water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

2030 NDP

DETERMINATION OF WATER RESOURCE CLASSES AND ASSOCIATED RESOURCE QUALITY OBJECTIVES IN THE THUKELA CATCHMENT

PROJECT STEERING COMMITTEE MEETING 4

Presented by:
Golder Project Team

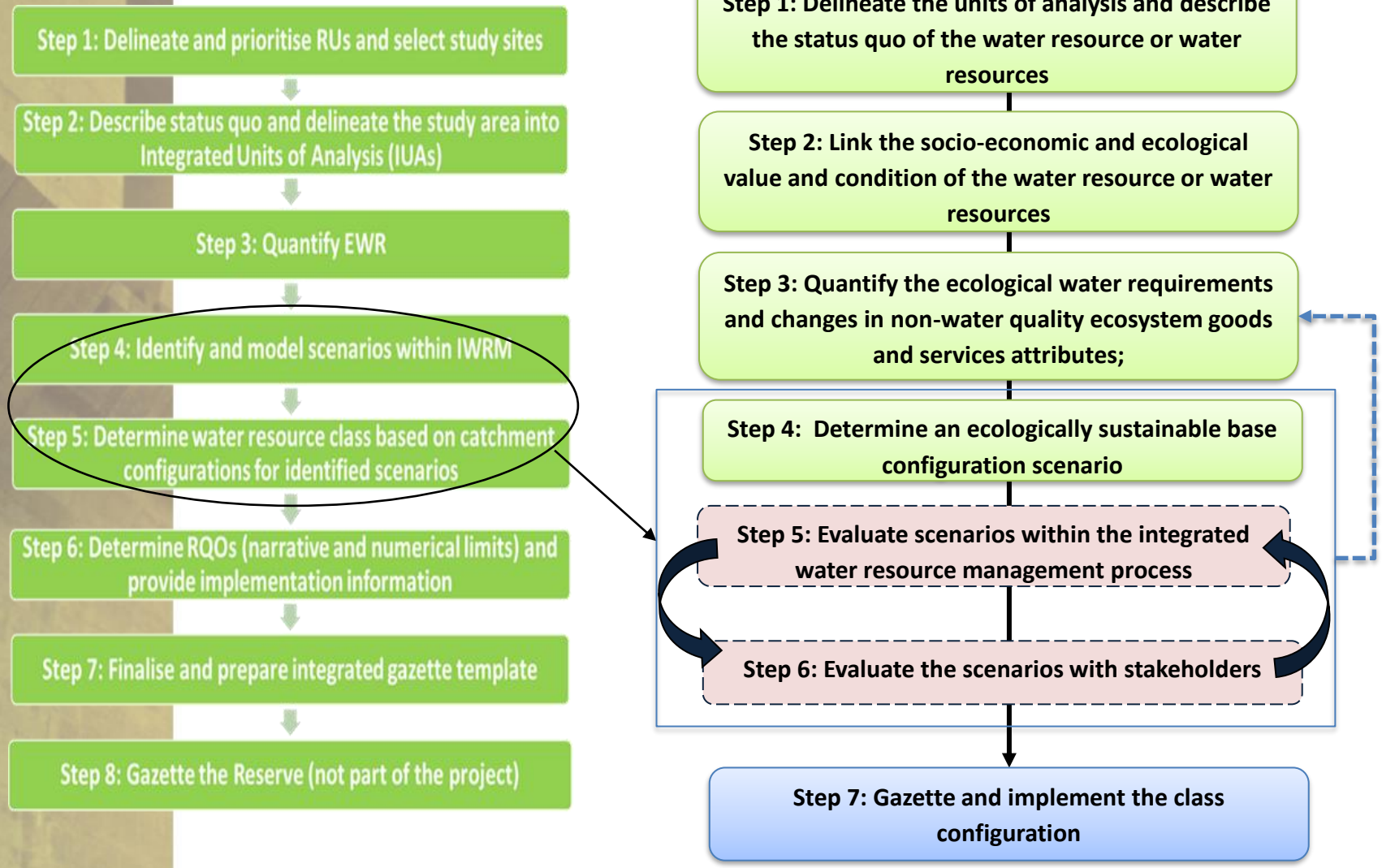
Date: 3 March 2021

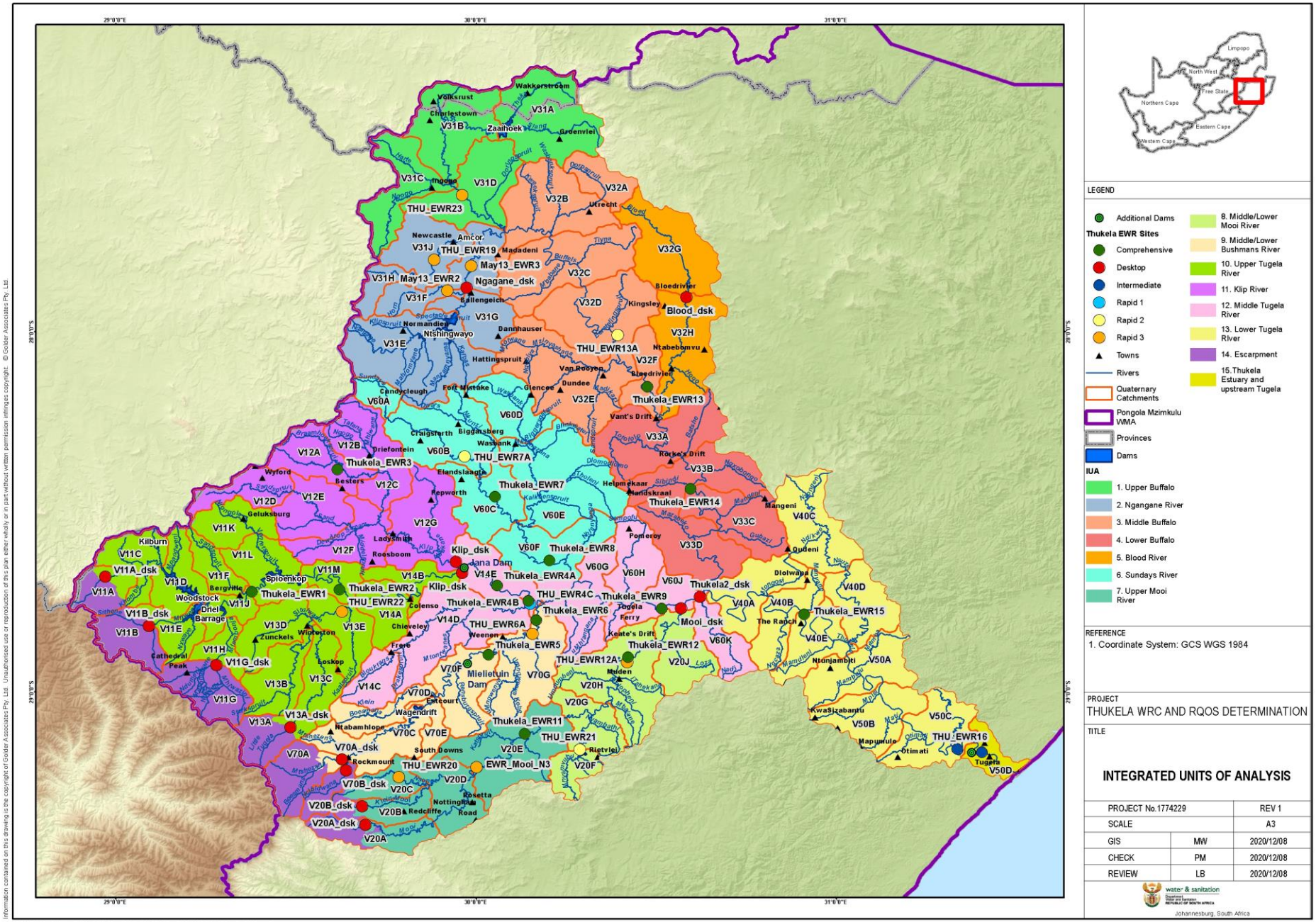
Purpose of the meeting

To present the:

- Trade-off evaluation based on scenario outcomes
- Proposed Water Resource Classes, and
- Next steps i.r.o. determining RQOs for the proposed classes.

Study Process – classification component





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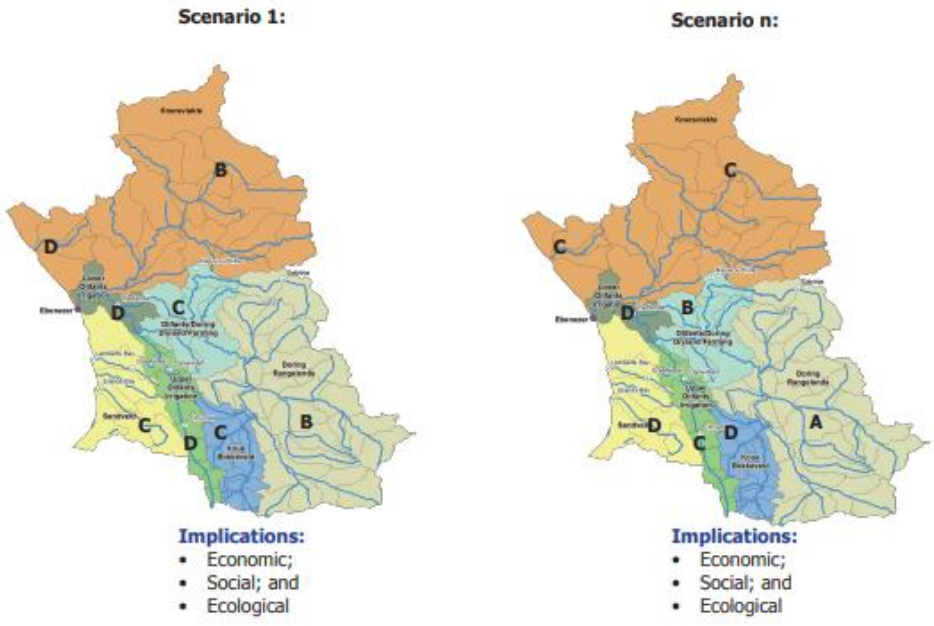
THE EVALUATION OF SCENARIOS WITHIN THE INTEGRATED WATER RESOURCE MANAGEMENT PROCESS

What is a scenario

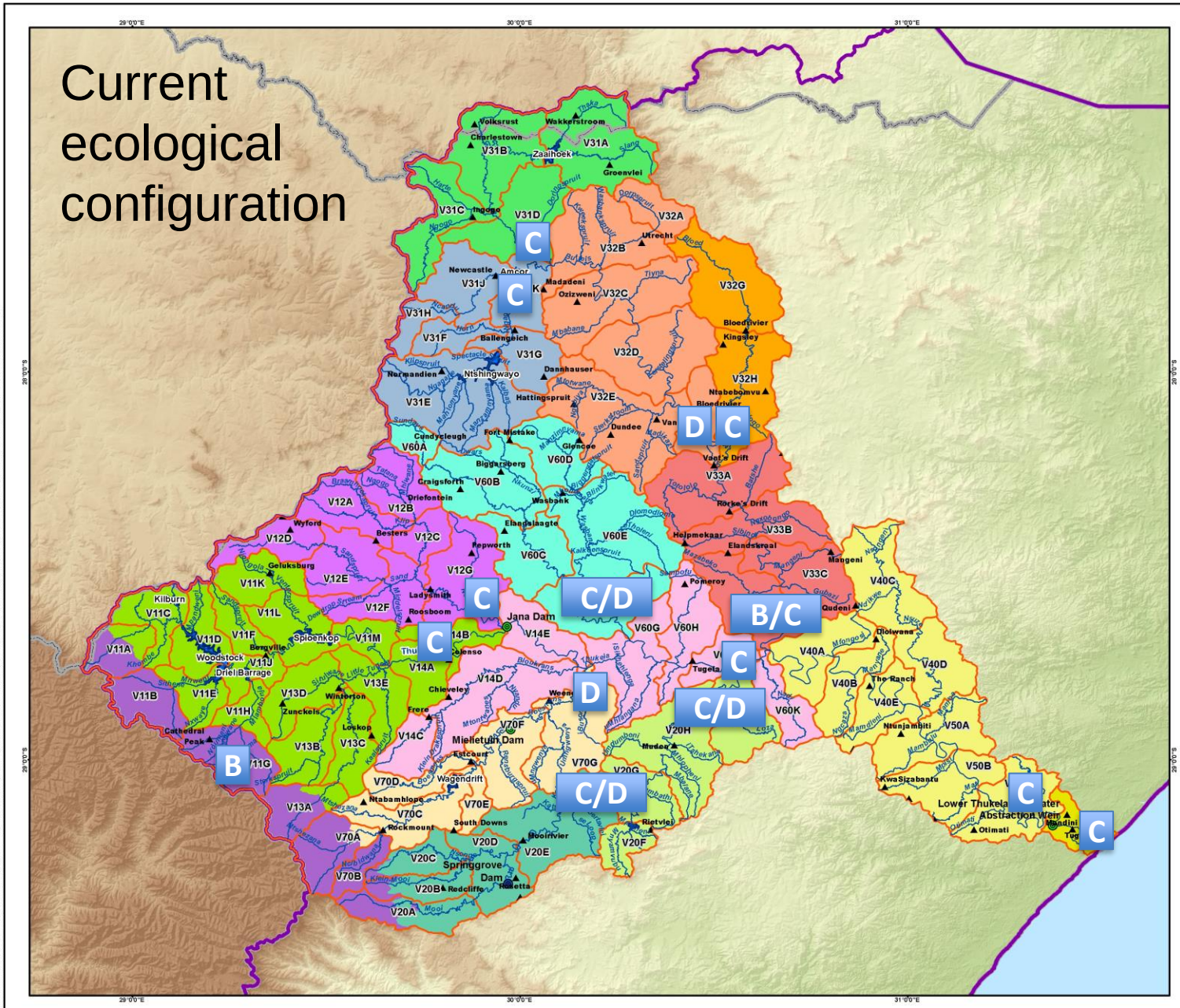


- Scenarios, in the context of water resource management and planning are **plausible definitions (settings) or factors (variables) that influence the water balance and water quality in a catchment and the system as a whole**
- Each scenario represents an alternative future condition, generally reflecting a change to the present condition. Analysis thereof gives the ability to compare the implications of one scenario against another, with the ultimate aim of making a selection of the preferred scenario.
- Tested 2 ecological scenarios

Ecological Scenarios

Present Ecological Status (PES)	Target Ecological Category (TEC)
Ecological Sustainable Base Case (ESBC)	Slightly improved ecological categories
The ESBC scenario, which could permit the *maximum water use scenario*, requires that the base condition for each water resource is at *minimum established as either a D category* or whichever higher category is required to maintain all downstream nodes in at least a D category. However, where the ecological condition requires it, a higher ecological category needs to be set. The selected ecological category per IUA for the Thukela catchment is the **Present Ecological State (PES)** and not a D throughout.	The Target Ecological Category (TEC) was also determined as an alternate scenario at the nodes. The TEC is based on the ultimate target to achieve a sustainable system both ecologically and economically, considering the PES and Recommended Ecological Category (REC). Thus, the TEC can be the same as the PES or the REC. However, it may also be worse than the PES if a system is targeted for development that will impact the present state, or better where a higher level of protection is needed.

Current ecological configuration



LEGEND

REFERENCE
1. Coordinate System: GCS WGS 1984

PROJECT
THUKELA WRC AND RQOS DETERMINATION

TITLE

INTEGRATED UNITS OF ANALYSIS

PROJECT No.1774229		REV 1
SCALE		A3
GIS	MW	2020/06/29
CHECK	PM	2020/06/29
REVIEW	LB	2020/06/29

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IUA Ecological Configurations for the PES and TEC

IUA		Quaternary Catchment	PES	EI/ES	TEC
1	Upper Buffalo	V31D	C	High	C
2	Ngagane	V31K	C	Low	C/D
3	Middle Buffalo	V32H	D	Moderate	C/D
4	Lower Buffalo	V33B	B/C	High	C
5	Blood	V32H	C	High	C
6	Sundays	V60C	C/D	Moderate	C/D
7	Upper Mooi	V20G	C/D	Moderate	C/D (with a medium to long-term B/C)
8	Lower Mooi	V20H	C/D	High	C
9	Middle/ Lower Bushmans	V70G	D	High	C/D
10	Upper Thukela	V11M	C	Moderate	C
11	Klip	V12A	C	High/very high	C
12	Middle Thukela	V60J	C	Moderate	C
13	Lower Thukela	V50C	C	High/moderate	C
14	Escarpment	V11A/ V11B/ V11G/ V13A/ V70A/ V70B/ V20A/ V20B	B	High/very high/ moderate	B
15	Estuary	V50D	C	High	C

Planning interventions assessed

3 Development levels / time slices:

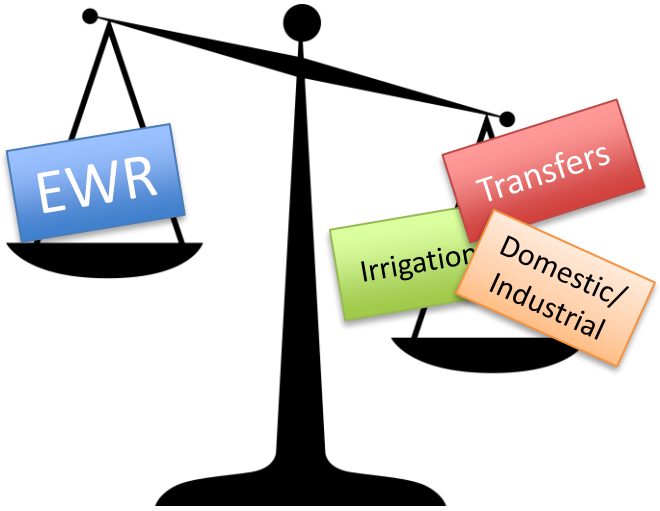
- Current day (± 2020)
- Intermediate (± 2030)
- Long term (± 2045)

Development interventions:

- Planned / committed interventions as part of approved reconciliation strategies included.
- Water requirements current and projected according to Water board / WSA plans.
- Longer-term infrastructure options added as an alternative to balance water supply.

- ***Challenge: no reconciliation strategy***

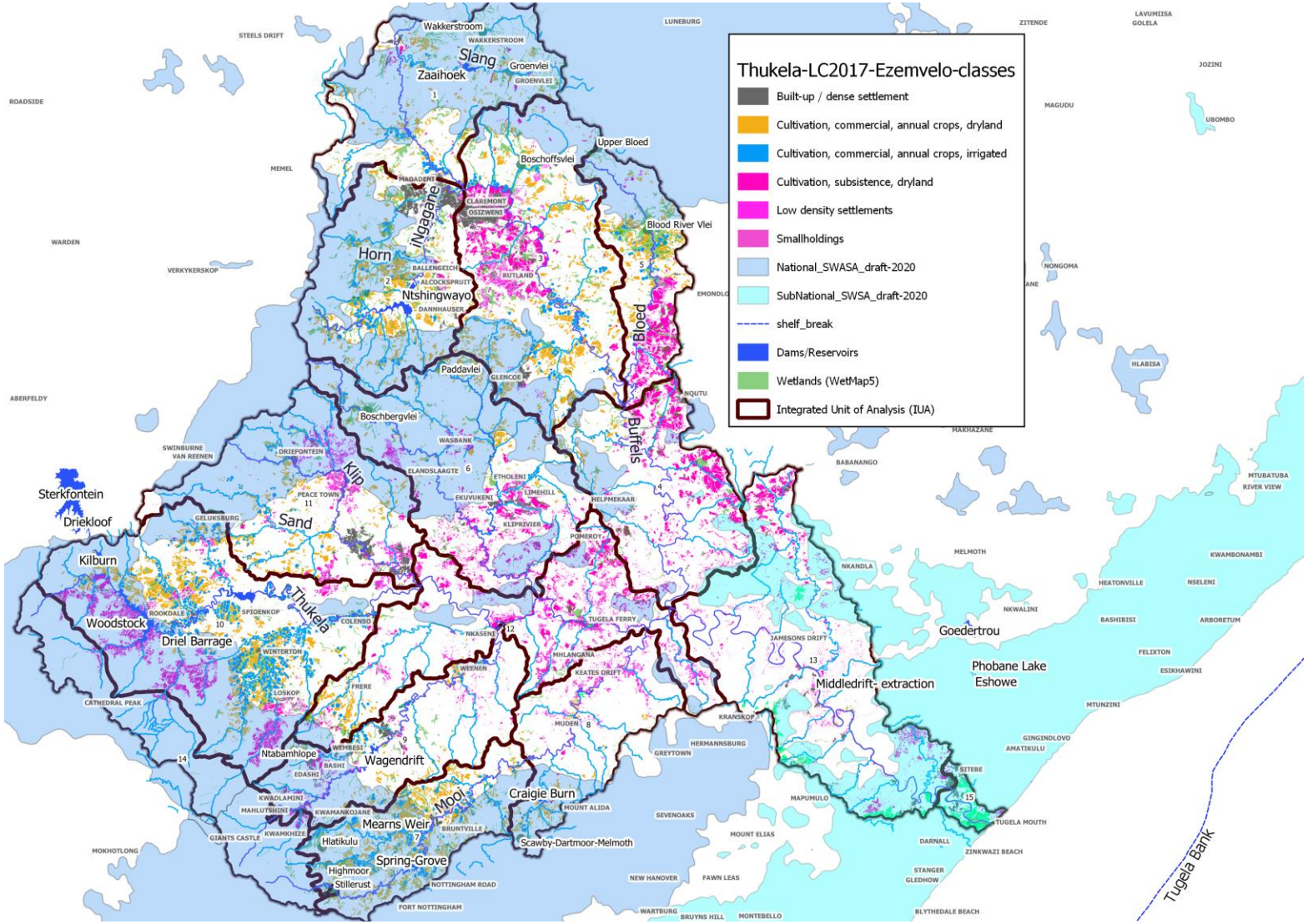
Scenario evaluation outcomes



Trade-off evaluation

- The process requires a wide range of trade-offs to be evaluated at a number of scales.
- Final outcome of the process is a set of desired characteristics for use and ecological condition for each of the water resources.
- Recommend classes for IUAs for the Minister's consideration

Background to the resource economic evaluation

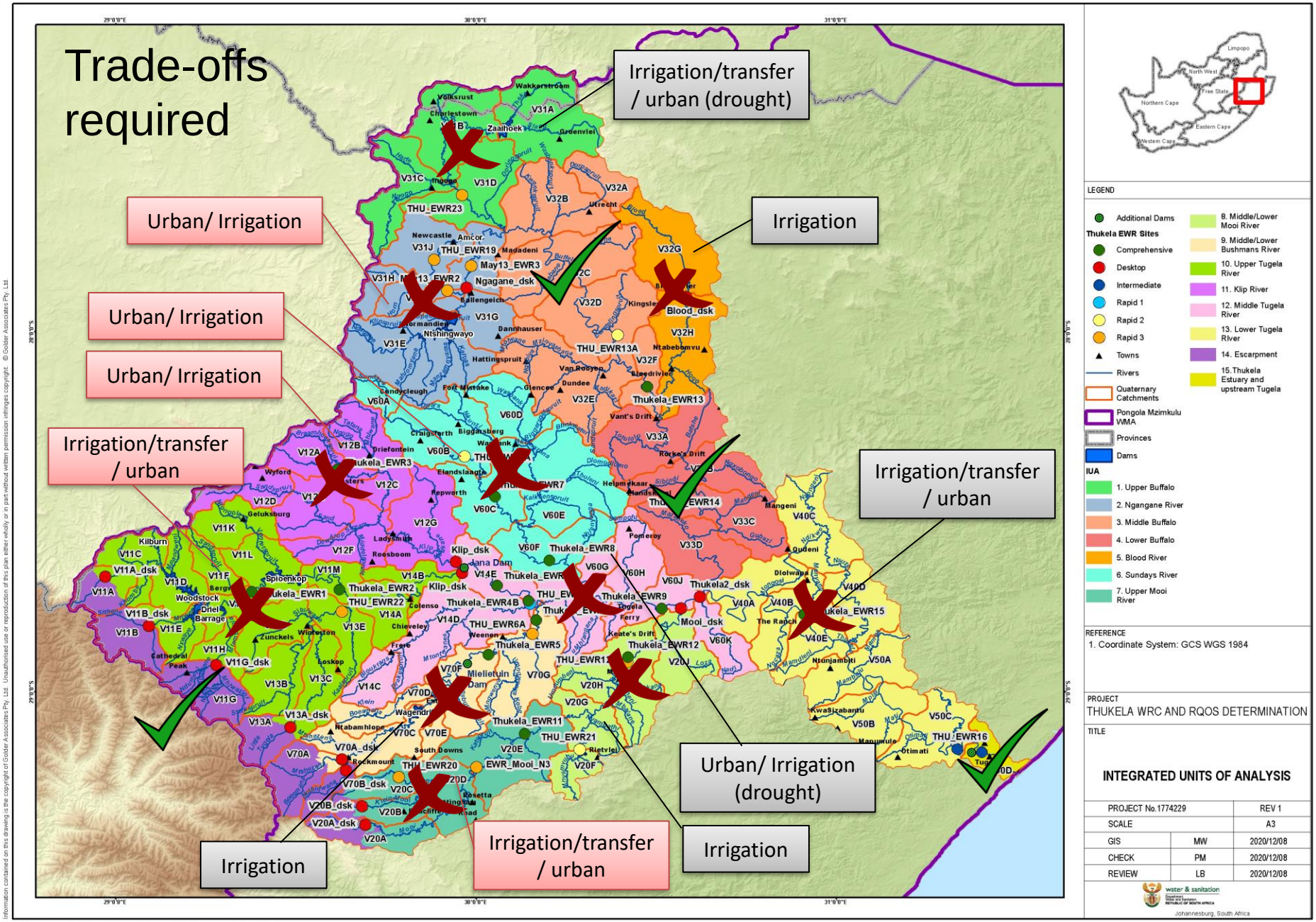


Background to the resource economic evaluation

- All water users are important: human and ecological
- Value of ecological water requirements
  - Aquatic, estuarine and marine ecosystem services are risk as a result of not implementing EWRs. These risks manifest in a cumulative manner and over a long period
  - A comparative risk assessment was performed to identify ecosystem services at risk, with key concerns being (1) provisioning services to local communities that depend directly on rivers, (2) regulating services that secure the long-term functionality of the system, and (3) other provisioning and cultural ecosystem services
  - The estuary is a highly unique asset, and raises the important economic concept of non-substitutability
  - The ecological classification process (that underlie the WRCS) provides a proxy for the regulating services effects
  - Thus: by implementing the EWR requirements, and implementing specific measures in areas with large community reliance, we secure the long- term health of the system and the delivery of ecosystem services
- Practically, the EWR is implemented through several measures
  - Managing the quantum of flow in the system
  - Managing the timing of flow (freshets and floods)
  - Treating polluted effluent
  - Resource quality objectives (e.g. for the SWSAs, or wetlands of special concern)
  - Practical measures include: dam operations, various regulations, monitoring programmes (and rehabilitation, etc

Background to the resource economic evaluation

- Value of impact on the economy
  - Water is used by Urban users (domestic and industrial), Irrigation users, and Transfers to the rest of South Africa
  - Such economic activities are measured by Statistics SA, and economy-wide models can be constructed from this data
  - GDP is not a perfect economic indicator, but it does tell us about creating jobs, investing in the economy and paying taxes
  - Typically, GDP/m^3 weighted average effects can range between ca. R10/m^3 to R80/m^3 (measured with economy-wide models)
- Allocating water required for ecological functioning to household and economic uses is an environmental externality
  - When we quantify the trade-offs that result from making water available for ecological requirements, we are “greening” GDP
- Mitigation measures exists for managing the effects of trade-offs (to some extent)
  - Ideally these are “win-win” measures, recognizing that an economic system is not a zero-sum game
  - A basket of mitigation measures were and still need to be considered, including optimizing the ecological water requirements specifications, augmentation projects, verification and validation of water use, water demand management, water pollution treatment
  - In future we will need additional and new mitigative policy instruments that internalise ecological asset values into economic decision-making



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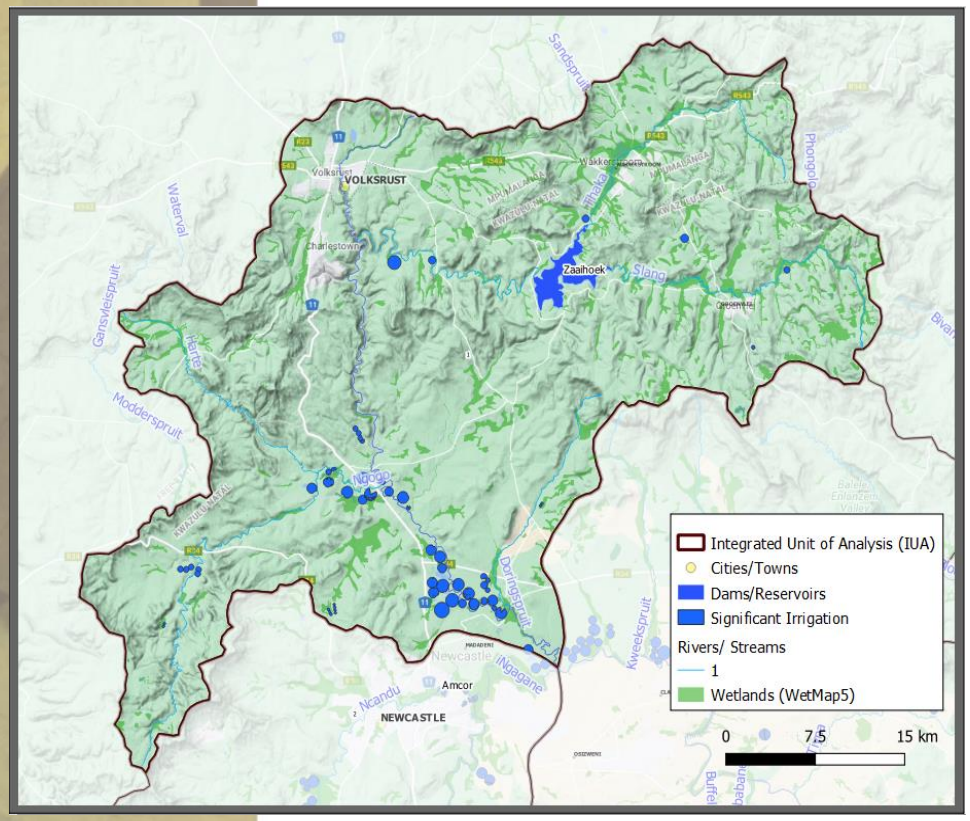
Key considerations to trade-off evaluation

- Key driver is flow (reduced flow/ seasonality loss)
- Modified flows - not getting freshets and floods through the systems (habitat not maintained)
- Overall the water resources of the Thukela are over utilised
- A key finding is that ecological requirements cannot be met because of over allocation to transfers and local catchment demands
- For the water resources to remain sustainable some vital decisions will need to be made as some significant trade-offs will be required over the planning horizon assessed; in some IUAs mitigation options are available to reduce trade-offs
- Domestic supply to local households to supply basic needs to be prioritised (vs future transfers)
- Ultimately the estuary (the only open mouthed system on the eastern side of SA; MPA) needs to be maintained - this requires a minimum flow and C category
- The evaluation has indicated that medium and long-term planning interventions need to be implemented sooner
- This classification process presents the most feasible option to achieve ecological sustainability with the least economic impact
- ***There is not enough water in the Thukela***

TRADE-OFF DISCUSSION PER INTEGRATED UNIT OF ANALYSIS

IUA 1: Upper Buffalo



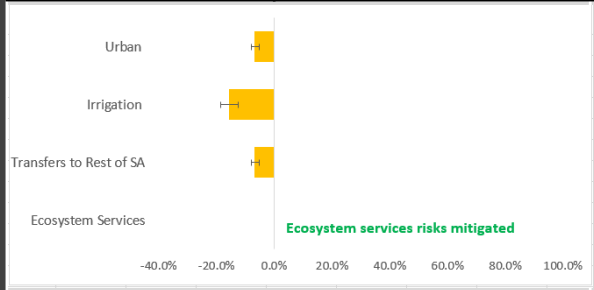
Percentage (%) of nodes in the IUA falling into the indicated EC groups				
A or A/B	**B or B/C**	**C or C/D**	**D**	**>D**
	36	55	9	

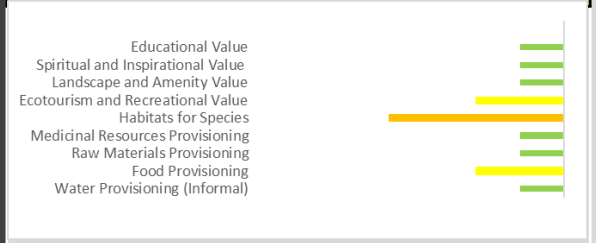
- V31A; V31B; V31C and V31D
- Thaka/Upper Buffalo/ Harte/ Ngogo/ Doringspruit/ Slang
- Zaaihoek Dam
- Wakkerstroom and Groenvlei wetlands (upstream of Zaaihoek Dam)
- Groundwater: Moderate to low shale siltstone aquifer resources.
- **SWSA:** Much of the IUA along the escarpment
- **Proposed EC: C**
- **Class III**

IUA 1 | Upper Buffalo: Maintain the current condition of C

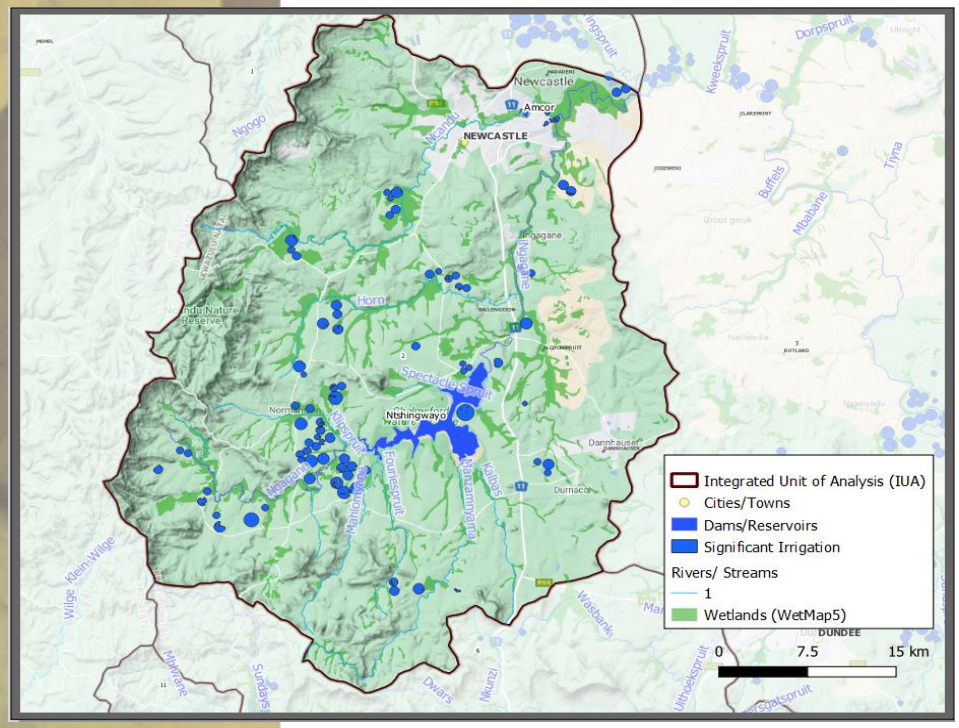
Drought related Trade-Off

	Costs	Benefits	Results	Conclusions

Economic Consequences			• Analysis shows 1 out of every 15 years drought conditions result in economic tradeoffs:
			• Average costs to economy from trade-offs:
			  • uThukela economy GDP effect: -R17 million/a
			  • Rest of SA economy GDP effect: -R196 million/a
				In IUA 1, users downstream of Zaaihoek Dam would experience water deficits as a result of implementation of the EWR, only during drought periods (approximately 1 out of every 15 years).
				
				Mitigative measures could include:
				- Implementation of special water allocation and demand management measures during drought periods
				- Addressing water quality problems
				- Verification and validation
				- Afforestation measures to reduce water loss

Ecological Consequences	**Ecosystem Service Risks Mitigated** 		**High and Extreme Ecosystem Service Risk Mitigated:** • Habitats for species within waterways downstream of Zaaihoek Dam. **Location of Risk:** • Downstream of Zaaihoek Dam. • (Upstream wetlands face non-flow related risks) **Impacts to be Mitigated** Modified flows impact natural seasonal flow patterns: • Unnaturally high flow volumes and sporadic flush events in the dry season • Increased mean annual water flow volumes	
Water Quality	**Water Quality Considerations** Drainage Region / Salinity / Nutrients / Sulphate V31 A (upstream of Zaaihoek dam): Ideal / Ideal / Ideal V31B (Volkrust): Unacceptable / Unacceptable / Acceptable V31C (Schurvepoort): Tolerable / Ideal / Acceptable		**Overall:** • The water quality in the upstream catchment of the Buffalo River is good, minimal impact **Hotspots:** • The Buffalo River in V31B is a potential hot spot likely due to elevated nutrients/salts and WWTW discharges from Volksrust area	

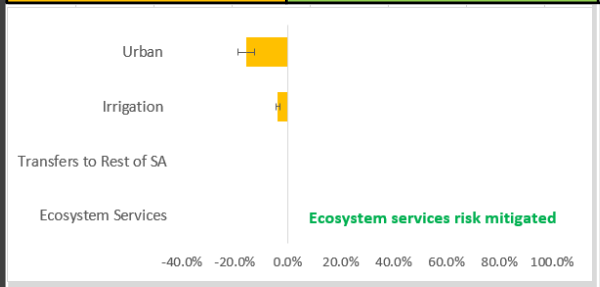
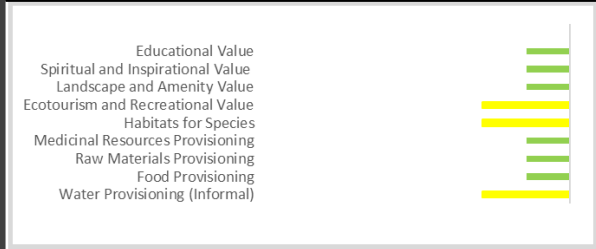
IUA 2: Ngagane River



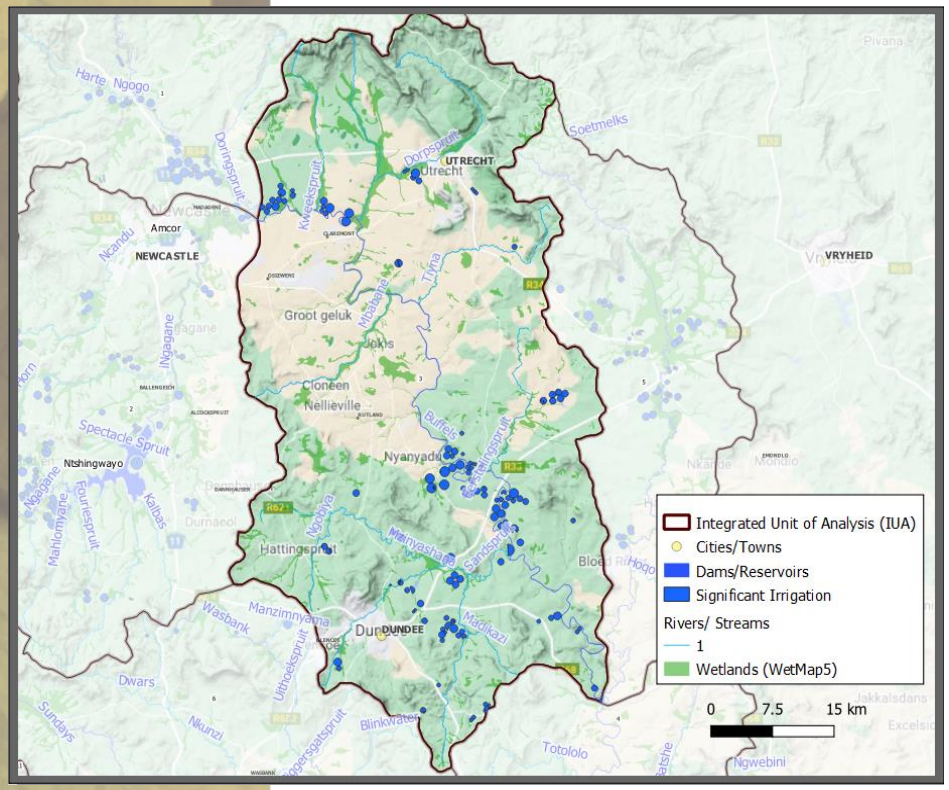
- V31J; V31H; V31F; V31E; V31K; V31G
- Ngagane/ Ncand / Horn / Klipspruit/ Mahlomyane/ Fouriespruit/ Manzamnyama/ Kalbas
- Ntshingwayo Dam
- No priority wetlands
- Groundwater: Moderate to low shale siltstone aquifer resource
- **SWSA:** Along the western escarpment
- **Proposed EC: C/D**
- **Class III**

Percentage (%) of nodes in the IUA falling into the indicated EC groups				
A or A/B	**B or B/C**	**C or C/D**	**D**	**>D**
	31.25	56.25	6.25	6.25

Summary IUA 2 — Ngagane: Maintain the current condition of C — Trade-Off

	Cost	Benefit	Results	Conclusions
Economic Consequences			• Economic trade-offs likely to occur only every second year • Costs to economy from trade-offs: • uThukela economy GDP effect: -R700 million/a	In IUA 2, Urban and Irrigation water users would experience water deficits, likely every two years, as a result of implementation of the EWR. This would result in an economic trade-off. As a mitigation measure, the EWR was modified by reducing freshets and floods. These trade-offs may be further mitigated to some (unquantified) extent by: - Development of a new Dam in the Buffalo catchment - Implementation of Verification and Validation processes - Water demand management measures - Addressing water quality problems
Ecological Consequences	**Ecosystem Service Risks Mitigated** 		**High and Extreme Ecosystem Service Risk Mitigated:** • The location of impacts results in no high or extreme risks on a local scale • Implementing the EWR to ensure long term maintenance of ecosystems locally and downstream **Location of Risk:** • Downstream of Ntshingwayo Dam. **Impacts to be Mitigated** Modified flows impact natural seasonal flow patterns: • Increased mean annual water flow volumes • Zero flows below Ntshingwayo Dam • Unnatural flush events in the dry season • Water quality- see below	
Water Quality	**Water Quality Considerations** Drainage Region / Salinity / Nutrients / Sulphate V31 J (Amscor): Ideal / Acceptable / V31F (Horn river): Unacceptable / Unacceptable / Unacceptable V31E (upstream of Chelmford nature reserve): Acceptable / Ideal / Acceptable V31K (Newcastle): Unacceptable / Unacceptable / Unacceptable V31G (Danhauser): Unacceptable / Acceptable / Unacceptable		**Overall:** • Water quality in the upper Ngagane catchment to Chelmsford Dam is relatively good, with the exception of the Horn River (V31F) and V31G and V31K which has high electrical conductivity and sulphate levels **Hotspots:** • Presence of WWTWs at V31G and V31K and presence of industries likely results in elevated salinity levels. Mining activities results in elevated sulphate levels and salinity levels	

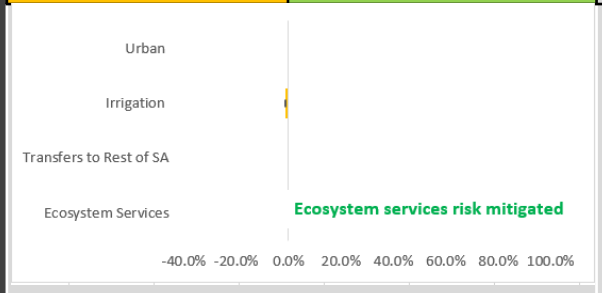
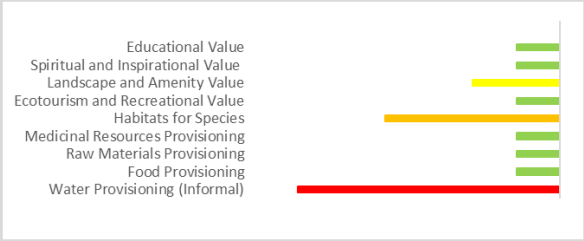
IUA 3: Middle Buffalo



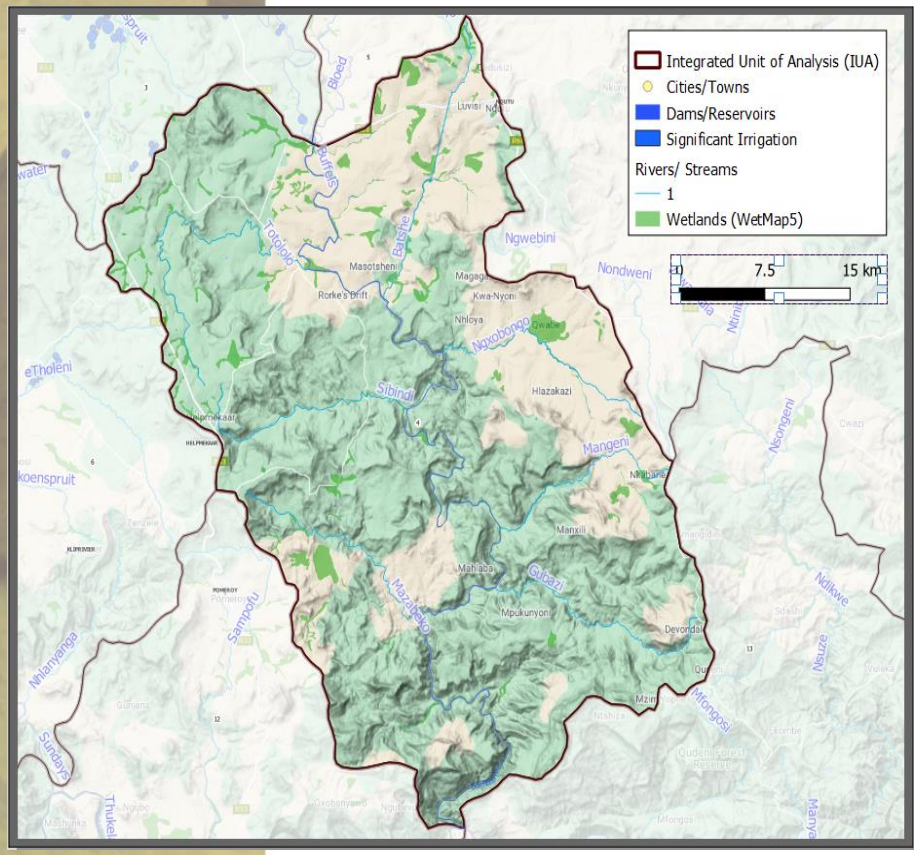
Percentage (%) of nodes in the IUA falling into the indicated EC groups				
A or A/B	**B or B/C**	**C or C/D**	**D**	**>D**
	39.13	52.17	8.70	

- V32A; V32B; V32C; V32D; V32E; V32F
- Middle Buffalo/ Dorpspruit/ Wasbankspruit/ Kweekspruit/ Tiyne/ Mbabane/ Eerstelingsruit/ Mzinyashana/ Motwane/ Ngobiya/ Sterkstroom/ Sandspruit/ Madikazi/ Doringspruit/ Ngagade
- Boschoffsvlei priority wetlands- Utrecht
- Groundwater: Alluvial aquifers with high surface to groundwater interaction. Moderate to low shale siltstone aquifer resources
- **Proposed EC: D**
- **Class III**

IUA 3 — Middle Buffalo: Improve to a condition of a C/D — No Trade-Off

	Cost	Benefit	Results	Conclusions
Economic Consequences			• Economic trade-off small to insignificant • Costs to economy from trade-offs: • uThukela economy GDP effect: < -R1 million/a	In IUA 3, although economic trade-offs are unlikely, the maintenance of the EWR would need the following: - Address water quality issues - This would also mitigate the risk to rural households relying on rivers for ecosystem services
Ecological Consequences	**Ecosystem Service Risks Mitigated** 		**High and Extreme Ecosystem Service Risk Mitigated:** • Fresh Water provisioning: 5.6% of population relies on natural sources as their primary source of water - 20 000 households; • Habitats for species: Pans specifically are at risk from water quality contamination **Location of Risk:** • Throughout Middle Buffalo River- waterways and aquifers **Impacts to be Mitigated:** Modified flows impact natural seasonal flow patterns: • Unnatural flush events in the dry season • Increased mean annual water flow volumes • Zero flows for large portions of the dry season	
Water Quality	**Water Quality Considerations** Drainage Region / Salinity / Nutrients / Sulphate V32B (Utrecht): Tolerable / Unacceptable / Acceptable V32C (Claremont): Tolerable / Unacceptable / Acceptable V32D (Winterton): Unacceptable / Unacceptable / Acceptable V32E (Dundee): Unacceptable / Unacceptable / Unacceptable V32F: Unacceptable / Unacceptable		**Overall:** • Poor water quality is generally observed in this IUA **Hotspots:** • The entire IUA has hotspots, and this is likely due to numerous WWTWs, coal mining activities and agricultural activities	

IUA 4: Lower Buffalo

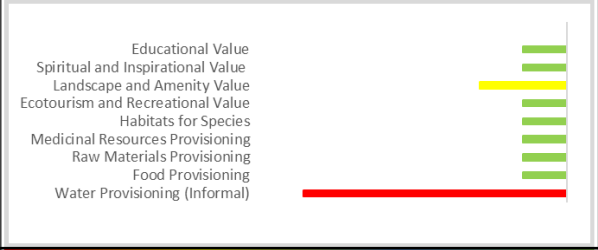


Percentage (%) of nodes in the IUA falling into the indicated EC groups				
A or A/B	**B or B/C**	**C or C/D**	**D**	**>D**
	57.14	21.43	21.43	

- V33A; V33B; V33C; V33D
- Rural socio-economic
- Lower Buffalo/Totololo/ Batshe/ Sibindi/ Ngxobongo/ Mangeni/ Mazabeko/ Gubazi
- No priority wetlands
- Groundwater: Alluvial aquifers with high surface to groundwater interaction. Moderate to low shale siltstone aquifer resources

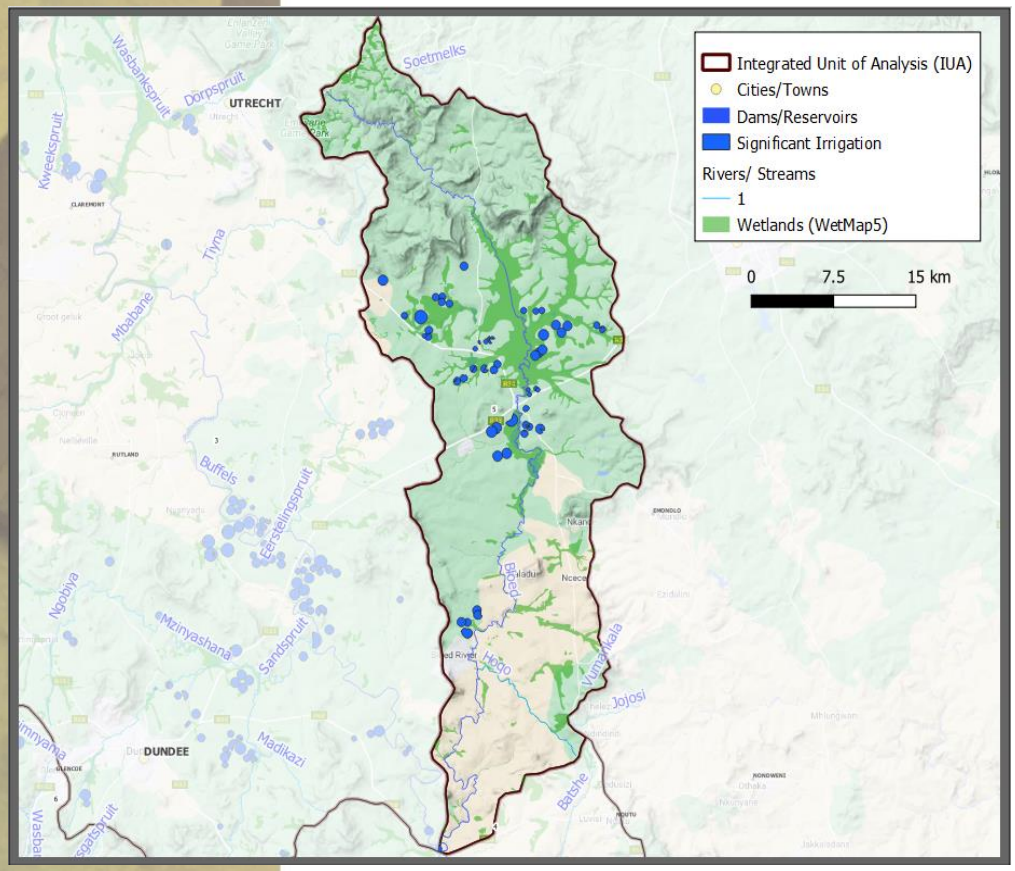
- **Proposed EC: C**
- **Class II**

IUA 4 | Lower Buffalo: Maintain the current condition of B/C | No Trade-Off

	~~Cost~~	Benefit	Results	Conclusions
Economic Consequences			• No economic trade-off • Allocating to the EWR has no impact on allocations	In IUA 4, although economic trade-offs are unlikely, the maintenance of the EWR would need the following: - Address water quality issues (pathogens) - This would also mitigate the risk to rural households relying on rivers for ecosystem services Small reductions were made to the maintenance flow for Sept to Dec in mitigation, and this eliminated the small deficits to rural supply.
Ecological Consequences	**Ecosystem Service Risks Mitigated**		**<u>High and Extreme Ecosystem Service Risk Mitigated:</u>** Fresh Water provisioning: 34% of population relies on natural sources as their primary source of water - 6 700 households); **<u>Location of Risk:</u>** Throughout the Lower Buffalo River waterways and aquifers **<u>Impacts to be Mitigated:</u>** • Key hazard is water quality issues • Modified flows which impact recharge of alluvial aquifers	
Water Quality	**Water Quality Considerations**		**<u>Overall:</u>** • IUA has tolerable levels of salinity and nutrients although additional monitoring is required in this lower reach to obtain a better perspective of water quality. **<u>Hotspots:</u>** • No water quality hotspots have been identified	

Drainage Region	Salinity	Nutrients	Sulphate
V33A (Endumeni LM)	Tolerable	Tolerable	Acceptable

IUA 5: Blood River



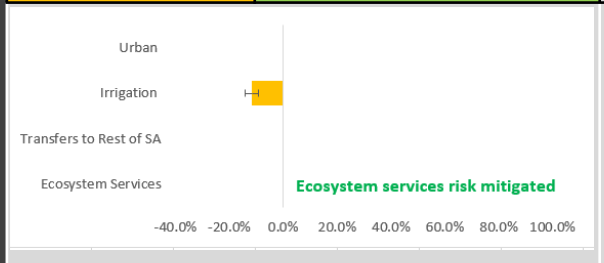
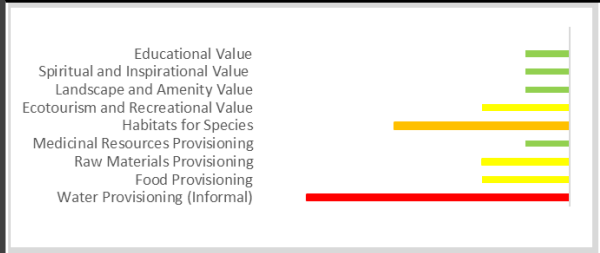
- V32G; V32H
- Rural socio-economic
- Blood River/ Hoqo River
- Blood River Vlei and Upper Blood priority wetland
- Groundwater: Moderate to low shale siltstone aquifer resources

- **Proposed EC: C**
- **Class III**

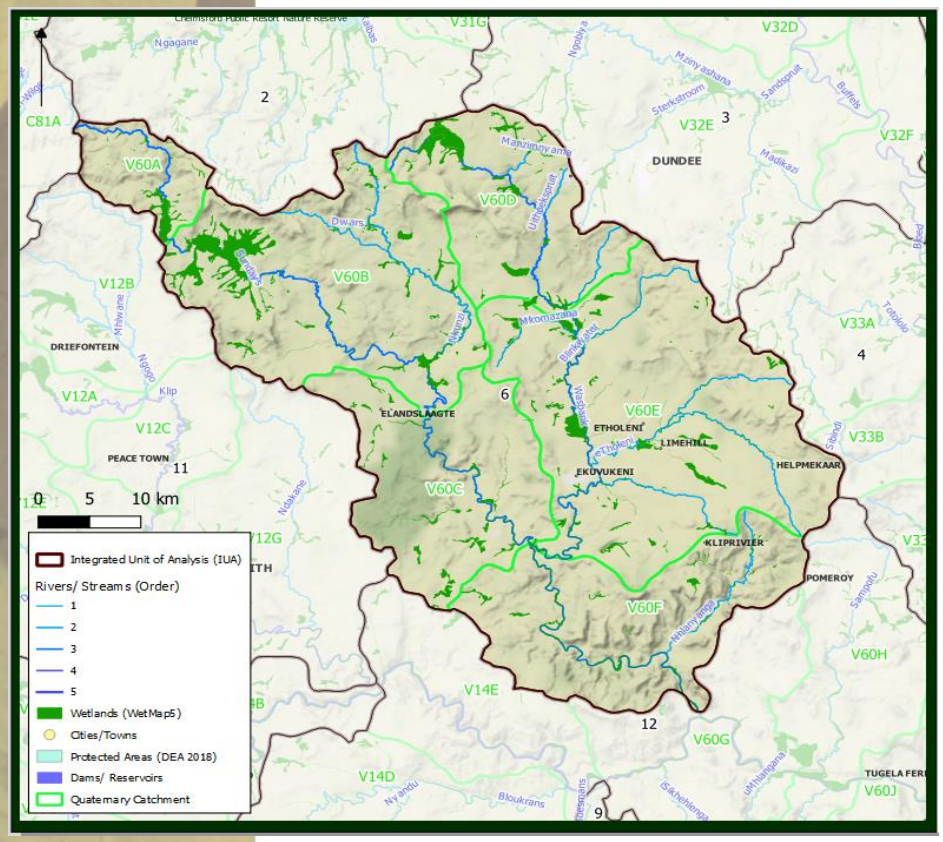
Percentage (%) of nodes in the IUA falling into the indicated EC groups				
A or A/B	**B or B/C**	**C or C/D**	**D**	**>D**
		100.00		

IUA 5 — Blood: Maintain the current condition of C

Trade-Off Required

	Cost	Benefit	Results	Conclusions
Economic Consequences			• Economic trade-offs likely to occur every year • Costs to economy from trade-offs: • uThukela economy GDP effect: -<R10 million/a	In IUA 5, Irrigation users has may experience a relatively small deficit in irrigation allocations. Mitigative measures could include: - Implementation of special water allocation and demand management measures during drought periods - Validation and verification of irrigation - Addressing water quality problems to mitigate risks to local communities
Ecological Consequences	**Ecosystem Service Risks Mitigated** 		**High and Extreme Ecosystem Service Risk Mitigated:** • Fresh Water provisioning: 10.6% of population relies on natural sources as their primary source of water - 880 households are affected by pathogens • Habitats for species within wetlands (species of cc) and waterways where habitats not especially diverse. **Location of Risk:** Wetlands in central catchment and lower portion of the Blood River **Impacts to be Mitigated:** Modified flows impact natural seasonal flow patterns: • Increased mean annual water flow volumes • Unnatural flush events in the dry season (No 0 flows) • No release management capacity (small farm dams) • Water quality issues (Pathogens and nutrients)	
Water Quality	**Water Quality Considerations** Drainage Region: V32H (Kwambunda); Salinity: Unacceptable; Nutrients: Unacceptable		**Overall:** • Water quality is likely impacted by the agricultural practices and the sewage discharges **Hotspots:** • Water quality data availability for IUA 5 is limited to catchment V32H and to salinity and nutrients, both of which are elevated	

IUA 6: Sundays

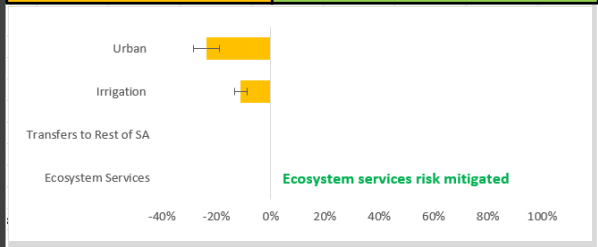
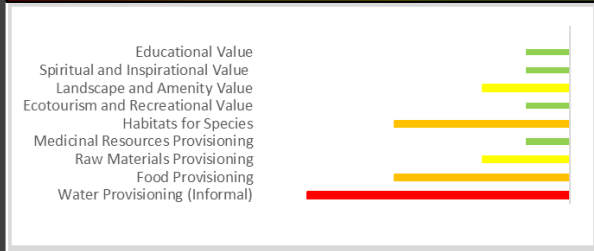


Percentage (%) of nodes in the IUA falling into the indicated EC groups				
A or A/B	**B or B/C**	**C or C/D**	**D**	**>D**
	12.00	68.00	16.00	4.00

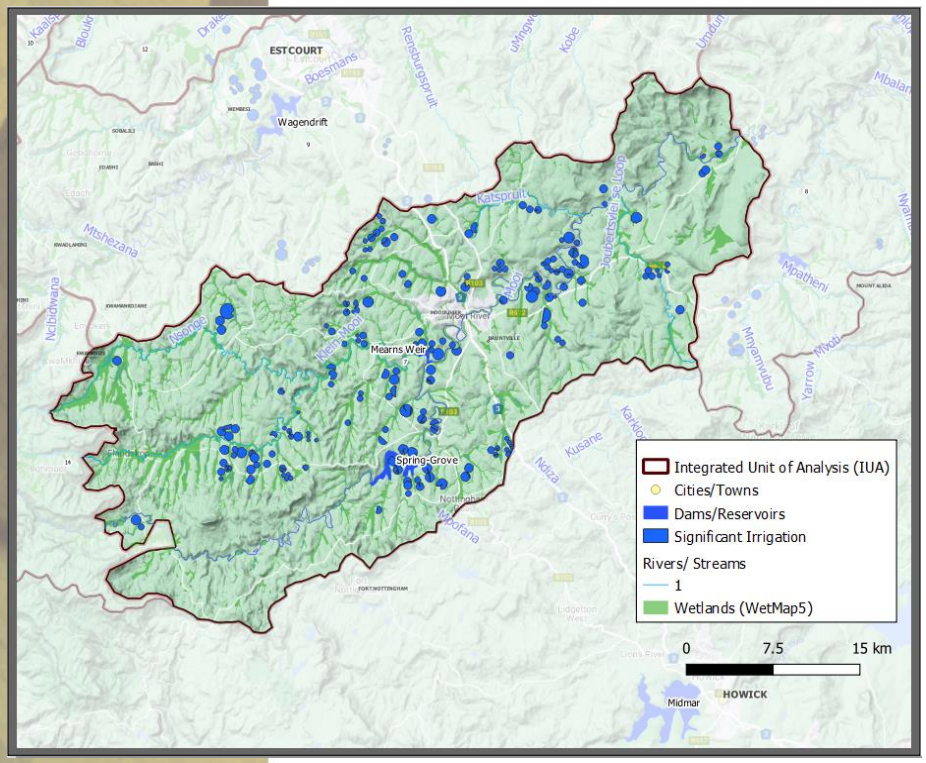
- V60A; V60B; V60D; V60C; V60E; V60F
- Mixed-Use Socio-Economic Zone
- Sundays River/ Dwars River/ Nkunzi River/ Manamntana River/ Biggersgatspruit/ Mkomazana River/ Binkwater River/ Dlomodlomo River/ eTHoleni River/ Kalkoenspruit/ Nhlanyanga River
- Paddavlei and Boshberg priority wetlands
- Groundwater: Moderate to low shale siltstone aquifer resources
- **SWSA:** Small portion of the IUA along the escarpment
- **Proposed EC: C/D**
- **Class III**

IUA 6 — Sundays: Maintain the current condition of C/D

Trade-Off Required

	Cost / Benefit	Results	Conclusions
Economic Consequences		• Economic trade-offs likely to occur every year • Costs to economy from trade-offs: • uThukela economy GDP effect: -R174 million/a	In IUA 6, Urban and Irrigation users would experience deficits in allocations. Reduced freshets and floods in an attempt to mitigate trade-offs. Additional mitigative measures could include: - Implementation of special water allocation and demand management measures during drought periods - Validation and verification - Exploring supply augmentation options (e.g. Groundwater) - Addressing water quality problems
Ecological Consequences	**Ecosystem Service Risks Mitigated** 	**High and Extreme Ecosystem Service Risk Mitigated:** • Fresh Water provisioning: 32% of population relies on natural sources as their primary source of water - 8 400 households are directly affected by reduced flow and increased sediments; • Food provisioning services: Specifically, livestock grazing • Habitats for species: Impacts on diverse habitats **Location of Risk:** Lower portions of the Sundays and Wasbank Rivers **Impacts to be Mitigated:** Modified flows impact natural seasonal flow patterns: • Decreased natural flows in the dry season (No 0 Flows) • Increased mean annual water flow volumes • Water quality issues (Sediments)	
Water Quality	**Water Quality Considerations** Drainage Region / Salinity / Nutrients / Sulphate V60B (Nkuzi): Unacceptable / Acceptable / Unacceptable V60D (Upstream of Wasbank): Unacceptable / Unacceptable / Acceptable V60E (Klipriver): Acceptable / Ideal / Acceptable	**Overall:** • The water quality in the upper Sundays River at Waterfall and Kleinfontein is good with low salts and low nutrients concentrations **Hotspots:** • The poor water quality likely a result of coal mining decants (acid mine drainage) in the Nkuzi and upper Wasbank, as well as from agricultural activity and likely WWTWS discharges.	

IUA 7: Upper Mooi



Percentage (%) of nodes in the IUA falling into the indicated EC groups

A or A/B	B or B/C	C or C/D	D	>D
		66.67	22.22	11.11

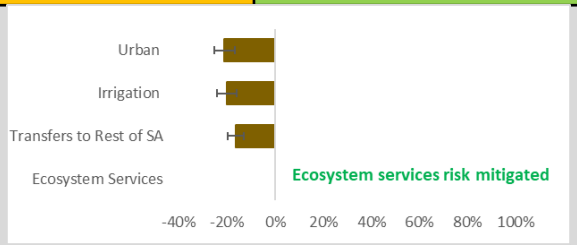
- V20A (lower portion); V20B (lower portion); V20C; V20D; V20E
- Agricultural Socio-Economic Zone
- Nsonge River; Klein-Mooi River; Katspruit; Joubertsvlei se Loop
- Hlatikulu and downstream portions of Stillerust priority wetlands
- Groundwater: Moderate to low shale siltstone aquifer resources
- **SWSA:** Almost half of the IUA extending from the escarpment

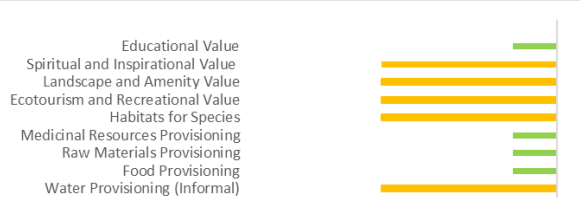
- **Proposed EC: C/D**
- **Class III**

IUA 7 — Upper Mooi: Maintain the current condition of C/D

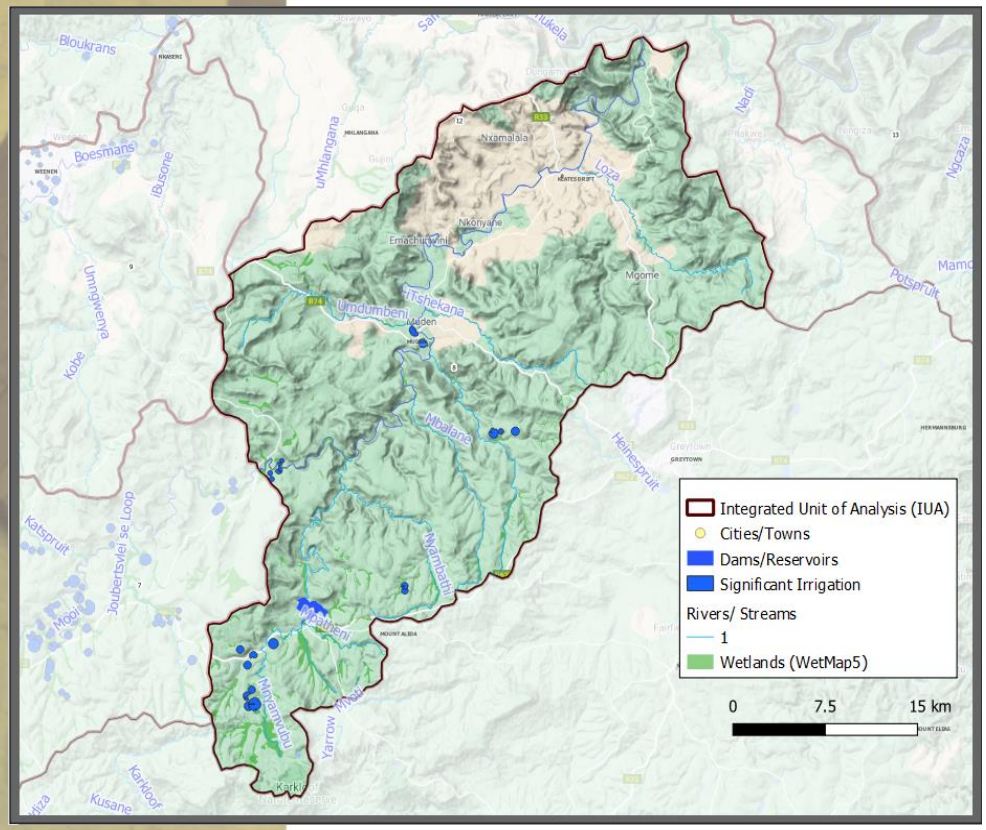
Trade-Off Required

	Cost	Benefit	Results	Conclusions

Economic Consequences			• Economic trade-offs over a 15 period (until the Mkomazi water project (Smithfield Dam) next phase is implemented by 2030)
			• Costs to economy from trade-offs:
			  • uThukela economy GDP effect: -R52 million/a
			  • Rest of SA economy GDP effect: -R787 million/a
				In IUA 7, Urban and Irrigation users, as well as the Umgeni transfer would experience water deficits as a result of implementation of the EWR. This is likely to occur until the development of the next phase of the Mkomazi water project (Smithfield Dam); at this stage the system should be improved to a B/C for the medium and long-term.
				
				Floods have been reduced to mitigate trade-offs in the short-term.
				
				Mitigative measures would include:
				- Fast tracking of Mkomazi water project
				- Water demand management measures
				- Addressing water quality problems
				- Verification and Validation

Ecological Consequences	**Ecosystem Service Risks Mitigated** 		**High and Extreme Ecosystem Service Risk Mitigated:** • Fresh Water provisioning: 16% of population relies on natural sources as their primary source of water - 1 400 households are directly affected by hazard; • Habitats for species: algae and altered flows; • Ecotourism and Recreation: linked to aquatics (Midmar, Midlands Meander, guesthouses, fishing, aquatic activities); • Impacts on real estate values (amenity values) and inspirational services linked to aquatic resources as per linked to a developed ecotourism industry. **Location of Risk:** • Upper portion of the Mooi River **Impacts to be Mitigated:** Modified flows impact natural seasonal flow patterns • Decreased natural flows in dry season (0 flows) • Increased mean annual water flow volumes • Water quality issues (Pathogens and Nutrients)	
Water Quality	**Water Quality Considerations** Drainage Region / Salinity / Nutrients / Sulphate V20A: Ideal / Ideal / Ideal V20C: Ideal / Ideal / Ideal V20D (Klein River): Acceptable / Ideal / Ideal V20E (Mooi River town): Unacceptable / Unacceptable / Ideal		**Overall:** • The upper Mooi River catchment exhibits to good quality **Hotspots:** • Presence of pollution sources above Mooi River town and diffuse runoff result in elevated salinity and nutrients at V20E	

IUA 8: Middle/ Lower Mooi



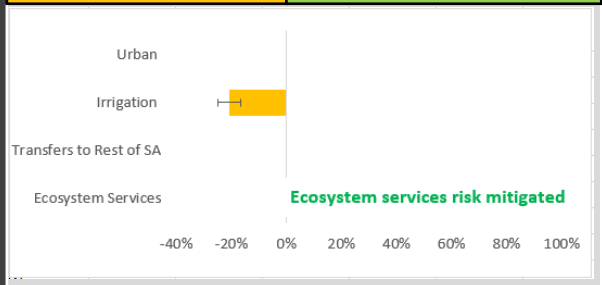
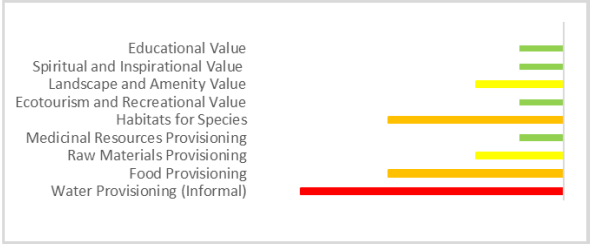
Percentage (%) of nodes in the IUA falling into the indicated EC groups				
A or A/B	B or B/C	C or C/D	D	>D
	33.33	61.11	5.56	

- V20F; V20G; V20H; V20J
- Agricutural Use Socio-Economic Zone
- Mpatheni River; Nyambathi River; Mnyamvubu River; Mbalane River; Mhlopeni River; Umdumbeni River; iTshekana River; Loza River
- Melmoth, Dartmoor and Scawby priority wetlands
- Groundwater: Moderate to low shale siltstone aquifer resources
- **SWSA:** Upper catchment

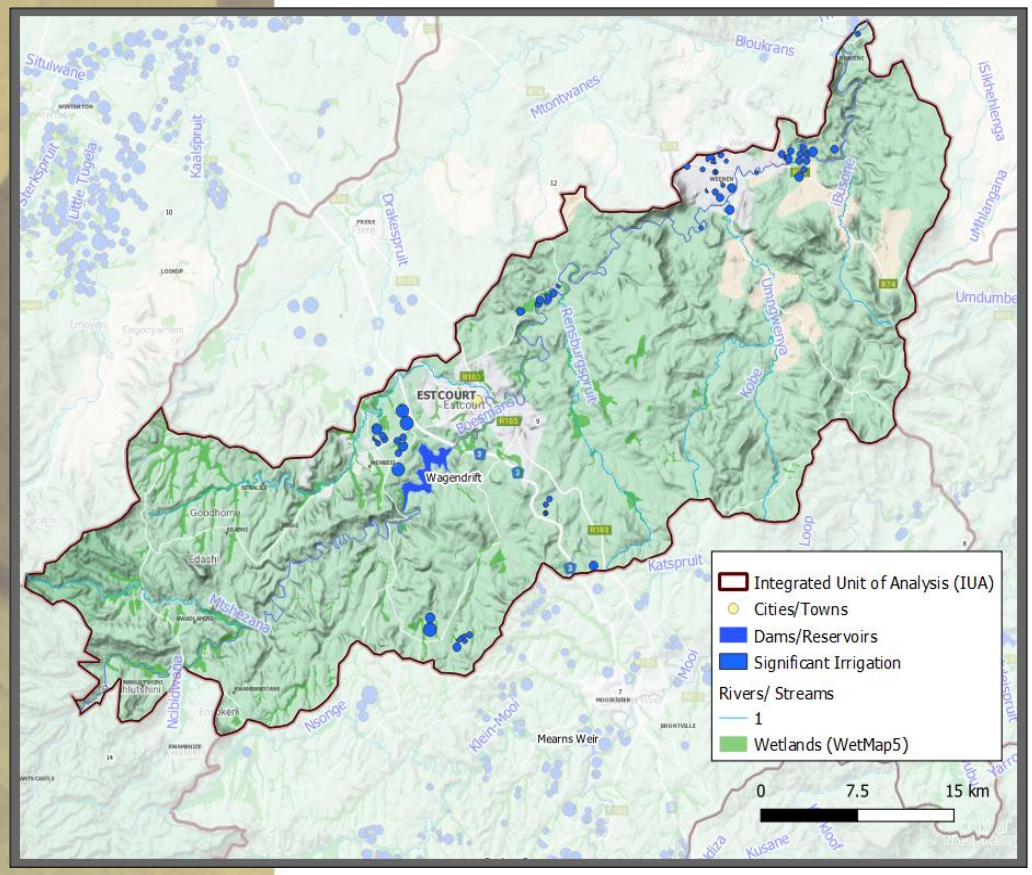
- **Proposed EC: C**
- **Class III**

IUA 8 — Lower Mooi: Improve the condition to a C

Trade-Off Required

	Cost	Benefit	Results	Conclusions
Economic Consequences			• Economic trade-offs likely to occur every year • Costs to economy from trade-offs: • uThukela economy GDP effect: <-R10 million/a	In IUA 8, Irrigation users may experience a relatively small deficit in irrigation allocations. Reduced floods to mitigate the trade-offs. Additional mitigative measures could include: - Implementation of special water allocation and demand management measures during drought periods - Validation and verification for irrigation
Ecological Consequences	**Ecosystem Service Risks Mitigated** 		**High and Extreme Ecosystem Service Risk Mitigated:** • Fresh Water provisioning: 33% of population relies on natural sources as their primary source of water - 4 300 households are directly affected by hazards; • Food provisioning: Reduced primary productivity of grazing areas and potentially fish species; • Habitats for species: High diversity in waterways (no species of cc) and Scawby wetland (crane species); **Location of Risk:** Lower portion of the Mooi IUA **Impacts to be Mitigated:** Modified flows impact natural seasonal flow patterns: • Decreased natural flows in the dry season (0 Flows) • Increased mean annual water flow volumes • Water quality issues (Pathogens and some Nutrients)	
Water Quality	**Water Quality Considerations** Drainage Region / Salinity / Nutrients / Sulphate V20F (Craige Burn nature reserve): Ideal / Ideal / Ideal V20H (Muden): Tolerable / Ideal / Ideal		**Overall:** • V20F is at the outflow from Craigie Dam thus water quality is good. **Hotspots:** • No hotspot water quality has been identified	

IUA 9: Middle/ Lower Bushmans



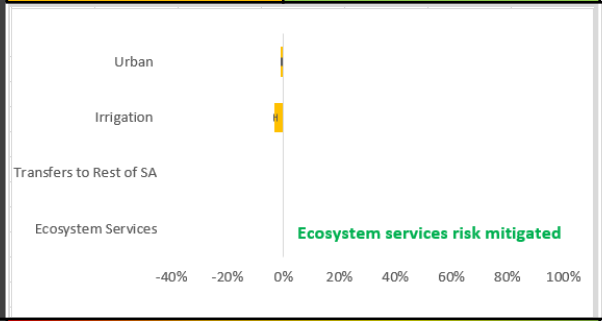
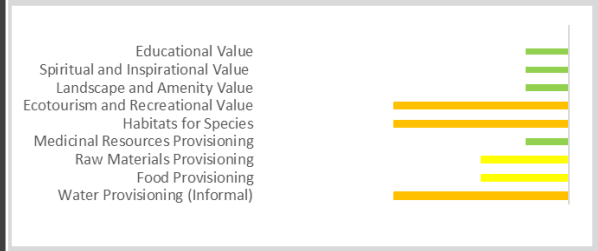
Percentage (%) of nodes in the IUA falling into the indicated EC groups				
A or A/B	**B or B/C**	**C or C/D**	**D**	**>D**
20.00	40.00	40.00		

- V70A (lower portion); V70C; V70D; V70E; V70F; V70G
- Mixed-Use Socio-Economic Zone
- Klein Boesmans River; Rensburgspruit; uMngwenya River; Kobe River; iBusone River
- Wagendrift Dam (proposed Mielietuin Dam)
- Ntabamhlope priority wetlands
- Groundwater: Moderate to low shale siltstone aquifer resources
- **SWSA:** Upper catchment extending from the escarpment

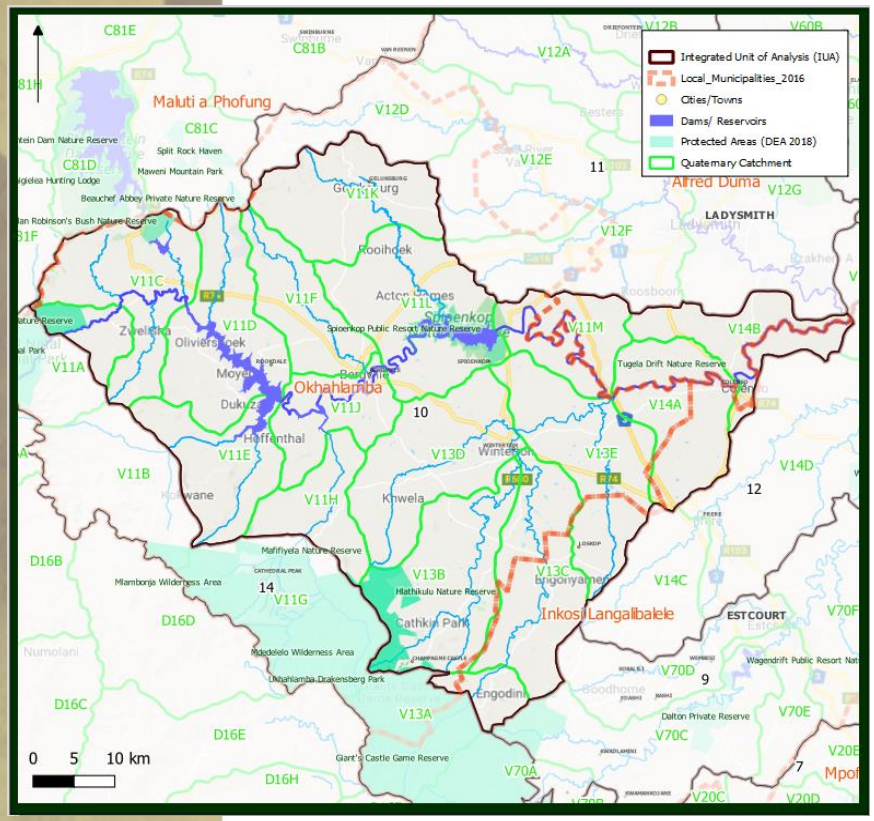
- **Proposed EC: C/D**
- **Class III**

IUA 9 — Bushmans: Improve the current condition to a C/D

Trade-Off Required

	Cost	Benefit	Results	Conclusions
Economic Consequences			• Economic trade-offs likely to occur every year • Costs to economy from trade-offs: • uThukela economy GDP effect: -R11 million/a	In IUA 9, Urban and Irrigation would experience water deficits as a result of implementation of the EWR. This deficits, although occurring every year, are small (and may be insignificant) Freshets and floods were reduced to mitigate trade-offs. Additional mitigative measures could include: - Development of Mielietuin Dam may mitigate the economic effect - Water demand management measures - Implementation of special water allocation and demand management measures during drought periods - Addressing water quality problems - Verification and Validation
Ecological Consequences	**Ecosystem Service Risks Mitigated** 		**High and Extreme Ecosystem Service Risk Mitigated:** • Fresh Water provisioning: 20% of population relies on natural sources as their primary source of water - Less than these 4 600 households at risk due to their position; • Impacts on high diversity habitats for species within waterways (no threatened species); • Potential impacts on ecotourism and recreation towards the Weenen area (fishing and accommodation) **Location of Risk:** • Lower portions of the Bushmans River - Towards Weenen **Impacts to be Mitigated:** Modified flows impact natural seasonal flow patterns: • No zero flows, decreased natural flows in dry season • Sporadic flush events in the dry season (Releases from Wagendrift) • Water quality issues (Nutrients, effluent from Estcourt, Pathogens)	
Water Quality	**Water Quality Considerations** Drainage Region / Salinity / Nutrients / Sulphate V70A: Ideal / Ideal / Ideal V70C (Delton private: Ideal / Ideal / Ideal V70D (Escourt: Acceptable / Tolerable / Ideal V70E (upstream of Wagedrift nature reserve): Ideal / Tolerable V70F (Weenen nature reserve): Unacceptable / Unacceptable		**Overall:** • Based on the compliance assessment the water quality in Bushmans River catchment is good with ideal and acceptable levels of water quality variables present. **Hotspots:** • Likely WWTW discharges industrial area impacts; forestry in upper reaches; sand mining, agriculture; elevated nutrients. Poor water quality downstream of town of Estcourt (V70F)	

IUA 10: Upper Thukela

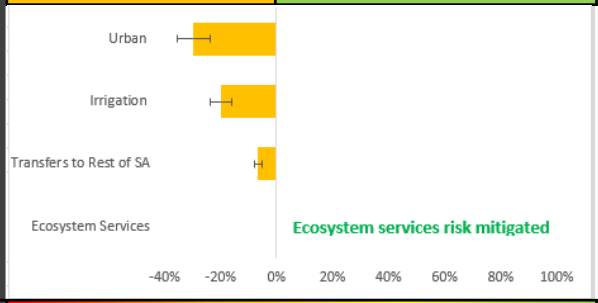


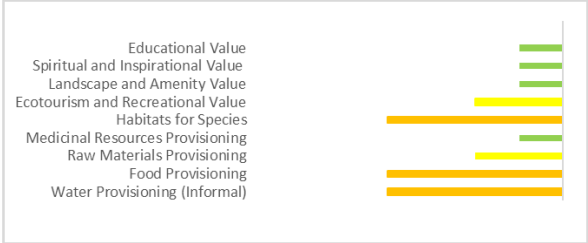
Percentage (%) of nodes in the IUA falling into the indicated EC groups				
A or A/B	**B or B/C**	**C or C/D**	**D**	**>D**
3.70	44.44	40.74	11.11	

- V11A (lower portion), V11C; V11D; V11E; V11F; V11H; V11J; V11K; V11L; V11M; 13A (lower reaches) V13B; V13C; V13D; V13E; V14A; V14B
- Upper Thukela River; Putterill River; Khombe River; Mpandweni River; Nxwaye River; Mnweni River (lower); Sandspruit; Mlambonja River (lower); Njongola River; Ventersruit; Situlwane River; Sterkspruit; Little Thukela River; Kaalspruit
- Spioenkop and Woodstock dams
- No priority wetlands
- Moderate to low shale siltstone aquifer resources
- **SWSA:** Much of the IUA along the escarpment
- **Proposed EC: C**
- **Class III**

IUA 10 | Upper Thukela: Maintain the current condition of C | Trade-Off Required

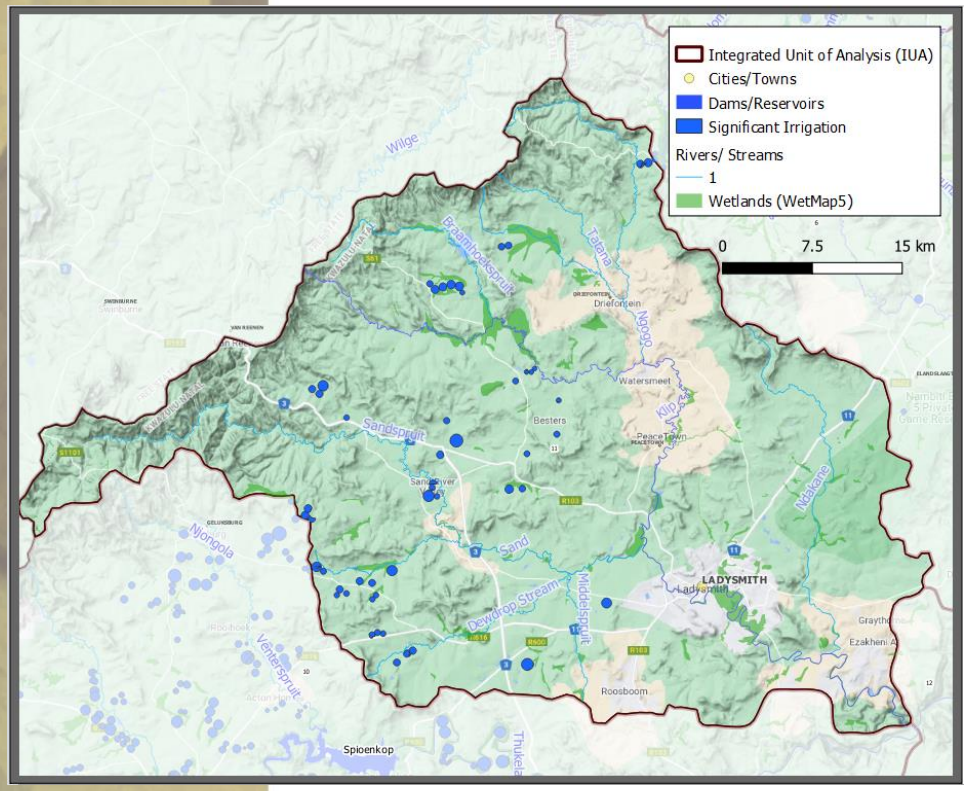
	Cost	Benefit	Results	Conclusions

Economic Consequences			• Economic trade-offs estimated to occur every year
			• Costs to economy from trade-offs:
			  • uThukela economy GDP effect: -R199 million/a
			  • Rest of SA economy GDP effect: -R1,400 million/a
				In IUA 10, Urban and Irrigation users, as well as the Vaal transfer would experience water deficits as a result of implementation of the EWR.
				
				Mitigative measures would be unlikely to fully mitigate these economic effects, but would include:
				- Construction of Jana Dam (linked to Spioenkop Dam)
				- Water demand management measures
				- Addressing water quality problems
				- Further investigation into an alternate ecological category of a C/D because of the physical constraints of the Spioenkop release capacity (35cumec).

Ecological Consequences	**Ecosystem Service Risks Mitigated** 		**High and Extreme Ecosystem Service Risk Mitigated:** • Fresh Water provisioning: below Woodstock dam (9.4% of total population relies on natural sources as their primary source of water); Likely less than 3 000hh due to position. • High prevalence of livestock agriculture and therefore livestock watering and risk to reduced food provisioning (grazing); • Habitats for species: within waterways due to altered flows and impacts on high habitat diversity; **Location of Risk:** • Between Woodstock and Spioenkop and below Spioenkop Dam **Impacts to be Mitigated:** • Decreased natural flows (esp below Woodstock).	
Water Quality	**Water Quality Considerations** See table below		**Overall:** • The water quality in the upper Thukela, upstream of Woodstock Dam is generally good, with minimal impact **Hotspots:** • Intensive irrigation does occur in the lower reaches of the catchment (V11J, V13D and V14B). Non-compliance is observed in V11J likely due to WWTWs	

Drainage Region	Salinity	Nutrients	Sulphate
V11A	Tolerable	Unacceptable	
V11C	Tolerable	Tolerable	Ideal
V11D (Dukuza)	Acceptable	Ideal	Ideal
V11J (Bergville)	Tolerable	Unacceptable	
V13D (Winterton)	Tolerable	Unacceptable	
V14B (Tugela drift nature reserve)	Tolerable	Unacceptable	

IUA 11: Klip River



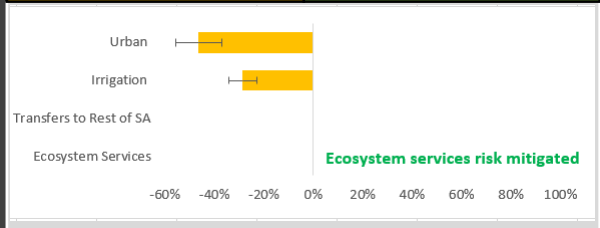
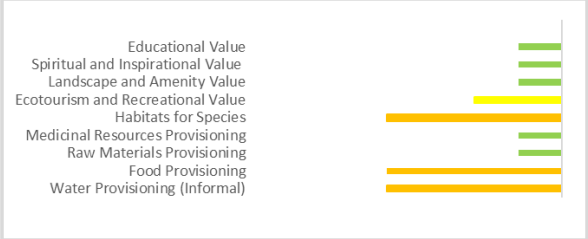
Percentage (%) of nodes in the IUA falling into the indicated EC groups				
A or A/B	**B or B/C**	**C or C/D**	**D**	**>D**
10.53	42.11	47.37		

- V12A; V12B; V12C; V12D; V12E; V12F; V12G
- Klip River; Mhlwane River; Tatapa River; Ngoga River; Braamhoekspruit; Sandspruit; Dewdrop Stream; Middelspruit; Ndakane River
- No priority wetlands
- Alluvial aquifers with high surface to groundwater interaction. Moderate to low shale siltstone aquifer resources
- **SWSA:** Limited along escarpment

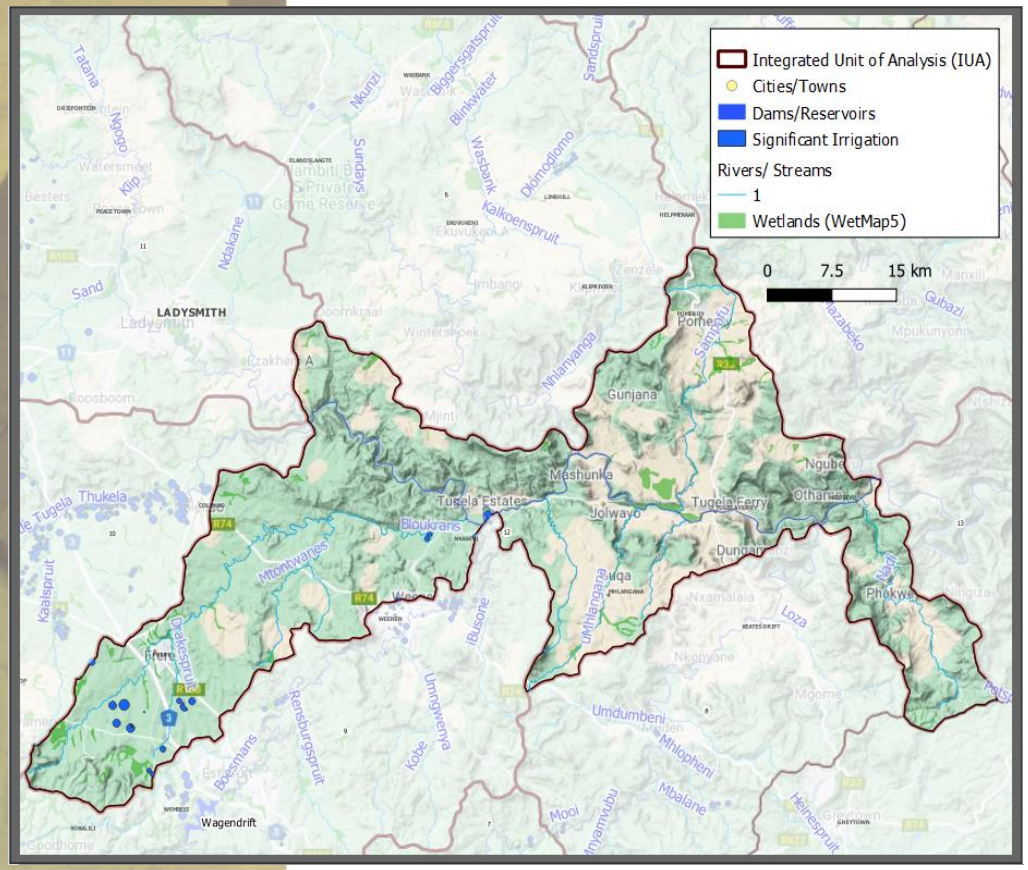
- **Proposed EC: C**
- **Class III**

IUA 11 — Klip River: Maintain the current condition of C

Trade-Off Required

	Cost	Benefit	Results	Conclusions
Economic Consequences			• Economic trade-offs estimated to occur every year • Costs to economy from trade-offs: • uThukela economy GDP effect: -R1,288 million/a	In IUA 11, Urban and Irrigation users would experience water deficits as a result of implementation of the EWR. Reduced the freshets to mitigate trade-offs. Additional mitigative measures would include: - Construction of augmentation scheme (linked to IUA 10)(proposed Jana Dam) - Water demand management measures - Addressing water quality problems - Verification and Validation - Current feasibility study being undertaken by Umgeni.
Ecological Consequences	**Ecosystem Service Risks Mitigated** 		**High and Extreme Ecosystem Service Risk Mitigated:** • Fresh water provisioning: 3.8% of population relies on natural sources of water (1 900hh) of which are mostly found in upper catchment; • Food provisioning: Livestock grazing • Impacts on diverse habitats for species within waterways (sedimentation). Migratory eels recorded here showing significant migration route. No clear linkage with beneficiaries however from conservation perspective their presence is important **Location of Risk:** Middle to lower portions of the Klip River **Impacts to be Mitigated:** • Modified flows are not a major hazard • Key hazard is water quality issues (Sediments upstream of Ladysmith and nutrients downstream)	
Water Quality	**Water Quality Considerations** Drainage Region / Salinity / Nutrients / Sulphate V12F: Unacceptable / Unacceptable / Ideal V12G (Ladysmith): Unacceptable / Unacceptable / Ideal		**Overall:** • Water quality data is limited or lacking for the upstream catchments in the IUA, however the data that is available indicate that the IUA has high salinity ad nutrients **Hotspots:** • Overgrazing and soil erosion is a concern to the areas north of Ladysmith. Ladysmith town in V12G is likely attributing to high salinity in the IUA	

IUA 12: Middle Thukela

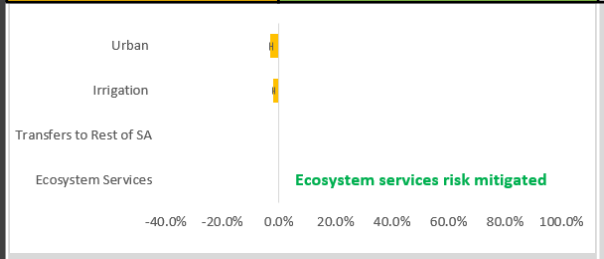
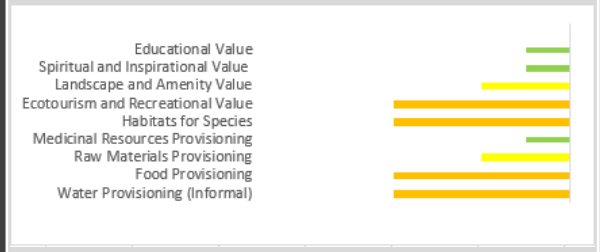


Percentage (%) of nodes in the IUA falling into the indicated EC groups				
A or A/B	**B or B/C**	**C or C/D**	**D**	**>D**
13.64	31.82	50.00	4.55	

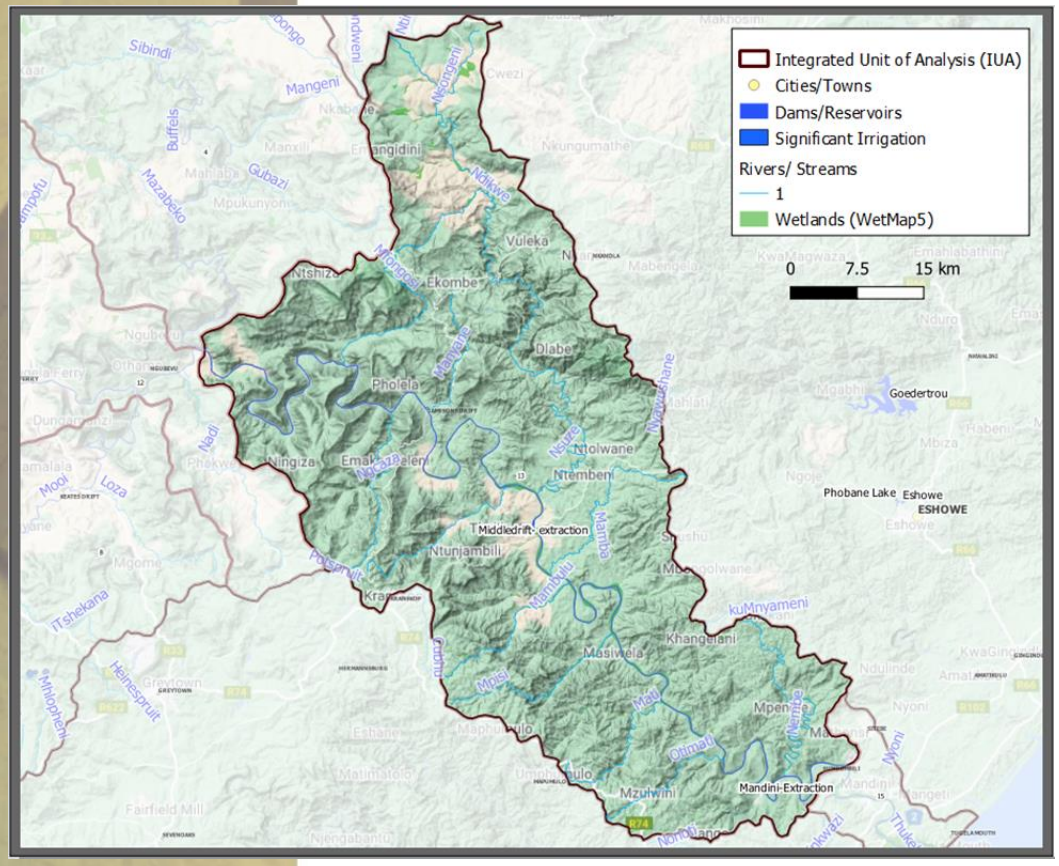
- V14C; V14D; V14E; V60G; V60H; V60J; V60K
- Middle Thukela River; Bloukrans River; Drakespruit; Mtontwanes River; Nyandu River; iSilwhehlenga River; uMhlangana River; Sompofu Rver; Nadi River; Mfongosi River; Manyane River; Ngcaza River; Nsuze River; Nsongeni River; Ndikwe River; Mamdleni River; Mamba River; Mambulu River; Mpisi River; Mati River; Nembe River
- No major wetlands
- Alluvial aquifers with high surface to groundwater interaction. Moderate to low shale siltstone aquifer resources
- **SWSA:** Limited within the IUA
- **Proposed EC: C**
- **Class III**

IUA 12 | Middle Thukela: Maintain the current condition of C

Drought related Trade-Off

	Cost	Benefit	Results	Conclusions
Economic Consequences			• Analysis shows 1 out of every 15 years drought conditions result in economic tradeoffs: • Costs to economy from trade-offs: • uThukela economy GDP effect: <-R5 million/a	In IUA 12, Urban and Irrigation users may experience a relatively small deficit in irrigation allocations. Mitigative measures could include: - Implementation of special water allocation and demand management measures during drought periods - Verification and Validation for irrigation
Ecological Consequences	**Ecosystem Service Risks Mitigated** 		**High and Extreme Ecosystem Service Risk Mitigated:** • Fresh Water provisioning: 41% of population relies on natural sources as their primary source of water - 14 000 households • Food provisioning: Livestock grazing • Habitats for species within waterways. The endemic Tugela Labio (IUCN vulnerable) • Uncertainty around risks to ecotourism and recreation however the potential for aquatic activities (Kayaking/boating/fishing) is associated with deeper water of the Tugela. **Location of Risk:** • Higher in upper IUA reducing downstream-waterways and aquifers **Impacts to be Mitigated:** Modified flows impact natural seasonal flow pattern: • Increased mean annual water flow volumes but with extended low flow periods (upstream extractions)- No 0 flows • Water quality issues (not major issues, nutrients and pathogens)	
Water Quality	**Water Quality Considerations** Drainage Region / Salinity / Nutrients / Sulphate V14D (Weenen Nature Reserve) — Tolerable — Ideal — Ideal V60G — Acceptable — Unacceptable — V60J (Tugela Ferry) — Acceptable — Ideal — Ideal		**Overall:** • Water quality in the IUA is relatively good **Hotspots:** • Elevated levels at V60J, the middle Thukela river is likely attributable to the upstream impacts related to agricultural run-off and the impacts from the Klip and Bushmans Rivers	

IUA 13: Lower Thukela



Percentage (%) of nodes in the IUA falling into the indicated EC groups				
A or A/B	**B or B/C**	**C or C/D**	**D**	**>D**
3.70	70.37	25.93		

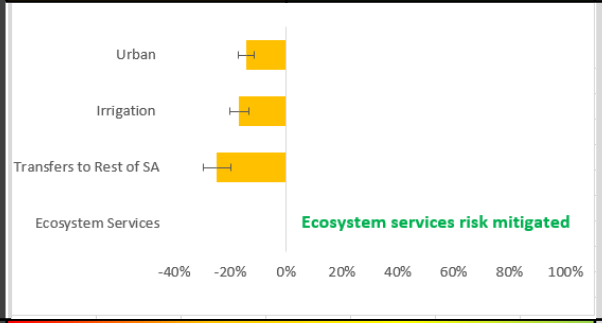
- V40A; V40B; V40C; V40D; V40E; V50A; V50B; V50C
- Lower Thukela River; Nsuze River; Nsongeni River; Ndikwe River; Mamdleni River; Mamba River; Mambulu River; Mpisi River; Mati River; Otimati River; Nembe River
- Very few wetland systems
- Moderate to low shale siltstone aquifer resources
- Scattered SWSAs throughout the catchment

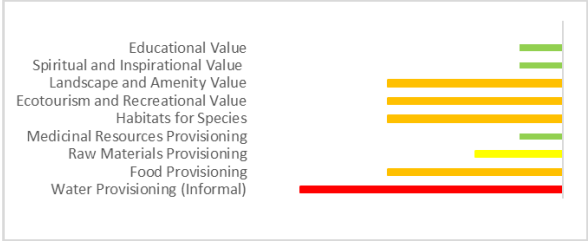
- **Proposed EC: C**
- **Class II**

IUA 13 — Lower Thukela: Maintain the current condition of C

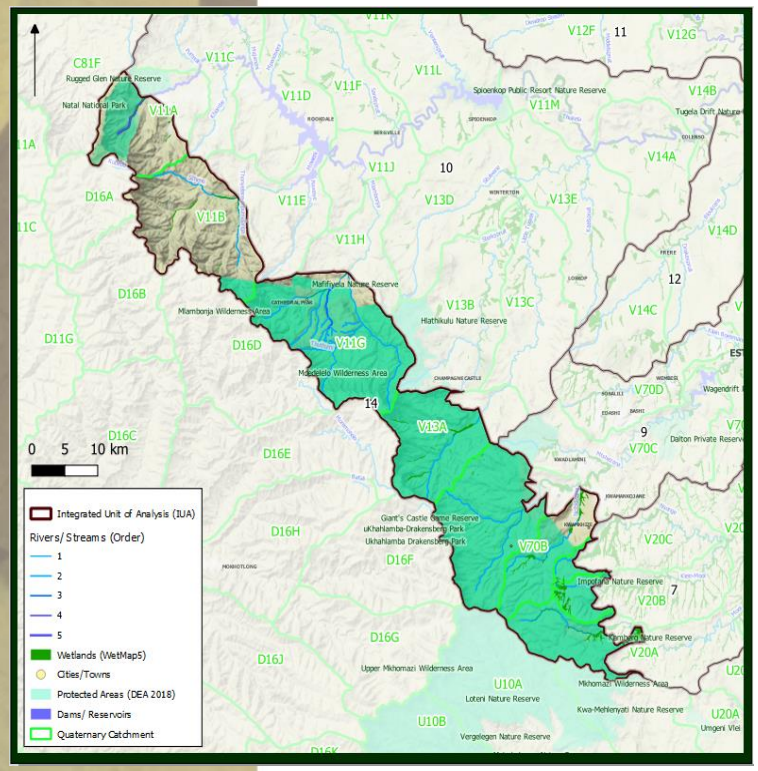
Trade-Off Required

	Cost	Benefit	Results	Conclusions

Economic Consequences			• Economic trade-offs estimated to occur every year
			• Costs to economy from trade-offs:
			  • uThukela economy GDP effect: -R200 million/a
			  • Rest of SA economy GDP effect: -R1,020 million/a
				In IUA 13, Urban and Irrigation users, as well as the Mhlatuze (Goedetrouw) and Lower Thukela Bulk Water Supply Scheme (LTBWSS) transfers would experience water deficits as a result of implementation of the EWR.
				
				Mitigative measures would be unlikely to fully mitigate these economic effects, but would include:
				- Construction of dam in Buffalo catchment (IUA 3)
				- Water demand management measures
				- Addressing water quality problems would mitigate issues for local communities

Ecological Consequences	**Ecosystem Service Risks Mitigated** 		**High and Extreme Ecosystem Service Risk Mitigated:** • Fresh Water provisioning: 65% of population relies on natural sources as their primary source of water - 30 000 households; • Food Provisioning: in terms of loss of aquatic food sources for communities; • Habitats for species: high diversity of species incl the endemic Tugela Labio. • Uncertainty around risks to ecotourism and recreation however the potential for aquatic activities (Kayaking/boating/fishing); • Landscape and amenity values: Traditional communities. **Location of Risk:** Waterways throughout IUA **Impacts to be Mitigated:** • Key hazard is water quality issues (Pathogens, nutrients and sedimentation due to rural/informal land use) • Modified flows are not a major hazard	
Water Quality	**Water Quality Considerations** Drainage Region / Salinity / Nutrients V40E — Tolerable — Unacceptable V50A — Tolerable — Unacceptable		**Overall:** • The IUA has limited water quality data available (sites, frequency and analysis) in catchments V40A to V50C. **Hotspots:** • Tolerable levels of salinity and elevated levels of nutrients are observed in V40E and V50A, with potential eutrophication in the river system.	

IUA 14: Escarpment



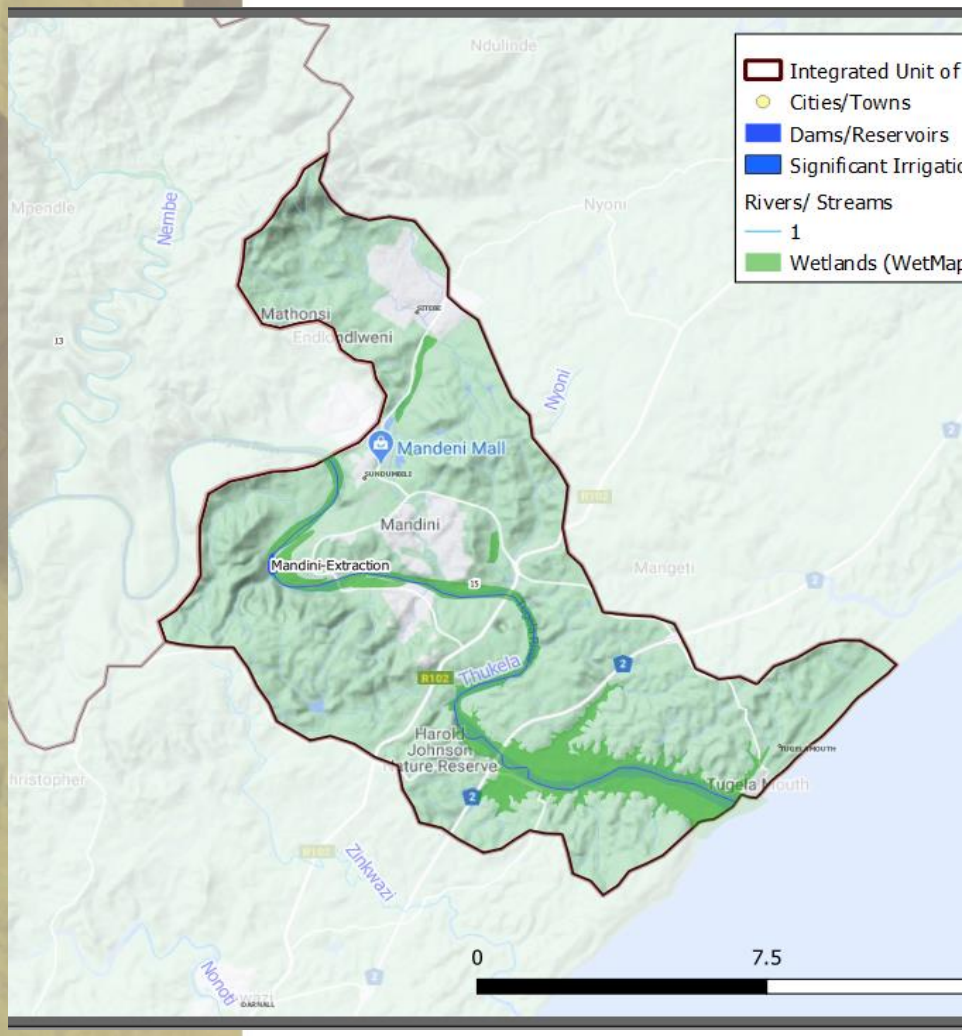
Percentage (%) of nodes in the IUA falling into the indicated EC groups				
A or A/B	**B or B/C**	**C or C/D**	**D**	**>D**
80.00	16.00	4.00		

- V20A (upper reaches); V20B (upper reaches); V70A (upper reaches); V70B; V13A (upper reaches); V11G; V11B; V11A (upper reaches)
- Thukela headwaters; Upper Little Thukela; Upper Boesmans River; Upper Mooi River; Upper Little Mooi River; Mtshezana River; Nsibidwana River; Sithene River; Thonyelana-mpumalanga River; Mnweni River (upper); Ndumeni River; Thuthumi River; Ndedema River; Mhlwazini River; Mlambonja River (upper)
- **SWSAs**
- **Proposed EC: B**
- **Class I**

IUA 14 — Escarpment: Maintain the current condition of B — No Trade-Off

	~~Cost~~	Benefit	Results	Conclusions
Economic Consequences			• No water allocation to demand • Maintain current condition (long-term stability) • No economic trade-off	The SWSAs need to be protected to ensure water for the Thukela system (for local catchments and the rest of the country). Although no economic trade-off, the maintenance of the EWR will need the following: - Address water quality issues - Improved water quality monitoring and evaluation - Limit development
Ecological Consequences		**Ecosystem Service Risks Mitigated** 	**High and Extreme Ecosystem Service Risk Mitigated:** • No extreme or high risks from scenarios identified. The significance of the IUA on an international and national scale to provide the range of ecosystem services makes it a priority in terms of maintenance. **Location of Risk:** • Downstream of WWTW (localised) and land use associated with settlements **Impacts to be Mitigated:** • No significant flow modifications • Water quality issues (Nutrients, Sedimentation)	
Water Quality		**Water Quality Considerations** Drainage Region / Salinity / Nutrients / Sulphate V11G (Mlanbonja Wilderness Area): Unacceptable / Tolerable V70B: Ideal / Ideal / Ideal V20A: Ideal / Ideal / Ideal	**Overall:** • The rivers are largely pristine, in good ecological condition, and it is assumed that they would be of good water quality. **Hotspots:** • The water quality on the Mlambonja tributary (V11G) was found to have high salinity and nutrients likely a result of upstream WWTW	

IUA 15: Thukela Estuary

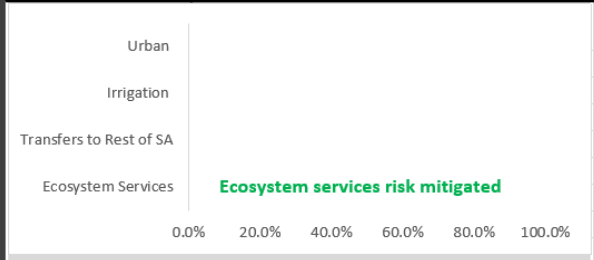
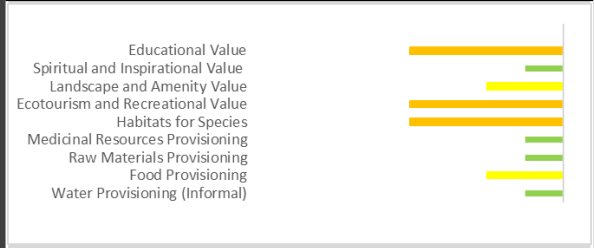


- Proposed EC: C
- **Class II, considering the MPA**

Percentage (%) of nodes in the IUA falling into the indicated EC groups				
A or A/B	**B or B/C**	**C or C/D**	**D**	**>D**
		100		

IUA 15 Thukela Mouth: Maintain the current condition of C

No Trade-Off

	~~Cost~~	Benefit	Results	Conclusions
Economic Consequences			• No water allocation to demand • Maintain current condition (long-term stability) • No economic trade-off	Although no economic trade-off, the maintenance of the EWR will need the following: - Address water quality issues - Maintain monitoring and evaluation of estuarine dynamics
Ecological Consequences	**Ecosystem Service Risks Mitigated** 		**<u>High and Extreme Ecosystem Service Risk Mitigated:</u>** • Habitats for species: Closure of the mouth, these events will have long term impacts on the entire system. • Ecotourism and recreation: Impacts on recreationally fished species and ability to utilise the estuary for recreational activities. • Educational value: As the only river mouth on the eastern coast and given the dynamics between the mouth and the banks it is the focus of many studies. **<u>Location of Risk:</u>** The Thukela Mouth Estuary and greater offshore marine protected area **<u>Impacts to be Mitigated:</u>** Modified flows impact natural seasonal flow patterns: • Reduction in baseflow, reduction in flush events (required to maintain opening of mouth) • Water quality issues (Nutrients, pathogens and industrial contaminants)	
Water Quality	**Water Quality Considerations** Drainage Region: V50D — Salinity: Unacceptable — Nutrients: Unacceptable		**<u>Overall:</u>** • Water quality in the lowest reach of the Thukela River upstream of the estuary in V50D is impacted, and compliance indicates elevated levels of salinity and nutrients **<u>Hotspots:</u>** • Elevated nutrients and salinity: likely due to industrial effluent and WWTW.	

PRELIMINARY WATER RESOURCE CLASSES

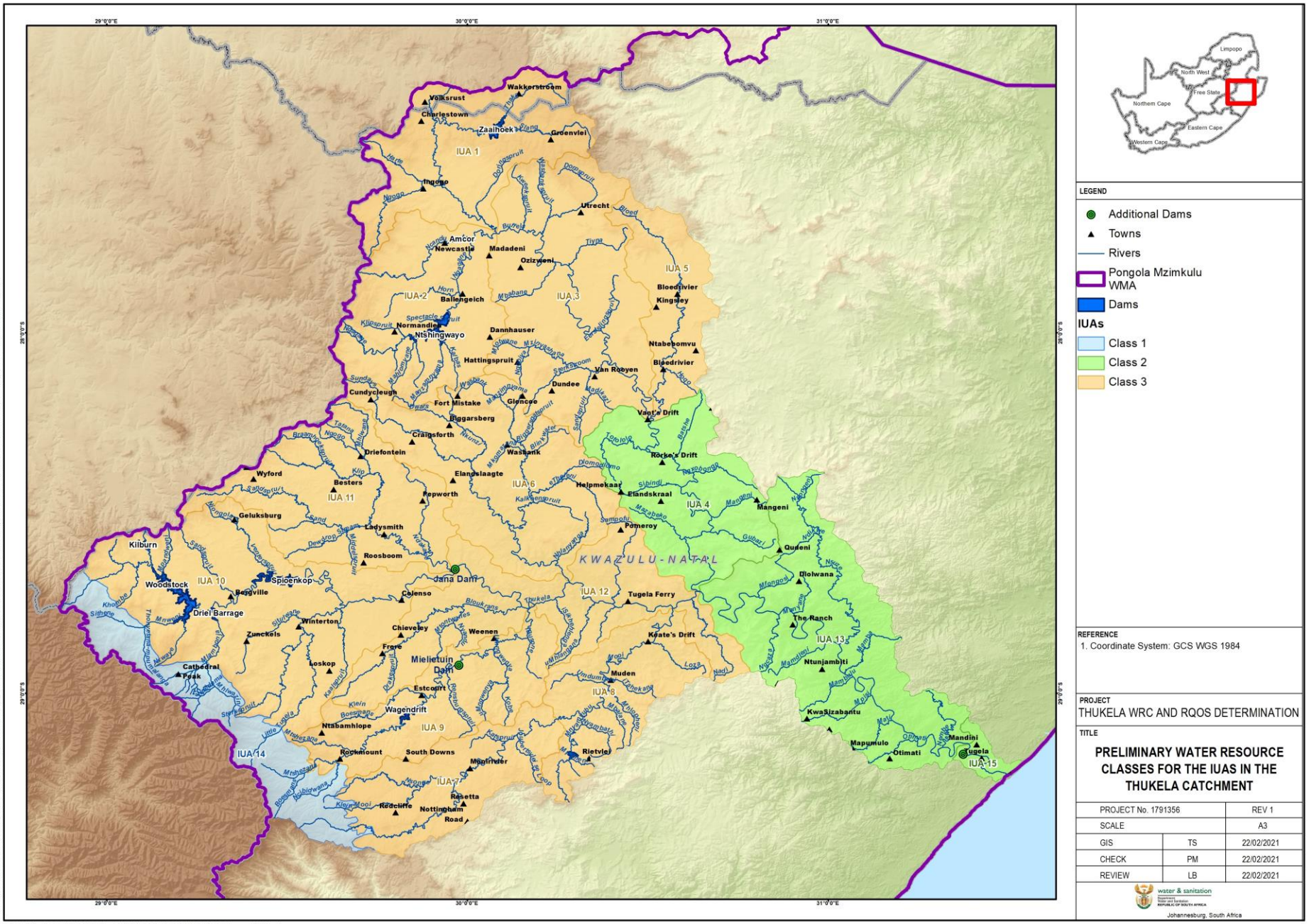
Proposed WRC Methodology

In summary the WRCS guidelines recommend that the water resource class be determined based on the ECs of the biophysical nodes residing in an IUA

		Percentage (%) of nodes in the IUA falling into the indicated EC groups				
		≥ A/B	**≥ B**	**≥ C**	**≥ D**	**< D**
Class I: minimally used and configuration of ecological categories of that water resource minimally altered from its pre-development condition		40	60	80	99	
Class II: moderately used and configuration of ecological categories of that water resource moderately altered from its pre-development condition			40	70	95	
Class III: heavily used and configuration of ecological categories of that water resource significantly altered from its pre-development condition	**Either**			30	80	
	Or				100	

Percentage (%) of nodes in the IUA falling into the indicated EC groups

IUA	Percentage (%) of nodes in the IUA falling into the indicated EC groups					IUA Class for ESBC (PES) Scenario	Aggregated Ecological Category (ESBC)
	A or A/B	B or B/C	C or C/D	D	>D		
1		36	55	9		III	C
2		31.25	56.25	6.25	6.25	III	C
3		39.13	52.17	8.70		III	D
4		57.14	21.43	21.43		II	B/C
5			100.00			III	C
6		12.00	68.00	16.00	4.00	III	C
7			66.67	22.22	11.11	III	C
8		33.33	61.11	5.56		III	C
9	20.00	40.00	40.00			III	C
10	3.70	44.44	40.74	11.11		III	C
11	10.53	42.11	47.37			III	C
12	13.64	31.82	50.00	4.55		III	C
13	3.70	70.37	25.93			II	C
14	80.00	16.00	4.00			I	B
15			100			II	C



LEGEND

- Additional Dams
- Towns
- Rivers
- Pongola Mzimkulu WMA
- Dams

IUAs

- Class 1
- Class 2
- Class 3

REFERENCE

1. Coordinate System: GCS WGS 1984

PROJECT

THUKELA WRC AND RQOS DETERMINATION

TITLE

PRELIMINARY WATER RESOURCE CLASSES FOR THE IUAS IN THE THUKELA CATCHMENT

PROJECT No. 1791356		REV 1
SCALE		A3
GIS	TS	22/02/2021
CHECK	PM	22/02/2021
REVIEW	LB	22/02/2021

water & sanitation
Department: Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Johannesburg, South Africa

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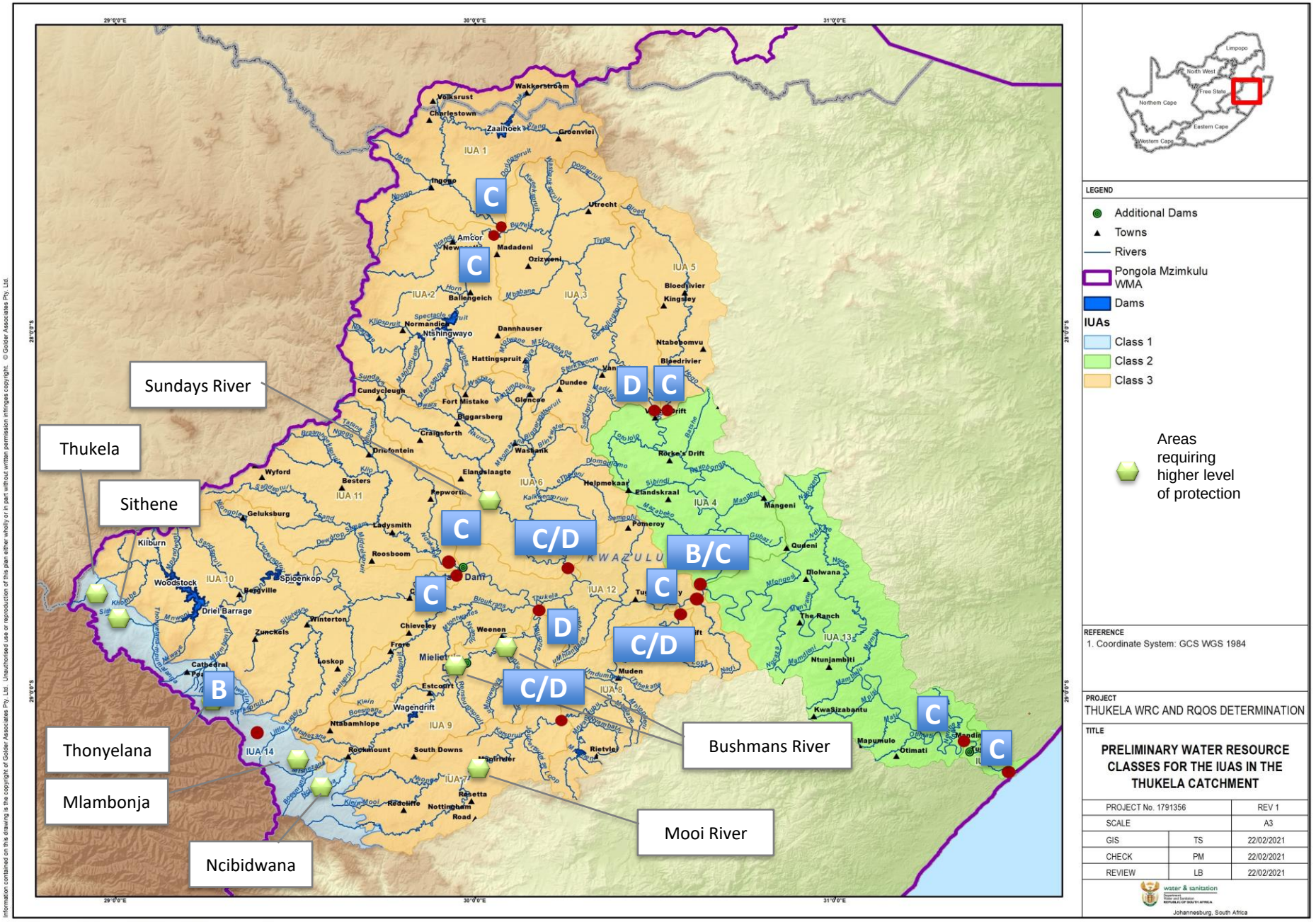

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Recommendations

- Reconciliation strategy for the Thukela needs to be developed as a matter of urgency
- Local town and urban water demand projections (future growth must be confirmed). Important so that local users needs are met before further transfer commitments.
- Improve the confidence of ecological status at several key EWR sites (update Reserve)
- The system operation can be optimised and numerous water quality interventions can be implemented to improve ecosystem health
- Groundwater sources need to be confirmed as an alternative water supply source
- Validation and verification of water use, specifically irrigation is required and may result in compulsory Water Use Licensing
- Further research into changes in the estuary conditions and drivers (inter departmental collaboration)
- Feasibility studies into proposed development options (e.g. future dams) needed
- Optimisation of system operation, specifically regarding transfers.

WAY FORWARD

- Update the draft Scenarios and Water Resources Classes Report
- Determine RQOs for the proposed Classes
- Circulate the draft RQOs Report by 22 April 2021
- 28 April 2021: PSC Meeting 05 (draft RQOs)