



water affairs

Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

The uMkhomazi Water Project Phase 1 (uMWP1)

Project Steering Committee (PSC)
3 September 2013

Progress Report

PSC meeting - Objectives

- ✓ To serve as a technical work session between
 - the three consultancies responsible for Modules 1 to 3 of the project (i.e. AECOM, Nemaï Consulting and Knight Piesold),
 - The Clients DWA and Umgeni Water; and
 - the District Municipalities/WSA

- ✓ Report back by the consultancies will be about the progress of the preceding period and the focus will be on alignment of the three studies

- ✓ Will take place in either Durban or Pietermaritzburg

PSC members

DWA

- Options analysis
- NWRP – East
- KZN
- *Other (on request)*

Umgeni Water

- Management
- *Other*

Municipalities/WSA:

eThekweni MM, Sisonke, Umgungundlovu, Ugu & Ilembe DMs and Msunduzi LM

KZN's Premiers Office /Provincial representative

Module 1: AECOM

- Management
- Task leaders (on request)

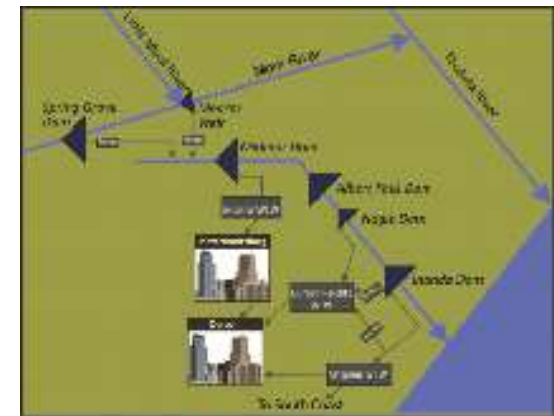
Module 2: Environmental Impact Study (Nemai Consulting)

Module 3: Technical Feasibility Study: Potable Water (Knight Piesold)

Other technical specialists

Background to the project

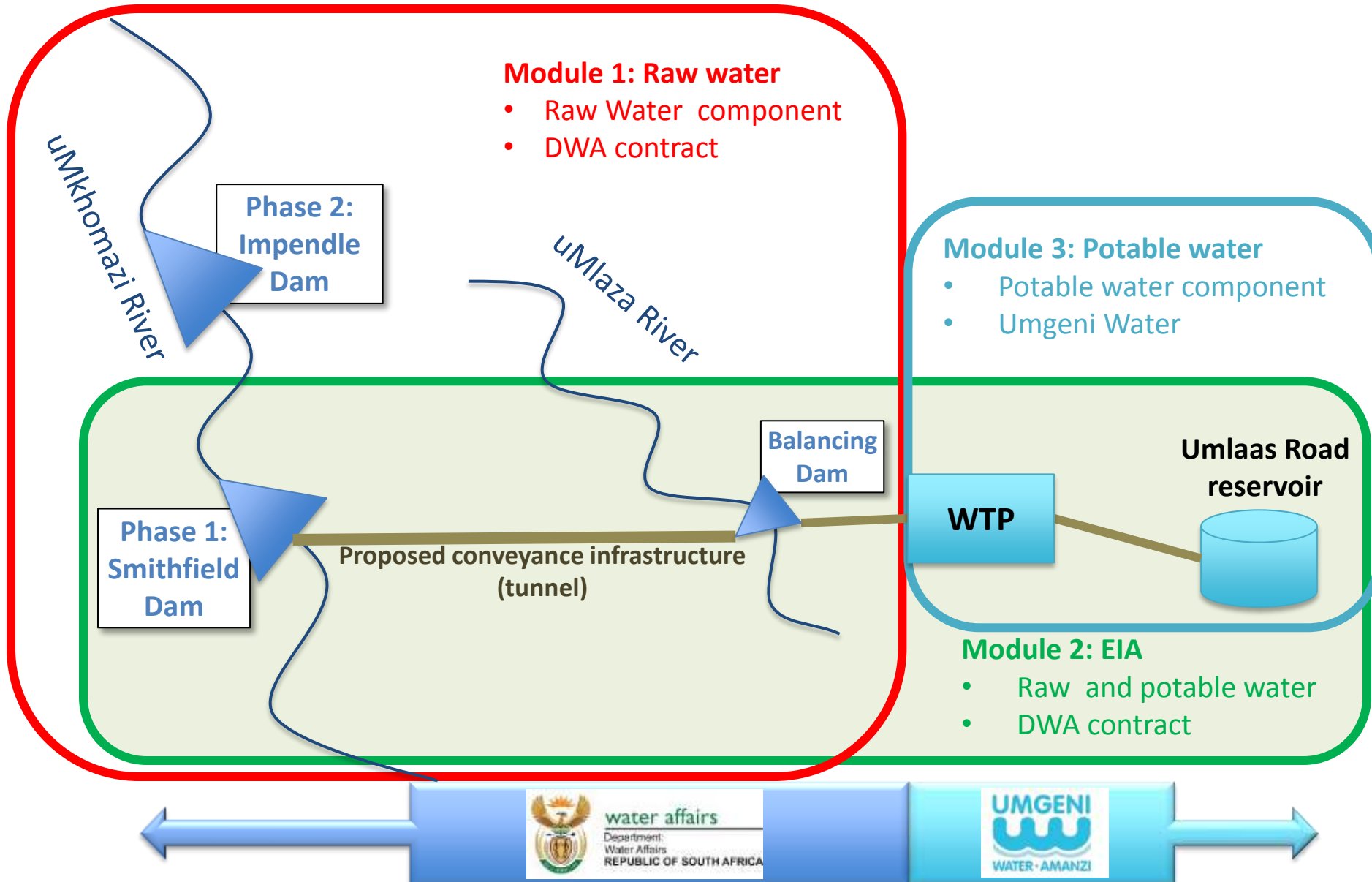
- The long-term water requirements of eThekweni MM (Durban), Msunduzi LM (Pietermaritzburg) and surrounding areas exceed the yield (334 million m³/a) of water resources of the Mgeni System (Midmar, Albert Falls, Nagle and Inanda dams)
 - Current interventions
 - ✓ **MMTS-2: Spring Grove Dam**
 - Long-term augmentation
 - ✓ **uMkhomazi Water Project Phase 1 (uMWP1)**



Location of the project



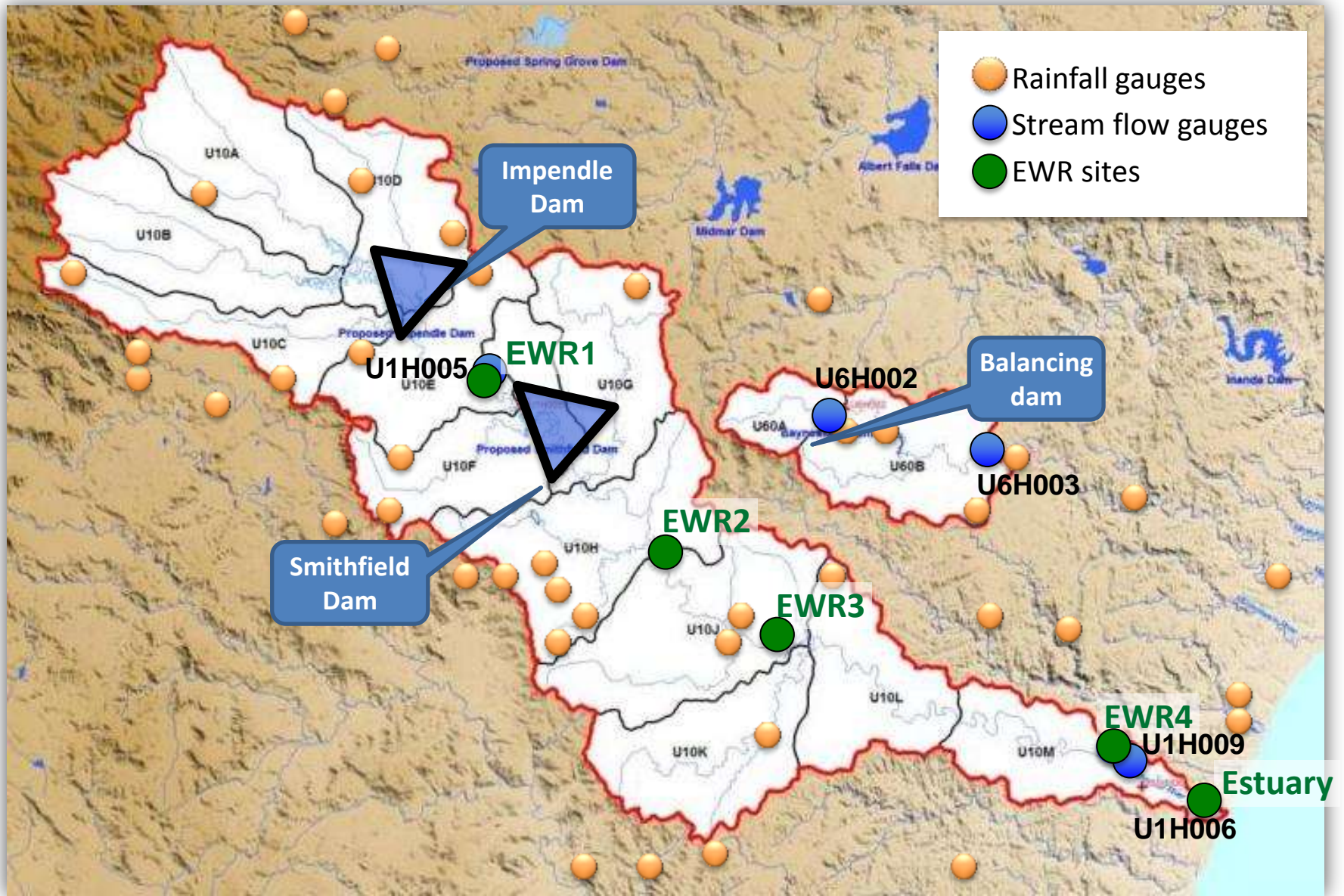
Project components / study modules



Task 4: Water resources

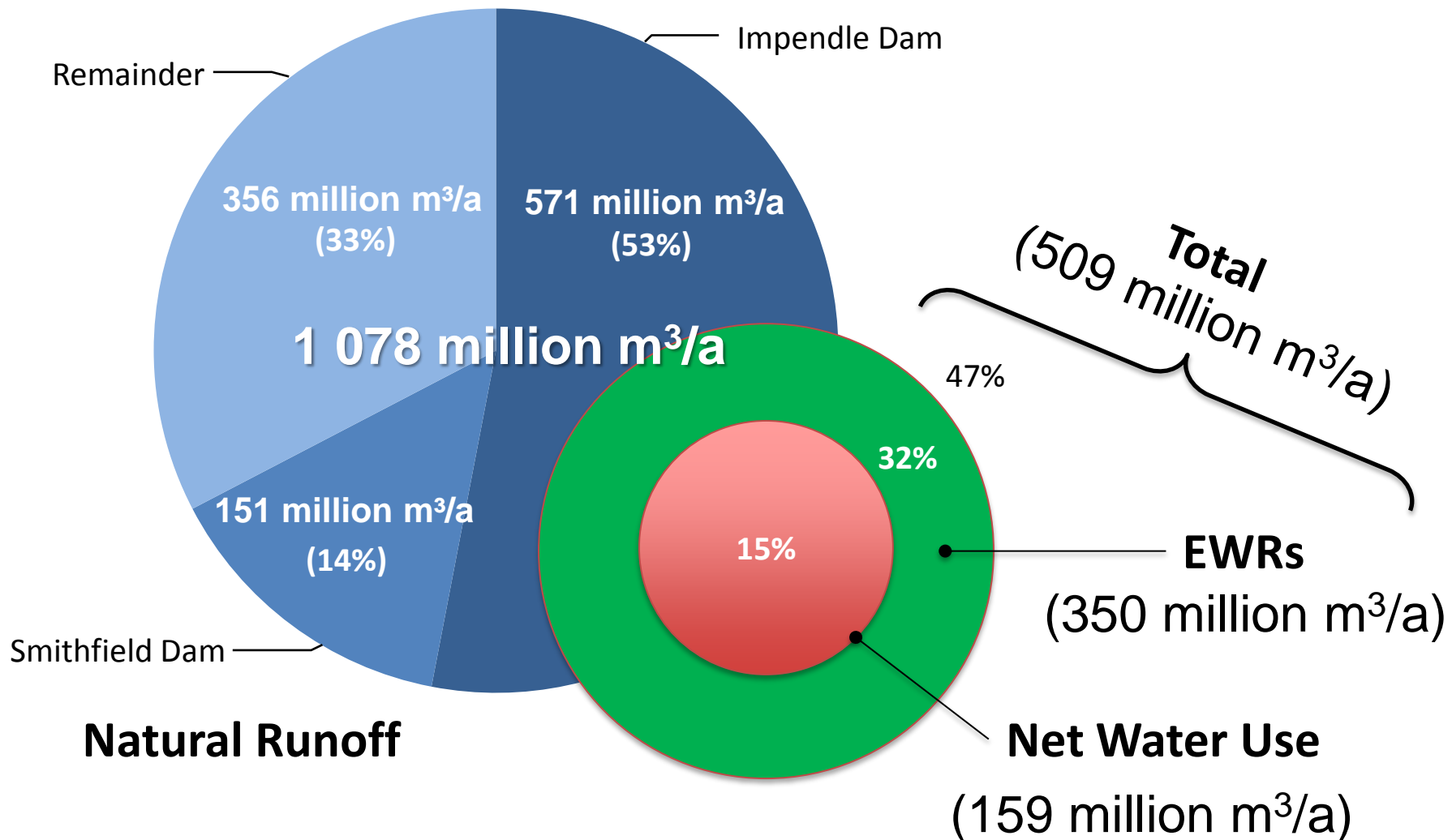


Water resource focus area

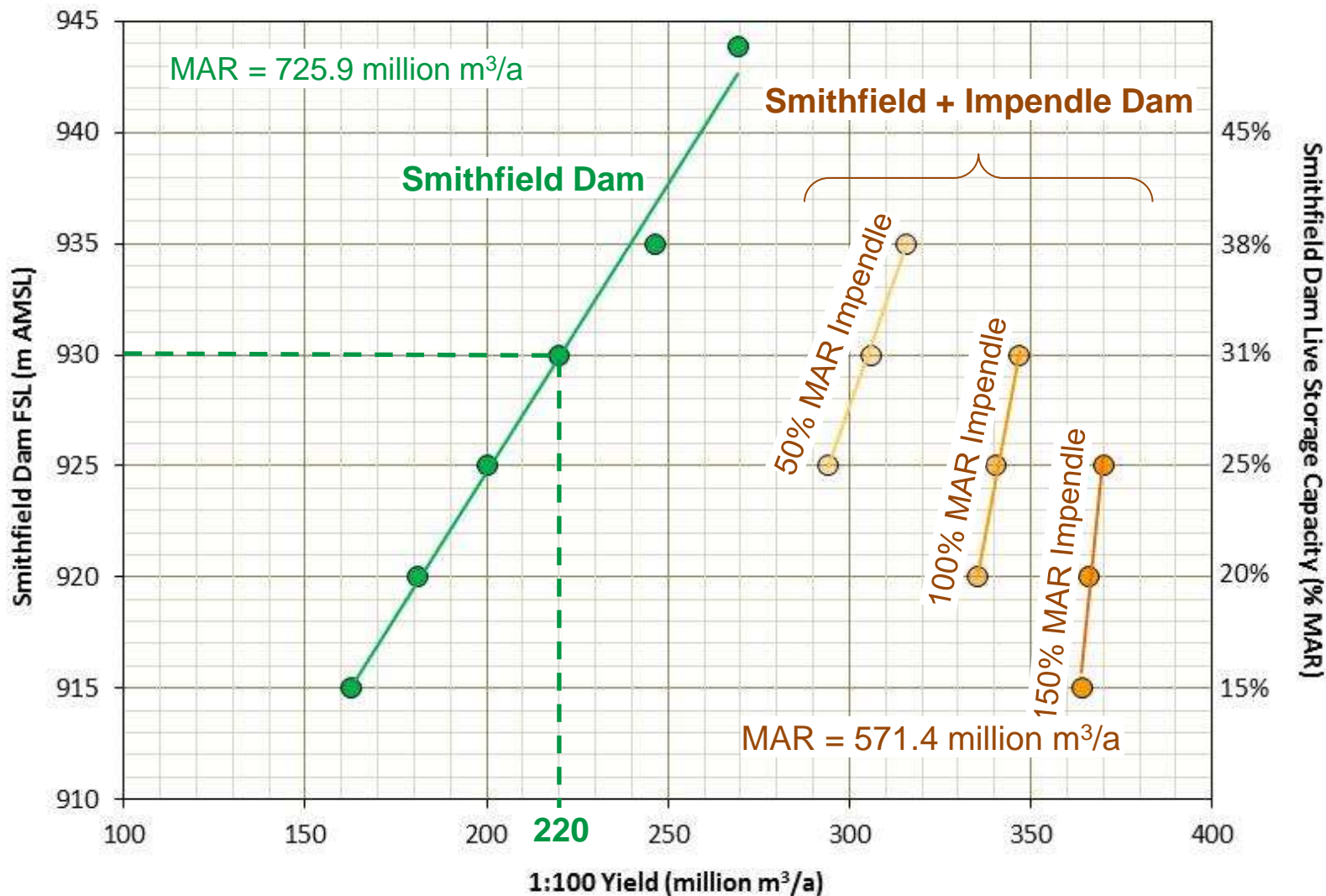


Hydrology of the uMkhomazi River Catchment

Natural runoff, water use and EWRs



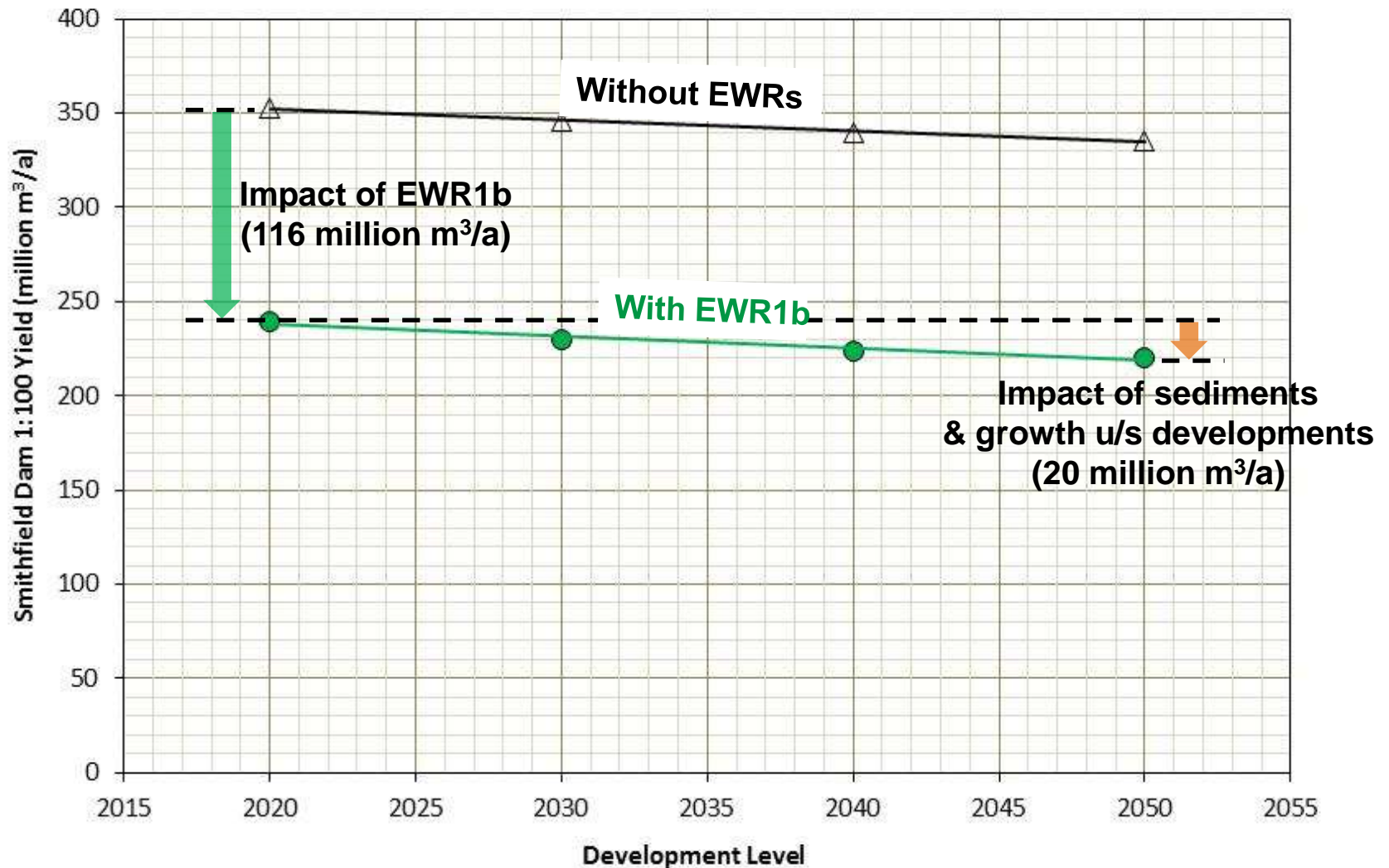
Summary of yield results



(1) At the 2050-development level

(2) All with EWRs based on Pre-feasibility (IWR, 1998)

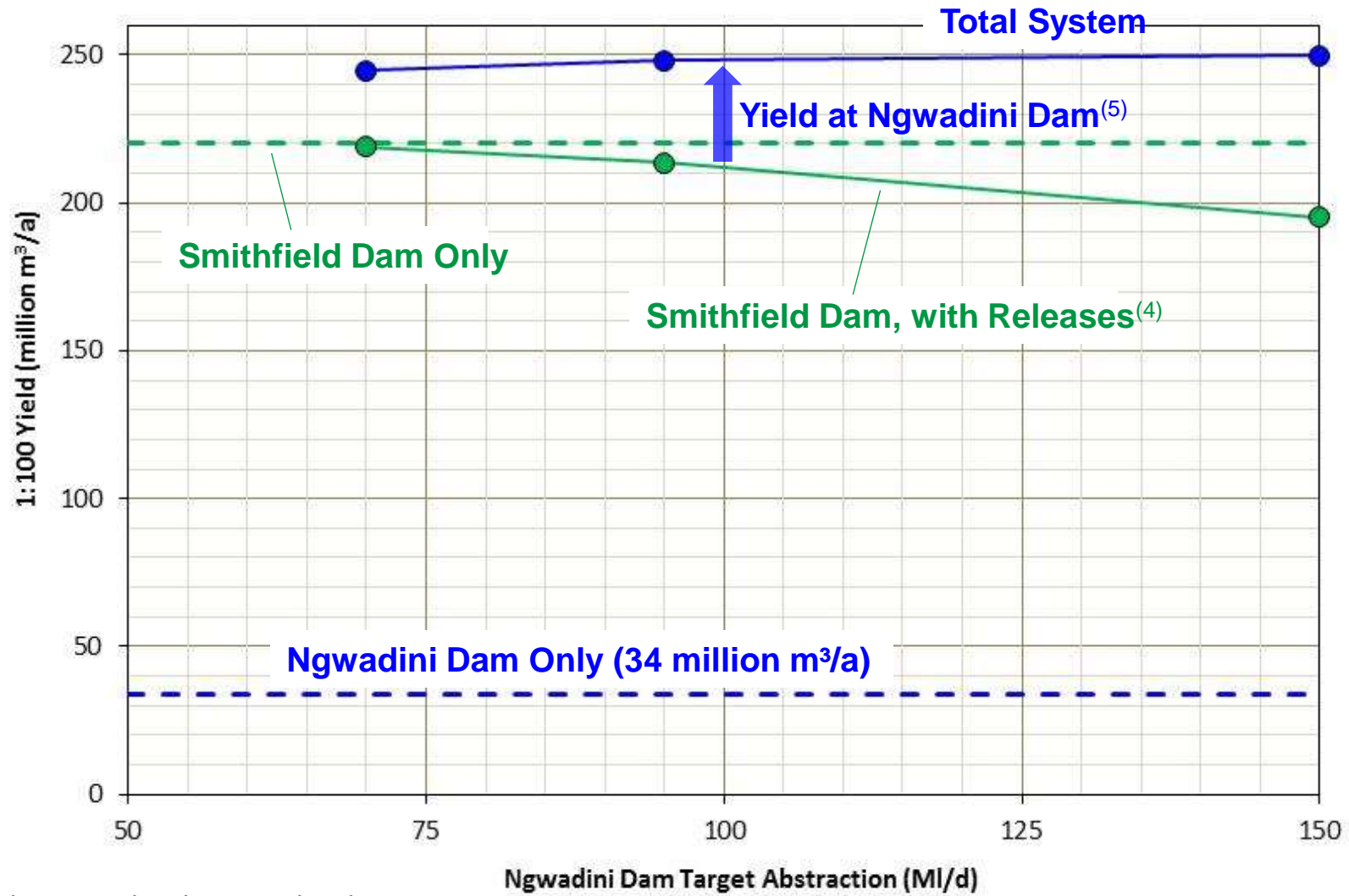
Impacts of EWR and development level



(1) All for Smithfield FSL = 930 m (31% MAR)

(2) All with EWRs based on Pre-feasibility (IWR, 1998)

Ngwadini Dam – Yields to the South Coast (UW)



(1) At the 2050-development level

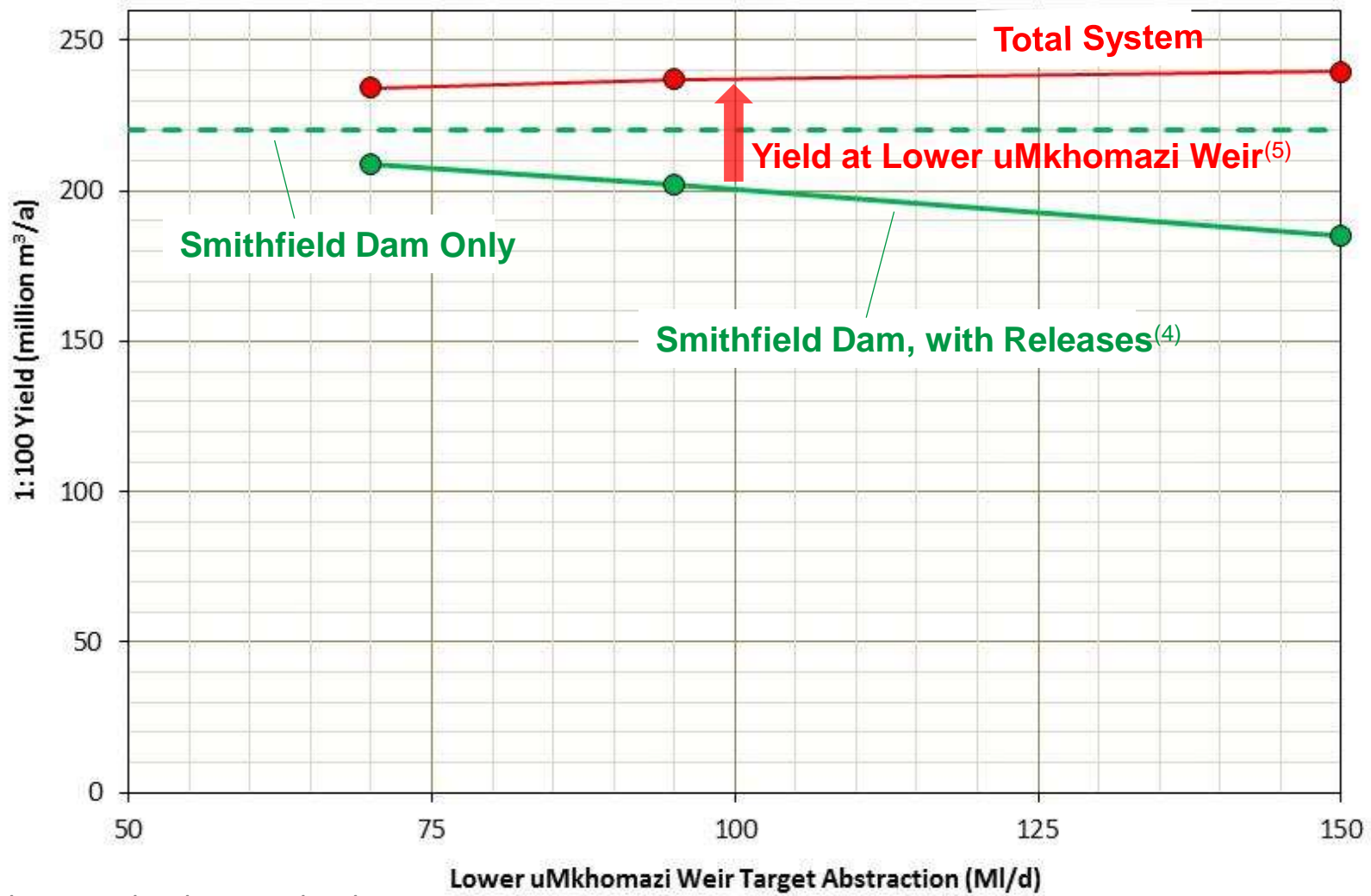
(2) Smithfield FSL = 930 m (31% MAR)

(3) All with EWRs based on Pre-feasibility (IWR, 1998)

(4) Assuming 10% losses

(5) After Estuary and Saiccor

Lower uMkhomazi – Yields to the South Coast (UW)



(1) At the 2050-development level

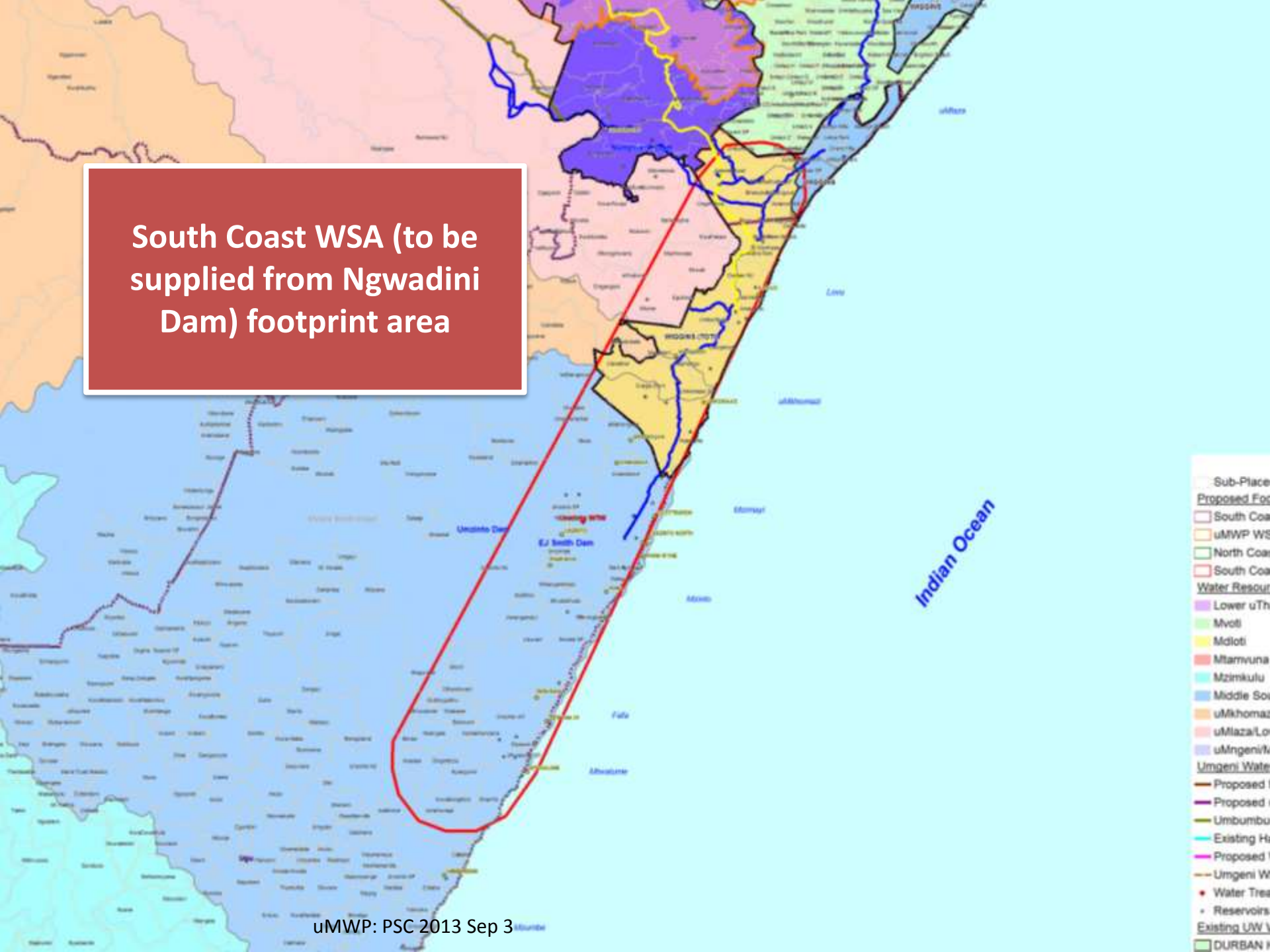
(2) Smithfield FSL = 930 m (31% MAR)

(3) All with EWRs based on Pre-feasibility (IWR, 1998)

(4) Assuming 10% losses

(5) After Estuary and Saiccor

South Coast WSA (to be supplied from Ngwadini Dam) footprint area



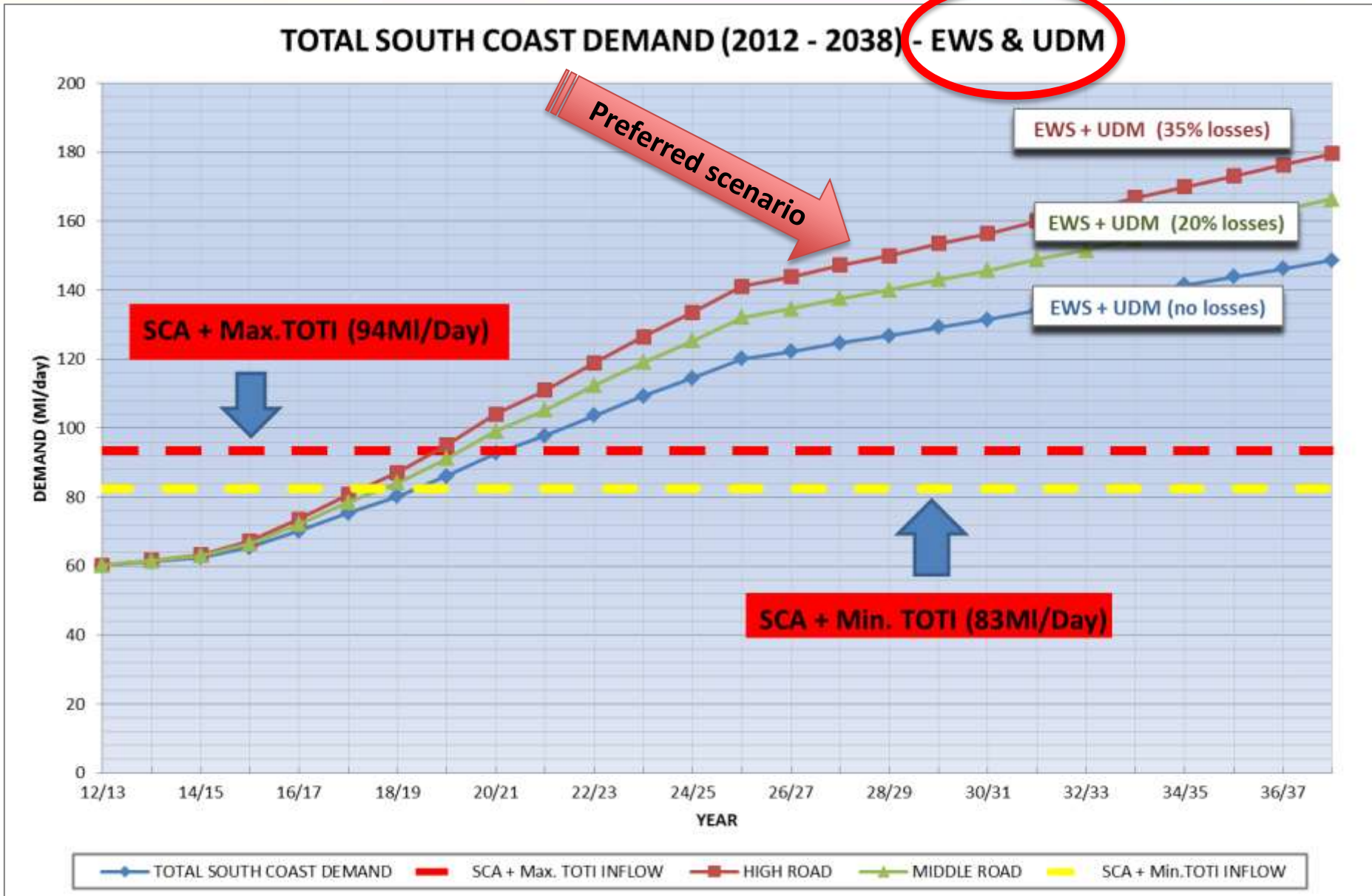
- Sub-Place
- Proposed For
- South Coast
- uMWP WSA
- North Coast
- South Coast
- Water Resource
- Lower uThungulu
- Mvoti
- Midoti
- Mtamvuna
- Mzimkulu
- Middle South
- uMkhomazi
- uMlazi/Lowveld
- uMngeni/West
- uMngeni/West
- Proposed
- Proposed
- Umbumbulu
- Existing
- Proposed
- uMngeni/West
- Water Treatment
- Reservoirs
- Existing UWSA
- DURBAN

Ngwadini Dam – Projected water requirements

SOUTH COAST DEMAND (2012 - 2038) - EWS only



Ngwadini Dam – Projected water requirements



Desalination – Yields

Desalination Plant	Capacity / Yield (Mℓ/d)
Tongaat Desalination Plant (North)	120
Lovu Desalination Plant (South)	150

Task 4: Water resources

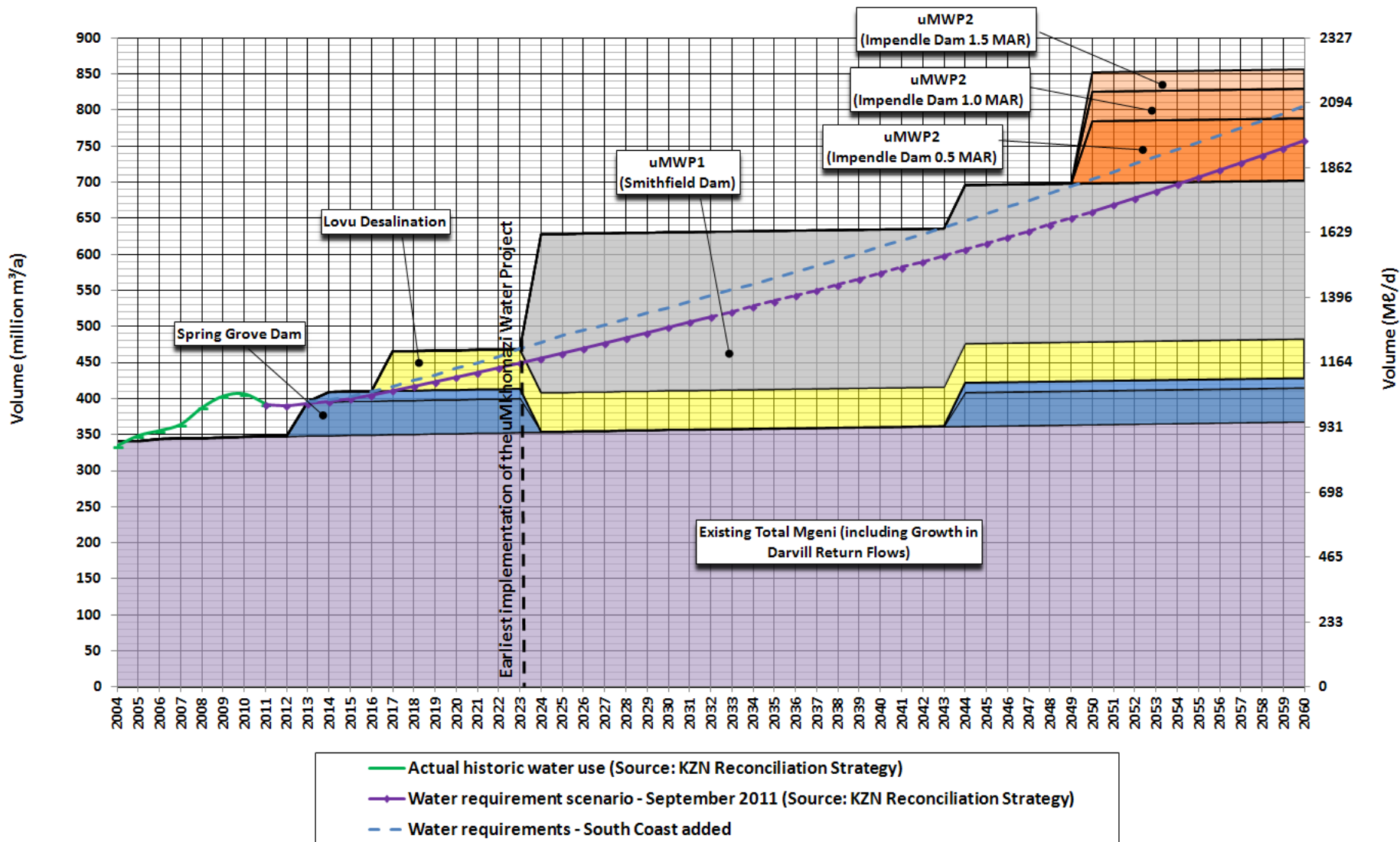
Updated water balance



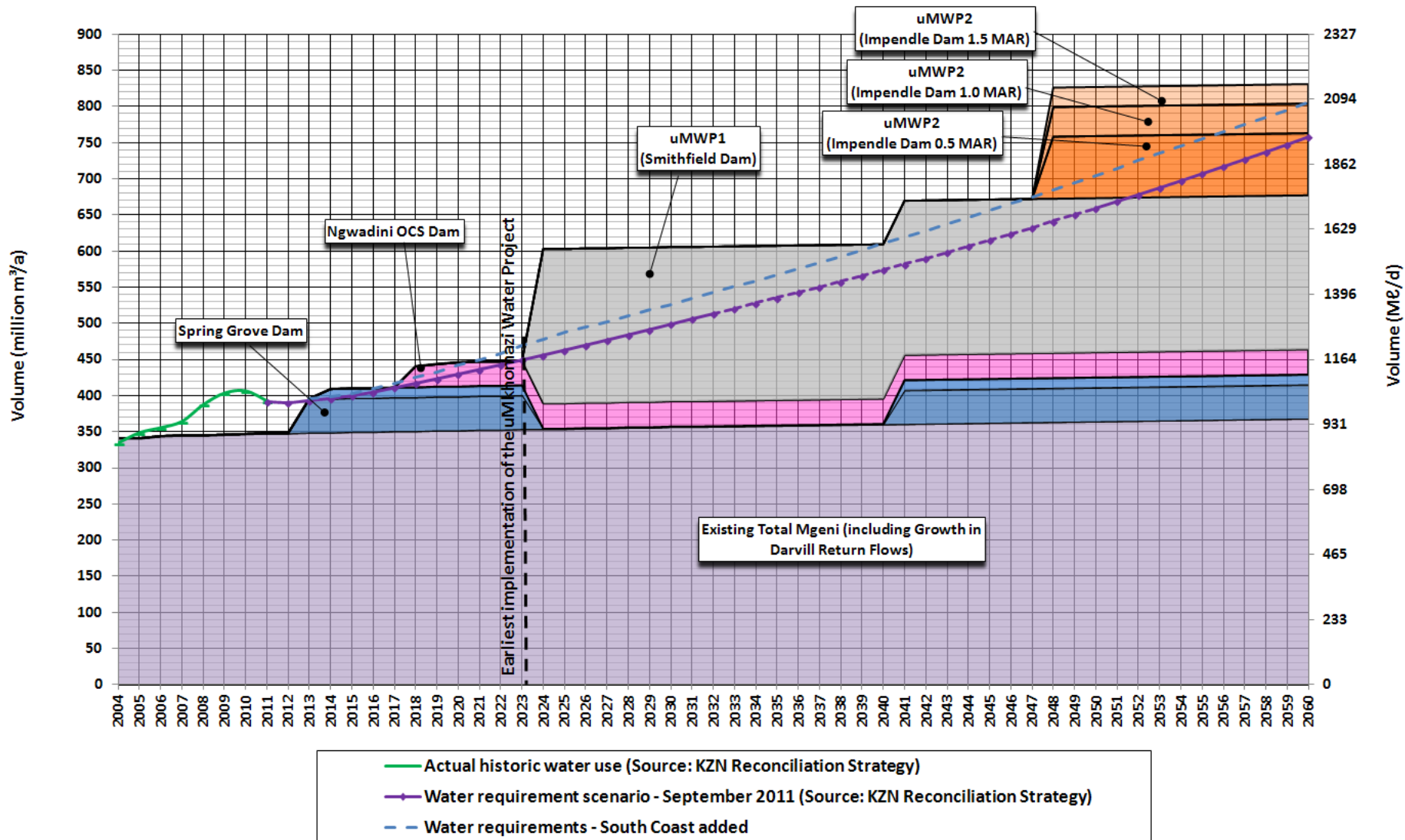
Updated water balance

- 4 scenarios compiled for comparative URVs
 - 2 scenarios as options for the South Coast:
 - ✓ **Ngwadini vs Lovu Desalination**
 - 2 scenarios as options for the greater supply area
 - ✓ **Desalination on the North and South Coast followed by the uMWP vs Ngwadini and the uMWP**

Water requirement projection for the integrated Mooi-Mgeni System and South Coast Scenario 1 - Lovu Desalination option

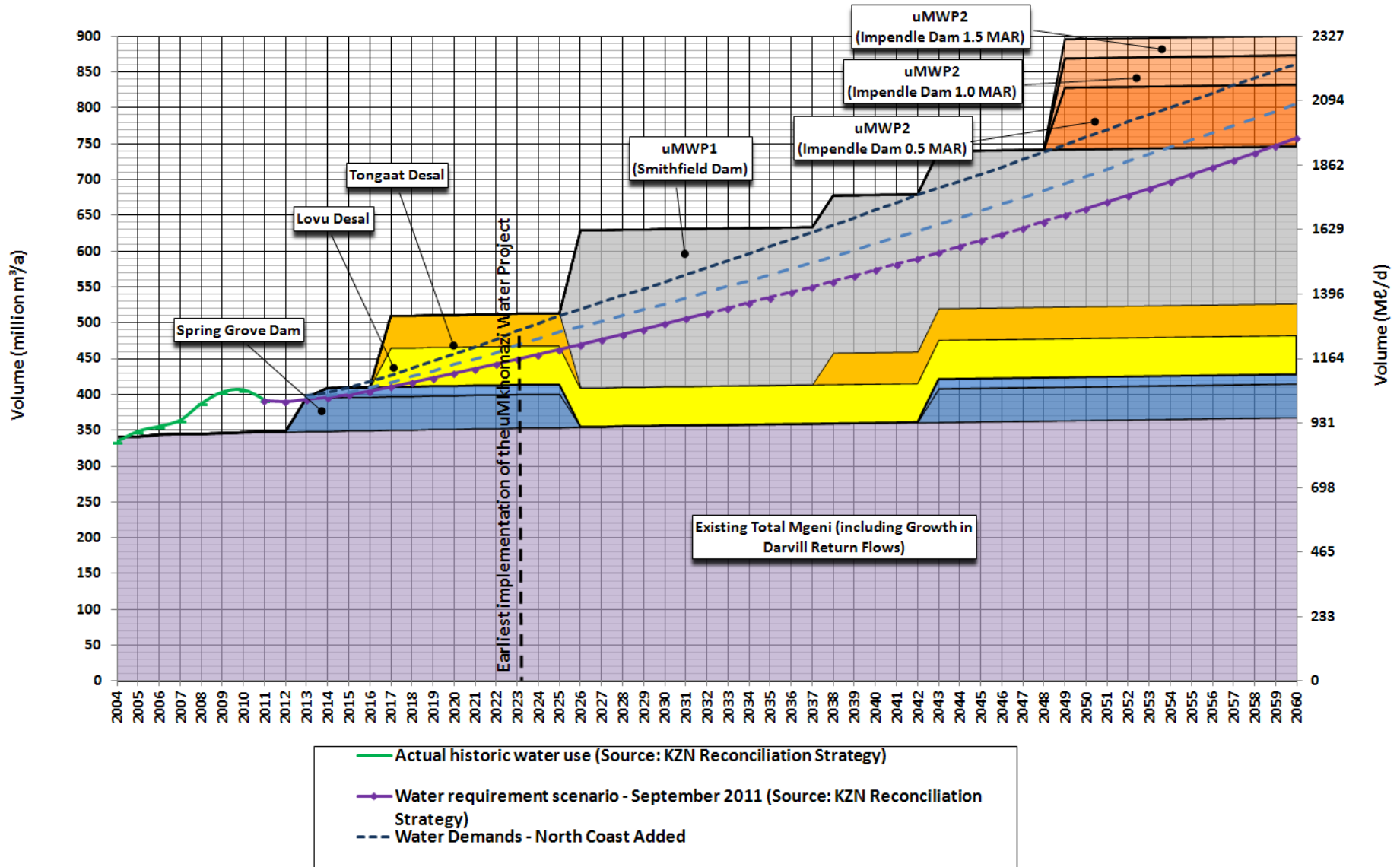


Water requirement projection for the integrated Mooi-Mgeni System and South Coast Scenario 2 - Ngwadini OCS Dam option



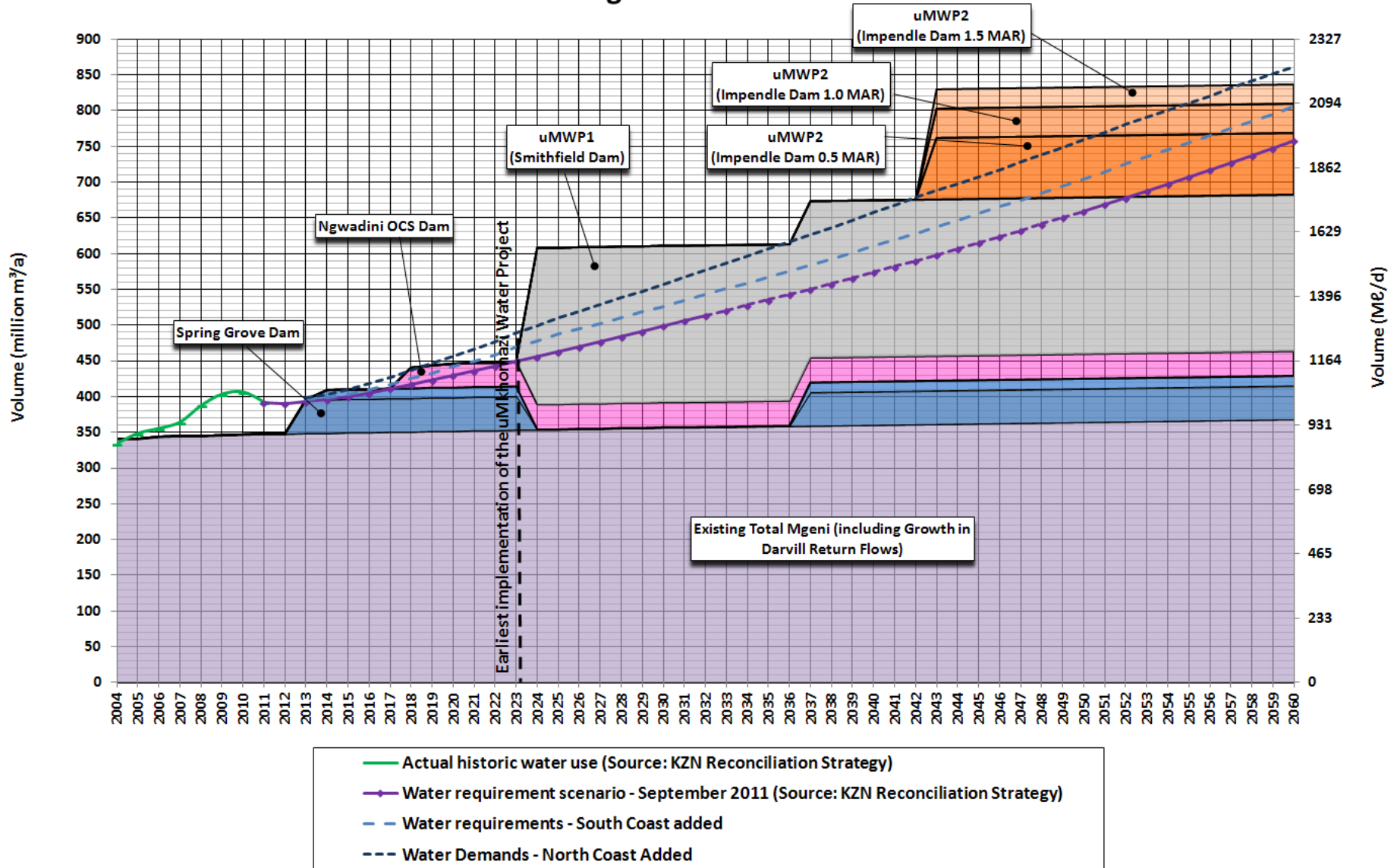
Water requirement projection for the integrated Mooi-Mgeni System

Scenario 3 - North and South Coast Desal



Water requirement projection for the integrated Mooi-Mgeni System

Scenario 4 - Ngwadini and uMWP



Task 4: Water resources

Water Resources Planning Model (WRPM)



Water Resources Planning Model (WRPM)

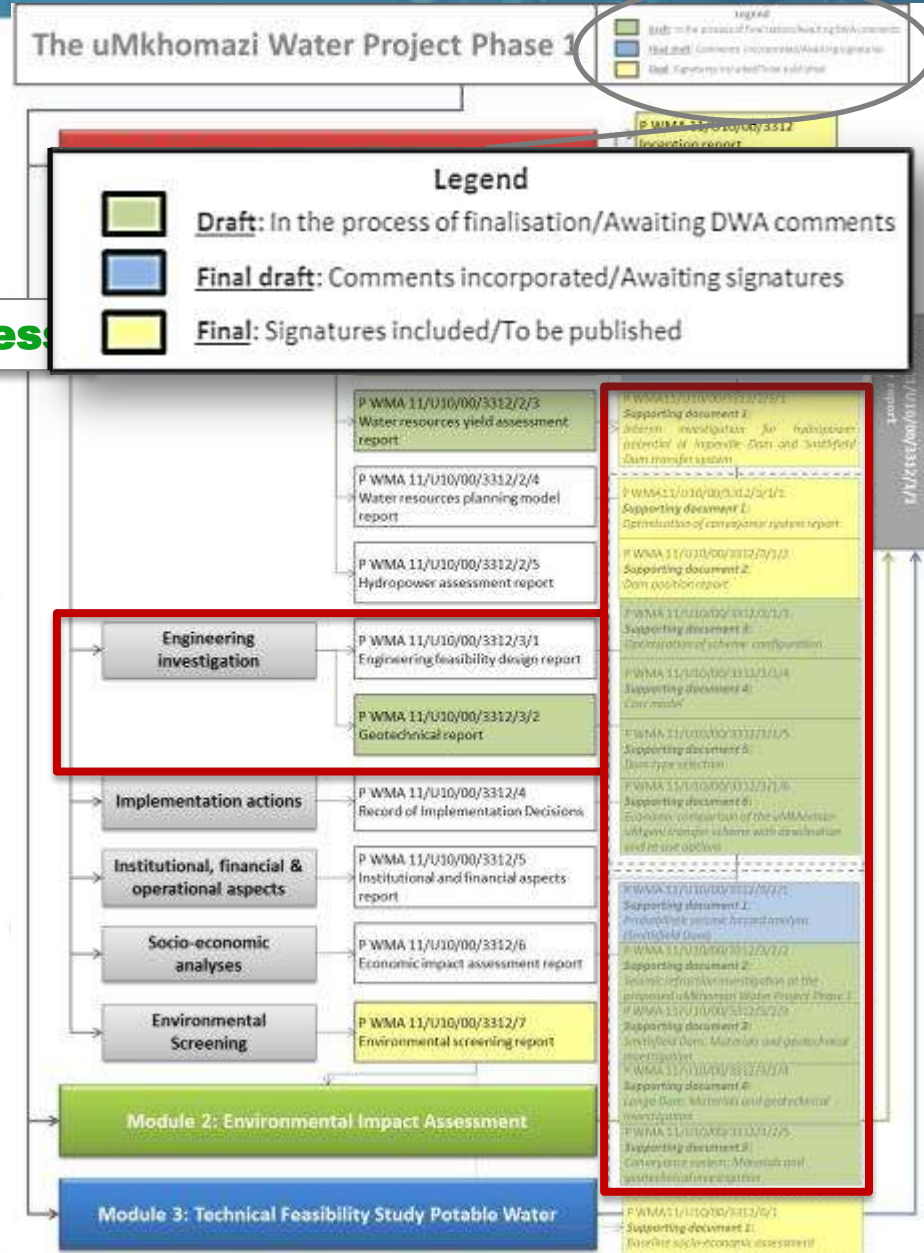
- The uMgeni WRPM is being reconfigured to:
 - ✓ Better capture infrastructure capacity constraints that will affect the ability of support from the upper uMgeni (which could impact the timing of the balancing dam)
 - ✓ Differentiate between the different Durban Heights supply areas, i.e. the shed zones vs. those zones that will remain on Durban Heights water supply
- The data files have been updated and testing is due to commence shortly. Testing will involve checking for any meaningful differences in results from those obtained by the recon study.
- Thereafter the uMkhomazi and the uMgeni systems will be integrated and scenario analyses will commence

Task 5: Engineering investigation



Task 5: Engineering investigation - Progress

- 5 **Task 5 Engineering investigation**
- 5.1 **Optimisation of conveyance system** ✓
- 5.2 **Dam position** ✓
- 5.3 **Materials investigation** **In process**
- 5.4 **Geomorphologic & seismic investigation** **In process**
- 5.5 **Geotechnical investigation** **In process**
- 5.6 **Survey** **In process**
- 5.7 **Dam type selection** **In process**
- 5.8 **Storage capacity of dam** ✓
- 5.9 **Flood & backwater calculations** **In process**
- 5.10 **Climatological data** **In process**
- 5.11 **Water quality & limnological review** ✓
- 5.12 **Sediment** ✓
- 5.13 **Land requirements & costs** ✗
- 5.14 **Optimisation of scheme configuration** ✓
- 5.15 **Hydropower** **On scheme to be done**
- 5.16 **Feasibility design** ✗
- 5.17 **Cost model** **In process**



Task 5: Engineering investigation – Contents

- 1. Progress with Materials and Geotechnical Investigation Reports**
- 2. Update on Smithfield Dam and Langa Dam sizes**
- 3. Sedimentation**
- 4. Update on Solid Waste Disposal Sites**
- 5. Preliminary dam type selection**
- 6. Comparison of Development Options**
- 7. Summary of actions**

Progress on geotechnical investigations

General



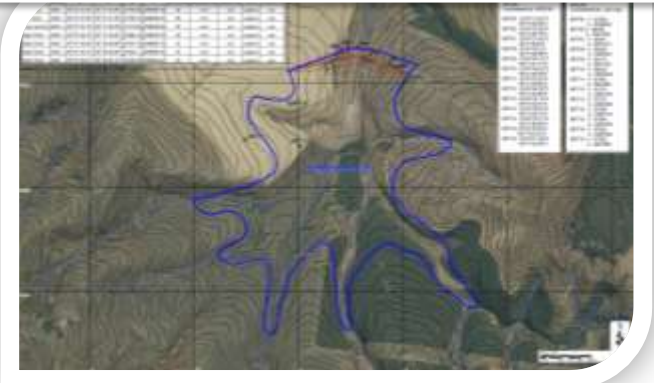
- The Smithfield Dam Construction Materials and Geotechnical Report is completed and has been audited. ✓
- The Langa Balancing Dam Construction Materials and Geotechnical Report is completed and has been audited. ✓
- The uMkhomazi to uMlaza transfer tunnel Geotechnical Report is completed and auditing is in process.

Geotechnical and material investigations

Langa BD– Borehole & test pits positions

Engineering investigation

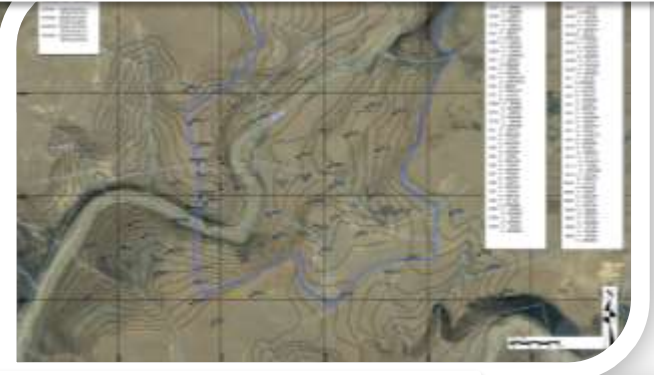
P WMA 11/U10/00/3312/3/2
Geotechnical report



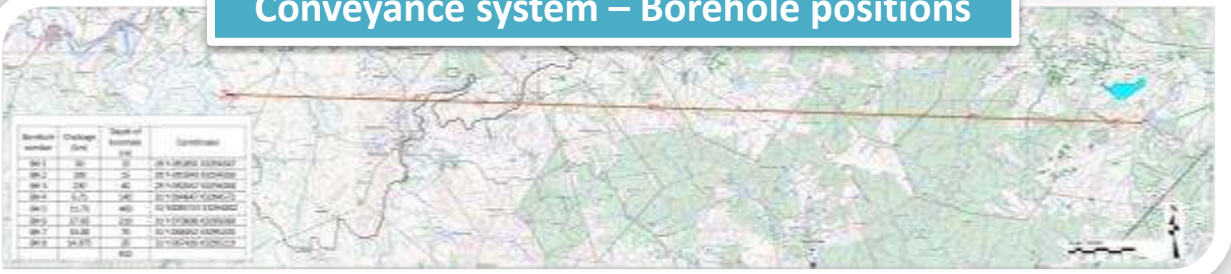
Smithfield Dam – Test pit positions



Smithfield Dam - Borehole positions



Conveyance system – Borehole positions



- P WMA 11/U10/00/3312/3/2/1
Supporting document 1:
Probabilistic seismic hazard analysis (Smithfield Dam)
- P WMA 11/U10/00/3312/3/2/2
Supporting document 2:
Seismic refraction investigation at the proposed uMkhomazi Water Project Phase 1
- P WMA 11/U10/00/3312/3/2/3
Supporting document 3:
Smithfield Dam: Materials and geotechnical investigation
- P WMA 11/U10/00/3312/3/2/4
Supporting document 4:
Langa Dam: Materials and geotechnical investigation
- P WMA 11/U10/00/3312/3/2/5
Supporting document 5:
Conveyance system: Materials and geotechnical investigation



In process

Progress on geotechnical investigations Smithfield Dam



Quarry and Earthfill Borrow Areas



Important findings of Smithfield Dam Report

- Sufficient clay for core of Embankment Dam identified
- No semi-pervious materials for outer zones of Embankment dam
- Carbon rich, baked and no carbon rich baked shales identified – sufficient for rockfill dams
- Good dolerite of volume 2,4 million m³ identified. This deposit is underlain by weathered shales to depth of 17m and more
- Foundation depth in central part of valley will favour a concrete dam, the outer parts not

Progress on geotechnical investigations

Langa Balancing Dam



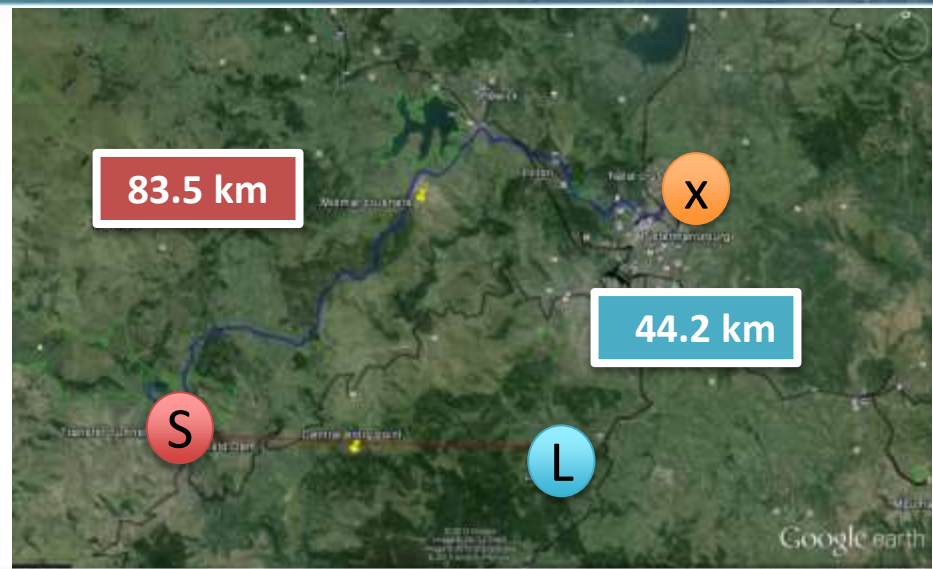
Important findings of Langa Balancing Dam Report

- No unweathered dolerite identified
- Shales of various weathered nature has been identified
- No earthfill materials identified
- Foundation conditions on left side of river better than on the right side
- Spillway to be located on left side
- Central river section good for concrete dam

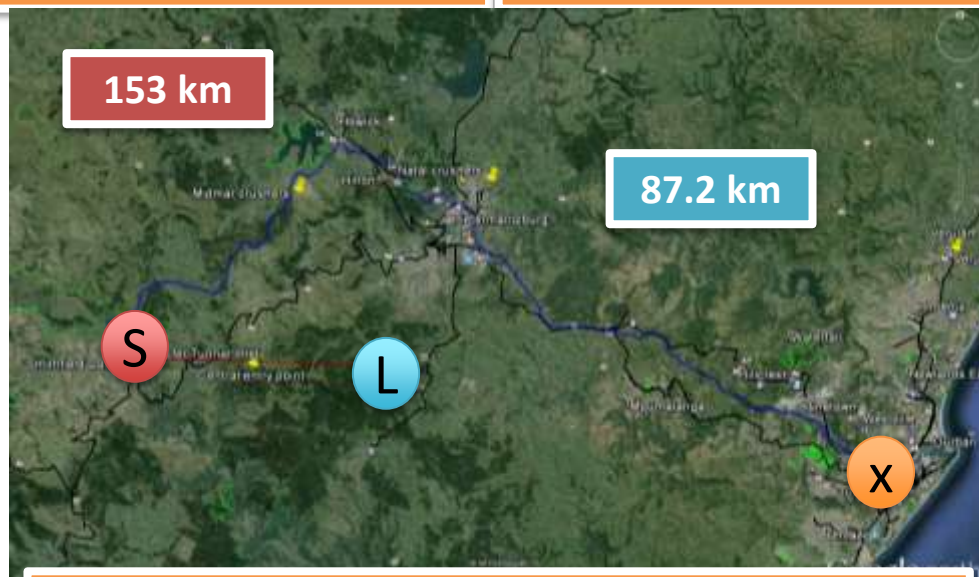
Other sources identified for materials



Midmar Crushers - aggregate



Natal Crushers - aggregate



NPC - sand

Progress on geotechnical investigations

Conveyance system



Important findings of conveyance system

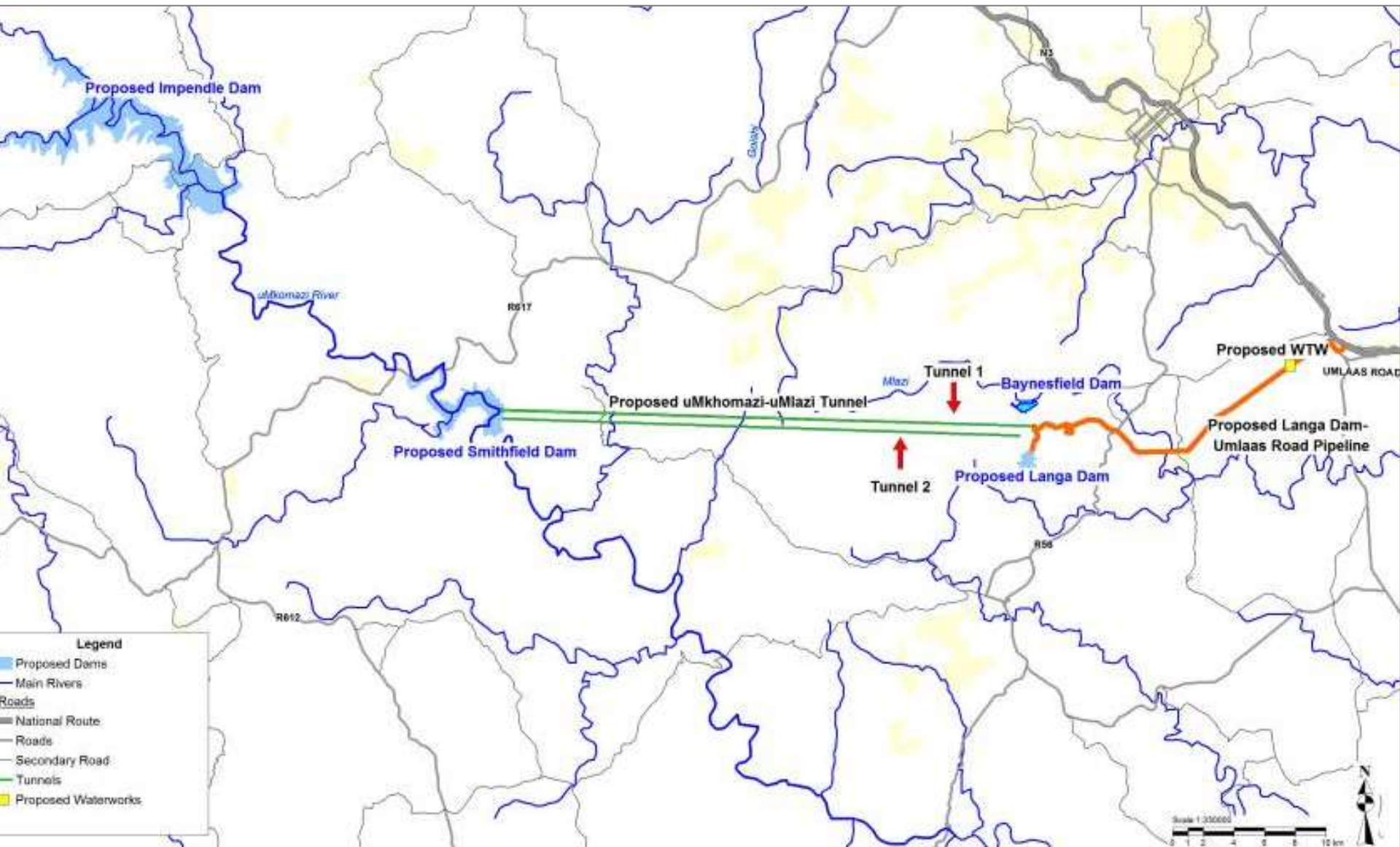
- It is anticipated that about 20km of the tunnel will be excavated in hard dolerites
- Rest in hard to very hard shale rock
- Water table close to surface at inlet portal but well below the exit point
- The inflow of water into the tunnel during construction will be a major issue due to the fractured nature of the shale rock and the high water table

Optimisation of scheme configuration

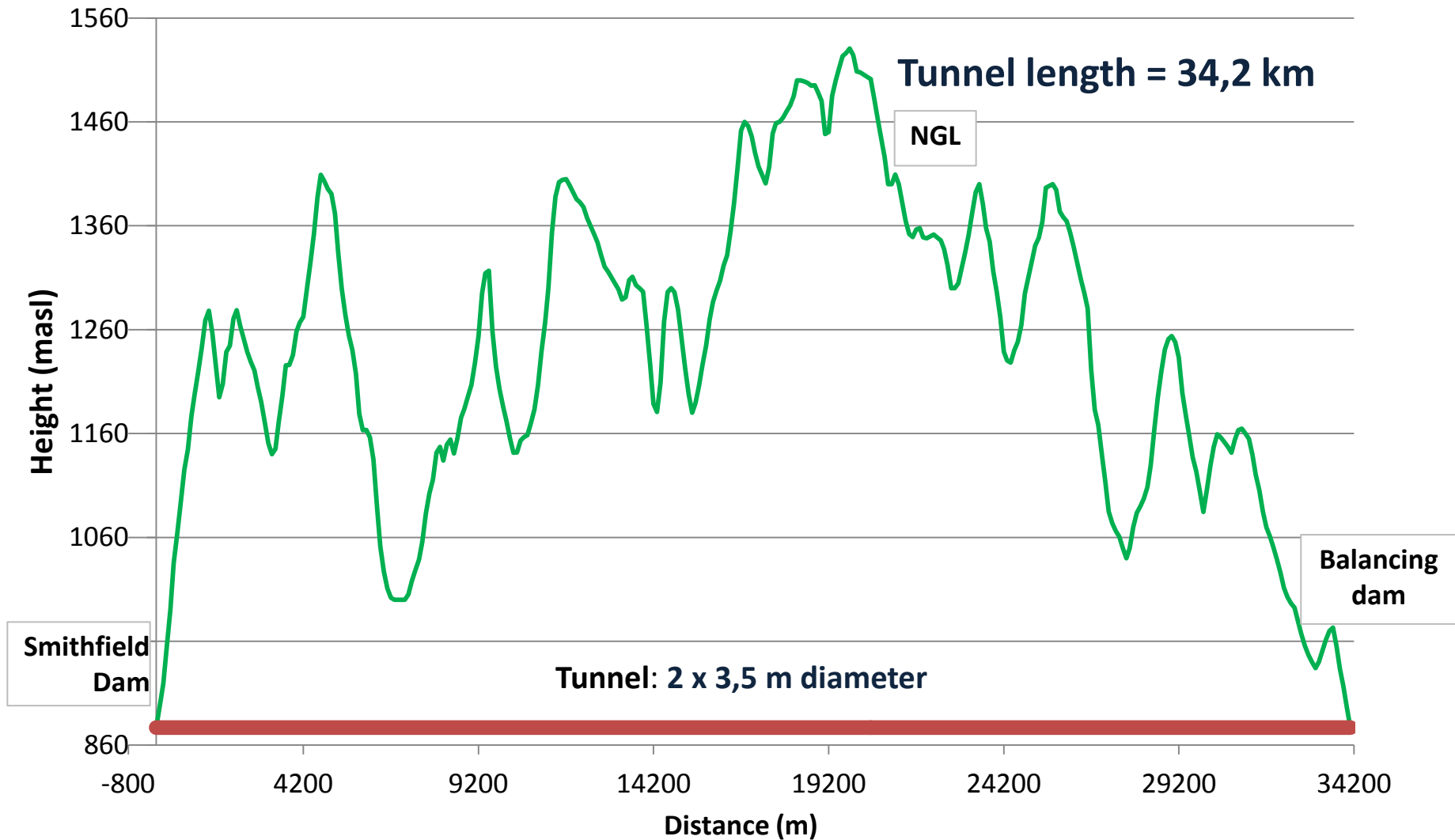
Findings and conclusions (Conveyance system)



Conveyance system – Selected scheme



Tunnel – vertical section

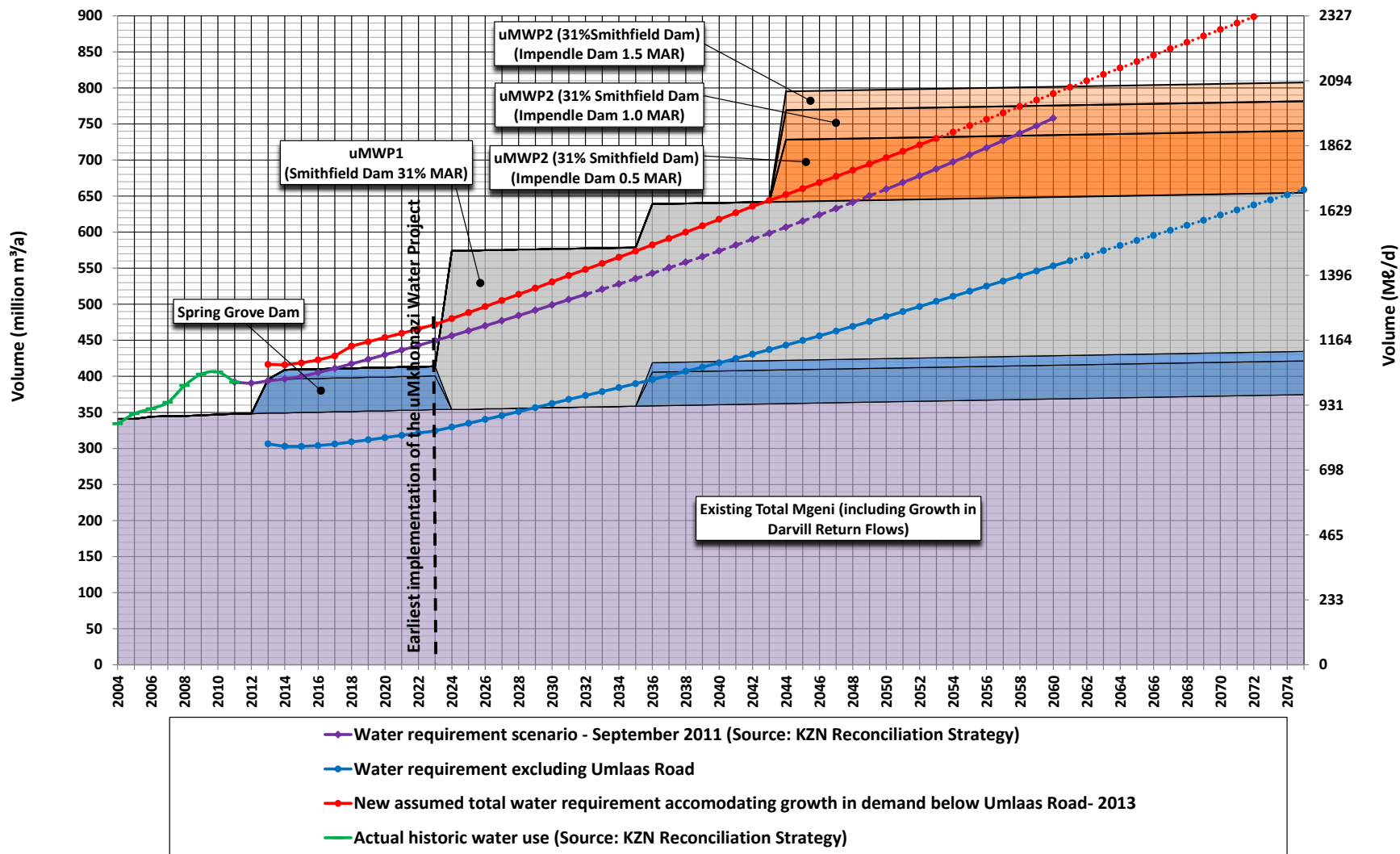


Update on Smithfield Dam and Langa Dam Sizes

- URV technique for two options, both with Spring Grove dam yield, used:
 - Option 1: Smithfield Dam and One Transfer Tunnel and associated pipelines and water transfer infrastructure to Umlaas Road.
 - Option 2: Smithfield Dam, Impendle Dam with double conveyance facilities to Umlaas Road.

Update on Smithfield Dam and Langa Dam Sizes

Water requirement projection for the integrated Mooi and Umkhomazi Mgeni System

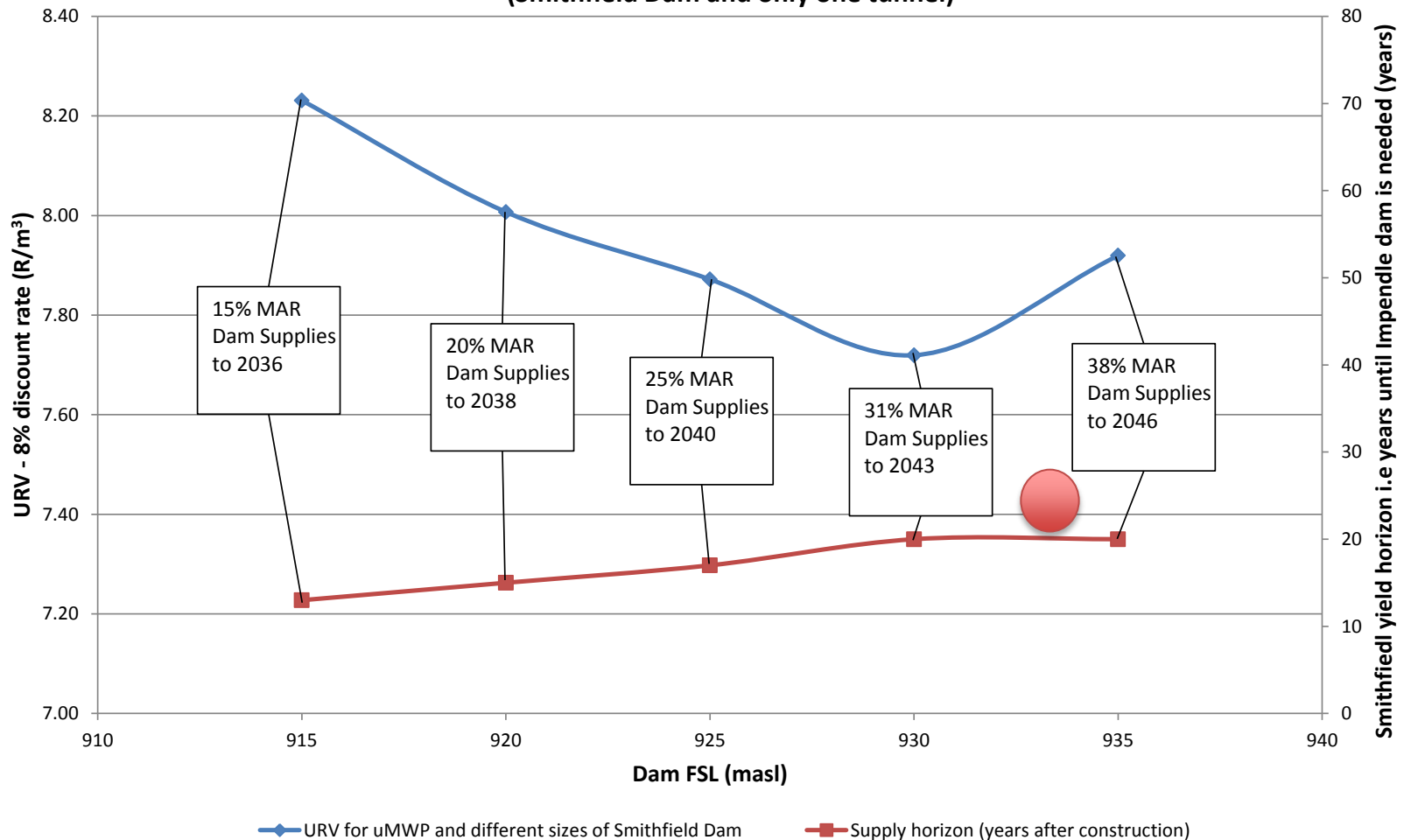


Smithfield Dam – Final dam size & layout

Option 1: Smithfield Dam and one tunnel transfer scheme

1

uMkhomazi Water Project - URVs for different size Smithfield Dams (Smithfield Dam and only one tunnel)

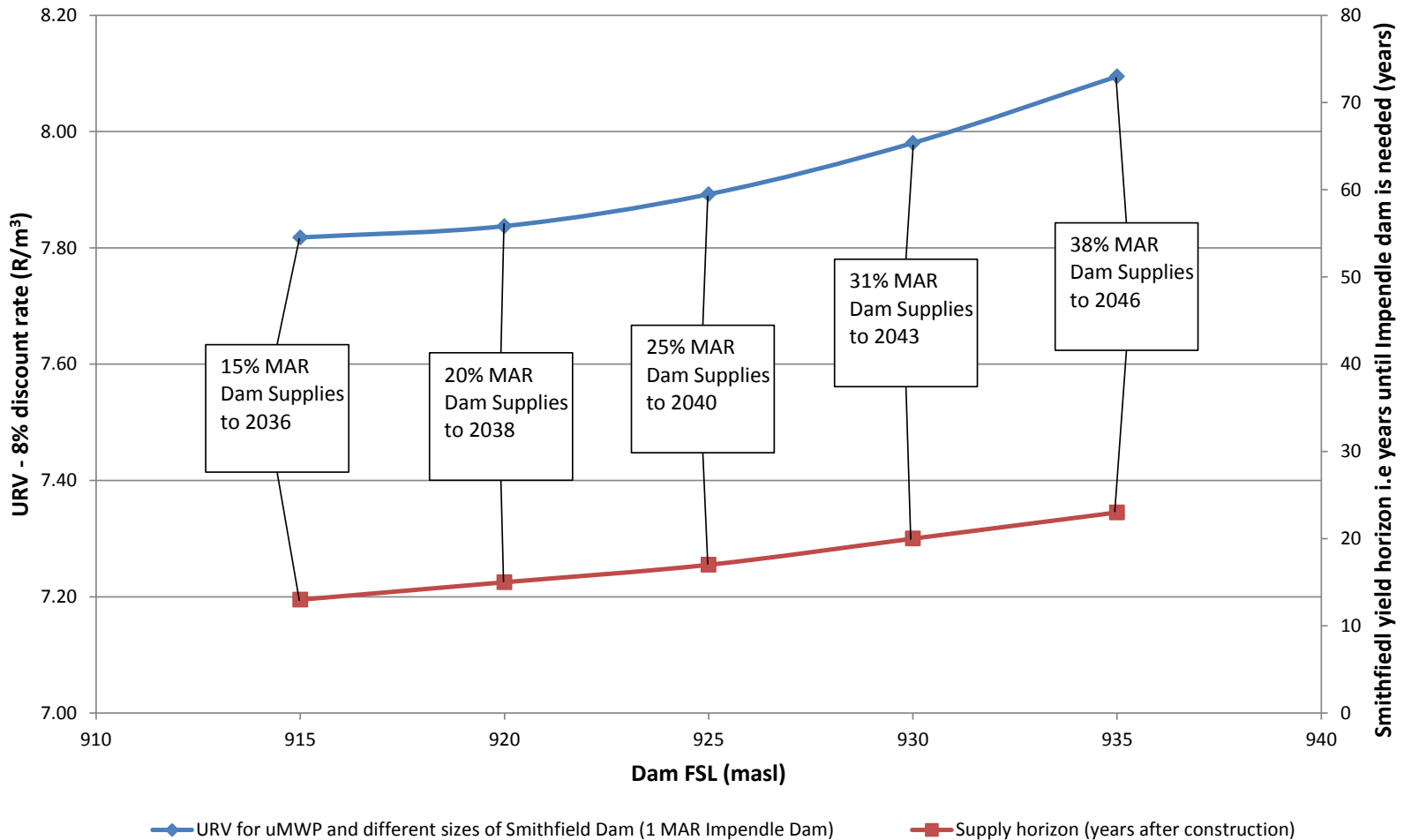


Smithfield Dam – Final dam size & layout

Option 2:

Total scheme (combinations of Smithfield and Impendle Dam sizes and two conveyance systems)

2 uMkhomazi Water Project - URVs for different size Smithfield Dams



Smithfield Dam – Final dam size & layout

- Option 1 (Smithfield Dam and 1 tunnel to be developed)
 - the 31% MAR Smithfield Dam has the lowest URV.
- Option 2 (combinations of Smithfield and Impendle Dam sizes and two conveyance systems)
 - the smallest Smithfield Dam has the lowest URV.
 - the 31% Smithfield Dam provides 21 year window before Impendle Dam would be required.
 - ✓ The unit reference values increase only by about R 0.15, which is 2%. This is insignificant and within the margin of accuracy. (At 38%MAR Smithfield Dam the unit reference value increase is 6%.)
- The 1.5 MAR Impendle Dam and associated transfer scheme provides the lowest URV.
- The 8% discount rate used for the calculation of URV is R7.80.

Smithfield Dam – Final dam size & layout

Based on:

- The optimum URV for the case where the Impendle Dam and second conveyance system are not developed;
- The insignificant difference in URV for a 31% Smithfield Dam with smaller dams;
- The timing of implementation of Impendle Dam to be 21 years after completion of Smithfield Dam (and not less);
- Possible uncertainty in the water requirement projections;

It is recommended:

- To size the Smithfield Dam to a 31% MAR capacity during the feasibility design of the Dam.
- The implementation of a 1.5 MAR Impendle Dam should be considered for in the future.



Selected scheme for Feasibility Design

- The selected dam and conveyance scheme for Feasibility Design is therefore:
 - A Smithfield Dam at Site B with storage volume equal to 31% of the MAR, FSL 930 masl.
 - A Langa Balancing Dam with storage volume 12,5 million m³ associated with a full supply level of 919masl.
 - A single 3,5m internal diameter uMkhomazi to uMlaza Tunnel and associated pipeline and water treatment plant system to Umlaas Road with design (seasonal) transfer capacity of 8,65 m³/s.

1.5 MAR Impendle Scheme to be planned/zoned for future use.

Optimisation of scheme configuration

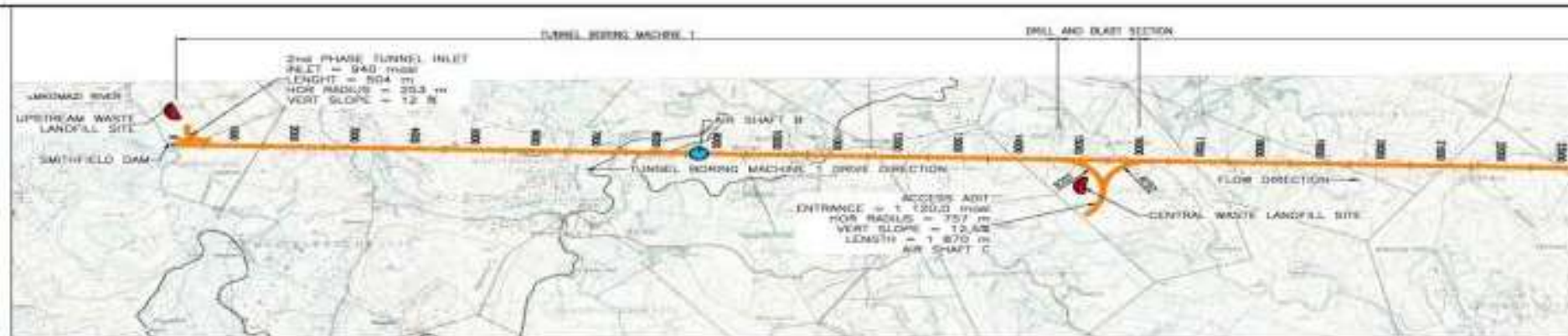
Update on waste disposal sites



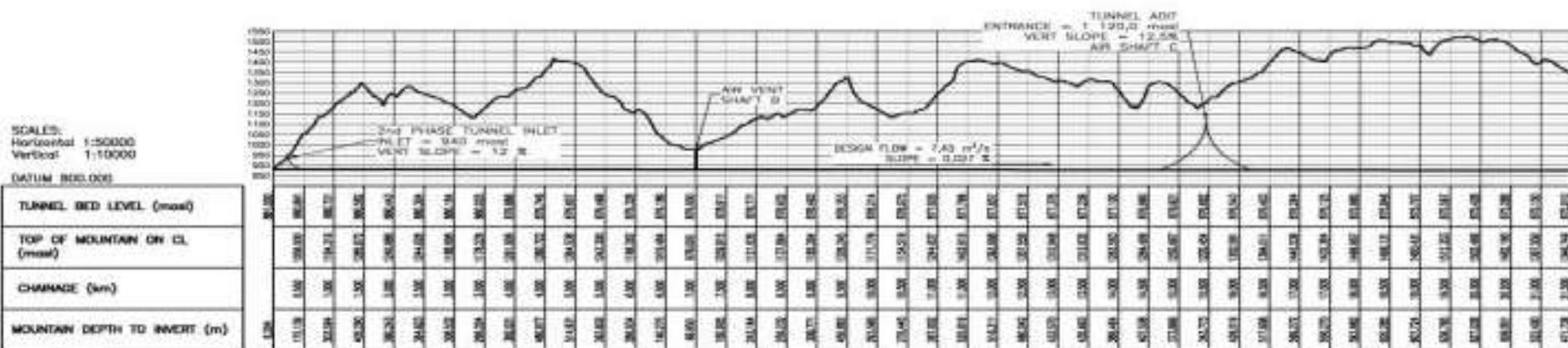
Update on Waste Disposal Sites

- **Three sites identified in previous presentation.**
Those are for licencing reasons.
- **The sizes were updated for spoil from portal excavations and for tunnel muck.**
- **It is likely that only one site will be used.**

Layout of waste disposal sites



PLAN OF TUNNEL ROUTE
SCALE 1:50 000

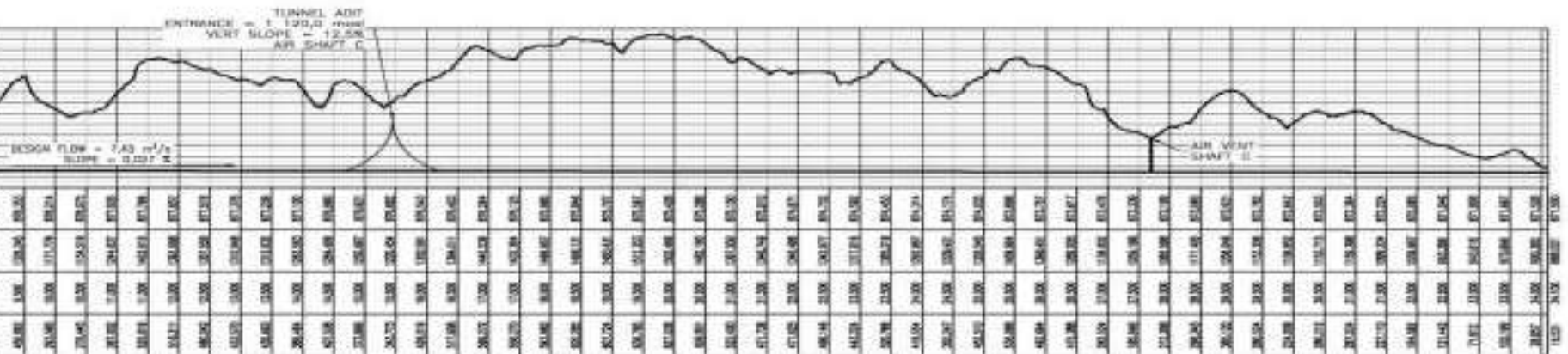


LONGSECTION TUNNEL
FROM 0.000 TO 34100.000

Layout of waste disposal sites



PLAN OF TUNNEL ROUTE
SCALE 1:50 000



LONGSECTION TUNNEL
FROM 0.000 TO 34100.000

Dam type selection

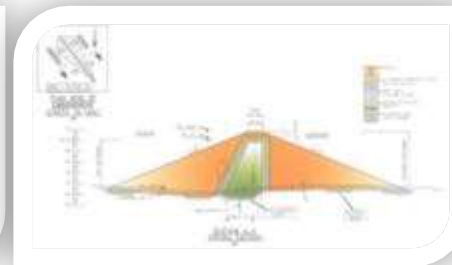
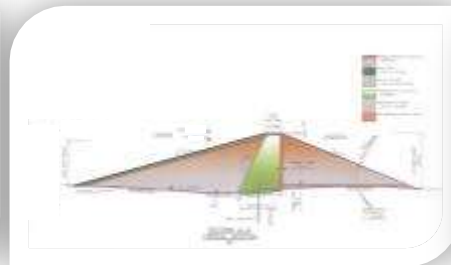
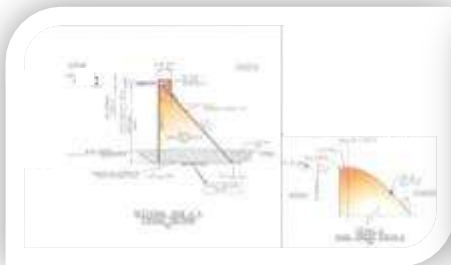
Smithfield Dam – Main & Saddle embankment

Langa Balancing Dam



Dam types

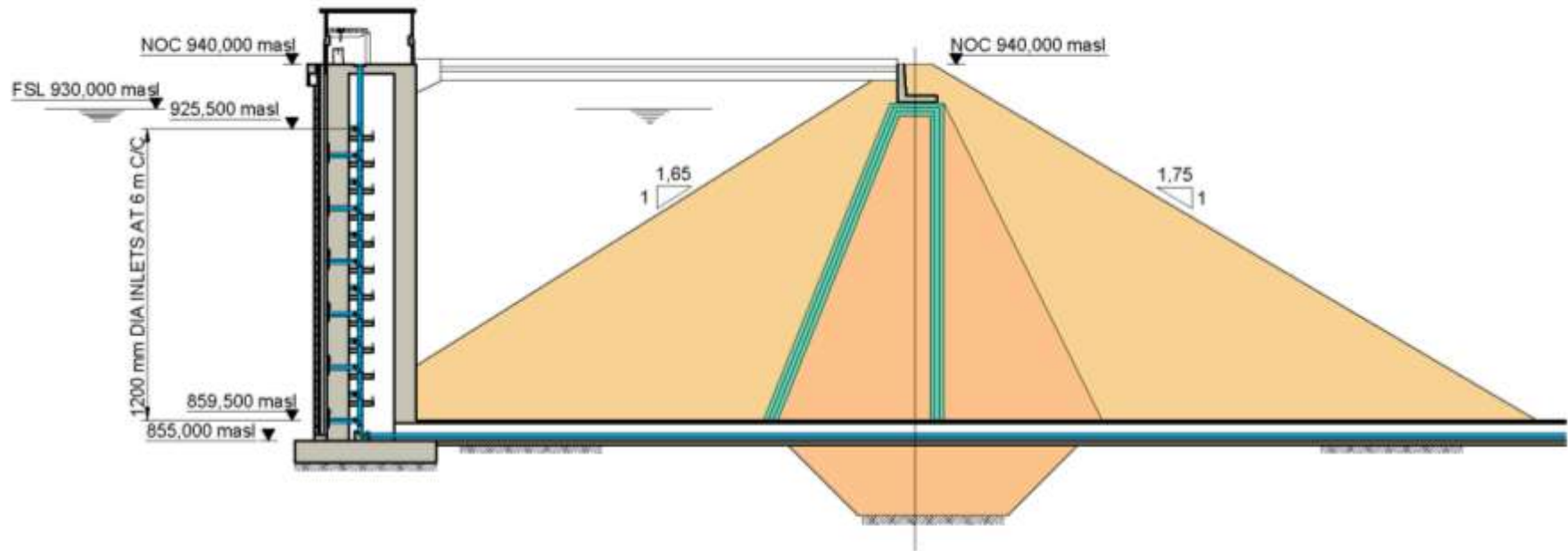
- Roller compacted concrete (RCC) gravity dam
- Zoned earthfill embankment dam
- Earth core rockfill dam (ECRD)
- Concrete faced rockfill dam (CFRD)
- Composite dam (various options)



Water quality and limnological review

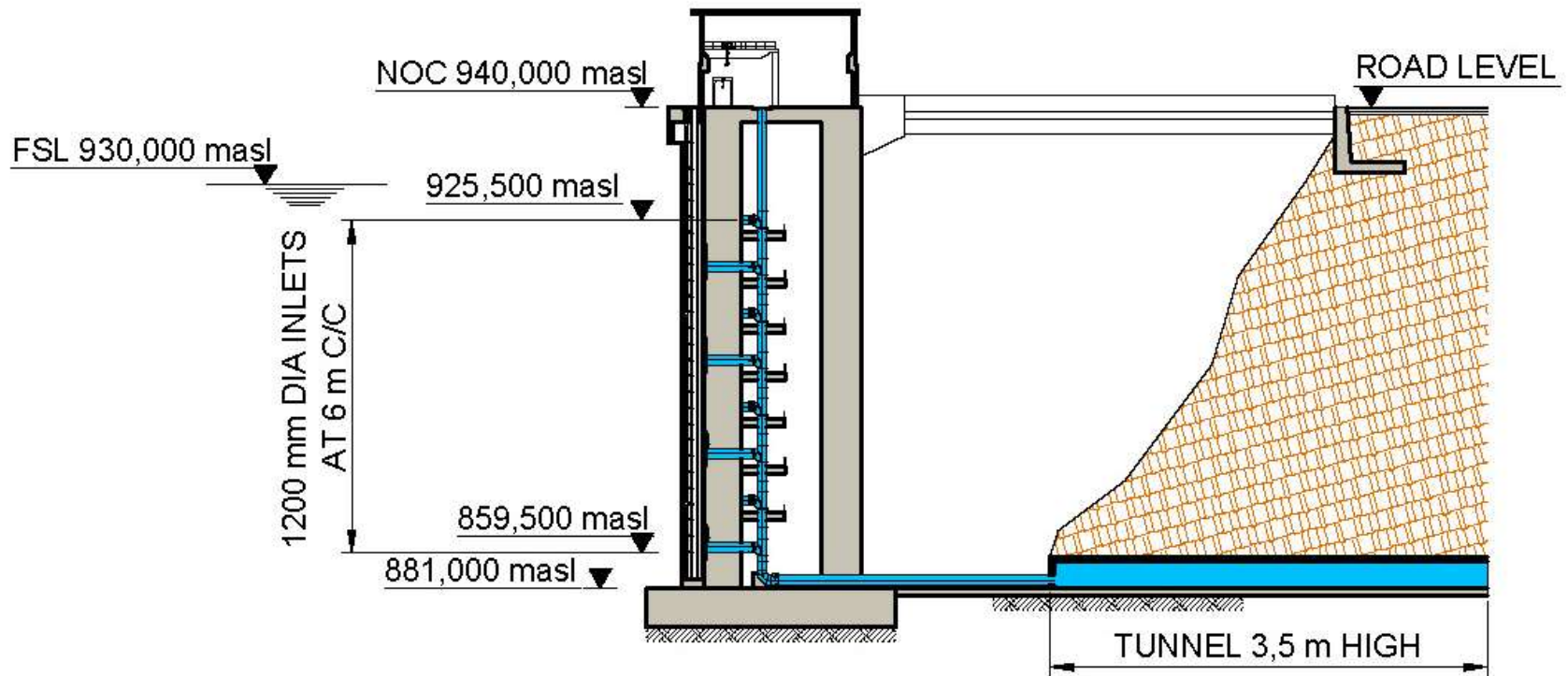
- ✓ Report received from Umgeni Water
- ✓ Assessment of both outlets regarding multiple draw-off requirements still outstanding

Water quality and limnological review



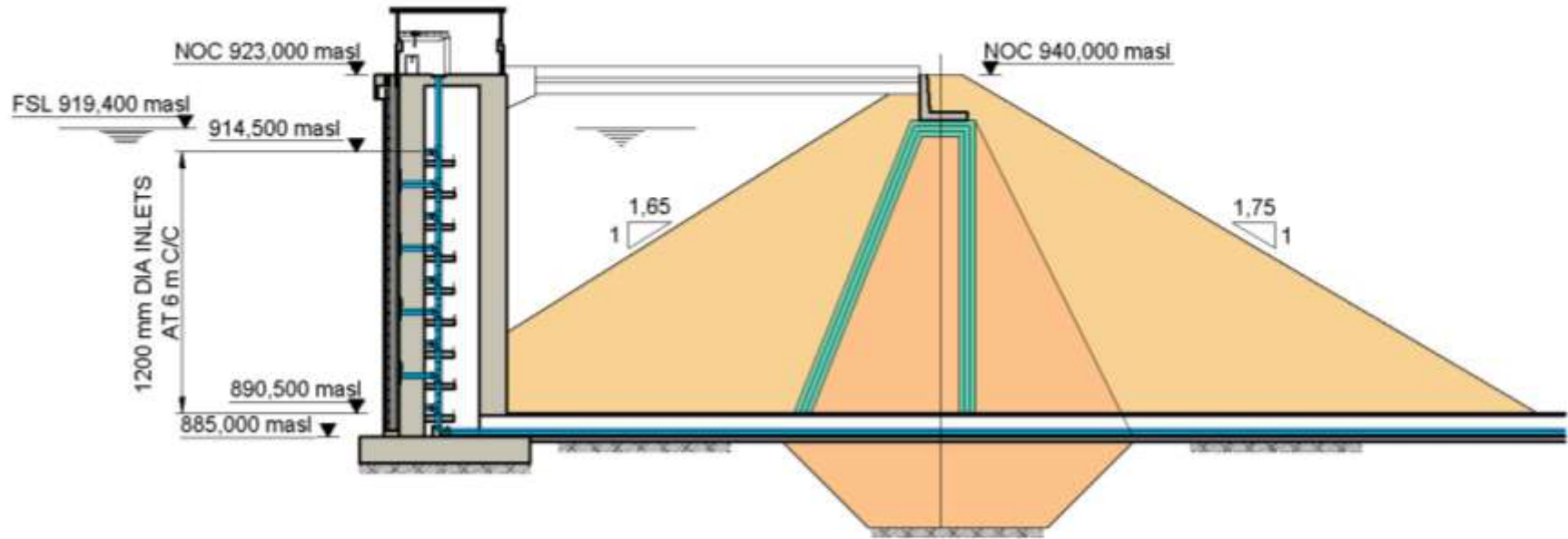
SMITHFIELD DAM : OUTLET WORKS
LONGITUDINAL SECTION

Water quality and limnological review



SMITHFIELD DAM : TUNNEL INLET WORKS
LONGITUDINAL SECTION

Water quality and limnological review



LANGA BALANCING DAM : OUTLET WORKS
LONGITUDINAL SECTION

Sediment deposition



Sediment deposition

Recommendation:

- ✓ A sedimentation deposition study should be carried out during the feasibility stage and must consider a period of longer than 100 years for the impact of sedimentation around the reservoir intake to the tunnel.
- ✓ This should be done to prevent changes to the vertical alignment during the design stage and to ensure that the tunnel entrance does not become blocked during the operational stage of the tunnel.

Cost comparison of Options

URV calculations

(uMWP vs. Desalination)



Possible scenarios defined by AECOM

- **Re-use is to be compared with uMkhomazi River Scheme but is not likely.**
- **Desalination is required before Smithfield Dam can be implemented – therefore it is a strategic decision to use desalination.**
- **Comparison as per terms of reference of study not possible – phasing in is possible.**

Possible scenarios defined by AECOM

- **Alternative 1 (supply area: South coast + uMWP footprint):**
 - ✓ Lovu Desalination Plant (phased), followed by
 - ✓ Smithfield Dam (AECOM comment: When?) with Desalination Plant mothballed, followed by
 - ✓ Lovu Desalination Plant, followed by
 - ✓ Impendle Dam.
- **Alternative 2 (supply area: South coast + uMWP footprint):**
 - ✓ Ngwadini Off Channel Dam, followed by
 - ✓ Smithfield Dam in 2023, followed by
 - ✓ Impendle Dam, followed by
 - ✓ Lovu Desalination Plant (phased)

Comparison between
desalination and Ngwadini Dam
(for the South Coast)

Possible scenarios identified by AECOM

- **Alternative 3 (supply area: South coast + North coast + uMWP footprint):**
 - ✓ Lovu Desalination Plant (AECOM comment: This may be different (i.e. Ngwadini instead of Lovu Desalination), depending on a comparison of results from Scenarios 1 and 2), followed by
 - ✓ Tongaat Desalination Plant, followed by
 - ✓ Smithfield Dam (AECOM comment: When needed), followed by Desalination Plants, followed by
 - ✓ Impendle Dam.
- **Alternative 4 (supply area: South coast + North coast + uMWP footprint):**
 - ✓ Smithfield Dam in 2023, followed by
 - ✓ Impendle Dam, followed by
 - ✓ Lovu Desalination Plant, followed by
 - ✓ Tongaat Desalination Plant.

Comparison
between
desalination and the
uMWP

Possible scenarios for supplying the North Coast

- **North Coast Alternative 1:**
 - ✓ Tugela Pipeline, followed by
 - ✓ Hazelmere augmentation, followed by
 - ✓ Tongaat Desalination Plant (if feasible to be phased), followed by
 - ✓ Smithfield Dam with Tongaat Desalination Plant mothballed, followed by
 - ✓ Tongaat Desalination Plant, followed by
 - ✓ Impendle Dam.
- **North Coast Alternative 2:**
 - ✓ Tugela Pipeline, followed by
 - ✓ Hazelmere augmentation, followed by
 - ✓ Smithfield Dam, followed by
 - ✓ Impendle Dam Tongaat, followed by
 - ✓ Tongaat Desalination Plant.

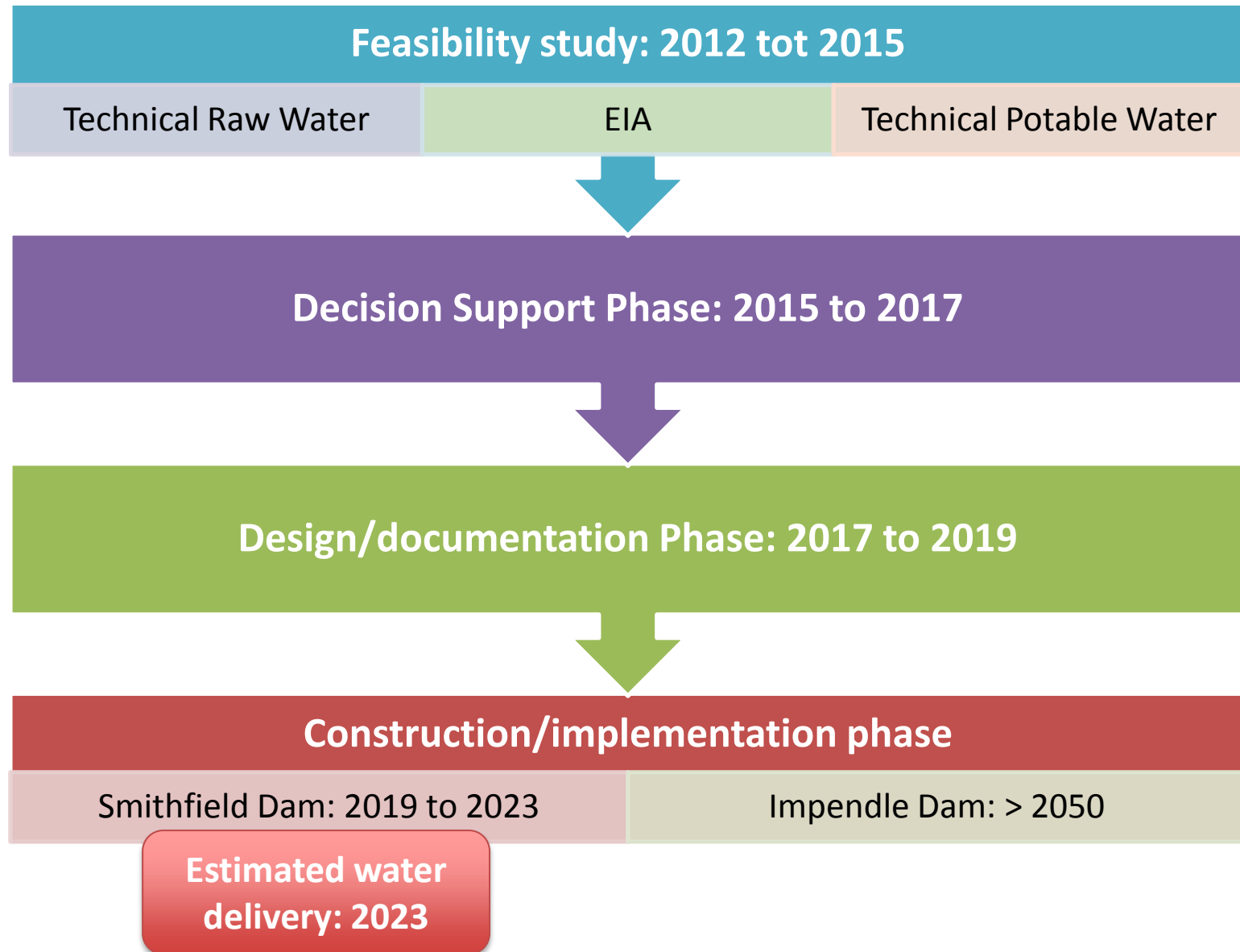
Possible scenarios for supplying the South Coast

- **South Coast Alternative 1:**
 - ✓ Lovu Desalination Plant (phased), followed by
 - ✓ Smithfield Dam with Lovu Desalination Plant mothballed, followed by
 - ✓ Lovu Desalination Plant, followed by
 - ✓ Impendle Dam.
- **South Coast Alternative 2:**
 - ✓ Ngwadini Off-channel Dam, followed by
 - ✓ Smithfield Dam in 2023, followed by
 - ✓ Impendle Dam, followed by
 - ✓ Lovu Desalination Plant (phased).

High level implementation programme



Project programme



Report on Institutional, Financial and Operational Aspects by September

- Options:**
- 1 Project**
 - 2 Umgeni**
 - 3 DWA Bulk Water and Umgeni**

Estimated Project Cost (base year: 2013)

Year	Estimated Capital Expenditure	
	(current values) (R million)	(Future nominal prices) ⁽³⁾
2017/18	90	95
2018/19	400	500
2019/20	2 597	3 314
2021/22	3 797	5 089
2022/23	1 845	2 597
Total⁽²⁾	8 729⁽¹⁾	11 595

Notes:

(1) Including Smithfield Dam, the tunnel, Langa Balancing Dam, the WTW, as well as the treated water pipeline to Umlaas Road

(2) All amounts include 14% VAT

(3) 5% annual escalation

Web page

The uMWP web page was updated with the following:

- Changes from BKS to AECOM;
- Descriptions of *Modules 2 and 3*;
- A description of the EIA process;
- Documentation of PSC meetings;
- Final reports that recently became available; and
- Contact information.



Introduction to the uMkhomazi Water Project, Phase 1 (uMWP1)

The uMWP1 is a feasibility study for the transfer of water from the undeveloped uMkhomazi river to the existing Ngweni system to further augment water supply to the Durban and Pietermaritzburg areas. It is a multi-disciplinary project, undertaken conjunctively by the Department of Water Affairs (DWA) and Umgeni Water (UW).

Phase 1 of the uMkhomazi Water Project (uMWP1) comprises three modules: a raw water module developing the resource and the transfer infrastructure (module 1), a treated water module (module 3) and an environmental impact assessment module (module 2).

The modules have been and will be assigned to professional service providers to address the following aspects related to a major water development:

- Water resources: uMkhomazi, uMlazi and uNgweni River catchments
- Water requirements: Water users in the uMkhomazi and uNgweni River catchments
- Engineering investigations: Proposed dams at Impendle (only for costing purposes) and Smithfield; the raw water conveyance infrastructure from Smithfield Dam via the proposed balancing dam at Beynesfield to the Water Treatment Plant; and potable water conveyance infrastructure to the Umhlanga Road/Cato Ridge reservoir
- Environmental impact assessment: Smithfield Dam to Umhlanga Road/Cato Ridge reservoir, including all conveyance infrastructure; and
- Socio-economic impact assessment: Regional, provincial (KwaZulu-Natal) and national.

If the scheme is deemed feasible, in relation to other options, it may be implemented by 2023.

Once complete, the uMkhomazi water transfer scheme will be the largest water transfer scheme in South Africa, comparable to the Lesotho Highlands Water Project in terms of water volume and tunnel lengths and diameters.



<http://www.dwa.gov.za/Projects/uMkhomazi/default.aspx>

3.3 Information management – Glossy pamphlet

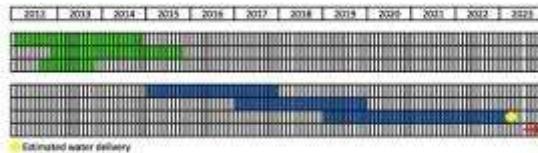
Governance

Because the project aims to augment water supply to the Mgeni system, an area that is managed by Umgeni Water with users mainly from eThekweni Municipality, this study requires participation from the three spheres of government, as well as from key stakeholders in the water sector. An extensive public participation process will be followed as part of the EIA (Module 2).



Project Programme

Feasibility Studies:
 - Module 1: Technical (Raw Water)
 - Module 2: Environmental Impact Assessment (EIA)
 - Module 3: Technical (Potable Water)
Implementation
 Decision Support Phase
 Design / Documentation Phase
 Phase 1: Construction - Sewerfield Dam and Tunnel
 Phase 2: Construction - Impounding Dam (1-9 years)



Contact Details



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Finalised the uMWP glossy pamphlet and distributed it at the PSC meeting that was held on 20 March 2013.



The uMkhomazi River is the third-largest river in KwaZulu-Natal in terms of the water that is discharged into the river from rainfall and the surrounding catchment and is largely undeveloped.

The Department of Water Affairs (DWA) is exploring options to meet the long-term water requirements of the almost five million domestic and industrial water users in the Durban and Pietermaritzburg regions of KwaZulu-Natal. To this end, it is currently implementing a Technical Feasibility Study as part of the uMkhomazi Water Project (uMWP), which aims to explore the preferred options for supplying water to meet the long-term requirements of water users in eThekweni Municipality's area of jurisdiction.

The uMWP will harness and transfer water from the uMkhomazi River to the existing Mgeni System, thereby developing the uMkhomazi River, augmenting the Mgeni System's water supplies to downstream users and ensuring that the area's long-term water requirements can be met. The project area focuses on the uMkhomazi, uMlaza and uMngeni River catchments.

By developing the uMkhomazi River and using its supplies to augment current systems, the DWA's long-term vision for reliable, efficient and sustainable water supplies for the hub of KwaZulu-Natal is being realised. In a water-scarce country such as



South Africa, the DWA is taking careful steps to optimise our current water resources to ensure sustainable supplies to support our developing economy.

Once completely developed, phase 1 and 2 of the uMWP will be the largest water transfer scheme in South Africa, comparable to the Lesotho Highlands Water Project in terms of water volume and tunnel lengths and diameters.





Thank you

“...Once completely developed, phase 1 and 2 of the uMWP will be the largest water transfer scheme in South Africa, comparable to the Lesotho Highlands Water Project in terms of volume and tunnel lengths and diameters...”

Site visit

No.	Day 1		Day 2	
	Name	Organisation	Name	Organisation
1	Hermien Pieterse	AECOM	Hermien Pieterse	AECOM
3	Kobus Bester	DWA	Kobus Bester	DWA
5	Niel van Wyk	DWA	Niel van Wyk	DWA
6	Kevin Meier	Umgeni Water	Kevin Meier	Umgeni Water
7	Kim Hodgson	Umgeni Water	Bill Pfaff	eThekwini Municipality
8	Madhu Moopanar	Umgungundlovu DM	Madhu Moopanar	Umgungundlovu DM
9	Salona		Salona	