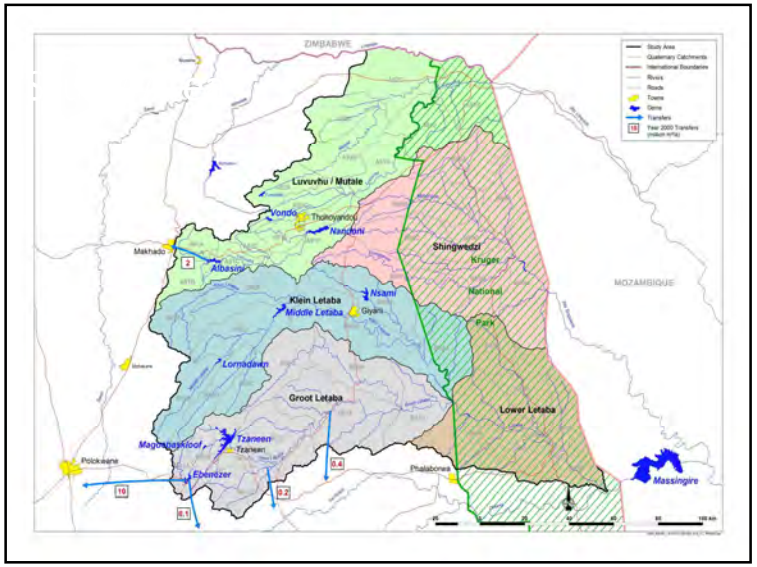
water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

Development of Reconciliation Strategies for Large Bulk Water Supply Systems of the Luvuvhu and Letaba Water Supply System Study Steering Committee Meeting No 5

20 June 2014

Proposed Reconciliation Strategy



Outline of Presentation

- Letaba / Luvuvhu - Mutale:
  - Water requirement scenarios
  - Yield analysis
  - Options for reconciliation
  - Water balance individual dams/systems
    - Reconciliation scenarios
  - Proposed Reconciliation Strategy
  - Recommendations

Urban Water Requirement Scenarios: Method

- High and low population scenarios
- Calibrate per capita consumption based on current water use and Level of Service (LOS)
- Apply high population scenario for balances (conservative target for planning purposes)
- Expansion of the LOS, two scenarios:
  - Rapid increase in the LOS
  - Gradual increase in the LOS

Water Requirement Scenarios

Irrigation based on current use and scheme allocations

High Scenario

- High Demographic Scenario
- Rapid implementation of increase in Levels of Service (LOS)

Low Scenario

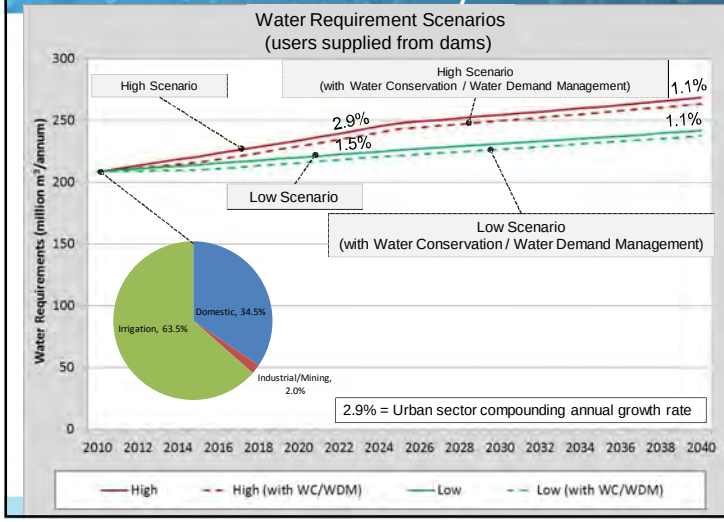
- High Demographic Scenario
- Gradual implementation of increase in Levels of Service (LOS)

Letaba: Summary of Water

Sector	Requirements in 2010	Future requirements (2040)	
		High growth	Low growth
Irrigation	132.6	132.6	132.6
Urban	72.0	131.8	105.2
Mining/Industrial	4.1	4.1	4.1
Sub-Total Letaba	208.7	268.4	241.9

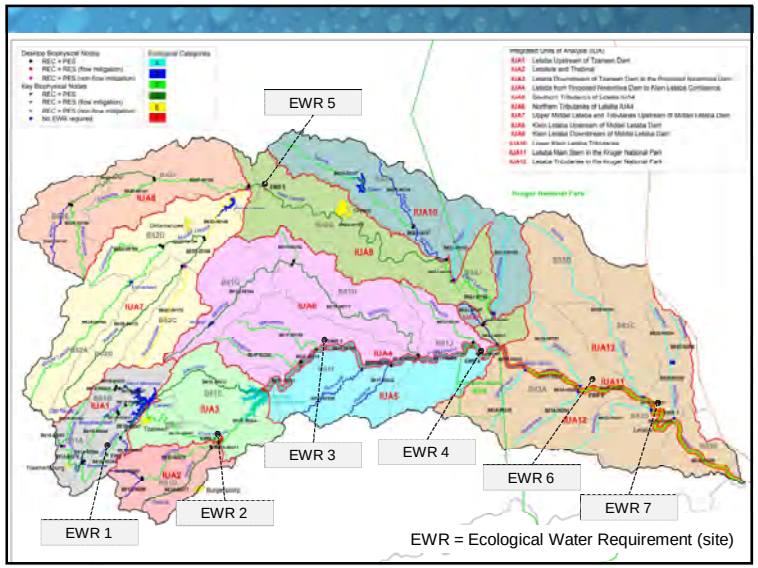
Water requirements supplied from dams / systems.

Letaba River System



Letaba: Ecological Water Requirements

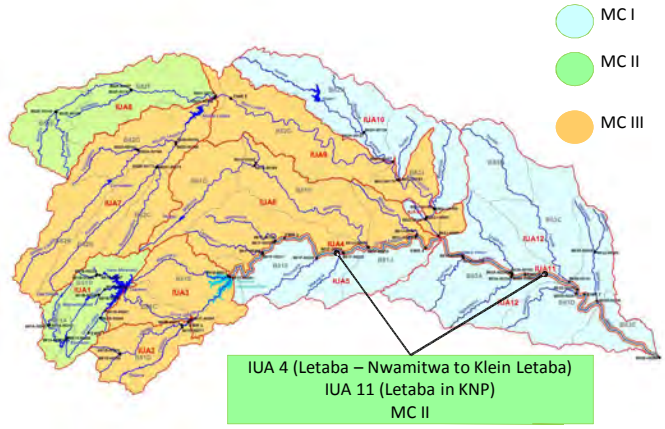
- Classification of water resource in accordance with the promulgated guidelines – parallel process selected the preferred scenario.
- Ecological Water Requirements determined for 62 biophysical nodes, including 7 sites.
- Balances were compiled in accordance with recommendation of the Classification study.



Yield Analysis: Methodology

- Applied the Water Resources Yield Model
  - Monthly time step, network simulation model
- Stochastic risk analyses were carried out for all the dams.
  - Ebenezer Dap Naudé sub-system
  - Groot Letaba River System (Ebenezer, Tzaneen,)
  - Hans Merensky Dam, Magoebaskloof & Vergelegen
  - Thabina Dam, Thapane Dam, Modjadji Dam
  - Middel Letaba (Middel Letaba & Nsami)
- High assurance yield based on the 1:50 year Recurrence Interval Yield (98% annual assurance)

Management Classes



Groot Letaba System Requirements and Tzaneen Dam Restriction Rule (Policy)

- Rule: below 95% irrigators cut to 50% allocation, reviewed incrementally as dam recovers above 95%
- Below 5% irrigators get 0%, urban cut to 70%
- Irrigation:
  - Noord Kanaal: 28.8 million m^3/a
  - N&N Kanaal: 13.03 million m^3/a
  - Main River Tzaneen: 31.86 million m^3/a
  - Resource Poor Farmers: 31.30 million m^3/a
  - **Total: 104.99** million m^3/a
- EWR releases: Classification Scenario
- Urban demands: Tzaneen town, Ritivi 1 & 2, Ba Phalaborwa: 16.51 million m^3/a

Groot Letaba Catchment Options

(Screening Workshop: April 2012)

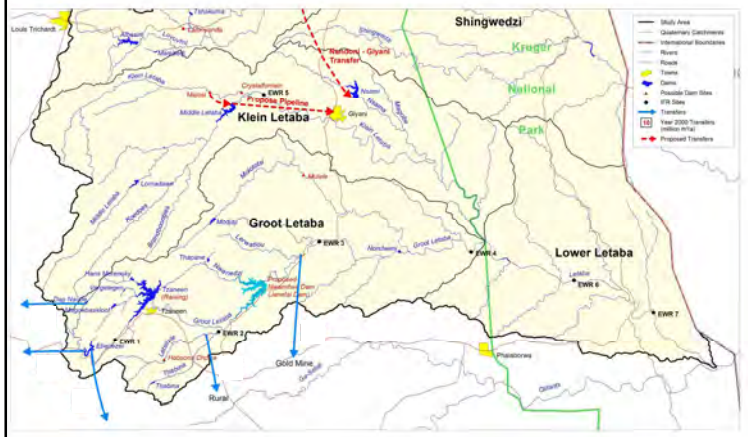
- **GL1: Raising of Tzaneen Dam.**
- **GL2: Construction of Nwamitwa Dam.**
- **GL3: Bulk Water Supply Infrastructure from Nwamitwa Dam.**
- **GL5: Artificial recharge at Mulele on Molototsi River.**
- **GL6: Groundwater regional scheme in conjunction with surface scheme.**
  (undertaken a desktop estimate of groundwater availability)

Middel & Klein Letaba Catchment

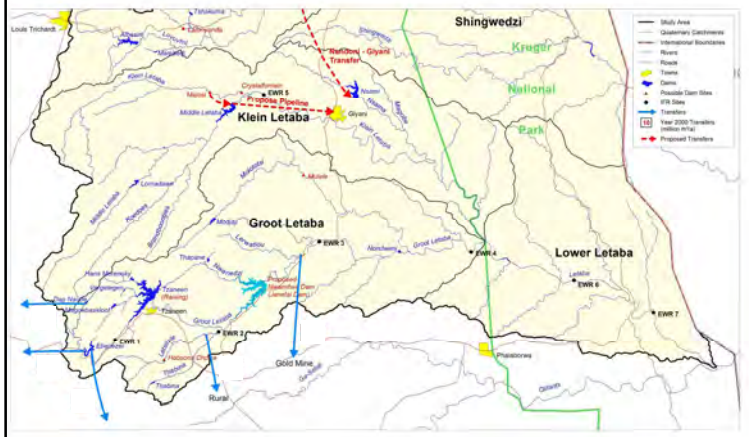
(Screening Workshop: April 2012)

- **MKL1: Water Conservation & Water Demand Management.**
- **MKL2: Development of groundwater resource.**
  (undertaken a desktop estimate of groundwater availability)
- **MKL3: Replacement of Middel Letaba canal with pipeline.**
- **MKL4: Transfer Scheme from Nandoni Dam.**
- **MKL5: Construction of new dam on Klein Letaba River:**
  - **Majosi Dam**
  - **Crystalfontein Dam**

Groot and Klein Letaba



Middel and Klein Letaba



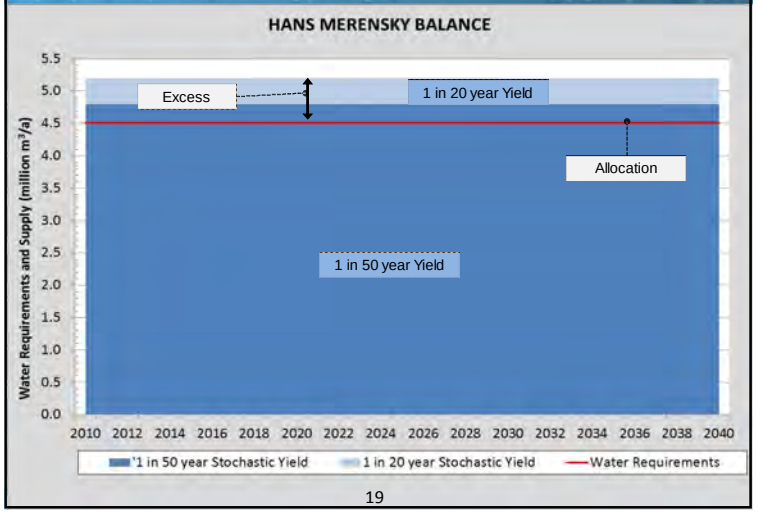
Reconciliation Scenario

Assumptions:

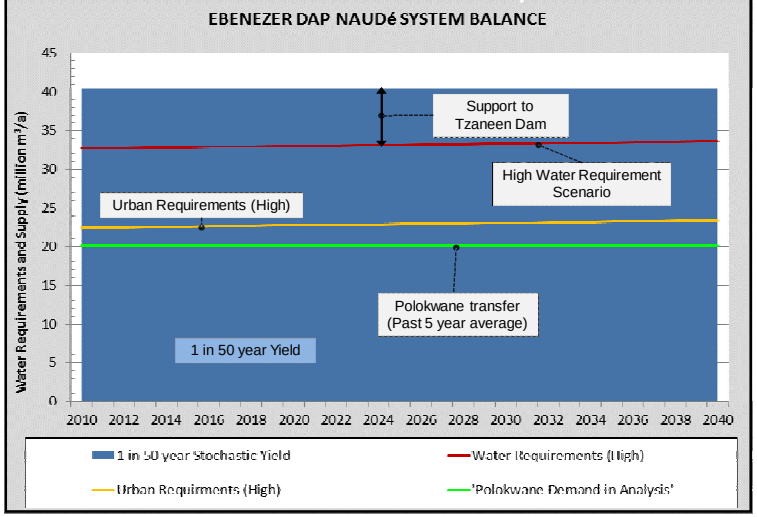
- High population scenario
- Rapid increase in Level of Service – urban sector
- Irrigation allocations exercised
- Ebenezer and Tzaneen Dam operated as a system
- Apply identified augmentation options (selection)
- EWR releases: Classification scenario
- Perspective on Polokwane support from Letaba
- Provide perspective on licence applications from:
  - Magoebaskloof / Vergelegen dams

EWR = Ecological Water Requirements

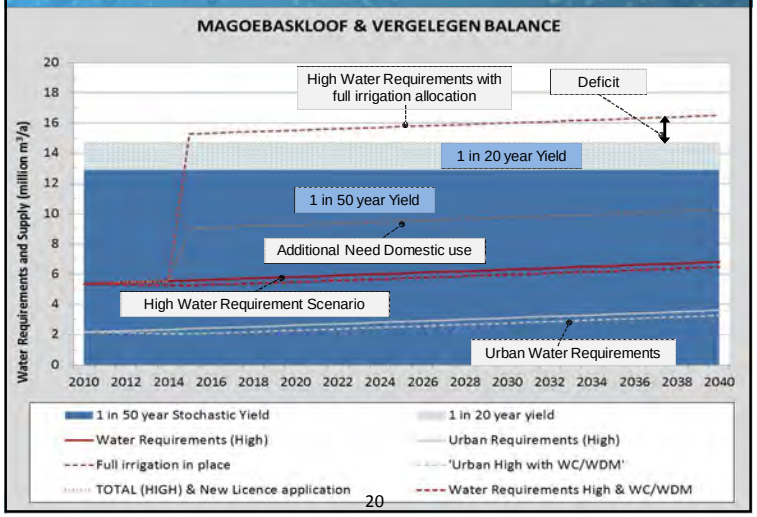
Reconciliation Scenario 1



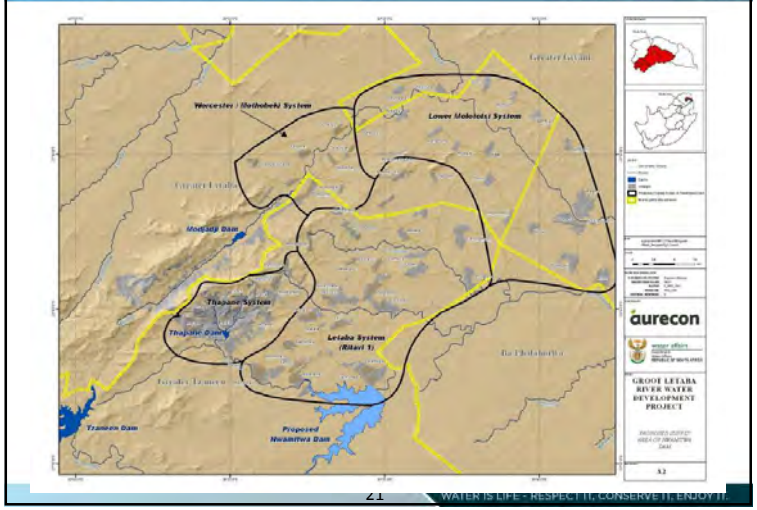
Combined Ebenezer Dap Naudé



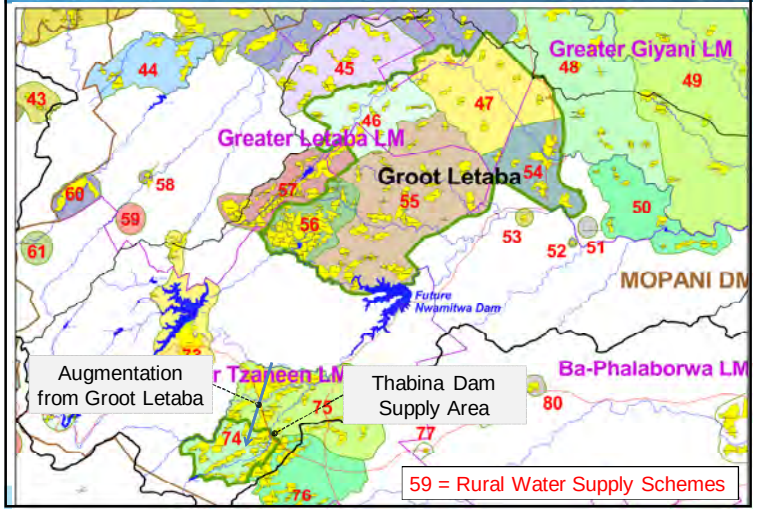
Unused Irr allocation & Domestic use



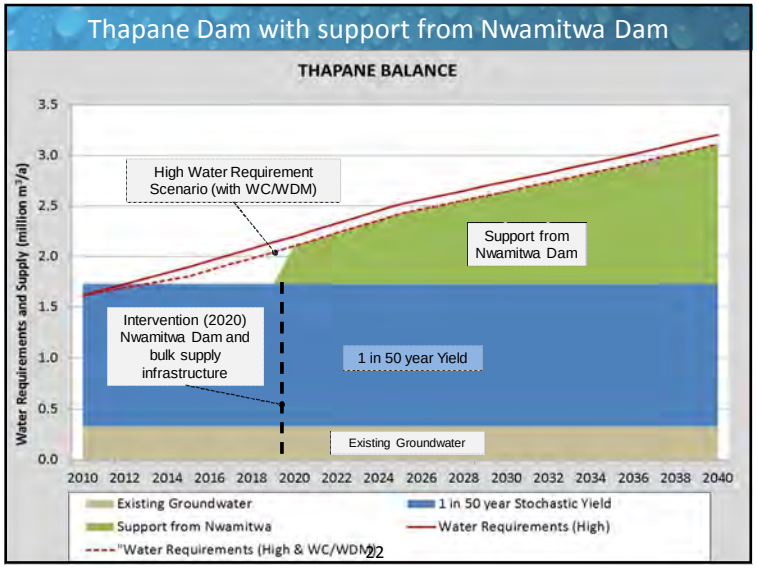
Target Supply Area from proposed Nwamitwa Dam



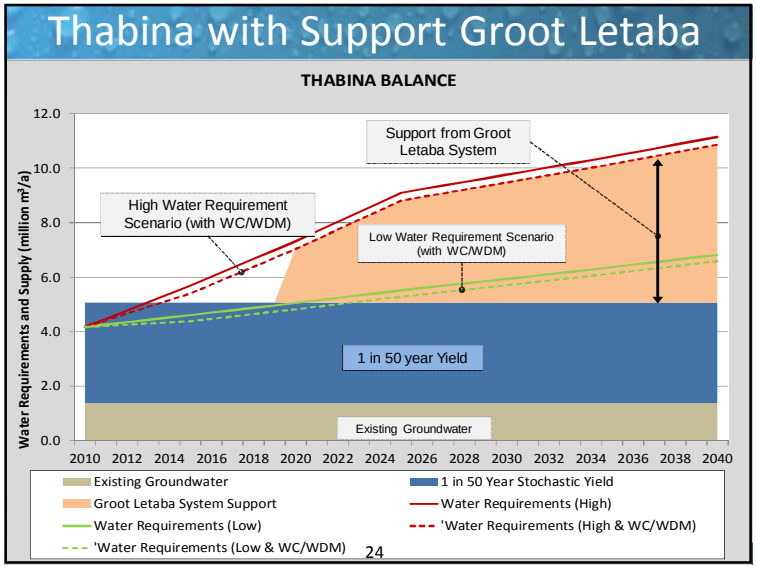
Thabina Dam Supply Area & augmentation



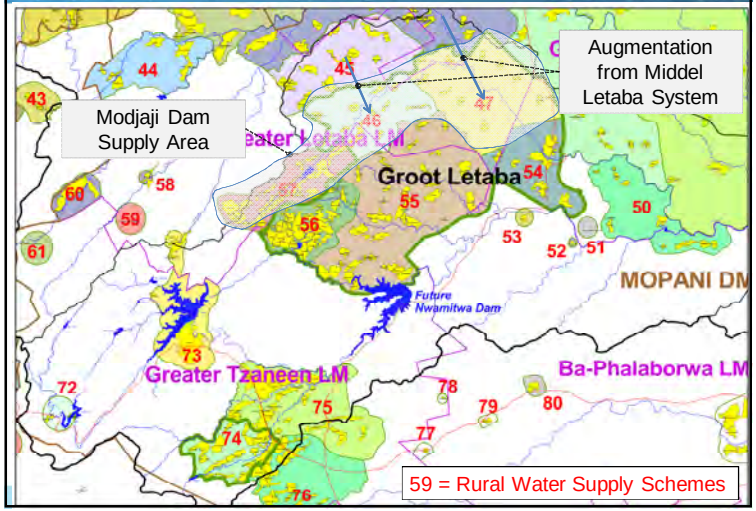
Thapane Dam with support from Nwamitwa Dam



Thabina with Support Groot Letaba



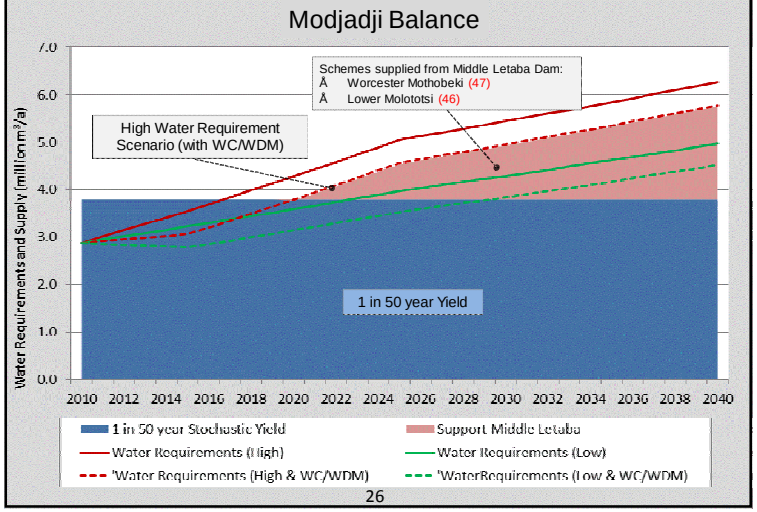
Modjadji Dam Supply Area & augmentation



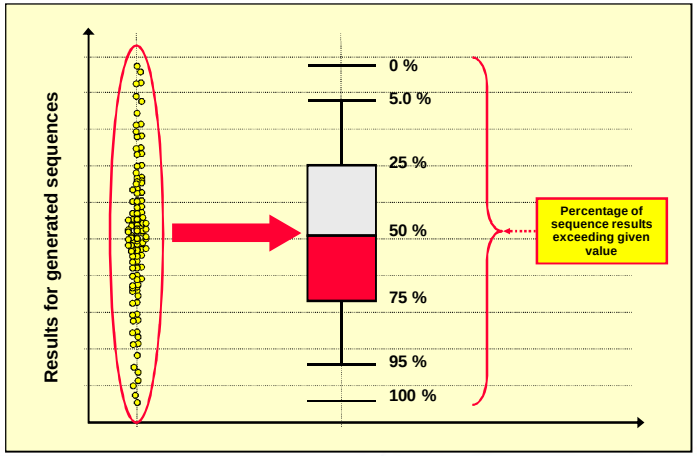
Groot Letaba System: Risk Analysis

- Risk analysis based on stochastic streamflow
  - Rigorous stochastic model validated by verification testing
- Constant development analysis
- Three scenarios:
  - 1: Current system and Tzaneen Dam raising, existing EWR.
  - 2: Scenario 1 and Nwamitwa Dam.
  - 3: Scenario 2 and Classification EWR.
- Applied curtailment rule (previous slide)
- Water supply results for 201 stochastic sequences

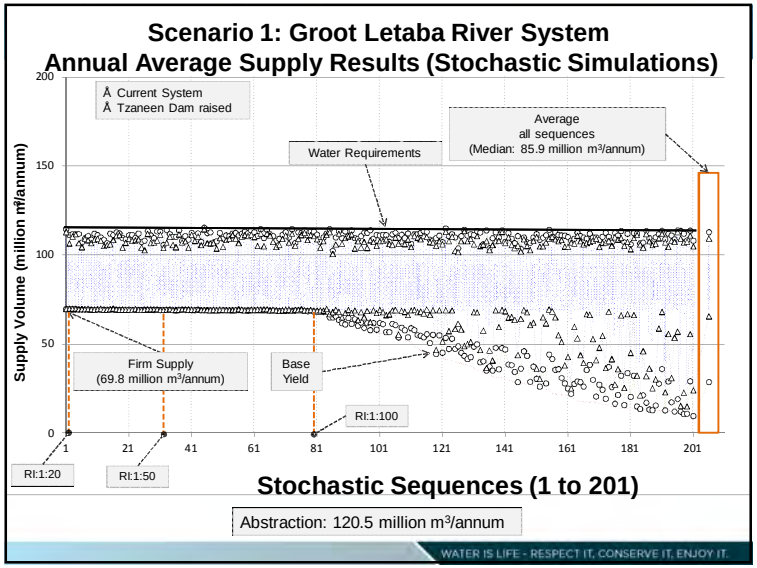
Modjadji Dam with support from Middel Letaba



Probability distribution (Box Plot)



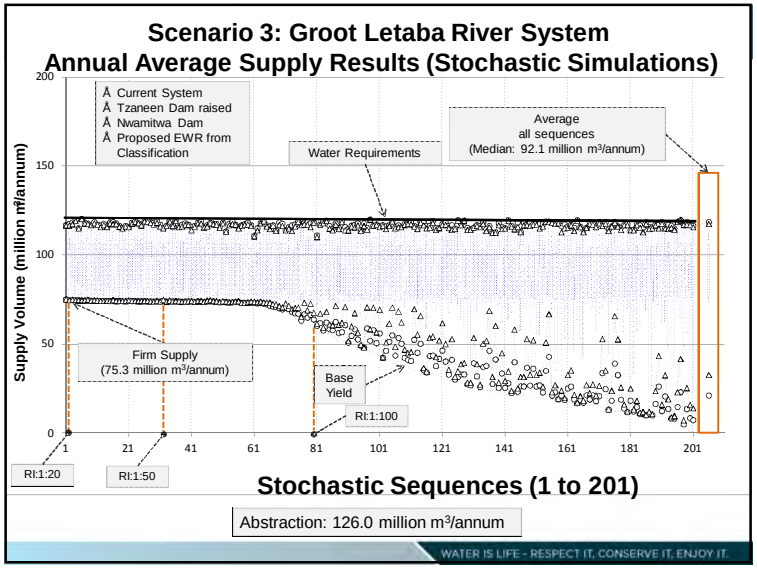
Scenario 1: Groot Letaba River System
Annual Average Supply Results (Stochastic Simulations)



Abstraction: 120.5 million m³/annum

WATER IS LIFE - RESPECT IT, CONSERVE IT, ENJOY IT.

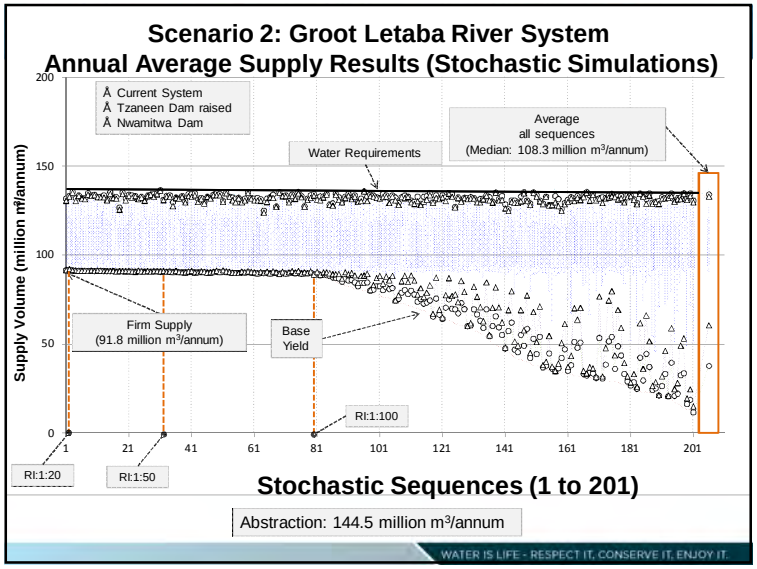
Scenario 3: Groot Letaba River System
Annual Average Supply Results (Stochastic Simulations)



Abstraction: 126.0 million m³/annum

WATER IS LIFE - RESPECT IT, CONSERVE IT, ENJOY IT.

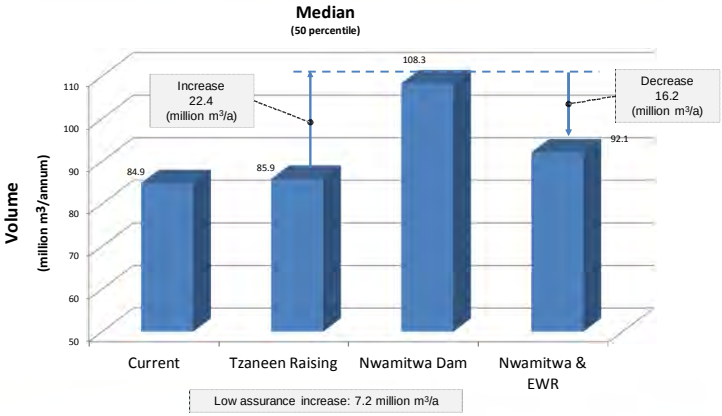
Scenario 2: Groot Letaba River System
Annual Average Supply Results (Stochastic Simulations)



Abstraction: 144.5 million m³/annum

WATER IS LIFE - RESPECT IT, CONSERVE IT, ENJOY IT.

Surface Development Options & EWR



Low assurance increase: 7.2 million m³/a

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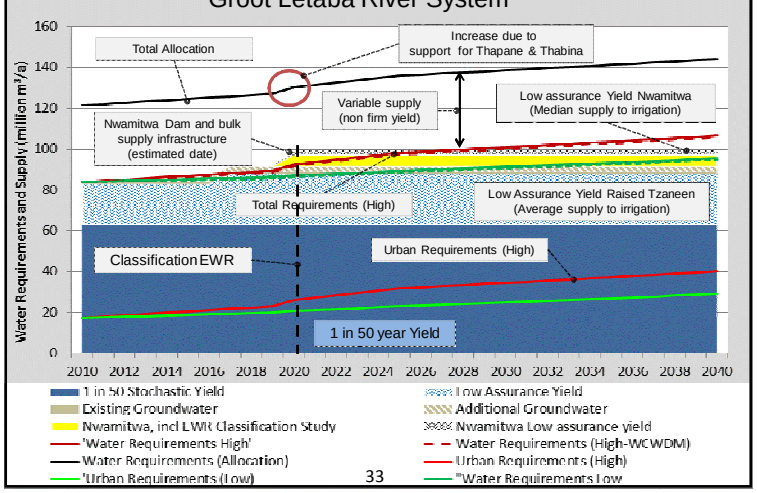
Groot Letaba River System



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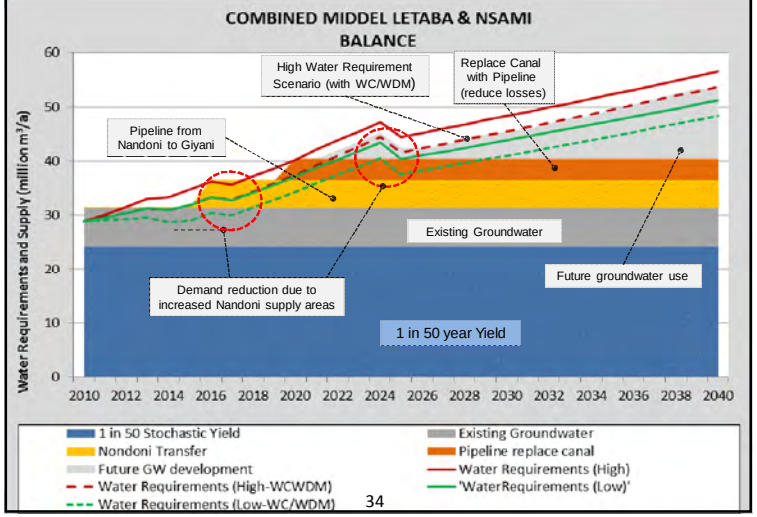
Letaba: Reconciliation Strategy (1 of

- No additional transfers out of the Letaba River System, Polokwane should be augmented from the Olifants River System.
- Groundwater important source towards reconciliation, currently fully utilised in many areas.
- Augmentation required from Groot Letaba System to area receiving water from Thabina and Thapane.
- Augment Modjadji Dam supply area from Middel Letaba System.
- Monitor water use to confirm water requirement projections before implementing options.

35 WATER IS LIFE - RESPECT IT, CONSERVE IT, ENJOY IT.

Middel Letaba and Nsami System



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Letaba: Reconciliation Strategy (2 of

Middel Letaba & Nsami system:

- All water requirements can be supplied up to the year 2040 by implementation the following interventions:

Intervention	Contribution (million m³/annum)	Date	Remark
Water Conservation and Water Demand Management in Urban Sector	2.8	2015	Saving
Pipeline from Nandoni Dam	5	2016	Additional yield
Pipeline to replace canal between Middel Letaba and Nsami dams	4	2016	Saving in losses
Supply from Nandoni Dam to committed areas	3	2017	Augmentation (2 Phases)
	7.7	2025	
Groundwater Developments in supply areas (Commission Feasibility Study)	12.9	2021	Additional yield

Letaba: Reconciliation Strategy (3 of

Groot Letaba River system:

Å All water requirements can be supplied up to the year 2030 by implementation the following interventions:

Intervention	Contribution (million m³/annum)	Date	Remark
Water Conservation and Water Demand Management in Urban Sector	0.8	2015	Saving
Raising of Tzaneen Dam	1	2017	Additional yield, improved assurance of supply
Implement Nwamitwa Dam	6.2	2019(1)	Additional yield 5.5 High assurance 0.7 Low Assurance
Classification EWR	Variable	2020	Reserve releases
Additional groundwater development (Commission Feasibility Study)	>2.5	2018	Additional yield

Notes: (1) Estimated date when Nwamitwa Dam is operational.

Letaba: Reconciliation Strategy (4 of

Thabina Dam system:

Å All water requirements can be supplied up to the year 2040 by implementation the following interventions:

Intervention	Contribution (million m³/annum)	Date	Remark
Water Conservation and Water Demand Management in Urban Sector	0.3	2015	Saving
Bulk supply Infrastructure to augment from Groot Letaba System	5.8	2019(1)	Indicated volume required by 2040

Notes: (1) Estimated date when Nwamitwa Dam is operational.

Letaba: Reconciliation Strategy (5 of

Thapane Dam system:

Å All water requirements can be supplied up to the year 2040 by implementation the following interventions:

Intervention	Contribution (million m³/annum)	Date	Remark
Water Conservation and Water Demand Management in Urban Sector	0.1	2015	Saving
Bulk supply Infrastructure to augment from Groot Letaba System	1.4	2019(1)	Indicated volume required by 2040

Notes: (1) Estimated date when Nwamitwa Dam is operational.

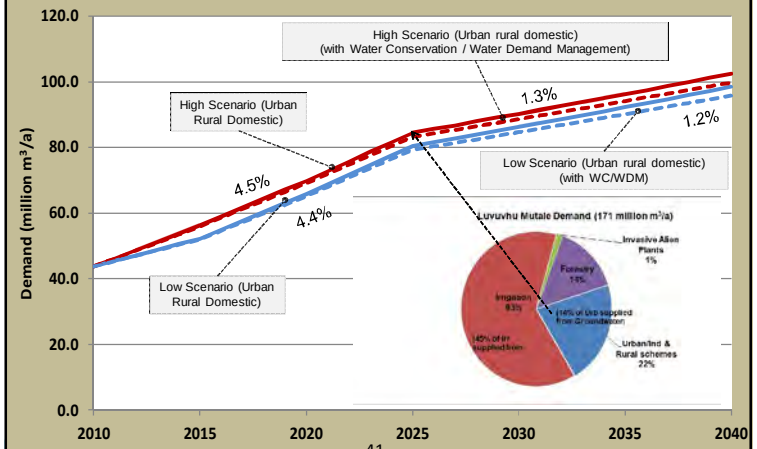
Letaba: Reconciliation Strategy (6 of

Modjaji Dam system:

Å All water requirements can be supplied up to the year 2040 by implementation the following interventions:

Intervention	Contribution (million m³/annum)	Date	Remark
Water Conservation and Water Demand Management in Urban Sector	0.3	2015	Saving
Bulk supply Infrastructure to augment from Middel Letaba System	2.2	2020	Indicated volume required by 2040

Luvuvhu River System



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Summary of Water Requirements

Sector	Requirements in 2010	Future requirements (2040)	
		High growth	Low growth
Irrigation	5.90	26.0	26.0
Urban	44.10	103.0	99.8
Mining/Industrial	0.55	0.55	0.55
Sub-Total Luvuvhu Mutale	49.55	129.55	126.35

Water requirements supplied from dams / systems.

Summary of Water Requirements

Sector	Requirements in 2010	Future requirements (2040)	
		High growth	Low growth
Irrigation	5.90	26.0	26.0
Urban	44.10	103.0	99.8
Mining/Industrial	0.55	0.55	0.55
Sub-Total Luvuvhu Mutale	49.55	129.55	126.35

Water requirements supplied from dams / systems.

Ecological Water Requirement Scenarios

Desktop EWR Estimations

DAM	Location (Quat)	Ecological Category	Yield reduction (million m^3/a)
Vondo	A91G	B/C	0.3
Albasini	A91B	D	4
Nandoni	A91H	B/C	12
Tshakhuma	A91D	C/D	1.4
Rambuda	A92D	B/C	2.5
Tswera	A92D	B/C	17

Note: EWR low confidence level requirements ï need Classification study

Luvuvhu Catchment Proposed Options

(Screening Workshop: April 2012)

- **Lu1, 2 & 3: Reconsider supply to Makhado – Albasini, Nandoni, smaller resources.**
- **Lu4: Groundwater utilisation.**
- **Lu5: Raising Vondo Dam.**
- **Lu6: Mid Dzindi Dam.**
- **Lu7: Latonyanda Dam.**
- **Lu8: Paswane Dam.**
- **Lu9: Xikundu Dam.**

Mutale & Shingwedzi Proposed Options

(Screening Workshop: April 2012)

- **Mu1: Water Conservation & Demand management.**
- **Mu2: Groundwater development.**
- **Mu3: New dam on Mutale River.**
  - **Rambuda, Tswera & dams (Thengwe).**
- **Mu4: Abstraction from the Limpopo.**
- **Sw1: Groundwater development.**
- **Sw2: Transfer of water from Luvuvhu**

Sub-system Historic Yield Results

Dam	HFY	Notes
Existing dams		
Albasini (Ti)	1.4	Current Albasini sub-system
Albasini (Tii)	7.3	No grourndwater abstractions for irrigation upstream
Albasini (Tiii)	11.8	No ground and surface water irrigation upstream
Phiphidi	0.2	Existing small dam part of Thohoyandou supply
Possible Future dams		
Latonyanda	7.8	Net yield-reduce Nandoni Yield by 7 million m^3/a (stor 96)
Lower Latonyanda	8.1	Net yieldreduces Nandoni Yield by 4 million m^3/a (Stor 96)
Proposed Paswane	43	Net storage 86
Proposed Xikundu	51	Net storage 119
Tswera	54	Net storage 131
Rambuda	12.6	Net storage 13.5
Thengwe	51.0	Net storage 116

Sub-system Stochastic Yield Results

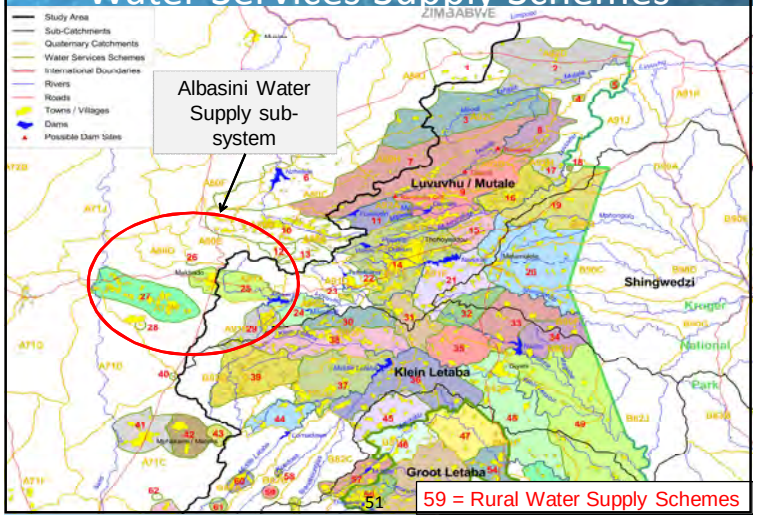
Dam	HFY ($million\ m^3/a$)	Long-term Stochastic Yield ($million\ m^3/a$)			
		1 in 20	1 in 50	1 in 100	1 in 200
Existing dams					
Albasini (Ti)	1.4	3.7	2.5	1.9	1.6
Vondo	16.8	25	21.9	20.5	18.9
Damani	4.8	5.7	5.3	4.8	4.5
Nandoni	62	83	70	64	58
Tshakhuma	1.4	1.8	1.5	1.3	1.2
Possible Future dams					
Tshakhuma	1.4	1.8	1.5	1.3	1.2
Proposed Paswane	43	64.5	55	50.8	46.3
Proposed Xikundu	51	71.5	62.5	56.2	51.5
Rambuda	12.6	18.7	16.7	14.6	13.4

URV & Costs of Selected Options

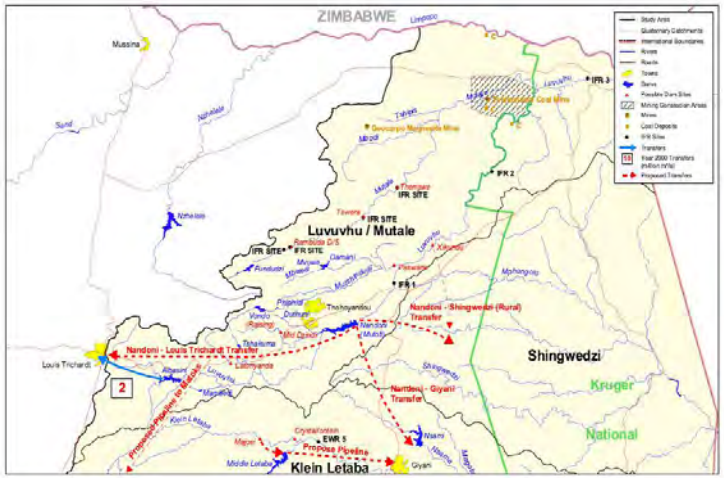
Dam	HFY (million m^3/a)	URV (8% rate)	Total cost (R-million)
Paswane	43 (55)	0.714	257
Xikundu	51 (63)	0.759	310
Rambuda	12.6	1.903	182
Tswera	54.0	0.834	344
Thengwe	51.0	0.579	225
Majosi	4.6	13.351	402
Crystalfontein	5.4	9.514	336
Mid Letaba Canal replace Pipeline	4.0	1.239	290

Notes: Total cost = Capital costs

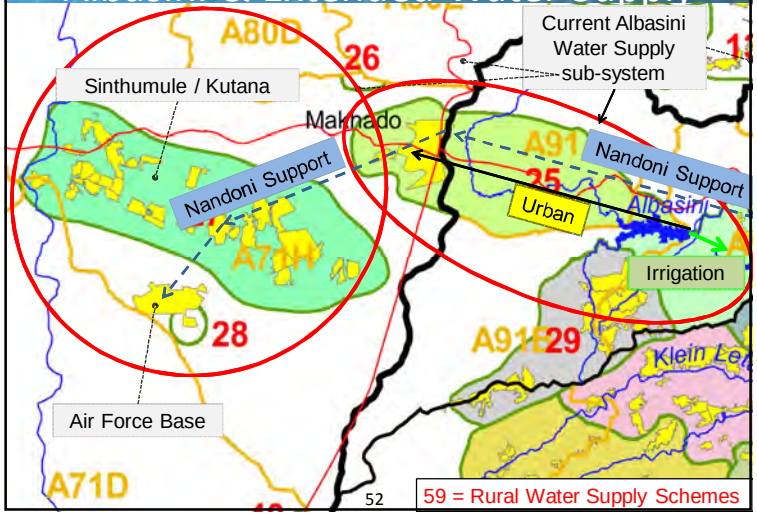
Water Services Supply Schemes



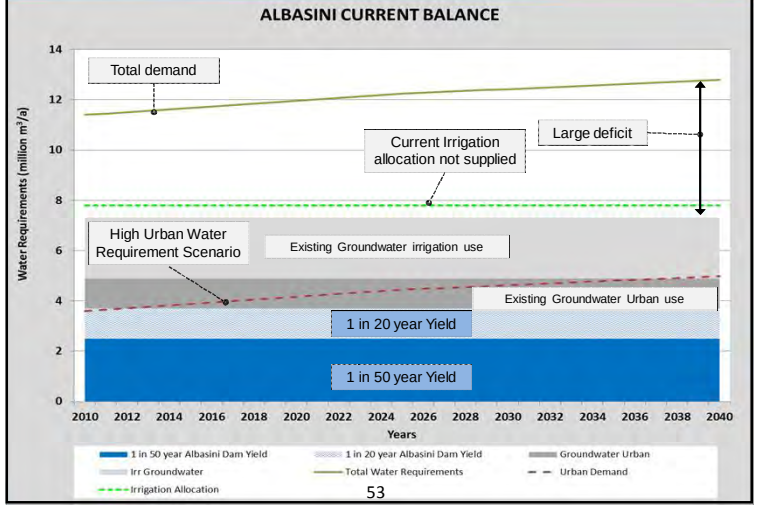
Luvuvhu & Mutale



Albasini & Extended Water Supply



Albasini Dam current situation



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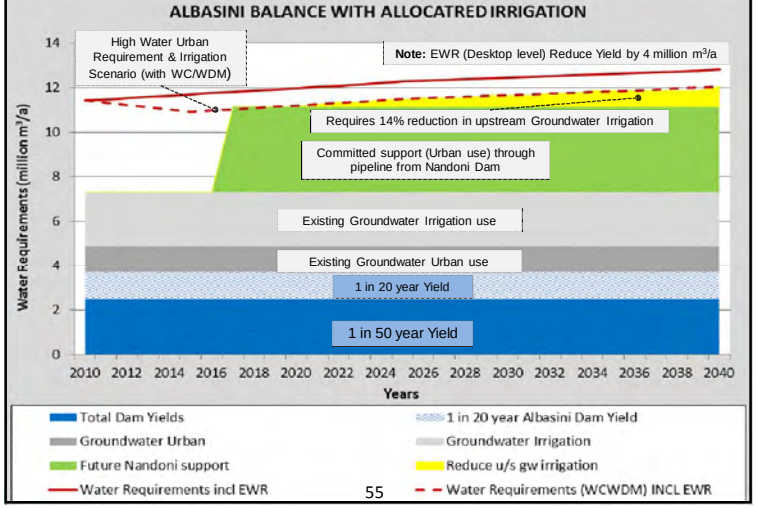
Albasini Dam with support to Irrigation



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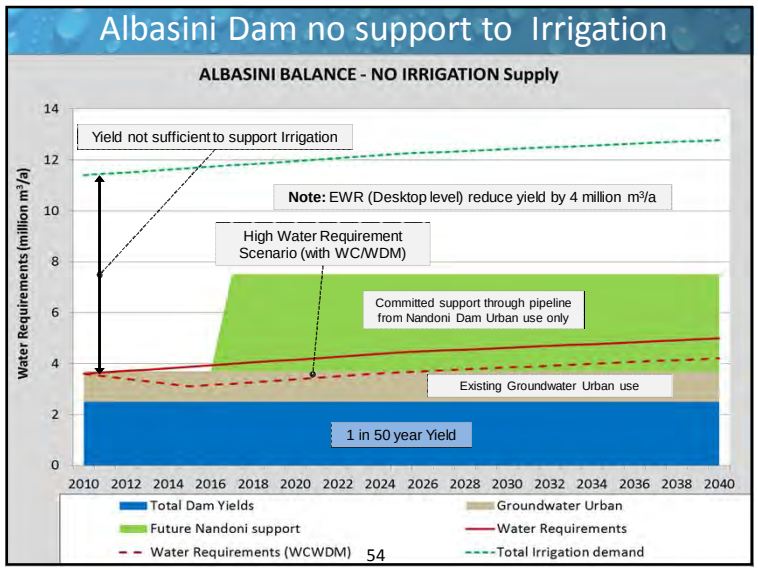
Albasini Dam no support to Irrigation



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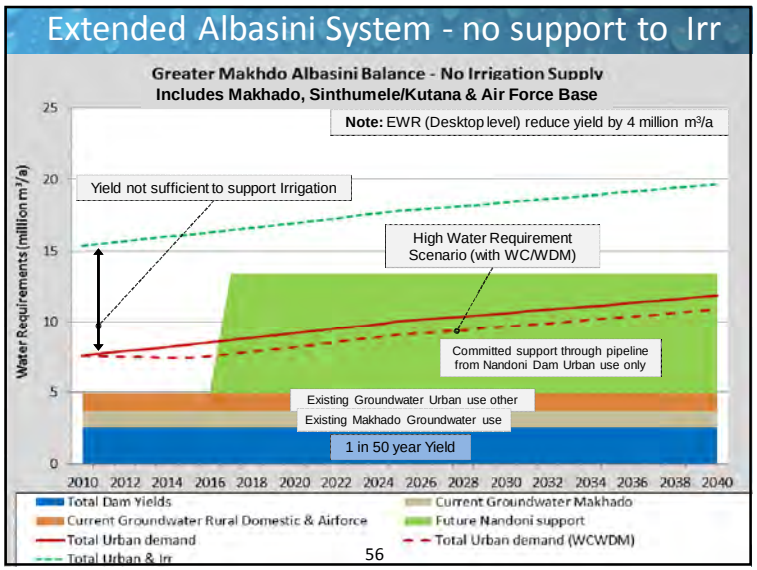
Extended Albasini System - no support to Irr



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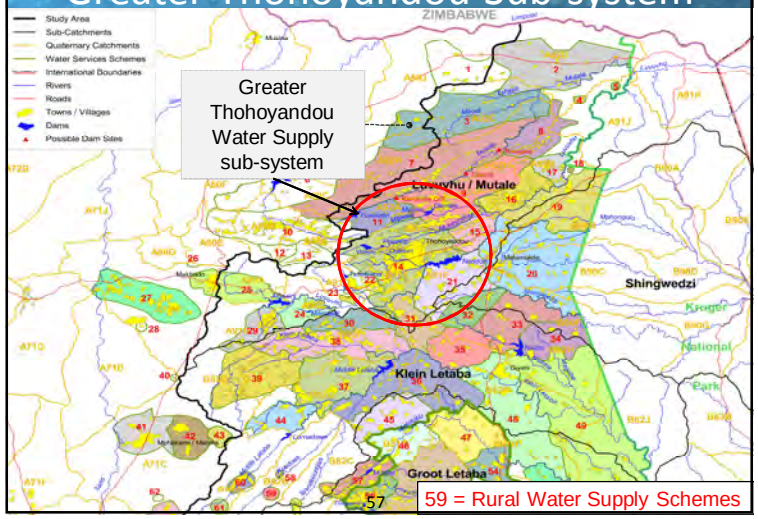
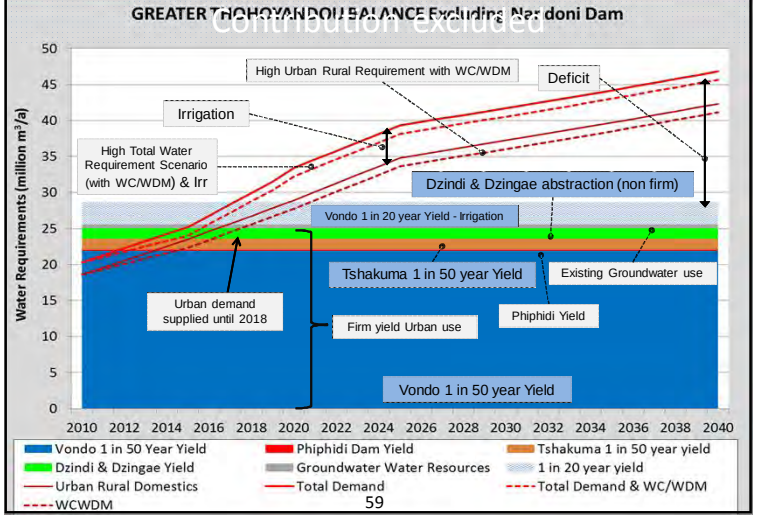
Greater Thohoyandou Sub-system



57

59 = Rural Water Supply Schemes

Greater Thohoyandou water balance Nandoni



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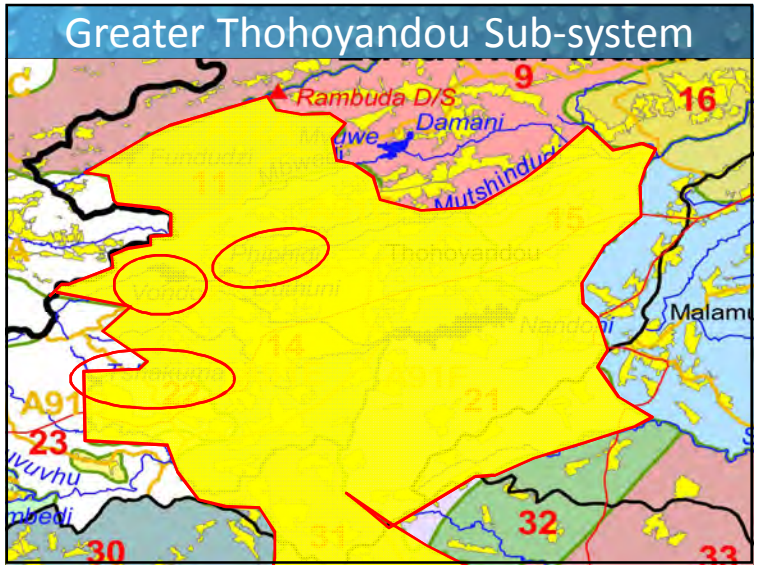
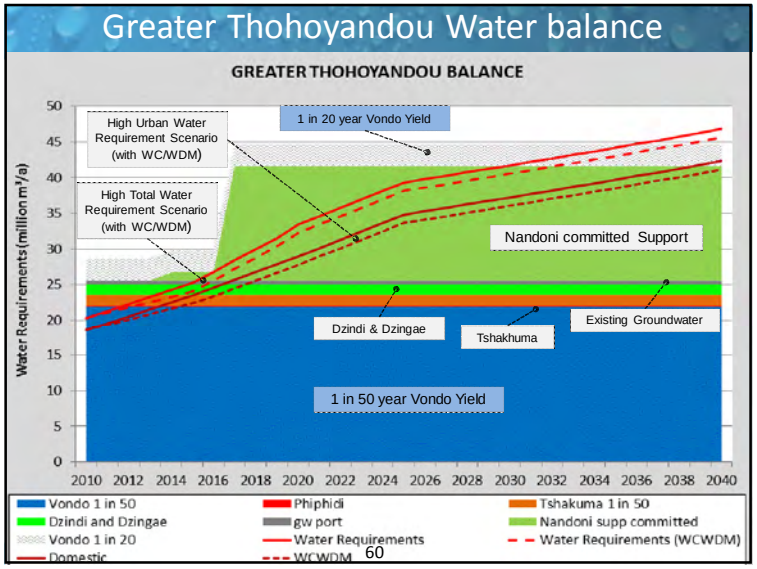
Greater Thohoyandou Sub-system



Greater Thohoyandou Water balance



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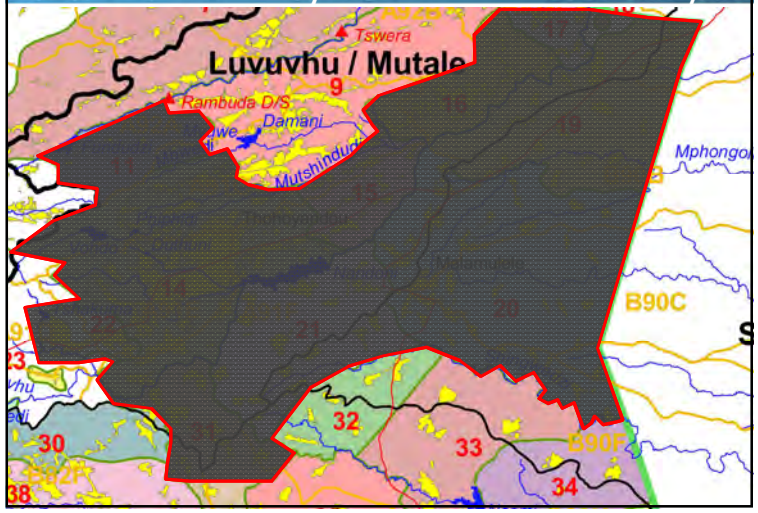
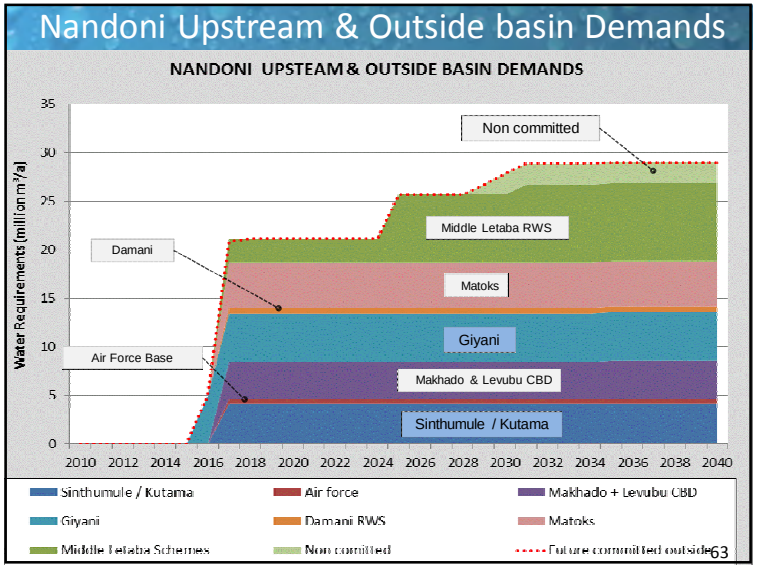
Greater Thohoyandou & Nandoni d/s



Nandoni Upstream & Outside basin Demands



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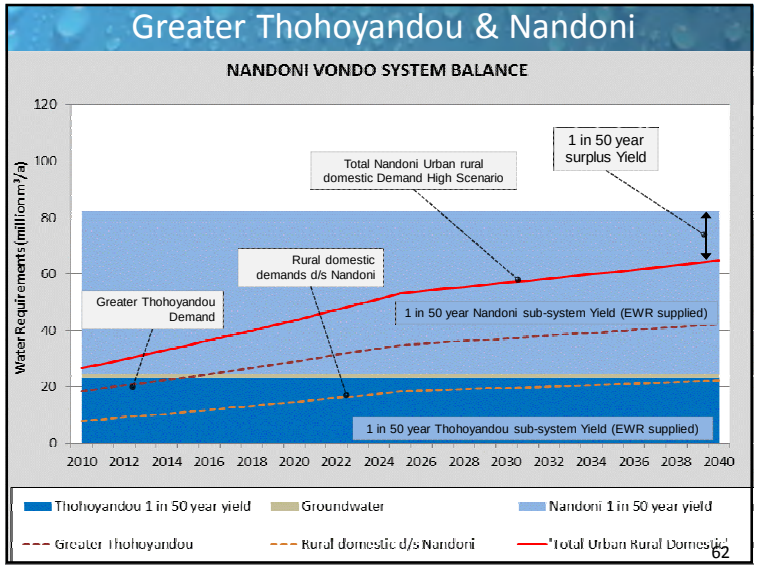

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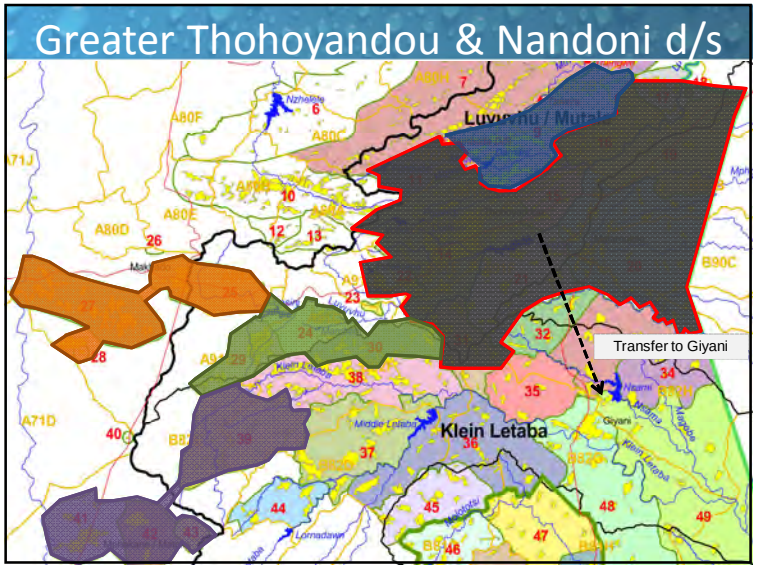

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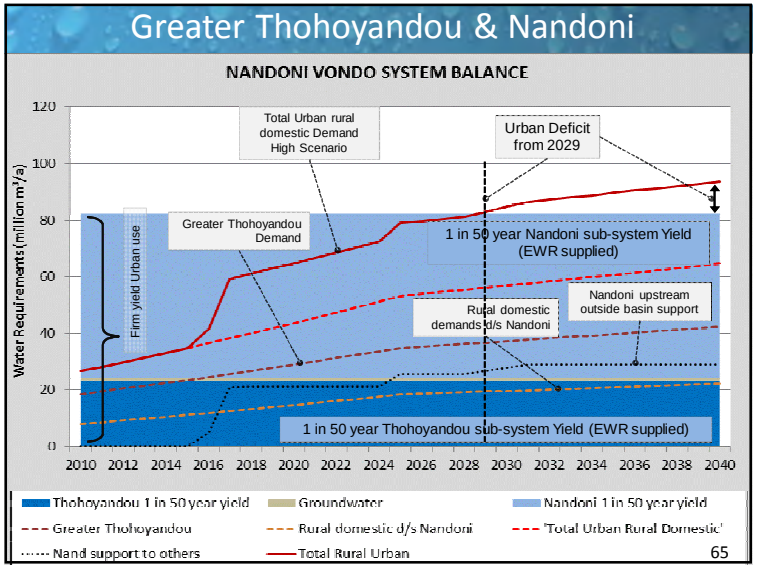

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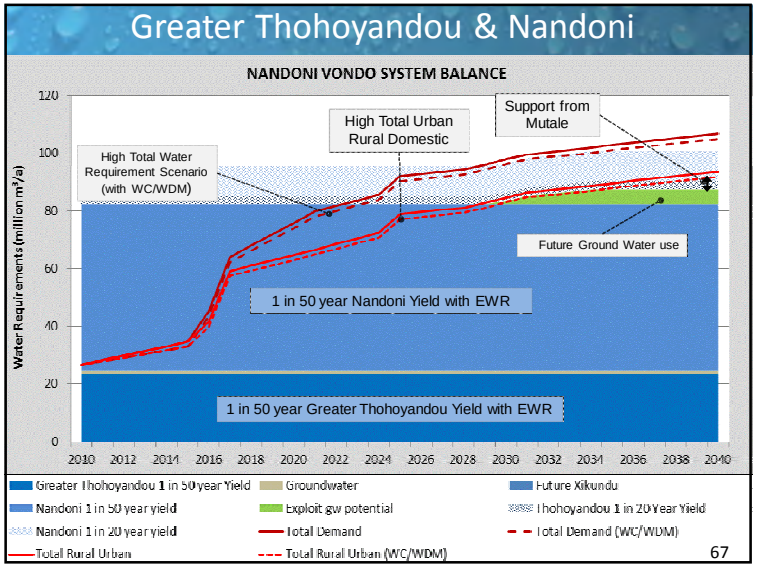
Greater Thohoyandou & Nandoni



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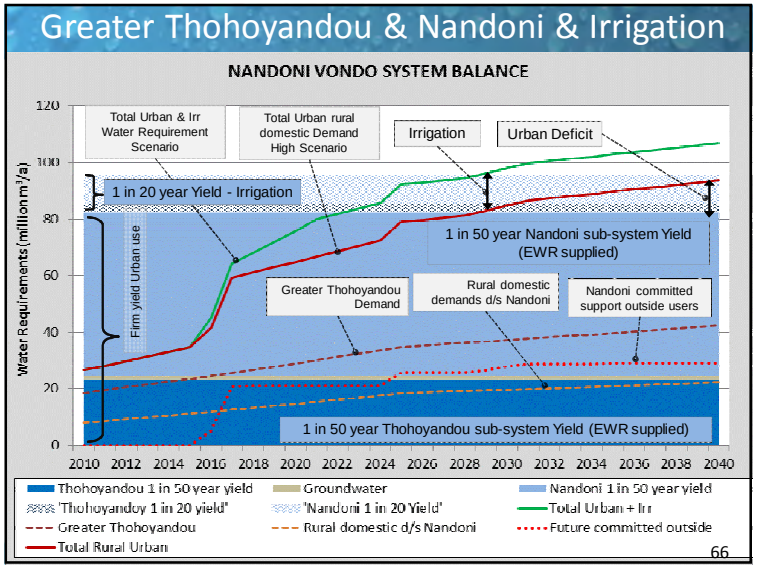
Greater Thohoyandou & Nandoni & Irrigation



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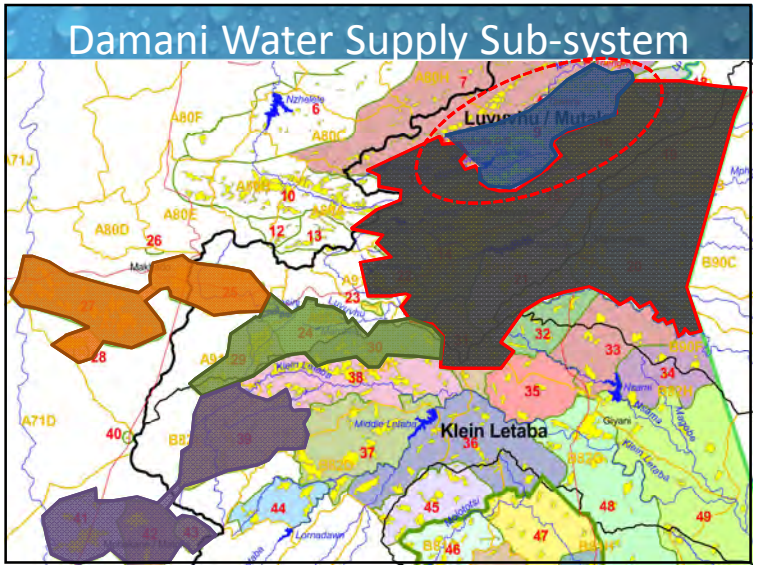
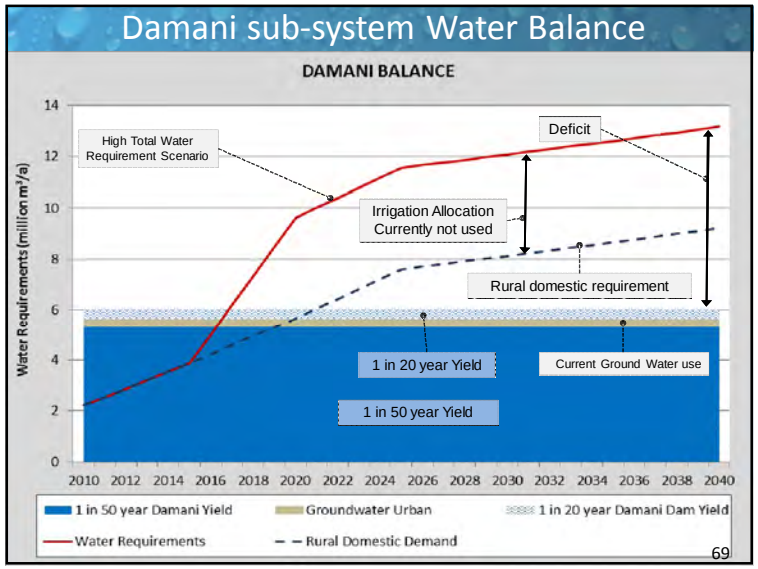
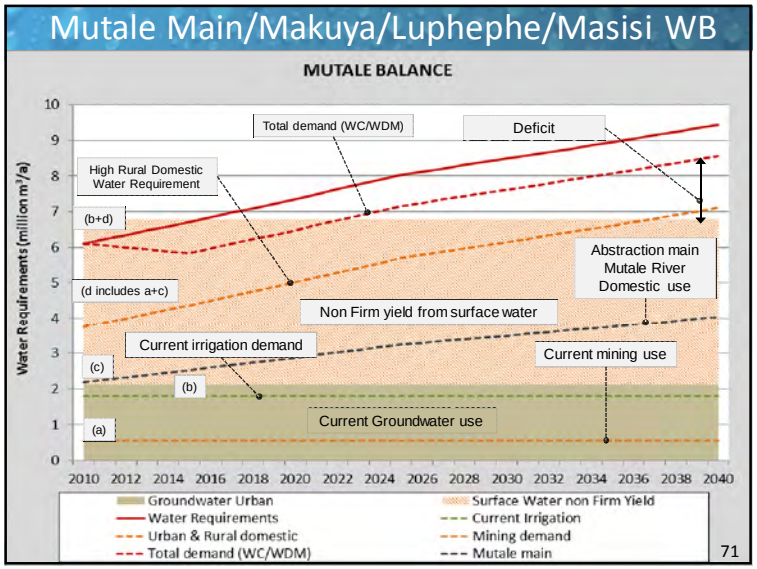
Damani Water Supply Sub-system



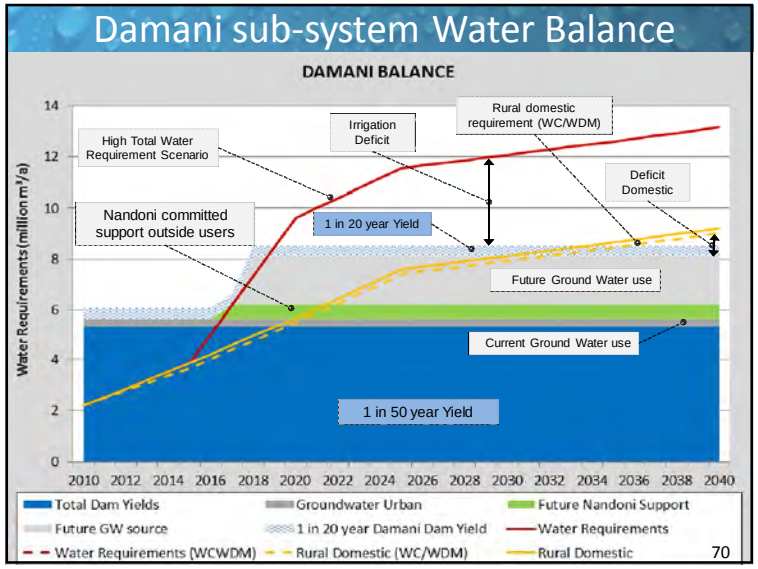
Damani sub-system Water Balance



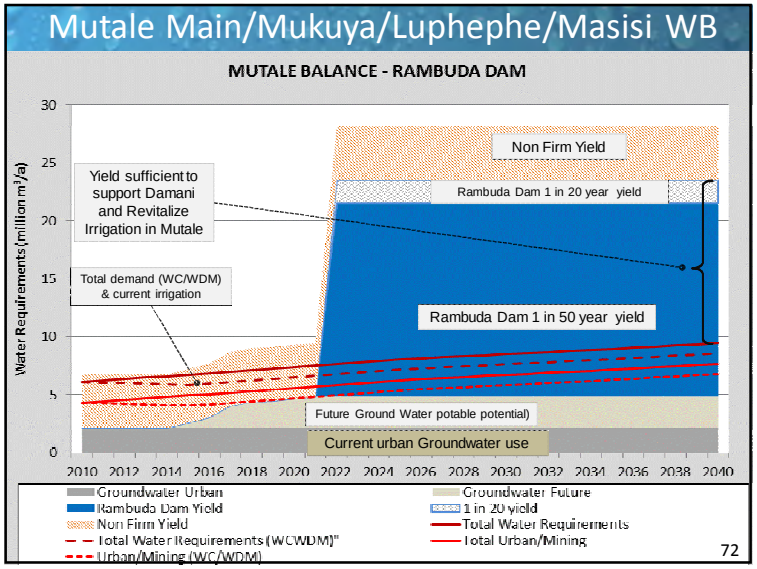
Mutale Main/Makuya/Luphephe/Masisi WB



Damani sub-system Water Balance



Mutale Main/Mukuya/Luphephe/Masisi WB



Reconciliation Strategy (1 of 6)

Albasini Dam sub-system:

Å All water requirements can be supplied up to the year 2040 by implementation the following

Intervention	Contribution (million m³/annum)	(1)Date	Remark
Water Conservation and Water Demand Management in Urban Sector	0.78	2015	Saving
Pipeline from Nandoni	3.82	2016	Support
(2) Reduce upstream irrigation (Ground and surface water abstractions based on V&V)	4.00 (when 50% reduced)	2023	Increase yield

Notes: (1) Estimated date when the development option is operational.
(2) Enable Albasini Dam to support current irrigation allocation

Reconciliation Strategy (2 of 6)

Greater Thohoyandou sub-system:

Å All water requirements can be supplied up to the year 2040 by implementation the following

Intervention	Contribution (million m³/annum)	(1)Date	Remark
Water Conservation and Water Demand Management in Urban Sector	1.18	2015	Saving
Support from Nandoni	16.05	2017	Support
Utilise remaining groundwater potential (only 60% of potable exploitation potential used)	5.14	2040	Increase resource yield

Notes: (1) Estimated date when the development option is operational.

Reconciliation Strategy (3 of 6)

Greater Thohoyandou and full Nandoni sub-system:

Å All water requirements can be supplied beyond the year 2040 by implementation the following

Intervention	Contribution (million m³/annum)	(1)Date	Remark
Water Conservation and Water Demand Management in Urban Sector	1.7	2015	Saving
Utilise remaining groundwater potential (only 60% of potable exploitation potential used)	5.1	2031	Increase resource potential
Support from future dam in Mutale	4.8	2035	Support

Notes: (1) Estimated date when the development option is operational.

Reconciliation Strategy (4 of 6)

Damani sub-system:

Å All water requirements can be supplied up to the year 2040 by implementation the following

Intervention	Contribution (million m³/annum)	(1)Date	Remark
Water Conservation and Water Demand Management in Urban Sector	0.2	2015	Saving
Support from Nandoni	0.6	2017	Increase yield
Utilise remaining groundwater potential (only 60% of potable exploitation potential used)	1.9	2018	Increase resource yield
(2)Support from a dam in Mutale	5.1	2022	Increase yield

Notes: (1) Estimated date when the development option is operational.
(2) Only fully develop irrigation once a Mutale dam is in place

Reconciliation Strategy (5 of 6)

Smaller sub-systems supported from Nandoni Dam:

- Includes Air force base, Sinthumule/Kutana, Matoks, Elim Vleifontein, Middle Letaba Vygeboom, Tshitale, Valdezia & Levubu CBD
- All water requirements can be supplied up to the year 2040 by implementation the following

Intervention	Contribution (million m³/annum)	(1)Date	Remark
Water Conservation and Water Demand Management in Urban Sector	0.74	2015	Saving
Support from Nandoni	28.0	2017	Increase yield

Notes: (1) Estimated date when the development option is operational.

Reconciliation Strategy (6 of 7)

Mutale water services schemes and irrigation:

- All water requirements can be supplied beyond the year 2040 by implementation the following

Intervention	Contribution (million m³/annum)	(1)Date	Remark
Water Conservation and Water Demand Management in Urban Sector	0.74	2015	Saving
Utilise remaining groundwater potential (less than 60% of potable exploitation potential used)	2.7	2015	Increase yield
(2)Rambuda or Tswera Dam (recommend to undertake a Pre-feasibility study)	12.6	2022	Increase resource potential

Notes: (1) Estimated date when the development option is operational.
(2) With Rambuda Dam can revitalise ±1500ha and with Tswera all areas identified and more

Recommendations

- Further Work - This assignment
  - Incorporate comments from SSC.
  - Undertake WRPM risk analyses with expected growth and expected future resource developments.
- Follow up studies/work
  - Consider information from the water use validation and verification study as an estimate of possible unlawful water use.
  - Commission Classification study on the Luvuvhu and Mutale rivers.
  - Commission Feasibility studies on groundwater development in relevant areas
  - Continuous integration between Water Balances and water supply planning to water services schemes