3. ENVIRONMENTAL IMPACT ASSESSMENT APPROACH AND METHODOLOGY

3.1 SCOPE OF THE EIA

3.1.1 Project components assessed in the EIA

The EIA will investigate the impacts of, and recommend mitigation and enhancement measures for the following project components:

- The Ntabelanga and Lalini Dams;
- Five new flow gauging weirs;
- Primary and secondary bulk potable water infrastructure comprising:
  - Primary infrastructure: main water treatment works, including four major treated water pumping stations and three minor treated water pumping stations, main bulk treated water rising mains, and eight Command Reservoirs that will supply the whole region;
  - Secondary distribution lines: conveying bulk treated water from Command Reservoirs to existing and new District Reservoirs;
- Bulk raw water conveyance infrastructure (abstraction, pipelines, one raw water pumping station, one reservoir and two booster pumping stations) for irrigated agriculture (raw water supply up to field edge);
- Impact of commercial agriculture in earmarked irrigation areas;
- WWTWs at the Ntabelanga and Lalini Dam sites;
- Accommodation for operational staff at the Ntabelanga and Lalini Dam sites;
- Upgrading and relocation of roads and bridges;
- Generation of hydro power and feeding of this power into the existing grid;
- Pipeline and tunnel/conduit at the proposed Lalini Dam;
- A 13 km power line from the Lalini Dam hydropower plant;
- River intake structures and associated works;
- Ten construction materials quarries and borrow pits;
- Information centres at the two dam sites; and
- Miscellaneous construction camps, lay down areas, and storage sites.

3.1.2 Issues that were not addressed in the EIA

Certain aspects related to the proposed project were identified but not specifically addressed in this EIA. These are listed below (please refer to the Scoping Report for more detail on each of these):

- Climate change projections and risks (no climate change specialist study was undertaken);
- Agriculture and land tenure: The details of how land tenure arrangements will be changed, as well as new commercial farmer establishment and support, are not included in the scope of this EIA;
- Potential for forestry: This is the subject of a separate planning process and not included in the EIA;
- Possible recreational and estate opportunities (not identified at this stage);

- Tertiary distribution lines (responsibility of the various DMs); and
- Activities undertaken as part of DEA's Catchment Rehabilitation and Management Programme (subject to a separate authorisation process).

3.2 PROPOSED APPROACH

The EIA builds on the Scoping Report and focuses on the assessment of key impacts, determining their significance, and recommending appropriate measures to mitigate negative impacts and enhance benefits.

3.3 IMPACT ASSESSMENT METHODOLOGY

The key issues identified during the Scoping Phase informed the terms of reference of the specialist studies. Each issue consists of components that on their own or in combination with each other give rise to potential impacts, either positive or negative, from the project onto the environment or from the environment onto the project. In the EIA the significance of the potential impacts will be considered before and after identified mitigation is implemented, for direct, indirect, and cumulative impacts, in the short and long term.

A description of the nature of the impact, any specific legal requirements and the stage (construction / decommissioning or operation) will be given. Impacts are considered to be the same during construction and decommissioning.

The following criteria will be used to evaluate significance:

- **Nature:** This is an appraisal of the type of effect the activity is likely to have on the affected environment. The description includes what is being affected and how. The nature of the impact will be classified as positive or negative, and direct or indirect.

- **Extent and location:** This indicates the spatial area that may be affected (**Table** 4:).

Table 4: Geographical extent of impact

Rating	Extent	Description
1	Site	Impacted area is only at the site – the actual extent of the activity.
2	Local	Impacted area is limited to the site and its immediate surrounding area
3	Regional	Impacted area extends to the surrounding area, the immediate and the neighbouring properties.
4	Provincial	Impact considered of provincial importance
5	National	Impact considered of national importance – will affect entire country.

- **Duration:** This measures the lifetime of the impact (**Table 5**).

Table 5: Duration of Impact

Rating	Duration	Description
1	Short term	0 – 3 years, or length of construction period
2	Medium term	3 – 10 years
3	Long term	> 10 years, or entire operational life of project.
4	Permanent – mitigated	Mitigation measures of natural process will reduce impact – impact will remain after operational life of project.
5	Permanent – no mitigation	No mitigation measures of natural process will reduce impact after implementation – impact will remain after operational life of project.

- **Intensity / severity:** This is the degree to which the project affects or changes the environment; it includes a measure of the reversibility of impacts (**Table 6**).

Table 6: Intensity of Impact

Rating	Intensity	Description
1	Negligible	Change is slight, often not noticeable, natural functioning of environment not affected.
2	Low	Natural functioning of environment is minimally affected. Natural, cultural and social functions and processes can be reversed to their original state.
3	Medium	Environment remarkably altered, still functions, if in modified way. Negative impacts cannot be fully reversed.
4	High	Cultural and social functions and processes disturbed – potentially ceasing to function temporarily.
5	Very high	Natural, cultural and social functions and processes permanently cease, and valued, important, sensitive or vulnerable systems or communities are substantially affected. Negative impacts cannot be reversed.

- **Potential for irreplaceable loss of resources:** This is the degree to which the project will cause loss of resources that are irreplaceable (**Table 7**).

Table 7: Potential for irreplaceable loss of resources

Rating	Potential for irreplaceable loss of resources	Description
1	Low	No irreplaceable resources will be impacted.
3	Medium	Resources can be replaced, with effort.
5	High	There is no potential for replacing a particular vulnerable resource that will be impacted.

- **Probability:** This is the likelihood or the chances that the impact will occur (**Table 8**).

Table 8: Probability of Impact

Rating	Probability	Description

1	Improbable	Under normal conditions, no impacts expected.
2	Low	The probability of the impact to occur is low due to its design or historic experience.
3	Medium	There is a distinct probability of the impact occurring.
4	High	It is most likely that the impact will occur
5	Definite	The impact will occur regardless of any prevention measures.

- **Confidence:** This is the level of knowledge or information available, the environmental impact practitioner or a specialist had in his/her judgement (**Table 9**).

Table 9: Confidence in level of knowledge or information

Rating	Confidence	Description
1	Low	Judgement based on intuition, not knowledge/ information.
2	Medium	Common sense and general knowledge informs decision.
3	High	Scientific / proven information informs decision.

- **Consequence:** This is calculated as extent + duration + intensity + potential impact on irreplaceable resources.

- **Significance:** The significance will be rated by combining the consequence of the impact and the probability of occurrence (i.e. consequence x probability = significance). The maximum value which can be obtained is 100 significance points (**Table 10**).

Table 10: Significance of issues (based on parameters)

Rating	Significance	Description
1-14	Very low	No action required.
15-29	Low	Impacts are within the acceptable range.
30-44	Medium-low	Impacts are within the acceptable range but should be mitigated to lower significance levels wherever possible.
45-59	Medium-high	Impacts are important and require attention; mitigation is required to reduce the negative impacts to acceptable levels.
60-80	High	Impacts are of great importance, mitigation is crucial.
81-100	Very high	Impacts are unacceptable.

- **Cumulative Impacts:** This refers to the combined, incremental effects of the impact, taking other past, present and future developments in the same area into account. The possible cumulative impacts will also be considered.

  In some instances, especially with regard to ecological impacts, no past, present or probable future uses/projects in the area that will result in cumulative impacts have been identified. In those cases therefore, no assessment of cumulative impacts was provided.

- **Mitigation:** Mitigation for significant issues has been incorporated into the EMPR.

3.4 ENVIRONMENTAL MANAGEMENT PROGRAMME

Based on the findings of the EIR, a practical and feasible EMPR has been compiled. The draft EMPR outlines how negative environmental impacts will be managed and minimized, and how positive impacts will be maximised, during and after construction. The EMPR fulfils the GN 543 requirements and includes mitigation measures required during the planning, construction and operational phases of the project as well as a framework for social and environmental monitoring. Recommendations are given with regard to the responsible parties for the implementation of the EMPR.

3.5 RELOCATION POLICY FRAMEWORK

The Relocation Policy Framework (RPF) is presented as a Chapter in the EMPR. The focus of the RPF is to:

- Confirm that there are no relocation, compensation or livelihood fatal flaws that could impact on the decision on whether the project should go ahead or not;
- Identify any relocation, compensation or livelihood related conditions that should be stipulated in the Environmental Authorisation;
- Estimate the magnitude of the task of implementation of the Relocation Action Plan;
- Agree on the structure of the final Relocation Action Plan (i.e. what will be included); and
- Unblock potential bottle-necks that could delay implementation.

Livelihoods are considered in the RPF and include aspects such as access to community facilities, social opportunities, clinics and schools. In order to achieve this, the Social Impact Assessment (SIA), Heritage and public participation tasks were more extensive than the minimal requirements of an EIA in terms of the EIA Regulations.

It is essential for the RPF to provide an accurate baseline of the existing structures and resources. The Social baseline is therefore more extensive than usually required for an EIA's SIA and includes a database of directly affected parties linked to a locality plan.

3.6 ASSUMPTIONS AND LIMITATIONS

The assumptions applying to this study and any limitations of the EIA are enumerated below:

Assumptions:

- The aim of this EIA is to inform the decision making related to the project and specifically with respect to environmental authorisation and associated conditions. In the Scoping phase the project was defined, project boundaries set, key issues identified and unpacked in order to inform the ToR for the Impact Assessment Phase of the study. The key issues are those that will inform the decision on whether the project should go ahead or not, and if so then on what conditions. It is well known and accepted that construction activities will have some temporary impacts. These can be managed by minimising them and monitoring whether acceptable targets are met, for example for dust, noise and visual impacts. These impacts will not influence whether the project is environmentally authorised or not and are therefore not investigated in detail in specialist studies. They are, however, still addressed in the Environmental Management Programme. The key NEMA principle that directs the focus of this EIA is to determine the Best Practical Environmental Option (BPEO) defined as "the option that provides the most benefit or causes the least damage to the environment as a whole, at a cost acceptable to society, in the long term as well as in the short term", including consideration of the "no project" alternative.
- Financial viability is not a requirement for a project of this nature, as the objective of the project is not to make a profit on the investment. The intention of the project is to be economically viable, in that the direct and indirect socio-economic benefits should exceed the financial cost of the project. This EIA therefore only considers economic viability.
- It was assumed that, with the exception of the access road to the hydropower plant (which will be tarred or concrete), all new roads proposed are gravel.
- If the use of an asphalt plant is required, the necessary applications for environmental authorisation and Atmospheric Emissions Licence will be submitted. No applications for asphalt plants were included as part of this process.

Limitations

- Not all project components were finalised at the time of undertaking fieldwork and compiling this report. The EIA was undertaken based on the project footprint as signed off by DWS on 30 July 2014, any subsequent amendments/refinements have not been considered. The project components not included in this EIA include (*inter alia*):
  - Access roads for the borrow areas and quarries within the Ntabelanga Dam basin;
  - A 13 km power line from Ntabelanga Dam to the Eskom grid;
  - Power lines to supply power during construction at Ntabelanga and Lalini Dam sites and to operate pumping and booster stations along the bulk distribution infrastructure;
  - Road re-alignments at Lalini Dam; and
  - Certain access roads to the hydropower plant at the Lalini Dam tunnel.

Assessment and authorisation of these project components (if required) will be the subject of a separate process.

- All heritage resources have not been identified.
- Dams require Resource Management Plans (RMP) that define how the water resource and its coastal area can be beneficially used. The RMP has not been compiled for the dams that form part of this project. Possible recreational and estate opportunities associated with the proposed dams are therefore not included in the activities for which authorisation is applied.
- The project will require land tenure reform and agricultural support to be a success. Although the impact of the irrigation has been considered in the broad community and social context, no land reform strategies have been discussed as part of this process.
- The potable water supply component of the project includes primary and secondary water supply pipelines and associated water treatment, pumping and storage reservoirs. Tertiary distribution lines (i.e. smaller pipelines supplying settlements along the secondary lines and from District Reservoirs) are not included in the application and are the responsibility of the water service providers (the District Municipalities).
- Activities undertaken as part of DEA's Catchment Rehabilitation and Management Programme are not included in this application.
- It was assumed that construction materials (e.g. sand) would be sourced from the borrow areas in the dam basins. If sand, rock or aggregate is brought in from other sources, the associated traffic impacts should be assessed.
- The objective of this project is socio-economic development of the region. The requirements of the NEMA EIA regulations include that an EIA consider alternative activities that will achieve the same objective. Because the mandate of the DWS is water resources development and management. No non-water related projects / use of the financial resources (R12.5 billion) were assessed in the EIA. The return on investment of any non-water socio-economic developments have not been compared to this project.

Assumptions and limitations relevant to the specialist studies are included in the respective studies (**Appendix C**), and have not been repeated here.

4. DESCRIPTION OF THE PROPOSED PROJECT

The Ntabelanga-Lalini conjunctive scheme consists of water resource infrastructure, treated domestic water supply infrastructure, raw water supply infrastructure, power and affected infrastructure.

4.1 PROJECT LOCATION

The Mzimvubu River Catchment is situated in the Eastern Cape (EC) Province of South Africa.

The project footprint spreads over three DMs namely the Joe Gqabi DM in the north west, the OR Tambo DM in the south west and the Alfred Nzo DM in the east and north east (**Figure 2** and **Table 11**).

The proposed Ntabelanga Dam site is located approximately 25 km east of the town Maclear and north of the R396. The proposed Lalini Dam site is situated approximately 17 km north east of the small town Tsolo.

Table 11 Project Location Information

Province	Eastern Cape					
District Municipality	Joe Gqabi, OR Tambo and Alfred Nzo District Municipalities					
Local Municipality	Mhlontlo, Nyandeni, Umzimvubu and Elundini Local Municipalities					
Ward number(s)*	Umzimvubu LM: Wards 20, 25 and 19 Elundini LM: Wards 1, 5 and 6 Nyandeni LM: Wards 1 and 10 Mhlontlo LM: Wards 1, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24 and 26.					
Nearest town(s)	Tsolo, Lalini, Maclear, Mthatha, Mount Frere					
Farm name(s) and number(s)*	59, 61, 65, 66, Esek 41, Mahlungulu 79, 59, 63, 55, 62, 55, Nxakolo 78, Mbalishweni 54, 54, Mimosa Hoek 42, Tsitsa Drift 41, Matanga's Kraal 40, 69, 54, 66, 38, 89, 68, 58, Xokonxa 4, 81, 62, 55, 37, 379, 71, 69, 404, 63, 64, 425, 64, 65, 61, 60, 59, 118, 406, 408, 392, 390, 119, 391, 76, Nxotwe 58, Lower Culunca 57, 412, 73, Upper Sinxago 410, 76, 74, 72, 50, 51, 87, 84, 86, 75, 409, 397, 419.					
Coordinates of corner points of study area	Latitude (S) (DDMMSS)			Longitude (E) (DDMMSS)		
	30	48	49.025	28	23	18.024
	30	49	19.141	29	21	12.074
	31	27	6.437	29	21	22.086
	31	27	10.739	28	23	8.013

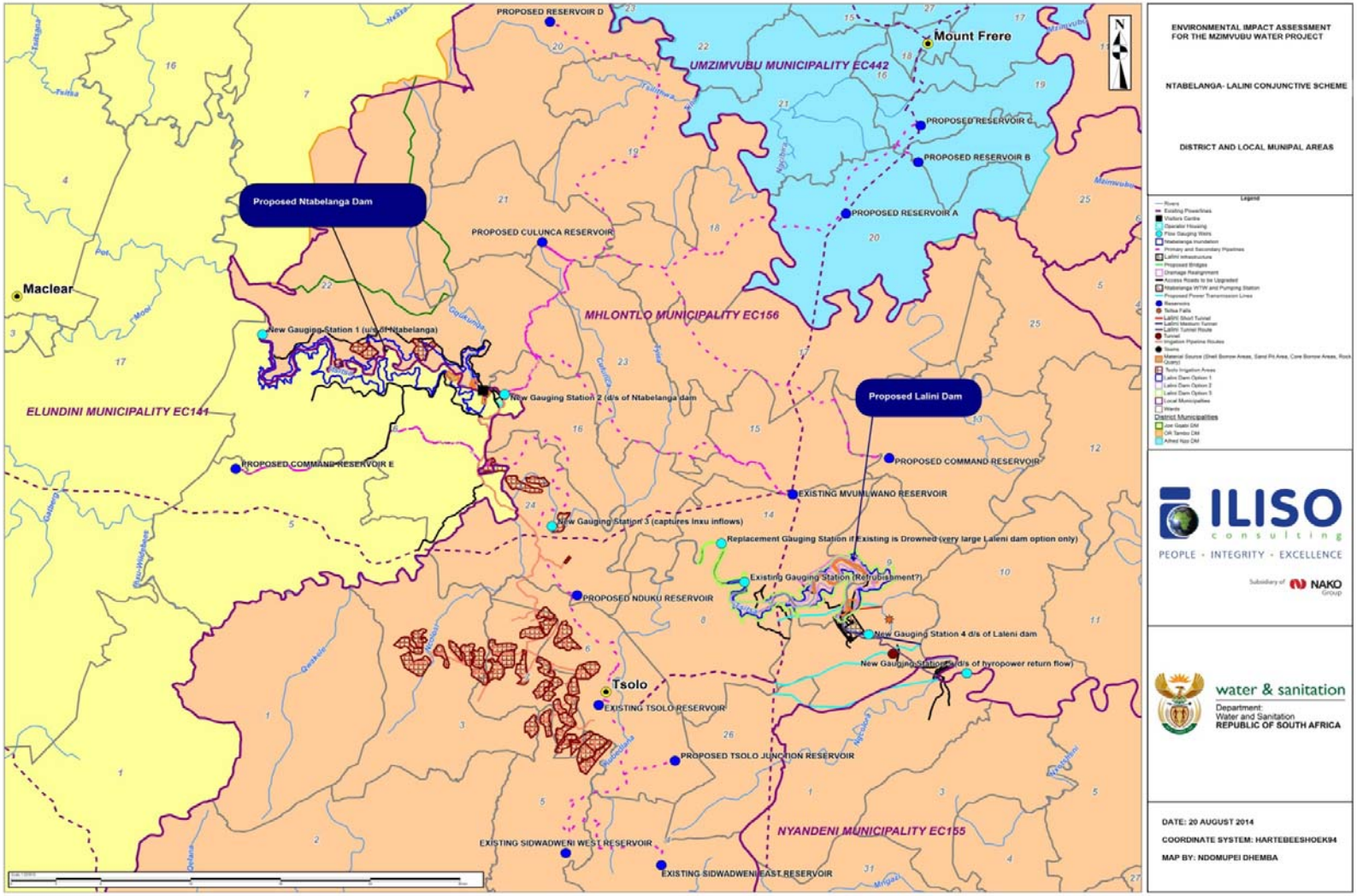

Figure 2: Study area

The Mzimvubu River has four major tributaries, namely the Mzintlava, Kinira, Tina and Tsitsa Rivers. The proposed Ntabelanga and Lalini Dams are situated on the Tsitsa River (**Figures 3** to **7**).

Figure 3: Proposed Ntabelanga Dam upstream basin

Figure 4: Proposed Ntabelanga Dam inundated area above dam

Figure 5: Approximate location of the proposed Ntabelanga Dam

Figure 6: Approximate location of the proposed Lalini Dam

Figure 7: Tsitsa Falls downstream of the proposed Lalini Dam

4.2 WATER RESOURCES INFRASTRUCTURE

Water Resource Infrastructure includes:

- A dam at the Ntabelanga site with a storage capacity of 490 million m^3;
- A dam at the Lalini site with a storage capacity of approximately 150 million m^3;
- A pipeline and tunnel/conduit and a power house at Lalini Dam site for generating hydropower;
- Five new flow gauging stations to measure the flow that is entering and released from the dams. These flow gauging points will be important for monitoring the implementation of the Reserve and for operation of the dams;
- Wastewater treatment works at the dam sites;

- Accommodation for operations staff at the dam sites (**Figure 8**); and
- An information centre at each of the dam sites.

Figure 8: Location of accommodation and waste water treatment works at the Ntabelanga Dam

Two thirds of the water at the Ntabelanga Dam will be utilised for hydro-energy, one sixth for potable water and on sixth for irrigation.

4.2.1 The Ntabelanga Dam

The technical characteristics of the proposed Ntabelanga Dam are summarised below:

- Dam wall crest length: 407 m
- Maximum dam wall height: 67 m
- Mean Annual Runoff of River at Dam: 415 million m^3/a
- Volume impounded by dam: 490 million m^3
- Spillway capacity: 5 530 m^3/sec
- Dam type: Roller Compacted Concrete (RCC) with integral spillway
- Surface area of lake behind dam: 31.5 km^2
- Backwater reach upstream of dam 15.5 km

Water levels at the Ntabelanga Dam will vary considerably as water is released to the Lalini Dam for hydropower generation. **Figure 9** shows anticipated monthly variations of water levels at the dam. The monthly variations will be the same

whether base load or peaking power is generated. The daily variations would however be different depending on the power generation option.

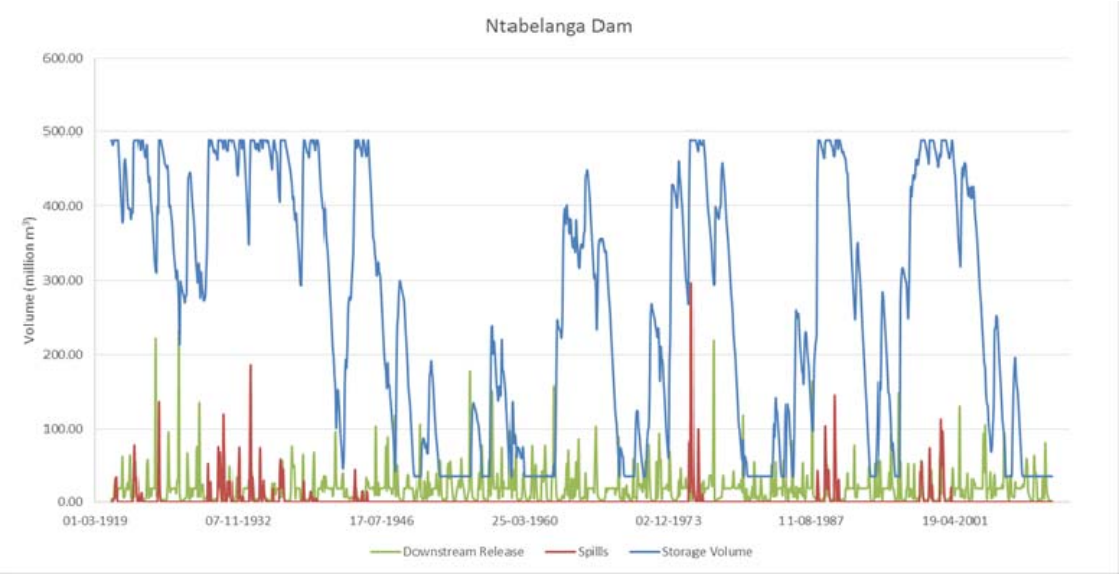

Figure 9: Monthly variation of water levels at Ntabelanga Dam

4.2.2 The Lalini Dam

The Lalini Dam characteristics are summarised below:

- Dam wall crest length: 383 m
- Maximum dam wall height 56.8 m
- Mean Annual Runoff of River at dam: 828 million m^3/a
- Maximum volume impounded by dam: 248 million m^3
- Surface area of lake behind dam: 14.7 km^2
- Backwater reach upstream of dam: 24.5 km^2

Water levels at the Lalini Dam will vary considerably as water is released for hydropower generation. **Figure 10** shows anticipated monthly variations of water levels at the dam. The monthly variations will be the same whether base load or peaking power is generated. The daily variations would however be different depending on the power generation option.

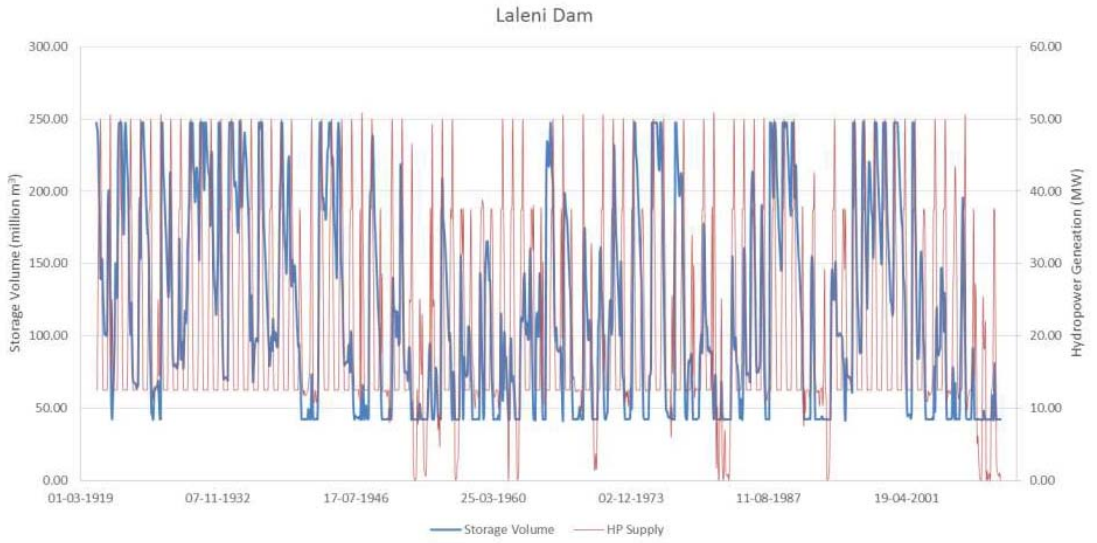

Figure 10: Monthly variation of water levels at Lalini Dam

4.2.3 The Construction of the dams

Construction of each dam will require construction camps, lay down areas, and storage sites: Five (5) areas at about 4 ha each. The site will accommodate the following:

- Concrete Batching Plants, including bulk storage silos for cementitious materials;
- Site Offices and Parking - comprising two office blocks (one to house the personnel of the Resident Engineer, and one to house the Site Agent and his personnel) and 20 covered parking bays per office block, and a taxi rank;
- Materials testing Laboratory;
- Workshops and Stores - approximately five buildings;
- Reinforcing Steel Bending Yard;
- Permanent Housing for married operating personnel;
- Helipad;
- Weather Station;
- Sand and crushed stone Stockpile Areas – less than 450 m x 250 m with access roads (above area of inundation);
- Areas for the handling of hazardous substances;
- An explosives storage magazine;
- Wash bays for construction plant;
- Radio communication infrastructure;
- Facilities for the bulk storage and dispensing of fuel for construction vehicles;
- Power lines;
- A small-scale sewage treatment plant; and
- Resurfacing existing gravel access road.

Construction activities will commence with the stripping of vegetation and topsoil to establish access and construction roads, site offices, dam foundations and crusher

and concrete mixer stations. Topsoil will be stockpiled for reuse during the rehabilitation stage, whilst cleared woody vegetation suitable for firewood will be stockpiled for collection by the local population for a period of time, after which it will be burnt.

Soon after commencement the river will be diverted to expose the rock foundations for the concrete spillway section / outlet works. During this period, coffer dams will be constructed to protect all foundation activities in the riverbed against flood damage (**Figure 11**). Excavators, bulldozers and trucks will be engaged to remove all loose material on the foundation of the dam until sound founding material is exposed. Limited controlled blasting will be necessary.

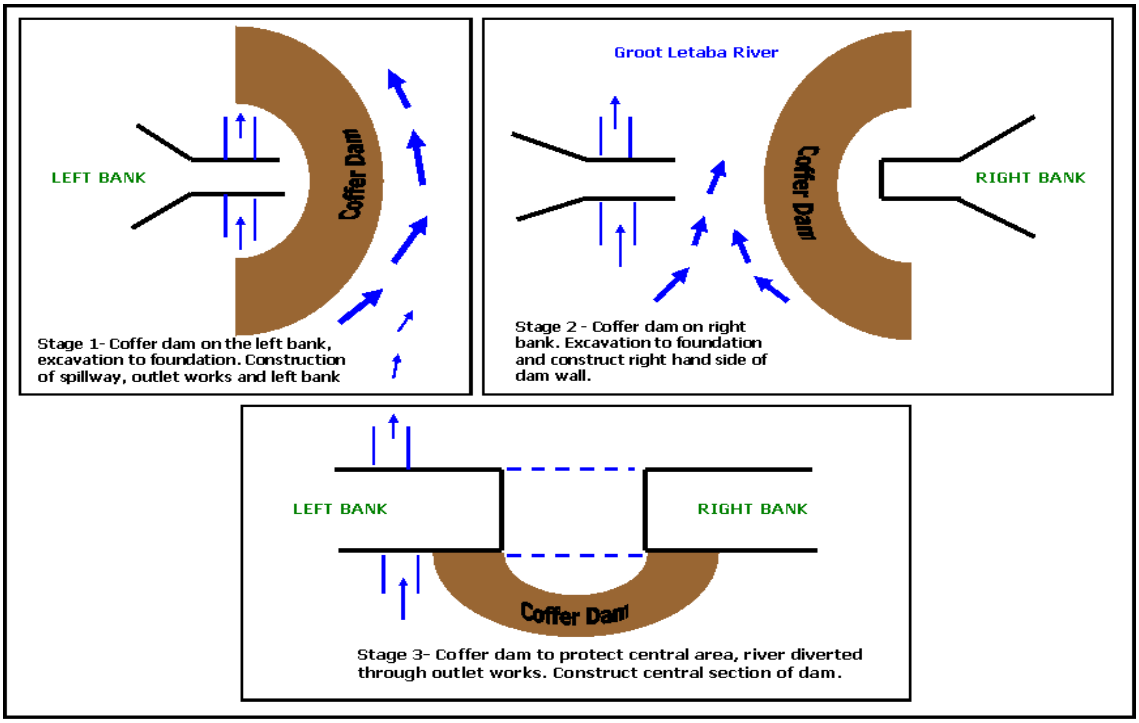

Figure 11: Typical Stages of River Diversion

Sand required for the production of concrete will be obtained from borrows areas in the dam basins and blended with sand from commercial sources to achieve the required grading. Stone for concrete production will be obtained from rock quarried in the dam basin and crushed to the required size in a crushing plant.

Concrete production at the batching plant will then commence and placement in the central spillway section, outlet works, non-overspill flanks and apron areas of the dam wall, probably by roller compaction techniques and the use of high tower and mobile cranes, will occur 24 hours a day, seven days a week, for a period of time.

The temporary site administrative buildings will be erected complete with security fencing, a water supply, sewage purification plant and an overhead power supply line.

After construction activities have been completed all the crushers, mixers and site offices, etc. will be removed and the construction site rehabilitated. All temporary access roads not in the dam basin will be ripped and covered with topsoil and planted with suitable grass and tree cover. The aim is to return the whole construction site as close as possible to its undeveloped appearance. Areas that are inundated by water in the dam basin will be shaped to avoid unintended ponding and no grass will be planted.

Permanent houses will be erected within the project area to accommodate operation and maintenance staff.

4.2.4 Flow Gauging weirs

Five new flow measuring weirs will be required in order to measure the flow that is entering and released from the dams (an example of a flow gauging weir is shown in **Figure 12**). These flow gauging points will be important for monitoring the implementation of the Reserve and for operation of the dams.

Positions of the weirs are indicated on **Figure 1**.

Each weir will take about six months to construct and will be a low concrete structure with erosion control measures on both banks to prevent out-flanking. It is envisaged that construction of the weirs will form part of the dam construction contract.

Figure 12: Flow Gauging weir in the Crocodile River at Nooitgedacht

4.3 DOMESTIC WATER SUPPLY INFRASTRUCTURE

The Ntabelanga Dam will supply potable water to 539 000 people, with provision to supply an estimated 730 000 people by year 2050. The domestic water supply infrastructure will include:

- An intake structure and associated works at Ntabelanga Dam;
- Regional water treatment works at Ntabelanga Dam;
- Potable bulk water distribution infrastructure for domestic and industrial water requirements (primary and secondary distribution lines);
- Nine (9) bulk treated water storage reservoirs strategically located; and
- Pumping stations.

The stand-alone water storage, treatment works and pumping station compounds will be up to 3 ha each.

The scheme will have a single WTW located at the Ntabelanga Dam site, that will treat raw water for domestic and industrial use. These works will be supplied with raw water from the dam outlet works to the WTW inlet works by gravity under all operating conditions.

Sludge produced from the settlement and filtration processes will be stored in sludge settlement tanks and drying beds which will periodically need to be dewatered and

de-sludged, in an environmentally acceptable manner. It is proposed that all the residuals produced by the works be dried and disposed of off-site.

A significant portion of the domestic water supply schemes in this area will fall under the OR Tambo and Joe Gqabi DMs (**Figure 13**). Some communities are served by existing schemes (**Figure 14**), which have been taken into account in the development of the proposed infrastructure.

The total pipeline servitudes amount to a length of approximately 375 km.

Construction of the pipelines will commence with pipes being strung out along the pipeline routes and trenches, up to 3.5 m deep and 2.5 m wide for the largest of the pipes, being excavated (**Figure 15**). Under normal circumstances a maximum of 5 km of open trench is permitted, whilst the pipes will be strung out as they arrive from the manufacturer. Excess spoil material from the trenches will be transported to a suitable disposal site and sandy material will be brought in as bedding and selected backfill for pipe protection. Once the pipes have been laid and tested, the trench will be backfilled, compacted and shaped to the natural ground profile. Topsoil will be replaced to re-establish vegetation.

A ten to thirty metre wide strip would be impacted during constructing **(Figure 16).**

Figure 13: Ntabelanga Dam potable water supply areas

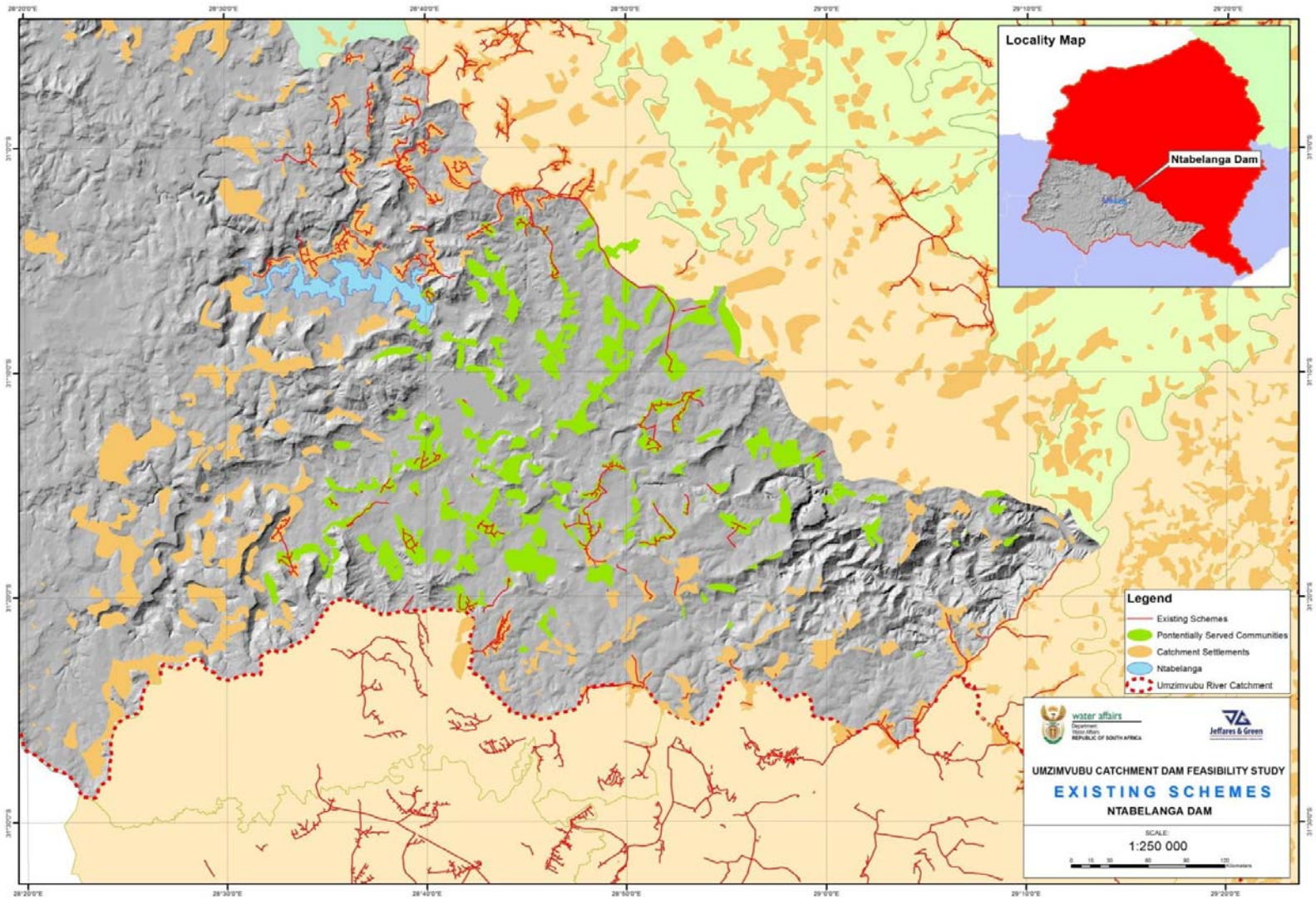

Figure 14: Existing water supply schemes

Figure 15: Pipe laying

Figure 16: Trench and working area for pipe lying

Although the reservoirs associated with the pipelines may differ according to their individual capacity and local topography, the technical details are similar for each and are presented below.

Construction Material -	Concrete or steel
Shape and Height-	Shape and height will be determined during the detail design stage but usually circular up to 8 m high (**Figure 17**). Steel reservoirs are rectangular.
Area Required -	Approximately 2 ha
Storage Capacity-	Approximately 1 Mℓ to 30 Mℓ providing between 4 and 24 hours storage per site, but subject to finalisation.

Fencing and Security- Each reservoir will be fenced. No permanent security staff will be present on site.

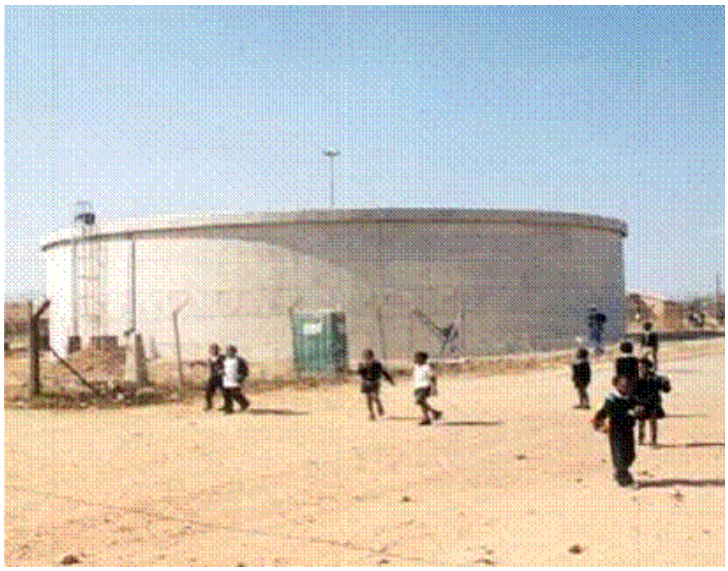

Figure 17: View of a typical large concrete reservoir

4.4 IRRIGATION

The Ntabelanga Dam will also provide water to irrigate approximately 2 900 ha. This project includes bulk water conveyance infrastructure for raw water supply to edge of field.

The entire Mzimvubu catchment was considered in the identification of high potential land for irrigated agriculture. During Phase 1 of the feasibility study, a desktop GIS exercise was carried out to identify high potential irrigable soils according to certain criteria, for purposes of ranking the dam sites identified. The criteria were:

- High potential soils according to soil form, depth, texture;
- Slope less than 12%;
- Elevation less than 60 m above the river at the dam site, or in the river below the dam site;
- Distance less than 5 km from the dam wall or either side of the river below the dam site; and
- Water deficit – medium to high water stress (shortage of natural rainfall).

When combined with other non-agricultural criteria in a ranking matrix, Ntabelanga Dam site emerged as the top ranked dam. The land identified around Ntabelanga Dam now met the following criteria:

- High potential soils;
- Slope less than 12; and
- Water deficit – medium to high water stress (shortage of natural rainfall).

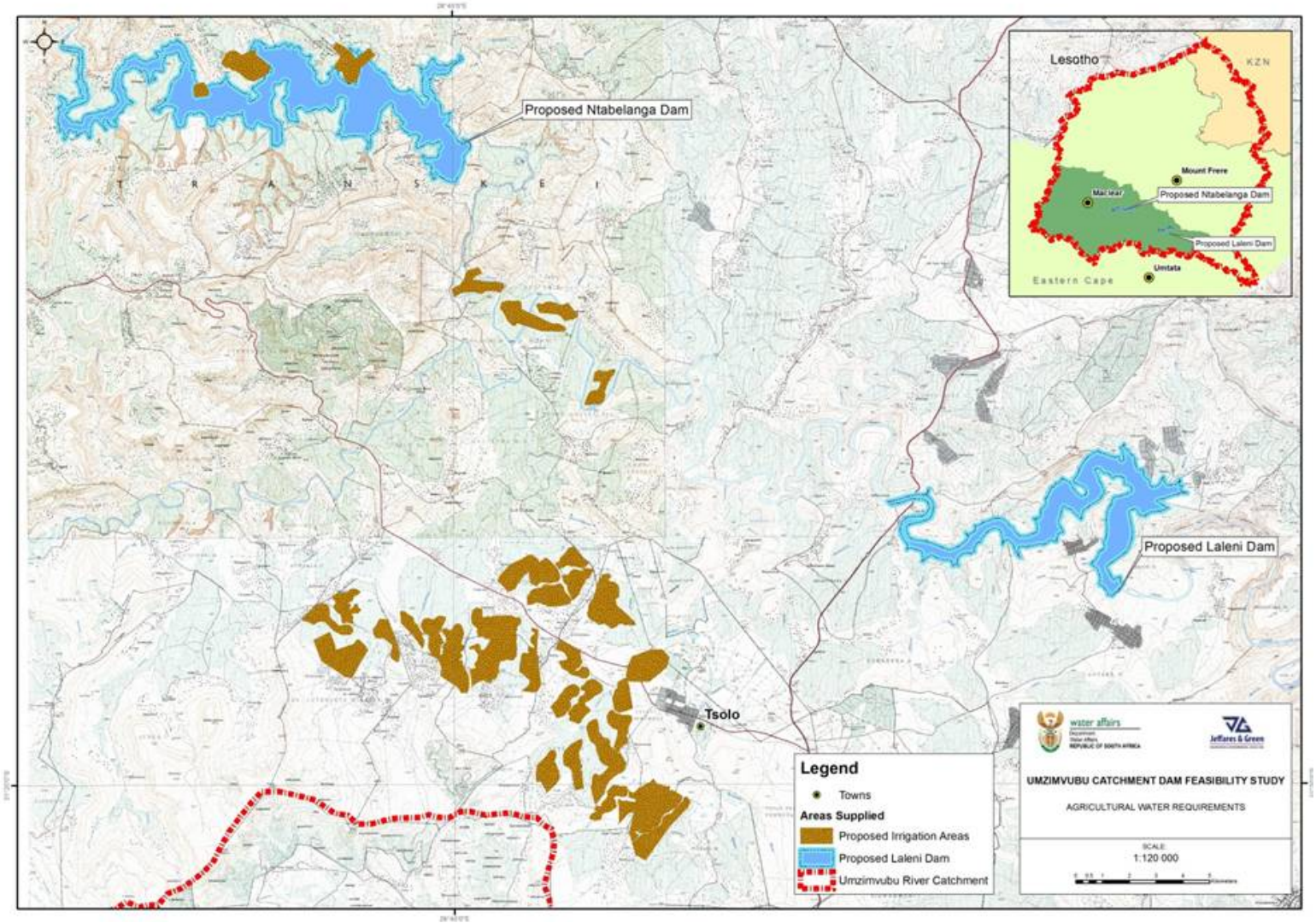

Figure 18: Proposed irrigation areas

The Irrigation Development study (DWA, 2013a) identified about 2 450 ha of the high potential land suitable for irrigated agriculture associated with the Ntabelanga Dam site. This land is located in the Tsolo area and the rest near the proposed Ntabelanga Dam and along the river, close to the villages of Machibini, Nxotwe, Culunca, Ntshongweni, Caba, Kwatsha and Luxeni (**Figure 18**).

Agricultural land near the river will be supplied with raw water pumped by pipeline from the nearest river abstraction point on the Tsitsa River, downstream of the Ntabelanga Dam.

For the Tsolo area schemes, raw water would be pumped from the dam to a storage reservoir and delivered to the edge of these fields through a bulk water distribution system. These lands are located near to the following settlements/wards: Godini, Qhotira, KuGubengxa, St Cuthberts, Jwabuleni, Mazizini, KwaNomadolo and Gumbini. For the other areas, raw water would be abstracted directly from the adjacent dam or river using mobile pumping systems.

The proposed farming model is commercial irrigation farming. Forty five (45) rationalised farming units of between 40 ha and 90 ha each (average of 60 ha) are envisaged. This will require acceptance of a change of land use and mind set from the current subsistence farming approach.

Distribution of water to the farming units will be mostly gravity based, with booster pumping stations for higher lying areas.

4.5 POWER

The feasibility study findings indicate that the viability of the proposed Ntabelanga Dam is dependent on its development as a strategic part of a conjunctive hydropower scheme. A dam at Lalini site, also on the Tsitsa River upstream of the Tsitsa Falls, is considered to be a viable hydropower generation scheme (**Figure 19**).

There will be a small hydropower plant at Ntabelanga Dam to generate between 0.75 MW and 5 MW (average 2.1 MW). This will comprise a raw water pipeline from the dam to a building containing the hydropower turbines and associated equipment, and a discharge pipeline back to the river just below the dam wall. The impact is expected to be similar to that of a pumping station.

Another small hydropower plant will be constructed at the proposed Lalini Dam.

The larger hydropower plant at the Lalini Dam and tunnel (used conjunctively with the Ntabelanga Dam) will generate an average output of 30 MW if operated as a base load power station and up to 150 MW if operated as a peaking power station. The power plant will require a pipeline (approximately 4.6 km) and tunnel (approximately

3.2 km) linking the dam to the power plant downstream of the dam and below the gorge. Neither the Lalini Dam nor the hydropower plant will be visible from the Tsitsa Falls.

The power line to link the Lalini power station to the existing Eskom grid will be approximately 13 km. It is expected that monopole structures will be used, which after planting, will protrude between 19.2 m and 21 m.

The Energy Trader Model, as currently used by Amatola Green Power, allows non-Eskom generators to supply electricity, as a supplement to the electricity conventionally supplied by both Eskom and municipalities, to consumers of power. The model envisages that a trader would be allowed to make use of the distribution networks of Eskom and municipalities to buy “Green Power” from non-Eskom generators for onward sale to consumers.

Amatola Green Power (AGP) pays generators in cash for the energy that they supply into the Eskom Grid, while the generators pay Eskom only for the grid access usage charges.

For each 1,000 kWh (1 MWh) purchased by AGP, a number is generated as a credit with Eskom. Tradable Renewable Energy Certificates (TRECS) are sold by AGP to energy consumers to allow them to obtain their energy requirements from their local grid (Eskom or Municipality), which energy is duly certified to have been generated from renewable sources.

It is envisaged that a similar model could be used for energy produced at the Lalini hydropower plant.

4.6 GEOGRAPHIC COORDINATES OF INFRASTRUCTURE COMPONENTS

The coordinates for all infrastructure components are indicated in **Table 12**.

Table 12: Geographic coordinates of infrastructure components

Infrastructure	Description	Start (Northern Most Point)		End Southern Most Point)		Western Most Point		Eastern Most Point		Length (m)	Area (ha)
		Latitude (S)	Longitude (E)	Latitude (S)	Longitude (E	Latitude (S)	Longitude (E	Latitude (S)	Longitude (E		
Reservoirs	Proposed Reservoir D	30.8832682	28.7162845								
	Proposed Reservoir C	30.9489748	28.9759191								
	Proposed Reservoir A	31.0046864	28.9236313								
	Proposed Culunca Reservoir	31.0226588	28.711001								
	Proposed Command Reservoir E	31.1661294	28.4963409								
	Proposed Command Reservoir	31.1593965	28.9538811								
	Proposed Nduku Reservoir	31.2459316	28.7353458								
	Proposed Tsolo Junction Reservoir	31.3507211	28.8039673								
	Proposed Reservoir B	30.9721418	28.9741931								
	Existing Mvumlwano Reservoir	31.1822777	28.8863359								
	Existing Tsolo Reservoir	31.3154003	28.7504963								
	Existing Sidwadweni West Reservoir	31.4090711	28.7273812								
	Existing Sidwadweni East Reservoir	31.4168338	28.7943707								
Gauging Stations	New Gauging Station 1 (u/s of Ntabelanga)	31.0810951	28.5149849								
	New Gauging Station 2 (d/s of Ntabelanga dam)	31.1189893	28.6846354								
	New Gauging Station 3 (captures Inxu inflows)	31.2024161	28.7177334								
	Existing Gauging Station (Refrubishment?)	31.2376586	28.852515								
	New Gauging Station 4 d/s of Lalini dam	31.2708878	28.9395301								
	New Gauging Station 5 (d/s of hyropower return flow)	31.2953937	29.0081783								
	Replacement Gauging Station if Existing is Drowned (very large Lalini dam option only)	31.2132512	28.8364011								
Operator Housing	Operator Housing	31.1206	28.6817	31.1263	28.68099	31.1222	28.6781	31.1251	28.6841		19.3321
Visitors Centre	Visitors Centre	31.1166	28.6695								
Ntabelanga WTW and Pumping Station	Ntabelanga WTW and Pumping Station	31.1201	28.6854	31.1216	28.6853	31.1207	28.6845	31.1211	28.6862		1.45167
Lalini Infrastructure	Lalini Infrastructure	31.25598	28.9264	31.2758	28.9264	31.26	28.9146	31.2688	28.93598		245.8226
Tunnel Options	Lalini Short Tunnel	31.2557	28.9262	31.2532	28.9484					2136.57	
	Lalini Medium Tunnel	31.269	28.9242	31.2769	28.9756					4973.75	
	Lalini Pipeline/Tunnel	31.2624	28.9207	31.2973	28.9874					8146.78	
Power Transmission Options	Powerline Alt 1	31.2532	28.9484	31.2621	28.8761					7189.01	
	Powerline Alt 2	31.2766	28.9755	31.30178	28.8733					10659.17	
	Powerline Alt 3	31.3085	28.8729	31.2994	28.9878					11568.43	
Irrigation Lines	Irrigation Lines	31.1208	28.686	31.356	28.7389	31.2834	28.6798	31.292	28.7481	94807.88	
Lalini Material Sources	Sand Pit Area	31.2217	28.9191	31.2443	28.9022	31.2374	28.995	31.2368	28.9387		130.16
	Shell Borrow Area	31.2491	28.9229	31.2589	28.9208	31.258	28.9193	31.256	28.9255		37.12
	Rock Quarry	31.2372	28.9451	31.2382	28.9421	31.2372	28.9416	31.2382	28.9457		4.14
	Core Borrow Area	31.2489	28.9253	31.2563	28.9271	31.2513	28.9255	31.2493	28.9328		37.92
Ntabelanga Material Sources	Rock Agrregate	31.1174	28.6733	31.1201	28.6733	31.1199	28.6723	31.1177	28.6745		3.42
	Sand Pit Area	31.1054	28.6495	31.1131	28.652	31.1058	28.6486	31.1063	28.6548		11.21
	Shell/General Fill 1	31.1044	28.6447	31.1104	28.6477	31.1071	28.6433	31.1067	28.6522		31.42
	Shell/General Fill 2	31.1092	28.6646	31.1131	28.6638	31.1115	28.6615	31.112	28.6659		12.13
	Core Borrow Area 1	31.1114	28.6608	31.116	28.6644	31.1136	28.6603	31.1154	28.6646		9.58
	Core Borrow Area 2	31.1199	28.6694	31.125	28.6713	31.1246	28.6686	31.1215	28.6715		11.02
Ntabelanga Dam	Ntabelanga Dam	31.0829	28.5892	31.1305	28.667	31.1095	28.51196	31.1178	28.6737		2333.4452
Lalini Dam Options	Lalini Dam Option 1	31.2182	28.9298	31.2628	28.9193	31.2384	28.8405	31.236	28.9555		1534.4723
	Lalini Dam Option 2	31.2216	28.919	31.26295	28.9196	31.246	28.8421	31.2346	28.9477		961.9287
	Lalini Dam Option 3	31.2258	28.8199	31.26356	28.9193	31.2351	28.9605	31.2122	28.332		2126.5298
Access Roads	Ntabelanga Access Roads	31.0765	28.5981	31.2176	28.664	31.0936	28.5228	31.1188	28.6854	75803.9	
	Lalini Access Roads	31.2382	28.8924	31.3247	28.9815	31.2591	28.8591	31.2887	28.9984	39826.8	
Primary and Secondary Pipelines	Primary and Secondary Pipelines	30.8832	28.6125	31.4167	28.7945	31.1661	28.4963	30.949	28.9759	228104	
Drainage Realignment	Drainage Realignment	31.2205	28.9192	31.2397	28.8945	31.237	28.8903	31.2239	28.9341		139.7919

4.7 AFFECTED INFRASTRUCTURE

The area to be inundated by the dams will submerge some roads as well as other infrastructure such as power lines.

4.7.1 Roads

Approximately 80 km of local roads will be re-aligned in the Ntabelanga Dam area (indicated in magenta in **Figure 20**). Additional local roads will also be upgraded to support social and economic development in the area (indicated in red in **Figure 20**). The road design will be very similar to the existing roads and will be constructed using similar materials.

All road designs will be submitted to the relevant road authorities to obtain their approval before construction commences.

The major items of work to be carried out are the following:

- Clearing of the road footprint;
- Construction of the roads with gravel surfacing;
- The gravel for the pavement layers and fill will be obtained from DMR approved borrow pits and/or cuttings along the road;
- All stormwater drainage will be accommodated using either pipe or portal culverts; and
- The existing roads will be utilised whilst the new realigned sections are constructed; in order to avoid the need for temporary detours during construction.

Materials required for the construction of the roads will be sourced as far as possible from borrow areas with existing permits or from commercial sources. Any new sources required will be subject to separate approval processes.

4.7.2 Power lines

Power line realignments will be required due to dam inundation levels for both the Ntabelanga and Lalini Dams. Consultation with Eskom is on-going to determine how affected areas will be re-connected. This will be finalised at detailed design stage when formal applications are submitted to Eskom for new power supplies.

Figures 21 and **22** indicate how the existing power line network will be affected by the inundation at the Ntabelanga and Lalini Dams respectively.

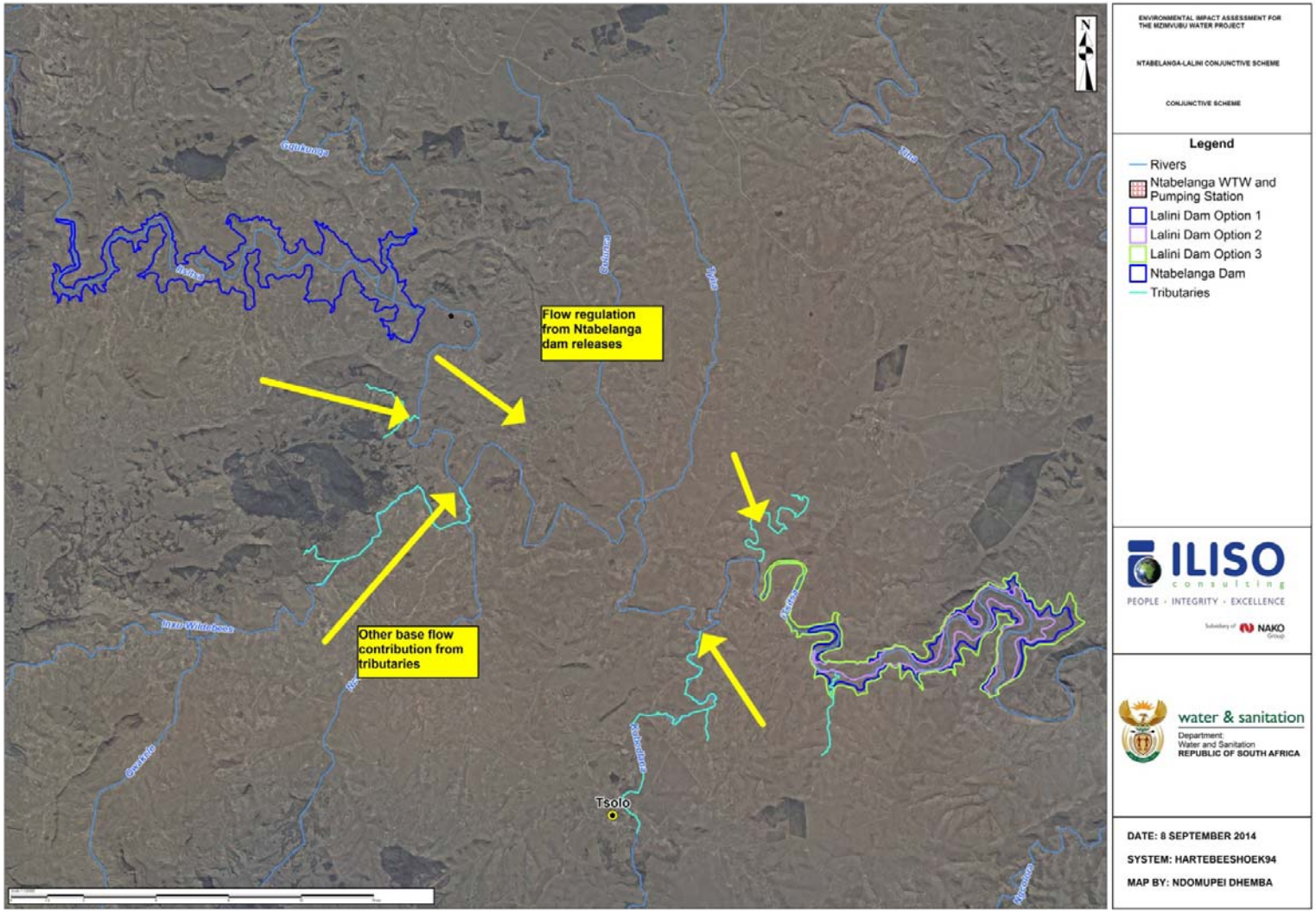

Figure 19: Proposed Ntabelanga-Lalini Conjunctive Scheme

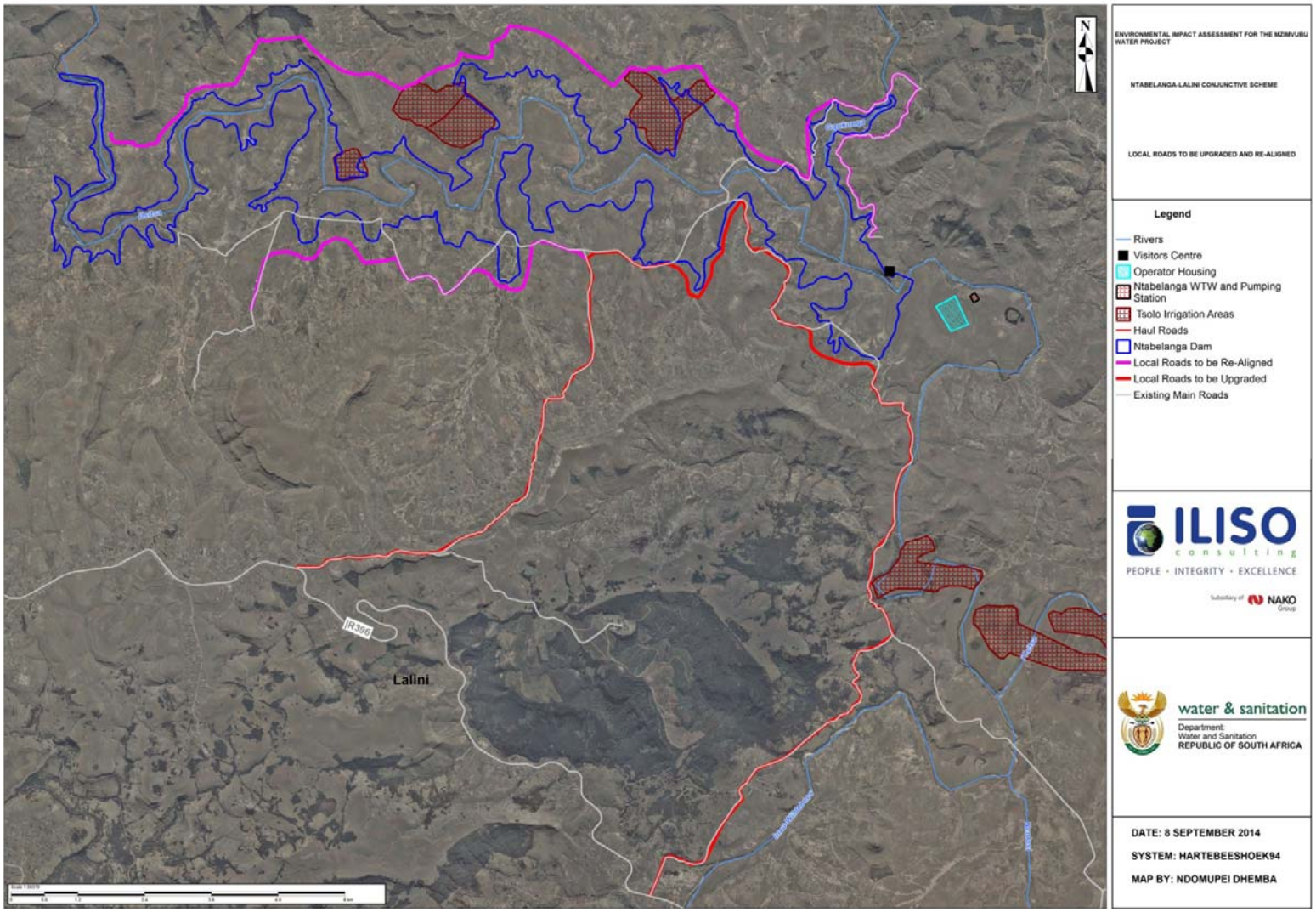

Figure 20: Re-alignment of inundated roads and upgrading of access roads in the vicinity of the Ntabelanga Dam site

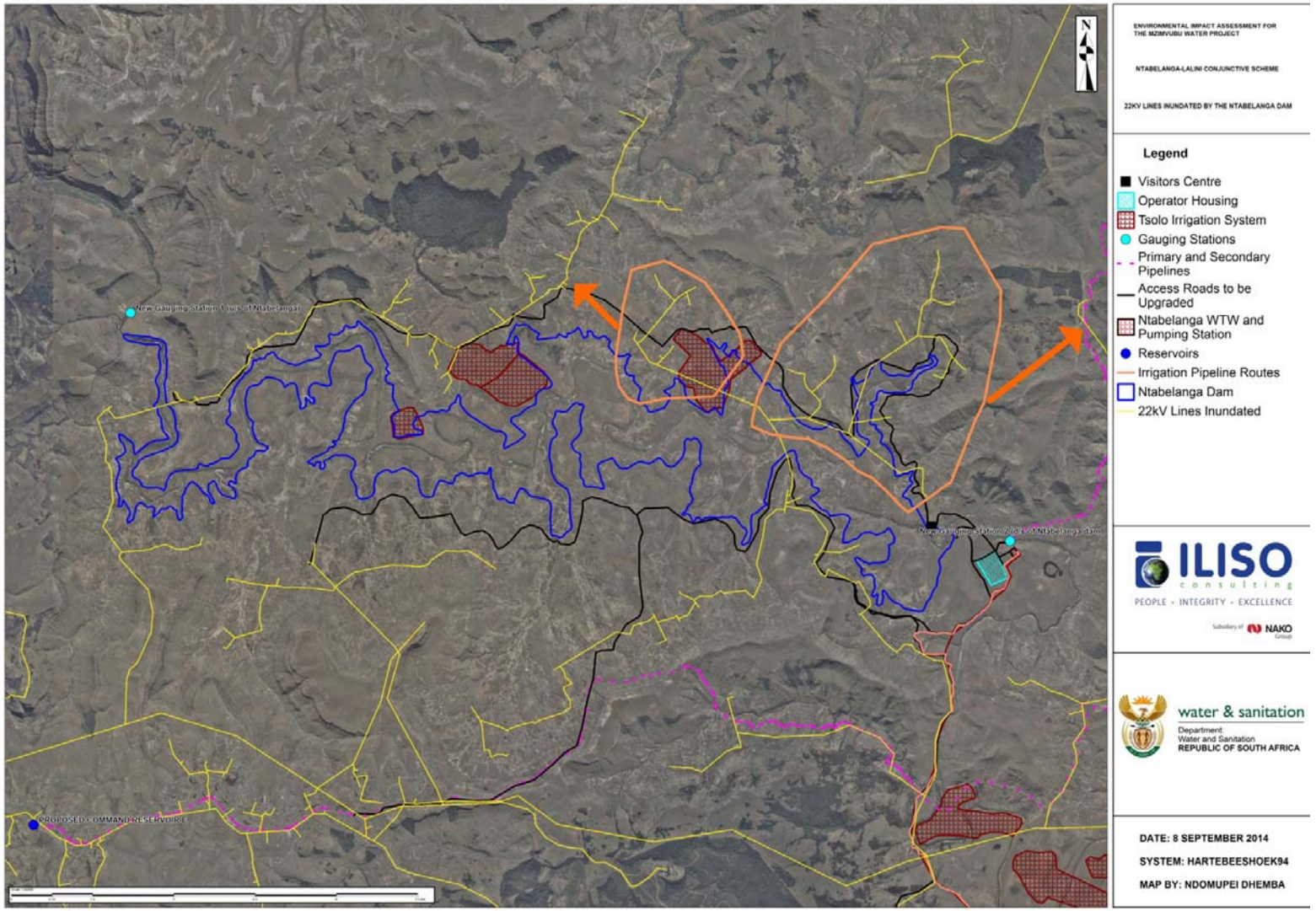

Figure 21: Affected power lines at Ntabelanga Dam

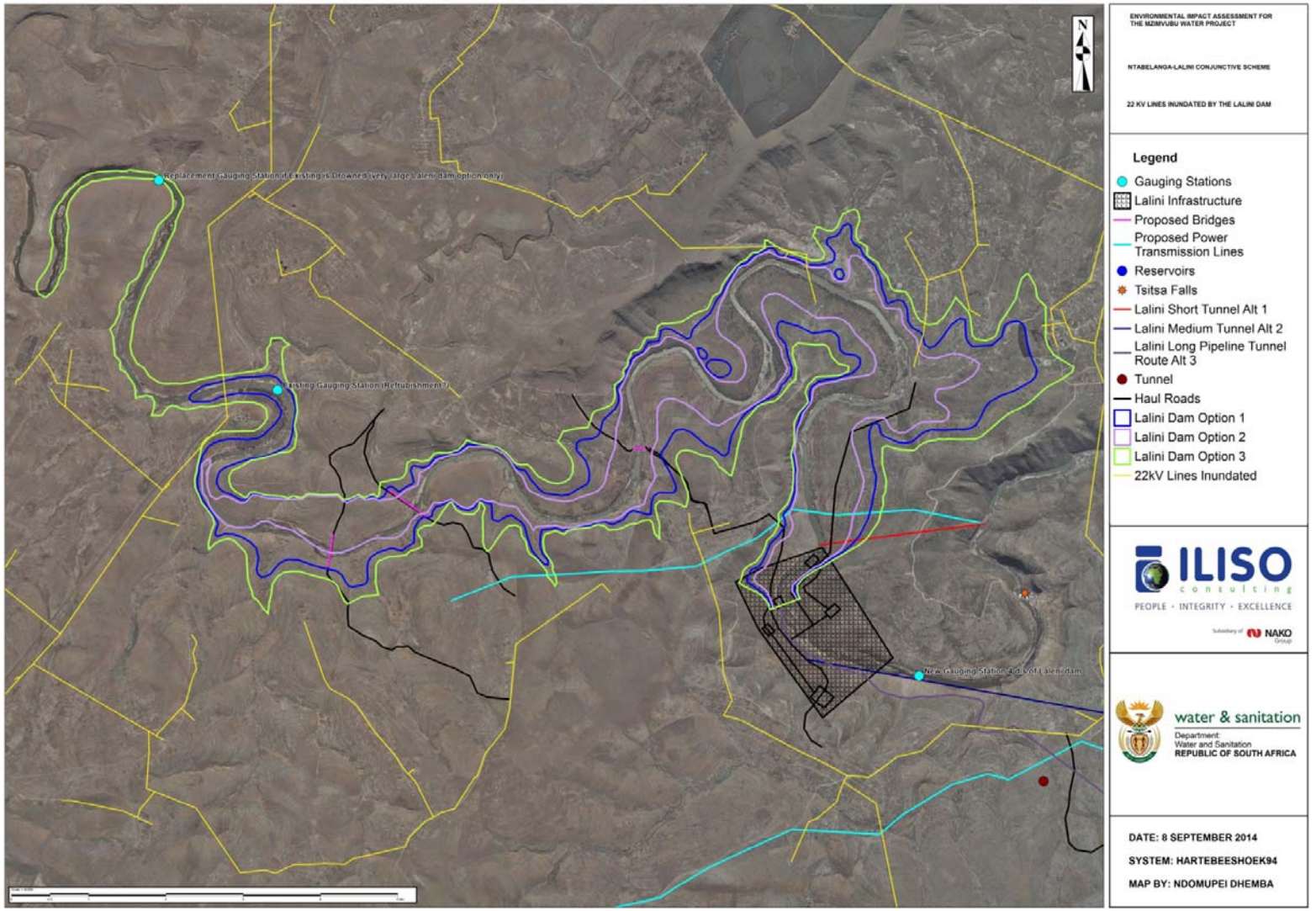

Figure 22: Affected power lines at Lalini Dam

4.8 SERVICES REQUIRED

During construction the Contractors will provide the following services:

- Water, initially via tankers until a treatment plant is installed;
- Sewage, by portable toilets and a treatment plant;
- Refuse removal, to a suitable landfill site; and
- Electricity, by generators until the power line from Eskom is completed.

The municipalities therefore will not provide any services, except to receive the waste at a landfill site (no up-front agreements needed). Eskom will provide power, but the application will only be made during implementation.

During operation, water supply, sewage treatment and power supply will be in place on site and operated as part of the scheme (i.e. not by the municipalities). There may be an agreement with the municipality/ies for refuse removal or the operator may transport refuse to a registered landfill site.

4.9 EXPENDITURE, INCOME AND EMPLOYMENT

Expenditure, income and employment anticipated by the project is summarised in **Table 13**.

Table 13: Projected Expenditure, Income and Employment

Anticipated CAPEX value of the project on completion	R12.45 billion
Expected annual income to be generated by or as a result of the project	R 5.9 billion during construction R 1.6 billion during operation
New skilled employment opportunities created in the construction phase of the project	And estimated 3 880 jobs
New skilled employment opportunities created in the development phase of the project	Up to 2 620 jobs
New un-skilled employment opportunities created in the construction phase of the project	Up to 2 930 jobs
New un-skilled employment opportunities created in the development phase of the project	Up to 2 300 jobs
Expected value of the employment opportunities during the development and construction phase	R 376 million/year during construction R 268 million/year during operation
Percentage of this value that will accrue to previously disadvantaged individuals	At least 30% during construction
Expected current value of the employment opportunities during the first 10 years	R 3.33 billion

5. ALTERNATIVES

One of the objectives of the EIA is to avoid and minimise negative impacts wherever possible. The primary tool for avoiding impacts is to consider alternatives. An alternative is a possible course of action, in place of another, that would generally meet the same purpose and need defined by the development proposal, but which would avoid or minimize negative impacts or enhance project benefits.

Alternatives must be practical, feasible, relevant, reasonable and viable. They can be in terms of:

- Activity (project) alternatives (e.g. incineration rather than landfill);
- Location;
- Scheduling (Timing);
- Technology (Process);
- Design;
- Different use of land;
- Demand;
- Inputs; or
- Routing.

It is also a requirement of the Regulations that the "No-go"/"Do nothing" option be comparatively assessed.

Previous investigations done in the feasibility phase of the project assessed alternative dam sites for the project. These assessments have been reviewed and are considered adequate for the EIA requirements. Further studies on alternative dam sites have therefore not been undertaken in the impact assessment phase of this study. Project level alternatives that have been considered are discussed in section 5.2.

5.1 ALTERNATIVES CONSIDERED DURING THE SCOPING PHASE

The following alternatives were considered during the scoping phase, but not carried forward to the impact assessment phase, for various reasons summarised below.

5.1.1 A different activity that achieves the same objective as the project

An activity alternative would be to consider different uses for the same financial investment that could provide potable and irrigation water to the supply area, improve the quality of life and generate an equivalent number of jobs and income to the area.

As the applicant for this project is the Department of Water and Sanitation who has a mandate to develop water resources infrastructure and not to implement development projects of a different nature, it is not feasible to investigate such alternatives.