4. 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 EIA 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 4.2.

4.1 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.

4.1.1 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.

However, within the mandate of DWS, the following alternatives have been proposed:

a) Construct smaller dams

Several smaller dams could be constructed. In parallel, improvements in water infiltration by improving vegetation cover in the catchment to provide more volume and quality with improved winter flows, could be implemented to render the extraction from those small dams more sustainable. Improvement of infiltration would also mitigate against big floods that are prevalent in the area.

The technical feasibility study has looked into options of building smaller dams vis-a-vis the project objectives of supplying as many households as possible within economic reach of the dams, maximising the development of irrigated agriculture, developing hydropower for local consumption on the scheme as well as excess energy for revenue generation to improve the economics of the scheme, employment creation and above all socio-economic development of the area. The study found that the potential sedimentation into the newly created reservoirs worked against smaller dams, as they could easily be silted up, thereby shortening the useful life of the project and decreasing its financial viability.

Catchment rehabilitation and management is being implemented as part of the broader development in the catchment, and also in direct support to the project. The rehabilitation of the catchment would need to be implemented, be effective and be sustainable before smaller dams could be economically constructed as an alternative to a large dam. This implies that the implementation of the proposed project to provide socio-economic upliftment of the area would need to be postponed for 10 to 15 years.

b) Develop groundwater resources

Improving water infiltration will improve underground water reserves and could allow for the development of boreholes in villages to provide higher quality water.

This alternative was considered but does not fully address the objectives of the project, notably in terms of socio-economic development of the area.

According to the 2009 DWAF Water Resource Study in Support of the ASGISA EC Mzimvubu Development Project. Volume 3 – Groundwater Assessment and the literature review done in the Feasibility Study for the Mzimvubu Water Project: Water Resources (DWA, 2013a), there is a low to moderate supply potential distributed across the Mzimvubu Catchment that could possibly meet the individual demands of selected towns or irrigation schemes. However, this type of supply scheme would involve multiple abstraction sites spread across vast geographical areas. In consultation with the stakeholders during the project steering committee meetings, the water services authorities in the area stipulated that they would prefer one single surface water source rather than multiple groundwater sources.

The development and operation of village boreholes is the mandate of district municipalities and not DWS, although the Department can provide support where possible. The district municipalities will still likely continue to develop groundwater to supply those communities that cannot be economically reached by the project and other developments in the area. A major disadvantage of isolated boreholes scattered throughout a wide area, as experienced by district municipalities, are the huge operational and maintenance challenges.

c) Provision of water by rain-fed tanks

Rain water harvesting does not fully address the objectives of the project, notably in terms of socio-economic development of the area. A rain water harvesting programme can however be implemented to complement the Mzimvubu Water Project.

4.1.2 Dam site alternatives

Location alternatives would be building the dam/s at a different site. As dam site alternatives have already been investigated, and as the site selection process included environmental and social criteria, only the preferred dam sites (i.e. Ntabelanga and Lalini) have been investigated in the EIA.

4.1.3 Alternative dam types

The feasibility study considered various dam types and the selected optimum dam type for both the Ntabelanga and Lalini Dams is a mass gravity Roller Compacted Concrete (RCC) dam, with integrated outlet works and spillway. A typical cross-section of the dam wall is shown on **Figure 25**.

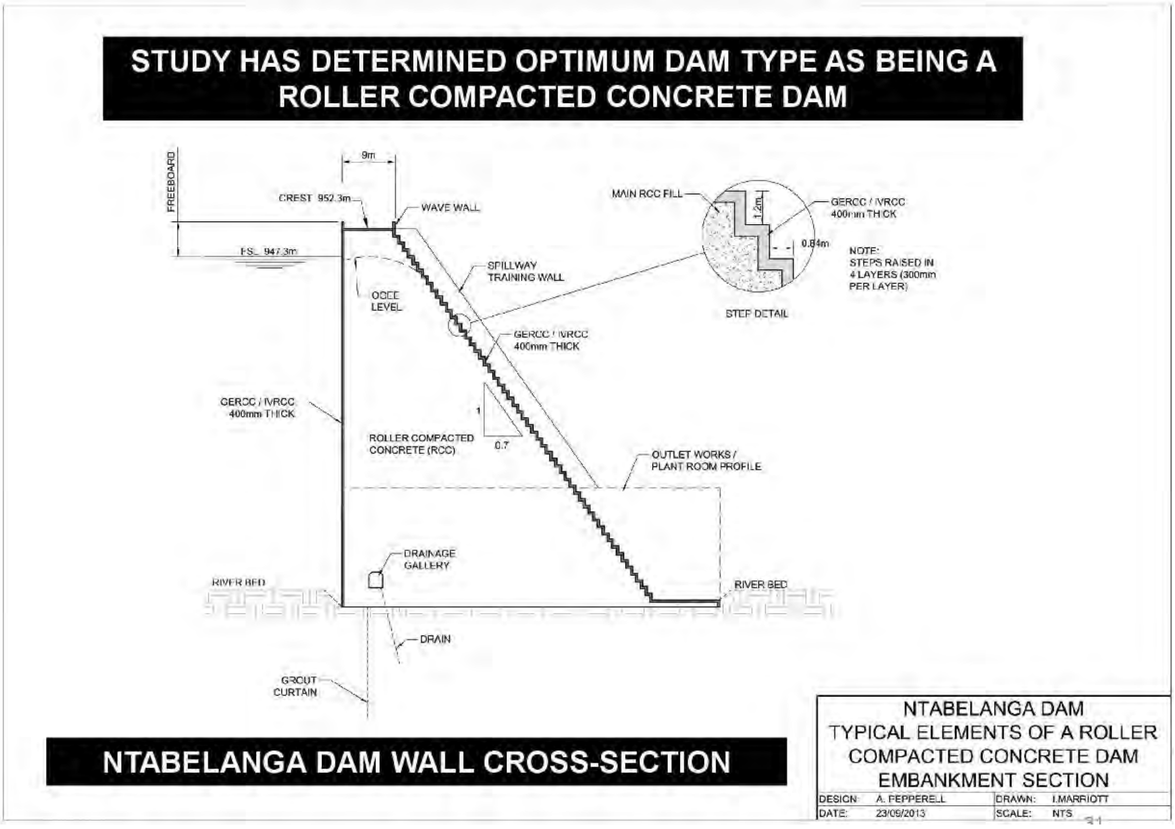

Figure 25: Typical Ntabelanga Dam wall cross-section

The choice of dam type is driven by technical aspects and is not included in the specialist studies.

4.1.4 A number of smaller water sources rather than a dam

For rural water supply a single large water source or a number of smaller sources can be used. The option of a number of smaller schemes has been considered but the conclusion was reached that, for the large population involved, the cost and risks of a large scheme should be accepted because of the difficulties and cost of sustaining a large number of smaller schemes (Muller, 2014). The smaller schemes alternative was therefore not considered in this report.

4.2 ALTERNATIVES ASSESSED DURING THE IMPACT ASSESSMENT PHASE OF THE EIR

4.2.1 Hydropower generation options

The Ntabelanga Dam is considered to be the best option to supply domestic water requirements and irrigated agriculture. The Lalini Dam, downstream of the Ntabelanga Dam but upstream of the Tsitsa Falls, is being proposed for generating hydropower. The two dams will be operated together in a conjunctive scheme to improve the economic sustainability of the overall scheme. Releases from the Ntabelanga Dam can provide a reliable stream flow for generating hydropower at the Lalini Dam. Water from the Lalini Dam will be conveyed to a Hydro Electric Power generating plant downstream of the Tsitsa Falls, after which the water used for generation is released back into the river.

The Mzimvubu Water Project infrastructure will require power supplies from ESKOM for an estimated peak demand of 12.5 MW, with average annual consumption of 87 million kWh/a, and an estimated energy cost of Rand 73 million/a. Developing the conjunctive hydropower scheme would allow a wheeling arrangement to be established, which could provide the above energy into the grid as well as generating surplus revenue to fund overall scheme operation and maintenance.

Power generation can be implemented as base load only, full-time peaking or part time peaking basis. The greatest impacts of the hydropower generation are that the natural flows in the river are altered (negative) and that income is generated (positive). The difference that these options will make will be in the size and timing of the flows that are released back into the Tsitsa River, and the amount of income generated. Base load generation will result in the release of consistent quantities of water, while peak generation will result in significantly larger flows of water being released for fewer hours in a day.

The EAP recommends, as indicated by the DEA, that any Environmental Authorization is subject to the Water Use License being obtained and adhered to. The WUL takes the Reserve determination, which includes setting the Ecological Water Requirements (EWR), into account. The EWR are determined to protect the in-stream aquatic and riparian ecology of the river by setting the limits of deviation from the natural flow beyond which the impact would be unacceptable. Whichever option of hydropower generation results in the greatest financial income while still fully meeting the EWR is therefore recommended. The feasibility study and EIA propose the base load scenario as the preferred option.

4.2.2 Alternative tunnel and associated power line routes

Three alternative power line routes, linking the hydropower plant downstream of the Lalini Dam to the grid, are being considered (**Figure 26**). The three power line routes correspond to three possible tunnel (or pipeline-tunnel combination) lengths from Lalini Dam to the hydropower plant. The amount of power generated depends on the available head, which increases with distance downstream of the Tsitsa Falls and corresponding increased length of the tunnel.

Alternative 1 consists of a 2.1 km tunnel and 7.1 km power line (in red and light blue on the map). Alternative 2 consists of a 4.9 km tunnel and 10.2 km power line (in dark blue and yellow on the map). Alternative 3 consists of a approximately 4.6 km pipeline and approximately 3.2 km tunnel (in purple on the map) and 12 km power line (in orange on the map). All three alternative routes have been considered in the EIA.

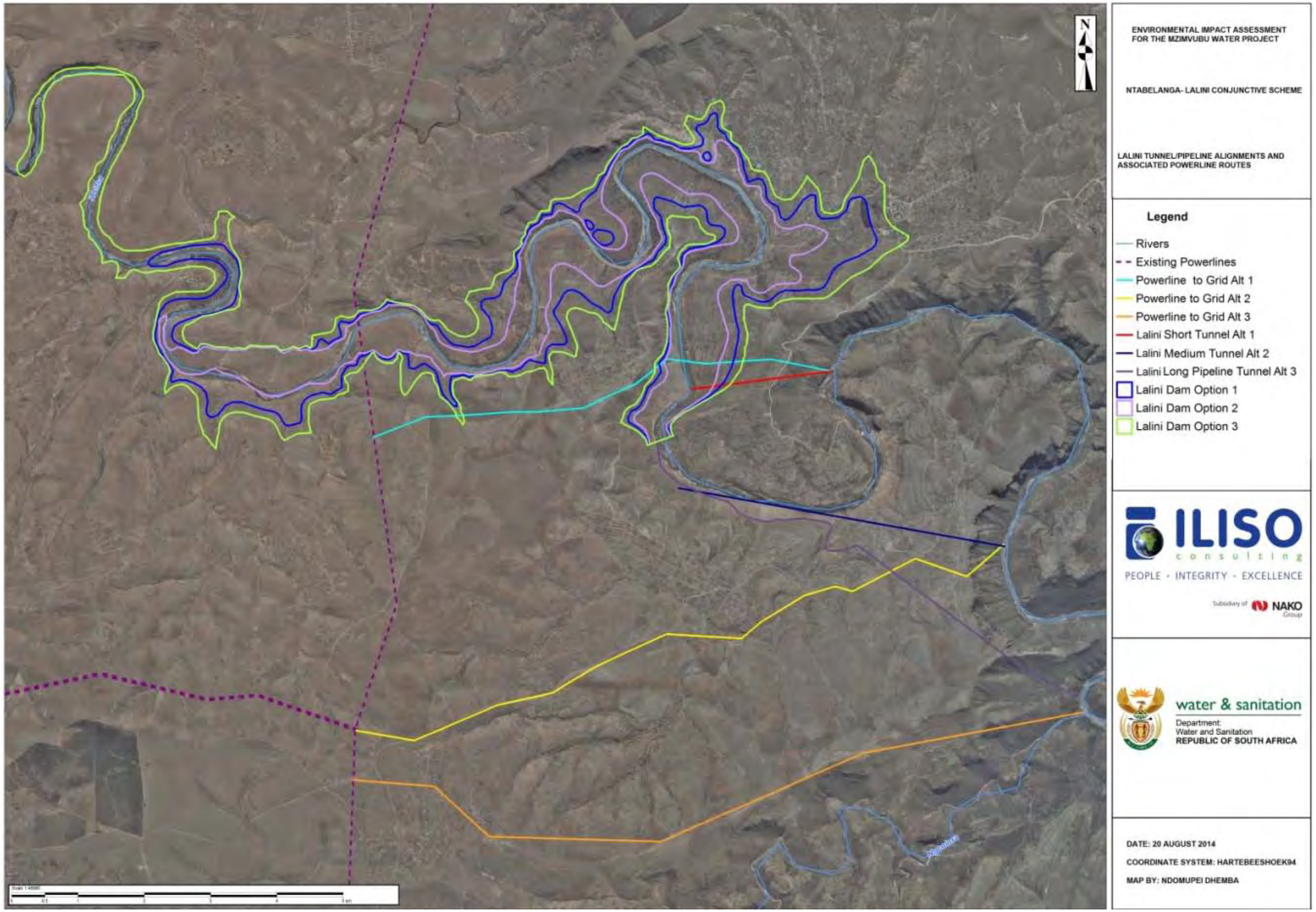

Figure 26: Alternative tunnels and power line routes at Lalini Dam

4.2.3 Alternative dam sizes

Three dam sizes are proposed for the Lalini Dam (**Figure 27**) and have been considered in the EIA.

4.3 SUMMARY OF ALTERNATIVES ASSESSED IN THE EIA

The alternatives that are considered in the EIA are therefore:

- Three hydropower tunnel positions and associated power lines;
- Peak versus Base load power generation;
- Three different dam sizes for the Lalini Dam; and
- The no project option.

Regarding the road alignments, pipeline routes and reservoir positions, no alternative routes/positions were identified during the feasibility study. The approach to the impact assessment was therefore to identify any sensitive areas that should be avoided, for consideration by the technical team. Any deviations derived in this manner were included in the ***Environmental Impact Assessment Report: P WMA 12/T30/00/5314/3***.

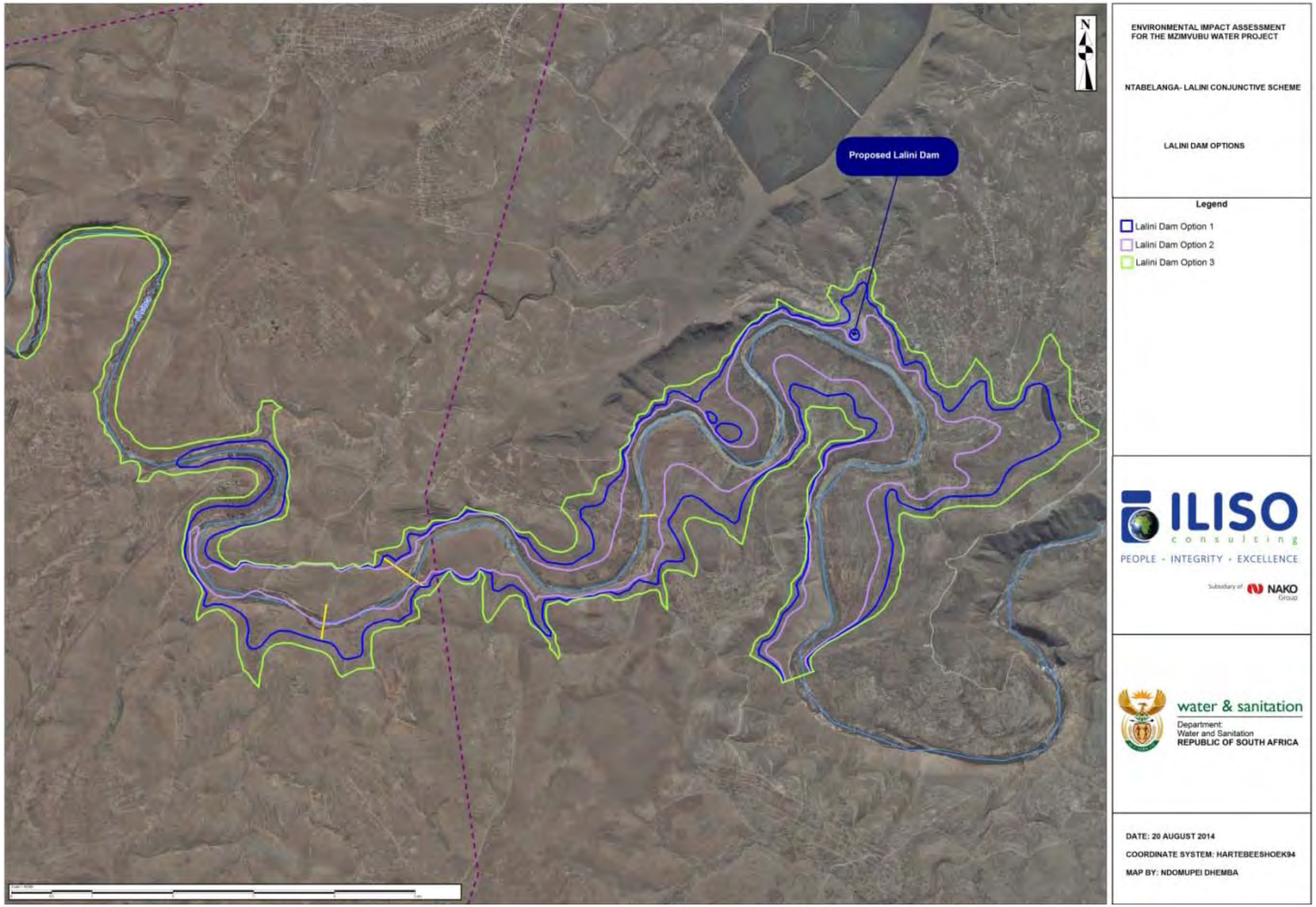

Figure 27: Lalini Dam alternative dam sizes

5. DESCRIPTION OF THE WATER USE

The following water uses will be applied for:

- **Section 21 (a)**: taking water from a water resource;
- **Section 21 (b)**: storing of water;
- **Section 21 (c)**: impeding or diverting the flow of water in a water course;
- **Section 21 (e)**: engaging in a controlled activity identified as such in section 37(1) (c);
- **Section 21 (f)**: discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
- **Section 21 (g)**: disposing of waste in a manner which may detrimentally impact on a water resource; and
- **Section 21 (i)**: altering the bed, banks, course or characteristics of a water course.

5.1 NTABELANGA DAM - WATER RESOURCES INFRASTRUCTURE

Water resources infrastructure will include the following:

a) <u>The construction of a dam at the Ntabelanga site</u>

The Ntabelanga Dam (RCC with integral spillway) will have a storage capacity of 490 million m^3 and will operate together with the Lalini Dam in a conjunctive scheme operated as one integrated scheme to improve the sustainability of the overall system.

- The purpose of the Ntabelanga Dam will be to:
  - Supply potable water to a new water treatment works with a capacity of 102,000 m^3/day (and a bulk water distribution system supplying some 724 000 people in the year 2050);
  - Supply raw water to 2 868 ha of high potential irrigable land, mostly in the Tsolo area;
  - Generate hydropower ranging from 0.75 MW to a peak of 5.0 MW;
  - Maintain Environmental Water Releases downstream of the dam; and
  - Release water downstream to supplement flow to the hydropower scheme at the Laleni Dam site.

The following water uses apply:

- The Ntabelanga Dam will store water which constitutes a **Section 21 (b)** water use.
- The dam wall will permanently impede the flow of the Tsitsa River during its operational phase. This constitutes a **Section 21 (c)** water use.

- During construction the Tsista River will be diverted to expose the rock foundations for the concrete spillway section / outlet works which constitutes a **Section 21 (c)** water use.
- The dam wall will permanently alter the bed, banks, course and characteristics of the watercourse which constitutes a **Section (i)** water use.
- The dam will inundate wetlands (
- **Figure** 28), permanently altering the characteristics of these watercourses within the proposed dam basin which constitutes a **Section 21 (i)** water use.

b) Five new flow gauging stations will be constructed to measure the flow that is entering and released from the dams.

The flow gauging points will be important for monitoring the implementation of the Reserve and for operation of the dams.

The construction of flow gauging weirs across the river will impede the flow of water in the Tsitsa River (**Section 21 (c)** water use) and alter the bed, banks and characteristics of this watercourse (**Section 21 (i)** water use). Although some water will be retained in the weirs, this is negligible and does not constitute a **Section 21 (a)** water use.

The locations of the proposed gauging stations are listed in **Table 7**.

Table 7: Location of flow gauging weirs

Name	Latitude (S)	Longitude (E)
New Gauging Station 1 (u/s of Ntabelanga Dam)	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 (Refurbishment)	31.2376586	28.852515
New Gauging Station 4 d/s of Laleni 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 Laleni dam option only)	31.2132512	28.8364011

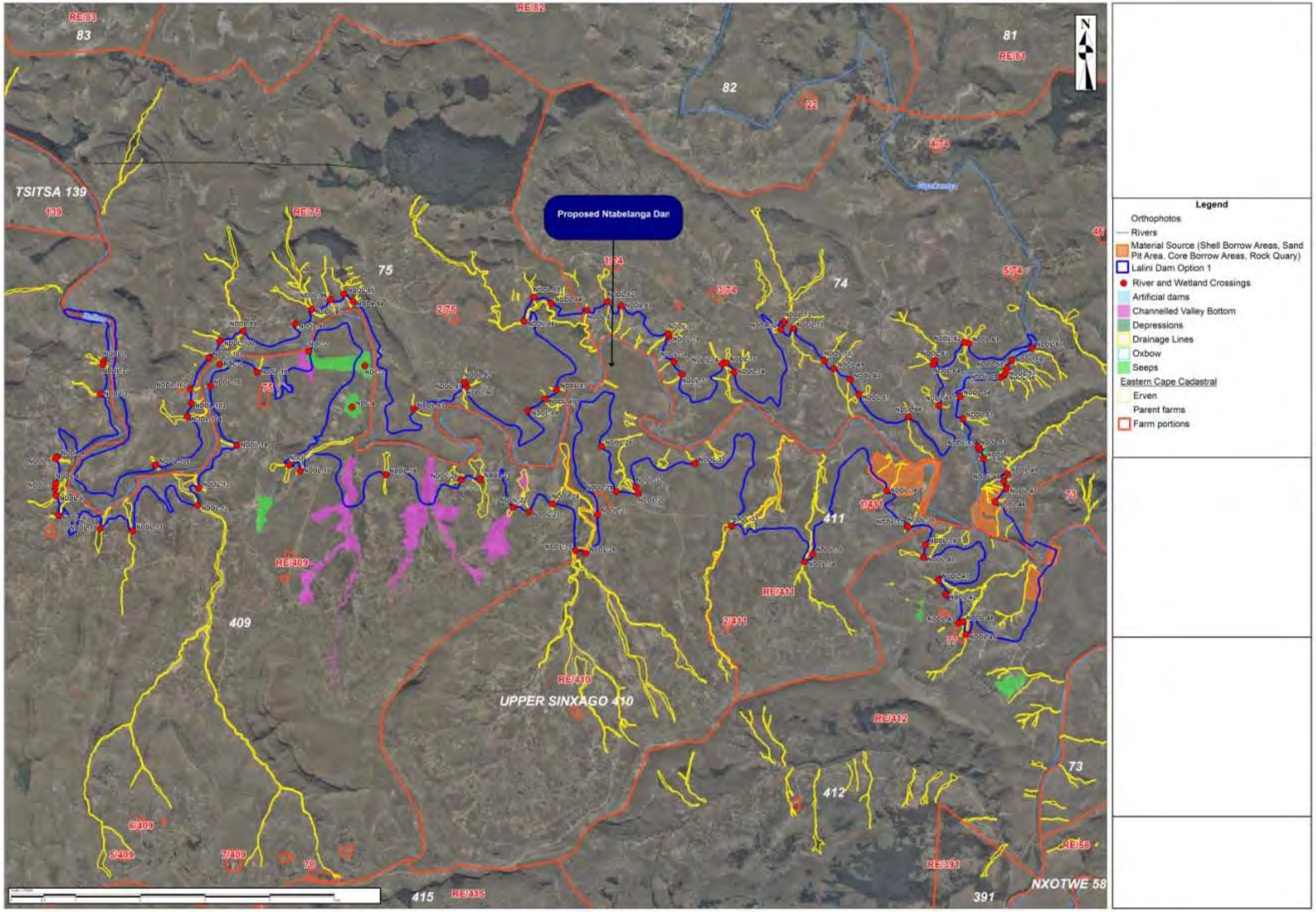

Figure 28: Ntabelanga Dam and Associated Infrastructure – Affected Wetlands

c) <u>Construction of a waste water treatment works (WWTW) at the Ntabelanga Dam Site.</u>

A wastewater treatment plant will be required to treat effluents produced by the Ntabelanga Dam operations centre and housing. This will be appropriately sized for this purpose and it is probable that this requirement could be met by using a screening and pre-treatment process followed by a reed bed system.

The wastewater treatment plant will not be used to treat the effluent from the construction activities, as this would be oversized and would have to deal with industrial pollutants as well as domestic effluents. The contractors are responsible for the safe and environmentally sensitive disposal of all of their effluents and waste products.

The treatment plant will consist of a small activated sludge WWTW with reinforced concrete septic tank, pre-treatment, aerobic reactor and settling tank. This is followed by a constructed reedbed which is lined with a Geosynthetic Clay Liner. The effluent from the reedbed is disinfected with gaseous chlorine (assuming this is what will be used at the water treatment plant). Sludge would be wasted to the septic tank which would be desludged every 6 months to taken to a larger WWTW for processing.

The plant will be designed to treat to the standards as set out in Section 2 of the General Authorisation published in Government Notice No. 665 of 6 September 2013.

The following water uses apply:

- Treated wastewater effluent (150 m³ /day) will be pumped into the Tsitsa River at (coordinates of probable discharge point 31° 7'8.24"S 28°41'24.63"E) upstream of the confluence with the Inxu River.

  General Authorisation No. 665 as published in GN 36820 allows for the -

  i) Discharge of up to 2 000 m³ of wastewater on any given day into a water resource not listed in Table 2.3 of General Authorisation No. 665. The Tsitsa and Inxu Rivers up to their confluence is listed in Table 2.3 of General Authorisation No. 665, thus the general authorisation does not apply and constitutes a **Section 21 (f)** water use.

5.2 LALINI DAM - WATER RESOURCES INFRASTRUCTURE

Water resources infrastructure will include the following:

a) The construction of a dam at the Lalini site

The Lalini Dam (RCC with integral spillway) will have a storage capacity of 150 million m^3 and will operate together with the Ntabelanga Dam in a conjunctive scheme operated as one integrated scheme to improve the sustainability of the overall system. The purpose of the Lalini Dam will be to generate hydropower.

The following water uses apply:

- The Lalini Dam will store water which constitutes a **Section 21 (b)** water use.
- The dam wall will permanently impede the flow of the Tsitsa River during the operational phase which constitutes a **Section 21 (c)** water use.
- During Construction the Tsista River will be diverted to expose the rock foundations for the concrete spillway section / outlet works. This constitutes a **Section 21 (c)** water use.
- The dam wall will permanently alter the bed, banks, course and characteristics of the watercourse which constitutes a **Section (i)** water use.
- The dam will inundate wetlands, permanently altering the characteristics of these watercourses within the proposed dam basin (**Figure 29**) which constitutes a **Section 21 (i)** water use.

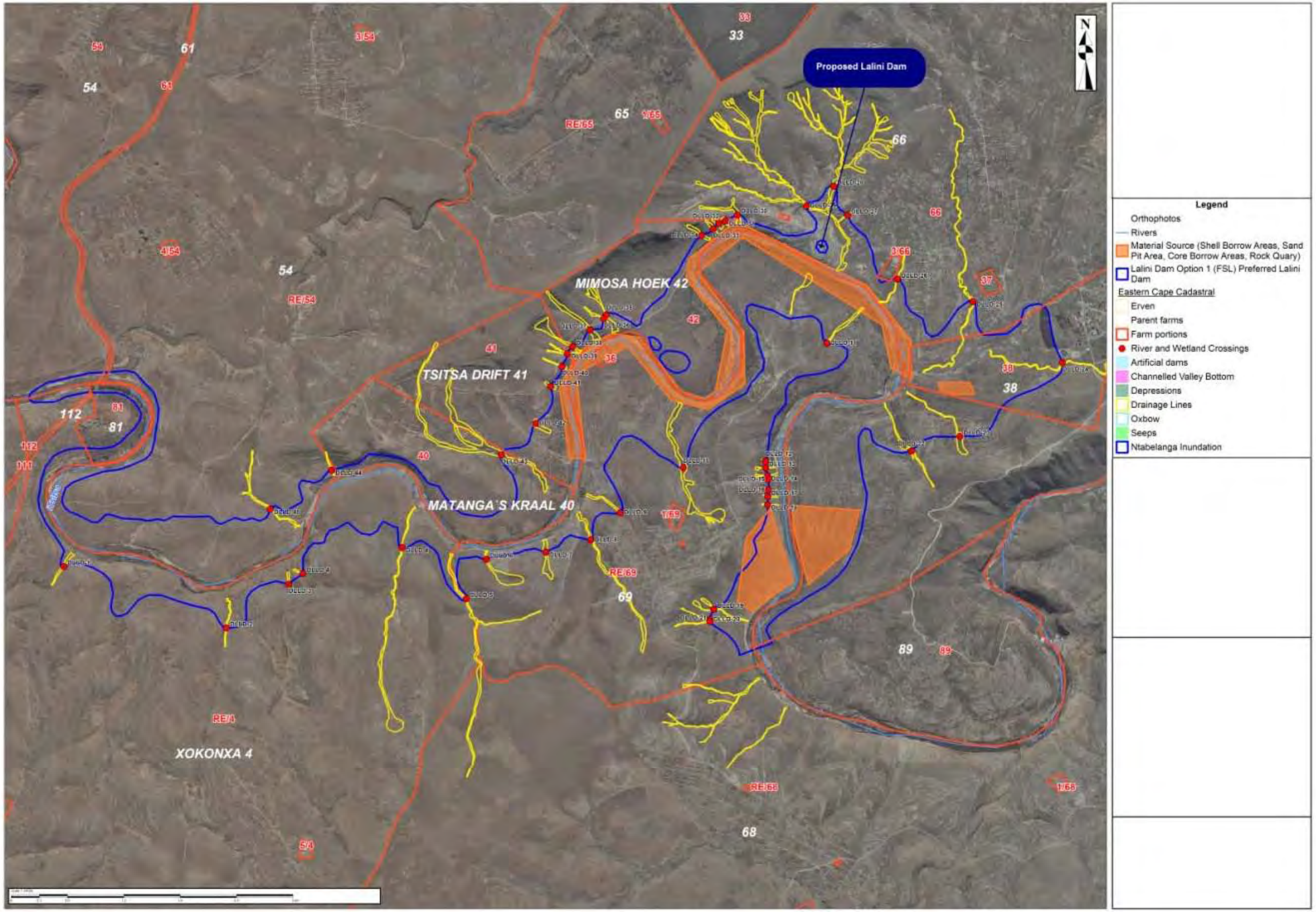

Figure 29: Lalini Dam and Associated Infrastructure - Affected Wetlands

b) <u>Construction of waste water treatment works (WWTW) at the Lalini Dam Site.</u>
A wastewater treatment plant will be required to treat effluents produced by the Lalini Dam operations centre and housing. This will be appropriately sized for this purpose and it is probable that this requirement could be met by using a screening and pre-treatment process followed by a reed bed system.

It is not recommended that such a wastewater treatment plant be designed or used to treat the effluent from the construction activities, as this would be oversized and would have to deal with industrial pollutants as well as domestic effluents. The contractors themselves must be made responsible for the safe and environmentally sensitive disposal of all of their effluents and waste products, leaving only domestic effluents for the permanent wastewater treatment plant to deal with.

The treatment plant will consist of a small activated sludge WWTW with reinforced concrete septic tank, pre-treatment, aerobic reactor and settling tank. This is followed by a constructed reedbed which is lined with a Geosynthetic Clay Liner. The effluent from the reedbed is disinfected with gaseous chlorine (assuming this is what will be used at the Water treatment plant). Sludge would be wasted to the septic tank which would be desludged every 6 months to taken to a larger WWTW for processing.

The plant would be designed to treat to the standards as set out in Section 2 of the General Authorisation published in Government Notice No. 665 of 6 September 2013.

The following water uses apply:

- Treated wastewater effluent (150 m³ /day) will be pumped into the Tsitsa River (31° 17’ 51.09” S, 28° 59’ 16.11” E) downstream of the confluence with the Inxu River.

  General Authorisation No. 665 as published in GN 36820 allows for the

  i) discharge of up to 2 000 m³ of wastewater on any given day into a water resource that is not a listed water resource set out in Table 2.3 of the General Authorisation.

     a) Complies with the general wastewater limit values set out in **Table 7**, which may be amended from time to time;
     b) Does not alter the natural ambient water temperature of the receiving water resource by more than 3 degrees Celcius; and
     c) Is not a complex industrial wastewater.

Table 8: Wastewater limit values applicable to discharge of wastewater into a water resource

SUBSTANCE/PARAMETER	GENERAL LIMIT	SPECIAL LIMIT
Faecal Coliforms (per 100 ml)	1000	0
Chemical Oxygen Demand (mg/l)	75 (i)	30(i)
pH	5,5-9,5	5,5-7,5
Ammonia (ionised and un-ionised) as Nitrogen (mg/l)	6	2
Nitrate/Nitrite as Nitrogen (mg/l)	15	1,5
Chlorine as Free Chlorine (mg/l)	0,25	0
Suspended Solids (mg/l)	25	10
Electrical Conductivity (mS/m)	70 mS/m above intake to a maximum of 150 mS/m	50 mS/m above background receiving water, to a maximum of 100 mS/m
Ortho-Phosphate as phosphorous (mg/l)	10	1 (median) and 2,5 (maximum)
Fluoride (mg/l)	1	1
Soap, oil or grease (mg/l)	2,5	0
Dissolved Arsenic (mg/l)	0,02	0,01
Dissolved Cadm ium (mg/l)	0,005	0,001
Dissolved Chromium (VI) (mg/l)	0,05	0,02
Dissolved Copper (mg/l)	0,01	0,002
Dissolved Cyanide (mg/l)	0,02	0,01
Dissolved Iron (mg/l)	0,3	0,3
Dissolved Lead (mg/l)	0,01	0,006
Dissolved Manganese (mg/l)	0,1	0,1
Mercury and its compounds (mg/l)	0,005	0,001
Dissolved Selenium (mg/l)	0,02	0,02
Dissolved Zinc (mg/l)	0,1	0,04
Boron (mg/l)	1	0,5

General Authorisation No. 665 thus replaces the need for a **Section 21 (f)** water use application.

5.3 DOMESTIC WATER SUPPLY INFRASTRUCTURE

The Ntabelanga Dam will supply potable water to 539 000 people, estimated to rise to 730 000 by 2050.

The whole scheme is to be supplied by a proposed new WTW located immediately downstream of the Ntabelanga Dam wall which will be supplied with raw water from the dam by gravity.

The system is divided into three components viz. Primary, Secondary and Tertiary systems (the tertiary distribution system is not applied for here and will be subject to separate water use license application and EIA processes).

From the WTW, treated water is pumped from pump station 1 (PS1) **(Figure 30**) via a rising main going north to Primary Command Reservoir 1 which then gravity feeds the bulk water distribution system designated as Zone 1.

A pump station (PS2) lifts water from Primary Command Reservoir 1 to Primary Command Reservoir 2 which is located at a higher elevation. From this reservoir water is gravity fed to the bulk water supply system in the higher elevations of the

Tsitsa Valley watershed, as well as supplying some of the neighbouring DM settlements over the watershed and reaching almost to the southern outskirts of the town of Mount Frere. This is designated as supply Zone 2.

Similarly on the southern bank, water is pumped from pump station PS3 at the WTW to Primary Command Reservoir 3 from where gravity fed bulk mains transfer water to the settlements in Zone 3.

A pump station (PS4) at Primary Command Reservoir 3 lifts water in a westerly direction to the higher lying Primary Command Reservoir 4, which can also deliver water by gravity in the direction of Maclear, and to settlements in the Tsitsa Valley adjacent to the flooded area of impoundment when the dam is constructed.

The *Secondary* bulk water distribution system consists of the main bulk pipelines fed by the Primary system, which then supply a network of *Tertiary* lines to the individual settlements, and Secondary Command Reservoirs, which form the second level of strategic storage, and which themselves gravity feed other tertiary pipelines supplying the many settlements to the north, east and south of the supply area.

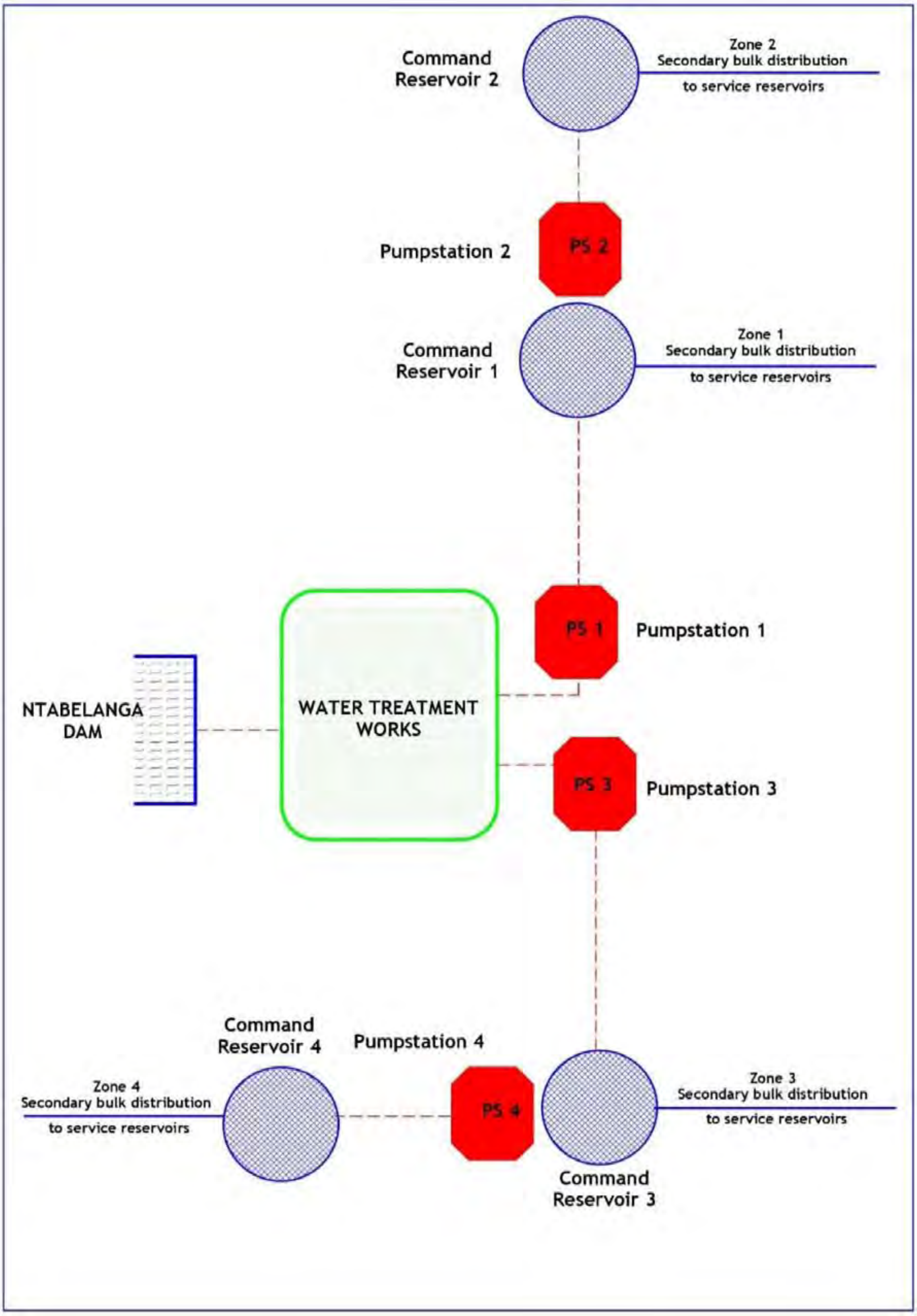

Figure 30: Diagram showing proposed layout of Primary Bulk Water Distribution System

The domestic water supply infrastructure will include the following:

a) An intake structure at Ntabelanga Dam

The works will be supplied with raw water from the dam outlet works to the WTW inlet works by gravity under all operating conditions. Water can be drawn off from the dam at different levels based upon the monitored limnology conditions, in order to obtain the best quality water given the seasonal and depth variations that occur in normal dam operation.

The normally preferred condition is to draw off water from as near to the dam surface as possible without experiencing vortex problems at the draw-off point. Outlet works will be set up with at least six different draw-off levels, so that a preferred level of abstraction can be selected for the full operating range of dam water levels.

The following water uses apply:

The abstraction of water from the Ntabelanga Dam constitutes a **Section 21(a)** water use.

b) Water Treatment Works (WTW)

The WTW will treat 100 000m³ of water per day.

The 898.00 m.a.s.l. elevation at the WTW inlet works is such that raw water from the Ntabelanga Dam outlet works can be transferred under gravity flow, even at the bottom operating level of the dam (**Figure 31**).

The works is also located with space allowed for sludge dewatering lagoons, and all works are located above the river flood line, even under SEF conditions.

The clear water pumping station containing PS1 and PS3 is also located such that the pumps will always operate under drowned suction conditions, when transferring treated water from the WTW clear water contact tank, to the Primary Command Reservoirs.

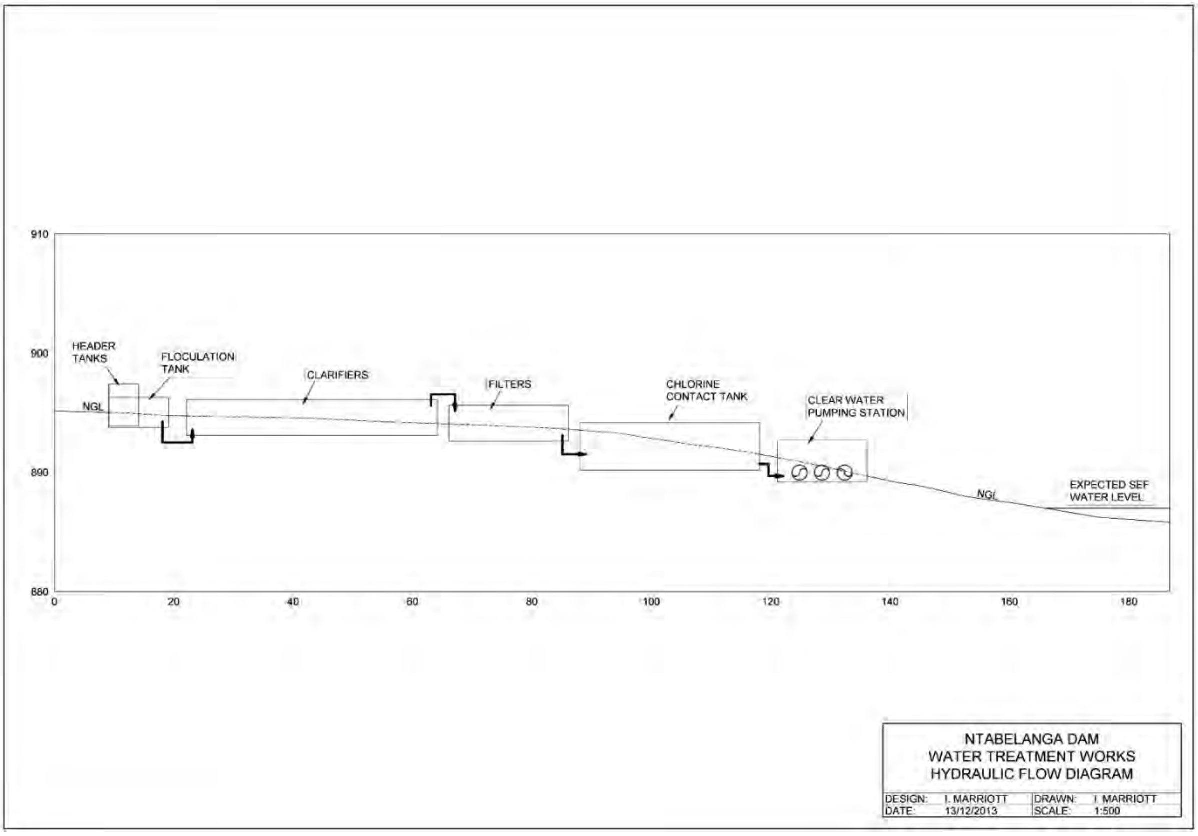

Figure 31: Hydraulic flow diagram through Ntabelanga WTW

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. The disposal of sludge from the WTW requires a WUL and this activity is included in this application. A Waste Management Licence may also be required if it is disposed to land and covers more than 50 m^2.

South African regulations limit the suspended solids concentration in discharges to the watercourse to a maximum of 25mgTSS/litre. Sludge withdrawn from the clarifiers is expected to be in excess of 5,000mgTSS/litre and cannot be legally discharged into the watercourse.

It is, therefore, proposed that all the residuals produced by the works be dried and disposed of off-site. Drying beds are allowed for dewatering the residuals generated by the plant as the technology is considered appropriate for the plant location. The volume of residuals will be reduced by the incorporation of backwash recovery tanks into the process train.

Disinfection is likely to be through a gaseous chlorination process unless the water quality dictates that specific alternative processes might be needed (eg Ozone). However, this latter option is unlikely to be needed.

Whilst the DWS requirements for minimum contact time is 6% of a day, or 1.5 hours, it is proposed that a total contact tank volume equivalent to 3 hours contact time be provided, with the contact tank split into two compartments so that the minimum contact time of 1.5 hrs can still be achieved with one tank off-line for servicing. This will also provide some flexibility of operation by providing more balancing capacity for the plant throughflow rate, and for the treated water pumps.

It is also recommended that the treated water pumping station is integrated into, or close to, the contact tank at the WTW, at an elevation such that the suction of these pumps are continuously drowned.

The net output capacity of the works being 84 596 m^3/day average and 101 515 m^3/day peak daily has been determined by the 2050 water demand into the bulk water delivery infrastructure inclusive of allowances for transmission losses, as well as losses within the process stream including backwash.

The WTW will be located close to the river downstream of the dam wall (**Figure 32**). The footprint of the works will be located close to the right hand bank of the river but outside the flood line of the river under SEF conditions.

The water treatment works structures will be orientated and located on sloping ground such that the hydraulic flow path from the WTW inlet works, through the settlement tanks, filters, and to the contact tank can be undertaken by gravity.

Backwash of the filters will require pumping, and may also include air scour. Treated water will be drawn from the contact tank and pumped into the bulk water infrastructure from the treatment works pumping station.

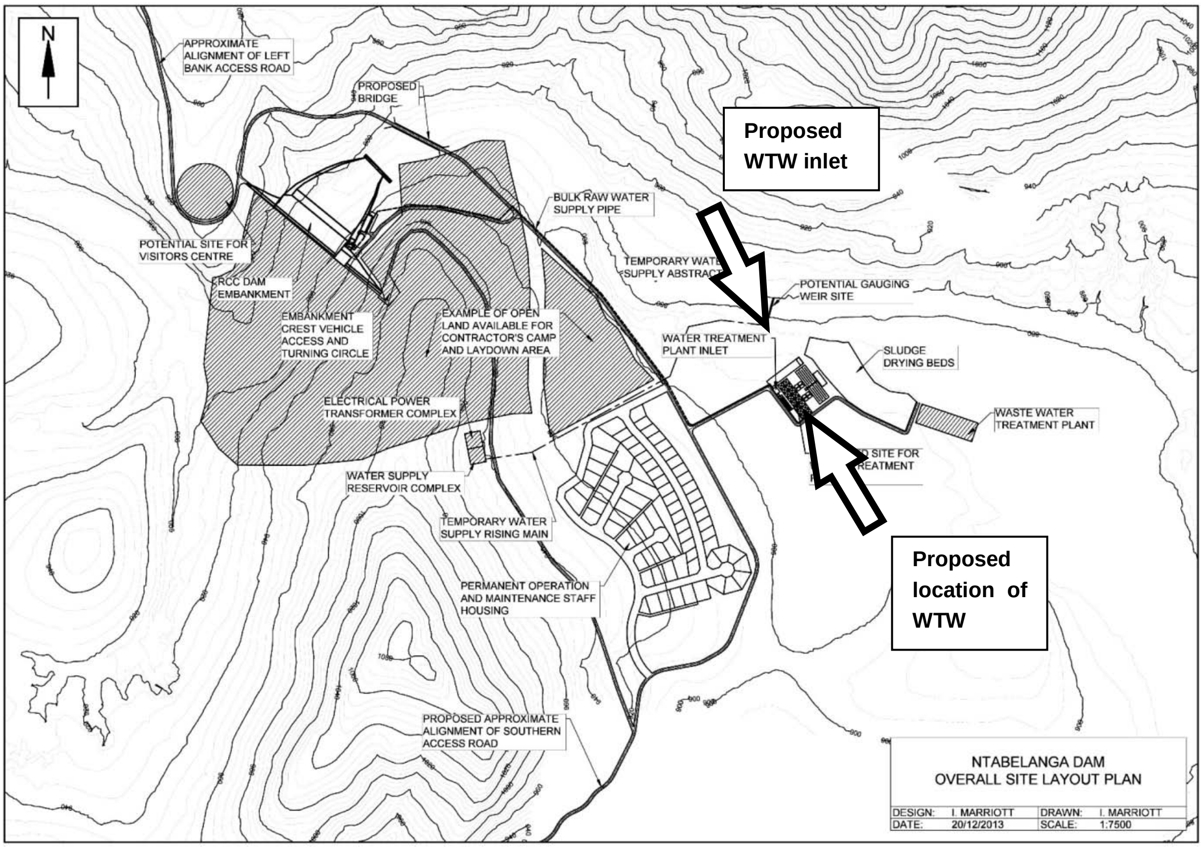

Figure 32: Proposed location of the WTW and inlet

The following water uses apply:

Sludge produced from the settlement and filtration processes will be stored in sludge settlement tanks and drying beds. This constitutes a **S21 (g)** water use.

c) <u>Potable bulk water distribution infrastructure for domestic and industrial water requirements (primary and secondary distribution lines)</u>

Construction of the primary and secondary distribution 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. 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 meter wide strip would be impacted during construction.

The Primary and Secondary distribution lines will cross various wetlands as well as the Tsitsa River and Tina River.

The following water uses apply:
Construction of the pipeline through rivers will require the diversion of the river at that point which constitutes a **Section 21 (c)** water use. The pipeline will permanently alter the bed and banks of the rivers and will alter the characteristics of the wetlands which constitute a **Section 21 (i)** water use.

d) Bulk water storage reservoirs (9)

The bulk water reservoirs will each have a storage capacity of approximately 1 Ml to 30 Ml providing between 4 and 24 hours storage per site.

General Notice (GN) 399 as published in the Government Gazette 26187 of 2004 allows for the storage of up to 50 Ml of water in accordance with the conditions as set out in the general authorisation, thus a **Section 21 (b)** water use **does not** apply.

The locations of the reservoirs are listed in **Table 9**.

Table 9: Locations of bulk water reservoirs

Name	Latitude (S)	Longitude (E)
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

5.4 IRRIGATION INFRASTRUCTURE

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

For the total irrigated area, the water demand from the dam would be a maximum of 32.724 million m^3/a at 80 % assurance of supply, and more realistically 17.753 million m^3/a at 80 % assurance of supply.

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.

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.

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

The following water uses apply:

- Raw Water will be abstracted from the Tsitsa River. The abstraction point will be located at the following coordinates: 31° 12’ 24.54”S, 28° 43’ 00”E downstream of the proposed Ntabelanga Dam.

  The abstraction of water constitutes a **S 21(a)** water use. The construction of the intake works will permanently alter the bed and banks of the Tsitsa River at this point which constitute a **Section 21 (i)** water use.

- The irrigation pipeline will cross various wetlands as well as the Inxu River. Construction of the pipeline through the river will require the diversion of the river at that point. This constitutes a **Section 21 (c)** water use. The pipeline will permanently alter the bed and banks of the river and characteristics of the wetlands which constitute a **Section 21 (i)** water use.

5.5 HYDRO POWER INFRASTRUCTURE

Ntabelanga Dam

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 of a raw water pipeline (maximum capacity of 16 m^3/sec, or 1382.4 Mℓ /day) 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.

The following water uses apply:

- Water will be abstracted from the Ntabelanga Dam which constitutes a **Section 21(a)** water use.
- The operation of a hydropower plant constitutes a **Section 21 (e)** water use (Engaging in a controlled activity) in terms of Section 37 (1) (c) (a power generation activity which alters the flow regime of a watercourse).
- The hydropower plant outlet will be constructed on the banks of the Tsitsa River which constitutes a **Section 21 (i)** water use.

Lalini Dam

There will be a small hydropower plant at 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.

The power line linking 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 and 21 m.

The final alignment of the power line and associated pylon positions have not been determined yet. It is therefore not possible to ascertain at this stage whether watercourses will be impacted by the power line infrastructure and whether a water use in terms of the NWA is triggered.

The following water uses apply:

- Water will be abstracted from the Lalini Dam which constitutes a **Section 21(a)** water use.
- The hydropower pipeline will cross five drainage lines thus altering the characteristics of these watercourses which constitutes a **Section 21 (i)** water use.
- The hydropower plant/tunnel outlets will be constructed on the banks of the Tsitsa River which constitutes a **Section 21 (i)** water use.
- The operation of a hydropower plants constitutes a **Section 21 (e)** water use (*Engaging in a controlled activity*) in terms of **Section 37 (1) (c)** *(a power generation activity which alters the flow regime of a watercourse*).

5.6 ROADS

Ntabelanga Dam

Approximately 80 km of local roads will be re-aligned in the Ntabelanga Dam area. Additional local roads will also be upgraded to support social and economic development in the area. The road design will be very similar to the existing roads and will be constructed using similar materials. All roads will be surfaced with gravel.

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.

The following water uses apply:

- The access roads will cross various wetlands thus altering the characteristics of these watercourses which constitutes a Section 21 (i) water use.
- One of the access roads will cross the Tsitsa River immediately downstream of the Ntabelanga Dam wall thus altering the characteristics of these watercourses which constitutes a **Section 21 (i)** water use.

Lalini Dam Basin

- Two new access roads will be constructed within the Lalini Dam basin. These roads will cross the Tsitsa River at 31° 15’ 21.92”S, 28° 51’ 34.99”E and 31° 15’ 05.96”S, 28° 52’ 17.04”E.
- An existing road, located within the proposed Lalini Dam basin, will be upgraded and will cross the Tsitsa River at 31° 14’ 39.86”S, 28° 54’ 06.27”E.
- Two haul roads will be constructed to gain access to and from the borrow areas in the Lalini Dam basin. These roads will cross three drainage lines.

Lalini hydropower plant

- A new access road will be constructed to gain access to the Lalini power plant and will cross two wetlands.

Lalini Dam construction site

- A new access road will be constructed to gain access to the construction site immediately upstream of the dam wall at 31° 15’ 56.4”, 28° 55’ 24.35”E

The following water uses apply:

- The two new access roads within the dam basin will cross the Tsitsa River, altering the banks of the river which constitutes a **Section 21 (i)** water use.
- The existing road to be upgraded within the dam basin will cross the Tsitsa River, altering the banks of the river which constitutes a **Section 21 (i)** water use.
- The proposed haul roads within the dam basin will cross three drainage lines thus altering the characteristics of these watercourses which constitute a **Section 21 (i)** water use.
- The access road to the hydropower plant will cross two drainage lines thus altering the characteristics of these watercourses which constitute a **Section 21 (i)** water use.
- The proposed new access road to the construction site within the dam basin will cross the Tsitsa River, altering the banks of the river which constitutes a **Section 21 (i)** water use.

5.7 BORROW AREAS

Exemption from Regulation 4(a) of GN 704 of the NWA

GN 704 of the NWA, 1999 contains regulations on use of water for mining, including borrowing activities and related activities aimed at preventing the pollution of water resources and protecting water resources in areas where mining activity is taking place.

Regulation 4(a) of GN 704 states that:

No person in control of a mine or activity may:

- locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood line or within a horizontal distance of 100 metres, whichever is the greatest, from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become waterlogged, undermined, unstable or cracked.

The borrow areas and quarries are located within the dam basin and will be inundated once the full supply level of the dams has been reached. This location therefore has the least long term impact.

According to GN 704, the borrow areas must fall outside of the 1:100 year flood line of the drainage feature or 100 m from the edge of the feature, whichever distance is the greatest. Therefore an exemption will be required from DWS since the borrow areas will be located within the 1:100 year flood line.

5.8 CONSTRUCTION WORKS

During the construction phase, water will need to be abstracted for various construction activities. The direct abstraction of water from any water resource constitutes a **Section 21(a)** water use.

General Authorisation 399 as published in Government Gazette 26187 replaces the need for a water user to apply for a licence in terms of the National Water Act for the taking of water from a water resource. Areas excluded from this General Authorisation, applicable to the MWP study area, are shown in **Table 10**.

The guidelines, as set out in the General Authorisation, must be adhered to. These include but are not limited to the following:

- Acceptable construction, maintenance and operational practices are to be followed to ensure the consistent, effective and safe performance of the taking of water from a water resource for construction purposes.

- The water user must ensure the establishment of monitoring programmes to measure the quantity of water taken, as follows:

    - The quantity of surface water abstracted must be metered or gauged and the total recorded as at the last day of each month; and
    - Where no meter or gauge is used, the quantity of water abstracted may be calculated to methods set by the responsible authority.

Table 10: Areas excluded from General Authorisation for the taking of surface water

Primary drainage region	Secondary/Tertiary/Quaternary drainage region and excluded resources	Description of main river in drainage region for information purposes
T	T11A & B T35A, B, C, D, F & G	Slang, Xuka Rivers **Tsitsa**, Pot, Mooi, **Inxu**, Wildebees, Gatberg Rivers

The abstraction of water for construction activities will not take place in any of the drainage regions that are excluded from the General Authorisation, thus **Section 21 (a)** water use does not need to be licensed separately.

Refer to **Appendix B** for a summary of the applicable Water Use Applications.

5.9 SUMMARY OF APPLICABLE WATER USES

5.9.1 SECTION 21 (A): “TAKING WATER FROM A WATER RESOURCE”

The following activities will constitute a Section 21 (a) water use:

- **Domestic Water Supply Infrastructure**
  - The WTW will be supplied with 100 000 m^3 of raw water per day from the dam outlet works to the WTW inlet works by gravity under all operating conditions.
- **Irrigation Infrastructure**
  - The Ntabelanga Dam will provide water (maximum of 32.724 million m^3/a) to irrigate approximately 2 900 ha of agricultural land. This project includes bulk water conveyance infrastructure for raw water supply to edge of field.
- **Hydropower Infrastructure**
  - Raw water will be abstracted from the Ntabelanga Dam (making use of available EWR flows) for the Ntabelanga hydro power plant (maximum of 16 m^3/sec, or 1382.4 Mℓ /day).
  - Water will be abstracted from the Lalini Dam for the Lalini hydro power plants (maximum of 16 m^3/sec, or 1382.4 Mℓ /day for the small hydro power plant and 19.5 m^3/sec, or 1684.8 Mℓ /day for the main hydro power plant).

5.9.2 SECTION 21 (B): “STORING OF WATER”

The following activities will constitute a Section 21 (b) water use:

- **Ntabelanga Dam**
  - The Ntabelanga Dam will store water and will have a storage capacity of 490 million m^3
- **Lalini Dam**
  - The Lalini Dam will store water and will have a storage capacity of 248 million m^3

5.9.3 SECTION 21 (C): “IMPEDING OR DIVERTING THE FLOW OF WATER IN A WATER COURSE” AND SECTION 21 (I): “ALTERING THE BED, BANKS, COURSE OR CHARACTERISTICS OF A WATER COURSE”

The following activities will constitute Section 21 (c) and (i) water uses:

- **Ntabelanga Dam**

    - The Ntabelanga Dam wall will permanently impede the flow of the Tsitsa River during its operational phase.
    - The dam wall will permanently alter the bed, banks, course and characteristics of the Tsitsa River at that point.
    - During the construction of the Ntabelanga Dam wall, coffer dams will be built to temporarily divert the Tsista River in order to expose the rock foundations for the concrete spillway section / outlet works.
    - The dam will inundate wetlands, permanently altering the characteristics of these watercourses within the proposed dam basin.
- **Lalini Dam**
    - The dam wall will permanently impede the flow of the Tsitsa River during the operational phase.
    - During Construction, coffer dams will be built to temporarily divert the Tsista River in order to expose the rock foundations for the concrete spillway section / outlet works.
    - The dam wall will permanently alter the bed, banks, course and characteristics of the Tsitsa River.
    - The dam will inundate wetlands, permanently altering the characteristics of these watercourses within the proposed dam basin.
- **Domestic water supply infrastructure**
    - Construction of the pipeline through rivers will require the diversion of the river at that point.
    - The distribution pipeline will cross various wetlands as well as the Tsitsa River, permanently altering the bed and banks of the river altering the characteristics of the wetlands.
- **Flow gauging weirs**
    - The construction of flow gauging weirs across the river will impeded the flow of the river and alter the bed, banks and characteristics of this watercourse.
- **Irrigation infrastructure**
    - The construction of the intake works will permanently alter the bed and banks of the Tsitsa River and impede the flow at this point.
    - The irrigation pipeline will cross various wetlands as well as the Tsitsa River, permanently altering the bed and banks of the river altering the characteristics of the wetlands.
    - Construction of the pipeline will also require temporary diversion of the watercourses at the point of crossing.
- **Ntabelanga hydropower infrastructure**
    - The hydropower plant outlet will be constructed on the bank of the Tsitsa River, permanently altering the bank of the river and impeding the flow at this point.
- **Lalini hydropower infrastructure**

  - The hydropower pipeline will cross five drainage lines thus altering the characteristics of these watercourses.
  - The hydropower tunnel outlet will be constructed on the banks of the Tsitsa River thus permanently altering the banks of the river.
- **Roads**
  - The access roads will cross various wetlands thus altering the characteristics of these watercourses.
  - One of the access roads will cross the Tsitsa River immediately downstream of the Ntabelanga Dam wall thus altering the banks of the river at this point.
  - The two new access roads within the Lalini Dam basin will cross the Tsitsa River, altering the banks of the river.
  - The existing road to be upgraded within the Lalini Dam basin will cross the Tsitsa River, altering the banks of the river.
  - The proposed haul roads within the Lalini Dam basin will cross three drainage lines thus altering the characteristics of these watercourses.
  - The access road to the Lalini hydropower plant will cross two drainage lines thus altering the characteristics of these watercourses.
  - The proposed new access road to the construction site within the Lalini Dam basin will cross the Tsitsa River, altering the banks of the river.

5.9.4 SECTION 21 (E): "ENGAGING IN A CONTROLLED ACTIVITY IDENTIFIED AS SUCH IN SECTION 37(1)"

The following activities will constitute a Section 21 (e) water use:

- **Ntabelanga Dam**
  - The operation of the hydropower plant at the Ntabelanga Dam.
- **Lalini Dam**
  - The operation of the hydropower plant at the Lalini Dam.

5.9.5 SECTION 21 (F): "DISCHARGING WASTE OR WATER CONTAINING WASTE INTO A WATER RESOURCE THROUGH A PIPE, CANAL, SEWER, SEA OUTFALL OR OTHER CONDUIT"

- **Ntabelanga Waste Water Treatment Works (WWTW)**
  - Treated wastewater effluent (150 m^3 /day) will be pumped into the Tsitsa River upstream of the confluence with the Inxu River.

5.9.6 SECTION 21 (G): "DISPOSING OF WASTE IN A MANNER WHICH MAY DETRIMENTALLY IMPACT ON A WATER RESOURCE"

- **Ntabelanga Water Treatment Works (WTW)**
  - Sludge produced from the settlement and filtration processes will be stored in sludge settlement tanks and drying beds.

5.9.7 OTHER

- **Bulk water storage reservoirs (9)**
  - The bulk water reservoirs will each have a storage capacity of approximately 1 Mℓ to 30 Mℓ providing between 4 and 24 hours storage per site.

    General Notice (GN) 399 as published in the Government Gazette 26187 of 2004 allows for the storage of up to 50 Mℓ of water in accordance with the conditions as set out in the general authorisation, thus a **Section 21 (b)** water use **does not** apply.

- **Lalini waste water treatment works (WWTW)**

  Treated wastewater effluent (150 m^3 /day) will be pumped into the Tsitsa River (31° 17' 51.09" S, 28° 59' 16.11" E) downstream of the confluence with the Inxu River.

  General Authorisation No. 665 in GN 36820 allows for the

  ii) discharge of up to 2 000 m^3 of wastewater on any given day into a water resource that is not a listed water resource set out in Table 2.3 of the General Authorisation. Thus a **Section 21 (f)** water use does not apply.

- **Borrow Areas**
  - *Exemption from Regulation 4(a)* of *GN 704 of the NWA*

    Regulation 4(a) of GN 704 states that:

    No person in control of a mine or activity may:
    - Locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood line or within a horizontal distance of 100 metres, whichever is the greatest, from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become waterlogged, undermined, unstable or cracked.

According to the above, the borrow areas must fall outside of the 1:100 year flood line of the drainage feature or 100 m from the edge of the feature, whichever distance is the greatest. Therefore an exemption will be required from DWS since the borrow areas will be located within the 1:100 year flood line.

- **Construction works**
  - During the construction phase, water will need to be abstracted for various construction activities. General Authorisation 399 in Government Gazette 26187 replaces the need to apply for a **Section 21 (a)** water use (see **Section 5.8**).