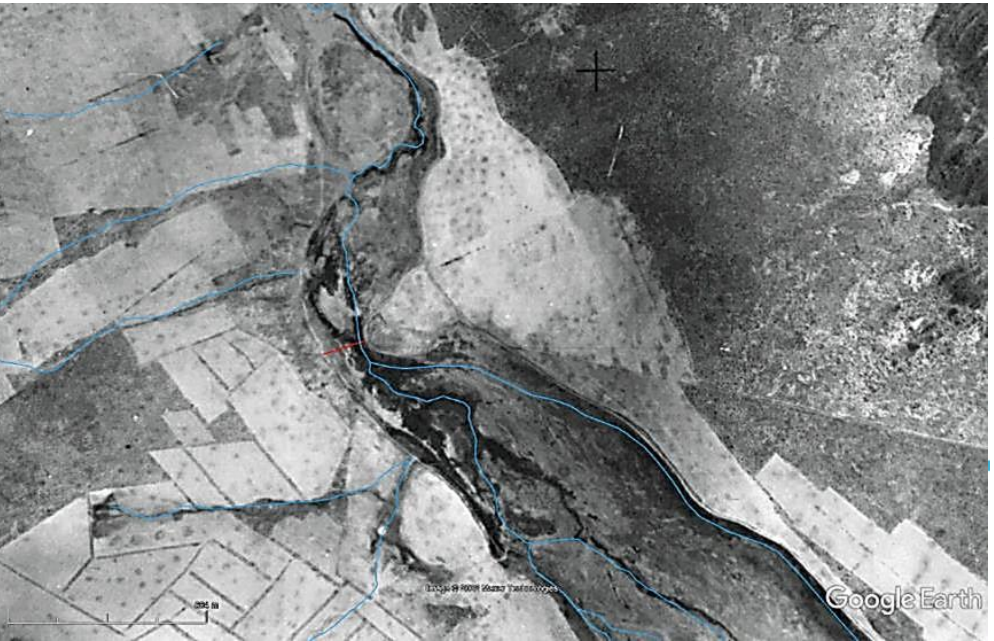
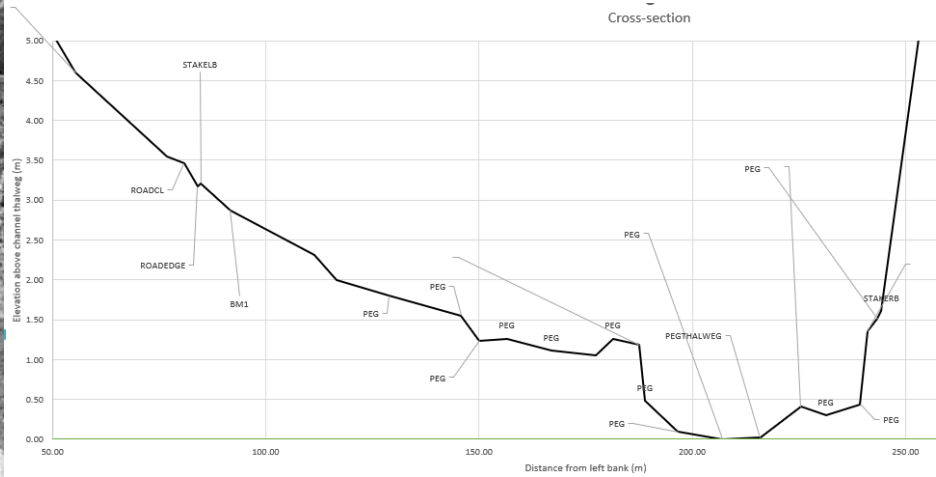


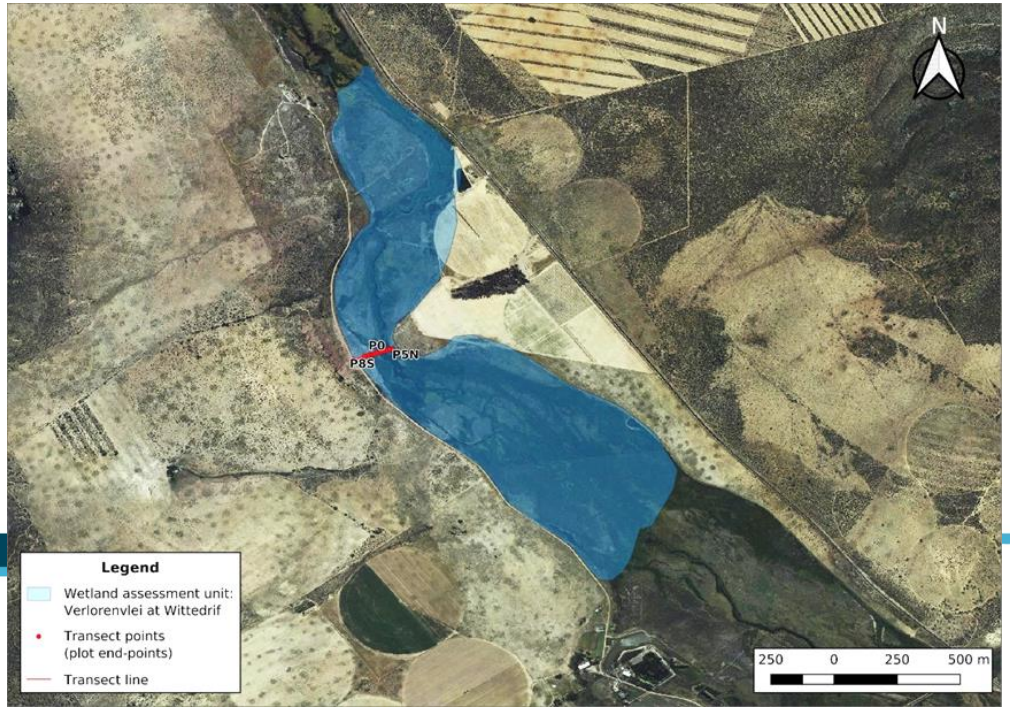


Wet Season Survey Report

Wet Season Survey Report

Verlorenvlei EWR transect @ Wittedrif: soil wetness data

Plot number	Plot length (m)	Standing water depth		Depth to water table		Depth to saturated		Notes
		Apr 2022	Sep 2022	Apr 2022	Sep 2022	Apr 2022	Sep 2022	
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	
P0	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 depth
P7-S	17.1	0	0	>100	>100	>100	>100	Clay from ~90cm depth
P8-S	44.1	0	0	>100	>100	>100	>100	



Wet Season Survey Report

Alphabetic Floristic data for VERLORENVLEI - WITTEDRIF, Western Sandveld Wetlands

Sample no. [VW=Verlorenvlei Wittedrif]	VWN5	VWN4	VWN3	VWN2	VWN1	VW0	VWS1	VWS2	VWS3	VWS4	VWS5	VWS6	VWS7	VWS8	No. of sample 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 ref plot start peg from Low point to Outer edge (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°31'3.16"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	7.77	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. Grazed. Trampled. Cobbles.	Channel with Artificially raised area	Bed often flooded. Heavy grazing.	Bed often flooded. Heavy grazing.	Bed often flooded. Heavy grazing.	Channel side. Dry clay.	Flattish regular overflow step.	Raised area. Added bed materials.	Slight dip at higher ooverflow level.	Channel side	Upper flood flats. Cattle	Back floodplain. Cattle	No. of species in area =
No. of species in sample plot	6	7	6	5	3	2	4	7	10	5	11	5	8	9	28

Taxon (* = Listed in RDB)	% occurrence in sample (brackets = changed values recorded on 8 September; 0 = absent)														No. of occurrences per species
Aponogeton distachyos L.f.			(30)			(50)	(50)								3
Arctotheca calendula (L.) Levyns														(<1)	1
Atriplex nummularia Lindl.													(<1)	(<1)	2
Atriplex semibaccata R.Br.	5	1						15(5)	25(1)	20(1)	65(<1)	2(1)	1		8
Bolboschoenus maritimus (L.) Palla		20(60)	30	30	15(10)		15(75)	15(35)	15(30)		20				8
Cotula coronopifolia L.			5	1							<1				3
Cotula turbinata (L.) Pers.														(1)	1
Cynodon dactylon (L.) Pers.	(1)														1
Cyperus textilis Thunb.		60(0)	50(0)	30(0)	15(0)		75(0)	15(0)	25(0)	20(0)	65(0)				9
Drosanthemum floribundum (Haw.) Schwantes														1	1
Exomis microphylla (Thunb.) Aellen var. *axyrioides* (Fenzl)	1														1
Frankenia repens (P.J.Bergius) Fourc.										1		5	1		3
Geophyte (different species)									(<1)					(<1)	2
Galenia africana L.													(1)		1
Hordeum capense Thunb.								5					<1(1)	1	3
Isolepis antarctica (L.) Roem. & Schult.			5					(5)			<1(1)				3
Juncus acutus L. subsp. *leopoldtii* (Parl.) Snogerup	(1)								(1)						2
Lolium multiflorum Lam.		(30)							(2)		(1)		(1)		4
Medicago polymorpha L. *		(2)												(1)	2
Oxalis pes-caprae L.														(1)	1
Paspalum distichum L.				10(0)	30(0)	10(0)									3
Pentaschistis densifolia (Nees) Stapf	5										(2)	(<1)			3
Phragmites australis (Cav.) Steud.			5	15			(5)	(5)	40(20)	(1)	(3)				7
Poaceae (annual juveniles)		(20)													1
Potamogeton pusillus L. (Boucher 8085)			(<5)			(40)									2
Rumex crispus L. *		<1							(1)		(1)				3
Ruschia sp.									(<1)				(1)		2
Sarcocornia natalensis (Bunge ex Ung.-Sternb.) A.J.Scott							1(2)				(1)				2
Sarcocornia pillansii (Moss) A.J.Scott								(2)	(10)	40		5(35)	60	60	6
Senecio burchellii DC.														2	1
Sporobolus virginicus (L.) Kunth	20(10)										1(<1)	(<1)	2	<1	5

Notes:

Sarcocornia 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 maritimus wrongly identifued as *Cyperus textilis* in April. *B m* seems to be more abundant under wetter saline conditions nearer Verlorenvlei

Aponogeton distachyos & *Potamogeton pusillus* not seen under dry season conditions as no free water compared to them being abundant in free water conditions in September.

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Wet Season Survey Report

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* (endemic, Endangered)

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 in situ measures taken with a YSI :

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

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/l N)	<.10
Nitrate Nitrogen (mg/l N)	<.20
Nitrite Nitrogen (mg/l N)	<.20
Total Inorganic Nitrogen mg/l N) Calculated	<.50

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