Report No: P WMA
19/G10/00/2413/7

DEPARTMENT OF WATER AFFAIRS
DIRECTORATE : OPTIONS ANALYSIS

RECORD OF IMPLEMENTATION DECISIONS REGARDING THE FIRST PHASE AUGMENTATION OF VOËLVLEI DAM

Final

December 2012

Approval

Project name:	*Pre-feasibility and Feasibility Studies for Augmentation of the Western Cape Water Supply System by Means of Further Surface Water Development Options*
Title:	*Record of Implementation Decisions Regarding the First Phase Augmentation of Voëlvlei Dam*
Author:	*Directorate: Options Analysis*
Status of Report:	*Final*
DWA Report No.:	*P WMA 19/G10/00/2413/7*
Final issue:	*December 2012*

DEPARTMENT OF WATER AFFAIRS
Chief Directorate: Integrated Water Resource Planning

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Received by:

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Chief Engineer:	**Chief Director:**
Betterment Capital Projects	**Infrastructure Development**

This report is to be referred to in bibliographies as:

Department of Water Affairs, South Africa. 2012. *Report No.4 : Record of Implementation Decisions Regarding the First Phase Augmentation of Voëlvlei Dam*. Prepared by Western Cape Water Consultants Joint Venture, as part of the Pre-feasibility and Feasibility Studies for Augmentation of the Western Cape Water Supply System by Means of Further Surface Water Developments.

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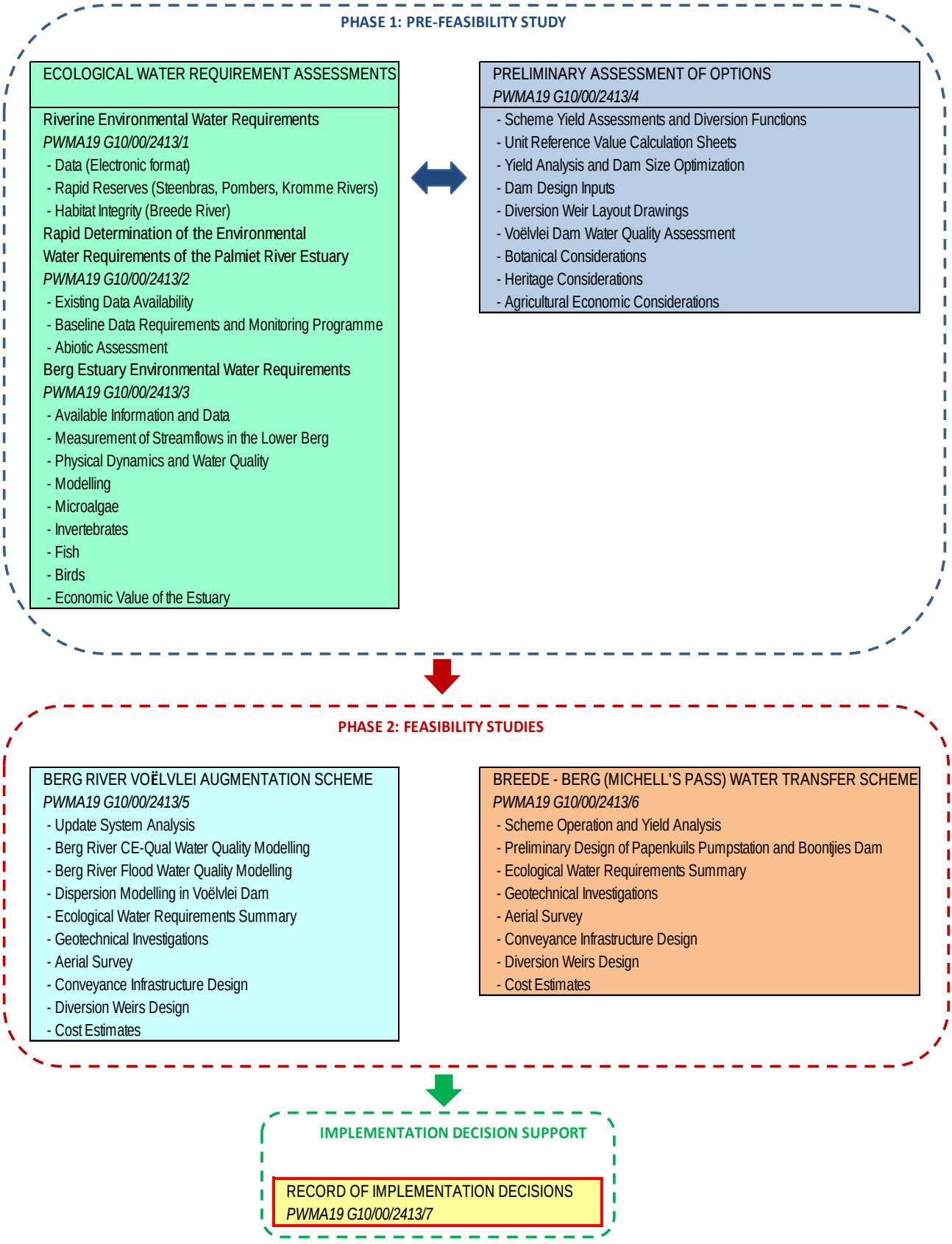

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Abbreviations

BBT	Breede-Berg Transfer
BOCMA	Breede Overberg Catchment Management Agency
BRVA	Berg River-Voëlvlei Augmentation
CCT	City of Cape Town
CD:ID	Chief Directorate: Infrastructure Development
CD:IWRP	Chief Directorate: Integrated Water Resource Planning
CMA	Catchment Management Agency
CMS	Catchment Management Strategy
CUC	Capital Unit Charge
D:EA&DP	Department of Environmental Affairs and Development Planning
DEAT	Department of Environmental Affairs and Tourism
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EWR	Environmental Water Requirements
GRP	Glass-fibre Reinforced Polyester
I&APs	Interested and Affected Parties
JV	Joint Venture
LiDAR	Light Detection and Ranging
mamsl	Metres above mean sea level
MFMA	Municipal Financial Management Act
Mm^3/a	million cubic metres per annum
m^3	cubic meter (equal to 1 kilolitre or 1 000 litres)
m^3/a	cubic metres per annum
m^3/s	cubic metres per second
MPS	Michell's Pass Scheme
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
NOC	Non-overspill crest
NWA	National Water Act
O&M	Operation and Maintenance
PES	Present Ecological State
RID	Record of Implementation Decisions
RoD	Record of Decision
RSE	Riviersonderend
URV	Unit Reference Value
WAAS	Water Availability Assessment Study
WCDM	West Coast District Municipality
WCRSS	Western Cape Reconciliation Strategy Study
WCWC JV	Western Cape Water Consultants Joint Venture
WCWSS	Western Cape Water Supply System
WMA	Water Management Area
WRYM	Water Resources Yield Model
WUA	Water User Association
WTW	Water Treatment Works
WWTW	Waste Water Treatment Works

1. INTRODUCTION

1.1 Background

The Western Cape Water Supply System (WCWSS) serves the City of Cape Town (CCT), surrounding urban centres and irrigators. It consists of infrastructure components owned and operated by both the CCT and the Department of Water Affairs (DWA). The Western Cape Reconciliation Strategy Study (WCRSS) investigated a range of bulk water supply schemes that could serve towards meeting the growing water requirements that will need to be supplied from the WCWSS. These included options such as desalination, effluent treatment for re-use, groundwater development and possible (albeit of limited size) surface water augmentation options. Investigations into these options are being embarked on by the CCT and DWA towards ensuring that planning, authorisation processes and implementation are timeously carried out so as to meet the projected water requirements on the WCWSS within a planning horizon to 2030.

In July 2008, DWA appointed the Western Cape Water Consultants Joint Venture to undertake Pre-feasibility level investigations into the potential development of six surface water options (Phase 1), from which two schemes would be prioritised for further study to feasibility level during Phase 2. The six potential schemes investigated to pre-feasibility level during Phase 1 were:

i. The Michell's Pass Diversion Scheme
ii. The First Phase Augmentation of Voëlvlei Dam
iii. Further Phases of Voëlvlei Dam Augmentation
iv. The Molenaars River Diversion
v. The Upper Wit River Diversion
vi. Further Phases of the Palmiet Transfer Scheme

Intensive Phase 1 studies were undertaken over a period of 21 months during which the above schemes were investigated to pre-feasibility level so that they could be equitably compared to one another. During this phase extensive effort was invested in assessing the technical, financial, social and environmental implications of each scheme. A comprehensive Reserve determination was undertaken for the Berg River and its estuary and Rapid (II) Reserve determinations for the Steenbras, Pombers and Kromme Rivers, providing valuable input to the assessment of the above schemes.

The Phase 1 investigations are documented in the Preliminary Assessment of Options Report.

1.2 Screening of Alternative Options

During Phase 1, effort was focussed in bringing all 6 options to an equivalent level of detail by making use of existing information from previous studies as well as substantial new work in determining the scheme yields.

An environmental screening exercise was undertaken, including site visits and obtaining specialist comment covering the following:

- Soil related concerns
- Agricultural and economic issues
- Heritage considerations
- Botanical considerations (fauna and flora)
- Environmental flow requirements

This was supported by a public and stakeholder engagement process which extended into Phase 2 of the study and involved the meetings and workshops during the study shown in **Table 1**.

Table 1: Summary of Public and Stakeholder Meetings

MEETING TYPE	TARGET GROUP	LOCATION	DATE
Public Meeting	Interested & Affected Parties	Elgin-Grabouw Country Club, Grabouw	5 March 2009
Including landowners, authorities and Water Users Associations (WUAs).			
Public Meeting	Interested & Affected Parties	Protea Cumberland Hotel, Worcester	7 March 2009
Committee Meeting	Water sector stakeholders	Department of Agriculture, Elsenberg	31 March 2009
Including national, provincial and local authorities, WUAs, conservation, emerging farmers and statutory bodies.			
Options Prioritisation Workshop	Water sector representatives & project specialists	Nelson's Creek Wine Estate, Paarl	25 March 2010
Including Municipalities, Catchment Management Agency, CapeNature, CSIR, Department of Agriculture and DWA (National and Regional).			
Committee Meeting	Water sector stakeholders	Department of Agriculture, Elsenberg	15 April 2010
Public Meeting	Interested & Affected Parties	Tri Active (Green Mountain Lodge), Elgin Valley	4 December 2010
Public Meeting	Interested & Affected Parties	Protea Cumberland Hotel, Worcester	4 December 2010
Stakeholder Meeting	Potentially affected landowners	Dutch Reformed Church, Wolseley	2 March 2011
Focussed specifically on Breede Berg (Mitchell's Pass) Water Transfer Scheme and the Berg River Voëlvlei Augmentation Scheme			

The outcome of Phase 1 (see **Table 2**) indicated that the First Phase Augmentation of Voëlvlei Dam (now referred to as the Berg River-Voëlvlei Augmentation (BRVA) Scheme) and the Michell's Pass Diversion (now referred to as the Breede-Berg Transfer (BBT) Scheme) were considered to be the two preferred schemes for further investigation as part of this study. It was also suggested that the potential raising of the Lower Steenbras Dam should be considered by DWA. The Department has taken cognisance of that suggestion and has identified this as a possible additional surface water scheme to be investigated to Feasibility Study at a later stage. **Table 2** shows the outcome of the prioritization process undertaken in Phase 1.

Table 2: Outcomes of Phase 1 Prioritization

	Scheme	Combined Score
1	Voëlvlei Dam Phase 1	13
2	Michell's Pass Diversion (3-5 m^3/s)	17
3	Voëlvlei Dam Further Phases	18
4	Palmiet Development: Raised Lower Steenbras Dam	19
5	Michell's Pass Diversion (8 m^3/s)	21
6	Molenaars Diversion	25
7	Molenaars Alternative: Elandspad River	26
8	Upper Wit River Diversion	27
9	Palmiet Development: Adding Campanula Dam	29

Note: Lowest scores denote preferred options

1.3 Scope of the Record of Implementation Decisions

A Memorandum of Agreement between the Chief Directorates Integrated Water Resources Planning (CD: IWRP) and Infrastructure Development (CD: ID) dated March 2005, clarifies "*the division and/or sharing of roles, responsibilities and accountability of the Chief Directorates through the various Project phases from planning to the commissioning of a project*".

The Memorandum furthermore states that once the detail planning of the project has been concluded and the scheme configuration, and other related requirements for implementation have been approved by the Minister, the project shall be formally handed over from the CD:IWRP to the CD:ID for implementation. This formal handing-over of the project would be concluded through an official document, the Record of Implementation Decisions (RID), and signed off by responsible officials from both the CD:IWRP and the CD:ID.

The RID should describe the scope of the project, the specific configuration of the scheme to be implemented, the required implementation timelines, the finalisation of required institutional arrangements and the required environmental mitigation measures as described in the Project's Environmental Impact Report (EIR), as well as any further requirements that may be prescribed by the Western Cape Provincial Department of Environmental Affairs and Development Planning (D:EA&DP) in the Record of Decision (RoD).

Any work carried out outside of the scope of the RID would be considered unauthorised work unless official approval for such work has been obtained from the CD:IWRP prior to such work being carried out.

This document serves as the RID for the implementation of the augmentation of Voëlvlei Dam by means of the Berg River-Voëlvlei Augmentation (BRVA) Scheme. This option has been found to be preferable from a number of perspectives, when compared with the Breede-Berg Transfer (BBT) Scheme. Whilst both options can be considered as feasible, the former would be more favourable, taking into account the required time horizon for implementation as set out in the Western Cape Reconciliation Strategy.

The purpose of the RID is to enable the DWA to implement the decisions taken on the basis of the recommendations of the Feasibility Study. In this regard the Feasibility Study Reports and their supporting detailed documentation serve to support this document. The RID should be read in conjunction with the feasibility study reports, which includes the Reserve determination reports. Importantly, the Environmental Impact Assessment (EIA) has yet to be undertaken for the BRVA Scheme. The Directorate: Options Analysis will appoint an EIA PSP in due course.

This RID briefly summarises the attributes of both schemes, touching on the important aspects regarding integration of the proposed schemes into the existing Western Cape Water Supply System and other considerations that would be required for the successful implementation of the project. Thereafter, the focus is on the preferred option, namely the BRVA Scheme.

The finalisation of the RID is premature at this stage. As such the Western Cape Water Consultants Joint Venture cannot produce an RID deliverable that is ready to be handed over from the CD:IWRP to the CD:ID, for implementation. This is due to the fact that the EIA has yet to be commenced and as such:

- No Record of Decision from DEA&DP is yet available.
- Due to the above, Ministerial Approval of the Project is premature.
- A Ministerial Directive for Implementation is premature.

2. OVERVIEW OF THE PROJECT

2.1 General Background to the Study

Both of the schemes investigated at feasibility level would involve the storage of winter water in the existing Voëlvlei Dam. The Department has adapted the scheme names to avoid potential confusion with existing diversion and supplement schemes of similar names. This study therefore reports on the basis of the following two schemes, both representing options for the **First Phase Augmentation of Voëlvlei Dam, namely:**

- **Berg River-Voëlvlei Augmentation Scheme,** abbreviated as the **BRVA** Scheme.
- **Berg-Breede (Michell's Pass) Water Transfer Scheme,** abbreviated as the Breede-Berg Transfer (**BBT**) Scheme.

Both potential schemes have been evaluated to the same level of detail, albeit at variable levels of confidence, influenced by the current status of hydrological information available for the Berg and Breede River systems. The schemes were investigated in detail towards reaching a recommendation on which of the two should be considered for implementation within the ambit of the Western Cape Reconciliation Strategy. The detailed findings and outcomes of the two feasibility studies can be referred to in the respective reports and associated Annexures, namely:

- Berg River - Voëlvlei Augmentation Scheme: *P WMA 19/G10/00/2413/5*
- Breede - Berg (Michell's Pass) Water Transfer Scheme: *P WMA 19/G10/00/2413/6*

The relative location of the two potential schemes in relation to Voëlvlei Dam is shown on **Figure 1**.

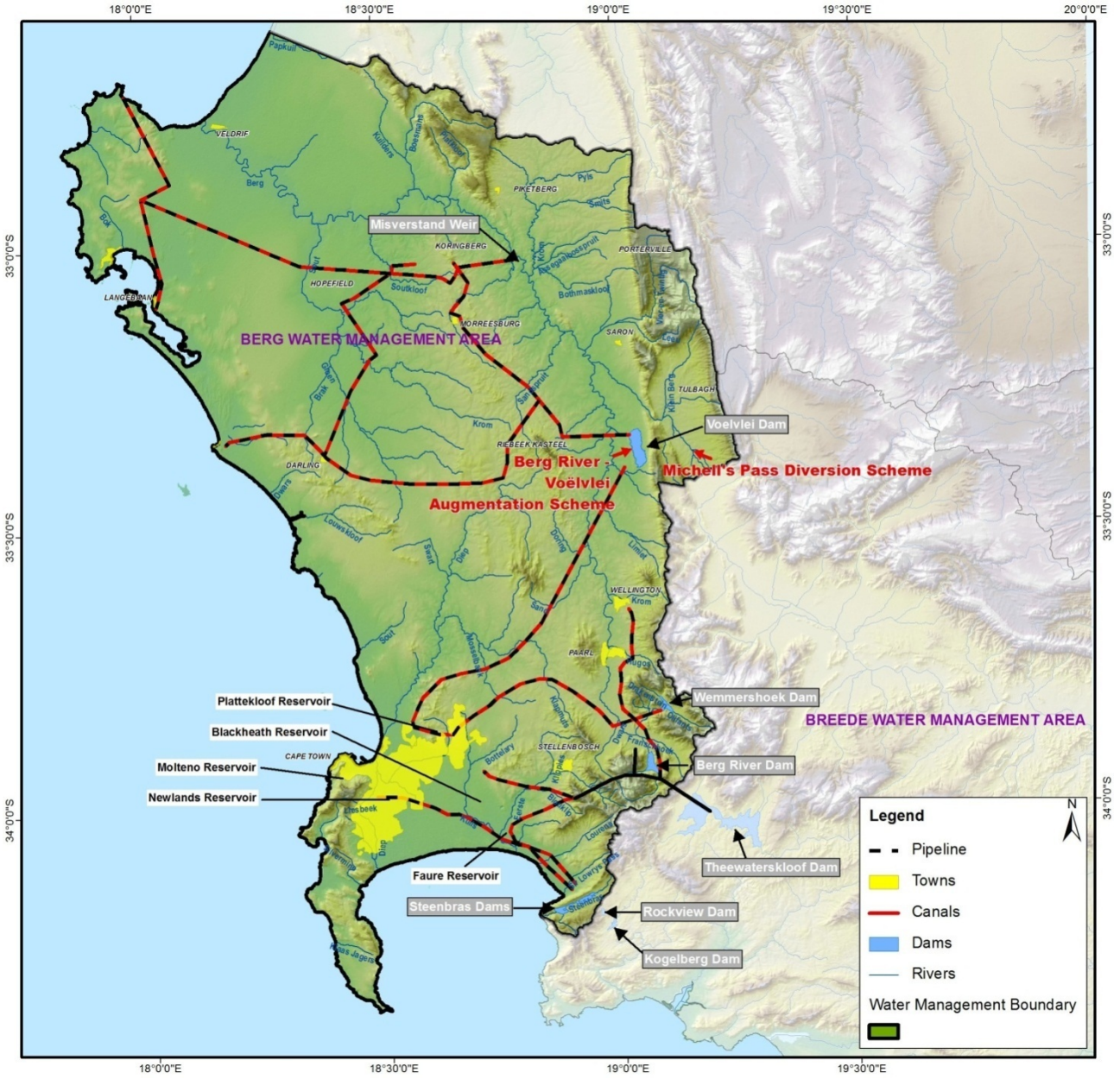

Figure 1: Relative Locations of the BRVA and BBT Schemes in relation to Voëlvlei Dam

It is important to take cognisance of the fact that these feasibility studies assessed the two schemes independently (as required by the original terms of reference). The potential implementation of either of these two schemes is based on the following fundamental approaches:

- Utilisation of spare storage capacity in Voëlvlei Dam;
- No raising of the Voëlvlei Dam wall;
- The utilisation of the spare capacity (3,16 m^3/s) during winter in the CCT's pipeline from the CCT's WTW at Voëlvlei Dam to Plattekloof reservoir;
- The potential to augment the supply to meet the growing water requirements of the West Coast District Municipality;
- The integration with proposed bulk water planning of the CCT;
- The provision for the EWRs (in summer and winter), in both the Berg and Breede Rivers and their respective estuaries;
- The recommendation that the hydrology of the Breede River system be updated via a Breede Water Availability Assessment Study (WAAS);
- That cognisance is taken of the environmental objections received during the public process meetings which indicated a strong resistance to further developments in the Breede Basin.

2.2 Overview Summary of the Berg River-Voëlvlei Augmentation Scheme

The Berg River-Voëlvlei Augmentation (BRVA) Scheme involves the abstraction of surplus winter water (after provision for the Environmental Water Requirements (EWRs) and downstream users) from a proposed low level diversion weir (less than 5 m high) across the Berg River and the pumped delivery of that water via a 6,3 km long rising main into Voëlvlei Dam. Various possible pipeline alignments were investigated and the preferred route shown in **Figure 2** would have least disruptive impact on current irrigated agricultural activities and least impact on the environmentally sensitive Renosterveld of the Voëlvlei Conservancy.

The proposed weir site (average low notch height of 3 m high) would be located on a bend in the Berg River which would be advantageous from a sedimentation management perspective, as well as being the only reach within this area where rock outcrops are visually evident. This is beneficial both from a weir foundation perspective as well as for the construction of the proposed pump station on the left bank (looking downstream).

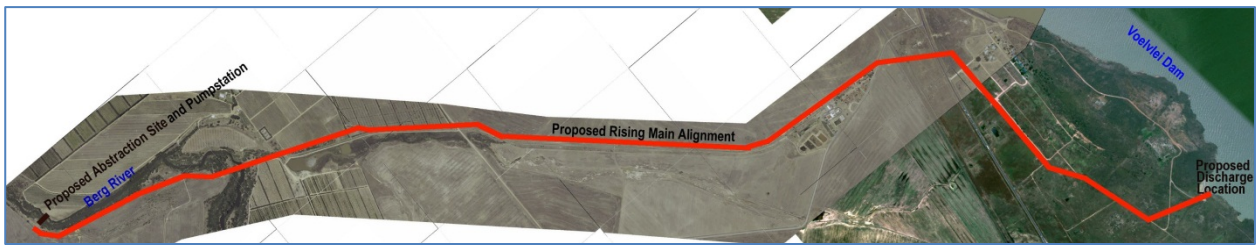

Figure 2: Proposed BRVA Scheme Layout

The scheme operation has been planned on the basis of winter abstraction from the river whilst still being able to meet the downstream EWRs for the river and the estuary in both summer and winter. A 4 m^3/s stepped pumping rule and a 6 m^3/s abstraction by means of variable speed drive pumps were considered. However from an ease of operation point of view, the 4 m^3/s stepped abstraction is preferred to that of the 6 m^3/s abstraction with variable speed pumping capacity.

The discharge location into the Voëlvlei Dam would best be sited midway between the CCT intake works and those of the West Coast District Municipality. This position would be optimum from a conveyance route and pumping perspective, as well as best for facilitating blending and mixing with the water in the dam to ensure that the best possible water quality conditions prevail at the intakes.

A more detailed description of the BRVA Scheme infrastructure is provided from **Section 3** onwards.

2.3 Overview Summary of the Berg-Breede (Michell's Pass) Water Transfer Scheme

The winter abstraction site for the BBT Scheme would be located at the same location as the DWA streamflow gauge H1H006 on the Breede River at Michell's Pass, at which a historic and current annual diversion under gravity takes place via the Artois canal diversion structure. The current diversion provides water for irrigation and towards the water supply for the town of Wolseley. The proposed scheme would effectively replace the current Artois diversion canal and would convey surplus winter water from the proposed new diversion weir (also a low level structure) at the H1H006 streamflow gauging station site to a tributary of the Klein Berg River.

The abstracted winter water would be conveyed by a gravity pipeline across the catchment divide into the tributary of the Klein Berg River. From there the water would flow into the existing Voëlvlei Dam, via the river, and the existing Klein Berg diversion weir and canal. Two winter diversion schemes were investigated both of which would supply the existing users of water from the Artois canal and would meet the summer EWR requirements of the Breede River immediately downstream of the diversion weir. During summer, the pipeline would continue to supply the existing irrigators and Wolseley and in winter would divert water to

Voëlvlei as well as supplying existing users. This would offer a significantly improved control of the irrigation supply and would further be advantageous in that it would replace the existing canal system which is known to experience water losses.

Various possible pipeline alignment options were considered, primarily to accommodate requests from landowners. These included design considerations to mitigate impacts on existing infrastructure investments, whilst ensuring the necessary hydraulic characteristics for a gravity fed scheme. The proposed weir would include a low notch, of only 2,5 m high, and as such would have no inundation impact on the environmentally important Witels River tributary, which joins the Breede River some 2,4 km upstream of the proposed weir site.

The scheme operation has been planned to abstract surplus winter water only, after first providing for the winter EWRs, whilst also reinstating the summer EWRs immediately downstream of the diversion site. Two options were considered in order to enable summer EWR re-instatement. The first would involve the possible use of surplus water in the Koekedouw Dam (14 km upstream) from which water would be released in summer to provide for the EWRs. The practicality of such releases would need to be physically tested to determine if such releases would ever reach the proposed diversion weir site in the form of surface flow, or if they would simply "disappear" into the alluvium along the 14 km upstream river reach.

A second possibility to reinstate the summer EWRs would be the construction of a storage dam on the Boontjies River (a tributary of the Klein Berg River) to store the winter diversions into that dam, from where the summer irrigation demands of the Artois users would be supplied by pumping water from the dam back up the pipeline. In so doing the current summer abstractions from the Breede River would no longer take place and the present-day streamflows at the current diversion site would be left un-diverted towards reinstating the summer EWRs at that location. **Figure 3** shows the proposed scheme layout for the scheme option involving the potential Boontjies Dam.

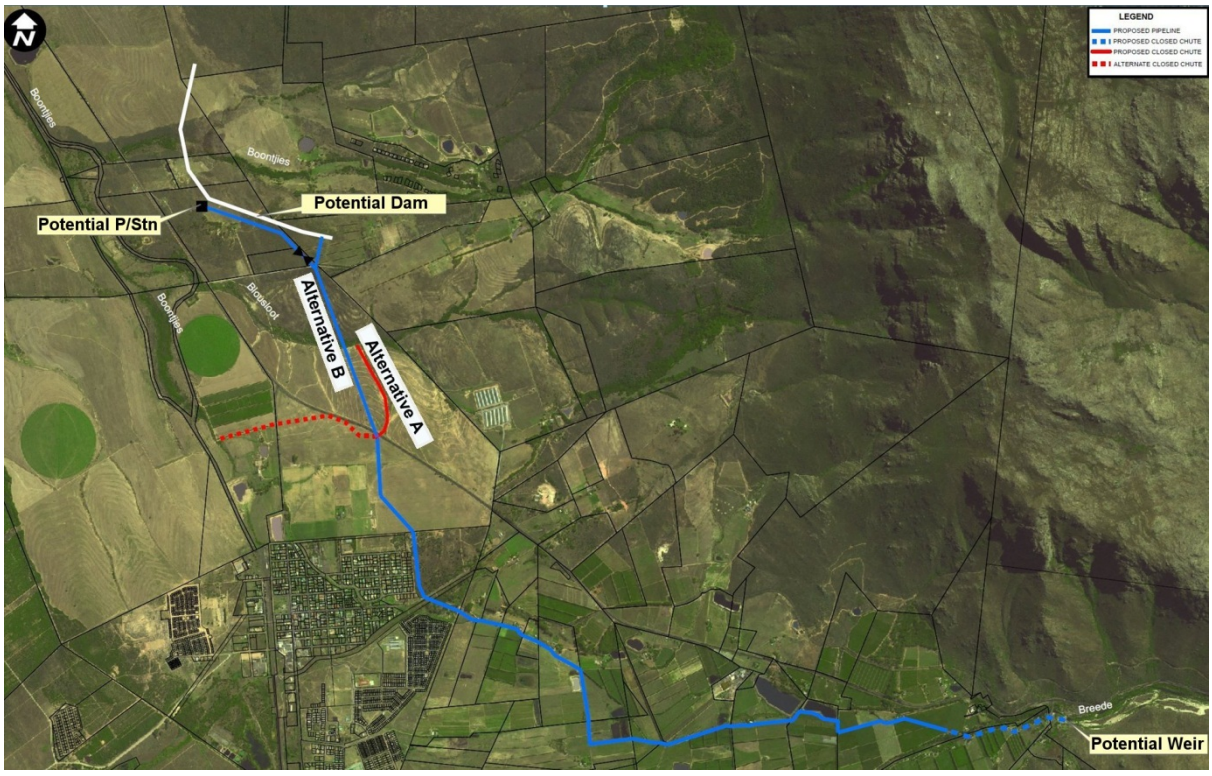

Figure 3: Proposed BBT Scheme Layout

2.4 The Preferred Scheme for Augmentation of Voëlvlei Dam

Based on the respective findings of the two feasibility studies, the BRVA Scheme has been identified as the preferred augmentation option involving the use of the existing storage in Voëlvlei Dam. A summary of the key findings and recommendations from the two feasibility studies is as follows:

Berg River – Voëlvlei Augmentation Scheme:

- The proposed abstraction site at Lorelei has favourable geology and sedimentation control characteristics and would also provide the shortest possible pipeline route to the Voëlvlei Dam.
- The proposed pipeline route offers opportunity to limit the environmental impact on the Voëlvlei Conservancy.
- The proposed rising main from the Berg River to Voëlvlei Dam would also serve as a closed conduct for making releases in summer, replacing the existing open canal which experiences substantial losses and spills.
- The water quality impacts on transferring winter water from the Berg River into the Voëlvlei Dam have been investigated and are not considered to be a limitation on the implementation of the scheme.
- The geotechnical conditions at the proposed weir site and adjacent pump station as well as along the rising main to the Voëlvlei Dam are favourable in terms of design considerations and constructability.
- Planning by the CCT's Bulk Water Department for future reservoirs and link pipelines to the existing CCT pipeline (feeding the Plattekloof Reservoir) would facilitate improved integration of this scheme into the WCWSS.
- The estimated capital cost of the two BRVA Scheme diversion capacities (4 m^3/s and 6 m^3/s) range from R 277 million to R 312 million (yielding 23 and 20 million m^3/a respectively), with URVs of R 1,52/m^3 and R 1,94/m^3 respectively (for a 8% discount rate). These URVs are considered to be relatively attractive.
- The BRVA Scheme has been assessed using the updated hydrology from the 2008 Berg WAAS.
- The 4 m^3/s diversion scheme using a stepped-pumping operating rule is proposed.
- The potential delivery of water by the BRVA Scheme would be possible by 2019, which is when the next water supply scheme to augment the WCWSS will be required.

Breede-Berg:

- An opportunity exists to reinstate the summer EWRs in the Breede River immediately downstream of the current Artois Canal diversion.
- A Breede WAAS is urgently required to enable support on decision making around any further allocations of water out of the Breede River.
- Improved streamflow gauging is an essential requirement, particularly within the reaches of the Middle Breede River.
- Of the two BBT Scheme options assessed, the option without the Boontjies River Dam is considered preferable, subject to it being feasible to make the EWR releases out of Koekedouw Dam.

- The estimated capital cost of the two BBT Scheme diversion options range from R 529 million to R 786 million (both yielding about 36 million m^3/a), with URVs of R 1,62/m^3 and R 2,37/m^3 respectively (for a 8% discount rate). These URVs are considered to be relatively attractive.
- The regional and national benefit of this additional inter-basin transfer needs to be considered in light of the current recommendations of the Breede Overberg Catchment Management Agency's (BOCMA) Catchment Management Strategy which does not encourage further water resource development at this scale, from the Breede River.
- The potential delivery of water from the BBT Scheme would only be possible by 2023, and would not be able to meet the current projected need for supply by 2019.

In comparing the BRVA Scheme and the BBT Scheme, the BRVA Scheme options appear to be the more favourable surface water intervention option, albeit only able to yield 20 to 23 million m^3/annum and therefore to augment the WCWSS system to accommodate about 2 to 3 years of future growth in demands. It is a scheme that can be implemented within the current planning horizon of the Western Cape Reconciliation Strategy.

Based on the above introduction and comparative recommendations between the BRVA Scheme and the BBT Scheme Feasibility Studies, the remainder of this Record of Implementation Decisions Report focuses on the preferred option, namely the BRVA Scheme.

3. THE BERG RIVER-VOËLVLEI AUGMENTATION SCHEME

3.1 Existing Scheme

Existing diversion schemes from the Klein Berg River and from the Leeu River and the Twenty Four Rivers divert water into two canal systems which feed into the existing Voëlvlei Dam (owned by DWA). The dam has an estimated yield of 105 million m^3/a, but is currently over-allocated. Both the West Coast District Municipality (WCDM) and the CCT own and operate WTW which are supplied from the Voëlvlei Dam. From the CCT WTW, a 1,5 m diameter pipeline of 80 km length conveys treated water that is pumped from the WTW to the City's Plattekloof Reservoir. This pipeline only has spare capacity in winter and this places a key constraint on the future uptake of water from the proposed scheme.

3.2 Proposed BRVA Scheme

The proposed scheme would meet downstream water users' entitlements and the EWR based on a Category D River. An estuary requirement of 0,5 m^3/s in the summer was determined during the Reserve determination and allowance for providing the necessary contribution to this from the Voëlvlei Dam has been made. The abstraction would be carefully managed and only operated during 4 to 5 months during the winter. The preferred site for the weir has a number of advantages, namely:

- it is located in the vicinity of a bend in the river (which assists in dealing with sedimentation);
- it is positioned at the only location near to the Voëlvlei Dam at which rock outcrop is evident;
- it provides the shortest possible pipeline route from the river to the dam, with least impact on established irrigation and on the environment; and
- it offers opportunity to replace the inefficient outlet canal from the Voëlvlei Dam by utilizing the rising main in reverse (under gravity) during summer.

3.3 Proposed Scheme Operation and Yields

Two abstraction approaches were considered both of which are designed to meet the EWRs before abstraction commences. These were:

i. A 4 m^3/s stepped-pumping rule operated in increments of 1 m^3/s, yielding 23 million m^3/a.

ii. A 6 m^3/s variable speed pump abstraction yielding 20 million m^3/a.

The 4 m^3/s option would be simpler to operate and would not require real-time operation and monitoring as would the significantly more difficult operation of the 6 m^3/s option, which would be equipped with variable speed drive pumps.

The Berg Water Availability Assessment Study (WAAS) of 2008 provided the hydrology for the assessment of the BRVA Scheme.

4. HYDROLOGICAL STUDIES AND SYSTEM YIELD

4.1 Hydrological Studies

The monthly streamflow sequences for both naturalised and current-day conditions, used in this study of the BRVA Scheme were derived from the following DWA Project: *"The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models" (DWAF 2008)"* (abbreviated to "Berg WAAS".)

The Berg WAAS, conducted by Ninham Shand in association with Umvoto, was completed in 2008 and comprised, amongst others, a complete update of the streamflow hydrology of the Western Cape System Analysis (WCSA). The WCSA Study (DWAF 1993) incorporated data up to the 1990/91 hydrological year.

The Berg WAAS comprised a comprehensive review and update of the surface water and groundwater hydrology and water use of all the catchments that form part of the greater Western Cape Water Supply System (WCWSS). These catchments include the Berg, Upper Eerste, Palmiet, Steenbras, Upper Breede and Upper Riviersonderend Rivers. The primary purpose of the Berg WAAS was two-fold; namely, to provide updated information to support planned feasibility studies for augmentation of the WCWSS, as well as to inform future water allocation decisions in the related catchments.

In the Berg WAAS the original WCSA catchment models were updated by extension of all input data, re-configuration and re-calibration. Land-use and water-use sequences, as well as infrastructure changes after 1990, were determined and thereafter configured in the WRSM2000 catchment model, up to the hydrological year, 2004/05. Monthly rainfall, evaporation and streamflow records after 1990 and up to 2004/05 were processed and thereafter incorporated in the WRSM2000 model. These updates allowed the Pitman rainfall-runoff model imbedded in WRSM2000 to be re-calibrated at selected streamflow gauging sites, using the WCSA Pitman parameters as starting values. The re-calibrated Pitman model parameters were used to generate naturalised monthly streamflow sequences at all points of interest in the WCWSS.

For the yield analyses related to the BRVA Scheme, the Berg WAAS naturalised streamflow sequences were incorporated in the WRYM system model of the WCWSS.

4.2 Water Resource Yield Model (WRYM) Adjustments

The following adjustments were incorporated into the WRYM in order to improve the estimates of the system yield for the WCWSS and to enable streamflow generation at specific points of interest.

- EWR nodes were introduced at specific points of interest.
- Adjustments were made to the Theewaterskloof Dam evaporation and to lake rainfall data.
- An analysis of actual spills from Kleinplaas Dam was undertaken and introduced into the model.
- Alternative approaches to the modelled operation of the Berg River Dam Supplement Scheme were investigated.

These adjustments were introduced to arrive at an improved base yield from the system, which was then used to assess the net yield increase to the system with the introduction of the proposed new scheme.

4.3 Yield Analysis and Impact on Overall System Yield

The yield analysis of the proposed BRVA Scheme was based on the assessment of its overall contribution to the yield of the WCWSS. The integrated model of the WCWSS was used to incorporate the proposed scheme as illustrated in **Figure 4.**

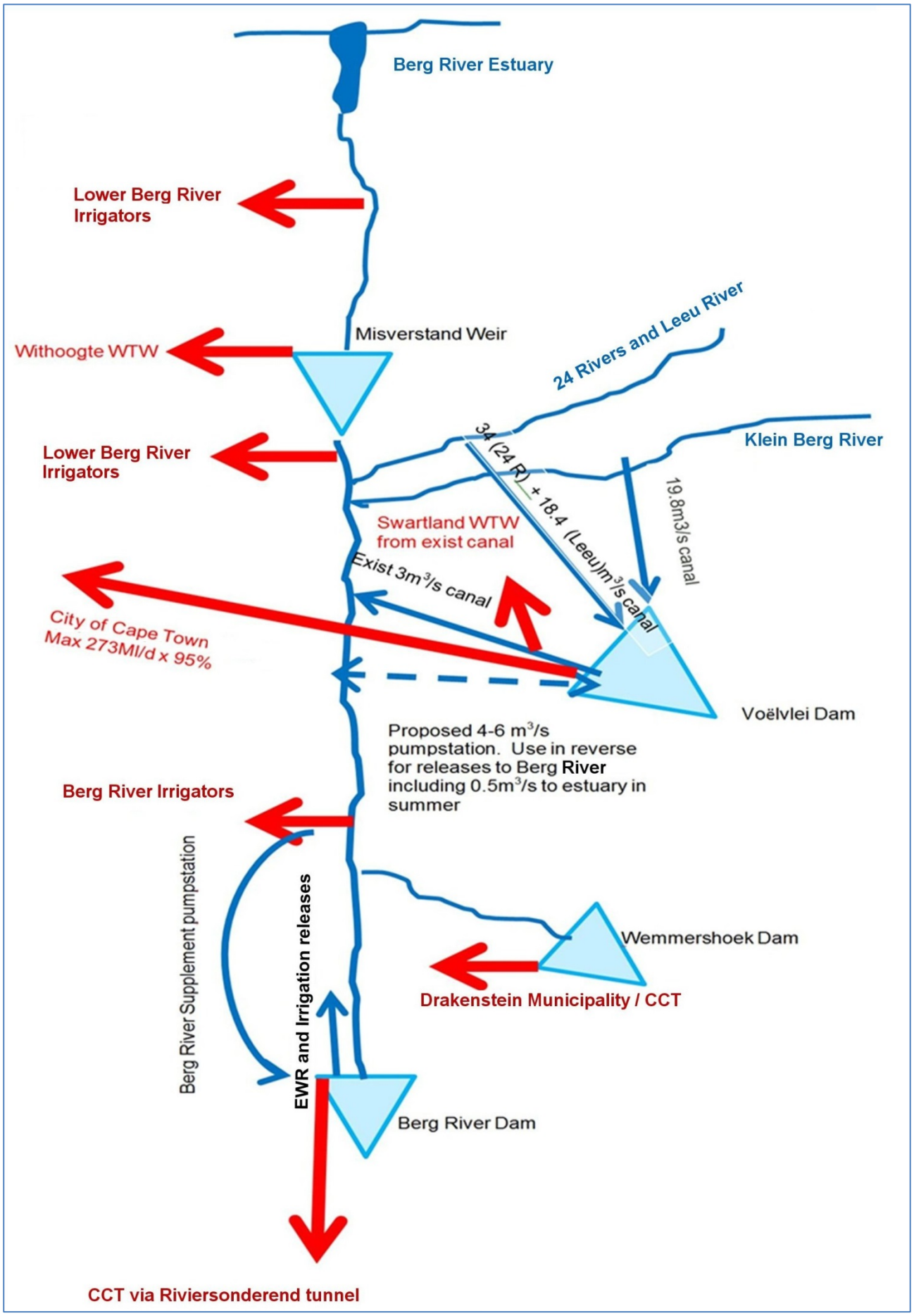

Figure 4: Schematic Presentation of the BRVA Scheme

The overall system yield of 529 million m^3/a (after the above adjustments) increased to:

- 549 million m^3/a for a 6 m^3/s abstraction (20 million m^3/a increase)
- 552 million m^3/a for a 4 m^3/s abstraction (23 million m^3/a increase)

4.4 Scheme Operation to Comply with the EWRs

Flow Duration Frequency Curves were used to assess the modelled compliance of the proposed BRVA Scheme with the required downstream EWRs. **Figure 5** shows the resultant Berg River flow after the 4 m^3/s (green) and 6 m^3/s (red) options in two selected winter mouths, namely June (1st month of abstraction) and August (3rd month) of abstraction, compared to the required EWR baseflow (blue) in each month.

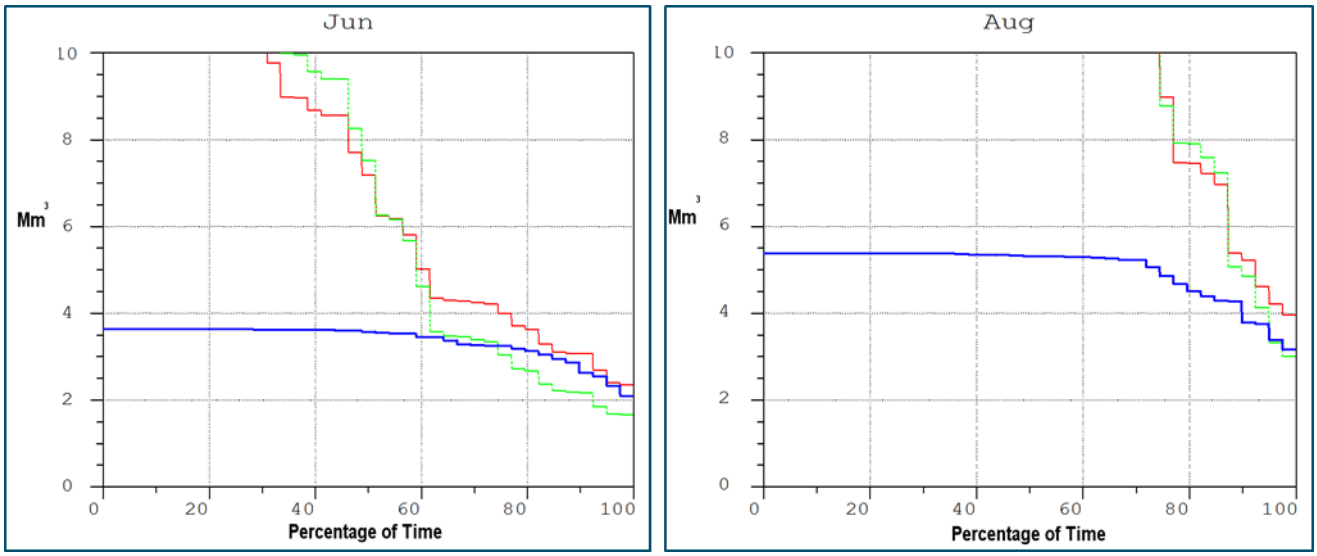

Figure 5: Typical winter Low Flow Duration Frequency Curves for 4 and 6 m^3/s Abstraction

The figure shows that in June for example, the 4 m^3/s resultant flow is slightly less than the baseflow incremental requirement 25% of the time whereas in August, it meets the requirement 98% of the time. In both months shown, the resulting river flow after the 6 m^3/s diversion (variable speed pumping) meets the EWR requirement almost all of the time. Although theoretically the 6 m^3/s appears more favourable from an EWR perspective, the practical implementation of continually varying the abstraction rate would be operationally very cumbersome and therefore the 4 m^3/s option was selected.

5. WATER REQUIREMENT PROJECTIONS AND RECONCILIATION

Figure 6 shows the historical and future water requirement projections for the urban and agricultural sectors from the WCWSS. This shows that by 2019, even if the targeted water conservation and demand management goals are achieved, the current yield from the system will move into a deficit. As such by the end of 2018 there will be a risk of water restrictions if augmentation of the system has not been implemented by then. **Figure 7** shows the influence of the BRVA Scheme in the reconciliation planning for the WCWSS.

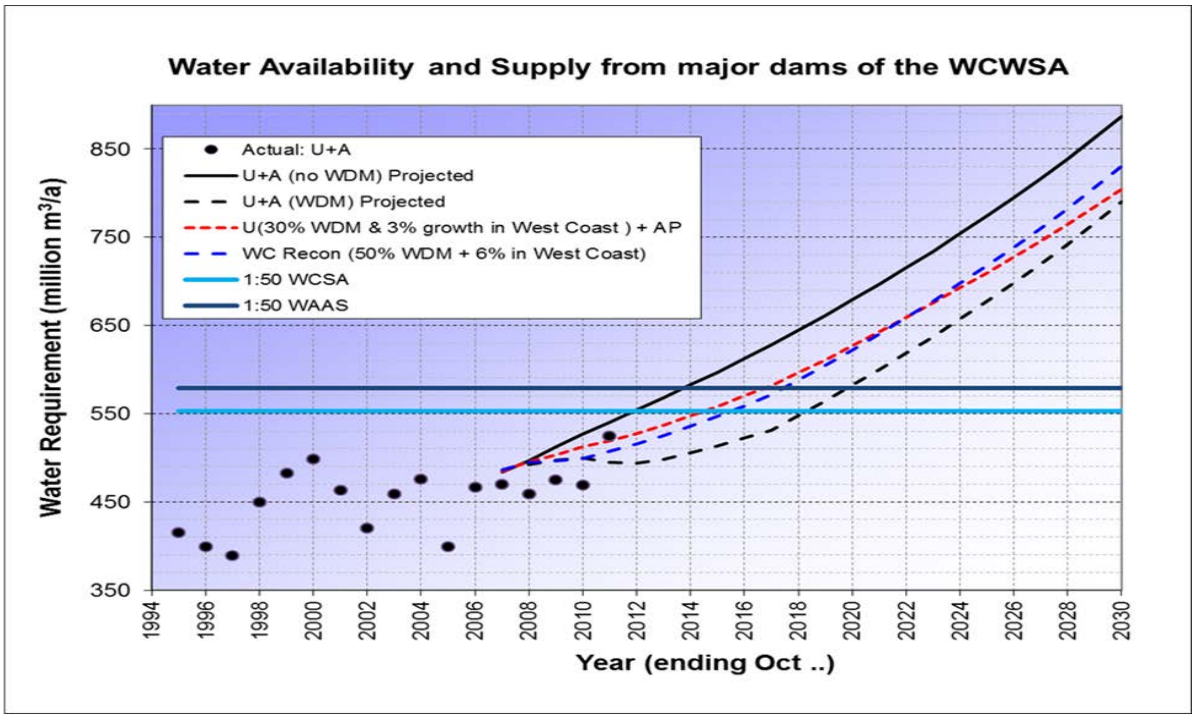

Figure 6: Water Requirement Projections for Total Supply from the Major Dams

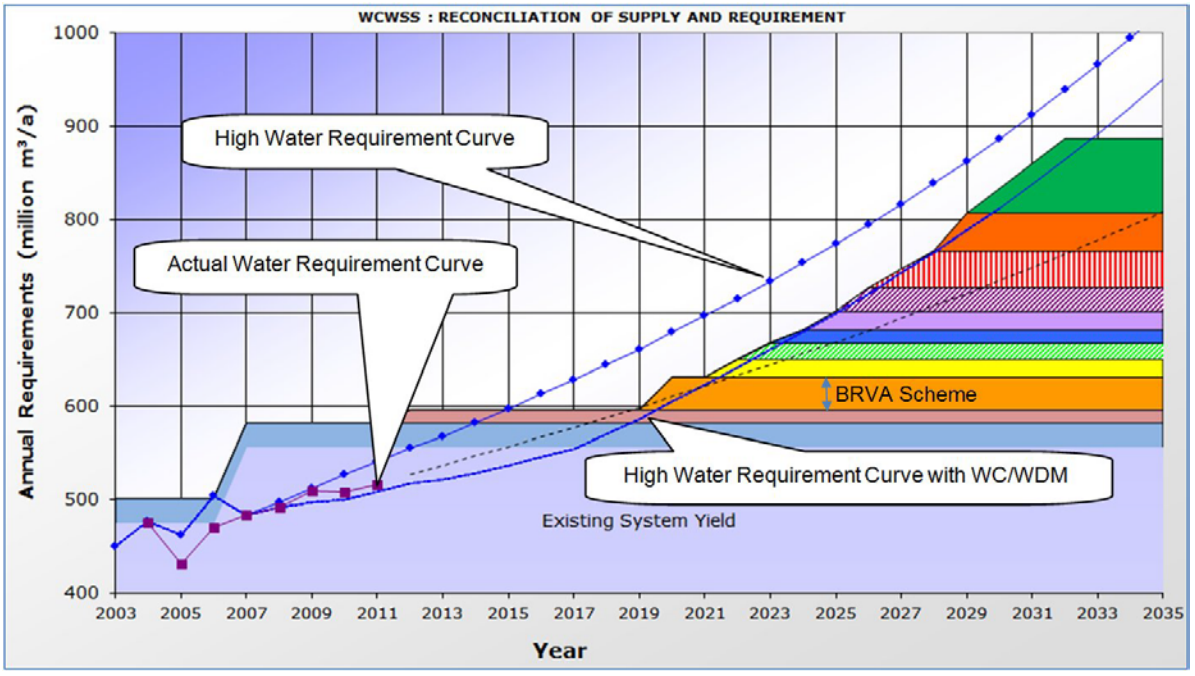

Figure 7: Reconciliation of the WCWSS showing the Impact of the BRVA Scheme

6. WATER QUALITY

Three fundamental aspects relating to water quality were investigated in the BRVA Scheme Feasibility Study, namely:

i. the assessment of the impacts of nutrient transfers from the Berg River into Voëlvlei Dam;

ii. the assessment of water quality changes during the winter high flow events in the Berg River; and

iii. the optimal location from a blending perspective for the discharge of Berg River water into Voëlvlei Dam.

The outcomes are briefly discussed hereafter.

6.1 The impact of Nutrient Transfers into Voëlvlei Dam

The CE-QUAL-W2 model was applied to determine the Berg River nutrient transfer impact on the mixed water quality in Voëlvlei Dam. The results indicated that:

- Increased nitrogen and Chlorophyll-a concentration may lead to aggravated problems with nuisance algae and increased treatment costs.
- Algal blooms have occurred more frequently since the 2004/5 drought at which time the dam changed from a clear-water to a turbid state (dominated by free-floating algae). This may be further aggravated by implementation of the scheme.

6.2 Berg River Water Quality during 2011 Flood Events

A sampling routine and protocol was developed and a monitoring program implemented to determine the changes in water quality characteristics during high flow events in the winter of 2011. The key findings were that:

- during early-winter high flows elevated concentrations of sediments, E.coli and phosphate could be expected;
- during mid-winter events higher salt concentrations but lower phosphates, sediments and E.coli could be expected; and
- the timing of the first transfers in each winter should preferably be delayed until the first few high flow events have passed the abstraction site.

6.3 Dispersion and Blending in the Voëlvlei Dam

The CE-QUAL-W2 dynamic reservoir model was applied to assess the impact (in particular eutrophication) of the Berg River winter abstractions stored in the Voëlvlei Dam. It was determined that the optimum location for the discharge structure would be mid-way between the WCDM's and CCT's intake works (at the proposed Southern Outlet Structure shown in **Figure 8**). The modelling results suggest that under average conditions of water depth in the dam, wind direction, wind strength, flow velocity along the shoreline, horizontal diffusion rates and bacterial decay rates, bacterial counts at the two intake works could be expected to be very low (even when E.coli counts in the Berg River are at their highest).

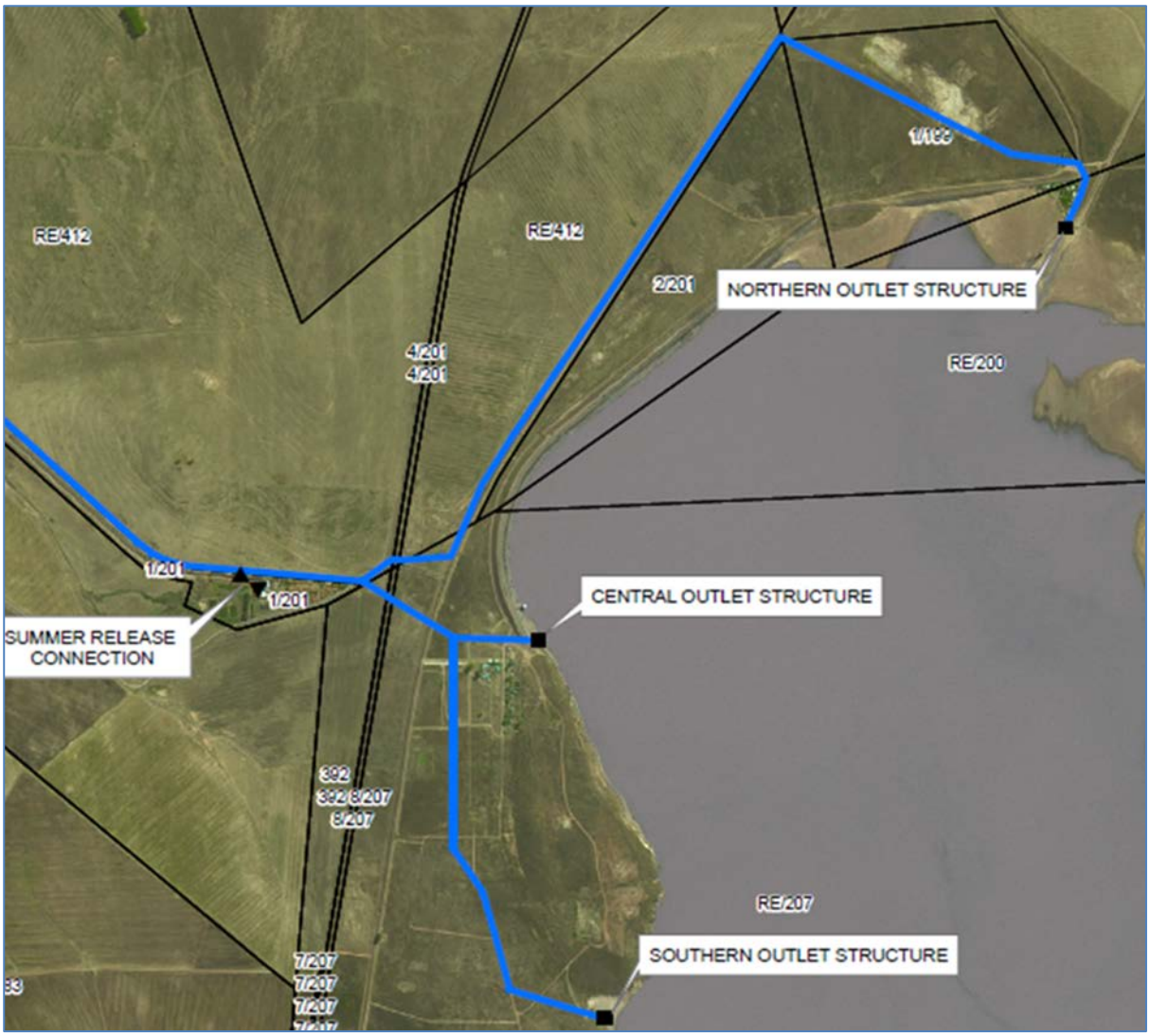

Figure 8: Potential Discharge Locations (Southern location is preferred)

7. SCHEME INTEGRATION AND POTENTIAL UTILIZATION OF WATER

The integration of the proposed scheme into the existing WCWSS is a critically important technical and operational consideration. Making use of the existing infrastructure, notably the Voëlvlei Dam, the WCDM and CCT WTWs and the 80 km pipeline to Cape Town, is fundamentally critical. The vulnerability of the pipeline to Cape Town varies along its length, however the City employs a dedicated maintenance team on permanent stand-by to repair pipe leaks and breaks.

Figure 9: Typical Pipe Burst on the CCT's Potable Water Pipeline from the Voëlvlei Dam

It is not anticipated that there will be any problems at either of the two water treatment works at the dam, or at the WCDM's Withoogte WTW at Misverstand Dam, in treating the resulting blended water.

The CCT is currently undertaking the planning of a new reservoir close to the Voëlvlei pipeline and of new link pipelines which will enable water available from its Voëlvlei WTWs to be reticulated to a wider reach and to additional growth nodes which can currently not be supplied from its existing distribution network. Taking this into account, it is considered likely that the full incremental yield from the BRVA Scheme could potentially be utilized by the CCT. This can be achieved without augmentation of the existing CCT pipeline. There is also opportunity to supply the increasing West Coast growth node, and towards addressing irrigation supply shortfalls of the Lower Berg River irrigators.

Further development of subsequent phases of Voëlvlei Dam Augmentation, such as the possible implementation of the BBT Scheme as well, would require a raised dam, and there is a strong possibility that the 1,5 m diameter (80 km long) pipeline to Cape Town would need to be duplicated or replaced. Both of these infrastructure requirements (dam raising and pipeline), and particularly the pipeline would require a significant capital investment.

8. INFRASTRUCTURE PRELIMINARY DESIGN

8.1 Geotechnical Investigations to Support Preliminary Design

The preliminary design of the scheme was undertaken after the completion of the LiDAR Aerial Survey for the scheme footprint area as well a detailed geotechnical investigation. The geotechnical investigations involved core drilling at the proposed Lorelei diversion site, the opening of trial pits, logging and photographing of cores and trial pits, materials testing and reporting. **Figure 10** shows the positions at the Lorelei site where core drilling was undertaken.

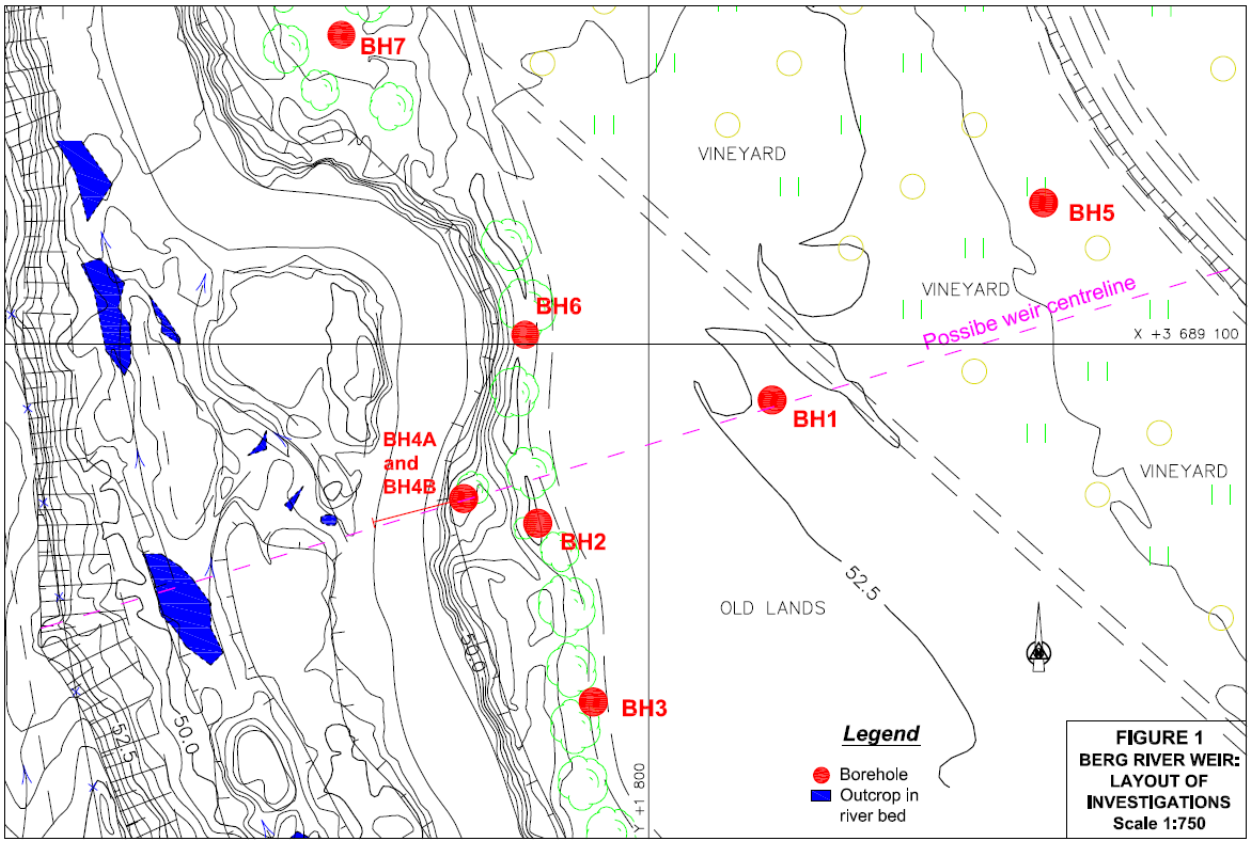

Figure 10: Core Drilling Locations at the Lorelei Diversion Site

The cores extracted during the geotechnical investigations at the Lorelei Site were handed over by the Western Cape Water Consultants Joint Venture to DWA's Operations Control Officer (Liezl Magalie) at Voëlvlei Dam on 14 February 2013. The 13 core boxes are stored at the DWA premises at the dam.

The outcome of the geotechnical investigation was that the proposed site for the weir and pump station was well suited for siting of this infrastructure. Furthermore the trial pit investigation along the proposed pipeline route for the rising main indicated suitable geotechnical conditions, although there will be a possible need to import selected backfill material during construction of the rising main. **Figure 11** shows the diversion weir site and the pump station location. The proposed rising main would cross under the Berg River about 1 km upstream from the weir.

Figure 11: Abstraction Site, Pump Station, Rising Main and Berg River Crossing

8.2 Rising Main Pipeline and Pump Station

The recommended pipeline sizes would be 1,7 m and 1,9 m diameter for the 4 m^3/s and 6 m^3/s conveyance capacities respectively. Glass-reinforced plastic (GRP) pipes have been recommended for the 6,3 km long rising main. For comparative purposes, the use of ductile iron has also been considered and the price differential is provided in **Section 11**. The proposed raw water pump station was designed for both the 4 m^3/s and 6 m^3/s schemes to deliver to the southern discharge point in Voëlvlei Dam, located mid-way between the WCDM's WTW and that of the CCT.

8.3 The Lorelei Diversion Weir on the Berg River

The proposed Lorelei weir was designed to accommodate the 1 in 100 year flood peak of 1500 m^3/s. **Figure 12** shows the hydrographs for various flood magnitudes at the proposed Lorelei diversion site on the Berg River.

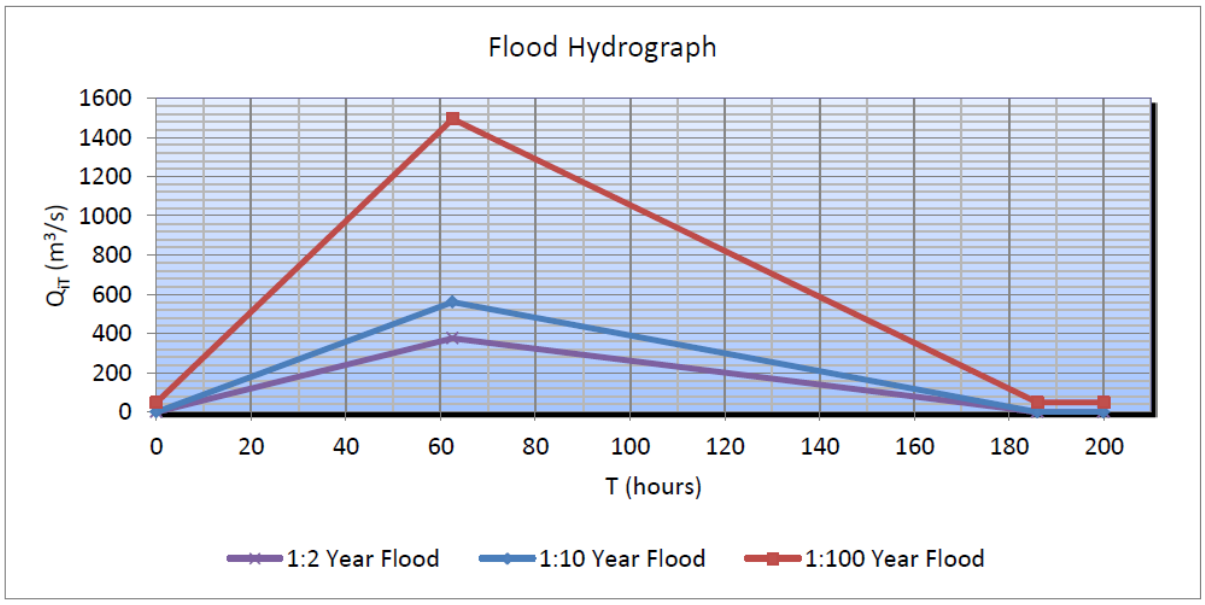

Figure 12: Flood Hydrographs at the Lorelei Site

The highest flow velocity at the abstraction site would be on the outside of the bend where the abstraction works would be sited. The bend effect would assist in limiting the abstraction of coarse sediment.

The proposed abstraction works layout is shown in **Figure 13**. This includes:

- A Crump weir.
- An earth embankment (with flood protection) on the right floodplain.
- A boulder trap with radial gate for flushing.
- A gravel trap with 2 canals, divider walls and radial gates for flushing.
- Trash racks and hoppers with jet-pumps.
- Pump intakes (using a dry well design).

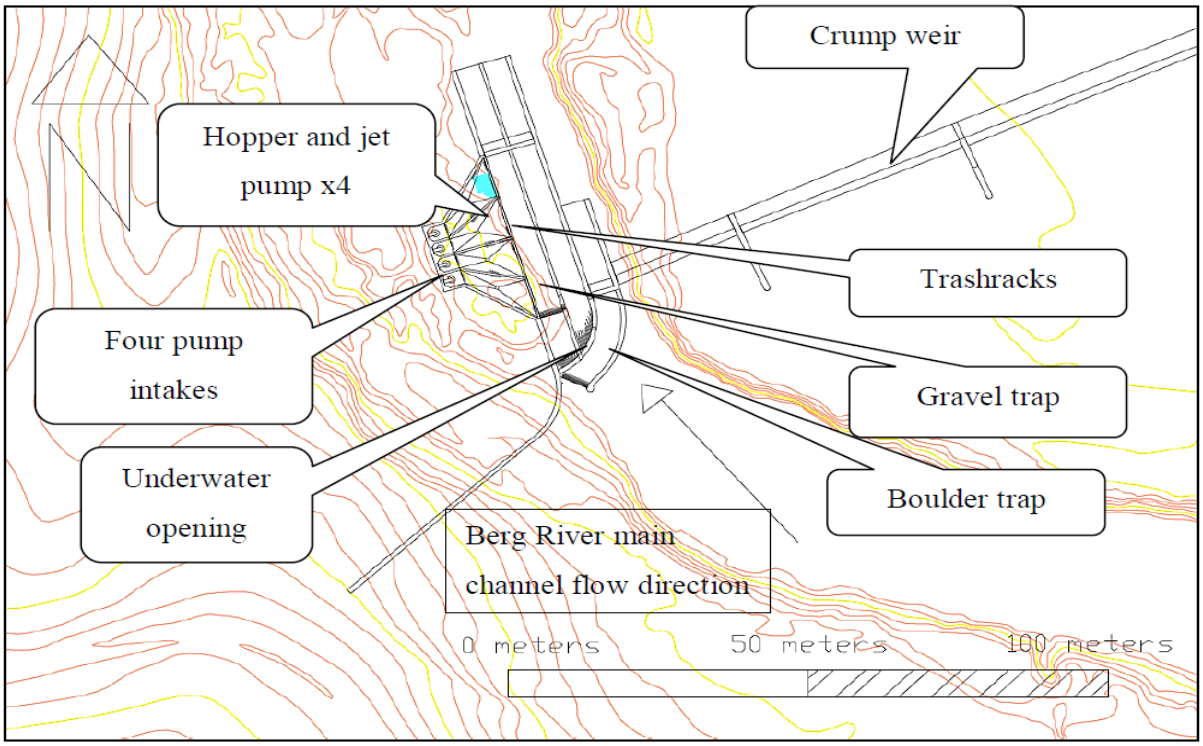

Figure 13: Plan View of Proposed Abstraction Works

The cross-section of the proposed abstraction works is shown in **Figure 14**. The average low notch level of the weir is only 3 m high (above the lowest bed level), to be founded on solid rock, thus not requiring an energy dissipation structure. Due to the low level nature of the abstraction weir, the upstream inundation effect was determined to be negligible.

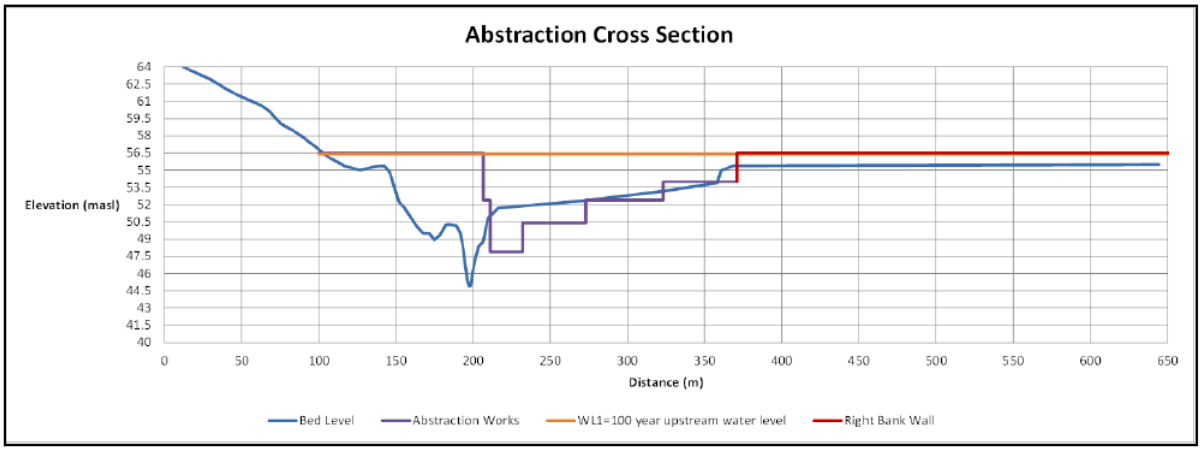

Figure 14: Cross Section of the Proposed Weir and Abstraction Works

A fish ladder similar to the rock-ramp type shown below is proposed and would be U-shaped approximately 0,9 m wide with broad concrete steps every 2 m. The base of the steps would make use of grouted stone pitching.

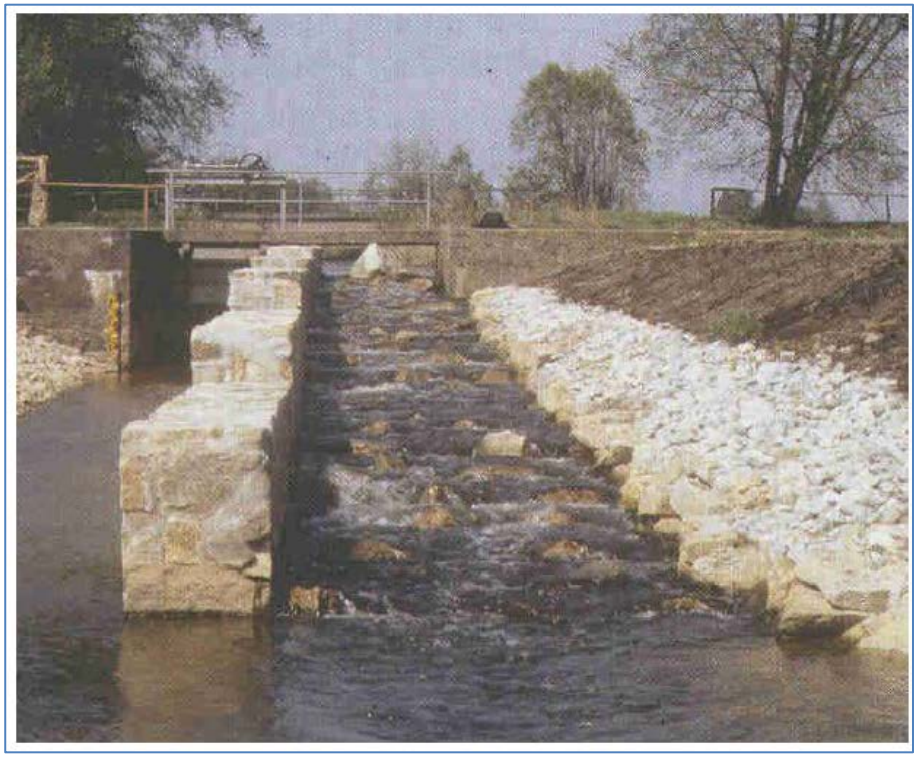

Figure 15: Typical Rock-Ramp Fish Ladder Structure

8.4 Operation of the Abstraction Works

The operation of the pumps themselves is described in **Section** 3. In terms of the weir operation, the following is envisaged:

- The structure would be self-scouring for floods larger than 1:5 years.
- The gravel trap would be flushed during small floods or at the tail-end of large floods.
- The boulder trap would be flushed before the gravel trap to keep coarse sediment out of the gravel trap.
- Flushing of the pump bays would be by means of submerged jets.
- The rising main should be operated from time to time at a velocity greater than 2 m/s, or alternatively mechanically cleaned, to limit sediment deposition so as to prevent the resulting increased friction losses from occurring.

8.5 Public Utilities

The construction of the proposed BRVA Scheme will have limited impact on existing roads and infrastructure within the footprint of the scheme. The full extent of the impacts will need to be determined during the detailed design of the scheme where construction approaches to road and rail crossings (such as pipe-jacking) will need to be considered. The following infrastructural issues arising from the proposed scheme were taken into consideration during the preliminary design:

- The continued provision of access to residences, farmsteads and cultivated land along the proposed pipeline route.

- The incorporation of stakeholder suggestions into the preliminary design in relation to existing farmlands and on-farm investments, including irrigation infrastructure, homesteads, farm buildings, holiday cottages, farms dams, etc.
- The selection of pipeline routes to minimise the impact on the Voëlvlei Conservancy, most notably the Renosterveld areas therein.
- The loss of land within the footprint area of the scheme, including the weir and pump station sites as well as the pipeline servitude.
- One-on-one meetings were held with each landowner along the pipeline routes as well as specific additional presentations to concerned landowner groups and where possible, their concerns were incorporated in the preliminary designs.

8.6 Acquisition of Land

The need to purchase land will be necessary for the Project. In particular, the expropriation of entire farms will not be necessary, although portions of farm land will be required to accommodate the diversion weir and pump station sites. In this regard, the owner of the Goudklip Farm on which the left abutment (looking downstream) of the diversion weir and the proposed pump station would be sited, has indicated his intention to further develop that area and is not in support of the project.

In terms of the pipeline route servitude to the Voëlvlei Dam, no strong objections from landowners were observed during the public participation process, although this will need to be confirmed during the environmental impact assessment (EIA).

8.7 Permanent Servitude for Access

Permanent access will be required to the weir, pump station and pipeline servitude. Access to the pump station (on the opposite side of the river) is proposed via the Sonquasdrift weir causeway, requiring an access road from the weir to the pump station across private farmland. This causeway is often submerged during periods of high flow in the Berg River and as such the alternative access would be via the existing Berg River bridge crossing near Hermon.

8.8 Fencing of Project Land

During construction, the weir and pump station site shall be fenced off according to DWA standards. The size and types of access gates, number and positions required, and the type of locking mechanisms shall be decided upon during implementation. Fencing shall also be required at any Eskom switchyard, according to Eskom standards.

9. GENERAL CRITERIA

The scheme will involve the augmentation of the existing Voëlvlei Dam which is a Government Water Works in accordance to the National Water Act, 1998 (Act 36 of 1998) Chapter 11. The implementation of the project shall therefore adhere to the general requirements stipulated in Chapter 11 of the Act.

9.1 Design guidelines

Guidelines for design can be found in documents, such as “Technical Guidelines for Planning and Design in the Development of Water and Sanitation Services” (2nd edition, 2004). These guidelines should be used together with Regulations Regarding the Safety of Dams (February 2012), SANCOLD Guidelines and the South African Bureau of Standards (SANS Codes).

9.2 Current best practices and efficiency

Current Best Practices and Efficiency and where applicable, international standards shall be applied to the design, construction, supervision and operation of the works. Detailed design and construction of the works shall be undertaken under supervision of a Professional Engineer with relevant experience.

9.3 Electricity supply

Secured supply of electricity will have to be given priority against the background of current ESKOM shortages. Agreement should be reached with ESKOM so that sufficient continuous power will be provided during winter months when the scheme will operate, a time when the national grid is typically already under pressure. The details of the required electrical supply need to be finalised during the detailed design phase.

9.4 Security measures

The project shall be implemented in compliance with the requirements for DWA infrastructure as defined in the National Water Act, 1998 (Act No. 36 of 1998) and the Manual on Physical Security Measures at Departmental Works and Schemes.

9.5 Land matters

Land rights (including servitudes) to implement and operate the required infrastructure shall be acquired in accordance with Departmental Policy, the Appropriation Act and the Constitution of South Africa.

9.6 Construction timing

Any construction work undertaken in the river channel and weir abutments shall as far as possible take place during the dry season in order to avoid possible flooding and associated damages of the works during the wet season.

9.7 Construction housing

The contractor will be responsible for accommodation for his employees during construction. Housing needs for permanent staff shall be identified through consultations with the operators, municipalities, local communities and landowners.

9.8 Quality assurance and control

Quality assurance shall be in terms of ISO 9001-2000 or functionally equivalent standards. All Consultants and Contractors shall be required to compile Quality Assurance Plans for the works and these shall be rigorously applied, monitored and reported on. The quality control aspects will follow logically from the aforementioned processes where it will culminate in the production of suitable reports, drawings, specifications and manuals meeting the operational and maintenance requirements of the Project.

9.9 Maintenance philosophy

The maintenance philosophy to be followed with the implementation of the project shall *inter-alia* comprise of the following points:

- The maintenance programmes shall be based on a planned preventative maintenance approach to meet the system availability criteria, which requires the assurance of supply for the users (including for the environment) as determined in the operating rules.
- Infrastructure at the structures shall allow for the removal and loading of equipment onto transport vehicles. Suitable maintenance and inspection procedures, including an asset register, shall be provided as part of the O&M manuals to ensure that the operator is able to proactively maintain the components.
- A spares philosophy for the major equipment shall be proposed and recorded in the O&M manuals.
- The assessment of the time periods required to carry out all maintenance during scheduled downtimes and seasonal operation requirements of the system is important. Planning for maintenance periods, with a one to two-year moving window, will ensure that inspections and repairs will be scheduled within operational and financial constraints. Plant and equipment that are easily maintainable are preferred. The maintenance work should preferably be carried out during periods of low water demand from Voëlvlei Dam, with flexibility made possible through the integrated nature of operation of the WCWSS.
- Prior to handover, the operators shall receive training on minor maintenance works by the Engineer and appropriate contractors, as applicable.
- Bulk water users shall be notified in advance of any shutdowns for planned maintenance, as per the operating rules. In case of shutdowns for emergency repairs, bulk water users shall immediately be notified.

9.10 Agreement between IWRP and Infrastructure Development

The conditions specified in the Memorandum of Agreement between the Chief Directorates Integrated Water Resources Planning (IWRP) and Infrastructure Development (ID) shall be adhered to.

10. COMPLIANCE WITH APPLICABLE LEGISLATION, REGULATIONS AND POLICY

10.1 Environmental Authorisation

The scheme would need to comply with the following relevant legislation, but not limited to:

- National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998)
- National Water Act (NWA), 1998 (Act No. 36 of 1998)
- National Heritage Resources Act (NHRA), 1999 (Act No. 25 of 1999)
- Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)

Environmental Impact Assessment:

The proposed BRVA Scheme would need to comply with the requirements of all relevant legislation, including (but not limited to) NEMA, NWA and NHRA. Specialist input and assessments would be required to provide the decision-making authorities with sufficient information to make an informed decision. Some of the requisite studies may need to be completed during a specific season to ensure a comprehensive assessment of potential impacts on the environment, e.g. botanical assessment. These studies should be carefully planned to prevent any unnecessary delays to the project programme. It is also important to ensure that project information provided to specialists and the Environmental Assessment Practitioner (EAP) does not change significantly during the EIA process as it could potentially necessitate the revision of assessments. Therefore it is recommended that a design freeze should be applied to the project to prevent unnecessary costs and programme delays during the EIA process.

Furthermore, it is important for DWA to take into consideration the EIA process timeframes when undertaking forward planning to meet future water requirements, as it can take up to 18 months (or in some cases even longer) to receive environmental authorisation. However, activities and timeframes involving the authorities cannot be guaranteed and should be considered as variable in the programme.

An independent EAP will need to be appointed to ensure compliance with the requirements of Section 17 of EIA Regulations. Once the EAP has been appointed, a public meeting should be undertaken to allow the Western Cape Water Consultants to present the technical findings in order to update Stakeholders and Interested and Affected Parties on the current project status and the way forward. The meeting would also familiarise Stakeholders and Interested and Affected Parties with the EAP and the EIA process to be undertaken.

Environmental Management Plans

The conditions and process requirements contained in the environmental management plans (EMPs) for the construction period should be incorporated into any tender documents and compliance to it should be compulsory for any contractor in terms of the tender documentation.

During the detail design the environmental specifications will need to be developed to ensure that the potential construction impacts of all aspects of the programme and anticipated works are controlled. A detailed riverine monitoring programme will also need to be developed. This will need to specify all significant monitoring criteria, thresholds and appropriate responses to potential situations during construction.

Any borrow or quarry areas for construction materials will need to comply with the conditions and process requirements contained in the EMPs for the construction period. These should be incorporated into any tender documents and be compulsory for any contractor in terms of the tender documentation.

10.2 Other Statutory Requirements

In addition to the statutory requirements mentioned elsewhere in this document, such as environmental authorisations, all applicable requirements specified by legislation and state regulations shall be complied with. Of particular note is the requirement for water use licences to be obtained before construction of new waterworks.

11. FINANCIAL EVALUATION

Table 3 summarises the capital costs of the two potential BRVA Scheme options, namely the 4 and 6 m^3/s abstraction schemes.

Table 3: Capital Costs for the Scheme

Cost Item	Scheme Option: costs in R(millions)	
	4 m^3/s	**6 m^3/s**
Weir at Lorelei	35,12	35,12
Berg River Pump Station (Mech/Elec)	38,33	48,09
Berg River Pump Station (Civil)	6,25	6,25
Rising Main to Voëlvlei Dam	120,94	137,50
Voëlvlei Dam outlet structure	0,05	0,05
Berg River protection	0,11	0,11
Contingencies (10% of above)	20,08	22,71
SUB-TOTAL CONSTRUCTION COST	**220,87**	**249,83**
Professional fees	17,20	19,19
Servitude & property	5,04	5,04
TOTAL CAPITAL COST EXCL. VAT	**243,11**	**274,06**
VAT @ 14%	**34,04**	**38,37**
TOTAL CAPITAL COST INCL. VAT	**277,14**	**312,43**

Annual Operation and Maintenance Costs for the Civil Works have been based on 0,5% of the civil capital cost, and the Mechanical and Electrical O&M on 4% of the mechanical and electrical capital cost. The economic analyses also make allowance for the future refurbishment of the mechanical and electrical equipment every 15 years. The Unit Reference Values (URVs) of the two possible schemes are shown in **Table 4.**

Table 4: Summary of Yields and URVs at Various Discount Rates

Scheme Option	Yield (million m^3/a)	Discount rate (per annum)		
		6%	8%	10%
4 m^3/s	23	R 1,31	R 1,52	R 1,75
6 m^3/s	20	R 1,67	R 1,94	R 2,24

The alternative use of ductile iron pipes rather than GRP was also considered. The impact on the overall scheme price is as follows:

- 4 m^3/s scheme: 24,5% increase from R 277,1 million to R344,9 million (including VAT).
- 6 m^3/s scheme: 31,3% increase from R 312,4 million to R410,2 million (including VAT).

For mild steel pipes, a capital cost increase of about 4% more than GRP (for both options) could be expected. Mild steel pipes would require more extensive maintenance and related costs in the longer term.

12. OVERALL CONCLUSIONS AND RECOMMENDATIONS

Of the two abstraction options considered for the BRVA Scheme, namely the 4 m^3/s stepped-pumping operation and the 6 m^3/s abstraction with variable pump speeds, the former offers a higher yield, at a lower cost, and with **significantly reduced operational complications**. The **4 m^3/s scheme**, based on a **stepped-pumping operating rule**, forms the basis of the scheme design.

The final decision to implement the BRVA Scheme as laid out in this report should await a comparative analysis of the scheme with non-surface water options being investigated by the City of Cape Town. The Department of Water Affairs, in consultation with the Western Cape Reconciliation Strategy Steering Committee, will make the decision based on the comparative analysis.

13. TIMING OF IMPLEMENTATION

The BRVA Scheme is based on the updated Berg River Hydrology undertaken during the recently completed Berg WAAS. Furthermore, the Comprehensive Reserve Determination for the Berg River and its estuary has been completed as part of this study.

As such, the hydrological and water use information can be considered as having been recently updated, providing a confident basis for the assessment of this option. It therefore represents the only surface water development option which can be implemented by 2019, the latest available estimate from the Reconciliation Strategy Steering Committee of the timing when the augmentation of the WCWSS is required. **Figure 16** shows the potential implementation timeframe for the BRVA Scheme.

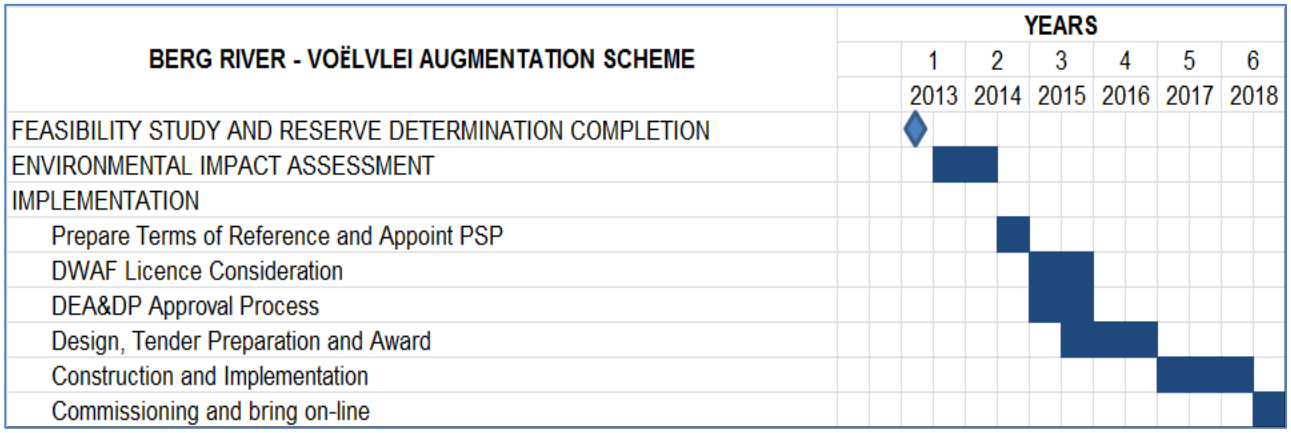

Figure 16: Potential Implementation Timeframe for the BRVA Scheme

In order to achieve the above programme in order that this scheme could be brought on line by the beginning of 2019, the following “fast track” assumptions have been made:

- The EIA will be completed before mid-2014.
- The detailed design task will run concurrently with the licence considerations and other approval processes without unforeseen delays.
- There will be no unforeseen delays in procurement processes of a professional service provider for the design and tender process.
- There will be no unforeseen delays in procurement processes of a contractor for the construction of the scheme.

14. FINANCING OPTIONS

A key factor in the financing of future water resource infrastructure is the issue of ownership. If the asset is owned by the DWA then the finance charges for the creation of the asset would fall under the Pricing Strategy for Raw Water Use Charges. If the asset is owned by the Municipality (CCT) the governing legislation would be the Municipal Financial Management Act (MFMA). In the case of this scheme it is unlikely that the assets will be owned by the Municipality as the scheme would be integral components of DWA's existing assets.

14.1 Assets Owned by DWA

There are a number of options set out in the Pricing Strategy for the financing of Water Resource Infrastructure.

Return on Assets (ROA)

This charge reflects payment towards the development and betterment of government waterworks. It is determined by setting a charge to earn a specific rate of return on the current depreciated replacement value of the infrastructure.

ROA is based on the social opportunity cost of capital to government and this should equal the cost of funding the annual capital expenditure budget requirement for the development of new waterworks and betterment of existing infrastructure from the fiscus.

In terms of the proposed revised Pricing Strategy, once a ring-fenced provision account for ROA has been established, ROA revenue will be applied to the funding of water resource development, prioritised as follows:

- Planning and feasibility studies of future augmentation
- Betterment works; and
- Social projects.

The scheme costs would ultimately be fully recovered from the water users.

Government Schemes Funded Off-budget

Water management institutions such as the TCTA (which are directed by the Minister of Water Affairs to implement and fund government water schemes off-budget) are entitled, by the NWA, to raise loans to finance the development of new water resource infrastructure, and should therefore be able to service these loans through cost recovery. These institutions, in consultation with stakeholders, can on a project by project basis determine the extent of charges as determined by financial modelling. The primary charge will be the Capital Unit Charge. This type of funding arrangement was employed for the construction of the Berg Water Project to augment the water supply to the CCT. The CCT has an Agreement with DWA which in turn has an Agreement with TCTA. The loans are raised by TCTA on the basis of these Agreements and the end users (CCT's consumers) pay for the full cost of the Berg Water Project.

Schemes Owned by CMAs and WUAs

Catchment management agencies (CMAs) and water user associations (WUAs) can also levy charges for the development and operation of waterworks. These charges, in terms of the Pricing Strategy for Raw Water Use Charges, must take inter alia the following into account:

(a) Recovery of overheads, operations and maintenance costs;

(b) Recovery of capital costs and the servicing of loans. Water management institutions are entitled by the National Water Act, 1998 (Act No. 36 of 1998) to raise loans to finance new water supply infrastructure, and should therefore be able to service these loans through cost recovery;

(c) Reasonable provision for the depreciation of assets, which can be placed in a reserve fund for utilisation at the appropriate time for refurbishment.

14.2 Funding for Municipal Assets

Should the asset be owned by the Municipality, it would have to form part of their long-term capital expenditure programme and would have to be specifically budgeted for. A municipal water asset would be recovered through water tariffs. The governing legislation would be the Municipal Finance Management Act, 2003 (Act No. 56 of 2003).