APPENDIX G

TEMPLATE FOR PRESENTATION OF RESULTS AS REQUIRED BY THE DWAF

1. **Description of the River**

    River: Orange River

    Drainage Region (monitoring point for Reserve):   At head of estuary, approximately 9.5 km for mouth (.............).

    Water Management Area: ....

2. **Preliminary determination of the recommended Ecological Flow Requirement Scenario - Section 17(1)**

MAR of 4 758.93 million cubic meters, 43.93% of the natural MAR (10 833.01 million cubic meters)

NOTE: This amount accounts for the Ecological Requirements only

3. **Preliminary determination of the Ecological Requirements for Water Quality - Section 17(1)**

Not determined as part of a Preliminary Determination of the Ecological Reserve on a Rapid level.

4. **Preliminary determination of recommended Ecological Category**

Recommended Ecological Category is **Category C.**

Category C represents *'Moderately Modified.'*

5. **Applicability**

5.1   This preliminary determination of the Reserve in terms of section(1)(a) is applicable to the following water resources or part of the resource:

Orange Estuary within the following geographical boundaries (Gauss Conform Projection, Clarke 1880 spheroid):

- **Downstream boundary:** The estuary mouth (..............................)

- **Upstream boundary:** Head of tidal influence, approximately 9.5 km for mouth (...................).

- **Lateral boundaries:** 5 m contour above MSL along the banks.

Note:

The precise extent of tidal variation has not been confirmed for the Orange River Estuary and needs to be verified through monitoring. It is also recommended that in future studies, in which new data is collected, the upper boundary be extended to include the area upstream from the bridge, i.e. the planned extension to the Ramsar site.

5.2   This preliminary determination of the Reserve in terms of section 17(1)(b) is applicable to the authorising of following water use:

- Section 21(a) - taking water from a water resource
- Section 21 (b) - storing water
- Section 21 (c) - impeding or diverting the flow of water in a watercourse
- Section 21 (e) – engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1)

- Section 21(f) – discharging water into a water resource through a pipe, canal, sewer, sea outfall or other conduit
- Section 21(g) - disposing of waste in a manner which may detrimentally impact on a water resource
- Section 21(h) - disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process
- Section 21 (i) - altering the bed, banks, course or characteristics of a watercourse

6. Supporting Documentation

Supporting documentation is provided in the following Annexures:

Annexure A: Preliminary Ecological Flow Requirement – Water Quantity	X
Annexure B: Preliminary Ecological Requirement – Water Quality	
Annexure C: Preliminary Basic Human Needs	
Annexure D: Resource Quality Objectives	
Annexure E: Special conditions and limitations	
Annexure F: Background and record of decision	X
Annexure G: Methodology	X
Annexure H: Specialist reports	X
Annexure I: Map of study area	X

ANNEXURE A
PRELIMINARY ECOLOGICAL RESERVE – WATER QUANTITY

1) **Level of confidence of the determination: Low (i.e. < 40%)**

2) **The flow requirement is based on the natural flow contribution of the catchments upstream of the head of the Orange Estuary (........S, ...E, approximately km upstream of the mouth) (The position of the head of the estuary, however, needs to be confirmed with tidal variation recordings).**

3) **Table 1 provides a summary of flow distribution (mean monthly flows in m³/s) of the recommended Ecological Flow Requirement Scenario for the Orange Estuary to meet the recommended Ecological Category of C.**

4) **Table 2 provides a simulated monthly runoff (in mean monthly m³/s) of the recommended Ecological Flow Requirement Scenario to meet the recommended Ecological Category of C.**

Category C (recommended Ecological Category)

The **recommended Ecological Flow Requirement Scenario for Orange Estuary** is estimated at an MAR of 4 758.93 million cubic meters distributed as set out in Tables 1 and 2.

TABLE 1: Orange Estuary: Summary of flow distribution (in mean monthly m³/s) of the recommended Ecological Flow Requirement Scenario to meet the recommended Ecological Category of C

MONTH	FLOW (m³/s) – flow should ≥ % in given month									
	90%ile	*80%ile*	*70%ile*	*60%ile*	*50%ile*	*40%ile*	*30%ile*	*20%ile*	*10%ile*	*1%ile*
OCT	54.95	53.72	50.64	46.25	39.4	32.11	25.65	20.05	18.1	5.93
NOV	178.06	82.19	76.11	67.59	55.37	43.18	34.06	28.53	26.19	14.73
DEC	228.73	120.75	96.31	78.53	59.44	43.42	35.94	31.54	29.99	27.44
JAN	545.82	147.26	82.87	70.39	54.06	47.74	41.1	37.92	36.72	27.64
FEB	1427.02	581.97	388.17	212.81	146.25	98.86	77.24	65.15	62.76	41.33
MAR	777.46	493.45	284.44	189.07	135.57	105.94	78.48	61.99	59.04	43.63
APR	736.15	218.39	145.73	103.03	96.22	74.42	64.29	58.27	54.21	43.9
MAY	223.13	81.83	47.96	44.89	41.77	38.29	35.68	33.51	32.5	26.28
JUN	61.89	30.69	29.17	28.44	27.31	25.17	23.3	21.9	21.17	19.77
JUL	24.81	24.56	23.85	22.82	21.96	20.57	19.18	18.08	17.46	17.24
AUG	23.14	22.85	22.36	21.59	20.12	18.75	17.45	16.31	15.73	13.53
SEP	21.03	20.51	19.88	19.17	17.99	17	15.62	14.03	8.96	6.11

White = State 1 (river dominated – Flows > 50 m³/s); Blue = State 2 (Strong marine influence – Flows 10 – 50 m³/s) ; Red = State 3 (Mouth closure – Flows < 10 m³/s)

NOTE:

The recommended Ecological Flow scenario for an Ecological Category C can still be refined. It, however is important that the revised flow scenario maintain the distribution of Abiotic States presented in the current recommended scenario (see above).

It is estimated, that to maintain the estuary in its **Present Ecological Status of a Category D+,** a flow (and abiotic State) distribution represented by **Scenario 7** (MAR = 4 529.73 x 10⁶ m³) is required:

MONTH	FLOW (m³/s) – flow should ≥ % in given month									
	90%ile	*80%ile*	*70%ile*	*60%ile*	*50%ile*	*40%ile*	*30%ile*	*20%ile*	*10%ile*	*1%ile*
OCT	28.17	27.63	26.25	24.3	21.25	18	15.13	12.64	11.85	11.66
NOV	229.69	35.27	33.68	31.45	28.45	25.55	22.7	21.26	20.68	16.75
DEC	236.25	113.03	38.42	36.78	32.51	30.18	26.85	25.63	25.2	23.19
JAN	545.17	148.81	74.47	42.26	37.73	31.13	27.47	25.71	25.1	19.89
FEB	1373.57	607.65	381.22	218.67	145.99	94.69	70.18	58.39	54.85	46.62
MAR	790.16	469.72	278.09	174.22	93.14	62.56	52.26	44.27	43.1	42.13
APR	713.61	206.18	139.12	76.9	62.42	47.61	38.31	34.94	30.17	26.65
MAY	213.14	102.63	54.34	43.68	37.87	33.01	28.79	25.29	23.67	21.16
JUN	63.03	33.68	31.69	30.69	29.11	26.51	24.08	22.28	21.32	19.85
JUL	26.4	26.13	25.35	24.23	23.29	21.77	20.24	19.05	18.38	18.13
AUG	23.21	22.98	22.49	21.66	20.18	18.8	17.49	16.35	15.83	15.14
SEP	24.42	23.35	22.06	20.6	18.17	16.14	13.28	11.9	11.12	7.58

White = State 1 (river dominated – Flows > 50 m³/s); Blue = State 2 (Strong marine influence – Flows 10 – 50 m³/s) ; Red = State 3 (Mouth closure – Flows < 10 m³/s)

TABLE 2: Orange Estuary: Simulated runoff (in mean monthly m³/s) of the recommended Ecological Flow Requirement Scenario to meet the recommended Ecological Category of C

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1920	54.97	45.36	30.17	38.55	253.57	144.91	159.57	48.03	28.38	19.18	16.38	19.12
1921	27.95	100.85	410.95	69.88	64.84	54.35	53.29	33.02	28.93	23.28	21.80	16.41
1922	52.11	359.27	70.43	476.88	617.30	394.31	213.54	38.41	30.24	24.64	21.51	15.90
1923	17.64	28.51	30.01	44.38	91.57	145.78	326.69	32.94	21.23	17.48	14.95	20.30
1924	43.83	81.36	120.31	63.68	409.85	3406.34	1872.23	701.34	113.80	24.28	19.90	19.70
1925	41.55	37.91	31.09	42.20	73.22	110.35	65.57	32.44	22.14	17.90	14.43	19.90
1926	30.32	28.56	33.98	37.46	77.11	142.08	96.78	33.28	21.05	19.10	20.75	13.83
1927	42.16	33.97	42.88	83.02	98.18	228.04	57.28	32.72	21.11	17.36	15.57	15.02
1928	27.64	55.49	35.81	47.95	64.85	173.35	63.76	36.76	30.70	24.81	22.44	21.03
1929	54.95	71.00	250.97	83.87	78.43	79.21	81.89	37.09	22.81	18.60	22.04	17.81
1930	30.93	19.83	29.95	66.70	124.75	187.62	106.11	46.59	21.92	24.81	22.91	12.41
1931	33.32	68.63	33.26	36.45	138.77	75.57	53.91	32.17	21.07	17.42	12.66	17.46
1932	20.63	27.61	31.65	36.14	59.34	59.32	53.64	30.58	21.04	17.43	13.96	6.03
1933	5.93	84.20	219.21	1063.63	871.27	529.05	103.01	46.44	30.37	24.60	23.14	17.13
1934	47.28	328.23	466.13	39.03	65.60	187.43	157.29	205.29	55.29	21.16	23.05	19.14
1935	18.29	25.98	30.66	46.89	83.59	210.25	78.32	159.03	31.41	22.47	18.33	10.63
1936	46.59	875.32	155.15	834.07	1379.36	261.62	57.01	33.53	21.89	18.48	16.27	6.15
1937	18.76	17.85	56.13	168.68	248.56	64.76	95.66	43.15	29.81	24.11	22.42	18.12
1938	53.73	85.13	83.73	93.08	1165.97	343.24	54.34	40.18	26.42	24.59	22.97	19.59
1939	53.77	113.70	68.34	37.61	130.47	131.64	332.83	216.75	30.10	22.48	18.30	21.03
1940	40.04	64.66	88.47	225.09	820.55	130.63	178.23	37.46	21.60	20.86	18.33	17.02
1941	47.99	22.41	29.93	69.06	476.03	128.86	109.73	37.81	22.87	19.18	22.77	18.95
1942	51.16	72.54	164.25	74.08	61.16	69.09	796.07	1166.30	200.76	391.32	147.45	31.50
1943	548.76	1837.53	1502.49	586.12	2122.16	567.27	59.76	35.55	30.68	24.27	19.75	20.95
1944	53.69	42.28	29.92	35.80	71.24	255.79	74.47	36.87	26.10	19.78	15.99	6.29
1945	5.93	8.39	29.92	81.55	184.71	98.73	74.24	47.33	30.41	20.31	15.89	8.15
1946	51.98	46.22	31.64	37.98	89.27	78.39	70.13	42.19	24.76	20.60	17.18	20.82
1947	51.14	34.01	96.52	72.44	119.60	646.35	369.53	41.10	23.13	18.09	15.90	9.42
1948	23.82	26.28	22.41	38.59	64.60	131.37	55.73	37.80	23.43	18.34	16.13	9.31
1949	22.34	71.67	113.54	49.76	388.27	440.58	221.62	291.75	52.62	24.74	90.01	20.83
1950	21.68	19.55	94.46	76.47	76.92	63.24	67.53	38.72	27.06	22.11	19.52	16.95
1951	54.97	43.41	30.44	38.62	428.85	64.83	56.42	34.04	23.72	26.12	22.97	19.66
1952	21.24	56.66	42.23	36.83	456.11	94.36	99.83	44.13	24.16	18.07	17.43	15.14
1953	48.18	49.12	70.84	41.51	124.42	504.69	100.48	40.72	28.67	21.16	15.80	7.42
1954	16.31	30.41	36.74	115.14	1617.67	476.59	165.90	80.14	28.86	22.64	18.85	10.61
1955	23.61	50.84	89.24	52.78	528.97	864.78	486.80	82.96	28.68	21.24	17.29	14.33
1956	38.77	73.10	803.67	528.55	153.72	194.87	64.27	33.59	22.96	24.81	23.14	1371.97
1957	1637.28	413.94	214.77	1069.63	199.88	58.71	81.69	238.02	69.39	21.11	17.25	18.46
1958	19.40	66.60	92.50	46.23	86.48	60.69	99.05	53.79	52.61	79.66	22.43	15.59
1959	46.17	67.33	105.30	50.34	155.99	139.49	137.61	51.09	27.56	22.07	22.38	19.01
1960	45.07	61.51	116.94	58.01	63.44	364.24	790.29	193.10	236.32	24.39	72.07	16.23
1961	15.51	76.32	174.22	41.06	993.94	290.83	62.41	58.11	23.29	18.16	16.11	15.26
1962	15.19	77.25	39.97	612.15	306.86	740.04	911.69	77.26	26.96	24.81	22.53	17.86
1963	28.33	81.51	77.90	54.90	63.65	95.81	130.05	35.13	26.96	23.50	21.58	18.70
1964	87.75	453.32	81.06	79.51	64.64	48.32	95.55	40.33	28.96	23.50	21.72	20.37
1965	36.14	28.10	29.95	103.79	416.93	55.97	61.65	32.47	21.16	17.17	14.25	8.02
1966	14.62	27.29	52.92	105.95	1538.24	536.52	1158.90	453.69	308.89	24.58	21.65	17.57
1967	19.66	57.16	35.85	35.99	30.22	102.25	84.36	77.85	28.21	22.59	17.39	17.80
1968	18.35	19.97	43.56	36.16	58.87	126.72	101.52	44.94	29.17	19.29	18.22	10.29
1969	53.78	32.49	50.73	37.49	69.03	41.85	24.87	19.33	17.39	17.38	16.48	19.28
1970	53.17	35.56	75.68	58.80	175.39	60.79	103.09	46.28	24.90	19.90	17.56	15.98
1971	19.11	34.45	52.38	238.64	308.02	726.47	146.63	46.32	28.32	20.46	17.71	15.29
1972	25.43	27.84	29.95	11.17	133.34	72.39	66.33	33.50	21.44	17.27	22.91	19.72
1973	34.82	29.11	72.67	691.90	2527.02	2384.46	712.95	282.38	112.82	23.85	341.22	20.45
1974	18.95	82.54	303.59	438.27	2028.79	938.07	188.73	41.48	28.18	24.53	21.46	20.40
1975	48.55	80.14	609.10	2023.50	2990.13	2880.90	996.95	575.59	151.80	34.13	22.20	20.83
1976	1061.88	670.52	37.89	50.12	968.32	897.68	124.05	42.05	26.55	21.85	19.00	20.44
1977	53.93	47.67	39.64	418.71	387.26	286.36	1133.68	107.15	29.17	23.81	21.24	20.88
1978	50.88	27.19	121.05	37.87	68.41	60.30	53.27	33.93	23.35	24.46	23.14	21.03
1979	54.12	55.25	49.01	44.84	183.76	106.86	53.87	31.43	21.17	17.95	22.05	20.38
1980	35.96	39.92	53.91	91.99	274.75	267.22	63.20	43.44	30.70	22.71	23.14	21.03
1981	29.49	34.93	62.76	38.74	58.68	56.01	102.83	44.88	28.06	23.68	20.34	16.73
1982	46.60	81.68	30.40	35.75	46.80	44.50	53.70	33.85	25.24	23.79	21.02	15.27
1983	36.98	74.17	98.04	77.82	57.31	61.16	64.46	43.91	21.77	17.90	19.09	19.69
1984	32.40	31.69	31.47	37.37	203.87	90.86	54.85	29.70	21.70	17.53	14.75	7.76
1985	40.23	77.53	135.38	52.79	99.02	59.95	55.08	32.91	27.77	17.87	19.24	20.54
1986	54.04	84.20	35.67	37.20	64.49	59.17	64.20	32.51	20.94	17.37	22.73	21.03
1987	54.97	83.23	107.88	53.22	2427.18	3733.57	630.37	107.46	58.67	24.63	22.92	322.07

White = State 1 (river dominated – Flows > 50 m³/s); Blue = State 2 (Strong marine influence – Flows 10 – 50 m³/s) ; Red = State 3 (Mouth closure – Flows < 10 m³/s)

ANNEXURE F
BACKGROUND AND RECORD OF DECISION

1. **Project Management**

   CSIR, Environmentek Stellenbosch: Ms L Van Niekerk

2. **Compilation of Rapid RDM Specialist Report**

   CSIR, Environmentek, Stellenbosch: Ms S Taljaard

3. **Consultants conducting the Ecological Reserve:**

TEAM MEMBER	ROLE/EXPERTISE	CONTACT DETAILS
Ms L van Niekerk	Project coordinator/Hydrodynamics	CSIR, Stellenbosch lvnieker@csir.co.za
Ms S Taljaard	Report Preparation/Water quality	CSIR, Stellenbosch staljaar@csir.co.za
Mr P Huizinga	Hydrodynamics (advisory role)	Private Consultant phuizing@csir.co.za
Mr A Theron	Sediment dynamics	CSIR, Stellenbosch atheron@csir.co.za
Dr J Adams	Microalgae &Macrophytes	University of Port Elizabeth btajba@upe.ac.za
Prof T Wooldridge	Invertebrates	University of Port Elizabeth zlathw@zoo.upe.ac.za
Mr S Lamberth	Fish	Private Consultant lamberth@mcm.wcape.gov.za
Mr M Anderson	Birds	Northern Cape Dept of Agriculture, Land Reform, environment & Conservation manderson@grand.ncape.gov.za

4. **Motivation for the preliminary Ecological Reserve determination study on a Rapid level**

   ……………

5. **Scope of Study**

   It was agreed among the different parties that the determination of the Ecological Reserve on a Rapid level for the Orange River Estuary be based on the methodology for estuaries as set out by South Africa's Department of Water Affairs and Forestry in *Resource Directed Measures for Protection of Water Resources; Volume 5: Estuarine Component (Version 1.0)* (DWAF, 1999) and subsequent revisions of the methods of which the documentation in currently in preparation (B Weston, RDM Directorate, DWAF, pers. comm.).   Although not usually required as part of a Rapid assessment, specialists were requested to prepare specialist reports based on readily available data (appendices to main report).

ANNEXURE G:
METHODOLOGY

The process followed in the preliminary determination of the Ecological Reserve on a Rapid level for estuaries is illustrated in Figure 1. The rapid determination is generally based on available information. It is therefore important that a desktop assessment of available information on the different abiotic and biotic components is conducted prior to the workshop. The process comprises of the following steps:

Step 1: Initiation of RDM study. During the initiation of an RDM study, it is important to establish the level as which the study needs to be conducted (e.g. rapid, intermediate or comprehensive), as well as the reserve components that need to be addressed (e.g. rivers, estuaries, wetlands or groundwater). The key outcome of Step 1 is therefore the detailed scope of the RDM study. In the case of the Orange River Estuary, it was decided to conduct the Ecological Reserve study on the estuary on a Rapid level.

Step 2: Definition of Resource Units. It considered appropriate to delineate each estuary as a separate resource unit within a larger catchment, characterized by site dependent abiotic and biotic characteristics. For estuaries, the default geographical boundaries are defined as follows:

- **Downstream boundary:** The estuary mouth (However, there are systems where the 'estuary' often expands to the near-shore marine environment and where this boundary definition may need to be reconsidered in future).

- **Upstream boundary:** The extent of tidal influence, i.e. the point up to where tidal variation in water levels can still be detected or the extent of saline intrusion which ever is furthest upstream.

- **Lateral boundaries:** The 5 m above MSL contour along each bank.

Step 3: Ecological Categorisation. The main outcome of this step is to define a recommended Ecological Category for the estuary.

The method used for estuaries uses simulated runoff scenarios, where scenarios are typically simulated over a 50-70 year period and are presented as average monthly flows that represent inflows at the head of the estuary. For the definition of the recommended Ecological Category simulated runoff scenarios for the *present state* and the *reference conditions* are used.

Firstly, the Present State of an estuary is defined as a quantitative description of the present abiotic and biotic characteristics and functioning of the system. For estuaries, the following components are usually:

Abiotic (or driving components):

- Physical dynamics (including hydrodynamics and sediment dynamics)
- Water quality

Biotic (response) components:

- Estuarine flora (microalgae and macrophytes)
- Estuarine fauna (invertebrates, fish and birds).

Thereafter the Reference Condition of an estuary is defined. For the purposes of the preliminary determination of the Ecological Reserve, the reference condition of an estuary refers to the ecological status that it would have had:

- when receiving 100% of the natural MAR
- before any human development in the catchment or within the estuary
- before any mouth manipulation practices (e.g. artificial breaching)

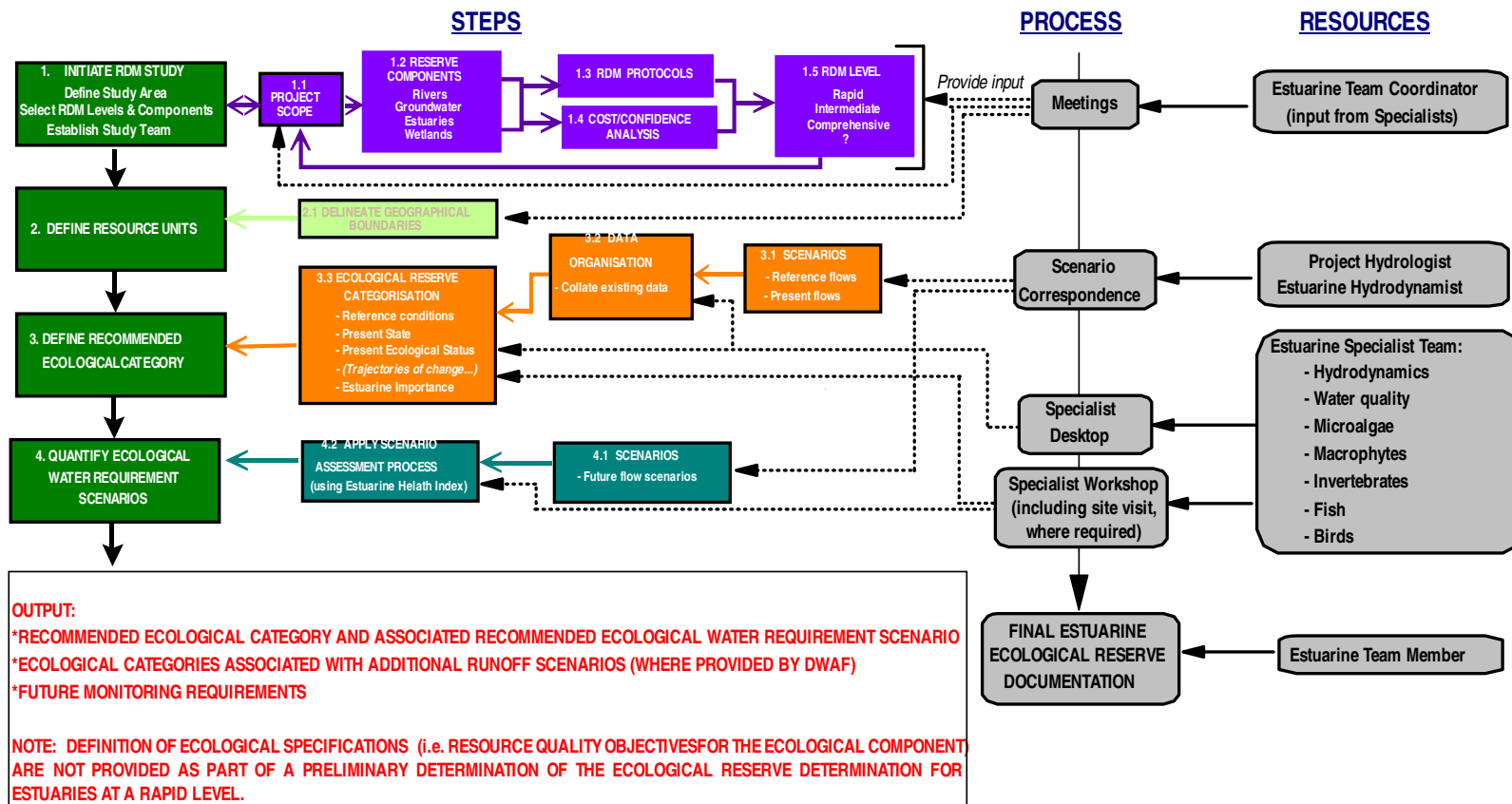Typically, the reference conditions in an estuary refer to its ecological status 50 to 100 years ago.

STEPS   **PROCESS**   **RESOURCES**

1. INITIATE RDM STUDY
Define Study Area
Select RDM Levels & Components
Establish Study Team

1.1 PROJECT SCOPE

1.2 RESERVE COMPONENTS
Rivers
Groundwater
Estuaries
Wetlands

1.3 RDM PROTOCOLS

1.4 COST/CONFIDENCE ANALYSIS

1.5 RDM LEVEL
Rapid
Intermediate
Comprehensive
?

Provide input

Meetings

Estuarine Team Coordinator
(input from Specialists)

2. DEFINE RESOURCE UNITS

2.1 DELINEATE GEOGRAPHICAL BOUNDARIES

3.2 DATA ORGANISATION
- Collate existing data

3.1 SCENARIOS
- Reference flows
- Present flows

Scenario Correspondence

Project Hydrologist
Estuarine Hydrodynamist

3.3 ECOLOGICAL RESERVE CATEGORISATION
- Reference conditions
- Present State
- Present Ecological Status
- (Trajectories of change...)
- Estuarine Importance

3. DEFINE RECOMMENDED ECOLOGICAL CATEGORY

Specialist Desktop

Estuarine Specialist Team:
- Hydrodynamics
- Water quality
- Microalgae
- Macrophytes
- Invertebrates
- Fish
- Birds

4. QUANTIFY ECOLOGICAL WATER REQUIREMENT SCENARIOS

4.2 APPLY SCENARIO ASSESSMENT PROCESS
(using Estuarine Helath Index)

4.1 SCENARIOS
- Future flow scenarios

Specialist Workshop
(including site visit, where required)

FINAL ESTUARINE ECOLOGICAL RESERVE DOCUMENTATION

Estuarine Team Member

OUTPUT:
*RECOMMENDED ECOLOGICAL CATEGORY AND ASSOCIATED RECOMMENDED ECOLOGICAL WATER REQUIREMENT SCENARIO
*ECOLOGICAL CATEGORIES ASSOCIATED WITH ADDITIONAL RUNOFF SCENARIOS (WHERE PROVIDED BY DWAF)
*FUTURE MONITORING REQUIREMENTS

NOTE: DEFINITION OF ECOLOGICAL SPECIFICATIONS (i.e. RESOURCE QUALITY OBJECTIVESFOR THE ECOLOGICAL COMPONENT) ARE NOT PROVIDED AS PART OF A PRELIMINARY DETERMINATION OF THE ECOLOGICAL RESERVE DETERMINATION FOR ESTUARIES AT A RAPID LEVEL.

Figure 1: Flow diagram showing the process followed in the preliminary determination of the Ecological Reserve determination on a Rapid level for estuaries

The present state and reference condition of an estuary are then used to determine the <u>Present Ecological Status</u> (PES). The PES is a measure of the health of a resource, based on a comparison between the reference condition and the present state. An Estuarine Health Index (EHI) is used to determine the PES for estuaries.

Also included in this step is an assessment of the <u>Estuarine Importance</u> (ecological) of an estuary (Chapter 3.4). Estuarine importance is an expression of the importance of an estuary to the maintenance of ecological diversity and functioning on local and wider scales.   Variables were discussed in a workshop setting, regarding their suitability for inclusion in an Estuarine Importance Index. The importance scores have been derived for most South African estuaries as part of a project entitled: *Classification and prioritisation of South African estuaries on the basis of health and conservation status for determination of the estuarine water reserve* (Turpie *et al.*, 2002). The only importance score that needs to be derived by the estuarine ecological reserve team (at the specialist workshop) is that for the link with freshwater and marine environment (i.e. functionality score).

Finally, the Present Ecological Status and estuarine importance score are used to come to a recommended Ecological Category for an estuary, according to pre-defined guidelines.

Step 4: Quantification of Ecological Water Requirement Scenarios. The method for the preliminary determination of the Ecological Reserve for estuaries uses a 'top down' approach, i.e. simulated runoff scenarios are used to resource directed measures. For the quantification of Ecological Water Requirement Scenarios simulated flows for a range of future scenarios are required.   Scenarios are typically simulated over a 50-70 year period and are presented as average monthly flows and should represent inflows at the head of the estuary.

To determine the Ecological Category of the estuary, associated with each of the flow scenarios, the runoff simulations together with an understanding of the present state are used to determine changes in abiotic states within an estuary for each of the scenarios. Changes in abiotic characteristics are then assessed in terms of the biological implications, using the same estuarine health index that was used to derive the Present Ecological Status. Results from these evaluations are then used to select the 'recommended Ecological Water Requirement scenario', defined as the run-off scenario, or a slight modification thereof, that represents the highest reduction in river inflow that will still protect the aquatic ecosystem of the estuary and keep it in the recommended Ecological Category.

If requested, the specialist team can also provide additional monitoring requirements. However, these can be obtained from the data requirements stipulated in the preliminary determination of the Ecological Reserve on an Intermediate or Comprehensive level in the Estuaries methods, depending on the level of confidence that would be required by the DWAF.

Although the rapid method also does not require the preparation of a detailed Resources Monitoring Programme, key baseline data requirements, that would be required to improve the <u>confidence</u> of the rapid preliminary ecological reserve determination, should be provided. In this regard, the data requirements recommended in the methodologies for the intermediate and comprehensive ecological reserve determinations need to be consulted.

The output of a preliminary determination of the Ecological Reserve on a Rapid level provides:

- Recommended Ecological Category and the associated recommended Ecological Water Requirement Scenario
- Ecological Categories for different runoff scenarios assessed as part of Step 4
- Additional Data requirements to improve confidence of preliminary Ecological Reserve (if requested).

ANNEXURE H
SPECIALIST REPORTS

DEPARTMENT OF WATER AFFAIRS AND FORESTRY (2003) Preliminary Ecological Reserve Determinations on Estuaries. Determination of the Preliminary Ecological Reserve on a Rapid Level for the Orange River Estuary. <mark>Report No.………….</mark>

APPENDIX A: Proposed Modification to the Ecological Reserve Methods for Estuaries
APPENDIX B: Specialist Report: Abiotic Components (Physical dynamics – Ms L van Niekerk & Mr A Theron, CSIR; Mr P Huizinga & Water Quality – Ms S Taljaard, CSIR)
APPENDIX C: Specialist Report: Microalgae & Macrophytes (Dr J B Adams, UPE)
APPENDIX D: Specialist Report: Invertebrates (Prof T Wooldridge, UPE)
APPENDIX E: Specialist Report: Fish (Mr S Lamberth, Cape Town)
APPENDIX F: Specialist Report: Birds (Mr M Anderson, Northern Cape Northern Cape Dept of Agriculture, Land Reform, environment & Conservation)

ANNEXURE I
MAP OF STUDY AREA

Map showing labels: Brandkaros 22km, Alexander Bay aerodrome, Swartkop, Sir Ernest Oppenheimer bridge, Dunvlei, NAMIBIA, RSA, Oranjemund, Alexander Bay, Log Cabin, CDM Airfield, Golf Club, Orange River, Embankment, Saltmarsh, Potential area of salt water intrusion, Survey beacon, ATLANTIC OCEAN